Identifying Technology Infrastructure Needs in America's Distressed Communities

A Focus on Information and Communications Technology

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Identifying Technology Infrastructure Needs in America's Distressed Communities:

A Focus on Information and Communications Technology

Final Report

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Acknowledgments

This project is the result of collaboration at many levels. The University of North Carolina research team availed itself early of the expertise of colleagues who were knowledgeable about various aspects of technology policy: Professor Irwin Feller at Pennsylvania State University; Dr. Peter Blair, then the Director of Sigma Xi scientific honor society, and now at the National Research Council; Professor Edward Feser, in the Department of City and Regional Planning at the University of North Carolina; and Deborah Watts, a technology consultant based in Raleigh, North Carolina. Feller's work on the geographic diffusion of knowledge and the evaluation of S&T policy at the state level is well known. Blair brought the perspective of national S&T policy to the table. Before directing Sigma Xi, he was Associate Director of Congress's Office of Technology Assessment. Feser is among the leading planning academics working on cluster analysis and economic development. And Watts had just been a principal participant in a statewide economic development planning exercise and an information and communications initiative for the state of North Carolina. Feller, Blair, Feser, and Watts did more than provide advice; they each conducted one or more of the case studies. That was critical to the success of the project since good fieldwork requires the involvement of team leaders who understand the subtleties of local and state politics, the dynamics of economic development, and the nature of information and communications technology (ICT) policies themselves.

We also involved a panel of business, government, academic, and economic development professionals from around the United States to review the research design and suggest case-study sites. (The expert advisory panel members are identified in Appendix B.) A few of them were asked to review parts of the draft final report. Their involvement kept us from being too "academic"; their primary interest was for us to make the study as useful to real economic development practitioners and policy makers as possible.

We worked collaboratively, as well, with the senior research staff in the Economic Development Administration, particularly Dr. Kelly Robinson and Dr. John McNamee. No project team could have had more supportive clients than these two gentlemen.

The authors are particularly grateful to Brande Roberts and the staff of the Kenan Institute of Private Enterprise for providing support on various aspects of the project. In addition, Karen Becker did an excellent job formatting the report. Among the graduate students who assisted, we acknowledge the input of Brian Kropp (now Dr. Kropp), who conducted some of the statistical analysis.

We acknowledge the involvement of all these people, but retain responsibility for any errors of fact or interpretation that the report may contain. While financial support for the project was provided by the United States Department of Commerce, Economic Development Administration, that does not constitute an endorsement of the policy conclusions or recommendations. These, too, are ours alone.

Executive Summary

This study focuses on the critical role that "technology infrastructure" can play in economic development, especially in helping distressed communities in the United States move successfully into the knowledge-based twenty-first century. In particular, it considers the role of information and communications technology (ICT) in overcoming distress and bridging the digital divide.

The specific research question we seek to answer in this study is ***In what ways does information and communications technology help distressed communities advance economically?***

The overall research question can be parsed into several subquestions that are addressed in this report:

- What is technology infrastructure, and ICT, in particular?
- What do we mean by "distress" and "distressed communities"?
- What types of ICT infrastructure are most needed and appropriate in distressed communities?
- What are the major constraints to improving the state of ICT infrastructure in America's distressed communities?
- What types of economic development do different ICT infrastructure investments support?
- How can EDA most effectively use its limited resources to help distressed communities upgrade their ICT infrastructure?

The study applies several methods, most centrally a qualitative analysis of ICT-related initiatives in thirteen distressed communities in eight states, to address these questions. It also includes a quantitative analysis of secondary data to ascertain the correlates of ICT investment.

Hypotheses

From reviews of the scholarly literature and best practices, we formulated the ten hypotheses summarized in Table ES-1 and explained in detail in the full report. We

modified the wording of the hypotheses somewhat following our field work, as we refined our thinking about the overall problem.

Testing the Hypotheses Using Case Studies

Our principal methodology to test the hypotheses was to use multiple cases to ascertain "critical success factors" for various ICT initiatives. That amounts to a subjective assessment of the importance of various hypothesized factors on outcomes, or what might be called a "soft" cause-and-effect analysis (Yin, 1984, 1993). Ragin (1994) refers to this approach as "comparative research" as opposed to "qualitative" research, since it is based on a set of carefully selected cases that differ in key attributes. A few comments are in order. First, any assessment of this nature relies on professional judgment. We used the expertise and experience of our team and advisory committee to form our judgments. Second, success/failure is not a dichotomous outcome, but rather, a continuum. Consequently, we used a six-point scale to describe outcomes, including "positive," "mostly positive," "mildly positive," "mildly negative," "mostly negative," and "negative."

Our intent in selecting case-study sites was to include several different types of technology infrastructure interventions and several types of community distress, as well as to attain a good geographic mix. The case-study sites all meet EDA's definitions of distress. Expert panel members (economic development professionals from around the United States) and EDA regional directors were consulted for nominations of candidate communities. In choosing case-study sites, we selected places where policies had been in place for a few years — not just proposed — and which putatively had

Table ES.1: Initial hypotheses tested in all case-study sites

1. Enabling infrastructure (roads, water, sewer, etc.) is necessary but not sufficient to assure the effectiveness of technology infrastructure investment.
2. Investments in technology infrastructure must be part of a larger local planning process to succeed.
3. A certain density or critical mass is required for information and communications technology (ICT) to work, because of the costs of provision.
4. Technological innovations and advances are reducing the costs of communications and linkages.
5. Institutional mechanisms must be in place to help users deploy the hard infrastructure appropriately.
6. Some hierarchical coordination or linkages among national, state, and local governments are important for a community to be truly "connected."
7. Linkages among government, education, and industry are a critical success factor for ICT interventions. State policies and corporate actions are important determinants of local "success."
8. Infrastructure providers must be partners in assessment and planning, not just the spending, for the intervention to succeed.
9. Work force development is a critical complement to any infrastructure intervention.
10. Because of the long-term and expensive nature of ICT, vision and leadership are critical success factors.

evidenced varying degrees of success. The intent was not to limit site selection to places that were all believed to be successful, but rather to learn from communities at various points on a continuum of progress. We considered several factors that mitigate distress, including type of economy, proximity to urban centers, and long-term versus short-term distress.

Our expert panel also advised us to choose multiple cases within several states as a way to ascertain better the role of state policy in local economic development activities around ICT. In response, we chose two sites in North Carolina, three in Pennsylvania, and three in Arkansas. In those cases, we did additional research on state policy and contacted state officials.

Table ES-2 briefly characterizes the thirteen selected sites and the nature of the technology intervention being tried in each.

Table ES.2: Summary of case-study sites

Place	Nature of area and its distress	Nature of intervention
Helena, AR	Delta: river town	Community network
Monticello, AR	Delta: agricultural town	Community network
Pine Bluff, AR	Delta: small city adjacent to Little Rock	Technology park: Bioplex
Hays, KS	Plains: small town in Corn Belt, losing population	Telemedicine network and call centers
Springfield, MA	Frostbelt: declining industrial city	Technology park and incubator
Billings, MT	Ranch country: small city in very low-wealth, low-density agricultural and oil area	Telemedicine network with rural towns in region
Kinston, NC	Coastal plain: low-growth agricultural area	Technology park: Global transpark
Greenville, NC	Coastal plain: small city in very low-wealth area	Telemedicine network with rural towns in region
Bloomsburg, PA	Frostbelt: small town, remote	Broadband Internet
Meadville, PA	Frostbelt: small town	Distance learning lab and strategic community IT initiative
Northeast PA	Frostbelt: declining industrial region	Call centers as stepping stone to higher IT
Willacy county, TX	Rio Grande Valley: low-growth, low-density agricultural area	Broadband Internet
Seattle, WA	Northwest: poor inner city neighborhood in large, growing high-tech metro area	Computer training for poor persons

We measured the success of each intervention against its expected outcomes for two practical reasons. First, the programs are all relatively new, so longitudinal outcome data do not exist, obviating the "progress over time" approach. Second, we did not choose the same interventions to track across multiple communities, nor a set of communities that were comparable. In defining success, we considered whether a "mindset change" about ICT had occurred in the community. That required a judgment about whether the local leadership — public, private, education, and nonprofit — had integrated information technology considerations and innovation more broadly into their economic development strategy and planning, and whether they work collaboratively in doing so. The creation of such a culture takes time, but once it takes hold can foster the community's capacity for innovation and further knowledge generation.

Our judgments about the "success" of the thirteen interventions in each of our case studies are summarized in Table ES-3 below. We proceed, in the full report, to test the ten hypotheses, one by one. The robustness of our results, in light of the wide range of places studied, increases our confidence in the external validity of the findings. Had the sites all been similar in their initial characteristics or the intervention tried, or had they shown vast differences in their support of the study hypotheses, it would be difficult to consider the results relevant in other communities.

Quantitative Analysis of Secondary Data

A good way to assure external validity is through quantitative analysis using data from a cross section of communities around the United States. Our intention was to specify an econometric model that would have explained economic development outcomes (the dependent variable) in terms of control variables, such as community size, region, demographics, and economic structure; ICT variables, measuring the degree of connectedness; and policy variables, namely metrics related to the interventions discussed above. We were limited in our ability to test that type of regression model by the unavailability of some key data. We also did not have information about recent ICT initiatives, except anecdotally and only for our thirteen case-study communities. Finally, we were constrained by the very timing of our study — at the turn of the decade before detailed year 2000 decennial census figures had been released, making available census data quite old.

We identified a county-by-county data source at the Federal Communication Commission (FCC), on the number of telecommunications establishments in various years, most recently, in 1997. Recognizing the limitations of that single measure as a measure of connectedness, we used it in a number of exploratory quantitative exercises, including correlations with community variables to establish the factors likely to be present in better-connected communities, and preliminary regressions of connectedness on community variables, and economic outcomes on connectedness, including a two-stage least squares approach that controls for the likely simultaneity in our specification.

The results are for 1,426 of the 3,141 United States counties for which we were able to collect consistent data. The variables included in the models and types of relationships that we specified were informed, in part, by the case studies.

Table ES.3
Judgments about interventions' "success"

Place	Outcome	Comment
Helena/Phillips County, AR	Neg	Helena was one of Nortel's information communication network (ICN) communities expected to create physical and human connectivity among sectors. It did not, due to unwillingness to overcome longstanding divisions.
Monticello/Drew County, AR	Pos	This community put in place a proactive broad-based committee to advance connectivity; the local university also was meaningfully involved. Area poised to be regional hub.
Pine Bluff/Jefferson County, AR	Mixed	This was among the most complex cases, with several interwoven initiatives, including participation in a regional Bioplex, development of a Fiberpark, and economic development related to reuse of the Pine Bluff arsenal. Not much has happened for a variety of understandable reasons; the jury, however, is still out.
Hays, KS	Pos	Four separate initiatives were going on: ICT curriculum development at FHSU; telemedicine at Hays Medical Center; an "information city" project; and expansion of call centers. Different regional, broad-based committees enhanced and coordinated these efforts (a coalition and an advisory group). FHSU leveraged investment by AT&T (establishing a point-of-presence) that provided benefits generally.
Springfield, MA	Pos	This is a story of an effective leader (president of community college) who understood the importance of the higher education-economic development link and the opportunities in the region for optical information companies. With cooperation of the regional planning commission and the commonwealth of MA, and strategic assistance from EDA, the Park and related activities (incubator) worked.
Billings and eastern MT	Pos	The Eastern Montana Telemedicine Network is a nationally recognized success. It includes an important role for the private provider (Qwest), effective leaders, and medical institutions. The technology is low key (not fastest everywhere) and attention was put into facilitating the use of the network.
Kinston, NC	Mostly neg	The major initiative here was the development of an air cargo-based industrial park that utilizes advanced logistics to capitalize on just-in-time production. After many years and many millions of dollars, there are few tenants. Public acceptance, especially outside the region, is wearing thin. The logistics training center is holding classes, but graduates still have few jobs to acceed to.
Greenville, NC	Pos	The NC legislature located a new medical school in agricultural and poor Greenville, in part, as an economic development policy. The medical school saw its niche in rural health, and saw telemedicine as a critical tool. The region now is a center for rural health and related health services.
Northeast Pennsylvania	too early	Two neighboring counties overcame decades of competition to form a regionwide alliance to focus development on information technology — specifically upgrading higher education, building a new image, attracting young people, and recruiting IT companies that provide increasingly good jobs.
Bloomsburg, PA	Mildly pos	This initiative was not very ambitious: mostly to elevate business leaders and the general population to the possible role of ICT in transitioning the community into the 21st century. A coordinating committee was formed that helped promote several modest initiatives. One leader has maintained the momentum; broad-based involvement has not been maintained on the committee.
Meadville/Crawford County, PA	Pos	This case is about the successful development and use of a link-to-learn training center, to prepare students for jobs and serve as a recruiting incentive to a nearby industrial park. It illustrates the importance of intergovernmental cooperation and effective coordinating committees.
Willacy County, TX	Pos	This very rural county was able to achieve a relatively high level of Internet connectivity because of some innovative actions of a local telecommunications co-op — that had universal service subsidies and good revenues from business in Mexico to take pressure off short term needs, enabling it to look at up-front costs as long-term investments, and that figured out how to bring down the cost of connectivity by developing new hardware and setting expectations appropriately (for less than the fastest and broadest bandwidth).
Seattle, WA	Pos	Seattle, of course, has world-class ICT resources from which to draw. This case illustrates how one visionary grass roots leader, the city of Seattle, and others employed those resources well to help the economic development of at-risk teenagers and increase the supply of IT professionals.

Critical Success Factors and Implications for Policy

Here, we draw some general lessons from the qualitative and quantitative analyses. First, from the case studies:

- Success of ICT initiatives is most likely when the condition and availability of both traditional and ICT infrastructure are good. The absence of traditional infrastructure makes success more difficult to achieve, but not impossible, since ICT infrastructure can sometimes be used as a substitute, at least in the short run.
- A larger planning process in which ICT is embedded is a critical success factor. In exceptional cases, the lack of planning can be overcome by strong individual/institutional leadership, but that is hard to sustain and not likely to work in larger communities. Having a planning process in place, however, will not guarantee success; other conditions must also be present.
- A critical mass of demand is crucial to induce the private sector to make ICT investments. That defines some important roles for the public sector: to provide subsidies in rural places, through grants, concessionary loans, and tax incentives, at least at an early stage, and to help aggregate demand, in part, by coordinating related ICT programs, by providing information about users to the providers, and by acting itself as a consumer of ICT services in the rural regions.
- Another way to offset the disadvantages of scale in rural places is to employ innovative technologies. The evidence suggests that innovation is a necessary, but not necessarily sufficient condition of success.
- Appropriate institutional mechanisms to help users deploy the technology infrastructure are a necessary but not sufficient factor for the success of ICT initiatives.
- Governmental linkage is neither necessary nor sufficient for success. It appears that good intergovernmental cooperation and funding contribute to success, but communities seem to have found ways to succeed without it.
- Flexibility/adaptability is a critical success factor: if public-sector partners are not able or willing to help a local community, it can still succeed by mustering its own resources. That, however, is much harder to do and sustain.
- The "innovation triangle" (cooperation among business-government-education leaders) is a necessary, if not sufficient factor for success.
- It is critical to involve the infrastructure providers in the planning, financing, and implementation of the initiative.
- Twenty-first century infrastructure is more sophisticated than it was previously, and requires specialized and constantly upgraded skills in the work force to be productive. It is not enough to put ICT hardware in the ground (or in the skies); a place must have an appropriately trained work force to use it.
- Vision and leadership are hard to measure, but critical for the success of initiatives, especially those requiring considerable resources and time.

From the quantitative analysis:

- History shows that isolated investments in traditional infrastructure have never been sufficient to turn regions left behind around and help them to catch up. This is even more the case when we look at the characteristics of telecommunications infrastructure and information technologies. State-of-the-art technologies and unlimited capacity alone are not enough to attract new businesses, if work force development and other important factors are neglected. Any public investment in information technology has to be part of a broader planning concept in order to be successful.

None of this constitutes a recipe for success: "follow these twelve principles and your initiative will succeed." The cases we have described support these as general propositions, and a community intent on using ICT as a basis for economic development should take them to heart. In some instances these are not even "necessary" conditions; we have illustrated where communities have overcome a deficit in one or more factors by being flexible and adaptive. Moreover, having most or all of them does not ensure success (the "sufficient" criterion). Good luck, good timing, and other intangibles play a role.

Just as there are kernels of wisdom in these observations for communities, there are implications for states and the federal government (EDA) who want to see ICT succeed as a means for reducing economic development disparities.

In general, both subsidies and policies to allow competition have been key background policies at the state level. In addition, states provided funds at strategic times — the Ben Franklin program in Pennsylvania, for example, provided capital funds in Bloomsburg and Northeast Pennsylvania, and North Carolina provided funds to construct a training facility in the Global TransPark. States also have helped aggregate demand to achieve a critical mass to make ICT provision economically viable. Local governments also have acted strategically; for example, Kings County (Washington) provided funds to the community college to upgrade training programs, and the city of Seattle created and funded an IT administrative position to provide coordination and leadership. These are a few of the many examples provided by the case studies. The findings above underscore the importance of hierarchical coordination between state and local governments to ensure that state resources are spent in a manner consistent with local plans, and leverage local effort. The same is true for local-federal relations.

Telecommunications policy is clearly an important background condition at the federal level. We saw in several cases (Willacy County, Hays, and Billings) the role universal service subsidies played in allowing private providers to operate in the face of thin demand.

But most relevant to this report is the role the Economic Development Administration has played in helping places left behind. In many of our cases, EDA made investments at critical times. Those investments seemed instrumental in many instances, in leveraging local effort. Examples include the following:

- Monticello used EDA funding for infrastructure for its industrial park;
- Springfield received $1 million grant from EDA's 302 program to help in incubator development.
- Kinston used EDA funds to develop the Global TransPark training facility;
- Northeast Pennsylvania has received funds for the Great Valley Technology Alliance.
- Meadville used almost $4 million in EDA funds for its link-to-learn initiative, for the facility, and the industrial park infrastructure.
- A $1 million EDA grant is being used to start a Center for Border Studies at the University of Texas-Pan American.
- Seattle's success was due, in large part, to the efforts of a grassroots activist (Luversa Sullivan) who received a $135,000 EDA grant that allowed her to quit her day job and focus on her innovative training and institution building activities.

All of these except Kinston were judged to be successes (and Northeast Pennsylvania is too early to tell). It is tempting to add strategic financial intervention by EDA as a critical factor in those successes since most of the communities we studied had few alternatives for infrastructure funding.

Conclusions

We conclude the report by proposing answers to each of the research questions (on page 1). Our summary includes some action items for EDA in terms of policy and further work to commission.

1. What is technology infrastructure?

Based on early input from our expert panel, in order to bring more focus to the research, we operationalized technology infrastructure as information technology and telecommunications. It can — and in "connected" communities does — include all of the following basic elements:

Hardware:

- Computers in every K–12 public school classroom and public library.
- Cost-competitive access for businesses to the Internet at high speed (256k and up) through broadband networks of fiber optics, wireless and/or cable.
- Local Internet access for all households who want it.

Knowledge institutions:

- Institutions (colleges, high schools, local governments, community development agencies) that provide training in the use of IT.
- Institutions (colleges, hospitals, companies) that offer professional and skills training that uses IT (e.g., distance learning, telemedicine).
- Companies that use IT for e-commerce with customers and suppliers.

Knowledge workers:

- Graduates from high school and/or college with basic IT, math, and reading skills for entry-level jobs in high or mid-tech companies.
- Access to programs to train displaced workers, locally or remotely.
- Entrepreneurs who can access business startup training and venture capital.

Our original typology, as well as much of the literature on how technology investment can spur economic growth, includes R&D-intensive activity and institutions. Although these can be important for innovation and the highest-tech growth that gets most of the media attention, many of the distressed communities in our study and elsewhere do not have and will never have research universities or institutes. With appropriate basic technology infrastructure, they can certainly better connect to these resources through IT.

One of the lessons from this research is that distressed communities can create better paying jobs, stem out-migration, enhance community image, foster entrepreneurship, and create more stable, if not growing, economies through the application of ICT. They do not need to become high-tech meccas like Silicon Valley or North Carolina's Research Triangle to be considered successful in using technology infrastructure to spur economic development. They have to start from where they are.

2. What do we mean by "distress" and "distressed communities"?

Although some of the attributes of the places vary in their proximity to urban areas, density, and terrain, our case-study communities have in common a baseline condition of distress that has some familiar dimensions. All of the included communities, and likely all those nationwide that are eligible for EDA funding, exhibit some of the following signs of distress:

- Low income and/or wages;
- High unemployment or underemployment;
- Population loss and/or out-migration of working age population;
- Increase in elderly population;
- High and/or persistent poverty;
- High welfare caseload;
- Other social and health problems — e.g., crime, teen pregnancy, infant mortality;
- Marked income inequity/lack of middle class;
- Dependency of economy on a single sector, esp. a declining one like agriculture, mining, textiles or apparel;
- Dislocation of laid-off workers who lack skills needed for technology jobs;
- Poor quality public schools for turning out young adults with appropriate (including math and science) skills to compete for tech jobs;
- Inadequacy of basic infrastructure (roads, water, sewer);
- Insufficient local fiscal capacity to address infrastructure needs;
- Weak institutions in terms of leadership and/or grantsmanship;

- Culture of poverty and/or negative self-image; or
- Isolation from realities and opportunities in their state, nation, world.

Much of the current discussion about the digital divide emphasizes that rural, inner-city, and other low-wealth communities must not be left behind in the knowledge economy. It is as though some of these other types of distress have been tolerated, but lack of connectivity to the Internet and the global economy will not be, as this would be the final blow to some of these places.

When we get more deeply into issues of ICT, another perspective about distress emerges that is important to understand, namely the capacity for knowledge-led growth in the "new economy." Our research indicates that communities characterized by distress in the ways itemized above also are deficient in physical, human, and social ICT infrastructure. But it is interesting to note that during the national economic expansion of the 1990s, some older regions did not appear in crisis by many of the traditional indicators, yet fell further behind in terms of connectivity and the skills of their work force. As we entered the recession of the new millennium, those areas are suffering badly.

3. *What types of infrastructure are most needed and appropriate in distressed communities?*

Based on the case-study research, as well as the essence of recent publications and conferences on the digital divide, there are a few types of infrastructure that are needed to help distressed communities. These include

- Affordable high-speed broadband networks;
- Knowledge institutions (including community colleges, universities, hospitals, and businesses) to help people understand how hard infrastructure can be used to solve problems; and
- People networks of leaders of all stripes.

4. *What are the major constraints to improving the state of technology infrastructure in America's distressed communities?*

The case-study sites, not all of which we characterized as successful (to date) in their investments in ICT, are rich with evidence of what is missing to make an intervention work to improve the overall economic standing of communities. The places that are successful have managed to address or overcome these barriers, which include

- Lack of knowledge of what technology infrastructure exists currently — in part due to providers' reluctance to reveal competitive information;
- Technology plans (if any) that are not integrally connected to an overall strategy for economic and community development;
- Leadership vacuums and community self-image problems;
- Lack of critical mass of population and/or business;

- Social barriers to launching an inclusive community effort to bring about connectivity; and
- Insufficient local tax base or political will for investment in necessary infrastructure and work force training.

5. What types of economic development do different technology infrastructure investments support?

The case-study sites each tried a somewhat different infrastructure investment that in most cases was a composite of several different interventions on the part of various actors. Nonetheless, in an attempt to characterize the expected economic development outcomes for different types of efforts (if successful), we can observe the following:

- Community networks help forge the necessary people connections among government, business, education and nonprofits to map out and make effective use of the physical technology for improving business competitiveness and the work force's preparedness for new economy jobs.
- Telemedicine networks help keep key institutions (clinics and schools) in small rural communities intact, and stem out-migration of both the general population and health care providers.
- Technology parks support the development of companies that need the high-speed fiber networks, the supportive services of technical training institutions, and/or the research spinoff opportunities of a federal lab or research university.
- Work force training and distance learning programs can help existing businesses be more competitive, allow the work force to stay local, and elevate the attractiveness of the area to other firms.
- Creation of community portals and specialized marketing portals can help create awareness of the community and open new markets for its economic products.

6. How can EDA most effectively use its limited resources to help distressed communities upgrade their technology infrastructure?

Some of the implications of this research for EDA are to do the following:

- Coordinate its investments with local and state planning efforts to avoid duplication and leverage local effort and resources.
- Emphasize the importance of cross-sectoral consortia and partnerships among local government, business, education (K–12 and higher), and nonprofits to the success of any ICT strategy. This cannot just be occasional interaction, but routine and regular joint information sharing and problem solving. Among other benefits, this type of approach helps workers, businesses, and economic developers stay current about what technology exists now.
- Require applicants to demonstrate that their investments in physical ICT infrastructure are connected to a long-term economic development strategy that builds upon the existing assets and addresses the nature of the distress of the community, region, and state. "We are targeting high-tech jobs" is too generic to be useful. There are many different ways to transition a distressed commu-

nity to the new economy, not one-size-fits-all. The technology is a tool for connecting people, knowledge, and markets, not an end in itself.

- Build upon (without undermining) the networks and universal service philosophies of rural telephone cooperatives, which are bringing ICT to areas previously underserved.

CHAPTER 1

Introduction: Study Purpose, Research Questions, and Guide to the Report

Much of the research of the last century about the importance of infrastructure for economic development focused on sites and buildings, roads, water, sewer, and natural gas. This study focuses on the critical role that new types of infrastructure called "technology infrastructure" can play in economic development, especially in helping distressed communities in the United States move successfully into the knowledge-based twenty-first century. In particular, we look at the role of information and communications technology (ICT) in overcoming distress and bridging the digital divide.

The purpose of this study is to provide insight into what types of investments in technology infrastructure are the most sound for distressed communities, and what local or regional factors are critical to their success.

Experts agree that the most successful economies in the early twenty-first century will be these with a strong knowledge base. Technology infrastructure (alternatively called "knowledge infrastructure") is a critical component of a "knowledge economy" (see Luger, 1997). Technology infrastructure — defined as facilities, labs, computers, and related "knowledge-based" hardware and software — enhances our research and development capacity, and hence, our ability to create the new ideas and products that keep businesses on the leading edge of their respective industries. It also enables the innovations that lead to productivity-enhancing improvements in process technology, which are associated with greater productivity and higher incomes, and with reductions in labor demand per unit of output. Technology infrastructure then can help entrepreneurs succeed in creating new businesses and job opportunities for workers who had been displaced or never employed.

Communities with strong knowledge bases and the capacity to innovate generate new productive activity from within. They also attract additional technology-based enterprises and "knowledge workers" from outside, which provides both the impetus and resources to improve "knowledge institutions" (local schools, colleges, universities, research institutes, media centers). This self-induced, upward spiral of development relates to what has become known as endogenous growth theory: "As the skill or

knowledge base of a regional labor force is perpetually enhanced from within, it becomes a continuous internally created source of competitive advantage . . . for an economic system" (see Feser, Goldstein, and Luger, 1998, p. 3).

In communities around the United States that are thriving in the "new economy," this upward spiral is at work. The question at hand is whether and how technology infrastructure can be used to help *distressed* communities reverse their downward spiral or stagnation. Communities classified as "distressed" by the United States Economic Development Administration (EDA)[1] include many types of areas, in different regions and size groups. Whether inner city, rural, or somewhere in between, distressed communities suffer chronic high unemployment and lagging incomes at a time when the rest of the United States has experienced sustained growth.

Research Questions

The specific research question we seek to answer in this study is ***In what ways does information and communications technology help distressed communities advance economically?***

The overall research question can be parsed into several subquestions that are addressed in this report:

- What is technology infrastructure, and ICT, in particular?
- What do we mean by "distress" and "distressed communities"?
- What types of ICT infrastructure are most needed and appropriate in distressed communities?
- What are the major constraints to improving the state of ICT infrastructure in America's distressed communities?
- What types of economic development do different ICT infrastructure investments support?
- How can EDA most effectively use its limited resources to help distressed communities upgrade their ICT infrastructure?

This study applies several methods, most centrally a qualitative analysis of ICT-related initiatives in thirteen distressed communities in eight states, to address these questions. It also includes a quantitative analysis of secondary data to ascertain the correlates of ICT investment. The methodology is discussed in more detail in chapter 4.

Structure of the Report

The remainder of this report is structured as follows: chapter 2 includes a conceptual discussion about the role of technology infrastructure generally, and ICT in particular, in economic development. It is based not only on our own original work, but also on

1. Defined by the EDA as per capita income no more than 80 percent of the national average, or an unemployment rate at least one percentage point greater than the national average over the last two years of reported data.

a synthesis of several literatures: regional economic development, infrastructure finance and planning, information economics, and technology policy.

Chapter 3 uses the literature to develop and justify ten study hypotheses that we apply in each of the thirteen case studies.

Chapter 4 describes our research design, specifically the contours of the qualitative and quantitative analyses we undertake, with particular emphasis on the threats to external and internal validity, and on the limitations to the methodology employed in the study.

Chapter 5 presents the results of the case study and quantitative analyses. The case-study findings are distilled from in-depth field reports that are included as Appendix A. We present a series of summary tables that contain our judgments about outcomes and inputs that are used to test the study hypotheses. We also present correlation and regression results using data from over 1,000 United States counties, intended to explain variations in "connectivity." We conclude the chapter by drawing out the implications of our findings for communities and for state and federal economic development policy makers.

Chapter 6 offers the overall conclusions from the study and addresses the original research questions. It includes the key recommendations from this research and identifies fruitful areas for further research.

Appendix A includes the full stories of each case-study place, organized alphabetically by state. Each includes background on the place, the nature of the intervention, judgments about the success, the disposition of each study hypothesis, and lessons learned.

Appendix B includes the operational definitions of technology infrastructure and community distress applied in the development of the study protocol, as well as a list of the participants on the expert panel convened early in the project.

CHAPTER 2

Background: The Role of ICTs in the "New Economy" of the 21st Century

In this chapter, we discuss the developments that have transformed the economy over the past decades. Advances in information and communications technology play a major role in these changes and affect not only economic development, but also all aspects of society. We first summarize the major developments and changes that are taking place and then focus particularly on the role of ICTs.

The Growth of the "New Economy"

In recent years, the term "new economy" has been used to describe the fundamental global transformation of our traditional economy. The transition from the Industrial Economy that characterized most of the 20th century to the knowledge-based new economy that characterizes the twenty-first century is changing the way businesses, regions, states, and nations compete with each other. New technologies — especially ICTs — have accelerated the pace of innovation and adoption. It is critical for agents at all levels (individual businesses, sectors, local and regional economies, states, and nations) to keep up with new developments and to implement mechanisms and strategies in a way that allows them to remain competitive in the global economy.

The new economy is characterized by shorter product development cycles (about half of all the products on the market in 1998 were new introductions), by competition that is growing at an exponential rate (e.g., IBM's competitors have grown from 2,500 in 1965 to more than 50,000 today), and by a faster pace in general (Daley, 1998). More recently, the dramatic rise and failure of many e-commerce and dot-com businesses illustrate the speed at which changes take place in the new economy. The recent developments also show the importance of careful planning and the need to integrate new technologies in broader strategic and development concepts. Whether for individual businesses or for regional economic development, ICTs alone cannot solve any problems or guarantee competitiveness or success. Increasingly, these technologies will become a necessary, but never a sufficient, condition for companies, communities, and states that will emerge as winners in the new economy.

The knowledge-based new economy differs in many ways from the old Industrial Economy. The new economy is dynamic, businesses face global competition, and networks have replaced bureaucratic, hierarchical forms of organization. Alliances and cooperatives are more important than individualistic, competitive relationships with other firms. Instead of mass production and economies of scale, flexible and customized production, innovation, and quality characterize successful businesses. Innovation and knowledge have replaced capital and labor as the key drivers of economic growth (see, for example, Tapscott, 1995, 1999). For more than a decade, Castells (1989, 1996) and others (Tapscott, 1995; Mougayar, 1998) have emphasized the change from mechanization to digitization, or "from atoms to bits." The new economy is also a digital economy, relying on information and the technologies that allow the real-time transformation of this information. The recent changes would not have been possible without the Internet, e-mail, videoconferencing, and the general availability and increased affordability of these technologies.

The changes have also significantly affected the work force. The new economy poses new challenges and requires completely different qualifications and attitudes. The job-specific skills of the Industrial Economy are not sufficient for the dynamic new economy, where broad skills and cross training are considered more important. The pace of the economy demands flexibility and the ability to work in teams based on specific project needs. As the failure of many Internet-startup firms has shown so clearly, employment is not as stable as it was for most of the time in the Industrial Economy, but is characterized by risk and opportunity. In order to take advantage of the opportunities, work force development and ongoing training are essential.

The Use of ICT Infrastructure in the New Economy

While information and knowledge have always been of key importance for businesses, information plays an important role as a distinctive production factor in the new economy. There are separate special industries that produce only (or mainly) information. The output of specialized services is information, not necessarily in the form of a tangible product. Information processing, administration, distribution, and searching become highly specialized internal functions of companies. We can observe that information has become an auto-cumulative process. The resulting mode of development can be characterized as "informational" (Castells, 1989, 1996). As a result, companies become networking and networked organizations. This refers to a wide range of internal and external relations that are done more and more in an electronic way. The changes affect most business activities. For example, many companies provide product information online, and marketing and public relations can promote new products and services on a global scale. Online customer service allows (almost) real-time interaction and feedback, thus increasing both customer satisfaction and the possibility for product and service improvements. In production and distribution it is now possible to order, sell, and make payments electronically and to perform transactions faster and cheaper. That enables more flexible production, more automation, integrated manufacturing systems, and improvements in logistics. Local and regional markets become global markets — everybody who has access to the global network can com-

pete in other previously local and regional markets, but at the same time face potential competition from businesses located anywhere on the globe.

The use of advanced technologies has increased both the speed and capacity of the networks dramatically. More businesses have more and faster access to more information than ever before. The information distribution nowadays takes place in real time, in better quality, and reaches more and more remote locations faster than only a few years ago. Some authors (Globerman, 1996; Mougayar, 1998) see the Internet as a replacement for "traditional" forms of electronic data interchange (EDI). The open design, the easy access, and the possibility to use the Internet for much more than simple data transfer make it much more attractive than the traditional — and in many ways, limited — proprietary networks. EDI has been used since the 1970s and 1980s, along with computer-aided engineering (CAE) and computer-aided manufacturing (CAM) systems. In the early days, installation and maintenance costs were so high that most small and medium-sized businesses could not afford to make such investments. In addition, the relatively small total number of users made it difficult even for larger companies to take full advantage of the technology. If many of their business partners did not use EDI, these early adopters were not able to realize the full potential savings (NTIA, 1998). The Internet, on the other hand, soon reached a "critical mass" of users to stimulate a self-reinforcing development. More users mean more potential clients and partners, so the Internet becomes more attractive, and also cheaper.

In order to utilize an advanced telecommunication infrastructure like the Internet to its full potential, companies have to adjust their organizational structure to fit the new requirements and opportunities (see, for example, Marshall and Richardson, 1996; Hwang, 1998). "Overall, and as a general trend, multidirectional networks are substituting for vertical bureaucracies as the most efficient, archetypical form of the new system, on the basis of flexible, affordable, and increasingly powerful information/communication technologies" (Castells, 1996, p. 19). This emergence of firm networks was well under way even before the Internet became a business tool (see, for instance, Bergman, *et al.,* 1991). The Internet, however, helps to speed up this transition. Information and communication technologies lead to the convergence of specific technologies into a highly integrated system.

An important feature of the Internet, compared to earlier uses of computer networks, is that it is public. When two companies want to cooperate via the Internet they do not have to manage and finance the whole connection, but only their respective "access ramps" to the data highway. Because of these lower barriers to entry, small firms use the Internet more frequently than earlier forms of wide-area computer networking (for example, Hepworth, 1989). Smaller and younger firms also use the Internet more frequently because they tend to be more flexible in adopting new technological developments and rely more on market niches. Moreover, small young companies are usually less integrated into existing organizational networks and can therefore benefit more from the options that the Internet provides.

The modern economy is characterized by much shorter product life cycles, the need for real-time communications, and a changing role of time, in general. Information is generated at one location and then distributed. Innovations diffuse from the

location where they first occur (usually an agglomeration) to other areas. The diffusion depends on the existing communications channels and links. The dissemination of new information takes time, and under traditional assumptions and conditions, the knowledge is not available everywhere at the same time. The availability of real-time telecommunications technologies allows a much faster diffusion of information. Given access to information networks, information about new developments and innovations can be accessed everywhere at the same time, right when it becomes available, with significant implications for competitiveness.

The shorter life span of new products also increases the need for greater productivity to be competitive. Rapid technological developments as well as frequent changes in demand require high flexibility of the internal organization. Lean production, lean management, flexible specialization, just-in-time, and outsourcing are thus important strategies of companies in the global economy (Davidow and Malone, 1992; Maier, 1995). The possibility of real-time interaction with the customers is a key factor. Instant feedback allows companies to match requests and preferences of their clients better and faster and thus to gain a competitive advantage. In the digital economy, the customers become more and more integrated in the development and the design of products and services (Tapscott, 1996).

The importance of ICT infrastructure within the new economy is not limited to businesses and commerce. All levels of government and public services undergo transformations as well. E-government solutions simplify access for individuals and improve efficiency. Community networks often provide access and training for minorities and disadvantaged persons who would otherwise not have access to the Internet. As a matter of fact, local community and public-service initiatives are of key importance in any attempt to bridge the "digital divide." While the gap between urban and rural Internet users is getting smaller, there are still many "have-nots" among low-income families, racial minorities, people with disabilities, and other socioeconomic groups. The adoption and use of ICTs changes communities in many ways — not just directly by providing access to remote information sources, but also by creating new interaction and meeting points and by bringing people together. Public access terminals, for example, as well as training facilities and events in public libraries or other facilities, provide opportunities for people from different social groups and backgrounds to interact and become part of the community. Unlike personal Internet access that provides a connection to the Internet from the anonymity of the private home, community networks can actually bring users together, stimulate interaction, integrate minority groups better, and create additional indirect benefits.

We present best practice examples and discuss the effects of ICTs on businesses, individuals, and communities in greater detail throughout this report.

Definitions and Concepts

Before we proceed further, we need to define a number of terms related to information and communication technology. We define "infrastructure" below as we use it throughout the report, and then describe the types of information infrastructure to which we refer.

Infrastructure

Infrastructure is commonly used to describe utilities and physical networks (roads, water and sewer lines, telephone lines, etc.). In this report, we use a broader conceptual definition. Knowledge infrastructure includes not only physical infrastructure (fiber optics networks and other information technologies), but also human capital and knowledge institutions (universities, community colleges, local governments, etc.).

A number of authors (see, for example, Knight 1995; Malecki, 1997) emphasize the importance of knowledge institutions and knowledge workers in addition to hardware. Information technologies (IT) alone cannot be successful economic development tools if nobody knows how to take advantage of the new capabilities and if there is no one who can train potential users. Therefore our conceptual definition of knowledge and technology infrastructure includes the physical (hardware) components of information technology (computers, fiber optic lines, routers, switches, etc.) as well as knowledge institutions and knowledge workers.

Based on early input from our expert panel, in order to bring more focus to the research, technology infrastructure was operationalized as information technology and telecommunications.[2] It can include — and in "connected" communities does — all of the following basic elements:

Hardware

- Computers in every K–12 public school classroom and public library
- Cost-competitive access for businesses to the Internet at high speed (256k and up) through broadband networks of fiber optics, wireless and/or cable
- Local Internet access for all households who want it

Knowledge institutions

- Institutions (colleges, high schools, local governments, community development agencies) that provide training in the use of IT
- Institutions (colleges, hospitals, companies) that offer professional and skills training that uses IT (e.g., distance learning, telemedicine)
- Companies that use IT for e-commerce with customers and suppliers

Knowledge workers

- Graduates from high school and/or college with basic IT, math, and reading skills for entry-level jobs in high or mid-tech companies
- Access to programs to train displaced workers, locally or remotely
- Entrepreneurs who can access business startup training and venture capital

Types of information technology infrastructure

In this section, we present a typology of information technologies and discuss recent developments and technological advances. New technologies are providing faster,

2. An initial inventory of measures of technology infrastructure as well as the suggested additions from our expert panel is included in Appendix B.

easier, and cheaper access to the Internet, but they are still not generally available in every part of the country. In addition, a lack of information about available services and cost structures prevents many remote and distressed areas from becoming part of the global economy. We discuss variations in Internet access, growth rates, and differences in service provision and show why distressed areas have often been left behind.

The following list summarizes the most important types of services that are currently in use. While all of them can connect individuals, businesses, public institutions, and other organizations with each other and to the Internet, there are significant differences in convenience, speed, and costs.

Dial-up connections

- ***Analog*** telephone service is the oldest technology, originally developed only to handle voice communications, and has been widely replaced with digital lines. Analog lines are considered relatively slow and unreliable.
- ***Integrated Services Digital Network (ISDN)*** is a nationwide standard, digital dial-up telephone line that can handle voice, video, and data communications all at the same time, on the same telephone call, over the same telephone line. ISDN could be the optimal solution for many businesses. It provides significantly faster access than a regular dial-up connection and is sufficient for the needs of businesses that do not need a permanent connection to transfer large amounts of data all the time. ISDN requires special hardware (ISDN terminal adapter, ISDN digital modem). There are different bandwidths available:
  - ***Basic Rate Interface (BRI)*** provides two B channels for simultaneous voice, video, and data communication and a D channel for line signaling and control. Total bandwidth is 128 Kbps. BRI meets the needs of most small businesses as well as residential customers. There are distance limitations, however; BRI is only available within 18,000 feet (3.4 miles) from the central office.
  - ***Primary Rate Interface (PRI)*** is an ISDN solution for larger businesses and provides a total bandwidth of 1.472 Mbps (23 B channels + D). There is no distance limit on PRI.

Permanent connections

- ***Dedicated leased lines*** are still widely used by many businesses. A router is needed to connect a local area network to a dedicated line. For many years, leased lines were the only alternative to dial-up connections, but from a technical perspective they are inefficient and almost obsolete as a way to connect individual businesses. They are only needed for permanent or very frequent large file transfers, for top-security information, and for the transmission of medical images where no delays at all are acceptable. Unlike a switched circuit (asynchronous transfer method or frame relay), a dedicated line is a permanent direct communication link between two points. Therefore dedicated lines always offer full bandwidth to the user. However, when the user of a point-to-point connection does not transmit any data, then the bandwidth of that line

is "lost" — no other user can take advantage of it. With a switched circuit connection, on the other hand, "excess" bandwidth is reassigned to other users. While a point-to-point connection was the best (and at some point the only) solution in the past, now frame relay and especially asynchronous transfer method (ATM) provide the same quality service for much less money.

- ***Digital subscriber line (DSL)*** provides speeds up to 1.5 Mbps, but requires even closer proximity to a central office or DSLAM[3] than ISDN (10,000–18,000 ft., depending on the exact technology used). A network interface card and a DSL modem are required. ADSL (asymmetric digital subscriber line) modems allow data to be sent over existing copper telephone lines. ADSL supports data rates of from 1.5 to 9 Mbps when receiving data (known as the downstream rate) and from 16 to 640 Kbps when sending data (known as the upstream rate). Until recently, because of the distance limitation, DSL was not seen as a feasible technology for sparsely populated rural areas.[4] The cost for the installation of a DSL switch in a central office is about $150,000; phone companies usually need a certain population density around the central office to make that investment. There is a DSL technology based on fiber that will be available by the end of 2002 and work well for companies whose outside plant is fed directly by fiber; older plants would have to update their coaxial cabling to fiber.[5]
- ***Cable*** TV companies have also entered the business of high-speed Internet access. The same cable that hooks up to the television is used for high-speed data transfer. Unlike DSL, several users actually share bandwidth on the same cable. Again, special hardware (a cable modem) is needed in order to use this service. Broadband differs from current technologies by increasing the amount of data that can be sent and the speed with which data can be sent. Some experts estimate that broadband technology will increase the rate at which information is transferred by 50-fold. Although only fifteen states had operational broadband systems at the end of 1999, cable is now well established in urban areas nationwide and represents about 70 percent of the market for broadband to the home or small business. Rural areas without cable television still lack cable broadband, however.

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3. Digital Subscriber Line Access Multiplexer (DSLAM) is a mechanism at a phone company's central location that links many customer DSL connections to a single high-speed ATM line. When the phone company receives a DSL signal, an ADSL modem with a splitter detects voice calls and data. Voice calls are sent to the Public Switched Telephone Network, and data are sent to the DSLAM, where they pass through the ATM to the Internet, then back through the DSLAM and ADSL modem before returning to the customer's PC. The more DSLAMs a phone company has, the more customers it can support.

4. As the case study for Willacy County, Texas shows, there are some technologies available now to create mini-central offices that help extend DSL into remote areas. Essentially this involves putting a DSLAM in a cabinet several miles from the central office and then running the lines out from there.

5. Estimate provided by an official from BellSouth in North Carolina. Interview: June 2002.

- ***Frame relay*** is a flexible and affordable solution for businesses that need high bandwidth, but do not continuously transfer large amounts of data and can accept occasional slight transmission delays. Frame relay uses switches (like the plain old telephone service). Every frame-relay customer has a direct link to the nearest frame-relay switch, either through a frame-relay access device (FRAD) or a router. Connections between the frame-relay switches (and thus between users) are set up only when they are required. Frame-relay networks offer a committed information rate (CIR; the rate that the network will guarantee for the connection), which is half of the total capacity (e.g., a 256 Kbps frame relay customer has a committed information rate of 128 Kbps). Frame-relay customers can get guaranteed rates up to T3 speed (43 Mbps); monthly charges are based on the guaranteed rate. If there is no congestion in the network, the customer's premises equipment (CPE) may be allowed to transmit at the full speed. If there is congestion, the user might experience delays in the data transmission. Usually, however, these slight drops are not noticeable.
- ***Asynchronous Transfer Mode (ATM)*** is a network technology based on transferring data in cells or packets of a fixed size. The cell used with ATM is relatively small compared to units used with older technologies. The small, constant cell size allows ATM equipment to transmit video, audio, and computer data over the same network. ATM provides a stable environment for seamless connectivity at a variety of transport speeds (up to 155 Mbps). ATM supports both private and public networks, uses the same technology for local and wide-area networks, and transports voice, video, and data traffic on a common circuit. There are four service levels available, ranging from economical "unspecified bit rate" connections (with no guaranteed bandwidth; connection can be dropped if the network is at capacity) to a constant bit rate that guarantees a constant cell rate (analogous to a leased line) for videoconferencing and other applications sensitive to delay. ATM requires special hardware. Some people think that ATM holds the answer to the Internet bandwidth problem, but others are skeptical. ATM creates a fixed channel, or route, between two points whenever data transfer begins. This differs from TCP/IP, in which messages are divided into packets, and each packet can take a different route from source to destination. This difference makes it easier to track and bill data usage across an ATM network, but it makes it less adaptable to sudden surges in network traffic.[6]
- ***Satellite*** **and** ***microwave*** connections offer high bandwidth, but both services are primarily relevant for ISPs and other very high-volume customers. The initial hardware investments are substantial and prohibitive for the average business customer.
- ***Fixed wireless*** can be a relatively affordable technology to deploy and offers good bandwidth. Its limitation is that the users of it must be within a direct line of sight from the tower and within 30 miles. Some towns allow the wire-

6. www.isp.webopedia.com

less tower to be put on top of an existing water tower, to avoid the costs of building a tower. The user needs a connection and an antenna at the site.

- ***Cellular wireless*** technologies are developing rapidly and showing promise for many rural areas with relatively flat terrain and where the lack of density limits the availability of other high-speed connections such as DSL. As with the fixed wireless system, electromagnetic or acoustic waves carry a signal from one location to another through the air (rather than through a wire). Cellular phones are essentially sophisticated radios that transmit on one frequency and receive on another. However, while a radio signal is sent from one radio directly to another, the cellular signal is sent from one cellular phone to a cell and then relayed to the cellular phone that it is trying to reach. This process allows for increased range and continual communication throughout an area that has cellular access. As of December 2001, roughly 80 percent of the United States had cellular access, according to the Cellular Telecommunications Industry Association (see CTIA Web site).

  Most wireless systems use radio-frequency (RF) waves, and the systems can take several forms. Global System for Mobile Communications (GSM) is the most commonly used form of wireless telecommunications, with over 120 million users in 120 countries. High-Speed Circuit-Switched Data (HCSD) uses a different technology and is superior to GSM in its ability to carry data at a rate up to 38.4 Kbps (GSM has a rate of between 9.6 and 14.4 Kbps). The speed of HCSD is equivalent to fixed telephone lines in most homes and businesses. Code-Division Multiple Access (CDMA) is a digital cellular technology that uses spread-spectrum techniques. Unlike competing systems, such as GSM, that use time division multiplexing, CDMA does not assign a specific frequency to each user. Instead, every channel uses the full available spectrum. Individual conversations are encoded with a pseudo-random digital sequence. One upcoming wireless technology is General Packer Radio Systems (GPRS). This technology will allow cellular phones and computer notebooks to have continuous access to the Internet with the aid of a fixed phone or ISDN line. The technology efficiently packages units of information for rapid transmission throughout the Internet at a rate of up to 114 Kbps.

There are several ways to compare the currently available technologies, based on costs and technical details. The decision as to which technology is the "right" one for a business has to be based on applications and individual needs. The following tables present some guidelines and examples for that decision. Table 2.1 provides a comparison of all services.

Individual technologies differ by speed, hardware, and costs; while some services require almost no prior technical knowledge, some involve more complex installation procedures and special knowledge for maintenance. Table 2.2 summarizes the hardware and software requirements (including fixed costs, where known) and indicates the level of expertise needed to install and maintain the service.

Table 2.1
Advantages and disadvantages of available technologies

	Advantages	Disadvantages/problems
Analog connection	Available even in remote rural areas, cheap.	Very limited bandwidth, no guaranteed bit rate.
ISDN	Uses existing phone lines, carries voice and data traffic over the same line, relatively inexpensive.	Requires digital phone service, therefore limited availability. Distance limitation and bandwidth limitation (BRI).
DSL	High bandwidth, uses copper wires, costs only a fraction of dedicated point-to-point service.	Limited availability, does not yet work with fiber (though expected to soon). Distance limitation, partially overcome by use of DSLAM cabinets.
Cable	Now available in most areas served by cable television, as fast and similar cost as DSL, does not tie up telephone line.	Not available yet in many rural areas; possible security issues.
Frame relay	Cheaper than dedicated point-to-point service, covers all bandwidth requirements, available everywhere, easy to add additional connections in a WAN (only one line needed for each additional location to be able to communicate with all existing locations).	Guaranteed constant bandwidth is less than what one gets with dedicated point-to-point service or ATM constant bit rate.
ATM	Same as frame relay, plus provides more service options at different prices (unspecified, constant or variable bit rate, real time transmission).	Unless one selects the constant bit rate option, one might not get the same constant bandwidth as with dedicated point-to-point service
Dedicated leased line (point-to-point)	High bandwidth (56K, fractional T1, full T1, T3), high security and reliability.	Highest costs. Connects only two locations. Requires two additional lines to link a third location to two existing ones, even more for a fourth, etc. (if all locations need to be linked to each other).
Satellite	High bandwidth.	High equipment costs.
Microwave	High bandwidth.	High equipment costs.
Fixed wireless	High bandwidth.	Requires line-of-sight to tower.
Cellular wireless	Does not require expensive installation of fiber.	Broadband technologies for data still under development.

Table 2.2
Hardware, software, and "brainware" requirements, and fixed costs of selected technologies

	Hardware	Software	Brainware
Dialup connection	Modem (<$100).	Internet connection software, Web browser (free).	Easy setup and use.
ISDN	ISDN terminal adapter ($200).	ISP and Web browser.	Easy setup and use.
DSL	DSL modem ($100).	ISP and Web browser.	Easy setup and use.
Cable	Cable modem ($100).	ISP and Web browser.	Installation and setup is often done by provider.
Frame relay	Frame relay access device (FRAD) or router ($1,200–$2,000).	Network software (costs depend on network size).	Installation and setup is often done by provider; network administrator needed for maintenance.
ATM,Dedicated leased line	Router ($1,200–$2,000).	Network software (costs depend on network size).	Installation and setup is often done by provider; network administrator needed for maintenance.
Fixed wireless	Individual access requires Wi-Fi (802.11b) modem or PC card ($50).	Minimal requirements — on users' machines.	Many emerging networks are set up informally in urban areas by civic-minded organizations that construct access nodes (antenna and server: $1,000) and enthusiasts who connect to them.
Cellular wireless	Phones ($0 to $400 depending on service plan).	Provided on phone by provider.	Easy setup and use.

Bandwidth requirements depend mostly on applications (see Table 2.3), but also on the number of concurrent users and on the need for real-time connection. For many single users, a 56 Kbps connection is acceptable for e-mail communication and Web browsing. A faster connection — such as ISDN — allows a faster file transfer. If a user transfers many large files or visits Web sites with streaming (real-time) videos, then ISDN saves time and allows one to watch the videos without delays. If it is not crucial whether it takes 30 seconds longer to transfer a file, then the regular phone line might be sufficient. A 256 Kbps connection is enough bandwidth to support videoconferencing (possibly with minor delays), while a T1 is still not fast enough to transmit a broadcast-quality video. At the same time, a 256 Kbps connection can connect up to 50 workstations to the Internet for concurrent use — enough to cover the needs of most small businesses. A T1 line provides capacity for up to 1,000 concurrent users.

For some applications — such as telemedicine — even the smallest delays are not acceptable. In most cases, however, small delays do not matter. Delays can occur when too many users try to access the same Web page at the same time. This is important for e-commerce businesses, so they need more bandwidth. But a fast connection is not enough when the local server cannot handle all the traffic — another potential bottleneck.

Table 2.3
Bandwidth requirements of popular applications

Application	Examples	Bandwidth (Kbps)	Special Characteristics
Speech	Standard telephony	8 – 64	Sensitive to small delays
Still image	Medical images	64 – 1,544	High bandwidth essential in emergency cases
Moving image	Videoconferencing	128 – 384	Real time*
Moving image	Broadcast-quality video	5,000 +	Real time* and very high quality
Moving image	Home-quality video (VHS)	1,544 +	Real time*
Messaging	E-mail	1 +	Not real time*
Messaging	Electronic funds transfer	1 +	Real time*
Document transfer	Fax	2 – 64	Not real time*

* Real time indicates information that must be transmitted without delay.

Understanding the Channels through which ICT Operates

ICTs affect all aspects of life. The most important users of ICTs are individuals (or households), businesses, and communities. Most public investment in ICTs, however, focuses on specific sectors or activities, not necessarily on specific groups of users. Common examples are health, education, government and public services, and business applications. Technology infrastructure is often put in place with these specific sectors and applications in mind. For example, education networks are created to bring broadband access to schools and community colleges in rural areas and to provide access to university resources through distance education and videoconferencing. Other networks are funded to connect rural hospitals and medical centers with the intention to share resources and to improve the quality of service through telemedicine applications. Different federal and state grants and investments target local governments and the public sector and try to improve efficiency and accessibility through e-government.[7]

In many cases, the original focus of ICT investments is fairly narrow and restricted. Successful communities, however, recognize the value of using the infrastructure capacity that is already in place for additional applications. For example, education networks are expanded to link healthcare facilities and teaching hospitals as well. At the beginning, the North Carolina Information Highway linked mainly universities, community colleges, and schools. The final goal is to include more than 3,400 sites — public schools, hospitals, libraries, community colleges, universities, law enforcement centers, courthouses, prisons, as well as local and state government locations. Such expansions not only include a number of sectors and activities, but also affect many different actors, some of whom are involved in more than one activity.

The overlap is quite obvious. For example, individuals can access distance education programs (either online courses or other electronic material) from home. At the same time, communities and local governments increasingly provide access to the Internet (and thus to distance education) through public access terminals in libraries, community centers, and other locations. Some communities (as well as private businesses, sometimes in cooperation with institutions of higher education) also provide specific training to bring groups online who otherwise would not become users. Therefore, ICT investments that target the "education" sector affect and involve a number of users: individuals, communities, and (to a lesser degree) businesses. We can show a similar connection for the health sector. Providers (businesses) and patients (individuals) both benefit from telemedicine networks. Similarly, through telecommuting/teleworking and e-commerce, individuals and businesses are equally affected by the possibilities that ICTs provide for the business sectors. And individuals as well as governments benefit from community networks and e-government applications. The following matrix (Table 2.4) illustrates the complex connections of applications and us-

7. We recognize the importance and value of e-government: similar to other sectors, local governments can reduce costs, improve internal efficiency and internal as well as external communication through the use of ICTs. However, we do not discuss local governments' specific applications and implementation strategies for ICT in this report.

ers. It also makes clear that providing infrastructure for a specific purpose (application) is not enough; it is important to ensure that all potential users receive appropriate information and training to benefit from these investments.

ICTs and Regional Economic Development

In this section, we discuss how the prominence of ICTs within the new economy can affect regional economic development. ICTs alone may not have a direct impact on regional development; regardless, access to new technologies and successful adoption and implementation of ICTs are key for future competitiveness.

Many authors (e.g., Castells, 1996; Tapscott, 1996; Cairncross, 1997) compare the development of information technologies and their impact to the Industrial Revolution. Similar to the steam engine and electricity in the past, the computer and more recently the Internet have transformed our society. The digital revolution, however, is happening much more quickly. No other technology has been adopted by so many people in such a short time: only four years after the Internet was opened to the general public, 50 million people were using it. Radio took 38 years to reach that benchmark, TV 13 years, and personal computers took 16 years (Meeker and Pearson, 1997).

The Internet growth rates are still impressive, with an additional 2 million users coming on-line in the United States each month. There were 143 million Americans online at some location in September 2001, 26 million more than there were only 13 months earlier. During this same period the percentage of homes with Internet access increased 22 percent (from 41.5 percent in 2002 to 50.5 percent in 2001) (NTIA, 2002).

Along with the dramatic growth rates we see declining prices. Personal computers that cost far less than $1,000 (and are considered "entry-level") are more powerful

Table 2.4
Connections of applications and users

	Actors/typical users		
Sectors/applications	**Individuals/ households**	**Businesses**	**Communities/ local governments**
Education	X	X	X
Health	X		
Government/ public services	X	X	X
Business/commercial	X	X	X
Social/cultural/ recreational*	X		

* This category is probably the most important one for individuals and households. Most private users access the Internet mainly for personal entertainment, to get information and make plans related to recreational activities, and to communicate with family members and friends. This kind of private use and the effects that the Internet has on the social life of individuals, however, are not the subject of this report. We list this category only to provide a complete list of uses for ICTs.

and better equipped than high-end machines that were sold for $3,000 and more only two or three years ago. Computing power has been doubling every 18 months for the past 30 years. In just six years (1991–1997), the cost of microprocessor computing power had decreased from $230 to $3.42 per MIPS (NTIA, 1998). One estimate now places the cost of computing at $1 per MIPS).[8]

Connecting to the Internet has become more affordable as well. As discussed above, new broadband technologies provide a number of different options for fast Internet access — something that was only affordable for large businesses or organizations a few years ago. Now that DSL, ATM, and other technologies offer flexible alternatives to dedicated leased lines, high-speed data connections are no longer a luxury. While the pricing of the old technologies (dedicated leased lines) was entirely based on distance, prices for the new technologies (which take advantage of packet-switching technology) do not depend on distance.[9] The new technologies are not only cheaper (because more users share bandwidth); the costs are also the same for all areas *where the technologies are available*. However, not all technologies are available in all areas of the country due to technical limitations and lack of demand.

The widespread availability of ICTs could have potentially tremendous implications for regional economic development. Traditional agglomerations are the result of a number of forces that operate in physical space. Spatial proximity reduces transportation costs. For many industries, and over a long time, these costs played a crucial role in the optimal location decisions. The classic location theories (e.g., Weber, 1929) focus mainly on transportation costs. Another important agglomeration force is (external) economies of scale. Formal and informal production networks have also contributed to a spatial concentration of businesses. The importance of face-to-face interactions and trust is a reason why close spatial proximity is still important for some business functions and for specific sectors. To a certain degree, history plays an important role as well. Agglomerations and centers that emerged a long time ago — sometimes "by accident" — are so well established now that the availability of new technologies such as the Internet is not going to change their position in the urban hierarchy. Historically, businesses often made their location decisions on resource needs and production methods. Lumber mills, for example, located near forests. And other industries located on major waterways or near other transportation infrastructure. Residential location patterns have been influenced by similar decisions. Over time, a settlement pattern has evolved that is characterized by geographic clusters and spatial agglomerations — cities, towns, and metropolitan areas. These existing agglomerations offer general advantages for new businesses. As a result, many firms simply decide to locate in existing agglomerations for that reason (Feser and Sweeney, 1998).

Cities and agglomerations, however, only exist and will continue to exist if the spatial clustering of economic activities leads to economic advantages (cost savings). The Internet has some specific characteristics that allow businesses to reduce costs

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8. www.battery.com/news.cfm?section=featuredpapers&file=curme

9. For example, the same provider will offer DSL at the same rate wherever the technology is available. There are also no mileage costs for technologies such as ATM and frame relay.

and operate successfully regardless of geographic location and spatial proximity, if they can take advantage of the new Internet agglomeration forces.

One of the most important reasons for the rapid development of the Internet is the existence of positive economies of scale (Maier, 1995). The fact that millions of users are potential customers or at least recipients of marketing and product information makes the Internet so attractive. And the permanent increase in the number of networks, hosts, and users is motivation for additional users and information providers to utilize this facility for their needs. Higher demand and supply due to positive economies of scale induce the circular-cumulative increase that can be observed over the recent years.

Another important aspect is the cost structure of the underlying infrastructure. The main costs are fixed (hardware and physical network), thus with increasing volume of transactions the costs per unit transferred decrease. This constitutes an economic mechanism toward expanded use of networks like the Internet (MacKie-Mason and Varian, 1993).

As compared to other infrastructure components, the Internet has some completely new characteristics. Once a computer is connected to the Internet, the user has access to all other Internet hosts, regardless of their physical location. Terms like "cyberspace" and "virtual communities" describe this phenomenon and the diminishing importance of space and location (Rheingold, 1993). Distance becomes a negligible component for the Internet user (Maier, 1995). Companies that use the Internet to its full potential are expected to be more flexible in their location decisions. Access to a global computer network is key for such firms, while traditional location factors lose importance.

The resulting spatial implications are far-reaching. For administrative functions, for example, spatial proximity becomes less important. Some back-office activities — credit card slip processing, among others — are now frequently located offshore where labor is cheap — but sufficiently qualified and reliable — and where fast and reliable Internet access exists (Glasmeier and Howland, 1995). What does that mean for cities and agglomerations? Access to the Internet was initially concentrated in larger cities where sufficient demand ensures the profitability of Internet nodes. Thus, Internet access has made larger cities more attractive for companies that need efficient network connection than rural regions where network access is limited. Maier (1995) argues that cities are now engaging in a new form of competition, around advanced connectivity, as a way to attract more innovative, "interesting" companies that have that need.

Existing empirical evidence indicates that information technology can both centralize and decentralize activities. On the one hand, it has freed the office from the previous necessity of locating next to the operations it directs. Large multinational companies have used computer networks for a long time for internal coordination and communication. Usually these proprietary networks have no connection to the "outside world" (Cronin, 1994). The Internet provides advantages for these companies as well. They are able to reduce costs by using a public network, and the use of the Internet reduces the barriers between their internal and external activities. It is

easier for individual parts of the company to access and use external information and supply sources and to benefit from external knowledge (Maier, 1998).

On the other hand, however, information technology has helped to gather offices in large concentrations in special areas. The financial sector provides a good example of that tendency. The already available technologies would have allowed businesses to relocate at least some of their activities to nonmetropolitan areas. Beyond the issue of control, the general question of trust played an important role, particularly in the financial services sector (Code, 1991). Recently, we have been able to observe the increasing consolidation of local banks into interstate banking companies and the replacement of the local branch offices with ATMs. The recent mergers of NationsBank and Bank of America, and of Wachovia and First Union, illustrate the increasing concentration within the banking sector.[10] The new Bank of America was the first bank to provide service from coast to coast from its headquarters in Charlotte, N.C. That is only possible because of the capacity of the current information and communications technologies. Nowadays, retail banks are no longer defined by real estate but by electronic networks. A bank without real-time connection to the financial centers cannot compete.

Cronin (1997) summarizes banking and finance activities on the Internet in a number of case studies. Security First Network Bank and Atlanta Internet Bank were the first banks that operate solely in electronic space, as a "virtual bank." Charles Schwab & Company offers mutual funds on the Web, and "telebanking," "home-banking," or "PC-banking" are being offered by most banks to allow their customers to handle financial transactions from home, 24 hours a day. However, most of the services are only in addition to the standard services offered by the financial institutions. Online financial services are still very recent, but established banks and brokers face a new form of competition. The use of the Internet helps service providers and customers to overcome distances (Cronin, 1997).

Access to computer networks will become almost ubiquitous with further improvements in information technology and with the realization of large telecommunications infrastructure projects. That could have dramatic consequences for regional economic development, making spatial distance or proximity a completely irrelevant factor for location decisions for certain activities. Regions without adequate access to the Internet, however, could soon face substantial problems. As Castells (1993) points out: "This technological informational revolution creates a new communication world made up at the same time of the global village and of the incommunicability of these communities that are switched off from the global network." With the rapid development of new ICTs, areas that still rely mainly on dial-up service or on less robust services with limited bandwidth (such as frame relay) are facing a competitive disadvantage. While such — mostly rural — areas are not completely switched off from the global network, they do not provide adequate infrastructure to meet the needs of information-intensive businesses.

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10. The correlation that this implies is confounded by regulatory changes that allowed banks to offer new services and products.

Challenges for Distressed Communities

The new economy brings new opportunities, but also new challenges to businesses, communities, and regions. While all communities have to make adjustments and investments to be able to compete and succeed in the global economy, distressed communities face more obstacles than other areas. Before we discuss the challenges and potentials for distressed communities, we need to define what we mean by distress.

Although some of the attributes of the places vary — their proximity to urban areas, density, and terrain — our case-study communities have in common a baseline condition of distress that has some familiar dimensions. All of the included communities, as with others nationwide that are eligible for EDA funding, exhibit some of the following signs of distress (a more detailed inventory of distress measures is included in Appendix B):

- Low income and/or wages;
- High unemployment or underemployment;
- Population loss and/or out-migration of working-age population;
- Increase in elderly population;
- High and/or persistent poverty;
- High welfare caseload;
- Other social and health problems — e.g., crime, teen pregnancy, infant mortality;
- Marked income inequity/lack of middle class;
- Dependency of economy on a single sector, especially a declining one like agriculture, mining, textiles, or apparel;
- Dislocation of laid-off workers who lack the skills needed for technology jobs;
- Poor-quality public schools for turning out young adults with appropriate (including math and science) skills to compete for tech jobs;
- Inadequacy of basic infrastructure (roads, water, sewer);
- Insufficient local fiscal capacity to address infrastructure needs;
- Weak institutions in terms of leadership and/or grantsmanship;
- Culture of poverty and/or negative self-image; or
- Isolation from realities and opportunities in their state, nation, world.

Much of the current discussion about "the digital divide"[11] emphasizes that rural, inner-city, and other low-wealth communities must not be left behind in the knowledge economy. It is as though some of these other types of distress have been tolerated, but lack of connectivity to the Internet and the global economy will not be, as this would be the final blow to some of these places.

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11. For example, the Southern Growth Policies Board hosted a Digital Divide conference in Roanoke, Virginia, in October 2000. Governors and their senior staff from several southern states, as well as private telecom providers, high-tech businesses (Nortel, Earthlink), educators, and researchers spoke about bridging this divide as being imperative to the survival of many communities. Their solutions for addressing the divide were in most cases institutional, leadership, and training remedies rather than recommendations just to provide or upgrade the hardware.

Distressed communities face a paucity of private investment, and consequently, of new job opportunities. The slow rate of new job formation is particularly problematic when existing businesses are closing or downsizing. Laid-off workers and new entrants into the labor force are faced with the decision to move out of the region, to accept a lower-paying job requiring fewer skills than they possess (if even such a job exists), or to remain unemployed. The specific skills that were required for workers in traditional industries are not relevant in the new economy and are not sufficient to attract new, future-oriented and competitive businesses. Without a critical mass of skilled and flexible labor, distressed communities will find new businesses reluctant to invest there. Retraining and skill-building programs may serve to increase their human capital; however, if there are no jobs in the region requiring these new skills, these workers are likely to move from the region.

Businesses' reluctance to locate in distressed communities, urban and rural, is based on different reasons from place to place, but typically relates to an area's poor-quality physical and technology infrastructure. On the physical side, basic utilities (water, sewers, electricity, basic roads) either are not available or appropriate (in rural areas, for example), or are in disrepair (in inner cities and declining mid-sized cities). Communities that have maintained or expanded their physical infrastructure often must charge high rates or impose high local taxes. Some distressed communities charge uncompetitive utility rates for other reasons. For example, many small towns in North Carolina are locked into high electricity rates because they agreed to purchase high-priced nuclear energy from energy companies many years ago.[12] High rates and taxes, as with poor-quality physical infrastructure, discourage private investment and job creation.[13]

Rural communities face additional challenges and disadvantages in the new economy. Because some of the new ICTs (ISDN, DSL) are only available within a certain range of a central office, customers in sparsely populated rural areas are limited in their choice of technologies. Dial-up access may be sufficient for private households and very small businesses, but some remote areas still cannot connect to the Internet through a local access number. They face additional long distance costs and therefore a cost disadvantage, as do businesses that are required to use dedicated leased lines because other, cheaper technologies are not available in these areas. Geography remains a significant impediment to the realization of the benefits that can be deliv-

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12. The ElectriCities program between Carolina Power & Light or Duke Power Company and cities in North Carolina provided energy to these towns for a long contract period for a price based on the construction of nuclear plants. These obligations are preventing these towns from changing electricity providers, as would be allowed under electricity deregulation. The utilities do help develop and market sites in these areas. See Luger, Komives, and Wu (1998).

13. This is consistent with a classic 1983 report by the Advisory Committee on Intergovernmental Relations (ACIR), which identified seven market failures in distressed communities that justify government action: 1) risks are not pooled widely enough; 2) high transaction costs; 3) lack of competition in key industries (such as capital); 4) discrimination on the part of financial institutions; 5) government regulations having adverse side effects; 6) high barriers to entry for local small businesses, leading to low likelihood of successful entrance into various industries; and 7) too little capital making its way to small business owners and community organizations (ACIR, 1983).

ered by ICTs in many mountainous and remote distressed communities. The more cost-effective delivery technologies just do not function as reliably in these areas, creating a situation where if service is available at all it is only via less reliable means or cost-prohibitive satellite options. Population density and demand often do not justify the investments necessary to upgrade outdated technology. Lack of competition among providers, lack of information about services that are available in the area, and lack of marketing efforts from the providers result in higher prices and poorer service in many distressed communities.

The Promise of ICTs as a Vehicle for Regional Economic Development in Distressed Communities

Despite the problems and the limited availability mentioned above, ICTs — in combination with other economic development strategies — could help distressed communities catch up and become more competitive. One hope is that this interconnectivity can help overcome the disadvantages of rural or otherwise remote locations, for businesses in areas that lack access to urban amenities and markets, for individuals who attend schools that may have poor knowledge resources such as libraries and expertise, and for educational institutions.

Different communities, and for that matter, different businesses within a given community, are involved in a variety of economic activities that need to be better networked in order to add value and compete. While material flows today still may go from raw materials to primary manufacturing to assembly to distribution to transportation to retail outlets, the necessary information flows now need to be among all these nodes and not just between adjacent nodes on the supply chain (see Greis and Kasarda, 1997). For remote rural or inner city areas to move from distress to productivity and profitability, their businesses must be well connected with their entire transaction webs, in terms of both physical infrastructure and human communications.

Technology infrastructure is also important because of its ability to improve economic performance by helping to integrate new technologies into existing economic activities, upgrade technology and skills at the local level, and develop and commercialize new technologies. The Levi Strauss Company attempted to make a traditional apparel process more competitive by using technology to personalize jeans: company stores transmitted customer measurements electronically to Mountain City, Tennessee, where the jeans were made and express-shipped to the customer's home. The Tennessee facility has since closed anyway, but there are other successful examples where companies have been able to combine the competitive factors that were paramount in the past — cost in the 1970s, quality in the 1980s, and delivery speed in the 1990s — with the agility needed to compete globally in the twenty-first century (see Greis and Kasarda, 1997).

Technology infrastructure is important, as well, because of its potential for economic development in the inner city, among concentrations of nonwhite populations. Forty-five percent of America's poor now live in cities, and they are increasingly concentrated in desperately poor neighborhoods cut off from the social and economic mainstream. Most of the residents of these distressed inner-city communities do not

own or have access to computers or the Internet. And inner-city schools have far fewer up-to-date computers than their suburban counterparts. Yet, as a United States Department of Commerce report indicates, employment in information technology occupations grew six times faster than the overall United States job growth rate in the 1990s. Projections indicate the need for more than 1.3 million new highly skilled IT personnel by 2006 (United States Department of Commerce, 1999). By improving the access to information technology, then, we will be increasing both workers' employability and national competitiveness.

Technology infrastructure is important, finally, for urban management. Intelligent vehicle highway systems and computer-aided traffic management systems enable given roadways to be used more efficiently. Similarly, innovations in water and electricity metering and distribution can stretch these resources.[14] These innovations have the potential for distressed communities to overcome problems of congestion and the high cost of services that deters business location.

It is important to keep in mind, however, that investment in ICT infrastructure alone is not a realistic approach to economic development in distressed areas. Similar approaches — massive investments in traditional infrastructure — have failed to produce the expected results in the past, and hardware is only one necessary component of technology infrastructure. A lot of progress has been made recently to bring high-speed access to more users outside metropolitan areas. While in many cases the physical infrastructure is either already there or will never become available because of technical limitations or lack of demand, the main problems are lack of information and training. Users at all levels — individuals, businesses, and local governments as well as other public services — are frequently not aware of the technologies that are available to them, about the true costs, and about the best way to take advantage of existing technologies and facilities. A lack of coordination and communication leads to redundant investments and higher costs. Potential users who do not have sufficient skills and training are unable to benefit from a technology that becomes ubiquitous and part of everyday life. ICTs will only be a successful regional economic development tool for distressed regions if investments and strategies focus on the human capital part — the users, education and training facilities, and work force development — and if technology infrastructure investments are part of a broader development plan that involves all sectors and areas of community and regional development. We will discuss these aspects in greater detail in the next chapter on the study hypotheses.

14. The literature on this topic goes back at least thirty years to the Association for Computing Machinery (1969).

CHAPTER 3

Developing Hypotheses from the Literature

In this chapter we present a series of hypotheses that were formulated at the outset of the project, based on our review of the academic and professional literature as well as our knowledge of best practices. We convened a national advisory panel early in the project to verify the plausibility of these hypotheses.

We modified the wording of some of the hypotheses presented here based on what we learned in our field work. Specifically, as we collected information and conducted interviews we were able to refine our thinking about the key phenomena to test. We discuss the case-study design more fully in the next chapter. Then, in chapter 5, we explain how we modified the wording of the hypotheses, report our test "results," and draw some conclusions for EDA and others interested in the use of ICT to help distressed communities.

Ten Hypotheses

1. ***Enabling infrastructure (roads, water, sewer, etc.) is necessary but not sufficient to assure the effectiveness of technology infrastructure investment.***

The focus of this study is on technology infrastructure. Indeed, ICTs have become increasingly important in the new economy; they are often seen as the twenty-first century equivalent to the interstate highway system. However, while businesses seek advantage from more advanced connectivity, they still need a means to get their employees to work and their goods to market, and they still require water, wastewater and solid waste disposal, and power to operate.

This suggests that traditional infrastructure is a necessary complement to ICTs (hence, our reference to "enabling" infrastructure). In the case of transportation, for example, recent developments show that the need for proximity will never disappear completely, because certain types of interactions (whenever tacit knowledge is involved) cannot take place without spatial proximity (Burmeister, 1998). The concepts of firms as learning organizations and of learning regions are also based on the assumption that communications technologies cannot substitute for spatial proximity completely (Malecki, 1997; Traxler, 2002).

Research also indicates that traditional infrastructure is necessary for economic development, but not sufficient.[15] Building more or better roads and airports, and more sewer, water, and power generating capacity may not be sufficient to guarantee further economic growth unless other determinants of development are in place, such as a skilled work force, a strategic location, access to raw materials, good weather, and so on.[16] This can be illustrated using a case from the Commonwealth of Kentucky. The Appalachian Regional Commission helped provide funding to cut down a mountain, re-route a river, and re-route railroad access to redefine the economic options facing Pike County. Despite large infusions of money to bring jobs and provide access to the county, Pike remains distressed. Its poverty rate has been as high as 25 percent and its unemployment rate was 10 percent in 2000, well above the national level at that time.

We found many other examples in the literature of communities that made strategic investments in enabling and soft infrastructure in order to bolster their efforts in ICT infrastructure development. These examples suggest an important link between the different types of infrastructure, but do not specifically speak to the hypothesis, as stated, namely, whether enabling infrastructure is a necessary but not sufficient condition for economic development.

A project in Muskegon County, Michigan, illustrates the blending of traditional and ICT infrastructure in the form of a telecommunications-intensive industrial park. Muskegon County suffered a severe economic downturn during the late 1970s and early 1980s.[17] Administrators from the West Michigan Shoreline Regional Development Commission (RDC), Muskegon County, GTE, and the Economic Development Administration (EDA) worked together to develop SmartPark — an industrial site that offers state-of-the-art communications (i.e. satellite uplink, downlinks, and fiber-optic wiring) technology. Many in the region believe that SmartPark has largely been responsible for a resurgence of economic confidence in the Muskegon County region. Many of the lots already have been sold or optioned to prospective businesses; when built-out, the park will have created nearly 1,750 jobs and close to $125 million in private investment.

Other examples of the blending of traditional and new capital come from traditional manufacturing companies in rural North Carolina that have invested in high-tech equipment: [18]

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15. Over the past decade, several studies have shown a significant relationship between the availability and quality of public infrastructure and private sector productivity (see, for example, Aschauer, 1989; Munnell, 1990a, b). The most important public capital investments include highways, mass transit, airports, electrical and gas facilities, and water and wastewater services.

16. See, for example, Fox (1997) and Johnson (1996).

17. A more detailed description of the program as well as contact information can be found online at www.rurdev.usda.gov./ideas/case28.html

18. These examples are from "A New Way to Work: High technology spawns new Tar Heel industries and the means to prevent the end of some old ones," Business North Carolina, February 2000.

- In Ashe County, the Gates Rubber Company made hoses until 1998. Faced with low returns it considered closing the plant, but instead invested in robotics and now makes rubber belts. Lee Act tax credits are helping the company to retrain 200 workers to run the computerized equipment to make belts instead of hoses.
- In Caswell County, Royal Park Uniforms is a niche apparel business that expected to bring in $15 million in revenues for 1999. Royal Park is now the nation's largest maker of plaid uniforms. Plaid fabric must be cut so that the patterns match when sewn. The brothers running this family-owned business, determined to keep their company thriving in North Carolina, worked with Gerber Technology, Inc. to custom-design an automated fabric-cutting machine. They also bought a computer-controlled conveyor that delivers the pieces of a garment to each of the sewing operators, eliminating handling errors and reducing downtime. The two conveyors, installation and retraining of employees (in partnership with Piedmont Community College) cost over $500,000. Royal Park is paying a premium to employees willing to retrain to learn multiple skills. With these and similar technology upgrades, the executives are confident the company can achieve mass customization in the future, providing 24-hour turnaround of uniforms to specified measurements. Its current turnaround time for orders is about two weeks, down from sixteen weeks ten years ago.
- In Alleghany County, a group of businessmen including the CEO of Parkdale Mills, Inc., invested $40 million in Magnolia Manufacturing Co., a plant expected to employ 100 and rely heavily on robotics equipment.

There are also important links between ICT infrastructure and what we call "soft" infrastructure: the provision of training and other types of support that make ICT capital more productive. For example, in Georgia, support for technology infrastructure ranges from the government sponsored PeachNet, the state's education network that links public educational institutions and libraries across the state, to the Economic Development Institute at Georgia Tech, home of the Advanced Technology Development Center (ATDC). The ATDC has acted both as a catalyst for "high-tech start-up development," but also as a support system to existing high-tech companies. It provides consultant services and financing, encourages corporate partnerships among small and larger companies, and provides funding to promote commercialization of new technology innovations (OED, 1999).

Small business incubators represent a blend of hard and soft infrastructure that is intended to make any type of new and small business — including these related to information and communication technology — more viable. Increasingly, connectivity is a key item on the menu of services offered to tenants. The North Carolina Technological Development Authority, for example, provides funds to ensure that its rural incubator tenants have Internet access.

2. ***Investments in technology infrastructure must be part of a larger local planning process to succeed.***

In the preceding section we suggested that ICT infrastructure alone is not likely to lead to successful regional economic development. There need to be complementary investments in traditional infrastructure, in soft infrastructure, and in an appropriate tax and regulatory environment. Each of these supporting structures seems to be necessary if not sufficient for success.

The missing ingredient is planning — a process to tie together all the complementary elements required for success in the new economy. Regional development policies, including these related to ICTs, must recognize the primacy of existing regional infrastructure and knowledge bases in the development process (Abler, 1991).

The literature is filled with examples of how planning has made a difference. Luger and Goldstein (1991), for example, illustrate the role various planning efforts have played in the success of research parks in North America. "Coordinated planning," meaningful "public-private partnerships," and involvement of local universities are among their list of critical success factors for research parks, including these based on ICTs. Atkinson (1990) tells a similar story for state S&T policy, including early efforts in ICT-oriented development.

3. ***A certain density or critical mass is required for information and communications technology (ICT) to work, because of the costs of provision.***

The future development and success of any city or region in the global economy depends in part on the availability of physical infrastructure — fiber-optic lines, ATM switches, wireless networks, and other technologies that provide high-speed Internet access. While almost all regions now have some form of Internet access (at least dial-up using the standard telephone system), there are wide variations in the quality of service available to potential customers in different locations. These differences reflect variations among regions in population density, which affects the cost of provision and willingness of private providers to invest.

Better Internet access makes larger cities, particularly these close to major hubs, more attractive for companies that need efficient network connection than rural or otherwise less-connected regions (Wheeler and O'Kelly, 1999 discuss the uneven location of high speed hubs on the information superhighway). Moss and Townsend (1997, 1998a, b) analyze regional variations in Internet accessibility using different indicators and find that large shares of Internet hosts, organizations using the Internet, and backbone capacity are concentrated in a small number of cities and urban areas. For example, seven metropolitan areas (San Francisco/Silicon Valley, Washington, DC, Chicago, New York, Dallas, Los Angeles, and Atlanta) share 62 percent of the nation's backbone capacity (Moss and Townsend, 1998b). These metropolitan areas also have more direct connections to a great variety of other agglomerations and cities than any other location in the United States. The top five metropolitan areas (Silicon Valley, Boston/Route 128, Los Angeles, New York, and Washington, DC) account for approximately one third of the nation's Internet hosts.

It is interesting to note that the largest and most diversified national centers and "world cities" (New York, Los Angeles, Chicago, and Houston) have only experienced domain registration growth rates slightly higher than the national average. San Francisco and Manhattan are the "mega-nodes" of Internet activity, followed by a group of mid-sized cities that are hubs for technology-based growth industries (Atlanta, Miami, Minneapolis, Boston, Portland, and Seattle), and a mixed group of regional centers, including Dallas, Phoenix, San Jose, San Diego, Denver, and Washington, DC (Moss and Townsend, 1998a). That development indicates potential changes in the urban hierarchy with respect to IT growth industries. It also implies that other factors become increasingly relevant for the location decisions in the new economy as well. In addition to providing the necessary infrastructure, cities will also have to demonstrate that they are attractive locations for business owners and employees. Quality of life, culture, and a healthy environment become more important.

While various service providers offering different technologies compete with each other in urban areas, low-density and rural areas are falling behind. Many providers of fiber and cable, for example, try to meet the still growing demand in highly profitable and competitive urban areas first and virtually ignore the other markets, citing high initial infrastructure costs and a perceived lack of demand. Diffusion of new ICTs to rural areas is still slow, and businesses in some regions might never have ISDN lines or other distance-sensitive technologies available. Low-density areas as well as regions where telephone companies have not yet upgraded old equipment are facing a significant disadvantage. Not only are businesses and other potential users restricted in their choice of technologies (most often only dial-up access or dedicated lines), they also face higher costs because the cheaper technologies are not available. That causes additional problems for distressed communities — which are often remote, small, and low-growth, and therefore not a top priority for telecommunications providers who struggle to build and upgrade the infrastructure in high-growth regions.

The emergence of wireless, microwave, and satellite technologies for data transfer provides a possibility for low-density areas to catch up. These technologies provide enormous bandwidth and might present an alternative to expensive fiber-optic networks. At this point, wireless data transfer is still a fairly new and expensive technology, but technical improvements, increasing demand, and capacity problems on existing terrestrial networks might become a more generally available and competitive solution. A possible scenario in this context is that areas that are not currently "connected" and depend on older technologies might bypass the most recent technological advances (DSL, ATM, frame relay) altogether and go straight to the next level, using wireless networks instead. Parts of former East Germany and some developing countries made a similar decision when they were confronted with large investments necessary to upgrade the existing (or non-existing) terrestrial telephone lines. Faced with enormous costs and multi-year projects, they decided to invest in cellular communications networks instead.

Access to computer networks will become almost ubiquitous with further improvements in information technology and with the realization of large telecommunications infrastructure projects. That could have dramatic consequences for regional eco-

nomic development, making spatial distance or proximity a completely irrelevant factor for location decisions for certain activities. Regions without adequate access to the Internet, however, could soon face substantial problems. As Castells (1993) points out: "This technological informational revolution creates a new communication world made up at the same time of the global village and of the incommunicability of these communities that are switched off from the global network." With the rapid development of new ICTs, areas that still rely mainly on dial-up service or on less robust services with limited bandwidth are facing a competitive disadvantage. While such — mostly rural — areas are not completely switched off from the global network, they do not provide adequate infrastructure that meets the needs of information intensive businesses.

4. Technological innovations and advances are reducing the costs of communications and linkages.

One of the main arguments in favor of ICTs is cost reduction. Since the technologies can be used to assist internal as well as external communication, we can expect effects on coordination as well as transaction costs (Hwang, 1998). Coordination costs are derived from the need to keep the production process and all related activities integrated within the firm (Antonelli, 1988). ICTs make it possible to retrieve, process, and store information about the individual functions at a lower cost. Transaction costs are the costs of exchanging goods and services among independent businesses. Businesses get their information from various sources, including customers, partners, subcontractors, competitors, universities, and other public and private sources. Traditional ways to distribute and access information are publications, conferences and fairs, as well as through personal contacts, by mail, phone, and fax. Traditionally, the acquisition of information involves costs that can sometimes be substantial, including both the direct costs of information and the transportation and opportunity costs. Businesses sometimes need personnel whose only task is to find and to access information sources. ICTs have an impact on transaction costs by reducing imperfections in the market information; they also reduce operational costs (Hwang, 1998).

Businesses (and other organizations as well) are able to save money by using ICTs to improve their efficiency (see, for example, Gerstein, 1987). Business-to-business e-commerce has grown so fast over the past years because of the enormous savings potential for all parties that are involved, buyers and sellers. Businesses lower procurement costs by consolidating purchases, building close relationships with key suppliers, and by reducing inventories and response times. The larger number of suppliers that can be reached online allows businesses to find better deals. At the same time, suppliers can expand their markets and thus increase revenues. The Internet also provides a way to provide more efficient and effective customer service — another way to reduce costs and to ensure customer satisfaction. Finally, lower sales and marketing costs allow businesses to realize even more savings (NTIA, 1998).

Cost reduction, however, is not achieved through labor substitution. Previous studies (Solow, 1990; Brynjolfsson, 1993) have not found any evidence that information technology substitutes for labor. There is even some evidence that the use of IT may actually increase employment (Osterman, 1986; Morrison and Berndt, 1990; Berndt

and Morrison, 1991). It is more likely that the use of IT reduces both internal and external coordination costs. Brynjolfsson, *et al*. (1993) show that the use of IT leads to smaller average firm sizes within the same sector or industry. The authors hypothesize that this might be the result of an increasing externalization of services, which in turn would lead to a shift in employment from manufacturing to the service sector.

Private businesses are not the only beneficiaries of ICT use. Some experts estimate that telecommunications applications could reduce health care costs by $36 billion to $100 billion each year while improving quality and increasing access (United States Advisory Council on the National Information Infrastructure, 1996). Already more than a third of Americans are using the Internet routinely to search for health information (NTIA, 2002). Benefits of ICT applications in health-related arenas include:

- Telemedicine: Health care providers can consult with non-local specialists, upgrade their education and skills, and share medical records and other vital information with reduced time and costs. For example, doctors at the Mayo Clinic have provided expert help to patients and local doctors at the Pine Ridge Indian Reservation in South Dakota.
- Personal Health Information Systems: Misinformation and a lack of information results in 50–80 percent of people entering the health care system unnecessarily. Communications and Computer Applications in Public Health estimates that if personal health information, made available on the Internet, was used just 25–35 percent of the time, savings on medical care would be $40 to $60 billion dollars per year.
- Technological innovations and advances reduce costs and time loss associated with professional development. Nurses in North Carolina have attended training sessions given at a hospital in Atlanta, Georgia, without ever leaving their own hospital. The hospital does not have to pay travel or housing costs, and time away from the job is minimal. As a result more nurses are being trained at a lower costs.

5. Institutional mechanisms must be in place to help users deploy the hard infrastructure appropriately.

As discussed above, infrastructure provision alone is not sufficient to ensure success. In many cases — not only in distressed communities — a lack of information about technologies and services that are available in the area and insufficient training are the main problems, not the availability of the hard infrastructure itself. Investing in fiber-optic lines and wireless networks, networking computers and providing Internet access is important, but that investment has to be accompanied and supported by appropriate training and information.

Community networks present one possible way to use existing public facilities as "gateways" and training facilities. Public library networks, community colleges, and a variety of community and regional technology centers are functioning as community-based education resources for low-income and rural areas around the United States. In many places, schools are "the most important component of the Information Su-

perhighway" (U. S. Advisory Council on the National Information Infrastructure, 1996). Inner city and rural schools across the country benefit from investments in information technology (computers and high-speed Internet access). Students acquire new, important skills as computers are more and more integrated in the classroom. A crucial aspect in this context is training for the teachers — again, it is not enough to spend money on hardware and physical infrastructure. Programs to train the users (in this case the educators) how to integrate and use the technology in the most efficient way are absolutely necessary to ensure success.

The Southern Growth Policies Board member states[19] focus on closing the gap between Internet and computer access for students in low-income or rural communities and those in more affluent suburban communities. All are devoting increasing attention not just to the provision of the necessary technology, but also the steps needed to ensure that it is used effectively (Bohland, *et al.*, 2000).

Many public libraries use information technologies to develop community information resources — for example, by installing public access terminals in a number of neighborhoods and housing projects in Seattle. That program reaches out to groups that might otherwise not have access to the Internet — senior citizens, homeless people, job seekers, and others. Other communities offer professional training and establish new partnerships using library networks.

Museums and community centers are other institutions that can play an important role in providing access to the Internet. Some of the initiatives are local while others are regional or statewide. A key to success is the integration of public institutions such as schools, community colleges, public libraries, and the private sector (infrastructure providers) into development and infrastructure planning activities.

Private initiatives and public-private partnerships can also provide the necessary training. In some cases, community networks operate as nonprofit Internet cooperatives and provide local Internet access. The Mountain Area Information Network (MAIN) in Asheville, NC is such an example. MAIN offers full Internet access in thirteen counties in Western North Carolina and offers reduced fees for low-income and disabled users. With funding from the federal Appalachian Regional Commission and through a partnership with the N.C. Cooperative Extension Service, MAIN has put public access terminals in remote community centers to reach citizens who cannot afford a computer. MAIN also recycles used computers and places them in the homes of disabled, low-income citizens. In addition to providing hardware and access, MAIN offers various training sessions and assists communities and local businesses with Web site development.

6. Some hierarchical coordination or linkages among national, state, and local governments are important for a community to be truly "connected."

We have mentioned several times that Internet access — especially high-speed Internet access — is not equally distributed. While newer "digital divide" reports show that rural areas are catching up, there are still population groups that do not have

19. Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, Missouri, North Carolina, Oklahoma, South Carolina, Tennessee, Virginia, West Virginia, and Puerto Rico.

access to the Internet, for various reasons. The role for government (at all levels) could be to ensure fair access regardless of geography, to ensure a basic level of service, and to create a policy and regulatory climate that allows the Information Superhighway to thrive. "[A]ll levels of government have significant roles to play in ensuring the effective development and deployment of the Information Superhighway . . . [and] should work together to encourage private investment, foster flexible and responsive governmental action including harmonization of laws and regulations, and to provide privacy and security protection to users" (United States Advisory Council on the National Information Infrastructure, 1996).

Communities play a key role in providing access and learning, while government has a critical role as a catalyst. All levels of government have a significant role to play in ensuring the effective deployment of the Information Superhighway.

7. Linkages among government, education, and industry are a critical success factor for ICT interventions. State policies and corporate actions are important determinants of local "success."

According to the United States Advisory Council on the National Information Infrastructure (1996), successful information technology infrastructure development requires a broad range of stakeholders: private sector leaders, community partnerships/coalitions, government leaders, and strong individuals who champion the cause. The Council further comments: "Where appropriate, the private sector should take a leadership role in working with the government in the continued development of innovative uses of the Information Superhighway in socially beneficial areas such as education, cultural enrichment, public safety, and health care."

Bohland, *et al.* (2000) similarly point out: "perhaps the most significant recent development within the member states of Southern Growth has been the creation . . . of broad-based policy initiatives designed to address the Digital Divide on a number a fronts simultaneously. . . . The challenges of the Digital Divide, like information technology, cross many boundaries and require a broader more coordinated approach."

Both of these studies emphasize the importance of what has been referred to as the "innovation triangle" in the creation and implementation of ICT policy. The vertices of the triangle represent business, government, and higher education (see, for example, Watts, 1999).

The deployment of ICT infrastructure is not unlike the installation of other types of infrastructure; by definition of the word "infrastructure" large amounts of capital and long time horizons are needed for the hardware to be put into place. This requires the identification of funds, cutting through regulatory requirements, and management of a cumbersome construction period. These tasks typically involve multiple layers of government and, increasingly, public-private partnerships. One key to successful ICT integration is that market segments such as schools, hospitals, businesses, and government branches learn to maximize their resources by sharing them among themselves. By doing that, they create economies of scale, which allow connected institutions to derive greater value from the network while increasing revenue and reducing costs. They also create "economic linkages" which allow institutions to im-

port the information that they seek from others while they export the information that others seek from them. These linkages provide opportunities for technology resources to be shared (services/facilities exchanged) for the benefit of two separate institutions. The cooperation between hospitals and public education provides a good example. Hospitals can use public school facilities to provide public health classes in topical areas of interest such as childbirth, parenting, elder care and coping with common diseases. A Northern Telecom (1996) report emphasizes the importance of cooperation as well: "If one of the community network user groups is left out of the planning process, or refuses to share its resources, the momentum for the community support is reduced. The project may be stalled, derailed, underdeveloped, or even canceled."

8. Infrastructure providers must be a partner in assessment and planning, not just the spending, for the intervention to succeed.

One of the major obstacles to effective and efficient use of ICTs is the lack of information about availability of services and characteristics of different technologies. Potential users — individuals, businesses, or public institutions — are sometimes confronted with a wide range of choices when they make decisions to adopt new technologies. These choices encompass computer hardware that differs greatly in performance and price; different computer and network operating systems; and a large number of different technologies through which Internet access can be established. Many users feel overwhelmed and confused by the number of alternatives, and they find insufficient information and technical advice to help them determine which technological solution is best for their specific needs.

Nobody can expect public officials or new users — especially in distressed communities — to become ICT experts and to make the right planning and investment decisions. Therefore it is necessary for the infrastructure providers — who know all the details, advantages and disadvantages of the individual technologies — to get involved in the early planning stages of new infrastructure projects. The providers need to make efforts to actively educate existing and potential users about new developments and services. Through close contact and conversations with businesses and other users they can help to assess the actual demand. Information sessions for all local business leaders, for example, can help to establish that there is a critical mass that justifies certain investments from the provider. Close cooperation and ongoing information exchange makes it easier to provide the appropriate hardware capacity and to plan network expansions and upgrades in an efficient and timely manner.

9. Work force development is a critical complement to any infrastructure intervention.

Work force development and training become crucial factors in the digital economy. Any community or region that wants to be competitive and able to attract new businesses and development needs to have some knowledge institution to provide adequate education and training. A skilled work force may be more critical to technology-oriented companies than to other businesses, but with the increased use of new tech-

nologies in all sectors, skill requirements are changing for *all* job types and levels. Predictions made in 1996 by the United States Advisory Council on the National Information Infrastructure that "fully 60 percent of jobs in 2000 will require a working knowledge of technology" can only be expected to increase further as the connected future unfolds.

Demand for workers in technology-oriented industries and for workers who can design, program, maintain, or repair computing and communications infrastructure has grown dramatically and will continue to grow. In 1996, more than seven million people worked in these jobs, earning an average wage of just under $46,000. The Bureau of Labor Statistics projects that by 2006 an additional 2 million workers will be needed just in these specific areas (NTIA, 1998).

While the overall demand for IT workers is growing, there is a trend toward higher skilled workers. Employment in jobs like computer engineers, scientists, and systems analysts is projected to more than double between 1996 and 2006 (Malecki, 1997; NTIA, 1998). These positions typically require a four-year college degree (most often in science, math, or engineering) and in many cases, advanced training. Employment in jobs with lower skill requirements (for example computer or duplicating machine operators) is expected to decline (NTIA, 1998).

The new economy creates many new jobs, while at the same time, certain existing (mainly low-skilled) jobs become obsolete. For example, electronic (online) news distribution and delivery requires staff for programming tasks, operation, and maintenance of servers and networks. But there is less need for printing presses, delivery trucks, and workers to produce and distribute the traditional physical product. We can observe similar trends in e-commerce and online shopping. "Virtual" stores need IT personnel to design and maintain the Web sites, servers, and networks; they also need customer service representatives, marketing and accounting staff. While there are workers who pack and ship the actual physical products in the warehouses, there are no cashiers or people who clean the store and stock the shelves, because there is no physical store. The development of e-commerce has also led to more outsourcing, order fulfillment centers and warehouses process orders for online companies like Amazon.com. At the other end of the spectrum, companies such as VeriSign specialize in credit card verification for online purchases.

The rapid changes and new developments require a much more flexible work force than traditional industries. Changes in work organization take place, flexible teams replace old hierarchies. These changes go along with the increased use and importance of internal corporate networks (Intranets) and include the creation of more telecommuting jobs as well. The estimated number of telecommuters in 1997 was already seven million and is expected to increase to fifteen million workers within the next years (NTIA, 1998). On the one hand, more flexibility in work organization and the opportunity to work from home creates new possibilities (also for people in remote areas); on the other hand, the increasing number of these jobs requires even better skilled workers. The ongoing changes require a change in attitude as well; the willingness to continue learning, and the flexibility to accept and actively search new work assignments.

Flexible production requires workers with multiple skills, who are able to perform more than one task. The basic skills in the "new economy" include "deep" technical skills, skills for learning, communication, adaptability, personal management, and group effectiveness (Malecki, 1997). Carnevale (1995) lists eight categories of worker training that address these needs:

- Organizational training (e.g., management and supervisory training and team training);
- Technical training to develop, install, and maintain new technologies as they arise;
- Skill training to learn new technology and new software;
- Customer interface training for employees who work with customers;
- Strategic training for specific goals, such as quality;
- Professional training to help non-technical professionals (e.g., accountants, architects, doctors) keep up with new technologies;
- Basic skills training in reading, writing and computation; and
- Regulated training to respond to environmental, safety, and other regulations as they arise.

The leading technology regions are investing heavily in programs to enable the work force to learn and re-learn the competencies and skills in that dynamic economic world. That includes, for example, basic literacy, including a working knowledge of science and math, lifelong and distance learning, displaced workers programs and incentives to increase interest in science and engineering fields (OED, 1999).

Education and training now take place in a number of institutions and organizations. In order to meet the challenges of the new economy, schools and universities need to show flexibility as well and adjust their curricula to integrate the emerging technologies and to ensure that their graduates acquire the necessary skills required by their future employers. Many community colleges set up partnerships with industry (e.g., Cisco, Microsoft) to offer network and operating system certifications. These programs help to train highly qualified technicians who are heavily recruited by many companies. A university or community college that provides that kind of training and work force development is a key asset, especially for a distressed community that wants to attract technology-oriented businesses.

As firms seek employees with higher-skill levels, communities that have invested in education will have an advantage over communities that have not. Communities with a strong education and training system will be able to attract, keep, and expand companies that seek well-educated productive workers. Communities that fail to focus on improving the education level of the work force will continue to attract manufacturing investment of firms seeking low skilled, poorly trained workers for low-wage employment. Such companies are very likely to move their production wherever they can find the cheapest labor force. Especially in these days of the North American Free Trade Agreement (NAFTA), even rural communities in the United States are no longer able to compete with low-wage production sites in Mexico.

Investment in education and training has not only direct benefits for the individuals, who can expect higher wages, but also indirect benefits to the communities. A number of studies have found a significant relationship between education and plant location or manufacturing employment growth.

It is never too early or too late for work force development. Activities and work force development strategies often focus on high-school students, older workers, and retirees — the whole spectrum of potentially available labor.

Pennsylvania's "Unified Plan for Workforce Investment"[20] provides a good example of the many dimensions that are essential for work force development. The state recognized that high illiteracy rates and other basic skill deficiencies impede the ability of some Pennsylvanians to take advantage of the best economic opportunities that are unfolding in the state. The plan is designed both to close the skills gaps and address the labor shortages of the state's most promising industries. Some of the key aspects of the Unified Plan include:

- Literacy improvement;
- Enhanced basic skill attainment;
- Scholarships to encourage students to pursue careers in high technology;
- Internships with technology companies;
- Customized job training programs; and
- Programs for special populations, including adults reentering the work force or otherwise in transition, welfare recipients, disabled persons, and older workers.

An example from Kentucky illustrates the role of work force development in meeting the demands of successful community economic and information technology development. In response to increased demands for computer technicians, Innovative Productivity Inc. (IPI) in Louisville developed a computer-training program that utilizes donated computers to train people for A+ certification as computer technicians. The computer-training program, which cost $1,400 for the two-week intensive course, was created to produce entry-level technicians for the labor market. Louisville is located next to UPS's international air hub, making it a prime location for businesses to ship computers in need of repair. In 1998, there were ten computer repair firms around the hub in Louisville, with that number expected to grow, which created projected demands for up to 6,000 technicians by 2003 (Ward, 1998).

"HAIL Kentucky!" (Home Access to the Internet & Learning in Kentucky Project, 2000) is a collaborative effort between industry (IPI and Clark Communication Corporation), county governments, chambers of commerce, and school districts to use technology to provide literacy and workplace skills-training resources. The project focuses on families and communities in the eight southeastern counties of Kentucky to break the vicious cycle of poverty and isolation by:

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20. "Building Pennsylvania's Workforce for the New Economy: Unified Plan for Workforce Investment." Available online: www.dced.state.pa.us/PA_Exec/DCED/business/workintro.htm

- Providing computers for home-use and training to low-income families;
- Providing online access to training resources for literacy and workplace essential skills;
- Providing rural low-income families home access to Internet-based high school and college courses;
- Providing volunteer and paid staff to operate community technology centers; and,
- Establishing a community oriented learning project that actively engages youth and adults in lifelong learning.

These activities represent a well-coordinated alignment of resources between industry, government, and nonprofit organizations to serve low-income communities in Kentucky. The effort was implemented on a small-scale basis, with plans to expand it throughout the state.

10. Because of the long-term and expensive nature of ICT, vision, and leadership are critical success factors.

The literature on the importance of leadership and vision at the state and local levels comes from a variety of applications and contexts.[21] For example, a Nebraska study[22] of rural places makes the following observations:

- Leadership plays key role in business success. The leaders of excellent businesses and of successful communities will shape the future of America. In small communities nearly all of the citizens become cheerleaders to promote the success of new enterprises. They understand the importance of cooperation between businesses and all other parts of a total community.
- Technology and attitude are more important than location. With the use of advanced telecommunication technologies, successes of entrepreneurial efforts are more related to "possibility thinking" than to geography or the size of a community.

Summary

- A wide range of information technologies and hardware solutions are available, but some are not available in all parts of the country because of technical limitations (ISDN, DSL).
- Providers are focusing on high-density, high-demand, high-growth areas to maximize their profits. The initial technology infrastructure investments required are fairly significant, therefore providers will rather compete in urban

21. For example, in a study of research parks (a type of enabling infrastructure), Luger and Goldstein (1991) concluded that vision and leadership were perhaps the most critical of success factors in the success of North American parks.

22. "What's Behind Small Business Success: Lessons from Rural Communities," by the Heartland Center for Leadership Development, Lincoln, Nebraska, 1992.

growth areas than in rural, remote, low-density, or declining regions where there is insufficient demand to justify the investments. Unless these communities and regions can aggregate demand to show that there is a critical mass of users, providers are not going to make efforts to market their services in these areas.

- Wireless networks might provide a more promising alternative for low-density and remote areas.
- Capacity (or bandwidth) is not necessarily the full answer. Providers need to work together with users and decision-makers to plan infrastructure that meets the actual needs of the users. Many businesses do not have adequate information about services that are available and solutions that would be most effective.
- Technology infrastructure not only changes the way businesses communicate with each other, but also how they purchase, market, and sell goods and services. ICT networks make communication and information exchange more efficient.
- Technology infrastructure helps businesses to reduce operating and transaction costs and allows them at the same time to expand their linkages to both suppliers and global markets.
- Technology infrastructure alone cannot solve the problems of distressed communities. ICT needs to be embedded in a broader planning and development approach that includes traditional infrastructure, other elements of knowledge infrastructure, and quality-of-life aspects.
- Work force development is a crucial aspect in the new economy and has to be part of any successful infrastructure investment or development program. Work force development has to be both a clear target for ICT applications and the platform from which a community captures ICT-derived economic benefits in the coming years.
- Schools are key resources as computer literacy becomes more and more important. Along with providing hardware and physical infrastructure, programs must also ensure that the teachers receive appropriate training to integrate information technology in the classroom.
- Community colleges and other institutions of higher education have to adapt their curricula to the changing demands and offer much needed training for information technology workers, both on-campus and on-site via distance learning applications.
- Any existing institution (community college, public library) can be used to provide and expand public access to the Internet.
- Leadership and vision, and the weaving together of broad-ranging community interests, are critical to success in ICT development, as for any expensive and long-range policy thrust.

CHAPTER 4

Choosing Cases, Defining "Success," and Testing Hypotheses about ICT and Economic Development in Distressed Communities

In this chapter, we discuss our research design — the choices we made about how to conduct the study. Those choices were guided by principles of good social science research as well as limitations in the data.

The central research method we employ is case-study analysis. That approach is qualitative more than quantitative in nature, but because the cases were chosen to be representative of the diverse set of areas in the United States that are implementing ICT-related strategies, we conduct what Ragin (1994) calls "comparative analysis." If constructed properly, this approach is able to provide rich contextual detail that helps make sense of the data collected (high "internal validity"). And, to the extent that the cases chosen are representative of the universe of places in the United States, we can generalize from the sample of cases chosen to the entire country ("external validity").

In the sections that follow, we discuss, in turn, our qualitative and quantitative approaches, including the steps we took to maximize the internal and external validity of the study. Following that, we explain how we set up the hypothesis tests. In short, that required us to make judgments about the degree to which each case represented a "success" story in the application of ICT to help places in distress, and about the extent to which the different factors (represented by the hypotheses) contributed to that success, or were associated with failure. We conclude the chapter with caveats about the approach taken.

Designing a Case-Based Approach

Assuring internal validity

To ensure rigor in our case-study approach we developed a common set of constructs and measures and applied them consistently across all the sites.

Development of measures and protocols

We started our work by reviewing national data and literature to develop preliminary typologies both of technology infrastructure and distressed communities. As discussed in chapter 2, technology infrastructure includes hardware (computers, broadband networks, cable systems) as well as knowledge institutions (universities, hospitals, technology companies) and knowledge workers. Dimensions of distress include low income or earnings, high unemployment, high poverty rates or welfare dependency, population loss, poor health, and weak institutions.

Because new infrastructure technologies tend to be introduced with increasing frequency, and knowledge about how those technologies can be used to improve business and government performance is rapidly narrowing, we convened a panel of public and private technology experts to advise the project. The perspectives of individuals who understand the constantly changing nature of technology and the capacity and needs of industry helped us to focus on the most relevant local issues to consider in our data collection. The group met on December 13, 1999 in Washington DC to review our preliminary typologies, which are included in Appendix B.

These typologies were then used to develop initial interview protocols for the site visits to each selected community. After developing and reviewing these initial protocols, the study team grappled with how best to conduct the case-study research in parallel despite the wide variety of situations and communities where the research would take place. We thus generated the set of ten study hypotheses presented in chapter 3 that could be tested in each place as a way to ensure some comparability of findings. These are shown again in Table 4.1.

Table 4.1: Initial hypotheses tested in all case-study sites

1. Enabling infrastructure (roads, water, sewer, etc.) is necessary but not sufficient to assure the effectiveness of technology infrastructure investment.
2. Investments in technology infrastructure must be part of a larger local planning process to succeed.
3. A certain density or critical mass is required for information and communications technology (ICT) to work, because of the costs of provision.
4. Technological innovations and advances are reducing the costs of communications and linkages.
5. Institutional mechanisms must be in place to help users deploy the hard infrastructure appropriately.
6. Some hierarchical coordination or linkages among national, state, and local governments are important for a community to be truly "connected."
7. Linkages among government, education, and industry are a critical success factor for ICT interventions. State policies and corporate actions are important determinants of local "success."
8. Infrastructure providers must be partners in assessment and planning, not just the spending, for the intervention to succeed.
9. Work force development is a critical complement to any infrastructure intervention.
10. Because of the long-term and expensive nature of ICT, vision and leadership are critical success factors.

Our general approach for the case studies was to gather and synthesize data and perspectives from published materials and telephone contacts, and then use time on-site to generate issue- and solution-focused discussion with key parties. In addition to talking with these individuals about their own plans, barriers, and ideas, we assessed the extent and nature of their interaction with each other, with the expectation that good local communication among public and private sector leaders is one of the enabling conditions for sound infrastructure investments.

Site visits were conducted from the spring of 2000 through the winter of 2001. Each site visit team of two people used the same approach to the field work and spent two or more days per site. The types of informants we interviewed or convened during the site visits included:

- Local/regional economic developers;
- Local government staff;
- State government staff;
- Local/regional telecommunications providers;
- Local industry CEOs;
- Small business owners or budding entrepreneurs;
- Applied research lab scientists; and
- Community college and other education officials.

Each site visit team set up the majority of appointments in advance, and then used free time on-site to conduct a few additional impromptu meetings with informants identified in other interviews. Most of the interviews were conducted with the assistance of a notetaker. The lead researcher and notetaker met afterward to consolidate their notes and generate summary notes within a day after the interview. Then, upon return, a case-study report was written for each place, synthesizing the results from all the interviewees in that place. Each team also wrote up a summary of how the study hypotheses applied (or not) in that place.

After the field work for most of the sites was complete, the study team shared case reports and met to compare results and apply a consistent interpretation of findings.

Maximizing external validity

The smaller the number of cases in a multiple case-study project, the more suspect it becomes in its ability to apply the findings to other than the studied places, or what is called "external validity." Since case-study research is expensive and time-intensive, we were constrained initially to eleven cases, which we later increased to thirteen.[23] Our challenge was to maximize external validity within the constraint of a relatively small sample of cases. That was done by careful case selection.

23. The Billings and Seattle cases were added by EDA after the first eleven were complete.

Choosing cases

Communities classified as "distressed" by the EDA[24] include many types of areas, in different regions and size groups. Whether inner city, rural, or somewhere in between, distressed communities suffer chronic high unemployment and lagging incomes at a time when the rest of the United States experiences stability or sustained growth.

Our intent in selecting case-study sites was to include several different types of technology infrastructure interventions and several types of community distress, as well as to attain a good geographic mix. The case-study sites all meet EDA's definitions of distress. Expert panel members and EDA regional directors were consulted for nominations of candidate communities. In choosing case-study sites, we selected places where policies had been in place for a few years — not just proposed — and which putatively had evidenced varying degrees of success. The intent was not to limit site selection to places that were all believed to be successful, but rather to learn from communities at various points on a continuum of progress.[25] We considered several factors that mitigate distress, including type of economy, proximity to urban centers, and long-term versus short-term distress.

Our advisory panel also advised us to choose multiple cases within several states as a way to ascertain better the role of state policy in local economic development activities around ICT. In response, we chose two sites in North Carolina, three in Pennsylvania, and three in Arkansas. In those cases, we did additional research on state policy and included state capitals as part of our site visits.

Table 4.2 briefly characterizes the thirteen selected sites and the nature of the technology intervention being tried in each.

The robustness of the results, reported in Chapter 5, in light of the wide range of places studied, increases our confidence in the external validity of the findings. Had the sites all been similar in their initial characteristics or the intervention tried, or had they shown vast differences in their support of the study hypotheses, it would be difficult to consider the results relevant in other communities.

Quantitative analysis of secondary data

Another way to assure external validity is through quantitative analysis using data from a cross section of communities around the United States. Our intention was to specify an econometric model that would have explained economic development outcomes (the dependent variable) in terms of control variables, such as community size, region, demographics, and economic structure; ICT variables, measuring the degree of connectedness; and policy variables, namely metrics related to the interventions discussed above.

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24. The criteria are that per capita income is no more than 80 percent of the national average, or an unemployment rate is at least one percentage point greater than the national average over the last two years of reported data.

25. We chose Northeast Pennsylvania on that assumption, but learned during the site visit that its initiative was at an earlier stage than we initially understood.

We were limited in our ability to test that type of regression model by the unavailability of some key data. Specifically, connectedness measures at the sub-state level were not uniformly accessible. Some states centralize the collection and make available such data as number of telephone lines per county, number of POP sites, number of ISPs, and so on, but in many places, those data are considered proprietary by private providers. We also did not have information about recent ICT initiatives, except anecdotally and for our thirteen case-study communities. Finally, we were constrained by the very timing of our study — at turn of the decade before detailed decennial census figures had been released, making available census data quite old.

Table 4.2
Summary of case-study sites

Place	Nature of area and its distress	Nature of intervention
Helena, AR	Delta: river town	Community network
Monticello, AR	Delta: agricultural town	Community network
Pine Bluff, AR	Delta: small city adjacent to Little Rock	Technology park: Bioplex
Hays, KS	Plains: small town in Corn Belt, losing population	Telemedicine network and call centers
Springfield, MA	Frostbelt: declining industrial city	Technology park and incubator
Billings, MT	Ranch country: small city in very low-wealth, low-density agricultural and oil area	Telemedicine network with rural towns in region
Kinston, NC	Coastal plain: low-growth agricultural area	Technology park: Global transpark
Greenville, NC	Coastal plain: small city in very low-wealth area	Telemedicine network with rural towns in region
Bloomsburg, PA	Frostbelt: small town, remote	Broadband Internet
Meadville, PA	Frostbelt: small town	Distance learning lab and strategic community IT initiative
Northeast PA	Frostbelt: declining industrial region	Call centers as stepping stone to higher IT
Willacy county, TX	Rio Grande Valley: low-growth, low-density agricultural area	Broadband Internet
Seattle, WA	Northwest: poor inner city neighborhood in large, growing high-tech metro area	Computer training for poor persons

We identified a county-by-county data source at the Federal Communication Commission (FCC), on the number of telecommunications establishments in various years, most recently, in 1997. Recognizing the limitations of that single measure as a measure of connectedness, we used that in a number of exploratory quantitative exercises, including correlations with community variables to establish the factors likely to be present in better-connected communities, and preliminary regressions of connectedness on community variables, and economic outcomes on connectedness, including a two-stage least squares approach that controls for the likely simultaneity in our specification.

The results are for 1,426 of the 3,141 counties in the United States for which we were able to collect consistent data.[26] The variables included in the models and types of relationships that we specified were informed, in part, by the case studies.

Despite the reservations noted here, we present the results in chapter 5 for two reasons. First, the results from even this basic model are useful as a check on the more qualitative case studies. Second, the combination of case study and econometric approaches is a common and effective research strategy employed by the study team, with success in a policy setting.[27] However, given the poor availability and quality of the data, we do not consider this component of the work to be a major deliverable, though we expect it to be suggestive of more detailed follow-up work.

We used data from the 1990 census, from the 1997 economic census, and from the FCC. The specific measure of connectedness we used is the number of telecommunications establishments in each county (from the 1997 economic census). Our demographic variables included population, population density, median household income, and percent of the population with an advanced degree (bachelor's or higher).[28]

Other indicators in our data set measure traditional forms of distress — unemployment rates and percent of families below the poverty level. We wanted to examine the relationship between traditional and new forms of distress. Are "traditional" distressed counties also falling behind when it comes to connectedness?

The last group of variables measures the availability of infrastructure and services as well as the basic economic structure of the counties. We included the number of community hospital beds and the number of commercial banks in our analysis, as well as the percent of earnings that are goods related (to measure the importance of the manufacturing sector) and the percent of earnings that are related to the finance, insurance, and real estate sector (FIRE). Businesses in that sector depend more on ICT infrastructure than most other businesses, so we would expect a high concentration of FIRE businesses in a county to increase the demand for ICTs and therefore to correlate strongly with the number of establishments that provide telecommunications services. We also examined the relationship between the availability of traditional ser-

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26. We were able to verify that the sample of counties is representative of all counties.

27. Luger and Goldstein (1991) and Luger and Temkin (2000).

28. The use of census data presents further problems and limitations. For example, the information that is available at the county level is not typically very recent. In addition, results from the 1997 economic census are not reported for a large number of counties.

vices and the number of telecommunications providers to identify potential patterns of regions left behind.

Testing Hypotheses

Judging "success"

Our principal methodology was to use multiple cases to ascertain "critical success factors" for various ICT initiatives. That amounts to a subjective assessment of the importance of various hypothesized factors on outcomes, or what might be called a "soft" cause-and-effect analysis (Yin, 1984, 1993). Ragin (1994) refers to this approach as "comparative research" as opposed to "qualitative" research, since it is based on a set of carefully selected cases that differ in key attributes.

The first challenge was to operationalize "success." That is a normative concept, so one must have a frame of reference (or "benchmark") against which to measure it. One approach, used increasingly by economic development agencies, is to benchmark progress against past performance, whereby "success" is defined as improvement over time. Alternatively, benchmarking is done against comparison places ("peer groups") — as popularized in publications such as *Places Rated Almanac*, or various magazines' "Best Places to Live" or "Best Colleges" editions. In those instances, "success" is defined as movement up in the rankings or maintaining a position in the top five or top quartile, for example. A third framework, which we employ here, is to compare outcomes against intended effects, or what policy scholars call "effectiveness analysis." A "successful" intervention, by this approach, is one that achieves what the creators of that program (for example, legislators) had in mind, especially if there are no unintended consequences.

Each of these approaches has pros and cons. The "progress over time" method is relatively easy to implement because it requires data only from one place. However, it lacks an external validity check; even with annual progress, a place could be losing ground relative to others, or may continue to be far behind. The "progress against peers" approach provides an external reality check, but it is often difficult to find appropriate peers, which is necessary in order to control for background/context differences among places. Both of these approaches, moreover, require judgment about how much progress is "enough" to qualify as a success; for example, is 2 percent annual growth in real income "good" or "disappointing?"

We measured the success of each intervention against its expected outcomes for two practical reasons. First, the programs are all relatively new, so longitudinal outcome data do not exist, obviating the "progress over time" approach. Second, we did not choose the same interventions to track across multiple communities, nor a set of communities that were comparable.

The program effectiveness approach we took has several drawbacks that are important to note. First, it is easier to claim success for an intervention that was developed to achieve modest goals than for one that had lofty goals. Yet, the more ambitious program may have more measurable results, albeit less than expected. Consider a weight-reduction plan that promises dieters a loss of 10 percent of their body weight

in four weeks. A 300-pound dieter who loses "only" 20 pounds in that period could still claim the program to have failed to deliver its promise. Another program that promised a 20-pound loss would have been deemed successful. Second, we still have to develop meaningful outcome metrics. Expected results often are not articulated in easy-to-measure terms. For example, consider a program designed to "increase awareness" of the potential of ICT (as is Bloomsburg, Pennsylvania's program). How do we operationalize "awareness?" That is another source of bias. Third, there may be a difference between articulated expectations and meaningful results. For example, the stated goal to "establish a high-speed Internet connection" could be met, signifying success, but if businesses and households did not use that resource, there might be no economic development benefit. Then the declared "success" would be empty (pyrrhic victory).

A final way to measure success is perhaps the most subjective but also very important, and that is to decide whether a mindset change[29] about ICT has occurred in the community. This is a judgment about whether the local leadership — public, private, education, and nonprofit — has integrated information technology considerations and innovation more broadly into their economic development strategy and planning, and whether they work collaboratively in doing so. The creation of such a culture takes time, but once it takes hold can foster the community's capacity for innovation and further knowledge generation.

Our judgments about the "successfulness" of the thirteen interventions in each of our case studies are summarized in the first table of Chapter 5. A few comments are in order here. First, any assessment of this nature relies on professional judgment. We used the expertise and experience of our team to form our judgments. Second, success/failure is not a dichotomous outcome, but rather, a continuum. Consequently, we use a six-point scale to describe outcomes, including "positive," "mostly positive," "mildly positive," "mildly negative," "mostly negative," and "negative."

Operationalizing the hypotheses

Each hypothesis is stated in a way that can be operationalized. In short, we develop "input metrics" for the condition and availability of enabling and ICT infrastructure, the presence of a larger local planning process, the size of demand for ICT, the degree of innovativeness, the presence of institutional mechanisms to deploy ICT infrastructure, the degree of intergovernmental linkage, the strength of the "innovation triangle," the involvement of private providers in the initiative, the use of work force development, and the extent of local leadership and vision. To test the hypotheses we relate the input metrics to the output, or success, measures.

Drawing inferences from the hypothesis tests

The principal investigator used his intimate knowledge of the case studies and structured summaries of the hypothesis tests to draw cross-cutting inferences. Those also are reported in Chapter 5.

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29. See, for example, Montana *et al.*, *Strategic Planning in the Technology-Driven World: A Guidebook for Innovation-Led Development*, p. 11.

Limitations of the Study

We noted several limitations of the study throughout this section. They relate to the nature of the subject matter, the lack of good data for quantitative analysis, and the subjective nature of qualitative analysis.

Nature of the subject matter

ICT is a very rapidly changing area of application. The scope and labor-intensiveness of this project required three years for completion, and certain facts changed over that time span. And ICT will continue to change rapidly following release and publication of this report, so we caution readers to understand the tension between static reporting and dynamic events.[30]

Paucity of data

In part because of the newness of ICT as a policy application and its rapidly changing nature, there are no complete, region-specific, data bases on "connectedness." Some states centralize the collection and make available such data as number of telephone lines per county, number of POP sites, number of ISPs, and so on, but in many places, those data are considered proprietary by the private providers who collect them. We also were constrained by the very timing of our study — at turn of the decade before detailed decennial census figures had been released, making available census data quite old.

The poor quality and availability of the data limited considerably the type of quantitative analysis we had hoped to perform for the study. The results we report in chapter 5 are preliminary and suggestive, at best.

Limitations of qualitative research

Even the best examples of qualitative research are subject to a number of threats. First, the relatively small number of cases (thirteen) makes it difficult to generalize to all places. We essentially used a stratified sample, stratifying by geographic type (rural, small urban, larger urban); EDA region; and type of intervention. For some stratified categories, then, there was a single case. While that case may well be typical of all others with those characteristics, we do not make that claim. Instead, we employ comparative research, which requires a wide diversity of cases, as we have, in order to test the robustness of outcomes.

Second, our hypothesis tests required us to make subjective judgments about the degree of success of the various initiatives and the status of various "conditions" (inputs). We are confident that our research and professional experience have allowed us to make correct interpretations, but there is no simple way to verify the accuracy of our judgments.

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30. We have, and will continue to update some of the material in this report. See www.unc.edu/depts/oed.

CHAPTER 5

Testing Hypotheses and Drawing Inferences about Factors that Affect the Success of ICT Strategies

Communities throughout the United States have been turning to information and communication-oriented strategies to reverse decline and/or create new opportunities for growth in the twenty-first century. As indicated in the previous chapter, those strategies vary from ambitious, broad-based, and long-term, to more modest, and from hardware-based to soft-skills-oriented.

Given this diversity in cases studied, the application of a common set of hypotheses constitutes a hard test of phenomena: what Ragin (1994) calls "comparative analysis." If hypothesis tests were robust across such different cases, we would seem to have uncovered some strong relationships.

The full write-ups of the case studies are included in Appendix A. Here, we attempt to distill that large volume of material in the following way. First, we summarize our judgments about the degree to which the different ICT initiatives have been successful. Then, we test the hypotheses one by one, by looking at all cases together, by hypothesis. In the last part of the chapter, we draw some conclusions about what might be called "critical success factors."

Judging Program Success

Table 5.1 summarizes our judgments about the thirteen interventions' success. In chapter 4 we stressed the subjective nature of these observations, and the inherent difficulty in comparing different types of initiatives.

We conclude that eight of the cases had positive outcomes, one had a somewhat positive result, one had a mixed outcome, one was mostly negative, one was negative, and one was too early to tell. The distribution of cases, by level of success, is shown in Table 5.2.

Northeast Pennsylvania (Scranton/Wilkes-Barre/Hazleton) is deemed too early to judge because the intervention is long-term in nature, and as of the spring, 2002, key

Table 5.1
Judgments about interventions' "success"

Place	Outcome	Comment
Helena/Phillips County, AR	Neg	Helena was one of Nortel's information communication network (ICN) communities expected to create physical and human connectivity among sectors. It did not, due to unwillingness to overcome longstanding divisions.
Monticello/Drew County, AR	Pos	This community put in place a proactive broad-based committee to advance connectivity; the local university also was meaningfully involved. Area poised to be regional hub.
Pine Bluff/Jefferson County, AR	Mixed	This was among the most complex cases, with several interwoven initiatives, including participation in a regional Bioplex, development of a Fiberpark, and economic development related to reuse of the Pine Bluff arsenal. Not much has happened for a variety of understandable reasons; the jury, however, is still out.
Hays, KS	Pos	Four separate initiatives were going on: ICT curriculum development at FHSU; telemedicine at Hays Medical Center; an "information city" project; and expansion of call centers. Different regional, broad-based committees enhanced and coordinated these efforts (a coalition and an advisory group). FHSU leveraged investment by AT&T (establishing a point-of-presence) that provided benefits generally.
Springfield, MA	Pos	This is a story of an effective leader (president of community college) who understood the importance of the higher education-economic development link and the opportunities in the region for optical information companies. With cooperation of the regional planning commission and the commonwealth of MA, and strategic assistance from EDA, the Park and related activities (incubator) worked.
Billings and eastern MT	Pos	The Eastern Montana Telemedicine Network is a nationally recognized success. It includes an important role for the private provider (Qwest), effective leaders, and medical institutions. The technology is low key (not fastest everywhere) and attention was put into facilitating the use of the network.
Kinston, NC	Mostly neg	The major initiative here was the development of an air cargo-based industrial park that utilizes advanced logistics to capitalize on just-in-time production. After many years and many millions of dollars, there are few tenants. Public acceptance, especially outside the region, is wearing thin. The logistics training center is holding classes, but graduates still have few jobs to acceed to.
Greenville, NC	Pos	The NC legislature located a new medical school in agricultural and poor Greenville, in part, as an economic development policy. The medical school saw its niche in rural health, and saw telemedicine as a critical tool. The region now is a center for rural health and related health services.
Northeast Pennsylvania	too early	Two neighboring counties overcame decades of competition to form a regionwide alliance to focus development on information technology — specifically upgrading higher education, building a new image, attracting young people, and recruiting IT companies that provide increasingly good jobs.
Bloomsburg, PA	Mildly pos	This initiative was not very ambitious: mostly to elevate business leaders and the general population to the possible role of ICT in transitioning the community into the 21st century. A coordinating committee was formed that helped promote several modest initiatives. One leader has maintained the momentum; broad-based involvement has not been maintained on the committee.
Meadville/Crawford County, PA	Pos	This case is about the successful development and use of a link-to-learn training center, to prepare students for jobs and serve as a recruiting incentive to a nearby industrial park. It illustrates the importance of intergovernmental cooperation and effective coordinating committees.
Willacy County, TX	Pos	This very rural county was able to achieve a relatively high level of Internet connectivity because of some innovative actions of a local telecommunications co-op — that had universal service subsidies and good revenues from business in Mexico to take pressure off short term needs, enabling it to look at up-front costs as long-term investments, and that figured out how to bring down the cost of connectivity by developing new hardware and setting expectations appropriately (for less than the fastest and broadest bandwidth).
Seattle, WA	Pos	Seattle, of course, has world-class ICT resources from which to draw. This case illustrates how one visionary grass roots leader, the city of Seattle, and others employed those resources well to help the economic development of at-risk teenagers and increase the supply of IT professionals.

personnel were still being hired for the Great Valley Institute. To the extent that a change in the attitude of local actors is a positive outcome, we were inclined to put this case into the "somewhat positive" column. However, knowledge about the initiative is not widespread in the region, so the change in attitude so far has been confined to a relatively small number of people. The ambitious nature of the Northeast Pennsylvania case also puts in place a higher bar for success. Ultimately, framers of the policy hope to see a transformation of the region's economy, from lower-skilled processing to higher-skilled ICT. The region has a long way to go before progress is measured in that direction.

Table 5.2
Summary of outcomes

Outcome	Place
Too early	Northeast PA
Positive	Billings and eastern MT Greenville, NC Hays, KS Meadville/Crawford County, PA Monticello/Drew County, AR Seattle, WA Springfield, MA Willacy County, TX
Somewhat positive	Bloomsburg, PA
Mixed	Pine Bluff/Jefferson County, AR
Mostly negative	Kinston (Eastern NC)
Negative	Helena/Phillips County, AR

Of the eight communities judged to have been successful, three focused in whole or part on the development of telemedicine (Billings and eastern Montana; Hays; and Greenville). Telemedicine is a discrete and tractable application that, generally, makes sense in less densely settled places that have good regional medical centers. Seattle and Springfield are more densely settled places, and in part, their success stemmed from the use of the resources that were available locally. Willacy County is a story of a progressive telecom co-op. And Monticello and Meadville are communities that overcame hurdles by drawing segments together and working cooperatively.

Bloomsburg is shown to be "somewhat positive" in its success because the rather modest approach has seemed to change the thinking and expectations of some of the local elite. However, there appears to be limited buy-in from the business community.

Pine Bluff is judged to be "mixed" because the initiative consists of many parts that have differed in the degree to which they have succeeded. Moreover, setbacks all have understandable explanations.

Eastern North Carolina's Global TransPark initiative has been the subject of considerable discussion in the state's press. Some observers declare it to be an abject failure, given the volume of state and federal investment that has been forthcoming, and the small number of businesses that have located there. Others, more hopeful, point out that the project was poorly marketed as a job generator long before extensive infrastructure improvement and environmental approval processes were underway. Substantial investments may be required to overcome persistent underdevelopment in poor regions like eastern North Carolina. The positive spin on the case is that local and regional officials work well together and have been able to sustain early setbacks.

The one failure we identify is in Helena/Phillips County, Arkansas. There was an early roadmap of where the community wanted to go, and ample evidence that it has not been able to approach that goal.

Testing Hypotheses, One-by-One

1. Enabling infrastructure is necessary, but not sufficient to assure the effectiveness of IT-related initiatives.

Table 5.3 includes scores for "condition of traditional (or enabling) infrastructure," for "condition of information and communications infrastructure," and for "outcomes," as discussed immediately above.

For the hypothesis to be TRUE, enabling infrastructure would have to be of good quality in the cases judged successful. However, "necessary but not sufficient" means that good traditional infrastructure does not assure a positive outcome. Conversely, an absence of good traditional infrastructure where the outcome is negative would also be consistent with this hypothesis.

We see in the table that traditional infrastructure seems to be a necessary condition for success in six of the thirteen cases, which is mixed evidence. In three other cases, the hypothesis is also true, but rather, because there is both an absence of good traditional infrastructure and negative, mixed, or mostly negative outcomes. That is most apparent in eastern North Carolina, where road connectivity is critical for it to succeed as a multi-modal center using advanced logistics.

The table allows us to address another issue: to what extent traditional and ICT infrastructure are complements or substitutes. In the six cases where the hypothesis is judged TRUE because the state of enabling infrastructure and outcomes are both positive, ICT infrastructure is also of good quality. In three other cases, enabling infrastructure was sub-par, but ICT infrastructure was good, and the outcome was successful, indicating some substitutability.

Taking all this evidence together, we conclude that success is most likely when the condition and availability of both traditional and ICT infrastructure are good. The absence of traditional infrastructure makes success more difficult to achieve, but not impossible, since ICT infrastructure could be used as a substitute, at least in the short run. One exception may be when traditional infrastructure is an integral element of the intervention, as in the case of the Global TransPark's transportation linkages in Kinston, N.C.

2. Investments in technology infrastructure must be part of a larger local planning process to succeed.

Table 5.4 indicates whether the case-study community employed a larger local planning process, and whether the outcome was successful. For this hypothesis to be judged TRUE, there should be a positive correlation (both positive or both negative) between the two variables.

Table 5.3
Hypothesis 1: ***Enabling infrastructure is necessary, but not sufficient to assure the effectiveness of IT-related initiatives***

		Outcomes and inputs			
Place	Hypothesis	Outcome	Condition of IT	Condition of traditional infrastructure	**Comment**
Helena/Phillips County, AR	TRUE	Neg	Neg	Neg	Condition of traditional infrastructure not good; ICT program not effective. Location on Mississippi River not exploited; community did not work effectively together.
Monticello/Drew County, AR	FALSE	Pos	Pos	Neg	Development of good IT substituted for the lack of good traditional infrastructure.
Pine Bluff/Jefferson County, AR	TRUE	Mixed	Pos	Neg	Inadequacy of roads and other transportation is single biggest impediment to the success of the fiber park.
Hays, KS	TRUE	Pos	Pos	Pos	The availability of basic infrastucture, especially education, makes Hays attractive for call centers and back office functions; Hays uses IT to overcome some traditional infrastucture deficiencies.
Springfield, MA	TRUE	Pos	Pos	Pos	Without basic infrastructure, Springfield would have been just one community with a complex of fiber optic lines. The combination of both types of infrastructure made the tech park and enterprise center successful.
Billings and eastern MT	FALSE	Pos	Pos	Neg	Development of good IT substituted for the lack of good traditional infrastructure.
Kinston, NC	TRUE	Mostly neg	Pos	Neg	The particular plan required certain kinds of traditional infrastructure (4-lane roads, longer runway) that were not present. Yet, IT is helping the situation.
Greenville, NC	TRUE	Pos	Pos	Pos	Traditional infrastucture was in place; it took IT to make something happen.
Northeast Pennsylvania	too early	too early	Pos	Neg	Area is working to address traditional infrastructure deficiencies.
Bloomsburg, PA	TRUE	Mildly pos	Pos	Mostly pos	There were some traditional infrastructure deficiencies but these did not get in the way since expectations were constrained.
Meadville/Crawford County, PA	TRUE	Pos	Pos	Pos	The critical traditional infrastructure element — the building — was the object of attention.
Willacy County, TX	FALSE	Pos	Pos	Neg	The intervention involved IT only and was successful. To create jobs here, however, the basic infrastructure (other than roads) needs to be improved.
Seattle, WA	TRUE	Pos	Pos	Pos	Basic infrastructure is in place but did not influence the success.

Table 5.4
Hypothesis 2: ***Investments in technology infrastructure must be part of a larger local planning process to succeed***

		Outcomes and inputs		
Place	Hypotheses	Outcome	Larger local planning process present	**Comment**
Helena/Phillips County, AR	TRUE	Neg	Absent	The inability of community to coalesce is single most important reason for lack of success.
Monticello/Drew County, AR	TRUE	Pos	Present	Pro-active and broad-based, committee was instrumental.
Pine Bluff/Jefferson County, AR	Mostly FALSE	Mixed	Present	This suggests that a larger, effective planning process is necessary, but not sufficient for success.
Hays, KS	Mostly TRUE	Pos	Present but not fully coordinated	The initiative had many pieces. One (information city) had a cohesive planning effort. The others had planning but were only loosely coordinated. The success of planning was by happenstance and due to a culture of cooperation.
Springfield, MA	TRUE	Pos	Present	The regional planning organization (Pioneer Valley Planning Commission) played a pivotal role.
Billings and eastern MT	Mostly FALSE	Pos	Mostly absent	Intervention was not designed to spur economic development, and local planning leadership is not coordinated. But planning underway now through the university business school will leverage the telemedicine network as an economic asset.
Kinston, NC	FALSE	Mostly neg	Present	County commissioners and the regional planning organizations have worked well together and effectively planned, including leveraging outside resources. Again indicates that planning is necessary but not sufficient.
Greenville, NC	Mostly TRUE	Pos	Present but limited	Planning was conducted by the university and state, and to some degree, by the regional planning agency. But the initiative was not part of a large planning effort.
Northeast Pennsylvania	too early	too early	Present	The core of the initiative is a new planning body.
Bloomsburg, PA	Mostly TRUE	Mildly pos	Present	This also revolves around a regional planning initiative (BTC3R). We point out, though, that not all members of the consortium were equally committed.
Meadville/Crawford County, PA	TRUE	Pos	Present	Clear and strong planning and coordination among entities, notable Crawford County Development Corporation and Crawford County Regional Alliance.
Willacy County, TX	FALSE	Pos	Mostly absent	The telecommunications coop proceeded with the cooperation of local government and public schools, but this was not a result of a larger local planning effort. This suggests that planning may not be necessary as a condition for initial success, but it will be to realize economic growth for the area.
Seattle, WA	Mostly TRUE	Pos	Present but not coordinated	The various pieces were planned, although sometimes loosely. There was no grand plan.

We were able to support the hypothesis in eight of twelve cases (the thirteenth being too early to tell). That includes several cases where the planning process was present but limited, and the outcome was somewhat, rather than fully, successful. In two cases, a planning process was in place but outcomes were negative or mixed, signifying that the condition is necessary but not sufficient. In three other cases, a larger regional planning process was not present, but outcomes were mixed or positive. These were cases where very strong individual or institutional leadership pushed reforms through.

The sum of the evidence suggests that a larger planning process in which ICT is embedded is a critical success factor. In exceptional cases, the lack of planning can be overcome by strong individual/institutional leadership, but that is hard to sustain and not likely to work in larger communities. Having a planning process in place, however, will not guarantee success; other conditions must also be present.

3. ***(1) A critical mass of ICT is needed for an ICT strategy to succeed; (2) Without a critical mass of demand, subsidies or other approaches are necessary to develop ICT resources***

The first of the two statements above (1) is our initial hypothesis. As we unfolded the thirteen stories, we realized that the wording was not sufficiently sharp, and modified it to (2). The elaborated hypothesis specifies the need for sufficient demand to make ICT investments economically viable.

Table 5.5 provides our assessment of demand conditions, as well as the outcome scores. Given the rural bias of our sample, it is not surprising that critical mass is not fully present in eight of the cases. In the successful cases attention has been given to demand aggregation and marketing, to increase the critical mass. Given the preponderance of thin demand, it is not surprising to observe a common use of subsidies through state and EDA programs, as well as Universal Service.

The evidence seems clear that a critical mass of demand is crucial to induce the private sector to make ICT investments. That defines some important roles for the public sector: to provide subsidies in rural places, through grants, concessionary loans, and tax incentives, at least at an early stage, and to help aggregate demand, in part, by coordinating related ICT programs, by providing information about users to the providers, and by acting itself as a consumer of ICT services in the rural regions.

4. ***(1) Technology innovations and advances are reducing the costs of communications and linkages; (2) Those innovations/advances are important for success***

This hypothesis also has been modified from its initial version (1). As originally stated, the hypothesis seemed trivial, so we modified it to relate not to the impact on costs, but rather, to the likelihood of success. Table 5.6 relates our judgments about the presence of innovations and advances in ICT technology to our measured outcomes, as a way to test the hypothesis.For the hypothesis to be TRUE, outcomes and inputs have to be positively correlated (both positive or both negative). The hypothesis is not rel-

Table 5.5
Hypothesis 3: ***(1) Critical mass of ICT is needed for an ICT strategy to succeed; (2) Without a critical mass of demand, subsidies or other approaches are necessary to develop ICT resources***

		Outcomes and inputs		
Place	Hypotheses	Outcome	Critical mass exists	**Comment**
Helena/Phillips County, AR	TRUE	Neg	No	Critical mass is absent both in demand and in people understanding the need. Demand aggregation efforts have been discussed only.
Monticello/Drew County, AR	(2) Somewhat TRUE	Pos	No, but growing	Committee is aggressively seeking to increase critical mass by connecting existing demand across sectors.
Pine Bluff/Jefferson County, AR	Mostly TRUE	Mixed	Yes, but isolated; planned	The Arsenal has critical mass that is underutilized, but regulatory hurdles prevent it from being spread. Otherwise, area is constrained by low demand. The FIberPark concept is based on need to develop critical mass.
Hays, KS	(2) Somewhat TRUE	Pos	No, but growing	Local leaders are working with SW Bell and contemplating wireless as an answer to this dilemma. Important distinction between large and small providers: former can afford to invest now for returns later; latter cannot.
Springfield, MA	TRUE	Pos	Yes	Springfield was already served well by ICT and is in a dense state. The initiative built on that and developed a cluster of IT businesses that provided critical mass.
Billings and eastern MT	(2) Somewhat TRUE	Pos	No, but the community has maximized what it has	The hospitals are critical masses in themselves, and serve as a basis for other aggregation efforts.
Kinston, NC	(2) Somewhat TRUE	Mostly neg	No	As in other small regions, an ICT network has been built using subsidies and political largesse. Now, it is underutilized.
Greenville, NC	(2) Mostly TRUE	Pos	No, but has been pieced together	The strategy here was to build related uses of ICT that complement telemedicine.
Northeast Pennsylvania	Probably TRUE	too early	Yes	Bell of PA has a POP site there; otherwise well-served due to density of region.
Bloomsburg, PA	(2) Somewhat TRUE	Mildly pos	No, but growing	Leaders are conscious of the importance of demand and have been working within the consortium to achieve a critical mass among the schools, university, local government, and businesses. The Commonwealth has preempted their efforts to do demand aggregation.
Meadville/Crawford County, PA	TRUE	Pos	Developed as part of initiative	The development of an industrial park proximate to the L2L center attracted users of ICT and recognized the importance of critical mass.
Willacy County, TX	(1) FALSE (2) TRUE	Pos	No	This is a case of an unusual utility providing service at a loss in anticipation of future profits, as well as using heavy universal service subsidies.
Seattle, WA	TRUE	Pos	Yes	The critical mass is present and the initiative builds on it.

It seems clear rural and smaller urban places lack sufficient demand to interest providers in putting much hardware in place, at least without subsidy. What varies among the cases is the local leaders' foresight and aggressiveness in overcoming this barrier.

Table 5.6
Hypothesis 4: ***(1) Technology innovations and advances are reducing the costs of communications and linkages; (2) Those innovations/ advances are important for success***

		Outcomes and inputs		
Place	Hypotheses	Outcome	Innovations and advances present?	**Comment**
Helena/Phillips County, AR	TRUE	Neg	No	
Monticello/Drew County, AR	TRUE	Pos	Yes	The committee focused early on networking government and introducing scheduling and tracking technologies.
Pine Bluff/Jefferson County, AR	NOT CLEAR	Mixed	Mixed	There is scientific innovation in the research facilities at the Bioplex site that may be commercializable, but the regulatory hurdles to the development of the project do not allow success to be fairly judged yet.
Hays, KS	TRUE	Pos	Yes	The case says a lot about innovativeness as a source of success.
Springfield, MA	Mostly TRUE	Pos	Yes	The cost of ICT has been falling in the region, which actually could undermine Springfield's initial competitive advantage, due to the hardware installed there.
Billings and eastern MT	NOT CLEAR	Pos	Mixed	In this case, hardware and installation costs have been falling, but monthly operating costs are rising.
Kinston, NC	(2) FALSE	Mostly neg	Yes	The Global Transpark employs and has put in place many innovations within the development itself and the greater region. They may pay off in the future, but so far, very little, perhaps because some innovations came from outside the region and were not well understood and marketed.
Greenville, NC	TRUE	Pos	Yes	Innovative monitoring systems linked to traditional communications devices are making it possible to get real-time and trend data on patients in a cost effective way.
Northeast Pennsylvania	n/a	too early	n/a	
Bloomsburg, PA	TRUE	Mildly pos	Yes	Innovations/advances were demonstrated in the library, in Bloomsburg University's instructional media program, and in a private business.
Meadville/Crawford County, PA	TRUE	Pos	Yes	L2L and Bainbridge's facilities reduce costs to users. Not clear, though, whether cost savings due to economies of scale or innovations.
Willacy County, TX	TRUE	Pos	Yes	Telecom advances are increasing the options for telecom providers to serve underserved areas.
Seattle, WA	n/a	Pos	n/a	Technology innovations and advances were not discussed since Seattle has been at the leading edge of technology for some time.

(1) is fairly obvious.

evant in two places (Northeast Pennsylvania and Seattle) because the ICT infrastructure was advanced prior to the initiatives undertaken, so was not an issue on the case studies. In eight of the remaining eleven cases, there is a positive correlation. In two cases, there are mixed results that prevent us from drawing conclusions about the hypothesis. In one case (Kinston) the hypothesis was deemed FALSE because there was innovation but disappointing results.

These results reinforce those from the preceding hypothesis (regarding the need for a critical mass of demand to make investments viable). Another way to offset the disadvantages of scale in rural places is to employ innovative technologies — as best illustrated in Willacy County, Texas.[31] The evidence suggests that innovation is a necessary, but not always sufficient condition of success.

5. ***(1) Institutional mechanisms must be in place to help users deploy the hard infrastructure appropriately; (2) Those mechanisms contribute to success***

Again, we modified the original hypothesis to make it more useful in the context of this report. Initially, we speculated that institutional mechanisms were necessary for hard infrastructure to be employed. That was TRUE in every case. We restated the hypothesis be able to determine whether or not these institutional mechanisms are a critical success factor. In all but two cases that was TRUE as well. In one case where we judged the hypothesis to be FALSE the mechanisms were present, but outcomes were negative (Helena); in the other, the training center is giving the project a more successful reputation despite limited economic outcomes (Kinston).

This evidence is consistent with the view that appropriate institutional mechanisms are a necessary, but not sufficient factor for the success of ICT initiatives.

6. ***Hierarchical coordination or linkages among national, state, and local governments are important for a community to be truly connected.***

The table shows the degree to which there has been intergovernmental coordination. For the hypothesis to be true, the score would have to be correlated with the outcome (in the same direction).The results for this hypothesis are quite scattered: among communities with successful outcomes, only Springfield and Seattle had good hierarchical coordination. (Helena/Phillips County had no coordination and negative outcomes, supporting the hypothesis from the other direction.) Northeast Pennsylvania was off to a good start, placing high emphasis on inter-county and state cooperation. In Pine Bluff, Billings, Greenville, and Bloomsburg, there was some intergovernmental cooperation and positive (or mostly positive) outcomes, lending weak support to the hypothesis.

Quite striking, however, there are four communities that we judged to be successful (or mostly successful) despite the fact that there was no or little intergovernmental

31. The telephone co-op used cabinets as mini-"central offices" to extend DSL into very sparsely populated areas of the Rio Grande Valley.

Table 5.7
Hypothesis 5: ***(1) Institutional mechanisms must be in place to help users deploy the hard infrastructure appropriately; (2) Those mechanisms contribute to success***

		Outcomes and inputs		
Place	Hypotheses	Outcome	Mechanisms in place?	**Comment**
Helena/Phillips County, AR	(1) Somewhat TRUE; (2) FALSE	Neg	Some	Interviewees described a "first wave" of institution building, that then stalled. Institutional mechanisms may be necessary, but not sufficient for success.
Monticello/Drew County, AR	TRUE	Pos	Yes	Example: designation of a technology liaison at the hospital.
Pine Bluff/Jefferson County, AR	Mostly TRUE	Mixed	Yes	The Pine Bluff Arsenal had state-of-the-art technology and personnel that were available to help the community.
Hays, KS	TRUE	Pos	Yes	But public sector programs must be careful not to bias technology choices in a particular direction. In Hays, FHSU and the Medical Center worked out their needs with the private provider. So did the Sykes facility in the FIberPark.
Springfield, MA	TRUE	Pos	Yes	Interviewees here referred to organizational innovations among governments that allowed them to work so well together.
Billings and eastern MT	TRUE	Pos	Yes	The main users — the hospital and the outlying clinics — implemented changes to maximize the network and provided necessary training. Other users — the schools, libraries, and university — are part of a new statewide network.
Kinston, NC	(1) TRUE; (2) not yet	Mostly neg	Yes	Until recently, there was no training center or other physical presence for local citizen involvement and understanding of the project. The fact that there is now a "there" there is likely to be an important factor in the project's success.
Greenville, NC	TRUE	Pos	Yes	As in Billings, the main users were quite innovative, making the applications practical.
Scranton/Wilkes-Barre, PA	Probably TRUE	too early	Yes	The Great Valley Technology Alliance was designed to bring actors together to implement a strategy. The proposed training facility was conceived to provide the expertise. The universities banded together to make the whole greater than the sum of the parts.
Bloomsburg, PA	TRUE	Mildly pos	Yes	BTC3R is a new mechanism. The university also built new institutional mechanisms to advance ICT.
Meadville/Crawford County, PA	TRUE	Pos	Yes	User training is interwoven with the hardware through L2L. CCRA is the entrepreneur, operator, and landlord to L2L, and has support staff available.
Willacy County, TX	Somewhat TRUE	Pos	Yes, though limited	The major user — the school system — is committed to provide training, as is the telco. Business and government use is weaker.
Seattle, WA	TRUE	Pos	Yes	Across the board: the city created a new position of IT coordinator; Luversa Sullivan created some new organizations; the community colleges changed, etc.

(1) is fairly obvious. Of course, the definition of "institutional mechanisms" varies from place-to-place, ranging from creation of new organizations, changing the rules so units can work better together, creating new job positions, etc.

Table 5.8
Hypothesis 6: ***Hierarchical coordination or linkages among national, state, and local governments are important for a community to be truly connected.***

		Outcomes and inputs		
Place	Hypotheses	Outcome	Intergovern-mental coordination?	**Comment**
Helena/Phillips County, AR	TRUE	Neg	No	Opportunities missed, for example, for federal funding.
Monticello/Drew County, AR	FALSE	Pos	No	Committee in Monticello was openly ambivalent about state or other outside involvement, preferring to rely on local can-do spirit.
Pine Bluff/Jefferson County, AR	Somewhat TRUE	Mixed	Some	Pine Bluff was turned too inward. There has been some federal involvement, but little coordination with state or other local agencies.
Hays, KS	Somewhat FALSE	Pos	Little	Hays gets information relevant to its programs by tapping into state and federal government websites, rather than through programmatic, interpersonal, interagency cooperation.
Springfield, MA	TRUE	Pos	Yes	Pioneer Valley Regional Planning Commission tied Springfield together with other local governments in the area. The state and EDA were involved and supportive.
Billings and eastern MT	Somewhat TRUE	Pos	Some	Montanans are not very government-oriented to begin with. Nonetheless, Deaconess Billings Clinic used federal grants and universal service subsidies were critical. However, if competing organizations banded together they could have leveraged more state and federal support.
Kinston, NC	Mostly FALSE	Mostly neg	Yes	Despite good inter-governmental coordination and cooperation, there is little measureable success to date. And despite state funding, the project did a poor job of marketing itself realistically within the state.
Greenville, NC	Somewhat TRUE	Pos	Some	Similar to Hays in nature of governmental links, but more cooperation was planned for the future.
Northeast Pennsylvania	Probably TRUE	too early	Yes	The bi-county link was critical, as was involvement of state and EDA. Some local governments in the region were laggard though. A good decision was not to think too ambitiously on the geographic scope.
Bloomsburg, PA	Somewhat TRUE	Mildly pos	Some	The consortium itself was an example of inter-governmental cooperation, and EDA provided some funds. The state was a secondary player that could have done more.
Meadville/Crawford County, PA	Mostly FALSE	Pos	Little	This was almost entirely a county effort.
Willacy County, TX	Mostly FALSE	Pos	Some	This was almost entirely a private sector effort, though it relied heavily on federal universal service subsidies.
Seattle, WA	TRUE	Pos	Yes	City agencies, King county, community colleges, school system, state all worked in the same direction, if not in a formally structured manner.

Linkage appears to be neither necessary but not sufficient, nor even necessary for success. Monticello and Billings had some measure of success without the linkage. Kinston had good cooperation, but little to show as outcomes. Linkage, therefore, seems to be circumstantially important. The type of intervention is key when assessing the case.

cooperation (Monticello/Drew County, Hays, Meadville, and Willacy). And eastern North Carolina scored well on intergovernmental cooperation, yet poorly on outcomes.

From this, we conclude that linkage is neither necessary nor sufficient for success. It appears that good intergovernmental cooperation contributes to success, but communities seem to have found ways to succeed without it. That suggests that flexibility/adaptability is a critical success factor: if public-sector partners are not able or willing to help a local community, it can still succeed by mustering its own resources. That, however, is much harder to do and sustain, unless private actors provide the civic leadership over a long period, as the telco has done in Willacy County.

7. ***Linkages among government, education, and industry are a critical success factor for ITC interventions. State policies and corporate action are important for local success.***

The linkage of concern here is not among units of government, but between the vortexes of what has been called the "innovation triangle:" business, government, and education, especially higher education. For this hypothesis to be judged TRUE, there should be a correlation in the same direction between that indicator and the indicator of outcome success.

The results are similar to the previous linkage hypothesis. In eight cases, there is some level of cooperation, and some degree of success. In one case, there is neither. And one case is too early to tell. Billings and Willacy enjoyed some success despite cross-cutting action, and eastern North Carolina has yet to reap the fruits of its efforts.

The weight of evidence here suggests that Billings and Willacy are outliers — both where a private business is the primary driver — and the innovation triangle is, indeed, a necessary, if not sufficient factor for success. That is based on the balance between TRUEs and FALSEs and on the observation that ties with universities, hospitals, and private businesses could substitute for linkages with government (as seems to be the case in Monticello and Hays). Again, this suggests that flexibility/adaptability is a key factor.

8. ***Infrastructure providers must be a partner in assessment and planning, not just the spending, for the intervention to succeed***

This is a more refined version of two other hypotheses. We previously asked about the use of a broad planning framework in the case-study communities, and about community-industry linkages. Here we focus specifically on the connection between the community and the ICT provider, in a broad range of activities, including planning. In short, have providers been full partners?

The results are quite strong. In every case except Bloomsburg, meaningful involvement of the providers in the initiative was associated with some level of success, and a lack of involvement was associated more with failure.

Table 5.9
Hypothesis 7: ***Linkages among government, education, and industry are a critical success factor for ICT interventions. State policies and corporate action are important for local success.***

		Outcomes and inputs		
Place	Hypotheses	Outcome	Linkages present?	**Comment**
Helena/Phillips County, AR	TRUE	Neg	No	Gaps in relationships abounded; no mention was made of local university.
Monticello/Drew County, AR	TRUE	Pos	Mostly	Committee is clear rendition of this 3-way partnership at the local level. State policy actors were not salient.
Pine Bluff/Jefferson County, AR	TRUE	Mixed	Yes	An informal tri-partite committee worked well together to link education, government, and business.
Hays, KS	Mostly TRUE	Pos	Yes	There were strong linkages among the sectors. However, some state policies were cited to be holding the plan back: a lack of statewide ICT strategy and prohibitions on tax abatements.
Springfield, MA	TRUE	Pos	Yes	Pioneer Valley Planning Commission and Springfield Technical Community College both worked hard to create opportunities for all three sectors to meet and provide input.
Billings and eastern MT	Mostly FALSE	Pos	Little	Higher education, government, and business are not well integrated. The independent streak in Montana dominates. And there is a historical absence of strong government.
Kinston, NC	Mostly FALSE	Mostly neg	Mostly	The three sectors worked in unison and effectively getting considerable outside resources onto the table. Some public agencies could have been involved more (DOT); but generally, there were good linkages. The key university linkage, however, was to a campus outside the region in a more liberal urban culture.
Greenville, NC	TRUE	Pos	Yes	The ECU hospital is itself a hybrid of state, educational and private sector influences, and the network connects public, private and educational users.
Northeast Pennsylvania	Too early	Too early	Some	Through the sponsorship of the chambers of commerce, the business communities are working together. Some state agencies are involved, though not that deeply. Of the involved state agencies, the Ben Franklin program is the most visible. The Great Valley alliance has also worked well with the local higher ed sector. The weak link is the local government side.
Bloomsburg, PA	Somewhat TRUE	Mildly pos	Mostly	BTC3R was well connected with universities and schools. The Ben Franklin Partnership also was involved. A subset of county commissioners participated, but the support of the local governments in the region was mixed, as was corporate participation.
Meadville/Crawford County, PA	TRUE	Pos	Mostly	The most important elements of the innovative triangle were present and involved.
Willacy County, TX	Mostly FALSE	Pos	Little	The coop had some connection with the schools, but connections with universities and government are weak. To realize an economic development benefit, these may be necessary.
Seattle, WA	TRUE	Pos	Yes	Although the connections were not centralized and planned, the segments worked well together.

This appears not to be a strong factor. It appears to be necessary, but not sufficient.

Table 5.10
Hypothesis 8: ***Infrastructure providers must be a partner in assessment and planning, not just the spending, for the intervention to succeed***

		Outcomes and inputs		
Place	Hypotheses	Outcome	Providers have been a full partner?	**Comment**
Helena/Phillips County, AR	TRUE	Neg	No	This is a story of a failure of the local community to work with consultants and providers.
Monticello/Drew County, AR	TRUE	Pos	Yes	This has a special twist: a local retailer of satellite cable systems in the area changed to become the local ISP, and was closely involved at all levels.
Pine Bluff/Jefferson County, AR	Mostly TRUE	Mixed	Yes, but with qualifications	ICT provider involvement stems from a settlement with the state negotiated in lieu of other penalties for rate violations. SW Bell has refused leadership in the FiberPark program, but is involved.
Hays, KS	TRUE	Pos	Yes	Providers worked closely with FHSU and HMC, in bringing Sykes site fiber cable, and in developing the fiber park.
Springfield, MA	TRUE	Pos	Yes	New activities in park accomplished via cooperative agreement in lease. Leadership is aggressive in leaning on providers to keep infrastructure state-of-the-art.
Billings and eastern MT	TRUE	Pos	Yes	Success of telemedicine program at Deaconess Billings Clinic due to support of rural telecom coops and Quest.
Kinston, NC	TRUE	Mostly neg	To some degree	This may have been more successful if transportation providers had been involved earlier and more fully. There was good cooperation on the telecom side.
Greenville, NC	Mostly TRUE	Pos	Yes, with qualifications	This initiative has done well, but not necessarily due to active and full involvement of the private providers. The state played a major role and Bell South cooperated.
Northeast Pennsylvania	Probably TRUE	too early	Yes, with qualifications	Two key providers are on the steering committee of the Alliance (ALLTEL, Comm Telephone,). Verizon, Lucent, Adelphia, NE Comm, all have expressed willingness to help, but to date, they have not been asked for much.
Bloomsburg, PA	Mostly FALSE	Mildly pos	No	There is a disconnect between providers and local planning for ICT here. The mildly positive assessment of outcomes refelcts the limited expectations for the initiatives. Arguably, further success is limited by this problem.
Meadville/Crawford County, PA	TRUE	Pos	Yes	The owner of the industrial park (CCDC) is the service provider and is intimately involved in all aspects.
Willacy County, TX	TRUE	Pos in terms of Internet availability	Yes	The telecom coop was service provider and took the lead. If there is a problem, it is the lack of partnership of the public sector in the effort.
Seattle, WA	TRUE	Pos	Yes	The private ICT sector is advanced in Seattle and has donated time and resources to the various initiatives. Individuals in those companies have served on boards, as mentors, and as employers of program graduates.

There is a difference among cases in the scope of involvement of providers. In some instances, they are expected to be involved at the community scale in all aspects of planning. In others, there is a limited scope within a specific project.

9. Work force development is a critical complement to any infrastructure intervention.

We have argued throughout that twenty-first century infrastructure is more sophisticated than it was previously, and requires specialized and constantly upgraded skills in the work force to be productive. It is not enough to put ICT hardware in the ground (or in the skies); you must have an appropriately trained work force to use it. This hypothesis states the importance of work force development.

The results are strong here, as well. The only incidence of FALSE is in eastern North Carolina. As discussed in the full report (Appendix A), that case was a hard one to classify in terms of success, since the impediments it faced were so large and the necessary time frame for results so long.

The case of eastern North Carolina also points out a hazard of this type of "critical factor" analysis. We have to be careful not to suggest that all factors (hypotheses) are of equal weight in every case. In the case of eastern North Carolina, the one factor that is critical for its success, given the type of initiative it is (a multi-modal center relying on advanced logistics) — enabling infrastructure — was not sufficiently present. Improvements to the surrounding transportation network are nearly complete, so our assessment about a lack of success may be premature.

10. Because of the long-term and expensive nature of ICT, vision and leadership are critical success factors

Vision and leadership are among the most abstract factors to judge. We did so by reading the history of each intervention and interviewing the architects of the initiatives and other key business, education, and government leaders. Studies of other types of policy interventions had concluded that vision and leadership were critical success factors, and we hypothesized it to apply to ICT interventions, as well.

The evidence strongly supports the hypothesis, since it was judged to be TRUE in every case but two, Pine Bluff and Kinston. In Pine Bluff, however, outcomes were mixed, allowing for vision and leadership to have affected at least some elements of the initiative. Also, regional leadership around eastern North Carolina helped create a revenue source (vehicle tag fee) to support basic infrastructure and site development in the region, even as they await the impacts from the Global TransPark itself.

Quantitative Evidence

Empirical evidence shows that not all regions and communities are equally connected. But there are several interpretations of the causes for the inequalities discussed above. In this section, we try to examine the relationship between ICT infrastructure and socioeconomic characteristics of counties.

As mentioned before, some of the new technologies have technical limitations that restrict their availability in low-density areas. Data released by the FCC show that in December 2000, subscribers to high-speed Internet services were present in 97 percent of the most densely populated ZIP codes, but only in 45 percent of the ZIP codes with the lowest population density. At the same time, it is important to notice that

Table 5.11
Hypothesis 9: *Work force development is a critical complement to any infrastructure intervention*

		Outcomes and inputs		
Place	Hypotheses	Outcome	Workforce development present?	**Comment**
Helena/Phillips County, AR	TRUE	Neg	No	At least, no workforce development related to the initiative.
Monticello/Drew County, AR	TRUE	Pos	Yes	Leadership recognized importance of this and higher education institutions stepped up to the plate.
Pine Bluff/Jefferson County, AR	TRUE	Mixed	Yes	Educational institutions are key partners in the effort.
Hays, KS	TRUE	Pos	Mostly	Training capability helped attract call centers. Not much in the way of targeted training except for call centers. Telcom providers see good general, basic education as key.
Springfield, MA	TRUE	Pos	Yes	Critical link between community college and tech park — focusing on college extension and other programs for park tenants.
Billings and eastern MT	TRUE	Pos	Mostly	Efforts put into training medical professionals; some concern over broader training of workforce for 21st century.
Kinston, NC	Mostly FALSE	Mostly neg	Mostly	The GTP training center is a critical component of the plan. The regional consortium of technical colleges is well positioned to serve businesses' needs, once businesses can be recruited. K-12 education may be sub-par, however. Given outcome, workforce development appears to be necessary, but not sufficient.
Greenville, NC	TRUE	Pos	Yes	Training and certification are key elements of plan. One early spinoff company provides training.
Northeast Pennsylvania	Probably TRUE	too early	Mostly	Improved workforce development is part of the plan to network the area's higher education institutions, which have aded ICT-relevant instructional programs. The development of an IT center at the airport also is relevant. The technical college system is somewhat undeveloped in that part of PA.
Bloomsburg, PA	TRUE	Mildly pos	Mostly	Main thrust of BTC3R is to make workforce more aware of opportunities and requirements of an information society. BU also has been at the cutting edge of curriculum development. Here, too, technical college programs are not readily available.
Meadville/Crawford County, PA	TRUE	Pos	Yes	L2L was developed to provide workforce training. Allows CCEMS to offer software training in Crawford county.
Willacy County, TX	Somewhat TRUE	Pos in terms of Internet availability	Some	The coop telecom provider was able to make Internet widely available, and provides free technical assistance to users. Public schools provide training as well.
Seattle, WA	TRUE	Pos	Yes	Training provided by Sullivan's academy, by tech colleges, by UW, and by some high schools.

Table 5.12
Hypothesis 10: ***Because of the long-term and expensive nature of ICT, vision and leadership are critical success factors***

		Outcomes and inputs		
Place	Hypotheses	Outcome	Vision/ leadership present	**Comment**
Helena/Phillips County, AR	TRUE	Neg	Limited	There is fatigue among the local leaders who are stretched thin across many initiatives. Isolation has limited leaders' exposure to outside ideas.
Monticello/Drew County, AR	TRUE	Pos	Yes	Community installed a broad and redundant leadership structure to ensure sustainability.
Pine Bluff/Jefferson County, AR	FALSE	Mixed	Yes	Community had good leadership and shared vision, but disappointing results. That suggests leadership is necessary, but not sufficient.
Hays, KS	TRUE	Pos	Yes	Leadership originated from hospital and university sector (the users) that exerted pressure on public officials (the agencies responsible for economic development).
Springfield, MA	TRUE	Pos	Yes	One leader in particular (STCC President Sciabelli) overcame skepticism of region's business leaders.
Billings and eastern MT	TRUE	Pos	Yes	This leadership also comes from the users/providers of the service rather than from local or state government. To see economic development benefit, other leadership will be required.
Kinston, NC	FALSE	Mostly neg	Yes	Whatever positive results there have been have been from the cooperation among regional leaders. Again, a necessary but not sufficient condition.
Greenville, NC	TRUE	Pos	Yes	Leadership in this case was at different levels.
Northeast Pennsylvania	too early	too early	Yes	
Bloomsburg, PA	TRUE	Mildly pos	Yes	Leadership in this case came from one person, in particular, who mobilized other local leaders to help advance the cause.
Meadville/Crawford County, PA	TRUE	Pos	Yes	
Willacy County, TX	TRUE	Pos	Yes	Here, leadership came entirely from the private sector/service provider, which has been a longstanding civic presence, rather than from the government. To see economic development benefit, other leadership needs to get on board.
Seattle, WA	TRUE	Pos	Yes	This case is about a policy entrepreneur/grassroots activist who made things happen, and about a progressive and innovative local government.

low-density areas are catching up — in 1999, the number was 24 percent. The same report also shows clearly that more densely populated areas are better served in terms of capacity. Information is only available at the state level, but Figure 5.1 shows that the more urbanized states — especially in the Northeast — have a larger percentage of ZIP codes with four or more high-speed lines in service than states in the Midwest or in the South.

Population density is only one factor that is related to the availability of ICTs. Private investments in ICT infrastructure are mainly based on demand — providers are not going to establish services and build new infrastructure unless there is already an existing market or at least a clearly identified potential market. Therefore, size alone is important — for example, population and the number of businesses that depend on or use ICTs. Not all types of businesses use the technologies in the same way, so the economic structure is another underlying factor. Finally, one can ask the question whether other characteristics — education, poverty and unemployment rates, income, and availability of other services — are correlated with the availability of ICTs.

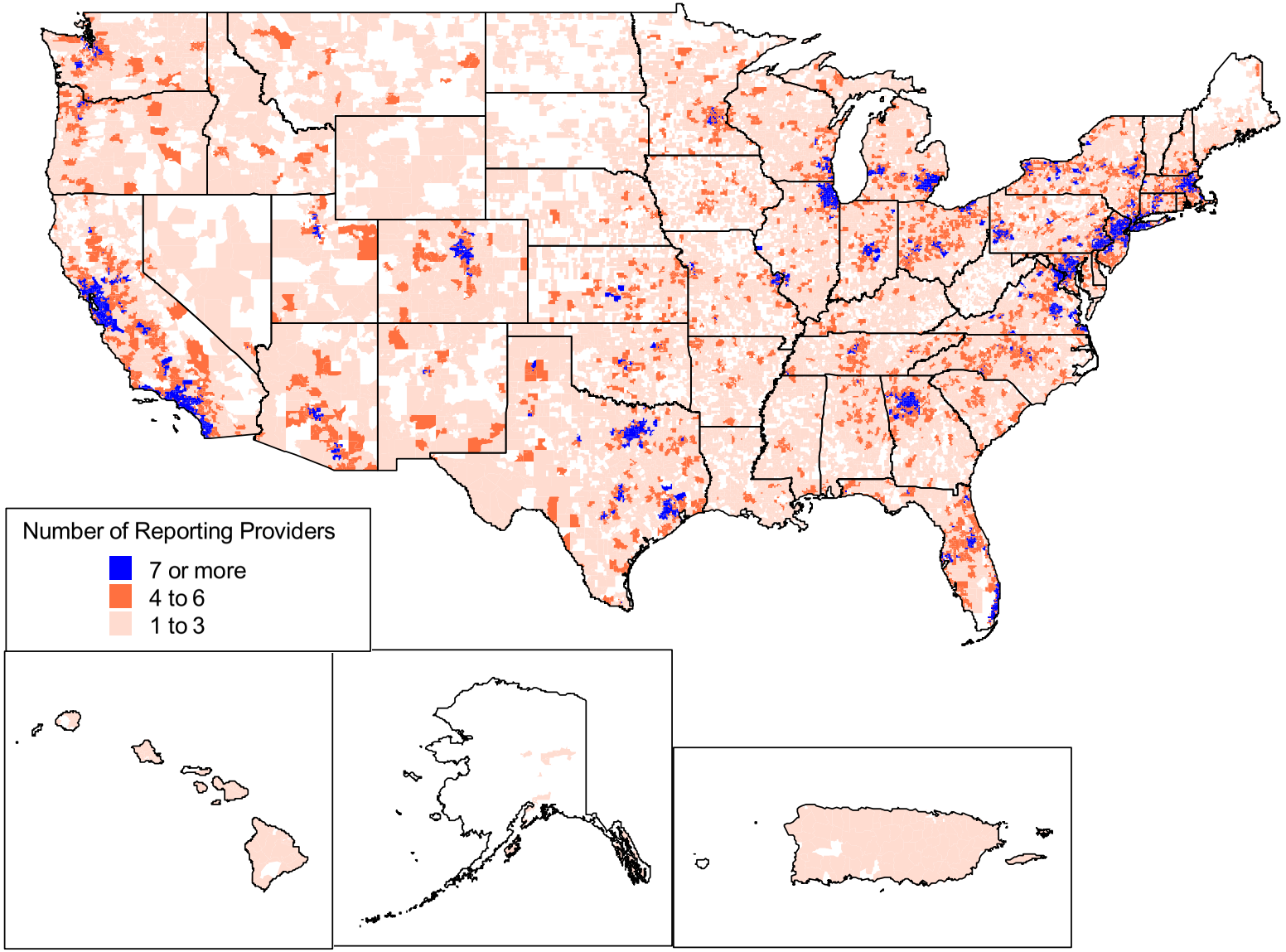
The correlation matrix, presented as Table 5.13, shows a strong positive correlation between the number of telecommunications establishments in a county and population, number of community hospitals, and the number of commercial and savings banks, all as we hypothesized. While the relationship between the number of telecommunications providers and county size is neither new nor surprising, the advantage of scale is still important to stress. When there are more providers, there is more competition and potential users have a broader choice of services and can select the one that meets their needs. With only one or two providers, users are restricted and potentially have to accept suboptimal solutions, lower quality of service or higher prices.

Other significant, but weaker, correlation coefficients confirm the importance of population density and the economic structure. Counties with a larger share of businesses in the FIRE sector have more telecommunications establishments, while the size of the manufacturing sector does not seem to be important. A higher median family income and the percentage of college graduates are also positively correlated with the number of telecommunications establishments.

Of course, correlation begs the question of causality. As our discussion to this point should suggest, there is likely to be a two-way relationship between ICT infrastructure (or "connectedness") and economic development. We argue that good connectedness contributes to economic development, but also, that the more urban, high-tech, and wealthy (i.e., more economically developed) a place is, the more connectedness it is likely to have.

The two-way significance is demonstrated in regression models that use, in turn, measures of connectedness and economic development as dependent variables. The first model regresses our telecommunications variable on seven regressands, including two common measures of economic development: median income and the unemployment rate. The income variable is significant at the 0.01 level with a negative sign. That is contrary to our expectations, and is different from the simple, bi-variate correlation. The coefficient values are small. We suspect this result is an econometric arti-

Figure 5.1
High-Speed Providers by ZIP Code (As of June 30, 2001)



Source: Federal Communications Commission, "High-Speed Services for Internet Access: Subscribership as of June 30, 2001." Industry Analysis Division, Common Carrier Bureau, February 2002. Available online at www.fcc.gov/ccb/stats.

Table 5.13
Correlations

		Number of telecom-munica-tions estab-lishments in 1999	Population 1992 ABS	Median Family Money Income 1989 DOL	Persons 25 Years and Over, Percent with Bachelor's Degree or Better	Population Density	Percent of Families with Income Below Poverty Level 1989 PCT	Civilian Labor Force, Unemploy-ed 1991 ABS	Community Hospital Beds 1991 (Copyright) ABS	Commercial and Savings Banks, Offices June 1992 ABS	Earnings, Percent Goods-Related, Manufac-turing 1990 PCT	Earnings, Percent Service-Related, Finance, Insurance, and Real Estate
Number of telecommunications establishments in 1999	Pearson Correlation	1.000	.863**	.331**	.356**	.385**	-.143**	.836**	.849**	.874**	.004	.442**
	Sig. (2-tailed)	.	.000	.000	.000	.000	.000	.000	.000	.000	.823	.000
	N	3141	3141	3141	3141	3141	3141	3141	3141	3141	3141	3141
Population 1992 ABS	Pearson Correlation	.863**	1.000	.325**	.311**	.369**	-.130**	.980**	.927**	.929**	.023	.366**
	Sig. (2-tailed)	.000	.	.000	.000	.000	.000	.000	.000	.000	.203	.000
	N	3141	3141	3141	3141	3141	3141	3141	3141	3141	3141	3141
Median Family Money Income 1989 DOL	Pearson Correlation	.331**	.325**	1.000	.691**	.171**	-.762**	.270**	.260**	.419**	.103**	.295**
	Sig. (2-tailed)	.000	.000	.	.000	.000	.000	.000	.000	.000	.000	.000
	N	3141	3141	3141	3141	3141	3141	3141	3141	3141	3141	3141
Persons 25 Years and Over, Percent with Bachelor's Degree or Better	Pearson Correlation	.356**	.311**	.691**	1.000	.220**	-.433**	.245**	.296**	.397**	-.173**	.387**
	Sig. (2-tailed)	.000	.000	.000	.	.000	.000	.000	.000	.000	.000	.000
	N	3141	3141	3141	3141	3141	3141	3141	3141	3141	3141	3141
Population Density	Pearson Correlation	.385**	.369**	.171**	.220**	1.000	-.036**	.372**	.509**	.425**	-.033**	.315**
	Sig. (2-tailed)	.000	.000	.000	.000	.	.043	.000	.000	.000	.067	.000
	N	3141	3141	3141	3141	3141	3141	3141	3141	3141	3141	3141
Percent of Families with Income Below Poverty Level 1989 PCT	Pearson Correlation	-.143**	-.130**	.762**	-.433**	-.036**	1.000	-.096**	-.088**	-.191**	-.114**	-.171**
	Sig. (2-tailed)	.000	.000	.000	.000	.043	.	.000	.000	.000	.000	.000
	N	3141	3141	3141	3141	3141	3141	3141	3141	3141	3141	3141
Civilian Labor Force, Unemployed 1991 ABS	Pearson Correlation	.836**	.980**	.270**	.245**	.372**	-.096**	1.000	.914**	.889**	.029	.324**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.	.000	.000	.103	.000
	N	3141	3141	3141	3141	3141	3141	3141	3141	3141	3141	3141
Community Hospital Beds 1991 (Copyright) ABS	Pearson Correlation	.849**	.927**	.260**	.296**	.509**	-.088**	.914**	1.000	.895**	.010	.429**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.	.000	.577	.000
	N	3141	3141	3141	3141	3141	3141	3141	3141	3141	3141	3141
Commercial and Savings Banks, Offices June 1992 ABS	Pearson Correlation	.874**	.929**	.419**	.397**	.425**	-.191**	.889**	.895**	1.000	.040*	.467**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.	.026	.000
	N	3141	3141	3141	3141	3141	3141	3141	3141	3141	3141	3141
Earnings, Percent Goods-Related, Manufacturing 1990 PCT	Pearson Correlation	.004	.023	.103**	-.173**	-.033**	-.114**	.029	.010	.040*	1.000	-.112**
	Sig. (2-tailed)	.823	.203	.000	.000	.067	.000	.103	.577	.026	.	.000
	N	3141	3141	3141	3141	3141	3141	3141	3141	3141	3141	3141
Earnings, Percent Service-Related, Finance, Insurance, and Real Estate	Pearson Correlation	.442**	.366**	.295**	.387**	.315**	-.171**	.324**	.429**	.467**	-.112**	1.000
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.
	N	3141	3141	3141	3141	3141	3141	3141	3141	3141	3141	3141

**Correlation is significant at the 0.05 level (2-tailed); *Correlation is significant at the 0.01 level (2-tailed)

fact, reflecting omitted variable, or even more likely, simultaneity bias. The sign on the unemployment variable is negative, as expected, but not significant at conventional threshold levels. The signs on the control variables conform with our priors.

We also regressed measures of economic development on a set of explanatory variables, including the telecommunications measure. The results, reported in Table 5.15, are very similar to the previous regression model: the connectedness measure is significant with a negative sign, but all other variables that are significant have the sign we expected.

To establish whether these outcomes are the consequence of simultaneity bias, or whether there actually is a contrary relationship between economic development and connectedness, we reran the models using instrumental variables in two-stage least squares (2SLS) regressions. Essentially, this procedure substitutes a constructed exogenous variables for the endogenous one. The procedure ensures that the instrument is well-enough correlated with the variable it replaces, to serve as a good, and unbiased proxy.

In the first model (Table 5.16), we constructed a new exogenous variable for the median income, using a number of other measures of economic development. However, the new (exogenous) income variable still has a negative sign and is not significant. In addition, the sign for one of the control variables (percent earnings from finance, insurance, and real estate) becomes negative, but remains highly significant. All other variables maintain the correct signs.

The results for the second model (Table 5.17) are equally disappointing. Replacing the number of telecommunications establishments with a constructed exogenous variable does not yield any improvements. Again, the new variable still has a negative sign and is not significant. The other variables have the correct signs, but unemployment and the number of banks are not significant.

These results indicate that simultaneity bias is not a problem in our models. More likely, the combination of different data sources contributed to the unexpected outcomes. While the demographic information dates back to the 1990 census, the data on telecommunications providers come from a 1997 source. That means our data set does not reflect changes — and potential improvements — that took place as the result of economic development strategies and investments in the 1990s. We are confident that the results of the model could be improved considerably by adding additional (and more sensitive) measures of economic development and ICT infrastructure (as discussed earlier in this paper).

Implications of quantitative analysis

We have used county-level data on distress and connectedness to support our claim that the digital divide continues to exist, and in fact, is likely to widen as wealthier, more urban places are able to devote more resources to their ICT technology than their rural and poorer counterparts. The existing economic structure and the size of a region are the key factors that determine investments in telecommunications infrastructure. That alone puts rural, remote areas in a disadvantage. While the number of providers alone does not say anything about the quality of service that is available in

Table 5.14
Regression with connectedness (number of telecommunications establishments in 1999) as dependent variable

Independent variables	Coefficients	Standard Error	t-values
Constant	5.428	1.984	2.736 *
Median family money income 1989 DOL	0.000	0.000	-6.088 *
Persons 25 years and over, percent with bachelor's degree or better	0.262	0.077	3.385 *
Population density	0.000	0.000	0.752
Civilian labor force, unemployment rate 1991 in percent	-0.140	0.111	-1.256
Commercial and savings banks, number of offices, June 1992	0.660	0.008	78.930 *
Percent earnings from manufacturing in 1990	-0.022	0.025	-0.885
Percent earnings from finance, insurance, and real estate in 1990	0.722	0.199	3.630 *

R^2 = .77; N=3,141; * = significant at 0.01 level

Table 5.15
Regression with economic development outcome (median family money income 1989 DOL) as dependent variable

Independent variables	Coefficients	Standard Error	t-values
Constant	18,931.536	370.930	51.038 **
Number of telecommunications establishments in 1999	-27.323	4.488	-6.088 **
Persons 25 years and over, percent with bachelor's degree or better	683.774	15.307	44.672 **
Population density	-0.141	0.066	-2.151 *
Civilian labor force, unemployment rate 1991 in percent	-299.740	27.664	-10.835 **
Commercial and savings banks, number of offices, June 1992	42.245	3.573	11.824 **
Percent earnings from manufacturing in 1990	110.526	6.082	18.174 **
Percent earnings from finance, insurance, and real estate in 1990	-37.790	50.336	-0.751

R^2 = .57; N=3,141; * = significant at 0.05 level; ** = significant at 0.01 level

Table 5.16
Two-stage least squares regression with connectedness (number of telecommunications establishments in 1999) as dependent variable

Independent variables	Coefficients	Standard Error	t-values
Family income (exogenous)	0.000	0.000	-0.819
Percent earnings from finance, insurance, and real estate in 1990	-33.734	7.157	-4.713 *
Persons 25 years and over, percent with bachelor's degree or better	2.148	0.477	4.503 *
Civilian labor force, unemployment rate 1991 in percent	-1.382	0.446	-3.098 *
Percent earnings from manufacturing in 1990	-0.410	0.119	-3.437 *
Population density	0.006	0.002	4.124 *
Commercial and savings banks, number of offices, June 1992	1.108	0.096	11.503 *
Constant	93.118	19.338	0.000

R^2 = .24; N=3,141; * = significant at 0.01 level

Table 5.17
Two-stage least squares regression with economic development outcome (median family money income 1989 DOL) as dependent variable

Independent variables	Coefficients	Standard Error	t-values
Telecommunications (exogenous)	-185.819	151.218	-1.229
Percent earnings from finance, insurance, and real estate in 1990	4,806.481	1,461.414	3.289 **
Persons 25 years and over, percent with bachelor's degree or better	404.933	91.513	4.425 **
Civilian labor force, unemployment rate 1991 in percent	-124.711	82.232	-1.517
Percent earnings from manufacturing in 1990	150.057	28.846	5.202 **
Commercial and savings banks, number of offices, June 1992	83.112	115.350	0.721
Population density	-0.926	0.332	-2.792 *
Constant	6,055.747	3,829.285	0.114

R^2 = .24; N=3,141; * = significant at 0.1 level; ** = significant at 0.01 level

a specific area, it is clear that the availability of competing technologies increases competition, which should have a positive impact on quality and price. The digital divide is easy to cross for places that have sufficient critical mass to attract private providers, and when economies of scale and networking exist. The availability of high quality ICT infrastructure attracts more high-tech businesses that pay higher wages and taxes, and thereby, help further enrich the better-off places.

This is a story of frustration for the less well-connected, rural places. Some have figured out how to bring connectivity to their businesses and households, in many cases, utilizing special funds provided by their state to enhance rural infrastructure. But at least as long as fiber optic and microwave are the technologies of choice in the United States, there are inherent cost disadvantages to rural location. Besides, the rural places we have studied seem to have been chasing a moving target: their investments have been more than matched by the more advanced, more urban places, so the gap is maintained or widened.

We see no good alternative to the current situation, where public subsidies help the places left behind to at least maintain their relative position. New and cheaper technologies are on the horizon that can help restore the balance, and policy could be used to accelerate their development. They include longer-distance wireless and cheaper, higher quality video capture and streaming for real time conferencing.

Critical Success Factors and Implications for Policy

Here, we draw some general lessons from qualitative and quantitative analyses presented in this chapter. First, from the case studies:

- Success of ICT initiatives is most likely when the condition and availability of both traditional and ICT infrastructure are good. The absence of traditional infrastructure makes success more difficult to achieve, but not impossible, since ICT infrastructure can sometimes be used as a substitute, at least in the short run.
- A larger planning process in which ICT is embedded is a critical success factor. In exceptional cases, the lack of planning can be overcome by strong individual/institutional leadership, but that is hard to sustain and not likely to work in larger communities. Having a planning process in place, however, will not guarantee success; other conditions must also be present.
- A critical mass of demand is crucial to induce the private sector to make ICT investments. That defines some important roles for the public sector: to provide subsidies in rural places, through grants, concessionary loans, and tax incentives, at least at an early stage, and to help aggregate demand, in part, by coordinating related ICT programs, by providing information about users to the providers, and by acting itself as a consumer of ICT services in the rural regions.
- Another way to offset the disadvantages of scale in rural places is to employ innovative technologies. The evidence suggests that innovation is a necessary, but not necessarily sufficient condition of success.

- Appropriate institutional mechanisms to help users deploy the technology infrastructure are a necessary but not sufficient factor for the success of ICT initiatives.
- Governmental linkage is neither necessary nor sufficient for success. It appears that good intergovernmental cooperation and funding contribute to success, but communities seem to have found ways to succeed without it.
- Flexibility/adaptability is a critical success factor: if public-sector partners are not able or willing to help a local community, it can still succeed by mustering its own resources. That, however, is much harder to do and sustain.
- The "innovation triangle" (cooperation among business-government-education leaders) is a necessary, if not sufficient factor for success.
- It is critical to involve the infrastructure providers in the planning, financing, and implementation of the initiative.
- Twenty-first century infrastructure is more sophisticated than it was previously, and requires specialized and constantly upgraded skills in the work force to be productive. It is not enough to put ICT hardware in the ground (or in the skies); a place must have an appropriately trained work force to use it.
- Vision and leadership are hard to measure, but critical for the success of initiatives, especially those requiring considerable resources and time.

From the quantitative analysis:

- History shows that isolated investments in traditional infrastructure have never been sufficient to turn regions left behind around and help them to catch up. This is even more the case when we look at the characteristics of telecommunications infrastructure and information technologies. State-of-the-art technologies and unlimited capacity alone are not enough to attract new businesses, if work force development and other important factors are neglected. Any public investment in information technology has to be part of a broader planning concept in order to be successful.

None of this constitutes a recipe for success: follow these twelve principles and your initiative will succeed. The cases we have described support these as general propositions, and a community intent on using ICT as a basis for economic development should take them to heart. In some instances these are not even "necessary" conditions; we have illustrated where communities have overcome a deficit in one or more factors by being flexible and adaptive. Moreover, having most or all of them does not ensure success (the "sufficient" criterion). Good luck, good timing, and other intangibles play a role.

Just as there are kernels of wisdom in these observations for communities, there are implications for states and the federal government (EDA) who want to see ICT succeed as a means for reducing economic development disparities.

States and local governments

The cases are filled with evidence of how state interventions made a difference in enhancing or thwarting success. In general, both subsidies and policies to allow competition have been key background policies. In addition, states provided funds at strategic times — the Ben Franklin program in Pennsylvania, for example, provided capital funds in Bloomsburg and Northeast Pennsylvania, and North Carolina provided funds to construct a training facility in the Global TransPark. States also have helped aggregate demand to achieve a critical mass to make ICT provision economically viable. Local governments also have acted strategically; for example, Kings County (Washington) provided funds to the community college to upgrade training programs, and the city of Seattle created and funded an IT administrative position to provide coordination and leadership. These are a few of the many examples provided by the case studies. The findings above underscore the importance of hierarchical coordination between state and local governments to ensure that state resources are spent in a manner consistent with local plans, and leverage local effort. The same is true for local-federal relations.

Federal government/EDA

Telecommunications policy is clearly an important background condition. We saw in several cases (Willacy County, Hays, and Billings) the role universal service subsidies played in allowing private providers to operate in the face of thin demand.

But most relevant to this report is the role the Economic Development Administration has played in helping places left behind. In many of our cases, EDA made investments at critical times. These investments seemed instrumental in many instances, in leveraging local effort. Examples include:

- Monticello used EDA funding for infrastructure for its industrial park.
- Springfield received $1 million grant from EDA's 302 program to help in incubator development.
- Kinston used EDA funds to develop the Global TransPark training facility.
- Northeast Pennsylvania has received funds for the Great Valley Technology Alliance.
- Meadville used almost $4 million in EDA funds for its link-to-learn initiative, for the facility and the industrial park infrastructure.
- A $1 million EDA grant is being used to start a Center for Border Studies at the University of Texas-Pan American.
- Seattle's success was due, in large part, to the efforts of a grassroots activist (Luversa Sullivan) who received a $135,000 EDA grant that allowed her to quit her day job and focus on her innovative training and institution building activities.

All of these except Kinston were judged to be successes (and Northeast Pennsylvania is too early to tell). It is tempting to add strategic financial intervention by EDA as a critical factor in these successes since most of the communities we studied had few alternatives for infrastructure funding.

CHAPTER 6

Conclusion

In this concluding chapter we return to the research questions posed in chapter 1, and propose answers as a way to summarize the salient points in the report. Our summary includes some action items for EDA in terms of policy and further work to commission.

Summary of Findings by Research Question

1. What is technology infrastructure?

Based on early input from our expert panel, in order to bring more focus to the research, we operationalized technology infrastructure as information technology and telecommunications. It can include — and in "connected" communities does — all of the following basic elements:

Hardware:

- Computers in every K–12 public school classroom and public library.
- Cost-competitive access for businesses to the Internet at high speed (256k and up) through broadband networks of fiber optics, wireless and/or cable.
- Local Internet access for all households who want it.

Knowledge institutions:

- Institutions (colleges, high schools, local governments, community development agencies) that provide training in the use of IT.
- Institutions (colleges, hospitals, companies) that offer professional and skills training that uses IT (e.g., distance learning, telemedicine).
- Companies that use IT for e-commerce with customers and suppliers.

Knowledge workers:

- Graduates from high school and/or college with basic IT, math and reading skills for entry-level jobs in high or mid-tech companies.
- Access to programs to train displaced workers, locally or remotely.
- Entrepreneurs who can access business startup training and venture capital.

Our original typology (see Appendix B), as well as much of the literature on how technology investment can spur economic growth, includes R&D-intensive activity and institutions. Although these can be important for innovation and the highest-tech growth that gets most of the media attention, many of the distressed communities in our study and elsewhere do not have and will never have research universities or institutes. With appropriate basic technology infrastructure, they can certainly better connect to these resources through IT.

One of the lessons from this research is that distressed communities can create better paying jobs, stem out-migration, enhance community image, foster entrepreneurship, and create more stable, if not growing, economies through the application of ICT. They do not need to become high-tech meccas like Silicon Valley or North Carolina's Research Triangle to be considered successful in using technology infrastructure to spur economic development. They have to start from where they are (or were).

2. What do we mean by "distress" and "distressed communities"?

Although some of the attributes of the places vary in their proximity to urban areas, density, and terrain, our case-study communities have in common a baseline condition of distress that has some familiar dimensions. All of the included communities, and likely all those nationwide who are eligible for EDA funding, exhibit some of the following signs of distress:

- Low income and/or wages;
- High unemployment or underemployment;
- Population loss and/or outmigration of working age population;
- Absence of an entrepreneurial culture and low levels of new business formation;
- Increase in elderly population;
- High and/or persistent poverty;
- High welfare caseload;
- Other social and health problems; e.g., crime, teen pregnancy, infant mortality;
- Marked income inequity/lack of middle class;
- Dependency of economy on a single sector, especially a declining one like agriculture, mining, textiles or apparel;
- Dislocation of laid-off workers who lack skills needed for technology jobs;
- Poor quality public schools for turning out young adults with appropriate (including math and science) skills to compete for tech jobs;
- Inadequacy of basic infrastructure (roads, water, sewer);
- Insufficient local fiscal capacity to address infrastructure needs;
- Weak institutions in terms of leadership and/or grantsmanship;
- Culture of poverty and/or negative self-image; or
- Isolation from realities and opportunities in their state, nation, world.

Much of the current discussion about the digital divide emphasizes that rural, inner-city and other low-wealth communities must not be left behind in the knowledge economy. It is as though some of these other types of distress have been tolerated, but lack of connectivity to the Internet and the global economy will not be, as this would be the final blow to some of these places.

When we get more deeply into issues of ICT, another perspective about distress emerges that is important to understand, namely the capacity for knowledge-led growth in the new economy. Our research indicates that communities characterized by distress in the ways itemized above also are deficient in physical, human, and social ICT infrastructure. But it is interesting to note that during the national economic expansion of the 1990s, some older regions did not appear in crisis by many of the traditional indicators, yet fell further behind in terms of connectivity and the skills of their work force. As we entered the recession of the new millennium, these areas are suffering badly.

3. ***What types of infrastructure are most needed and appropriate in distressed communities?***

Based on the case-study research, as well as the essence of recent publications and conferences on the digital divide, there are a few types of infrastructure that are needed to help distressed communities. These include:

- Affordable high-speed broadband networks;
- Knowledge institutions (including community colleges, universities, hospitals, and businesses) to help people understand how hard infrastructure can be used to solve problems; and
- People networks of leaders of all stripes.

4. ***What are the major constraints to improving the state of technology infrastructure in America's distressed communities?***

The case-study sites, not all of which we characterized as successful (to date) in their investments in ICT, are rich with evidence of what is missing to make an intervention work to improve the overall economic standing of communities. The places that are successful have managed to address or overcome these barriers, which include:

- Lack of knowledge of what technology infrastructure exists currently — in part due to providers' reluctance to reveal competitive information;
- Technology plans (if any) that are not integrally connected to an overall strategy for economic and community development;
- Leadership vacuums and community self-image problems;
- Lack of critical mass of population and/or business;
- Social barriers to launching an inclusive community effort to bring about connectivity; and
- Insufficient local tax base for investment in necessary infrastructure and work force training.

5. ***What types of economic development do different technology infrastructure investments support?***

The case-study sites each tried a somewhat different infrastructure investment that in most cases was a composite of several different interventions on the part of various actors. Nonetheless, in an attempt to characterize the expected economic development outcomes for different types of efforts (if successful), we can observe the following:

- Community networks help forge the necessary people connections among government, business, education and nonprofits to map out and make effective use of the physical technology for improving business competitiveness and the work force's preparedness for new economy jobs.
- Telemedicine networks help keep key institutions (clinics and schools) in small rural communities intact, and stem out-migration of both the general population and health care professionals.
- Technology parks support the development of companies that need the high-speed fiber networks, the supportive services of technical training institutions, and/or the research spinoff opportunities of a federal lab or research university.
- Work force training and distance learning programs can help existing businesses be more competitive, allow the work force to stay local, and elevate the attractiveness of the area to other firms.
- Creation of community portals and specialized marketing portals can help create awareness of the community and open new markets for its economic products.

6. ***How can EDA most effectively use its limited resources to help distressed communities upgrade their technology infrastructure?***

A fuller comment about EDA's investments was provided in chapter 5. The implications of those comments were for EDA to:

- Coordinate its investments with local and state planning efforts to avoid duplication and leverage local effort and resources.
- Emphasize the importance of cross-sectoral consortia and partnerships among local government, business, education (K–12 and higher) and nonprofits to the success of any ICT strategy. This cannot just be occasional interaction, but routine and regular joint information sharing and problem-solving. Among other benefits, this type of approach helps workers, businesses and economic developers stay current about what technology exists now.
- Require applicants to demonstrate that their investments in physical ICT infrastructure are connected to a long-term economic development strategy that builds upon the existing assets and addresses the nature of the distress of the community, region, and state. "We are targeting high-tech jobs" is too generic to be useful. There are many different ways to transition a distressed community to the new economy, not one-size-fits-all. The technology is a tool for connecting people, knowledge, and markets, not an end in itself.

- Build upon (without undermining) the networks and universal service philosophies of rural telephone cooperatives, which are bringing ICT to areas previously underserved.

Some Directions for Further Work

The most immediate task to follow-up this report is for better quantitative analysis. During the past several years, more of the data needed to conduct the originally proposed modeling has become available. For example, in 2000, North Carolina created a Rural Internet Access Authority that has been working with private providers to develop the kind of database needed for quantitative analysis. Some other states are following suit. Researchers can assemble these data to develop better measures of county-specific connectedness. In addition, the detailed 2000 census data will have been released by the end of the summer 2002, providing more recent measures for economic development and control variables.

The case studies provided good stories from which to draw inferences. However, we admit that these stories are not yet complete, and to be able to speak with even greater confidence, we would follow-up this work by tracking the thirteen cases over a longer period of time.

Related to that, we would suggest that these cases and results be connected to a growing body of work on the topic by others, including researchers in Europe (see, for example, Wade (2002).

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APPENDIX A

Case Studies

ARKANSAS

Three Delta Communities in Search of Growth

1. Context of the Arkansas Case Studies

The focus of the three case studies in Arkansas is on communities in the southeastern region of the state that is part of a larger geographic area referred to as "The Delta." This larger area includes portions of Louisiana, Mississippi, Arkansas, Tennessee, and Missouri that are adjacent to the Mississippi River. The area shares a common economic heritage of labor-intensive agriculture characterized as a Plantation Economy. Significant artifacts of this shared history include the continued importance of agriculture to the local economies, a relatively high percentage of the population that is African-American (Table A.1) and the recognition that their region is perceived as underachieving and troubled, whether this is in fact true or not.

By any measure, economic or psychological, the Delta region of the United States qualifies as distressed. Characterized by chronically high unemployment, persistent poverty, under-funding of educational institutions at all levels, years of net out-migration, high concentrations of rural and minority populations, limited industrial diversity, a lack of infrastructure and institutional capacity supportive of economic development, and a general psychological malaise, the region has not responded to targeted economic and community development efforts.

Table A.1
Selected Arkansas Delta Community Demographics

City-County	1998 Population*	% Change 1990–98	White	African-American	Hispanic
Pine Bluff-Jefferson	90,912	27%	53%	46%	1%
Helena-Phillips	26,741	42%	41%	57%	2%
Monticello-Drew	19,284	20%	69%	30%	1%

* These figures reflect net population growth in the surrounding counties; populations in these three cities experienced a real population loss over the period from 1990-1998. U.S. Census Bureau.

In the most recent years, public sector efforts to redress the compound disadvantages of this region have targeted the digital divide as yet the latest metric on which the region trails the national average. Various federal, state, and regional level economic development initiatives that are recently underway, or currently under development, are focused on connectivity as a means of improving the economic status of the Delta. Case studies spotlighting three Delta communities that are actively involved in these connectivity efforts afford a unique opportunity to examine community-specific factors that may affect the success of these initiatives. The participating Arkansas Delta communities were Helena, Monticello, and Pine Bluff.

Connectivity in the Arkansas Delta

Arkansas presents a promising opportunity to examine the role connectivity-based economic development efforts may play in enhancing the economic potential of disadvantaged communities. From the governor down to individual district legislators, government leaders in Arkansas have made connectivity a pivotal issue in their public platforms, backing their commitment with significant political and real capital. In the Delta region of Arkansas a promising opportunity exists to examine three distinct community-based connectivity efforts.

To comprehend the situation in these communities it is first important to understand the evolution and history of the various efforts undertaken in recent years to enhance telecommunications in Arkansas. An abbreviated description of these initiatives and a basic explanation of the manner in which these efforts co-evolved follows.

2. Nature of the Interventions — Connectivity Efforts in Arkansas

Southwest Bell's FiberPark Initiative

As part of a stipulated agreement with the Arkansas Public Services Commission to redress alleged unearned profits, Southwest Bell is investing $231 million over three years to upgrade the telecommunications infrastructure in Arkansas. Investments include elimination of party lines; placement of fiber optics between cities and conversion of all central office switches to digital technology; establishment of distance learning networks linking more than six hundred educational centers; establishment of a rural medical network to connect fifty-five regional and rural hospitals and health centers; and deployment of fiber optics to fifteen business parks throughout the state.

These "FiberParks" are basically business parks/facilities that have redundant advanced telecommunications routes of fiber optic cable that connect the parks with Southwestern Bell's digital central office. This ensures diversity in the networks, virtually uninterruptible telecommunications services and high-speed, top quality links with a global telecommunications network. The fiber parks initiative was envisioned as a partnership between Southwestern Bell, long distance carriers, local governments, local development organizations and private developers. These partnerships are expected to be a critical element in the ultimate success of the parks as economic development tools.

Site selection criteria for inclusion in the initiative required that communities have 1) community preparation of and commitment to a diverse business recruitment strategy; 2) an economic development organization with a paid executive; 3) committed financial resources to implement the required additional infrastructure development, marketing and promotion and ongoing management of the park; 4) developed a strategic plan that analyzes and confirms strengths and weaknesses that are compatible with businesses most likely to be attracted to a FiberPark; 5) legal control of at least seventy-five acres for FiberPark development; 6) demonstrated a plan to make the FiberPark a regional effort so that larger geographic areas can benefit from its presence, and 7) a formalized agreement with Southwestern Bell to assure utilization of the investment made. The Bioplex FiberPark in Pine Bluff met these criteria and became part of this statewide initiative.

Arkansas Community of Excellence Strategic Planning Process

The Arkansas Community of Excellence (ACE) process is the cornerstone of partnerships between the Arkansas Department of Economic Development and local communities throughout Arkansas. This is a competitive, partnership-building and directed process that helps communities focus on economic growth through structured self-analysis, organization, and goal setting exercises. The end product is a two-year strategic plan to expand the local economy and improve the quality of life for residents. Communities that successfully navigate this process to the certification end point are officially recognized as ACE Communities.

As originally envisioned, the ACE process helps communities to perform what amounts to an in-depth, cross-sector SWOT analysis that feeds directly into the formulation and implementation of an action plan for future growth. Growth is defined as a product of the status and inter-relationships that exist among eleven different economic and twelve community development components. The rigor of the process is designed to accommodate the disparate levels of resources and degrees of complexity that characterize communities of different sizes. The number of economic and/or community development components that must be analyzed varies in a prescribed manner according to the size of the community, reflecting both differences in volunteer resources that can be devoted to ACE planning and the complexity of interactions among components. For example, communities with less than 5,000 individuals have to use a minimum of five of these development components in their analysis, while certification for communities of more than 20,000 people requires analysis of at least fifteen of these growth components.

The strong level of interest in the ACE process and the perceived success of ACE planning efforts led the Department of Economic Development to modify the ACE process to accommodate the need for analysis and planning related to connectivity in communities of all sizes. A resulting partnership between the Arkansas Department of Economic Development and Arkansas Department of Information Systems supports community-based strategic planning efforts that include information technology components. The partnership is seen as combining the strengths of the ACE and Nortel Integrated Community Network (ICN) initiatives (see below) and will take the place of ICN efforts that were in process.

Nortel's Integrated Community Network Initiative

Nortel is a global leader in telecommunications and in the integration of large information and communications technology (ICT) networks. Nortel has developed a highly structured, sequenced and issues-driven process that helps communities develop a comprehensive telecommunications network for linking community institutions into one powerful network. This Integrated Communities Network (ICN) process strategically connects multiple institutions that are typically isolated from one another, enabling a sharing of community ICT resources and bringing greater capabilities and performance to every network participant.

The basic approach requires that a cross section of community leaders undertakes a series of exercises to identify issues facing the community (for example: jobs creation, affordable healthcare, quality education, and reduction of crime). The leaders then consider what telecommunication application might help address each of the issues (for example: electronic town meetings, remote diagnosis, business videoconferencing, or Internet access). Considerations of the types of technology required to implement the application follows, along with an inventory of what ICT is currently available in the community. Examples of technology might include interactive video, Local Area Network, Wide-Area Network, and ISDN. ICT products are developed as the final stage in this process. The competitive advantage of this approach is that it does not take specific technology solutions as given. Rather it customizes the solution to real, specific community needs and opportunities, leverages existing ICT investments and specifies additional investments that most exactly meet the requirements of the community. This

approach can be characterized as one of market pull, not technology push.

In Arkansas, the state contracted with Nortel to provide consulting services in support of initiating the ICN process in three pilot communities — Fort Smith, Helena and Searcy. Monticello was to be one of three additional communities that were to be part of an expanded pilot program. A consultant from Maryland came into the communities to facilitate their progress in the ICN exercises. The pilot communities' level of satisfaction with the ICN process itself and with the consultant varied in the extreme from enthusiastic acceptance to vociferous rejection. The latter reaction undoubtedly contributed to the state's decision to rescind the agreement with Nortel and enfold the community technology planning efforts into the ACE program and the Governor's Technology Initiative. Differences between the perceptions and approaches to ICN efforts found in Helena and Monticello are instructive and will be discussed in detail in later sections of this report.

Governor's Initiative for Statewide Technology Advancement

Recognizing that Arkansas state government seriously lagged the business community in its use of electronic services, Governor Huckabee launched the Governor's Initiative for Statewide Technology Advancement (GISTA). GISTA represents a new vision allowing government to provide better quality of service to all, including government-to-government, government-to-citizen and government-to-business. Four elements are recognized as essential to this goal: information infrastructure, communications network, connectivity availability, and a new management paradigm. The Departments of Economic Development (AED) and Information Systems (DIS) share responsibility for GISTA.

DIS is taking the lead in a key element of GISTA, the use of Geographic Information Systems (GIS) to locate all state agencies and public buildings that are connected to the Internet. This effort to map Arkansas's information needs from the air (MAIN) is an attempt to rationalize the state's investment in ICT and to extend connectivity through public buildings to developing community information networks. The analogy used to explain the strategy was that the state and its local institutions and affiliates would become the anchor tenant in the information mall comprised of Arkansas communities. By December 1999, DIS had compiled location data of their existing and potential network consumers and designed an online interactive mapping Web site. The MAIN effort will 1) provide the first complete inventory of publicly-funded ICT resources in place throughout Arkansas, 2) identify opportunities for public-private partnerships to use existing links to optimize connectivity to communities throughout the state, and 3) give the state leverage through consolidated service agreements to encourage ICT providers to extend services to less profitable areas of the state.

Determining that the state could more effectively and broadly catalyze the self-analysis and communications planning goals that were part of the aborted Nortel Integrated Communications Network effort, GISTA enveloped technology planning as one component in the Arkansas Communities of Excellence (ACE) program. Steps involved in the GISTA information technology process include the following: process introduction; community commitment decision; information technology assessment (with assistance from AED and DIS); community visioning exercises; findings and prioritization; information technology planning; development of information technology strategic plan/business case; and GISTA feedback and development. The position of local/community planner was created in the DIS specifically to help Arkansas communities plan for their future in the Knowledge Economy.

To accomplish these tasks GISTA communities are encouraged to establish a number of task-focused committees comprised of appropriate community leaders from government, industry and education sectors. Committees include the following: 1) a steering committee that provides guidance and leadership for the overall initiative; 2) an applications committee to develop appropriate IT solutions; 3) a communications committee to provide on-going dialogue with all participating communities and counties;

4) a finance committee to research resources for ICT infrastructure development in communities; and 5) a technology committee to inventory existing capabilities. In some instances, the EAST (see below) lab students are assisting in the technology audits.

EAST Lab

The Environmental and Spatial Technology (EAST) model is an innovative education program targeting K–12 students in Arkansas to use advance technology to solve real-world problems. This collaborative effort between business and educational institutions has grown to include at least 90 EAST labs since its founding in 1994. One EAST lab project used GIS technology to audit ICT resources in a community as part of an effort to plot optimal locations of future fire departments. This project was widely cited as catalyzing community-based ICT audits that have evolved into the more sophisticated MAIN program. The EAST lab ICT project is an interesting example of a low-cost locally-driven ICT initiative that is springboarding a critical statewide initiative.

TEAM DelTA Project

The United States Department of Commerce's Experimental Program to Stimulate Competitive Technology (EPSCOT) funded a multi-state initiative targeting disadvantaged communities in the Mississippi-Arkansas-Louisiana Delta regions in an effort to increase the capacity of the region of use technology to build a new economy. The Technology-based Economic Development Alliance in the Mississippi River Delta (TEAM DelTA) effort involves a series of one-day workshops and hands-on efforts to raise community awareness regarding the role of technology in economic development. Tools, including Web-based learning modules to train community stakeholders in the use of technology assessments and the development of technology-based economic development strategies, will be developed and shared.

The TEAM DelTA project is envisioned as a pilot effort involving three communities in each of the three partner states. Participating Arkansas communities include Dumas and two of the communities spotlighted in this EDA project — Helena and Monticello. (Monroe, Tallulah, and Delhi in Louisiana, and Cleveland, Clarksdale and Greenwood in Mississippi are the other pilot communities). Coordinating the effort in Arkansas is the Arkansas Science and Technology Authority.

3. *Some Insights from the Arkansas Case Studies*

- **Timeframe paradox.** Economic development as a concept and practice is undergoing nothing less than a paradigm shift. Cultural changes that take a while to absorb are being pushed by technologies with ever-shortening generation times. We are not just adopting new technologies, but are being forced to adapt to revolutionary changes that strain our personal and cultural absorption capacity.

- **Ground-up effort, with emphasis on local/regional control and input.** This is a fundamental ingredient for success. Connectivity technology inevitably results in significant changes at different levels of the individual organizations and the broader linked community of which they are part. This points to the importance of insiders serving as primary change agents, increasing the comfort levels of those being asked to adopt new approaches and relationships. The evidence taken from all three Delta communities is that leadership and vision cannot be exogenous in origin, but must be embedded in the fabric of the community.

- **Engage decision makers.** Similarly, individuals from various sectors of the community with the capacity to commit human, physical and financial resources to the connectivity efforts need to be both visible and active supporters of the ICT project.

- **External bridges.** Enhanced connectivity is both the desired outcome and the process by

which ICT factors into economic development. It was exposure to novel ideas and planning practices that sparked the interest of leaders in Monticello and Pine Bluff to undertake their respective ICT efforts, which in turn fueled their commitment to become the bridge for their region to the new economy. In contrast, the relative isolation of Helena limited the resources that could be applied to connectivity efforts and dampened the sense of possibility that could have energized efforts there.

- **Clear goals.** Projects can get lost in technical jargon, targeted outputs and measurable outcomes**.** Technology should be seen as a means to an end, not the end itself. Both Monticello and Pine Bluff have clear vision of where they want to be down the road. They see technology as a vehicle with which they can achieve these goals. It is also important to consider that technology, and both communications and institutional infrastructure, are as important to these communities' economic and social definitions as are traditional hard infrastructure items, such as sewers and bridges.

- **Dedicated human resources.** The need to coordinate, balance and sustain the interests of diverse stakeholders coupled with the technical nature of decisions related to connectivity combine to create an almost intractable requirement for human resources to be dedicated to managing the community ICT planning and implementation efforts. Helena demonstrated the plight of disadvantaged communities where leadership and human resources are stretched too thin to support a successful ICT effort.

- **Partnerships or leveraged relationships.** If a single organization tries to change everything by itself, little if anything will happen. By combining forces of networking opportunities, both personal and technical, can be created. By the same token, such partnerships are less effective if those involved do not have decision-making power. For example, those involved in the technology committee in Monticello may not have the direct authority, but they have the support of those who do. The committee obtained the leaders' buy-in first. This allows those with the more technical knowledge to act with authority.

- **Coordination models needed.** Recognition of the growing role ICT plays in the economy is causing multiple agencies to attempt some aspect of technology training and transfer, but the overall effect is fragmented and confusing. There is a need for models of how to best rationalize these various efforts into a coordinated approach to bring disadvantaged communities up to speed in this arena. For example, state and community leaders in Arkansas are aware of the TEAM DelTA project and are cautiously optimistic that it will provide useful insights to participating communities about how to undertake connectivity planning efforts. However, there is no evidence that this project is being directly linked to any of the multiple ICT planning/ assessment efforts underway in the Delta region of Arkansas. In the case of Helena and Monticello it would have made sense to sequence the projects, not run them concurrently.

- **Leveraging existing resources**. Project leaders should determine how existing institutions could help communities achieve project goals, not just confirm they need help. For example, Pine Bluff properly identified its federal facilities as a major asset on which to build, and is engaging the leaders of these facilities in all aspects of ICT planning efforts.

- **The need for objective data.** Communities need a source of objective data from which to make informed decision about the connectivity technologies and providers that best suit their needs and budgets. As a case in point, a networking consultant shared the facts that various providers routinely practice price discrimination to segment the market to their advantage. The result is that different customers pay different prices for connectivity established over the same lines at the same base costs to providers. Different providers frequently utilize the same high-speed lines to deliver services to their respective customers, adding further complexity to cost/benefit considerations.

- **Next-step resources.** It is important to address the issue of where the implementation resources will come from early on in the planning process. On-going commitment to the process dissipates if it becomes clear that the planning process may be an end point rather than a beginning.

- **Image management.** Many connections are phased, long-term developments that do not progress in smooth increments. These periods of quiet incubation may be punctuated by important, but not highly visible accomplishments that can make the project appear stalled to those less intimate with the project's development milestones. Communities need to have a proactive deliberate strategy for managing the public relations aspect so that local stakeholders do not become discouraged and state and federal resources do not discount the project's potential for success.

- **Unfinished business.** Unresolved hurdles to communication interfere with results, impact and values. It is difficult not to look to the composition of the planning groups in Helena and Monticello as partial explanation for the stark differences in attitude that characterize these two communities' expectations for the success of their ICT planning initiatives. Monticello's can-do spirit appears based, in part, on the sense of shared destiny and the deliberately inclusive strategy that has guided leaders in their efforts to connect their community. In contrast, the only advice from the ICN consultant that resonated with Helena leaders was that connectivity efforts would fail as long as a network of relationships linking Helena with minority-dominated West Helena is underdeveloped. How can a region or a person communicate with the world when they will not talk to their neighbors?

Persons Interviewed

John Ahlen, President
Arkansas Science and Technology Corporation

Chris Allen, Customer Service Manager
Entergy

George Corley, Business/Industry Training Specialist
Southeast Arkansas College
Work Force Development Center

Martin Chaffin, Executive Director
Helena-West Helena Phillips County Port Authority

Sanford Cothren, Technical Planning Specialist
State of Arkansas
Department of Information Systems

Larry Crumby, Executive Director
Phillips County Chamber of Commerce

Libby Doss, Community/Business Development Team
Arkansas Department of Economic Development

Ron Garsh, Director
Information Technology
National Center for Toxicological Research

Becky Hall, Director
Delta Health Education Center (DHEC)
Helena Regional Medical Center

Regina Hall, Executive Director
Monticello Economic Development Commission

Gary Johnson
Local Community Technology Planning Specialist
Arkansas Department of Information Services

Terre McLendon, Research Specialist
University of Arkansas at Little Rock
Institute for Economic Advancement

Suzann McCommon, Executive Director
Great Rivers Educational Cooperative

Jack McNulty, Director
National Center for Toxicological Research

Ernesto Muniz, Manager
Information Systems
Timberland

Barbara Pardue, Director
Arkansas Department of Economic Development

J.T. (Cody) Partridge, Director
Environmental Health and Program Assistance Staff
U.S. Food and Drug Administration
National Center for Toxicological Research

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Helena/Phillips County

1. Context

Helena, Arkansas is located on the Mississippi River, 65 miles southwest of Memphis. Throughout Helena's history the river has shaped its destiny, and even today, the town is relying on the Mississippi to help revitalize its stagnating economy. The recently completed Helena Harbor is a case in point. Helena Harbor is one of the largest slack-water harbors ever constructed on an inland waterway. Already more than 2.5 miles long and 300 feet wide, a planned expansion will extend the harbor by an additional 1.6 miles. The Helena/West Helena/Phillips Port Authority owns an adjacent industrial park of 1,220 acres. While all standard utilities are in place, Southwestern Bell has so far declined to extend high-speed transmission lines to the park or harbor. Both facilities are largely unoccupied and underutilized, although a Saudi rice company has expressed interest in becoming the anchor tenant the park has been seeking.

Helena is handicapped by a relatively undiversified local economy, a limited ability to attract either growth companies or a highly skilled work force, and the failure to retain the most promising of its young people. Executives of local firms tend to commute in from other towns and multiple private schools support a pattern of de facto racial segregation in the public schools. The image of Helena is one of isolation. Years of out-migration have created a situation of ane-

Table A.2
Demographics for Phillips County, Arkansas

Population, 2000	26,445
Median household income, 1997 estimate	$18,898
Educational Attainment, High School or higher, 1990	51.5%
Educational attainment, Bachelor of Science or higher, 1990	9.2%
Poverty rate, 1997 estimate	37.5%
Unemployment rate, 2000 annual	8.3%
Per capita personal income, 1999 estimate	$15,766
Homeownership rate, 2000	56.2%
Percent Ethnicity, 2000	
White	39.2%
African-American	59.0%
Hispanic	1.4%

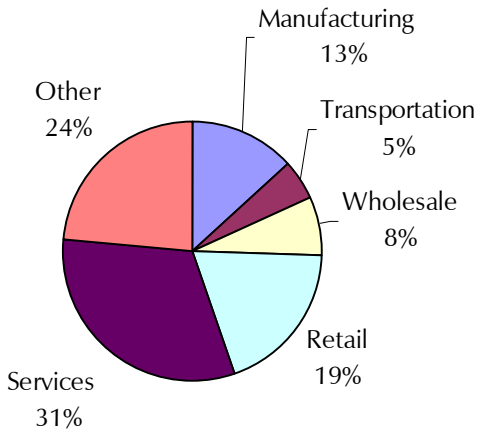
Sources: U.S. Census Bureau, U.S. Department of Labor.

mic human resources, leading the town's tired leaders to acknowledge the need for an infusion of innovation, ingenuity and initiative. Limited external networks further reduce sources of energizing ideas.

The most promising economic development in the region comes from a number of casinos built on the river in adjacent states that account for a large share of new jobs being created in the region. Some in the town still point to the closing of the area's largest industry, Mohawk Rubber, some 30 years ago as the beginning of the demise, but one suspects that it is not that simple. A dispirited sense of fatigue and pessimism characterized portions of nearly all interviews conducted in the town. While individuals were able to point with pride to initiatives that are underway in their specific institutions, all expressed concern that the community at large is being left further and further behind in the unfolding economy.

Therein lies one of the more interesting themes to emerge from this case study — that of fragmentation. While the individual elements of the community, the school systems, the hospital, and the economic development groups all recognize the need to make greater use of ICT, there is scant tangible evidence of collaborative undertakings involving telecommunications. Efforts are disconnected, groups do not appear well informed about what other groups are doing and there does not appear to be a mechanism to create the necessary bridges between the groups. This fragmentation may have deeper roots, in that while Helena exists as a discrete municipal entity, it is clearly only part of the broader community that must be involved in successful networking efforts. Connectivity will be hard to achieve in a town that is as disconnected from the total community as Helena appears to be.

Figure A.1
Phillips County Business Mix, 1999 estimate



Source: Bureau of Economic Analysis; total full-time and part-time employment by industry

In all discussions prior to visiting Arkansas the only reference given to the subject community was to "Helena." In fact, there are two parts of Helena that are physically contiguous, Helena (predominately white) and West Helena (predominately black). Although they share certain public, educational and healthcare resources, they remain politically distinct and largely disengaged from common development efforts. All ICT-related planning initiatives attempted in Philips County appear to have only involved leaders from the Helena side of the city-divide. Efforts to identify leaders in West Helena that the case-study team might interview regarding ICT interest and efforts were not successful.

Connectivity resources

There are isolated resources and islands of connectivity in Helena but even the most advanced of these might be described as still being under development. The University of Arkansas School of Medicine (UASM) operates the Arkansas Health Education Network (AHEC), a medical interactive compressed video network consisting of fifty sites located at hospitals throughout Arkansas. The Delta Health Education Center (DHEC), located on the grounds of the Helena Regional Medical Center, is part of this network. Ideally, the statewide network can serve as a format for administrative, business, and professional meetings, continuing education, degree programs, school health and science enrichment programs. Citizens may schedule the system for meetings, and can request a telemedicine consultation and/or a program on a specific healthcare topic. Physicians can use the system to instantly share audio and visual information with specialists at UASM.

In the Helena region, under-utilization of these services through DHEC is ascribed to a combination

of lack of technology, insufficient interest or knowledge about telemedicine's practice and benefits, and expensive line charges. DHEC's director cited the possible use of telemedicine and existing technology to provide on-site distance health and counseling services to nurses and students in public schools as one example of services that could be the success story needed to make connectivity relevant at a base level. This notion of linking connectivity islands is more of a gestational concept than a proactive strategy reflecting the basic level at which the potential of ICT is comprehended in Helena.

The Great Rivers Educational Cooperative (GREC) was established in1985 to provide a flexible mechanism to allow schools to respond to opportunities as they arise. Telecommunications-related services (including distance education) are only one area in which the GREC has been active. For example, GREC-brokered fiber to all schools in the Ozarks region of Arkansas with the five different ICT providers. GREC efforts led to the use of E-rate funds to develop and transmit distance education classes throughout the east Arkansas region, but shortfalls of equipment and licensed teachers are hampering the full utilization of these efforts. The story told is one of computers sitting in boxes because schools lack the funds to connect them. Schools that are wired through GREC efforts could be a major community resource, providing dial-up linkages from its student's homes, but the reality is that this is a distressed region where 30 percent of the students come from homes lacking even basic telephone service.

The University of Arkansas utilizes the Phillips County Community College (PCCC) as a satellite campus, with the two campuses linked via distance education courses. In addition, PCCC is linked with two other satellite campuses in the community college system. During interviews it was state-level contacts that expressly recognized PCCC as an excellent regional connectivity resource; PCCC was not cited in discussions with local participants. It should be noted that all meetings for the ICN project were hosted by the community college.

2. *Nature of the Interventions*

Nortel's ICN process

Helena's involvement in the ACE program, selection as an ICN pilot study site and participation in the TEAM DelTA project led to the recommendation to include it as one of the Arkansas case studies for this project. (It should be noted that Helena had failed in attempts to be selected as a Southwest Bell Fiber Park location.) The impetus for Helena's involvement in the Nortel ICN project came from the local state legislator who had adopted connectivity as a primary thrust of her efforts on behalf of constituents. Helena was to become the leader of a region covering five counties in Rep. King's district that was to obtain high-speed connectivity to the Internet. Helena, Searcy and Fort Smith were selected for the first iteration of the ICN technology planning process; expansion of ICN to other Arkansas cities was anticipated. Efforts in Fort Smith and Searcy are referred to as successes, while the Helena effort fell apart after only four meetings in the multi-stage process. Explanations for the failure of the ICN effort are illuminating.

On-site interviews included leaders representing a cross section of the institutions and organizations in Helena. Among these were the directors of the County Port Authority, the regional telemedicine program, the Chamber of Commerce, The Great Rivers Educational Cooperative, the Cooperative Extension Service and the local utility company's community relations department. The consistency of tone and content allows the following explanation that reflects a synthesis of recorded comments.

Everyone interviewed acknowledged that the ICN project was a failure, with much of the blame laid on the style of the consultant who came in to facilitate the process. He was described as "condescending," "arrogant," and "rude." (It should be noted that this description directly contradicts that of community leaders in Monticello who worked with the same consultant in facilitating their ICN effort.) There was significant resentment expressed concerning "an outsider coming in telling us what is wrong with our community."

This sentiment conflicts directly with statements made by the same interviewees that reflected their desire for someone to "come in and tell us what to do." The thrust of these statements is that small towns like Helena have limited human and leadership resources, resulting in the same small number of community leaders having to take on too many development and community support tasks. Helena leaders felt that the critical difference explaining the relative levels of ICN success among the three pilot communities was the fact that both Searcy and Fort Smith had paid community development personnel that were assigned the responsibility of keeping the ICN process on track and on schedule.

From the outset there was a miscommunication as to the level of effort community leaders were going to have to commit to the various research, analysis and planning steps of the ICN process. It is clear that the critical mass of local leaders needed to support the level of effort required by the ICN process never existed — none of the region's mayors and only one of the five regional school superintendents attended any but the first meeting. Helena leaders were confronted with a tight planning schedule, their own lack of understanding and information, and the perceived failure of the state or Nortel to provide adequate resources or explanations to assist their efforts. They felt like they were operating in an information vacuum where they never knew what they were doing. Rather then appreciating their constraints, they felt that the consultant criticized them for not completing assigned tasks between meetings. Leaders further determined that they had been mistaken in thinking that the state would provide funds to implement forthcoming recommendations. This combination of factors caused the leaders to decide at a mid-point during the fourth meeting to withdraw from the ICN project.

Subsequently, Helena leaders gave strong notice of their dissatisfaction with the process to state officials, a fact that contributed to the entire project being aborted throughout Arkansas. The Arkansas Department of Economic Development (ADED) incorporated technology into its ACE program. Helena has already successfully completed the ACE certification process and now plans to get the updated certification that includes developing a technology plan. Assisting them with their efforts will be specialists at the DIS and ADED. Helena is also one of the communities selected for the TEAM DelTA connectivity planning and assessment project that will be conducted with the assistance of the Arkansas Science and Technology Authority.

3. Impacts of the Intervention

Lessons learned

While the ICN process was not successful in Helena, it has had positive outcomes. Interviewees expressed a number of specific insights gained as a result of the ICN efforts; insights that they expect to put to good use in future ICT planning initiatives. To paraphrase and summarize, the town's leaders now have a better sense both of how much they do not know and of how important it is to address that lack of knowledge in a proactive, deliberate manner. Toward that end they recommend the following:

1) Dedicated resident human resources focused specifically on technology issues are absolutely essential to plan, implement and sustain ICT efforts. First among these individuals' responsibilities is that of facilitator, serving as an informed bridge between the community and external providers and internal users of ICT.

2) Technology planning processes require that the planners have a basic understanding of what the technology is and how it can be applied. In technologically disadvantaged communities this may require a pre-planning technology education effort.

3) Clear goals and objectives with specified products need to be established and broadly communicated at the outset of the planning process.

4) Flexible approaches are recommended over rigid structures, particularly for small and rural communities attempting to gain the understanding of connectivity issues and options needed to successfully transition to the Knowledge Economy.

5) External perspectives have value in helping a community recognize that technology alone cannot overcome crippling social impediments, whether they are in the form of pervasive negativism or ethnic divides rooted in history.

6) The sense of despair at ever catching-up in the fast-paced technology arena can be crippling. It is important to identify local needs that the technology can address in the relative short-term in order to accomplish the small successes that are needed to sustain longer-term emotional, political and financial investments in the technology.

7) External fresh perspectives on local situations have the value of forcing local attention to focus on issues that impede their progress. Helena leaders give the consultant credit for his suggestion that they need to create opportunities for young black and white professionals to interact and form relationships that can be the basis of more successful community planning efforts.

4. Testing the Study Hypotheses

1. Enabling infrastructure (roads, water, sewer, etc.) is necessary, but not sufficient to assure the effectiveness of technology infrastructure investment.

True. Community leaders complained about the availability and condition of traditional infrastructure and cited that as one reason for the lack of success in Helena's ICT programs. In addition, Helena has not taken full advantage of its position on the Mississippi, through recent efforts to develop a port facility indicate a shift in this position.

Beyond the hardware aspects of infrastructure, there are other sorts of softer infrastructure in the form of networks of inter-organizational and interpersonal relationships that are necessary components of successful implementation efforts. In Helena, frequent references were made to "unfinished business" as a critical factor in the failure to stake a community-wide effort to improve connectivity in the area. The business in this case referred to ongoing lack of integration of the efforts and interest of minority and white communities. The community actually consists of two separate entities, Helena and West Helena, which are predominantly white and black, respectively.

2. Investments in technology infrastructure must be part of a larger local planning process to succeed.

True. Relative to other Delta communities examined, Helena has been the least successful at organizing and moving forward efforts to enhance the local ICT capabilities. The inability to bring the different sectors of the community to the table for various planning initiatives, including ICT, was cited as the reason that the community does not seem to be making progress on several fronts. The recent failed ICT planning effort was actually part of a broader Integrated Community Network (ICN) planning effort that focused on ICT as part of holistic community planning. While this effort was truncated, the state's Division of Economic development is trying to take it on again.

3. A certain density or critical mass is required for information and communications technology (ICT) to work, because of the costs of provision.

True. The lack of sufficient demand makes local carriers reluctant to wire this community. The institutions that are well wired are heavily subsidized. Recognition of the need to seed connectivity is leading the state to attempt to consolidate its market power with utilities throughout Arkansas. It is anticipated

that by pulling the various state-supported users of ICT into one demand pool, Arkansas will be in a better position to leverage its buying power into a demand to enhance connectivity in communities that lack sufficient demand on their own.

There is a second issue of critical mass related to having a sufficient number of individuals in the community that can use their understanding of the issues and options to educate others as part of the technology adoption process. Density becomes a sort of chicken-or-egg conundrum — there cannot be demand density until there are a sufficient number of people that appreciate the potential of the technology.

4. *Technological innovations and advances are reducing the costs of communications and linkages.*

True. Efforts to develop internal resources for ICT have stalled in Helena. Anticipated forward movement is envisioned as involving networking among institutions that are wired as a result of heavy public subsidies (e.g., public schools and hospitals). Without advanced networking capabilities the level of connection in Helena is not expected to advance much in the near future.

5. *Institutional mechanisms must be in place to help users deploy the hard infrastructure appropriately.*

Somewhat true. It is the institutions in Helena that are most heavily committed to promoting the use of ICT. Efforts to expand the scope and span of telemedicine capabilities at the local hospital and to increase the use and proficiency of students at all levels are cited as first-wave steps to bringing the rest of the community along in the use of ICT. First wave really does describe the situation here.

6. *Some hierarchical coordination or linkages among national, state, and local governments are important for a community to be truly connected.*

True. Lacking certain critical technical skills and understanding, a community will find it difficult, if not impossible, to develop the capability to adopt and utilize ICT. In this case, there is not even sufficient understanding of what the options are to go after federal assistance from appropriate programs. A phased hierarchical coordinated effort involving state and federal initiatives will be required to connect communities. Recognition of the failure of local planning efforts has caused the state to undertake a more hands-on approach to ICT development in the Delta.

7. *Linkages among government, education and industry are a critical success factor for ICT interventions. State policies and corporate action are important determinants of local "success."*

True. The limited amount of success in Helena thus far has been attributed to the failure to develop and capitalize on linkages and common needs among the various sectors of the community. We already noted a concerted effort by the state government to audit its own use of ICT as the first step toward developing a coordinated state plan that can be used as the foundation for enhancing the resources and demand potential for smaller communities throughout the state.

While it may be a function of the limited number of interviews in Helena, it is notable that alone among the communities visited there was not explicit mention of the local university as a potential partner in ICT efforts. The failure of the community to explicitly recognize the value of this campus as an economic development resource was cited during a subsequent interview with a state official that has been working with Helena as part of the Team Delta project for the United States Department of Commerce.

8. *Infrastructure providers must be partners in assessment and planning, not just the spending, for the intervention to succeed.*

True. The failure of recent efforts by community leaders in Helena to work with an external ICT consultant and provider evidences the need for a sense of partnership in efforts to bring connectivity to disad-

vantaged communities. Such a partnership may not be easy or even possible to obtain. In the case of Helena, the lack of a baseline of technical competency or understanding on the part of community leaders about the product/service contributed to their distrust of the consultant/provider. The community leaders expressed concerns about whether the solutions developed would better serve the community's particular needs and opportunities or the set of products and services offered by the ICT that was doing the analysis. Helena was not in a position to really collaborate with any provider in an informed manner, and this lack of self-awareness and self-confidence precluded the success of any effort that was attempted.

9. *Work force development is a critical complement to any infrastructure intervention.*

True. Planning efforts have not been allowed to progress to the point where the application of ICT to work force development has been specified. Indeed, although there is a two-year campus of the University of Arkansas located in Helena, there was no evidence that the campus leadership had played any particular role in the ICT effort.

10. *Because of the long-term and expensive nature of ICT, vision and leadership are critical success factors.*

True. Two sorts of currency are required to underwrite ICT efforts — financial and human. Capital constraints can be finessed through a combination of subsidies, phased implementations, grants and strategic partnerships of providers, etc. In contrast, the evidence taken from Helena is that leadership and vision cannot be exogenous in origin, but must be embedded in the fabric of the community. The long-term nature of the investment required coupled with the relative novelty of the technology and the revolutionary impact it can have on various practices and sectors create another problem for distressed communities that was highlighted by the situation in Helena. What leadership there is may be rather thin in both number and capacity to understand and promote the potential resident in ICT for economic development. A frequent sentiment expressed in Helena was one of fatigue, wherein a limited number of over-extended individuals were at the center of all community-based economic development efforts. The technical nature of decisions related to connectivity enhancement efforts requires devoted attention from an individual with responsibility for taking care of the myriad of details that are involved in such projects.

This raises a related technology transfer issue. Exposure to novel ideas and planning practices can play a role in the receptivity of individual leaders to undertaking efforts to institute changes. Individuals cited as influential in other locales or state-level efforts to improve technology planning in Arkansas noted that it was their personal exposure to new practices and efforts elsewhere that catalyzed their interest in undertaking similar efforts in Arkansas. Among the communities visited, leaders in Helena seemed to be the most isolated and least likely to have experienced this outside stimulus for change.

ARKANSAS

Monticello/Drew County

1. Context

Monticello, the seat of Drew County, is located in the rolling hills in the southeast corner of Arkansas. It is 90 miles south of Little Rock, 50 miles east of Greenville, Mississippi, and 85 miles north of Monroe, Louisiana. Monticello hopes to capitalize on this relatively central location within the broader multi-state region with the development of a planned intermodal transportation facility. Monticello is a certified ACE community, a designation that recognizes the capacity of the town and its surrounding community to be a player in the economy.

Forestry, wood products and the recreation sector are mainstays of the region's economy. The University of Arkansas-Monticello offers the nation's only undergraduate degree in Global Information Systems (GIS) in its highly ranked forestry school. Agriculture plays a strong role in the area's economy as well.

Despite unemployment rates that double state averages and wage statistics that consistently underperform both state and national averages across all sectors,[1] the prevailing community attitude is not one of distress. Rather, Monticello's leaders consistently project a realistic grasp of the challenges

Table A.3
Demographics for Drew County, Arkansas

Population, 2000	18,723
Median household income, 1997 estimate	$27,738
Educational Attainment, High School or higher, 1990	63.1%
Educational attainment, Bachelor of Science or higher, 1990	13.9%
Poverty rate, 1997 estimate	19.9%
Unemployment rate, 2000 annual	6.8%
Per capita personal income, 1999 estimate	$19,924
Homeownership rate, 2000	69.0%
Percent Ethnicity, 2000	
White	70.3%
African-American	27.2%
Hispanic	1.8%

Sources: U.S. Census Bureau, U.S. Department of Labor.

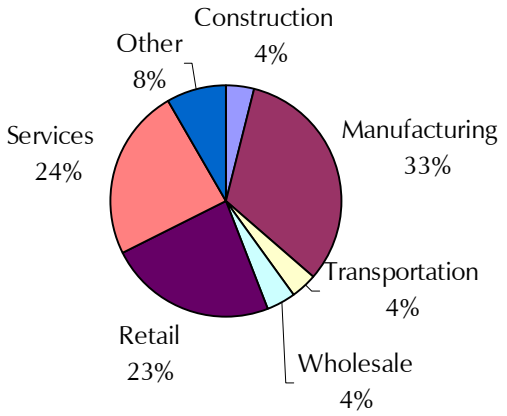
[1] Bureau of Labor Statistics, stats.bls.gov.

faced by their community, commitment to effecting positive change and optimistic faith that ultimately they will be successful. The attitude and spirit of leaders in this community stand in stark contrast to that communicated by leaders in Helena.

Connectivity, in various contexts, affords another point of comparison of these two Delta towns. While leaders in both Monticello and Helena recognize the need for more and better ICT connectivity, it is the group in Monticello that most clearly acknowledges the effect social connectivity has in determining the ultimate success of ICT efforts. Efforts in Helena failed to elicit participation from school and community leaders in surrounding counties or from the immediately adjacent West Helena. In contrast, Monticello leaders have adopted a deliberate strategy of inclusion in their ICT planning efforts. Representatives from industry, education and government organizations from across the surrounding region have successfully been drawn into Monticello's ICT planning efforts. The over-arching theme is one of cooperation.

Self-reliance is a further differentiating feature of the local spirit. Leaders point with pride to the fact that local industry is diverse and largely indigenous, with all but two of the major employers being locally owned. They acknowledge that they do not have all the information and understanding they need to develop and implement a comprehensive ICT plan, but have developed a strategy for obtaining missing information.

Figure A.2
Drew County Business Mix, 1999 estimate



Source: Bureau of Economic Analysis; total full-time and part-time employment by industry

The goal driving economic development in Monticello is the creation of higher quality jobs for residents and the ability to support the career aspirations of the region's young people with more management-level positions. Out-migration of its educated youth is a major concern. In support of this overarching goal, Monticello aspires to become both the economic and technological hub for southeast Arkansas and a model for community-led, technology-based economic development.

Education resources

Administrative and technical professionals from the local campus of the University of Arkansas system have been active in all phases of the ACE and ICN planning efforts. The relationship between the university and the community leaders appears to be a strong one forged from a sense of shared destiny and the need to collaborate to develop employment opportunities to keep graduates in the area. The university is in the process of establishing a networking laboratory, and anticipates having interns to place in the region's organizations. Demand for on-campus training resources already exceeds the supply of space and financial resources allocated to this effort. Partnerships forged in the community connectivity efforts are seen as a resource for addressing these impediments. An interesting note supplied by a state official involved in the Governor's Technology Initiative is that Monticello is one of the first instances in which local universities were involved in the ICT planning discussions from the outset.

Connectivity resources

An example of the proactive initiatives that support these development goals is the Monticello Technology Committee (MTC). The MTC can be seen as a direct spillover from the earlier ACE effort in Monticello that first brought together individual that have been instrumental in catalyzing the MTC. Leaders from across business/industry, government and education responded favorably to a request to ap-

point a representative of their organization to participate in the Monticello technology planning committee. The resulting technology committee met monthly for three months, developing a $500,000 proposal to the Arkansas Department of Information Services to up-grade city and county governments' computer resources, including the purchase of lap-top computers for public safety departments. When this proposal was put on hold the committee determined to lobby for inclusion in the ICN project.

For more than a year, the Technology Committee has met every Friday to study and facilitate the enhancement of the region's technology resources. The group follows a model that uses subcommittees to research and develop recommendations and the economic justifications needed to support them. Recognizing that their relatively unconnected state is not unique among communities in Arkansas and elsewhere, the Monticello technology committee has elected to document the various steps they undertake as a model for use elsewhere. They catalog their planning process and related research efforts, and videotape their meetings in order to be able to share their experiences with other communities that start down similar development paths.

Monticello is served by Southwestern Bell, which provides access to a fiber-optic telecommunication network to clients on an individual basis. Although initially part of the Monticello technology committee, Southwestern Bell (and other utilities) have since elected not to participate in the MTC, citing a potential conflict of interest in their need to protect proprietary information and the committee's need to understand rate structures and practices. A local Internet Service Provider is active in the group.

The regional hospital is yet another important resource for the broader connectivity effort. A hospital representative who is active in the technology-planning group sees her organization as a major asset to the connectivity effort. The hospital has invested significant fiscal and human resources in developing a system that includes a network of 72 personal computers and 85 stand-alone units. Hospitals and other public institutions that are required to invest and operate sophisticated information and telecommunications systems are expected to play a growing role in bringing other elements of the community up to speed in the use of technology.

A final resource driving connectivity efforts in Monticello is local industry. Leaders from local industry cited their recognition of the rapid rate of growth in computer networks in their own operations as indicative of a trend that can best be supported through cooperative efforts by the university, industry and government. Several leading firms share their in-house information technology experts with the MTC. Again, enlightened self-interest was cited as the catalyst for decision to work to build local resources.

2. Nature of the Intervention

Monticello leaders have a vision of their city as the hub of economic activity for all of southeastern Arkansas. Connectivity is a central element in achieving this vision and in supporting Monticello's broader economic development plans to be a player in the global economy. An example given by MTC members highlights the contribution ICT is expected to make in the short term to one of Monticello's traditional economic mainstays, agriculture. Although the area is renowned for its tomato production, its growers have historically had to sell to a limited number of buyers and consequently accept relatively low prices. By posting their product on the Internet growers are beginning to develop demand for their tomatoes in a worldwide market, resulting in increased competition among buyers, better prices, and ultimately, more jobs for the local economy.

ICT is viewed as a major tool for overcoming the negative and crippling stereotypes the MTC feels impedes economic development in the Delta. While leaders cited the role that enhanced traditional infrastructure can play in the economic development of their region (e.g., the proposed inter-modal transportation facility), they do not tie the current lack of connectivity or the ultimate success of their technology planning efforts to roads, airports or other traditional infrastructure elements. This is in contrast to both Helena and Pine Bluff, where community leaders offered inadequacies in traditional infrastruc-

ture as partial explanation for their failure to date to obtain the ICT infrastructure they desire.

In a replay of the chicken-and-egg conundrum, Monticello cannot attract high-skills industry without a highly skilled work force that local graduates could provide, if they were not relocating elsewhere in search of appropriate employment. Connectivity is seen as addressing the need for enhanced work force training and industry recruitment and providing higher-quality jobs that will retain the area's best students. A recent one-cent increase in sales tax has been designated for construction of a first-for-the-town industrial park that will use EDA funds to provide necessary infrastructure. Connectivity is seen as absolutely critical to the success of this broader effort.

An interesting side point is the link between Monticello's current connectivity initiative and its earlier (1997) efforts to achieve ACE certification. One relevant outcome of the ACE effort was that it created a forum that introduced community leaders from across various sectors to one another, developing the network of relationships that continues to energize and enrich the MTC today. Leaders see the ACE effort as the starting point of what they perceive as an evolutionary approach to economic development. Their operating philosophy is that the strength of their relationship network will empower them to meet their goals: if they need financial or other resources, they will find a way to get it.

Nortel's ICN process

The already-active technology committee gave Monticello a jump-start in its 1999 efforts to be selected as one of nine ICN pilot communities. The technology committee consists of representatives from large and small businesses (including minority-owned enterprises) in the region, educators from the secondary schools and university, local government and public institutions (including the hospital), the local Internet service provider, work force development officials, clergy, and ad-hoc representatives from minority communities within the region. This vital partnership had already targeted the connection of city and county governments to a common telecommunications network as one of its initial efforts. Preliminary plans called for hiring a professional support/technical employee to train users and to facilitate expansion of the system. Publicly placed kiosks were to be used to facilitate public interest and uses. Monticello was approved for the second round of ICN efforts in Arkansas that was to encompass nine different pilot communities.

Monticello held an ICN organizational meeting in March 2000, followed by a training session for facilitators. A second meeting devoted to initiating the visioning aspect of the ICN process was scheduled; it was at this point that the State's contract with Nortel for the ICN project was terminated and the ADED and DIS assumed responsibility for leading connectivity planning in Arkansas.

The reaction of Monticello leaders to this turn of events contrasted strongly with that of leaders in Helena. Whereas Helena leaders expressed an almost palpable relief at the possibility that someone would be holding their hands and providing connectivity planning resources, Monticello leaders are concerned that state-mandated approaches may not optimize the results for their community. They would welcome information, seed funds or access to community models they can study, but prefer that the "state not get in the way of what we already have going." They are confident that a grass roots effort has the best chance for success and they want to keep local control of forthcoming initiatives.

3. Impacts of the Intervention

Lessons learned

The Monticello Technology Committee invited the case-study researchers to attend one of their regular Friday meetings. This opportunity allowed the researchers to meet approximately 20 community leaders involved in this effort. Committee members summarized their experiences related to the ICN effort and addressed connectivity issues confronting their community. They were careful of the opportunity this meeting represented to get some of their concerns and experiences before the EDA, an organization that they hope will continue to support initia-

tives growing out of their on-going planning efforts. The following lessons reflect points distilled directly from their comments.

1) ICT creates needs and opportunities for sectors to work together to overcome resource limitations. ICT can both enforce and amplify a sense of shared destiny in smaller or disadvantaged communities that can be leveraged into unprecedented collaborative efforts.

2) ICT is a moving target, requiring frequent reassessments and upgrades. Communities need to have an on-going forum for exchange of information from the stakeholders in the local connectivity networks that allows for current, flexible, and on-going assessments of the local ICT resources.

3) There is an equally strong requirement for a mechanism to meet the need for on-going education of existing and potential ICT stakeholders.

4) Communities could benefit enormously from an ICT clearinghouse that would allow them to learn from the experiences of other communities.

5) Technology adoption is an evolutionary process that requires on-going education efforts interspersed with regular small successes along the way to expand communities' capacity to absorb the changes that the technology can bring to an area. To the extent possible, the small successes should be "scheduled" in a process timetable that is specified in the ICT plans.

6) Connectivity technology inevitably results in significant changes at different levels of the individual organizations and the broader linked community of which they are part. This points to the importance of insiders serving as primary change agents, increasing the comfort levels of those being asked to adopt new approaches and relationships.

7) A grassroots effort involving multiple perspectives will find a more receptive audience and will be more successful than an effort that is externally mediated, whether the subject is ICT or some other technology.

8) Inevitably it is human networks than form the social and financial templates that enable technological ones to come into being and succeed. As a result, interpersonal relationships are at least as critical as technology in explaining the success or failure of technology-based economic development efforts.

9) The MTC encourages the EDA to view the Monticello effort as representative of a "virtual center" or a "center without walls" approach that can leverage grassroots support with state and federal dollars. MTC thinks that this may be a particularly effective approach for addressing connectivity efforts in small and rural communities.

4. Testing the Study Hypotheses

1. Enabling infrastructure (roads, water, sewer, etc.) is necessary, but not sufficient to assure the effectiveness of technology infrastructure investment.

False. The community leaders in Monticello who we interviewed responded to this statement by reversing the direction of causality. They regard IT as a tool to overcome inadequacies of traditional infrastructure or in some cases, as an actual substitute for traditional infrastructure.

2. Investments in technology infrastructure must be part of a larger local planning process to succeed.

True. Community leaders in Monticello seemed particularly cognizant of the need to team ICT efforts with broader community development and strategic planning efforts. Citing technological illiteracy as having the potential to scuttle ICT efforts that might be launched, the committee expressed their commitment to on-going education of the needs and opportunities of ICT across all sectors in the community. Particular stress was repeatedly placed on the "local" component of the needed planning process as being the single most important determinant of successful ICT efforts.

3. *A certain density or critical mass is required for information and communications technology (ICT) to work, because of the costs of provision.*

Somewhat true. This committee was familiar with the arguments of critical mass that have been used by ICT providers as rationalization for not providing high-speed service in their area. They counter by citing examples wherein once connectivity was established the demand grew rapidly and soon reached a level to justify the risky investment taken by the provider. They are researching model situations that can be used to bolster the credibility of their claims.

4. *Technological innovations and advances are reducing the costs of communications and linkages.*

True. Monticello may be typical of small communities by servicing their needs for and uses of ICT in an unsophisticated way. A top priority of the committee is to get county government networked, which was cited as an improvement on the current system of literally walking the forms from one office to their destination across the street. They acknowledge that this may not be sufficient to garner widespread community support for the effort, but pointed to an equally low-tech application of technology that is realizing real cost and timesavings affecting a broad spectrum. Specifically, scheduling and tracking technology has recently been applied to routing school buses, resulting in improved service at a lower cost. The leaders see the ability to point to specific examples such as this as being important in generating appreciation for the use/need of ICT investments.

5. *Institutional mechanisms must be in place to help users deploy the hard infrastructure appropriately.*

True. There is evidence that the various members of the committee are calling upon the expertise and skills of other members of the group as they acquire/implement technology in their own organizations. The hospital is an example wherein the decision was made to designate an employee with no particular technical training or skills as the resident go-to person on ICT issues and have that person acquire the necessary skills on-the-job. She is the hospital's representative on the committee and is involved in working to educate other users in the community as the need arises.

6. *Some hierarchical coordination or linkages among national, state, and local governments are important for a community to be truly connected.*

False. The committee in Monticello was openly ambivalent about the ability of the state to positively contribute to the development of ICT capacity in their area. They plan to build deliberately and incrementally support for ICT efforts/investments at the local level, leveraging on-going support with early, strategic successes. The feeling expressed was one of concern about external entities imposing cookie cutter solutions that may not optimally fit the local landscape. Monticello is not against coordination or linkages, but they see the impetus as having to come from the ground-up if the effort is to have short-term success of long-term sustainability.

7. *Linkages among government, education and industry are a critical success factor for ICT interventions. State policies and corporate action are important determinants of local "success."*

True. In a similarly qualified sense expressed above the Monticello leadership group itself reflects a de-

liberate and careful effort to include the active participation and perspectives of representatives from the local government, industry and education sectors. They attribute successes to date, including their ability to sustain the effort with a strong degree of commitment from both the individuals and the institutions they represent.

8. *Infrastructure providers must be partners in assessment and planning, not just the spending, for the intervention to succeed.*

True. In another interesting take on growing their own resources, a local businessman whose family-owned firm has retailed satellite cable systems in the area for years has been led to expand/morph his firm to become a local ISP.

9. *Work force development is a critical complement to any infrastructure intervention.*

True. There is a clear sense among leaders in Monticello that ICT provides the best and perhaps only option for developing and delivering the training programs that are needed to supply the skilled labor force that will be needed to support growth of the regional economy. Representatives of the local higher education institutions are active participants in the planning effort and are leading a focused effort specifying work force development.

10. *Because of the long-term and expensive nature of ICT, vision and leadership are critical success factors.*

True. This community seems acutely aware of the importance of vision and leadership for the long-term success of ICT efforts. To ensure sustainability, the community installed a redundant leadership structure for the subcommittees.

ARKANSAS

Pine Bluff/Jefferson County

1. Context

As one of the larger cities in the state and the location of many of southeastern Arkansas's largest employers, Pine Bluff is the hub of what has historically been an economically depressed region. Traditional strengths in agriculture, timber and forest products (reflected in the fact that Tyson Foods, International Paper and Union Pacific Railways are the area's largest private employers) have been extended into other sectors. Other major employers include the University of Arkansas at Pine Bluff (680), the Arkansas Department of Corrections (850), the United States Food and Drug Administration's (FDA) National Center for Toxicological Research (540) (NCTR), and the United States Army Arsenal at Pine Bluff (1,350).[1]

Pine Bluff appears to have a strong and successful community development and planning structure that was significant in its selection as a FiberPark location. The Economic Development Alliance of Jefferson County (The Alliance) is a multi-layered umbrella organization that takes the lead in coordinating community development efforts. Leaders from the Alliance and other organizations that are pushing enhanced ICT for economic development are long-time

Table A.4
Demographics for Jefferson County, Arkansas

Population, 2000	84,278
Median household income, 1997 estimate	$27,363
Educational Attainment, High School or higher, 1990	65.9%
Educational attainment, Bachelor of Science or higher, 1990	14.6%
Poverty rate, 1997 estimate	24.9%
Unemployment rate, 2000 annual	7.1%
Per capita personal income, 1999 estimate	$20,141
Homeownership rate, 2000	66.2%
Percent Ethnicity, 2000	
White	48.5%
African-American	49.6%
Hispanic	1.0%

Sources: U.S. Census Bureau, U.S. Department of Labor.

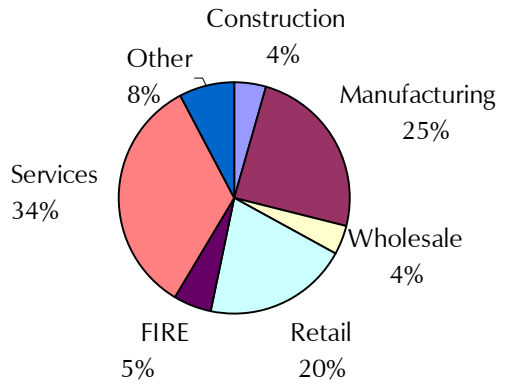
[1] Greater Pine Bluff Chamber of Commerce.

residents that are highly placed in their respective professional organizations. As a group, they are particularly well traveled and have strong ties with organizations outside their region, state or even country, giving them a critical perspective from which to view Pine Bluff's need for competitive ICT capabilities. It is this broader perspective that gives them an appreciation of the importance of broad-based planning and the integration of that planning with their own organizations' programs and investments.

Recent accomplishments of the Alliance and its constituent member organizations include 1) funding construction of an Advanced Technology facility at the local community college, 2) securing funds to build a shell industrial building, 3) creating the Arkansas River Region Multiple Transportation Authority that will be able to act as a utility to aggregate and share power loads and to build new water processing plants for industrial users. Efforts by the Alliance played strongly in Pine Bluff's successful bid for one of Southwestern Bell's FiberParks.

The Alliance can point to progress in revitalization and development efforts, but challenges remain. While Pine Bluff serves as an employment magnet (over 30 percent of the work force commutes in daily), too many of the jobs require low skills and pay low wages type. Twenty-five percent of the population is illiterate and/or living in poverty, more than half of the students at some high schools drop out, and the area has the second highest teen pregnancy rate in the industrial world.[2] Although the economy in Pine Bluff is diverse, the area exceeds the national average in the 20 percent employment share attributed to the manufacturing sector. While that has been a source of pride, area leaders increasingly recognize that an economic development strategy premised on recruiting traditional manufacturing firms is no longer sufficient. Leaders cite the effects NAFTA and other trade agreements are already having on the local economy as a catalyst for keeping their economic development strategies current. Technology figures strongly in plans that have been evolving for nearly two decades.

Figure A.3
Jefferson County Business Mix, 1999 estimate



Source: Bureau of Economic Analysis; total full-time and part-time employment by industry

As early as 1983 the idea of creating a high-technology corridor between Pine Bluff and Little Rock emerged as a focus for development efforts. Support for that as a strategy came from analysis of the community's assets by local leaders and external consultants that identified the NCTR and the Pine Bluff Arsenal as potential technology-based resources. Further analysis by community leaders determined that two advanced sciences, biotechnology and telecommunications, were the best targets for leveraging the existing resources. Near the end of his last term in Washington, former Senator Dale Bumpers inserted language into a defense bill to transfer 1,500 acres around the Pine Bluff Arsenal to the state for use as a high-technology facility. The roots of a highly integrated development strategy began to emerge — first referred to simply as "The Project" — the idea evolved over time into a comprehensive plan for the future called "The Bioplex."

The **Bioplex** will be a biotechnology research, production and training complex. It will wed the potential of biotechnology and telecommunications in a very specific strategy that leverages existing human and physical resources of the Arsenal and the FDA facility and extends the distinctive competencies of the region to a global market. The Bioplex consists of the 1,500 acres located adjacent to NCTR and the Pine Bluff Arsenal. The Bioplex location provides access to full utilities and infrastructure, access to

[2] United States Census Bureau.

world-class scientists at the NCTR and environmental expertise from the Arsenal and access to an impressive array of medical and agricultural biotechnology expertise. As envisioned, the Bioplex will have numerous components, including the Bioplex Center, a communications and technology transfer campus focused primarily on next-generation biotechnology and telecommunications. A number of individual facilities for public-private research and development operations will be developed throughout the park. These sites will be used by firms seeking proximity to regulatory and research personnel at the adjacent FDA and Arsenal facilities and for demonstration site for public-private partnerships and modeling prototype methods for expediting product development. Funds to develop a comprehensive land-use plan were provided in 1994 by the United States Economic Development Administration.

A key element in the Bioplex strategy is the **Pine Bluff Arsenal**, a historically important munitions production, distribution and storage facility that holds the nation's largest stockpile of chemical and biological weapons (12 percent). Disarmament treaties requiring the disposal of stockpiled weapons has resulted in the construction of a $600 million incinerator complex that will begin operations in 2003. Once the weapons are destroyed the incinerators are to be dismantled, in part, to allay the community's concern that it not become a hazardous materials dumping ground for the nation. On-going activities at the Arsenal include the production of conventional weapons and riot control mixes; production and testing of chemical defensive equipment; engineering and technical expertise applied to the design and equipping of munitions facilities; and provision of technical engineering expertise for pollution abatement programs. Community leaders view the on-site expertise in the safe management and disposal of extremely hazardous materials that has developed around the Arsenal as an asset that constitutes a unique high-growth technical niche.

After the chemical/biological weapons manufacturing function ceased twenty years ago some 500 acres and approximately one million square feet of buildings on the Arsenal property became obsolete. Since some of that space was of extraordinary value, having been designed to the highest safety standards for containment purposes, it was transferred from the United States Army to the FDA and designated the Jefferson Laboratories. The Jefferson Labs encompass two different FDA facilities: 1) the **National Center for Toxicological Research** (NCTR), a service-oriented toxicological research facility that models product approval, houses world-class computational chemistry facilities and staff, and works closely with industry and scientists to reduce risks to humans from toxic chemicals; and 2) the Arkansas Regional Laboratory of the Office of Regulatory Affairs. Efforts underway to consolidate the FDA's numerous operating centers will result in the Pine Bluff facilities being one of only five FDA facilities nationwide. FDA researchers in Chicago, Dallas, Denver, Detroit, Kansas City and Minneapolis will be relocated to Jefferson when current leases expire. NCTR facilities include 30 buildings valued at over $225 million, 100 doctoral-level scientists and another 500 contract and civil service personnel that are involved in more than 250 research projects.

A constellation of plans and efforts underway in the area of environmental management illustrates how the Federal resources, the focus on biotechnology and telecommunications, and the history and culture of the area are coming together to create a unique center of excellence related to hazardous materials. Building on resident expertise in toxic materials handling and chemical and biological weapons, various elements of the Bioplex are involved in the following activities:

- "First-Response" Training Programs: United States Department of Justice grants are funding a variety of on-site and distance education training and certification programs that target units of the National Guard and other public safety professionals from across the country. A 24-hour hotline will be available and a mobile team will be created to give training in remote locations. All operations will be centered at the Bioplex.

- The American Red Cross is planning a high visibility training facility at the Bioplex to prepare personnel to respond to hazardous materials release incidents.

- National Consortium on Counter-Terrorism: The Arsenal brings its specialization in chemical and biological weapons to bear on the development and production of needed technology and equipment. Related spin-off firms are expected to locate in the Bioplex.

- Department of Defense biological and chemical weapons vaccine facility: Efforts to locate this facility adjacent to the NCTR have strong support in Washington.

- Recruitment efforts targeting bioremediation service and equipment companies are underway.

- Sustainable and genetically-enhanced agriculture/forestry: Connectivity is expected to facilitate data sharing between the NCTR and area universities to support the growth of "smart foods" spin-offs and other genetically engineered applications for the area's agriculture, forestry and food processing.

Education resources

There is a strong recognition of the need to develop skills within the community to support ICT-related jobs that are expected to develop around the Bioplex/FiberPark. Leaders from the local higher education sector are active participants in the overall ICT planning efforts in Pine Bluff. Education resources within commuting distance from the Bioplex include the following institutions and laboratories:

- NCTR: The NCTR represents a unique educational resource and intellectual beacon in the region. NCTR's ties with area schools are strong, creating opportunities to put scientists in K–12 classrooms, a science summer camp for high school students, internships for university students, and opportunities to bring the brightest young scientists into the area for post-doctoral and employment related to toxicology.

- Southeast Arkansas Technical College (SEARK): Located in Pine Bluff, SEARK offers an associates degree in biotechnology and degree and certificate programs in networking and connectivity-related areas

- Southwestern Bell**:** Fifty percent tariff reductions are offered to schools in the region for distance learning networks. (It is important to note that the hardware costs ($40,000 per school) have kept all but two schools from taking advantage of this resource.)

- Stuttgart Agricultural Centers: The National Rice Germplasm Research and Enhancement Center, the Stuttgart National Aquaculture Research Center, Riceland Research and Technical Center, and the University of Arkansas Rice Research and Extension Center.

- University of Arkansas at Little Rock: A new program, Computer and Information Science and Systems Engineering (CISSE) was established in response to requests from local civic and industry leaders from throughout southeast Arkansas.

- University of Arkansas, Medical Sciences (UAMS): UAMS utilizes 4,000 square feet at NCTR. UAMS is operates Bioventures, a small business incubator, in support of entrepreneurial efforts on campus and from the Bioplex. UAMS (along with the University of Arkansas at Little Rock) has agreements with Jefferson Labs to provide research, training and technology transfer.

- University of Arkansas at Pine Bluff: A historically black institution with a unique curriculum in regulation.

Connectivity resources

Pine Bluff is located on a major fiber optic route that runs parallel to the railways in the area. Each of three major long-distance carriers has a point of presence (POP) in the area, making Pine Bluff one of a limited number of small cities with three POPs. The requirement that both of the federal facilities have redundant Internet connections provided the platform from which the Bioplex was enabled as a FiberPark. All installations supporting full connectivity from the Bioplex to global telecommunications networks were completed in late 1996. While the Bioplex provides the foundation for a guiding vision for connectivity efforts in the region, the reality is that current demand does not warrant ICT investments on the scale that has been made by Southwestern Bell. Barring the stipulated agreement between the utility and the state to establish the FiberParks, it is unlikely that ICT efforts in Pine Bluff would have developed to their current status based on existing demand or potential alone.

One wrinkle in this situation is that the federal facilities have high-speed lines that provide Internet and intranet linkages via state-of-the-art networking system that are supported by a 24/7 team of professionals. At present, federal and state regulatory hurdles stand in the way of the community accessing this resource. Leaders from these facilities expressed a willingness to work with other organizations and institutions to improve the capacity of the region as a whole. They joined others at the Pine Bluff meeting in recognizing the need for policy changes that support the broader use of federal and state connectivity resources to improve public access to the Internet.

SEARK, the local community college has major information technology initiatives underway to support connectivity in the region with its skilled technical graduates. A recently completed facility houses the college's fastest growing program — computer networking (17–22 percent growth per semester).[3] Construction is set to begin on a privately funded, advanced technologies building that will house expanded ICT programs. Zoning changes and land acquisition are underway as a joint project between SEARK and the city and county governments to absorb anticipated enrollment growth in ICT and biotechnology programs. SEARK offers extensive telecommunications network training courses and degrees, including Microsoft Network and Novell Certification. It is one of only eight Arkansas schools providing certification as a Cisco Network Associate or Professional. Articulation agreements with four-year institutions allow students to transfer into upper level computer and network courses.

2. *Nature of the Intervention*

Economic development efforts in Pine Bluff are spearheaded by an umbrella organization known as "The Alliance," which is comprised of the Greater Pine Bluff Chamber of Commerce, the Jefferson County Industrial Foundation and the Pine Bluff-Jefferson County Port Authority. It was the Technology Committee of the Alliance that coordinated the visit by the case-study research team.

The Bioplex is a major, long-term economic development platform for Pine Bluff and Jefferson County. Development of a FiberPark in the Bioplex is envisioned as the anchor of ICT-based economic development efforts in the broader region south of Little Rock. The decision to develop a FiberPark to support the twin biotechnology and telecommunication thrust of the Bioplex is supported by existing physical, work force and educational resources and by state economic development policies and incentives. The Arkansas Biotechnology Development and Training Act of 1997 provides tax credits of 5 percent for biotechnology facilities and equipment, 20 percent for qualified R&D expenses, and 30 percent for the cost of cooperative research with and advanced training at an accredited Arkansas university.

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[3] Greater Pine Bluff Chamber of Commerce.

Instead of technology and technical infrastructure being an end in itself, the Alliance sees advanced telecommunications as an integral element of this vision to leverage public resources to create a high-tech area that is attractive to private firms and spurs economic growth. The Alliance anticipates extensive use of the Internet to market the Bioplex to prospective tenants and to deliver services to and from the tenants. Leaders point to the cost efficiencies of shared networks, citing the common use of an existing fiber network by AHEC and the Arsenal that is already operational.

The intervention

In a 1994 settlement with the Arkansas Public Services Commission, Southwestern Bell agreed to invest $231 million over a three-year period to improve the telecommunication network of Arkansas. Incorporated in this settlement agreement was $7.7 million designated for FiberParks — business parks that use the presence of redundant high-speed Internet lines to attract high-tech businesses. Eventually twelve FiberParks were created across Arkansas, with six in metropolitan areas and six in non-urban locations. Pine Bluff competed for and won designation as one of the locations. Pine Bluff has received $1.8 million, the largest FiberPark investment to date. Connectivity infrastructure to provide redundant high-speed fiber-optic lines was completed in 1995.

Initially well received, the statewide FiberPark effort has recently come under fire in major Arkansas business publications.[4] The stated criticism is that although Southwestern Bell has held up its end of the 1994 settlement with the Public Service Commission, many of the individual communities receiving funds for FiberParks have not followed through on their related commitments. Pine Bluff is cited as one of the communities in which the FiberPark has yet to succeed in attracting jobs. Although accurate, the criticism may not be entirely fair.

In the case of the Bioplex and the connectivity-enabling FiberPark a primary asset is also a liability. While the Pine Bluff Arsenal is expected to be both a source of spin-off firms and a magnet for relocations attracted by proximity to the Arsenal's physical and knowledge resources, the need to remediate its holdings has created a serious bottleneck in the Bioplex development schedule. The current situation is reminiscent of a stalled game of dominoes. Final transfer of the 1,500 acres from the federal government cannot occur until on-site weapons are incinerated. This requires the construction of incinerators built for that purpose, which, in turn, requires approval from the state's Pollution Control and Ecology Commission's extensive permitting process. This approval was finally obtained in late 1999, allowing construction of the incinerators to get underway.

The lack of adequate transportation access to the Bioplex itself is another impediment to development that has its roots in the Arsenal's role in chemical and biological weapons production. Easy access was anathema to the tight security required by the Arsenal, with the result that today the only approach to the Bioplex from the interstate highway is over sixteen miles of narrow flat top road that winds past distressed rural residences and hog farms. Further investment in a transit artery linking the Fiber Park to the new highway that connects Pine Bluff and Little Rock is the next critical step in the development of the Bioplex and the region's ability to support high-tech growth.

It is clear from planning documents and from conversations with Alliance leaders that they expect the full economic development potential of the Bioplex will take years to realize. (The analogy to North Carolina's Research Triangle Park surfaced repeatedly.) It is equally clear that parties outside of the area do not understand that the Pine Bluff FiberPark was intended all along to be but one critical piece of infrastructure in the broader economic development effort that is the Bioplex. Pine Bluff cannot tie new jobs to the FiberPark yet because the Bioplex will not become a physical reality until the Arsenal land transfer is finalized in April 2001.

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[4] Arkansas Business vol.16 no.18, May 3–9, 1999. *FiberParks Fall Short of Expectations — Four Cities Scoreless So Far in Recruiting*, by James Wood and David Smith.

3. *Impacts of the Intervention*

Lessons learned

1) It is important to develop and apply the proper timeframes and milestones to evaluate connectivity projects. This is particularly important when the project is part of a complicated, multiphase or longer-term development effort.

2) Economic development efforts, particularly those that have a long gestational period, require appropriate management of public relations among extended stakeholders. While Pine Bluff has been able to sustain local support for developments at the FiberPark/ Bioplex there is evidence that efforts to build alliances and awareness of the status of their projects outside of the region have been less successful. In fact, Pine Bluff was included in this study at the suggestion of state officials who erroneously thought it would serve as an example of a stalled or failed ICT effort.

3) Alliance leaders suggest that the definition of infrastructure and related funding policies should be extended to encompass efforts that directly address efforts to develop human capital and enhance connectivity.

4. *Testing the Study Hypotheses*

1. Enabling infrastructure (roads, water, sewer, etc.) is necessary, but not sufficient to assure the effectiveness of technology infrastructure investment.

True. In an interesting fashion reminiscent of the situation in North Carolina's Global TransPark, the basics for ICT appear to be in place with the exception of critical pieces of enabling, conventional infrastructure, in the form of roads, sewer, etc. The Pine Bluff FiberPark is envisioned as the anchor of ICT-based economic development efforts for the broader region south of Little Rock. The widely held view by the community's leadership is that the inadequacy of roads and other transportation modes is the single biggest impediment to the success of the fiber park.

2. Investments in technology infrastructure must be part of a larger local planning process to succeed.

Mostly false. Enhanced connectivity is both the desired outcome and the process by which ICT factors into economic development. In Pine Bluff, individuals that are providing leadership to the ICT effort can be characterized as being long-time, involved residents of the community that are highly placed within their respective professional organizations. Many of them are particularly well-traveled or highly linked with organizations outside of their region, state or even country. That gives them a broad perspective when viewing the need of their organization and community to enhance ICT capabilities. That broader perspective gives them an appreciation of the need for planning by a broad base of stakeholders and for an integration of that planning with their own organizations' strategic plans and investments.

Specifically, in Pine Bluff completion of a major artery facilitating transit from Little Rock is viewed as one element in the plan to attract high-tech industry into the region. Enhanced technology curricula at the local colleges support firms that move into the area, and seed the development of indigenous firms. Zoning changes and land acquisition are jointly pursued by SEARK and the city/county government. That is important given the projected growth due to expansion of facilities. Further investment in a transit artery linking the FiberPark to the new highway is the next critical step in the development of the region's ability to support high-tech growth. All of these factors together strengthen plans to leverage a relatively strong federal presence with the recruitment of related public and private sector laboratories and their suppliers.

3. A certain density or critical mass is required for information and communications technology (ICT) to work, because of the costs of provision.

Mostly true. The reality is that current demand does not warrant ICT investment on the scale that has been made by Southwestern Bell. Barring the stipulated agreement between the utility and the state to establish the fiber parks, it is unlikely that ICT efforts in Pine Bluff would have developed as they have based on existing demand/potential alone. One wrinkle in this situation is that the federal laboratories are required to have redundant linkages that are an untapped resource for the community. Regulatory hurdles now stand in the way of such partnerships.

4. *Technological innovations and advances are reducing the costs of communications and linkages.*

Not clear: Technological innovation and advances, along with improved delivery efficiencies, may be reducing the costs of ICT. It is not at all clear however, that the resulting savings are passed on to the consumer. Communities do not have objective data from which to make informed decisions about the technology/provider that best suits their needs/budget. As a case in point, a networking consultant attending a working luncheon at the Pine Bluff Arsenal commented that Southwestern Bell and other providers routinely practice price discrimination to segment the market to their advantage. The result is that different customers pay different prices for connectivity established over the same lines at the same base cost to the provider. Different providers frequently utilize the same high-speed lines to deliver services to customers, adding further complexity to the selection of service provider.

On a different level, cost of hardware continues to be real issue for communities to take advantage of resources that are already available. An example is that even though Southwestern Bell offers 50 percent tariff reductions for its distance learning networks to schools, only two local schools have been able to take advantage of it because of the high cost of hardware (about $40,000 per classroom).

5. *Institutional mechanisms must be in place to help users deploy the hard infrastructure appropriately.*

Mostly true. Redundant high-speed lines currently link the federal installations in Pine Bluff to the Internet and within the facility via state-of-the art networking systems that are supported by a 24/7 team of professionals. To the extent allowed by law, these organizations presented a willingness to work with other organizations and institutions to improve the capacity of the region as a whole.

6. *Some hierarchical coordination or linkages among national, state, and local governments are important for a community to be truly connected.*

Somewhat true: The enabling links between improved roads and an adequately trained work force to the long-term success of the fiber park point to the need for partnering and inter-active linkages between the community and national and state government programs. To the extent that a community can be too inwardly focused, Pine Bluff has not done a particularly good job of building alliances and awareness of the status of their project outside of the region. This is evidenced by the suggestion by state officials that Pine Bluff be included in our study as an example of a ICT project that had stalled or was not showing as much promise as others in the state. On the other hand, various federal agencies have been strategic partners in the efforts to date, sharing a strong sense of shared destiny that comes from being committed to maintaining operations in the area.

7. *Linkages among government, education and industry are a critical success factor for ICT interventions. State policies and corporate action are important determinants of local "success."*

True. Development of the FiberPark is a long-term multi-phased effort that requires the concerted action of a number of different elements in the community. The continued existence of an unofficial information technology steering committee comprised of leaders in all three sectors is an important force to keep the efforts on-going and on track. Local education and industry leaders worked together to over-

come opposition from other University of Arkansas campuses to get a new degree program established at the Little Rock campus of the University of Arkansas in computer and information sciences and systems engineering (CISSE). Students from Pine Bluff will be able to commute to that program.

8. *Infrastructure providers must be partners in assessment and planning, not just the spending, for the intervention to succeed.*

Mostly true. In general, the relationship between the provider and the planners of an ICT effort must be delicately balanced. Providers need to share their knowledge and experience without seeming to overtly steer developments in a self-interested way. The lack of balance contributed to the failure of planning efforts in the Helena ICT project. The situation in Pine Bluff is different since ICT provider involvement stems from a settlement with the state that was negotiated in lieu of other penalties for rate transgressions. Southwestern Bell has avoided a leadership position in the FiberPark development. But the company is an important participant because it represents an ICT-experienced corporation. Southwestern Bell has funded a number of FiberParks around Arkansas as part of this settlement, and they are believed to be successful.

9. *Work force development is a critical complement to any infrastructure intervention.*

True. Leaders recognize the need to develop the skills within the community to fill ICT-related jobs that are expected to develop in the region. Leaders from the local higher education sector are active participants in the overall ICT planning efforts in Pine Bluff. The establishment of the CISSE program at the University of Arkansas at Little Rock (within commuting distance from Pine Bluff), and commitment of resources to develop related degree programs at SEARK (South East Arkansas Community College), are intended to build the reservoir of critical jobs skills that will be needed to support the growth of the region. High visibility given to these program in local press and on billboards, etc help to spread this vision throughout the community.

10. *Because of the long-term and expensive nature of ICT, vision and leadership are critical success factors.*

False. A shared sense of purpose among the leaders of the various sectors has maintained momentum for the project, yet the project has not yet succeeded.

KANSAS

Hays, Ellis County

1. Context

Founded in 1867 along the Kansas Pacific Railway, Hays, Kansas has its origins in the nation's westward expansion.[1] It took its name from Fort Hays, which was constructed after Fort Fletcher, a structure erected two or three years earlier on a site some 15 miles away, and destroyed by a flood. Within a year of its founding, Hays' population exceeded 1,000. In its early days, the town was home to General George Custer and the Seventh Calvary, James B. "Wild Bill" Hickok, Calamity Jane, and William "Buffalo Bill" Cody. Site of the original Boot Hill, it was a rough town, with its share of famous saloons and dance halls, not infrequent shoot-outs, and questionable administration of justice. Relations between the town and troops at the fort were rocky at best, erupting into armed conflict on at least one occasion after townspeople lynched several soldiers from an all-black unit.

Lawless behavior likely reached its peak while the city served as the terminus of the railway. Once the line was extended further westward, the attractiveness of

Table A.5
Demographics for Ellis County, Kansas

Population, 2000	27,507
Median household income, 1997 estimate	$33,279
Educational Attainment, High School or higher, 1990	80.6%
Educational attainment, Bachelor of Science or higher, 1990	23.4%
Poverty rate, 1997 estimate	11.2%
Unemployment rate, 2000 annual	2.6%
Per capita personal income, 1999 estimate	$24,669
Homeownership rate, 2000	63.3%
Percent Ethnicity, 2000	
White	96.1%
African-American	0.7%
Hispanic	2.4%

Sources: U.S. Census Bureau, U.S. Department of Labor.

[1] Thompson, Mary Ann, "Hays, Kansas History," www.ukans.edu/~hersite/kcn-2/hays/hayshist.html viewed 8/5/00. Other sources utilized in this section include "Our History, Heritage, Festivals," www.visithaysks.net/history/history.htm, viewed 8/6/00; and "Kansas History," skyways.lib.ks.us/history.

Hays to "those desperate and lewd characters who always desire to live on the line between civilization and barbarism, where they can carry on their nefarious practices undeterred by law and unchecked by restraint" was reduced.[2] In the mid- to late-1870s, Hays was settled in earnest by German immigrants from Russia's Volga region, who brought with them a hardworking tradition that would become the city's (and Ellis County's) economic mainstay.

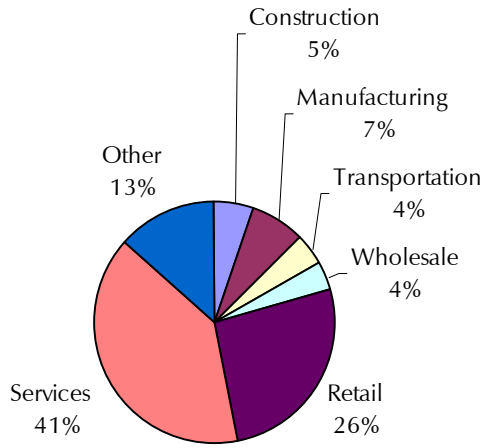
The city of roughly 18,000 is located in the center of 900 square mile Ellis County (population 26,000), on Interstate 70, 270 miles from Kansas City and 340 miles from Denver. Freight hauled via truck out of Hays takes five days to get to Atlanta or Los Angeles, four days to get to Chicago and Minneapolis, and three days to get to St. Louis. Rail-hauled freight to the same locations takes a day or so longer. United Air Lines (through Great Lakes Aviation's United Express) and U.S. Airways provide passenger service into Hays Municipal Airport, with daily flights to Kansas City and Denver. The airport built a new passenger terminal in 1992 and recently acquired full instrument landing facilities, permitting landings in almost any kind of weather.

Hays adopted the commission-city manager form of government in 1919, with the commission appointing the manager and one of the five elected commissioners serving as mayor on a rotating annual basis. The city has adopted zoning and maintains a comprehensive plan. General economic development efforts are led by the Ellis County Coalition for Economic Development, with the Hays Area Chamber of Commerce providing additional support, particularly for downtown business concerns. The city enjoys exceptional health services for a town its size through the Hays Medical Center, a regional hospital serving greater northwestern Kansas. Fort Hays State University (FHSU) and North Central Kansas Technical College are local post-secondary education options. With four colleges and a graduate school, over 300 faculty, and some 6,000 students, FHSU offers a wide range of educational programs from traditional arts and sciences to business, education, and health and life sciences.

Much of Ellis County is level prairie, although there are minor variations in land features, such as bluffs along the Saline River. Historically, the raising of crops in northwestern Kansas has met with mediocre results or outright failure. While the soil can be highly productive under good climatic conditions, the most profitable agricultural enterprises in Ellis County are sheep and cattle ranching; the rich buffalo grass provides excellent grazing for stock year round. Lack of consistent rainfall means that corn cannot be raised in any abundance on a regular basis, thus making hog farming largely infeasible. Artificial forestry also has been tried with little success. The county does have oil and gas. In 1999, some 1,700 wells produced 2.5 million barrels of oil (bringing its cumulative production total through 1999 to 456.9 million barrels), making Ellis the largest oil-producing county in Kansas.

Hays and Ellis County have emerged as a major service and distribution hub in northwestern Kansas, particularly as smaller surrounding communities have declined with on-going consolidation in the farm sector, the shrinking mining industry and long-

Figure A.4
Ellis County Business Mix, 1999 estimate



Source: Bureau of Economic Analysis; total full-time and part-time employment by industry.

[2] Cutler, William G., History of the State of Kansas (Chicago, IL, A.T. Andreas, 1883), www.ukans.edu/carrie/kancoll/books/cutler/ellis/ellis-co-p3.html, viewed 8/5/00.

term out-migration. Based on 1997 Bureau of Economic Analysis figures, services industries employ 33 percent of the work force in Ellis County, followed by retail trade (20 percent) and government (17 percent). The manufacturing sector accounts for just 7 percent of county employment. Only some 841 people in the county are employed in the farm sector, roughly 4 percent of the work force. The largest employers in Ellis are Fort Hays State University and the Hays Medical Center, both of which employ some 800, while the Hays School District employs another 600. Yuasa Exide Battery of Hays, a manufacturer of lead-acid batteries, employs 475. Telecommunications company Sykes Enterprises, Wal-Mart, automotive parts maker Adronics, and retailer Dillons employ 400, 315, 255 and 230 respectively. The mining industry, which now employs fewer than 1,000, has been declining steadily since the early 1980s.

Traditional infrastructure in Hays is solid. There is plenty of vacant industrial land and a quality road network. The quality of life is high, particularly for families seeking a small-town atmosphere, low crime, and good-quality primary and secondary schools. The primary limitation on further growth is water. Hays is too far west to access existing surface water supplies and too far east to tap the largest Plains aquifer. In the early 1990s, wells in and around Hays were running dry. The city introduced dramatic water conservation measures and passed a half-cent sales tax to fund a search for additional supplies. Hays took only two years to reduce its water consumption by 45 percent.

The search for additional supplies led, in January 1995, to the purchase of a ranch about 85 miles to the south in Edwards County for $3.5 million. Water will eventually be piped from the ranch, which is jointly owned with neighboring Russell County (Hays and Ellis have an 82 percent stake). Nevertheless, the continuing scarcity of water, as well as poor water quality as a result of the heavy use of fertilizers and pesticides some years ago, act as natural checks on the size of Hays. Certainly the city and county cannot afford to develop or recruit industries with heavy water demands.

2. Nature of the Intervention

Four major factors have contributed to the development of IT infrastructure in Hays: Fort Hays State University's efforts to establish teaching and research in the IT field and to stem declining enrollment through distance learning; the emergence of Hays Medical Center as a extra-regional health provider at the forefront of rural telemedicine; the growth of several small, local telecommunications companies and ISP providers; and the location of call centers, particularly Sykes Enterprises Incorporated, a large in-bound call center that provides third-party computer hardware and software support.

Although the constellation of expanding IT-related activity led to an attempt to provide strategic direction in the mid- to late-1990s (dubbed the Information City Initiative), much of what has happened in Hays is not a result of a coordinated citywide effort. Rather, dynamic individuals and agencies began utilizing information technology extensively to meet their own goals and objectives. The unique nature of the infrastructure, including its network qualities, human capital requirements and economic potential subsequently encouraged different agencies and organizations to collaborate on IT issues. The activity has also increased demand for IT services, making increased infrastructure investment by telecommunications companies possible.

The emergence of information technology both as an industry and resource in Hays must be viewed against the backdrop of significant economic distress in the mid-1980s. In November 1984, with oil prices per barrel up around $30 and the city enjoying an economic boom, Travenol Labs, a maker of plastic medical products, announced it was moving its operations to Puerto Rico. The closure resulted in a loss of some 700 well-paying jobs. (At its peak some years earlier, Travenol employed 1,200, so losses had already occurred.) A year and half later, the collapse of the OPEC cartel drove oil prices to an all time low near $11/barrel, leading to work force reductions by major oil companies in the area and a near elimination of independent wildcat operations.

The migration response to the decline was swift. Many of the younger families among the Travenol

work force moved away, most to Wichita or Colorado's Front Range. The oil collapse was felt in some direct unemployment, falling property values (which were inflated by the previous boom), and job losses in indirect and tertiary sectors. After averaging 3.4 percent during the first half of the decade, the rate rose to 5.0 percent in 1985 and then 8.2 percent in 1986. It fell back to 5.4 percent in 1987 and below 4.0 percent the following year.[3] Ellis County's population shrank by 6.7 percent over the period 1986 to 1988; subsequent slow growth meant that total population did not recover to its 1988 level for 10 years.[4] During the peak of the oil boom (early 1980s), Hays was experiencing 110–140 housing starts per year. In 2000, roughly 15 years after the collapse, housing starts were around 40–50 per year.

The 1980s economic crisis led many in Hays and Ellis County to re-examine the area's economic base and to identify ways in which the economy might be diversified. It was at that time that city, county, university and other officials engineered the creation of the Ellis County Coalition for Economic Development, a public-private partnership funded through contributions of the city and county as well as private subscriptions. The Coalition completed its first strategic plan in 1988. In 1992, it released a second strategic plan — its first effort to include strategies to develop information technology/telecommunications industries. The activities of the coalition and City of Hays in the area of telecom-related development was based on projections that such jobs would be increasing rapidly, be higher paying, require people with good work ethic and little accent. In this regard, FHSU researchers were instrumental in convincing officials to focus on IT.

Fort Hays State University. An important leader of the early IT-related initiatives in Hays was Fort Hays State University, which was suffering from severely declining enrollment related to Hays' economic troubles as well as decline in the surrounding western Great Plains. The university also had difficulty retaining students for four years; most of the top students from the area would attend FHSU for two years and then move on to University of Kansas in Lawrence or Kansas State in Manhattan. FHSU officials were concerned not only with the immediate impact of the enrollment declines on the university, but also the negative indirect and induced effects the decline would have on the community (through reduced purchases by FHSU and its students).

FHSU, led by its President Edward Hammond (who was named in 1987 in the midst of the economic crisis; Dr. Larry Gould was also a key player), began a major effort to integrate information technology in the curriculum, classrooms, labs and offices. The university established a Department of Information Networking and Telecommunications and made IT a focus of its Docking Institute of Public Affairs. The latter initiated an annual conference on the role of IT in rural America (dubbed the Telepower Conference). In searching for ways to help western Kansas diversify its industrial base, Docking researchers became convinced diversification would only be possible with adequate IT infrastructure.

FHSU convinced AT&T to place a point of presence in Hays, providing space for switching facilities so the company could serve more of northwestern Kansas. The utilization of telecommunications capacity by the university made it feasible for Southwestern Bell to upgrade facilities that would then serve the rest of Hays and surrounding communities. FHSU also worked with major utilities, Kansas Corporation Commission (KCC), and independents to improve facilities and infrastructure. Because most telecommunications companies are investing in infrastructure with future, rather than current, revenue streams in mind, the position of the university as a major consumer is important.

The importance of public-sector demand is also evident with respect to the state's two-way interactive video network, which connects schools throughout much of the state and makes distance learning possible. Profits on IT services to outlying areas are marginal; the telecommunications companies' purpose in supporting distance learning through infrastructure investment is to strengthen educational

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[3] Bureau of Labor Statistics, stats.bls.gov.

[4] United States Census Bureau, www.census.gov.

offerings in western Kansas, retain population (or at least stabilize the population), and therefore sustain or even grow demand for other telecommunications services.

FHSU also worked with the City of Hays on the student retention issue. In 1988, Hays established a scholarship program to help the university recruit and retain students for full four-year degrees. The Silver Scholarship Program provides FHSU with $100,000 annually; the university has used funds to help make IT as well as other programs more attractive to students.

Hays Medical Center. Concurrent with the university's initiatives, Hays' medical community's expertise in telemedicine was expanding dramatically. Hays was once served by two hospitals, Hadley Regional Medical Center and St. Anthony's Hospital, and served as a regional center for specialized medical care. In October 1990, the two hospitals began a merger, eventually leading to the loss of over 100 jobs and resulting in the consolidated Hays Medical Center (HMC). HMC has a long history of the utilization of information technology to cooperate with other hospitals. It maintains a centralized billing and payroll system that some 40 or 50 other hospitals utilize, thus allowing many smaller institutions to take advantage of state-of-the-art data processing.

But it is in the area of telemedicine that HMC has really made its mark. Dr. Robert Cox, current Medical Director at HMC, had pioneered telemedicine technologies and applications while in Hays and in association with the University of Kansas. HMC now has the capacity to place communications equipment in rural homes for $700–$750, allowing doctors to assess patients' progress, monitor medication dosages, and provide advice at a cost of roughly $35 per "visit," versus $90 per visit for the typical in-person examination. HMC's telemedicine capacity has also helped retain doctors in small, rural communities. Physicians feel less isolated if they can communicate with specialists at HMC and order tests easily. By moving information, HMC helps keep doctors (and patients) in place.

The recent establishment of the Michael E. DeBakey Heart Institute of Kansas at Hays Medical Center had a lot to do with the telemedicine capability at the medical center. The DeBakey Institute gives HMC a key specialization and is also instrumental in the community's efforts to attract retirees to the area. The strategy of recruiting retirees to Hays stands a good chance of success given the high quality of medical care, low cost of living, proximity to the university and its cultural and educational offerings. Telemedicine has thus generated an indirect economic benefit for Hays and the surrounding region.

The Information City Initiative. With the information-related activities of FHSU and Hays Medical Center, as well as the glaring need to diversify the area economy, a critical mass of Hays citizens and officials began to see the value of establishing a formal plan to make information and information technology the future of the city. The city's 1994 Strategic Plan states that Hays would aim to be "a city with special adaptation and skill in using information in networks to increase economic, cultural, medical and educational opportunities. Hays [would] contribute to [the] regional community through leadership as 'an information city.'"[5]

By the end of 1995, the city had formed an Information City Advisory Group (ICAG), a committee of more than 70 people from various businesses and other organizations in Hays and Ellis County. Leaders of the advisory group were Brad Boyer, president of Sensory Perceptions Internet, Inc.; Robert Cox of Hays Medical Center; Jay Gillette, then associate director of the Information Networking and Telecommunications Program at FHSU; and Gary LeCount, principal of Jefferson Elementary School. Also heavily involved were city manager Hannes Zacharias and three additional FHSU faculty: Mike Leikam (Information Networking and Telecommunications Program), Mark Bannister (Docking Insti-

[5] As quoted in Thomasson, Rod, and Nancy Selbe, 1997, *Successful Rural Information Networking: Case Studies in Economic and Community Development through Telecommunications*, Docking Institute of Public Affairs, p. 30. This section draws heavily from Thomasson and Selbe's historical account of the Information City initiative.

tute), and Larry Gould (Dean of the College of Arts and Sciences).

The group held regular meetings, organized five subcommittees (in the areas of civic and cultural activities, economic development, education, healthcare, and human services), and essentially served as a mechanism for inter-institutional collaboration on various information-related initiatives. Notable in the effort was the comprehensive approach to information and its social and economic implications. The initiative did not attempt to define information technology and networks strictly as a means of developing a high-technology industrial base, but rather as an important element of the quality of life of Hays citizens — thus the focus on improving civic participation, healthcare availability, education and basic services.

Among practical interventions, the ICAG was instrumental in initiating an Ellis County home page, modifying the Ellis County Economic Development Strategic Plan to target the information industry, developing a community e-mail directory and pressing local businesses to adopt use of the Internet to improve their competitiveness. The visibility of the ICAG and the general enthusiasm it helped sustain is also credited with encouraging the development of additional Internet services providers in the community.

In the end, the lack of a clear action plan, a single director, staff, and resources led to the gradual demise of the Information City Initiative, or at least the regularity of the meetings of the ICAG. According to a recent study, the ICAG played an important role as a catalyst. But as a voluntary effort, the Information City Initiative could not be expected to undertake any major actions. The ICAG was most active between 1995 and 1997, a period in which a number of information-related projects were launched, not least of which was the emergence of the community's nascent telecommunications industry with the arrival of Sykes Enterprises.

The telecommunications industry. Outside of Internet service providers, cable companies, and other suppliers of basic IT services, the telecommunications industry in Hays consists of call centers. Call center activity in Hays began around 1991, when Rural Telephone initiated an effort to put a call center on the edge of its territory in Victoria. The first tenant company in the facility paid wages $0.75 to $1 above minimum, and though that was not a substantial increase over typical jobs in the county, officials were still intrigued by the prospect of attracting similar enterprises. The facility, still owned by Rural Telephone, consists of 75 call stations. The current company in the facility is Contact America, a La Jolla, California-based company that provides e-commerce and in-bound/out-bound telemarketing services (e.g., sales, order processing, surveys and marketing, etc.).

Undoubtedly Hays' biggest success in attracting telecommunications companies, and the initiative — along with the IT programs of the university and the telemedicine expertise of Hays Medical Center — that put Hays on the map as a center IT-related activity in the Plains, was the recruitment of Sykes Enterprises Incorporated. Sykes is a provider of third-party computer hardware and software technical support for, among others, Compaq, IBM and Intuit. The story of Sykes' location in Hays is part serendipity and good luck, part regional advantage, and part old-fashioned economic development legwork and investment.

In the early 1990s, Sykes' only call center facility was in Sterling, Colorado. That operation had been started by Dan and Lori Jones, who were originally from Sterling and had returned there after working and living on the east and west coasts. While their concept of third party technical support was working, they were cash poor and had little prospects of expanding significantly. Lori Jones happened to sit next to John Sykes on an airplane and struck up a conversation that would eventually lead to Sykes buying the company. Sykes had the capital to develop the company in earnest.

In September of 1995, Lori Jones called Mark Bannister of the Docking Institute of Public Affairs and notified him that Sykes was looking to locate two additional call centers, each with approximately 425 to 435 workstations. In the fall of 1993, the Docking Institute had recognized three rural telecommuni-

cations success stories as part of its annual Telepower conference. One of those was the Jones' Sterling operation. Thus Jones knew Bannister as well as something about the characteristics of Hays and the resources of the town and university. Sykes was interested in Hays because of the Information Networking and Telecommunications degree program at FHSU, as well as the fundamental advantages of a Plains location: comparatively low-cost labor, an absence of accents, and a willingness of the community to meet infrastructure demands.

In September of 1995, six officials from Hays and FHSU visited the Sykes center in Sterling. They returned convinced it was the type of development that could benefit the Hays community. By February 1996, they had met with the Sykes site selection person and determined the company's needs and demands. Specifically, Sykes wanted $2 million in cash to construct the building, five-year tax abatements, and funds for training. In a very short period of time, city and county officials had assembled an incentives package that essentially met those demands. Notably, roughly half of the $2 million grant was generated through donations solicited from private businesses and citizens in Hays.

Sykes opened in October 1996. While the facility ramped up faster than expected, wages have not attained projections. In late 2000, the starting wage at the facility is $7 per hour. Studies by the Docking Institute have found that for workers there over one year, average wages were slightly over $10 per hour. In general, entry-level employees at Sykes must have basic computer skills and good customer service aptitude. Familiarity with the Windows operating system and some keyboarding and mouse skills are mainly all that is needed. Workers are supplied with a couple of weeks of intensive training when they start. FHSU students constitute many of the workers at Sykes. Several members of the management team are also Hays locals that have worked up the job ladder.

On the whole, the incentives provided to Sykes have been regarded as well conceived. A 1999 Docking Institute study found the present value of benefits accruing over the period 1996 to 2005, net of the initial investment, to be $8 million for the state of Kansas. The study also found that 84 percent of Sykes' employees live in Ellis County, 80 percent in Hays. For 59 percent of employees, Sykes is the sole source of family income.[6]

3. Impacts of the Intervention

Hays, Kansas, is a national leader among rural communities in information technology infrastructure and usage. With early and affordable Internet access provision, a comparatively extensive optical fiber network, several small telecommunications companies making determined investments in a combination of cable and fiber technologies, and three major institutional consumers of IT in the community, the small town of 18,000 is well positioned to benefit from the information technology revolution. While Hays is like many other Great Plains communities in its need to minimize the negative cyclical effects of the agricultural and oil industries by developing a more diversified economic base, it may be unique in its early commitment to utilize IT to improve the quality of the life of the community and to create wealth.

Hays is now in a position to utilize its IT strengths to pursue traditional economic development objectives. Indeed, buoyed by the town's success in attracting Sykes, the Ellis County Coalition for Economic Development is actively recruiting other IT-related companies. However, it would be a mistake to interpret IT in Hays as simply another lever for direct job creation (or an "attractor" for footloose, IT-sensitive companies). Far more important to date has been its role as an enabling technology for better education, healthcare and civic affairs. It has strengthened FHSU, helped ensure Hays Medical Center's position as a leading regional hospital in central and western Kansas, improved the viability of peripheral agricultural communities by providing a mechanism for the delivery of sophisticated services, and enhanced the capacity of Hays residents to be savvy consumers and informed citizens.

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[6] Gilson, P., and J.A. Aistrup, 1999, *Sykes, Inc. Economic Impact Analysis*, Docking Institute of Public Affairs.

In the words of Dr. Robert Cox, medical director at Hays Medical Center and a national expert on telemedicine, IT is helping Hays and its surrounding hinterland to be better "resource stewards," i.e. to counteract the lack of size and limited prospects for population growth by utilizing all available resources to their full. Such efforts help ensure a high quality of life and measure of economic stability without the quantitative increases in size and population that elude much of the Great Plains.

Low-cost dial-up access is available from multiple providers in the county, FHSU offers access for its students and staff, and free access (complete with training) is available at the public library. All offices in City Hall have Ethernet access, a rarity for a community with Hays' size and rural location.

Sykes constitutes a major customer of IT services, but it is not the only game in the area. Cellular One opened a small call center in 1996, while Classic Communications, a company providing cable service to rural communities in ten states, runs a call center in Plainville, about 30 minutes outside of Hays. IT infrastructure and services in the community continue to expand. In the mid-1990s, telecommunications services company Eagle Communications was stringing fiber loops through the community to serve businesses and households. As a result, fiber rings serve a good share of Hays. However, Eagle eventually determined that extending fiber was too expensive given demand. The company is now focusing on DOCSIS technology, or data transmission via cable. While the City of Hays has not been aggressive in working with Eagle to develop IT infrastructure, Hays Medical Center has. Eagle also maintains the local Interactive Television Network (ITV).

The Ellis County Coalition for Economic Development is now trying to leverage the Sykes success, as well as the relatively abundant complement of IT infrastructure, into the development of other IT-using industries. Southwestern Bell ran fiber to Sykes site (some 75–80 strands of fiber service), and the industrial land in the immediate vicinity has been dubbed the Hays Fiber Park. It is, in fact, one of Southwestern Bell's first so-called "fiber parks" located in a rural community. A continuing concern is that there is currently only one IT route into and out of Hays. Ultimately, the delivery of high quality, reliable IT services demands redundancy in connectivity to other communities both to permit a higher level of service and to reduce risk of downtime. Nevertheless, together with the sophisticated use of IT by the Hays Medical Center, clear expertise and unique training programs at FHSU, and relative abundance of aggressive telecommunications companies, officials in Hays and Ellis County believe they can justifiably lay a claim to be a leading center of IT related activity in the rural Great Plains.

Other comments and insights

Interviewees were asked to identify the role, if any, for government in the development of IT infrastructure and the provision of IT services. Respondents were asked to focus specifically on the federal role, although many also identified actions local and state officials should take. The following are implications and recommendations as supplied by the interviewees.

- Carriers must be provided an incentive to get service established. Southwestern Bell, which had Hays locked up before deregulation, determined that providing services to outlying areas was not feasible. Independents can go into communities to provide high speed bandwidth if there is funding to offset costs. In this part of Kansas, customers are an average of 3.7 miles apart. Providing fiber with such a dispersed population is prohibitively expensive.

- Hays should develop appropriate infrastructure so that multi-establishment companies that locate in the area will be able to network to their other divisions. Hays is not likely to attract a headquarters facility given its location and mix of amenities. At present, despite the growth of IT infrastructure here in the area, it is still difficult for Hays and Ellis County to attract mid-sized companies that require loose inter-company access via

Internet or other telecommunications technologies. This despite the growth of IT infrastructure in the area.

- Air access is a critical issue for Hays. Commuter airlines currently offer four daily flights out of Hays Municipal Airport, made possible through FAA subsidy programs. It is imperative that air service be maintained and even expanded. A current problem with the airport is resources for maintenance. The airport has not yet hit the passenger thresholds necessary to garner additional FAA funds.

- The region needs a grant or low-interest loan program–or more traditional infrastructure resources from the Economic Development Administration to be able to compete for companies. There is a need for traditional forms of support (site preparation, infrastructure) along with the dedicated programs (whatever they might be) for growing high-tech, IT-based industries.

- EDA must recognize that communities are increasingly pressed to provide cash outlays to companies, in addition to abatements, in-kind training services and the like. If communities the size of Hays are to compete in this environment, there must be some kind of direct grant program to allow them to put together an attractive incentives package. Either that, or the federal government must seek to curb incentives.

- Kansas should permit local governments to abate taxes for service businesses. The prohibition on such abatements has been a serious problem in attracting telecommunications/IT businesses.

- An issue that remains unclear in Hays is how large the city should become. Water remains a constraint. There needs to be a dialogue among city leaders and citizens regarding the objectives of programs designed to generate economic activity. Call center managers may oppose efforts to attract new industry, fearing that a tighter labor market will drive up wages. The bias in development policy toward quantitative growth is inappropriate for much of Plains. Even small telecommunications companies and ISPs would settle for stabilizing — rather than growing — the population in the Great Plains.

- Agriculture is still the primary economic base of western Kansas. It is important to retain population in rural parts of Kansas. That means keeping agriculture viable and providing health services.

- A key problem with telemedicine right now is that Medicare reimbursements for telemedicine services are inadequate. They will reimburse some procedures but the process of obtaining reimbursements is so onerous that they deter further development of telemedicine applications. Some estimates show telemedicine services can be offered for almost a third of the cost of delivery in person. Quality of life could be improved for populations in outlying areas by the extension of telemedicine.

- Universal Service Funding (USF), or E-rate, is used to fund technology infrastructure in support of the schools. A concern with the program is that access to those funds depends on school lunch participation (an indicator of poverty). Many rural communities, particularly in the Great Plains, do not have a lot of kids on school lunches, yet the families do not have enough resources to buy computers for the home, subscribe to an ISP, etc. The problem is compounded by the relatively high cost of telecommunications services in the sparsely populated Plains region. Thus the E-rate program disadvantages the

Great Plains with respect to obtaining necessary support for infrastructure.

- The federal and state government must ensure programs are technology neutral at a minimum, so not to favor one type of technology (e.g., wireless, cable, fiber) over another. Let the market determine the most cost-effective and highest-quality services by making sure various public-sector programs do not bias technology acquisition, perhaps leading to lock-in of sub-standard technologies.

- Because the education lobby is stronger than the health lobby in garnering resources for the development of IT infrastructure resources tend to go toward education before health. An example is the E-rate program itself. The health industry must be more aggressive in seeking support for infrastructure development that will further telemedicine goals.

- The public sector should do better in training individuals and companies to utilize technologies. Those users will then demand the most cost-effective infrastructure that is appropriate for their situation. Government should not adopt a supply-side approach — i.e. select a technology and encourage its development — but rather a demand-side one. There should be a greater emphasis on users rather than providers in public policy.

- A problem for some call centers in Hays is the lack of affordable childcare. Many call center employees are working parents, often women. One useful initiative might be the development of a child care center that could be shared by multiple companies — i.e., jointly funded, perhaps with some public support.

4. Testing the Study Hypotheses

1. *Enabling infrastructure (roads, water, sewer, etc.) is necessary but not sufficient to assure the effectiveness of technology infrastructure investment.*

True, although effectiveness may not be the right term in Hays' case. It is the case that Hays would not attract additional IT-demanding or IT-related activity without sufficient basic infrastructure, such as water, roads, and sewer. Perhaps the most important enabling infrastructure in this case has been education: the combination of quality primary and secondary schools (and a small-town way of life) and FHSU makes Hays extremely attractive for call centers and other back office services. So if the IT is designed to generate economic activity (that is the definition of effectiveness), the hypothesis holds. If effectiveness is defined in terms of the IT service itself, Hays is in fact utilizing IT to overcome other infrastructure and locational deficiencies. For example, it cannot cost-effectively provide direct healthcare for people in remote corners of northwestern Kansas. Therefore, it utilizes telemedicine technologies for the purpose.

2. *Investments in technology infrastructure must be part of a local planning process to succeed.*

Mostly true, if it is admitted that much "planning" is actually the result of concurrent activities of multiple agencies and individuals. In Hays, the only coordinated planning effort in the IT area was through the Information Technology Initiative. But that initiative lacked any significant resources and served primarily as a cheerleader and forum for collaboration. In fact, much of the IT infrastructure and initiatives undertaken in Hays were are result of two major IT-demanders — FHSU and Hays Medical Center — undertaking investments and developing programs to serve both their own interests and Hays' interests. Thus in Hays' case, a formal local planning process was not critical to the emergence of IT that has occurred there.

3. *A certain density or critical mass is required for information and communications technology (ICT) to work, because of the cost of provision.*

Somewhat true; additional research is needed to evaluate the hypothesis fairly. It is true that Southwestern Bell and other telecommunications companies are making investments in northwestern Kansas in anticipation of growth in future demand. What was unclear in the course of the case-study research was how much of that investment was indirectly subsidized in some form. At least one respondent (Jeff Wick of Nex-Tech) emphasized that low densities mean that smaller telecommunications companies cannot afford to provide state-of-the-art facilities to outlying areas (see policy recommendations below). It may very well be the case that the emergence of wireless may eliminate spatial density as an issue altogether, a point raised by several interviewees in Hays.

4. *Technological innovations and advances are reducing the costs of communications and linkages.*

True. The cost of serving Hays continues to fall for telecommunications companies as better technologies evolve (e.g., DOCSIS). Whether costs have fallen far enough is another issue.

5. *Institutional mechanisms must be in place to help users deploy the hard infrastructure appropriately.*

True, but public-sector programs must be careful not to bias technology choices in one direction or another based on pre-conceived notions of "appropriate" deployment. The user knows best what kinds of infrastructure will best suit his/her needs. In Hays, both FHSU and Hays Medical Center had specific needs that they worked out with the telecommunications providers. Likewise, the Sykes facility and new fiber park. Smaller businesses may have difficulty deploying the new technologies effectively, but the telecommunications services companies themselves have strong incentives to demonstrate the value of various applications. However businesses will not recognize the benefits of IT if they have imperfect information. There may be a role, in such a case, for public-sector intervention to make sure all enterprises are aware of the possibilities of IT for lowering costs, improving competitiveness, etc. There also may be a role for broad-based training programs targeted to consumers, teachers and small-businesses. But such programs must be careful to be as technology-neutral as possible.

6. *Some hierarchical coordination or linkages among national, state and local governments are important for a community to be truly "connected."*

Somewhat false: Hays government agencies are utilizing IT to tap into existing intergovernmental networks.

7. *Linkages among government, education and industry are a critical success factor for ICT interventions. State policies and corporate actions are important determinants of local "success."*

Mostly true. What characterizes the Hays case is the high degree of cooperation among business, education and governmental organizations. There are also some state policies that have affected ICT activities in Hays, including the lack of a statewide ICT strategy and prohibitions against granting tax abatements for services industries.

8. *Infrastructure providers must be a partner in assessment and planning, not just the spending, for the intervention to succeed.*

Clearly **true** in Hays, particularly in the case of initiatives at FHSU and Hays Medical Center. A close partnership was also important in bringing fiber to the Sykes site and the creation of the fiber park.

9. *Work force development is a critical complement to any infrastructure intervention.*

True. The training capability of the Hays and Ellis County area — principally through FHSU — was

critical in attracting call centers. Telecommunications services companies in Hays generally see the quality education system as a major asset. Targeted training, e.g., at the level of the community or technical college, was not as important. Facilities of the NCK Technical College are relatively limited. More important was a work force with quality basic skills (i.e. solid primary and secondary education) and a good work ethic.

10. *Because of the long-term and expensive nature of ICT, vision and leadership are critical success factors.*

Undoubtedly **true** in this case, though the leadership did not originate with public-sector development agencies or city officials. The hospital and university were the major drivers of ICT development in Hays and they exerted pressure on the city and county to follow suit. Indeed, the leadership of two major users of ICT — rather than agencies seeking to build a class of users — may have been one of the most important determinants of ICT success in Hays.

MASSACHUSETTS

Springfield, Hampden County

1. Context

Since the American Revolution, Springfield, Massachusetts and the surrounding Pioneer Valley has been among those United States geographic regions experiencing the deepest and most rapid economic transformations in the nation's history. In 1777, George Washington designated Springfield the fledgling democracy's first national arsenal for storing and protecting munitions. The town, overlooking the Connecticut River, was ideally situated for transportation access at the junction of a north-south river and a well-established east-west roadway. Ready access to raw materials and skilled labor added to the attractiveness of Springfield's location for the munitions industry so the manufacture of weapons began quite naturally in 1795. In 1797, the arsenal was designated by Congress as the Springfield Armory, which for nearly a century, served as the nation's principal national armory for research, design, and arms manufacture.

Following the War of 1812, the design and production processes of weaponry evolved as a model for quality manufacturing. Visitors from around the world came to Springfield to learn about modern manufacturing techniques. The armory became the core of the surrounding region's economy, which when combined with the light manufacturing infrastructure supporting it, came to dominate the region's entire economic base. Throughout the 1800s, Springfield was

Table A.6
Demographics for Hampden County, Massachusetts

Population, 2000	456,228
Median household income, 1997 estimate	$36,746
Educational Attainment, High School or higher, 1990	73.6%
Educational attainment, Bachelor of Science or higher, 1990	17.6%
Poverty rate, 1997 estimate	16.6%
Unemployment rate, 2000 annual	3.5%
Per capita personal income, 1999 estimate	$27,361
Homeownership rate, 2000	61.9%
Percent Ethnicity, 2000	
White	79.1%
African-American	8.1%
Hispanic	15.2%

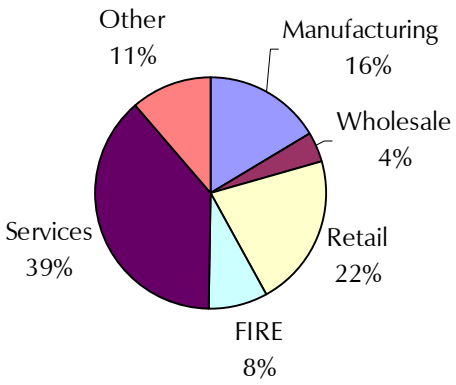
Sources: U.S. Census Bureau, U.S. Department of Labor.

the core of arguably the first and one of the largest industrial centers in the nation. When Harpers Ferry was destroyed in the Civil War, the Springfield Armory became the only federal manufacturing facility of small arms until well into the twentieth century. As the twentieth century dawned and as two world wars and the growth of the military ensued, the regional economic dominance of the Armory endured. For example, every M16 rifle used in World War II was assembled in the Springfield Armory.

The availability of manufacturing skills and machine tools for munitions gradually spawned the manufacture of other products as well, such as typewriters, bicycles and sewing machines, but the region remained principally dominated by the arms manufacturing business. As the United States military industrial complex grew in the post-World War II period to its peak during the Cold War, and as the nature of modern weaponry evolved quickly during that period, the defense industry boomed and the Pioneer Valley enjoyed new growth in aircraft and other defense-related industrial activities.

The armory, which had seeded much of the region's defense-inspired growth, had evolved away from manufacturing, but the facility was not as well suited to the newer mission of research and design. The Pentagon's decision to phase out the Springfield Armory was announced in 1964 and it was eventually closed in 1968. The closure was an ominous early milestone in the beginning of a dramatic regional economic downturn, as the region fell victim to international competition and successive waves of downsizing and manufacturing plant closures. By the 1980s the region had experienced a 40 percent decline in employment. Finally, as federal defense spending was cut back substantially in the late 1980s and early 1990s, the Springfield region emerged in the early 1990s as one of the most economically distressed in the nation. Nonetheless, in the armory facility, which had become the symbol of an economic past, lay the seeds of a dramatic economic rebirth.

Figure A.5
Hampden County Business Mix, 1999 estimate



Source: Bureau of Economic Analysis; total full-time and part-time employment by industry.

When the 55-acre Springfield Armory was closed in 1968, the facility was divided gradually into three parcels. The first was a historical compound honoring the unique role of the facility in American history; the compound ultimately became a National Historic Site in 1974. The second parcel became the home for the new Springfield Technical Community College (STCC), the twelfth of the Commonwealth of Massachusetts' growing portfolio of currently 15 community colleges, and to this date the only technical community college in the state. The third parcel became the site for a major manufacturing facility for Digital Equipment Corporation (DEC), which at the time was the world's second largest computer equipment manufacturer.

The federal government, through the National Park Service, retained and maintains to this day the 20-acre historical section as a National Historic Site, which includes an Armory Museum. An entrepreneurial team comprised of Springfield Mayor Charles Ryan, local industrialist Joseph Deliso, State Assembly Representative Anthony Sciabelli, and the founding president of STCC, Edmond Garvey, engineered the college's takeover of over 15 acres of the armory facility and the Commonwealth of Massachusetts supported the renovation of the new STCC facility. Finally, DEC invested over $20 million to renovate the remaining 15 acres of old armory buildings for manufacture of its mini- and mainframe computers of the early 1970s.

The new DEC facility assumed somewhat of a mantle of economic dominance in the Pioneer Valley, with dozens of supporting firms locating nearby

and vying to become suppliers to the new manufacturing activity. Again the region became dominated by and dependent upon a single major economic activity, this time the mini- and mainframe computer industry. As Moore's law[1] was proved time and time again in the computer industry in the mid 1970s and early 1980s, DEC's fortunes fell victim to the emergence of the personal computer and, despite the company's attempts to remain competitive, it began gradually scaling back the mini- and mainframe computer manufacturing activity at their Springfield facility, and eventually closed the facility in 1993.

By 1993 the DEC facility was essentially abandoned, although several small spin-off ventures from the DEC presence became residual tenants. The facility overall was put up for sale and even though it was marketed as prime real estate in the heart of Springfield, no buyer emerged in the community in the midst of a severe economic downturn precipitated in part by the facility's closure. Hence, as the 1990s opened, Springfield's economy was beset with among the highest unemployment in the nation, ranging between 7.6 and 11.8 percent between 1990 and 1995,[2] few prospects for turning the regional economy around. Indeed, as the United States economy began to emerge from a recession in 1991, the Springfield region found itself searching for tools to participate in and benefit from the longest and largest period of economic expansion in the nation's history.

The process of devising a set of economic transformation tools in the Springfield region came about as a fascinating combination of vision, luck, perseverance, and clever politics, which translated the vision into one of the most remarkable coalitions of industry, academia, and government for engineering regional economic change in the United States today. This case-study reviews the basic ingredients of this transformation, chronicles how they came together, outlines what the combination produced, and describes the resulting current conditions in the Springfield region.

2. *Nature of the Intervention*

The key to Springfield's economic rebirth in the early 1990s was rooted in a radical economic transformation that would ride the wave of the new economy as the United States emerged from the 1991 recession. The transformation began with the vision of a local educational leader and built toward success with a coalition of academic, business, and government leaders in designing the Springfield Technology Park, which emerged as a key new engine of economic growth in the region.

In 1983 Andrew Sciabelli, a faculty member of Springfield Technical Community College (STCC) and nephew of Anthony Sciabelli, one of the STCC coalition of founders, became president of the faltering college in the midst of a struggling regional economy. Sciabelli, the younger, perhaps more quickly than most in his field, recognized the value of tuning the community college's curriculum very closely to the needs of local employers, even as the economy was experiencing sweeping change, not just in Springfield, but across the nation.

STCC was among the first two-year colleges in the country to adopt economic development as part of its core mission. Sciabelli's vision was translated into an entire philosophy for the college that to this day has made it a compelling example of how education coupled with industry can become a key catalyst in regional economic development, in a manner both well suited to the region's economic assets but quite different from the path taken by the nation's great research parks, such as North Carolina's Research Triangle Park or the Route 128 corridor surrounding Boston.

In 1993, in what turned out to be a key component to Sciabelli's strategy, STCC sought to acquire

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[1] In 1965, Intel Corporation Chairman Gordon Moore delivered a speech in which he offered a memorable observation. In plotting the growth in computer memory chip performance, he noted that each new chip contained roughly twice as much capacity as its predecessor, and each chip was released within 18–24 months of the previous chip. With such a trend, he argued, computing power would rise exponentially over relatively brief periods of time, laying the way for personal and microcomputers. This observation became know as "Moore's Law."

[2] Bureau of Labor Statistics, stats.bls.gov.

the now vacated DEC facility and transform it into a technology park for "new economy" firms, particularly firms that could benefit from proximity to STCC. Sciabelli saw the vacant 15-acre DEC facility as an opportunity to leverage traditional college resources (skilled labor, work force education, and skills upgrading), new programs (entrepreneurship and a highly focused technical curriculum), a geographic concentration of resources (with STCC and the park), and a growing range of community outreach programs into new opportunities. There were many barriers standing in his way, however, and it would take successes on many fronts and at all levels of government to bring Sciabelli's vision to fruition.

As the role of advanced telecommunications networks in the United States economy has grown, locations with ready access to these networks have begun to carry a premium for many kinds of new economy firms. Springfield planners, largely through the regional planning activities undertaken by the Pioneer Valley Regional Planning Commission, discovered that the city is located at the nexus of many of the key optical data and telecommunications networks in the Northeast. Hence, a primary attraction of prospective tenants in the "Tech Park" would likely be easy and cheap access to fiber optic networks. Indeed, companies such as the Northeast Optical Network, Brooks Fiber, RCN, and others found Springfield to be an ideal location for network operations and the Tech Park provided a natural home for such operations, particularly if the park managers were willing to help with the infrastructure investments.

The entire package of network access, cost effective space, skills training capabilities tuned to the needs of new firms, business amenities such as shared support resources and parking, a supportive community government, as well as other factors comprised a compelling case for developing the Springfield Technology Park. Sciabelli began to formulate the plan for implementing the Tech Park, but there were many other worthy causes before the Massachusetts legislature, where Sciabelli turned for help in finding financing for the development. The abandoned DEC facility, now vacant for five years, was available but needed a great deal of retrofit work to make it attractive to new firms.

Sciabelli and his project team made a convincing case of the benefits of the park to the Pioneer Regional Valley Planning Commission (PVPC) and to all who would listen. In October of 1995, following a push from local legislators, the Massachusetts legislature created the Springfield Technical Community College Assistance Corporation (STCCAC) to oversee the proposed project and eventually to administer the Tech Park. This laid the groundwork for subsequent state funding of the project. A team of eleven business and community leaders was appointed to the corporation's board, chaired by Sciabelli. STCCAC was designed to operate the park separate from STCC, which is a state entity, but be essentially controlled by STCC. The advantages of this arrangement became more and more important as the project developed. For example, since STCCAC signed the leasing contracts for park tenants, many innovative features could be incorporated in those leases to help develop necessary infrastructure that would not have been possible, or at least would have been very difficult, under traditional state leasing contracting procedures.

Since the beginning of the economic downturn that reached its depths in the late 1980s, the PVPC had sensed that this downturn was different from previous ones. It was not just a cyclical or structural recession, it was a fundamental economic transformation stemming from the changing structure of the United States economy overall. The commission had been assembling an economic revitalization plan, which it released in 1994 as *The Plan for Progress.* The plan chronicled the fundamental shifts going on in the economy in the early 1990s, differentiating it from cyclical or structural recessions of the past and taking stock of the history of the region and its potential. The plan served as a roadmap for possible development. It included 21 different strategies, covering short-, middle- and long-term needs.

In June of 1996, following, Sciabelli's proposal, the commission endorsed the Tech Park concept, included it prominently in the region's economic plan, and endorsed STCC's acquisition of the former DEC

facility. Another key feature of the planning process was the formation of teams of community leaders focusing on each strategy. Once a strategy has been enacted, the PVPC continues re-evaluating and re-engineering the strategies to address changing needs and shifting environments. For example, as the STCC incubator, the STCC Enterprise Center (discussed below) evolved as a key component in the PVPC plan, and as it has come to fruition, the plan has gradually evolved to include establishing a network of incubators throughout the region.

The PVPC plan identified the region's telecommunications infrastructure, i.e., specifically five points of presence for major network carriers, as a key asset early on in the course of its plan. Prior to recognition of it in the PVPC plan, this extraordinary asset had never been even identified, let alone analyzed for its value in spurring economic development.

With the Tech Park plan continuing to take shape, in October of 1996, as business and other community leaders continued to endorse and lobby for the project's goals, the momentum led to a $4.5 million grant from the Commonwealth of Massachusetts to purchase and begin to refurbish the former DEC facility. STCCAC assumed ownership of the property, which was purchased for $3.8 million, and the balance of the grant was used to begin refurbishing space for new firms.

The inertia of the development of the STCC Technology Park, its growing recognition as a key to future economic growth in the region, and the highly developed working relationship between the community, the STCC, and the park tenants, laid the important groundwork for a high-tech incubator. The incubator was to become the capstone to the park complex and to Sciabelli's vision of an educational and industry complex focusing on entrepreneurship.

Realizing Sciabelli's vision of an incubator began with a concept paper submitted to the local office of the United States Economic Development Administration (EDA). The concept paper outlined the key features of how the Springfield Enterprise Center (SEC) within the Technology Park and STCC complex would be structured, how it could attract telecommunications, data warehousing, call centers, and other new economy operations very competitively, and how the STCC could be an important source of skilled labor, retraining, and skills upgrading activities for resident firms.

The local EDA office was impressed with the features of the SEC concept and recommended it for consideration by the agency's regional office, which requested a full proposal including certification that the regional planning commission considered the project to be the region's highest priority. In March of 1997 STCC received a $1 million grant from EDA's 302 Program. The next month the City of Springfield endorsed the project with capital funding loan guarantees and the Commonwealth of Massachusetts provided $500,000 in capital funding. Following a local corporate capital campaign, the SEC facility renovation of one of the armory buildings was completed in the fall of 1999 and opened the 39,000 square foot incubator for business in January of 2000. The SEC is dedicated exclusively to launching new high-tech business initiatives and assisting recent start-up firms to achieve profitability. As of 2000, it housed six start-up firms with facilities for up to 20 firms with an office for pro bono business consulting services, network-ready space with fiber optic connections to all major networks, and very favorable rental rates and rent structures for new firms.

The SEC director notes that a key to the center's operation is the advisory board composed of local entrepreneurs and professional service providers who act as mentors for the start-ups. The board screens all potential incubator residents, reviews business plans, and assists in business development activities. The SEC offers all of the board's activities pro bono, and members are not permitted to be formally involved with companies until they graduate from the incubator. The board also includes representatives from the local Small Business Development Center and the Service Corps of Retired Executives (SCORE), which is housed in the SEC facility. The success of the capital campaign and the initial financing plan has enabled the SEC to operate debt-free from the beginning of its operations.

The SEC also is designed to work closely, and even co-locates with some of the STCC's educational programs such as the college's Entrepreneurial Institute, the Young Entrepreneurial Scholars program for high school students, and a wide range of continuing education programs. The Institute houses a business library and teleconferencing center, facilitates access to local banks and other capital sources, provides a service locating technically-skilled labor, and makes available a host of other services accessible by SEC tenants.

3. Impacts of the Intervention

The primary attraction for tenants to the Tech Park is the easy and cheap access to a fiber optic network. Due to geographical serendipity, Springfield sits at the nexus of a major northeast fiber network. This location has served as an attractor for companies such as Brooks Fiber, RCN, and NEON.

STCC was able to develop synergies with these companies by adjusting its curriculum and inviting the companies to sit on an advisory board that periodically evaluates and updates the curriculum. STCC is a "joiner," constantly seeking to expand and strengthen its network of associations to improve its assets. For example, it has worked closely with the NTCC to develop work force training programs (e.g., Bell Atlantic fiber crews trained at STCC) and received an NSF Advanced Technology Center of Excellence distinction.

The following benchmarks can be used to gauge the incubator's success:

- Jobs created/companies generated
- Number of people involved in supporting programs
- Ripple effect — secondary job/income creations (e.g., vendor/support services involved with companies)

The incubator (Springfield Enterprise Center) opened in January 2000 and housed six start-ups by the end of that year. Potential incubees are carefully screened by an advisory board composed of local entrepreneurs and professional service providers who act as mentors for the start-ups. The board reviews business plans, mentors start-ups, assists in business development activities. All potential conflicts of interests are avoided; all work is pro bono and no mentors may be formally involved with companies until they graduate from the incubator. An angel/VC fund is in the works.

"Opportunity" and the "spirit of the region" were mentioned as key components of the project's success. Community support included a capital campaign (led by donations from the Davis family) that has allowed the SEC building to operate debt free. "Free advertising" (lots of press coverage) was also an important factor in widespread public knowledge of and support for the project. The fact that a community college housed a technology park and has received NSF grants was particularly newsworthy.

The SEC director predicts that there will be a "ripple effect" through the region as companies graduate from the incubator, as high school students complete the YES program, and as STCC students remain in the area to pursue careers (currently about 30 percent of RCN employees and about 15 percent of other Tech Park tenants are STCC grads). SEC hopes to stimulate this ripple effect by establishing satellite enterprise centers around the region. This effort would seem to be the only feasible way for both the Incubator and Tech Park projects to expand in scope, as land at the current site is limited.

The interconnectedness of the institutions involved (network formation) is critical to the success of the project. These include

- STCC: formal academic programs/continuing education — provides/strengthens labor force
- Incubator: allows start-ups to share space/resources — advertising, insurance, trade shows, experiences
- Entrepreneurial Institute: provides training — e.g., Young Entrepreneurial Scholars program (which has kept a number of problem students in high school)

- Advisory Boards: form an informal network which guides strategy, policy and maintains close links to community

The evolution of the Springfield Technology Park is a remarkable success story and remains a key development feature of the Pioneer Valley region. The park itself is now fully leased, housing a broad spectrum of firms (see Table A-7), all of which fit into the pattern of taking advantage of the shared resources of the park, the STCC work force training and education products, and the telecommunications infrastructure. Indeed, the park is commonly referred to as a "telco hotel." The STCC has also established a routine process for adjusting its constantly changing curriculum to the needs of park tenants, which, of course, keeps its course offerings very current and ensures that its graduates are well positioned for employment in the park. Indeed, many STCC education and training programs are fully integrated into park tenant operations. Over 150 STCC graduates already work in the firms housed in the park, which comprise nearly a third of RCN's payroll and 15 percent of that of other companies.

What has emerged as a very important management feature of the park is that the facility is not managed directly by STCC, which is a state organization. Rather, as noted earlier, it is run by the STCCAC, which is independent but essentially controlled by the STCC. This organization permits much more flexibility in carrying out key aspects of running the park, especially negotiating leases, contracts and other agreements, such as for expanding the park infrastructure. Hence, as the park has evolved, the ability to expand the features necessary to attract new tenants to the park have been much easier to acquire than if they were bound by, for example, state procurement procedures. Such features include high quality and load electric power supply (now including eight back-up generators), heavy load bearing floors and tall ceilings to accommodate extensive conduit and equipment. The park also houses six telephone switches and seven levels of fiber optics throughout the facility.

To date the resident tenants of the park have invested over $225 million in build-outs and capital equipment. STCC uses creative leasing structures to

Table A.7
Springfield Technology Park Tenants*

1 Brooks Fiber, a Division of MCI/Worldcom (a telephone switching company)

2 Choice One Communications (provider of telecommunication services)

3 CTC Communications Corp/fc.com (a wide-area telecommunications provider and a provider of integrated telecommunications services)

4 Equal Access Networks (telecommunications infrastructure)

5 Excitation L.L.C. (manufacturer of lasers for medical applications)

6 FutureWorks (a one-stop career center serving jobseekers and employers in Hampden county)

7 GlobalNaps, Inc. (provider of telecommunications services)

8 R. J. Greeley Company, LLC (a full-service commercial and industrial real estate company)

9 Group Four Transducers (a manufacturer/distributor of force transducers for the weighing industry)

10 Inlight Interactive (interactive CDROM and health educational developer)

11 NorthEast Optic Network, Inc. (NEON) (facilities-based provider of technologically advanced, high-bandwidth, fiber optic transmission capacity for communications carriers on local loop, inter-city and interstate facilities)

12 RCN (Residential Communications Network) (an Internet service provider)

13 Springboard Technology (computer repair company created by former Digital Equipment Corporation employees)

14 Williams Communications (a wide area telecommunications provider and a provider of integrated telecommunications services)

*STCC Technology Park, http://www.stcc.mass.edu/techpark/, March 31, 2000.

finance capital build outs to avoid carrying debt, which is considered complicated or even precluded by government ownership. Hence, while the park is operating in the black, due to initial capital outlays being financed through the leases, it will take several years to develop the park's full revenue potential.

According to the Park's chief operating officer, the park has a "three-legged" plan for future operations:

1) To provide a major new revenue stream for the college;

2) To house key extension programs for the college, such as the Bell Atlantic sponsored fiber optics training program; and

3) To locate a high-tech incubator to build the culture of entrepreneurship and other key community outreach features of the college.

This last feature of the STCC and Technology Park complex is the key to leveraging the combination of assets to generate new value and new activity in the park and as opposed to being dependent solely upon firms relocating to the Springfield area.

The second part of the "three-legged" plan, i.e., key educational extension programs, is a particularly important new innovative feature of the Tech Park complex. Sciabelli refers to the concept as an "enterprising college." Its focus on tuning the educational activities to the needs of new businesses has many benefits and has paid off in many ways beyond making it attractive for students to come to the college and for graduates to find jobs. For example, STCC is partnering with the National Science Foundation to draft a curriculum for teaching telecommunications technologies across the United States STCC was also selected by Microsoft to train other colleges in how to teach information technologies.

Following its successes in this area, STCC created the Northeast Center for Telecommunications Technology, which is a partnership aimed at developing education programs in telecommunications as well as textbooks and educational CD-ROMs. NSF awarded the Center a $5 million grant to become the only NSF Center of Excellence located at a community college. Local businesses in the Tech Park and beyond are finding the center an invaluable resource. For example, Bell Atlantic has commissioned STCC to provide a substantial work force training program in fiber optics in an $8 million "next step" program. Indeed, businesses such as Cisco Systems, Nortel Networks, IBM, MCI WorldCom, Time Warner Corporation, Microsoft and many others have become "educational partners" in STCC's educational and extension activities.

Many in the region and beyond consider the STCC complex to be almost revolutionary in its scope. For example, in an extremely unusual move the regional business journal for Western Massachusetts, *Business West* magazine, named Sciabelli "Top Entrepreneur for 1999." The award recognized his pivotal role in revitalizing the greater Springfield business outlook. Former STCC Board of Trustees Chair Brian Corridan notes, "It's easy to be an entrepreneur when times are good. It's a lot harder when times aren't so good, but even more necessary. Watching him through those difficult years is as indicative as watching what I call the 'visionary Andy' of today."[3]

Business leaders have fully endorsed the park concept. For example Telitcom President Geoffrey Little noted that the importance of the park's location at the crossroads of the nation's telecommunications fiber optic networks "cannot be overstated." He considers it a formidable resource leading to progressive development in the park with call centers, new telecommunications carriers, and application service providers (ASPs).

Other comments and insights

In many ways the STCC has provided the impetus for a new experiment in regional economic development. Indeed, even today, STCC remains the only community college in the United States to have es-

[3] "New School of Thought", *Business West*, Vol. 16, No. 9, January 2000, p 7.

tablished a technology park. The integration of a tech park, designed to capitalize on locational advantages for the telecommunications business, into the college's academic programs and the subsequent expansion of the park to include a high-tech incubator targeted in this same business segment has proved so far to be an overwhelming success. It remains to be seen how much new employment will be generated directly as a result of this strategy, but the impact on the economic vitality of the region has been substantial and the prospects for continued growth seem promising.

In retrospect, the discovery of the locational advantage of Springfield for the telecommunications business (at the hub of key fiber optic networks) was crucial to attracting new business to the technology park. The addition of the tech park's strategy for accommodating facility "build outs" very flexibly for tenants, for providing many other kinds of infrastructure support (power, telephone switches, business services, etc.), and for coordinating with STCC to provide a very tailored source of new labor and expertise has been crucial to the sustainability of the park. The addition of the SEC shows great promise for making Springfield a center for telecommunications business innovation and entrepreneurship (as well as perhaps other business areas) that will have lasting impacts on the region's prospects for sustained economic growth in the fast changing United States economy.

Finally, the STCC Technology Park and Enterprise Center seems to provide an alternative model to a research park for using science and technology infrastructure to spur economic development. This model supports technical innovation, but unlike a university-based center that might be focused on research, is more focused on business innovation and provision of an infrastructure for promoting business development and tighter integration with academic programs.

4. Testing the Study Hypotheses

The STCC case confirms all these hypotheses and perhaps underscores the particular importance of vision and leadership as critical success factors (hypothesis 10). In the following, brief discussions of each of the ten hypotheses are included in the context of the STCC case.

1. *Enabling infrastructure (roads, water, sewer, etc.) is necessary but not sufficient to assure the effectiveness of technology infrastructure investment.*

True. The historical key infrastructure advantages of the Springfield location that led to the dominant role of the arsenal in the region's economic history were not sufficient in the new economy of the 1990s. New infrastructure, however, turned out to be crucial in the STCC case. The nexus of key fiber optic networks in the northeast was crucial to attracting the early tenants to both the Technology Park and the Enterprise Center.

2. *Investments in technology infrastructure must be part of a larger local planning process to succeed.*

True. The Pioneer Valley Planning Commission process was crucial to the political success of the technology park concept at all levels of government: to receive the city and county governments' endorsements, to attract the initial seed funding for the park as well as support of the innovative management structure from the state legislature, and to establish credibility for EDA and NSF support for key programs housed in the park and for building the Enterprise Center.

3. *A certain density or critical mass is required for information and communications technology (ICT) to work, because of the costs of provision.*

True. The marginal additions to the existing nexus of fiber optic networks to accommodate various telecommunications tenants in the park were crucial and sizable relative to the size of the overall investment in the park, but the innovative management program allowed such investments to become part of the leasing arrangements for tenants. As noted in the case over $225 million in build out investments have been made by the first round of tenants in the tech park.

4. *Technological innovations and advances are reducing the costs of communications and linkages*.

While this aspect was not explored in detail in this case, some evidence suggests that this is **true** in the STCC case. For example, advances in optical switching and other networking equipment is making new additions in the park less costly and with higher capacity. In the end, the innovations in these areas may actually be found to undermine the comparative advantage that Springfield has right now in the telecommunications business because as the network expands and the bandwidth grows across the network, the locational advantage of Springfield may become less important.

5. *Institutional mechanisms must be in place to help users deploy the hard infrastructure appropriately*.

True. The coordination among levels of government, and in particular the support of local agencies proved to be very important in the development of the technology park. For example, the park managers' early efforts to work closely with local building inspectors established a culture of mutual trust that has proved invaluable in the major phase of growth in the park and major build out of infrastructure was required. Early awareness of special requirements related to the local implementation of fire code features and ADA compliance was especially important.

6. *Some hierarchical coordination or linkages among national, state and local governments are important for a community to be truly "connected."*

True. As noted above, the Pioneer Valley Regional Planning Commission process was important to coordinating all levels of government in the early stages of the project. The informal political linkages, however, were just as important. The relationship of local state legislators with the key state legislative committees depended upon the support of local political officials. The local EDA office's support was crucial to the ultimate regional office's endorsement of funding proposals. Since the Springfield Arsenal is also a National Historic Site, other federal and state agencies involved in regulating historic preservation are involved in decisions about the facility as well. Indeed, the array of national, state, and local entities involved in the Technology Park is quite large and their interactions complex. Aggressive coordination of contacts among all these entities was crucial to the enviable pace of progress in the conception, construction, and operation of the park.

7. *Linkages among government, education and industry are a critical success factor for ICT interventions. State policies and corporate actions are important determinants of local "success."*

True. The case-study notes the crucial role of organizations such as STCCAC, the PVPC's key strategy working groups, SCORE, and the SEC Advisory Board were and are key to the Park's activities. They provide important convening opportunities for collections of government, education and business stakeholders. The state policies that permit and regulate the activities of such groups are important benchmarks for these activities. More importantly, however, the park originators view the combination of attitudes and commitment that these leaders bring to bear in participating in these groups as a key strength of their approach.

8. *Infrastructure providers must be a partner in assessment and planning, not just the spending, for the intervention to succeed*.

True. As noted above, build-out for new activities in the park are accomplished via a cooperative agreement executed through the lease agreement. Coordination of infrastructure improvements to make the park a competitive place to locate has proved to be important in getting the park fully leased. Just as important, however, is the general culture of encouraging and promoting aggressive infrastructure improvements, which is likely to be important for the long-term sustainability of the park.

9. *Work force development is a critical complement to any infrastructure intervention.*

True. Work force development was, indeed, crucial to the original design of the park. However, the nature of that development has been quite different from other case studies. Being the nation's only technology park connected to a community college rather than a major research university, the focus is on integrating college extension and other programs into the park's activities (especially the SEC), and on tuning the educational programs of the college very closely with the needs of the park tenants.

10. *Because of the long-term and expensive nature of ICT, vision and leadership are critical success factors.*

True. As noted above, this hypothesis is particularly underscored by the STCC case. STCC President Sciabelli, in particular, but many others as well made this happen against fairly substantial odds including doubt at all levels of government, skepticism on the part of regional business leaders, and when the educational mission of the college was struggling.

5. Persons Interviewed

Fred Andrews
Springfield Enterprise Center

Tom Holland
Springfield Technical Community College

Geoffrey Little
Telitcom

Tim Brennan
Pioneer Valley Planning Commission

Andy Sciabelli
Springfield Technical Community College

Dick Saabot
eZiba.com

Ethan Zuckerman
Geekcorps

Matt Harris
Village Ventures

Tripp Peake
Mass Ventures Equity Fund

MONTANA

Billings and Eastern Montana

1. Context

The largest city in Montana, with 110,000 people, Billings was formed when the Northern Pacific Railroad came to the area in 1882. Formerly known as Coulson, it was renamed after Frederick Billings, a former president of Northern Pacific. Lying in the arid Yellowstone River Valley, it is an agricultural and oil refining center. The Beartooth Mountains are to the southwest and the Bighorns lie to the south; the valley is the traditional home of the Crow or Absarokee Indians.

Montana is an extremely large state in terms of land area. It can take up to ten hours to drive across the state in one direction. The entire state's population, however, is only about 810,000. Eastern Montana's population breaks down to only approximately one person per five square miles. The region, with many small towns scattered across a large landmass, is "geographically challenged," according to Kristianne Wilson, Vice President of Strategic Development at Deaconess Billings Clinic. Helena, the state capital, is a four hour drive from Billings.

The state is also relatively poor. It has a high elderly and Native American population, many of whom are on a fixed income. Montana is forty-eighth in the nation in per capita income, and 45 percent are on Medicaid. A high percentage of citizens lack any health insurance. Local economic developers in Billings said average wages are very low; 39 percent make only $7 per hour.

Table A.8
Demographics for Yellowstone County, Montana

Population, 2000	129,352
Median household income, 1997 estimate	$35,680
Educational Attainment, High School or higher, 1990	83.7%
Educational attainment, Bachelor of Science or higher, 1990	21.5%
Poverty rate, 1997 estimate	12.1%
Unemployment rate, 2000 annual	3.8%
Per capita personal income, 1999 estimate	$25,253
Homeownership rate, 2000	69.2%
Percent Ethnicity, 2000	
White	92.8%
African-American	0.4%
Hispanic	3.7%

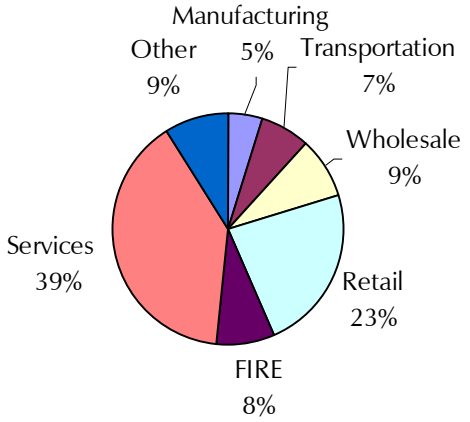
Sources: U.S. Census Bureau, U.S. Department of Labor.

Regionally, large-scale agriculture and ranching still make up the primary economic base of eastern Montana, so locals would like to bring more value-added agriculture to the area. Towns have seen a gradual reduction in one of their main sources of tax revenue, natural resources extraction. Because small- to medium-sized communities in the region are resource-dependent and lack a diversified economic base they are subject to slow growth and economic cycles. Billings alone has managed to diversify, emerging as a major service, distribution and financial hub for eastern Montana. It also has world-class medical facilities.

According to local economic developers, local government infrastructure is poor in the region. The tax rate in Billings has been frozen since 1985. The city and many of the surrounding towns need basic infrastructure, better information systems, and capital for business development. On the other hand, the cost of living is relatively low, and the work ethic is outstanding: "In Los Angeles, employers hire 300 to get 100 to show up, in Montana they hire 100 and 100 show up for work" (an interviewee).

A few technology companies call Billings home, including Computers Unlimited, a local startup that employs 140 people. Wells Fargo Bank is building a call center that will employ 500 people. In Calsbell, a call center that expected to hire 200 now employs 1,000. But the majority of the population in the region is in agriculture or works for "old economy" companies.

Figure A.6
Yellowstone County Business Mix, 1999 estimate



Source: Bureau of Economic Analysis; total full-time and part-time employment by industry.

Those interested in higher learning can choose from a variety of programs at several institutions, depending on their needs. Montana State University and Rocky Mountain College are located in Billings, as are May Technical Center, MSU-Billings College of Technology, Billings Business College, and Lincoln Adult Education Center. Medical facilities are available in two hospitals and 16 clinics. Over two hundred physicians represent all of the major specialties.

Montana State University recently relocated its College of Business to Billings and is in the process of accreditation. Within the college is a new Center for Applied Economic Research, which could provide an engine to help propel IT infrastructure in Billings.

2. *Nature of the Intervention*

Billings, Montana has two of the early adopters and leading edge practitioners of telemedicine residing within its city limits, Deaconess Billings Clinic and St. Vincent's Hospital.[1] These two technology-savvy organizations appear to be leading the way with regard to overall IT use and investment for the eastern Montana region. Billings is just now in the process of having DSL lines installed to the majority of citizens.

The Eastern Montana Telemedicine Network (EMTN) began in the early 1990s when a few enterprising individuals from the Deaconess Billings Clinic approached the local phone company, USWest (now Quest), about starting a program. In 1993, Quest donated the initial telecommunications equipment and

1. The focus of this case study is on the Eastern Montana Telemedicine Network as initiated and executed by Deaconess Billings Clinic. However it is clear that St. Vincent's Hospital is a key player in this arena as well, providing both friendly competition and cooperation with Deaconess in making telemedicine an important part of the regional economy. The two programs have an agreement not to duplicate service areas. They both received federal grants from the Office for the Advancement of Telehealth.

six months of funding. The program initially began with one T1 line that served five sites, including two in Miles City, and one each in Culvertson, Billings and Glendive. Subsequent funding came from the Rural Utilities Service (RUS), a department of the United States Department of Agriculture. In 1994 the clinic received a grant from the Office of Rural Health Policy (in the Health Resources and Services Administration) of $350,000 a year for three years; this allowed the addition of clinics in Colstrip, Glasgow, Baker, and a Billings-based community health clinic and mental health clinics.

The Deaconess Billings Clinic has long provided service to rural areas and its staff knew how important healthcare was to the survival of many small towns. The initial funding for the network came from Deaconess Hospital with later funding from grants and foundations. The driver for getting the local clinics on board was an enthusiastic local population and the clinic directors. They were able to see the benefits of fewer travel miles and improved access to specialty care.

Prior to the telemedicine program, residents of Miles City had to drive two hours to Billings to see any specialty doctors. When the network got up and running in 1993, it was one of only ten telemedicine programs in the country. The principle was to keep the patient at a certain level of care and avoid unnecessary transport to a bigger facility. The largest benefit of the network to physicians was that they could more easily and accurately determine whether patients actually needed transport or if they could be treated on-site. Now 98 percent of patients seen by telemedicine are kept in their own communities for treatment and care.

Chronic diseases, which account for a large part of healthcare demand in Montana, are particularly good for telemedicine, because the medical staff can see patients with sufficient frequency and detect illnesses early. Diabetes affects a larger-than-average share of the population in Montana, so the network hired an RN educator to provide ongoing diabetes education classes on-line.

The hardware network costs do not appear to have been a significant impediment to growth. While they initially were very high, they have come down considerably. A piece of video equipment that in 1993 would have cost $80,000 would now be $10,000. However, network administrators are concerned that the monthly line costs have remained high. Those costs are directly related to the distances traversed, and in the case of eastern Montana those distances are considerable. For example, the network cost from Miles City to Billings runs $1,270 per month. Their total line costs for eastern Montana comes to over $100,000 per year, nearly one-third of the organization's total annual operating budget of $450,000. St. Vincent's recently asked for a direct connection to EMTN, but the cost is $50,000. In general, however, the rural telcos have been very progressive in installing high-speed lines.

When the network began, T1 was the only type of technology available. It was only later that they realized that even with new technology such as frame relay, T1 was still the best for them in terms of cost, privacy and control. There was and still is a big concern for privacy. By controlling the bridging of hook-ups, the EMTN can restrict access. Of all the EMTN sites, Helena is the only one on a dial-up environment, because that was the only cost-effective way for it to be reached across a local access and transport area boundary.

The EMTN is certainly not sitting on its laurels, and is moving ahead with many new ventures, including determining whether lower bandwidth, which also comes at lower costs, will work for the smallest of prospective clinics.

The success of the EMTN appears to have many factors. They include having energetic, forward-thinking individuals championing their cause. These included: a doctor coming out of clinical practice in Alaska who understood rural medicine, the Deaconess Foundation, the hospital's medicine director, and the director of a mental health clinic in Miles City. A critical success factor was the decision to have a half-time site facilitator at each site. They are not "techies," they understand the need, value and benefits of technology to their own small communities, and provide public relations.

The EMTN sees itself as a model for very rural low-density areas elsewhere in the United States. Its advice to similar communities:

- Look at other programs that might be a good model
- Design the system to achieve concrete objectives with defined partners and stakeholders
- Recognize the need to push boundaries and have a little bit of a renegade attitude
- Line up support from administrators
- Take risks

The leadership of the EMTN did not start off thinking about technology as a way to enhance economic development; its motivation for the project was cost-effectiveness and quality of healthcare. As one interviewee noted, "digital divide was not a term in use when we began this project." But now, it is a potential model for other very rural, low-density areas.

3. Impacts of the Intervention

The telemedicine network extends the reach of health services within the region and improves the quality of patient care while reducing costs. The network also has benefits beyond health care and thus, contributes to the quality of life in the region.

- As of January 2001, the EMTN included partners in 18 sites.

- The EMTN has documented cost savings in education and training of over $500,000 per year for its network partners who would otherwise pay for employees to travel for training.

- While telemedicine was the driver, Deaconess also saw that the network technology could also be used more broadly. For example, the Girl Scouts could use it for sing-along training and meetings. Deaconess recognized the importance that churches, schools, and healthcare facilities play in the health of communities. They parlayed the network into a resource for the entire community. Thelma McClosky Armstrong, Program Director for EMTN, stated that from the beginning, the EMTN had a holistic perspective.

- EMTN founders also knew that just clinical interaction would not sustain the network on a long-term basis. In order to bring added value to their clinic partners, they brought tele-education to staff. Currently, Deaconess has documented over $500,000 per year in education training savings for partners. With long distances between places, and small staffs, travel time is expensive.

- For example, prior to the telemedicine network it was very difficult to get more than one or two nurses for training. Now, with courses held via the network, there are commonly 15 to 20 nurses per course. The first year was difficult, with each partner having different priorities and emphasis. EMTN then decided to go though a planning process with each partner to decide how to proceed with future training. They began to set clinic policies around the network. One clinic has recently stated that there will be no travel money allowed if the course or class is offered over the network.

- After adding the on-line mental health clinic in Billings, patient volume tripled in the first year. It appears that convenience plays a huge factor in whether both doctors and patients use the technology. Physicians were somewhat skeptical at first, due to the lack of actual contact with patients, worrying that technology would get in the way of patient care. Their reluctance was overcome, however, after they used it. The highest accolades are for patients on maintenance programs. Most mental health physicians appear to

want initial contact but are willing to use telemedicine as a way of providing maintenance.

- Having a successful telemedicine program has benefited the hospital as a whole. It has allowed the clinic to receive many competitive grants. By virtue of already having the technology infrastructure in place, grant applicants have a "leg up" on applicants looking for the first infusion of hardware and other startup dollars. For example, in applying for grants to provide educational courses, Deaconess was able to show experience with rural environments and high technology.

- The telemedicine networks in Billings allowed the two major hospitals both to develop a regional healthcare delivery system. EMTN's current budget is around $450,000 per year and it maintains a staff of four fulltime employees, while providing over 2,000 telehealth conferences per year. One hospital in the region received a private donation of $70,000 to join the EMTN. It wanted to buy teleradiology services and contracted with EMTN to provide them.

- The EMTN is not used much so far by businesses. The multinational oil companies have their own closed systems. But the employees of these companies, which have a high accident rate, use the system for their own healthcare.

- While not a focus of the telemedicine program, one outcome has been that a good statewide network has been developed, which can be used for other purposes. For example, METNET asked EMTN to provide it a bridge to NASA. Now that the infrastructure is in place, it can be used as a backup in case of failure somewhere else.

4. Testing the Study Hypotheses

1. *Enabling infrastructure (roads, water, sewer, etc.) is necessary, but not sufficient to assure the effectiveness of technology infrastructure investment.*

False. In many of the communities of eastern Montana, there is greater need for traditional infrastructure than for technology infrastructure, which at least in its physical elements appears adequate. The poor traditional infrastructure undoubtedly impedes economic development. There are some differences in both technology implementation and access across the region. For example, within Billings itself, high-speed DSL Internet access is just now becoming a reality but has been available in very rural surrounding counties for up to three years. Economic developers in the region would like to see a grant or low-interest loan program — or more resources of this kind from EDA — to be able to compete for companies. They need both traditional forms of support (site preparation, infrastructure) along with programs for growing high-tech, IT-based industries. One suggestion was to develop a high-tech park so companies that locate in the area will have tax incentives and access to technology.

There are other less tangible infrastructure needs, such as inter-organizational and inter-personal relationships that are necessary to successful implementation efforts. In Billings, there was frequently an inference to "lack of coordination" between government entities and private businesses as a critical factor in the area's lack of success in both building upon what they have and growing.

2. *Investments in technology infrastructure must be part of a larger local planning process to succeed.*

Mostly false. There are numerous organizations working to bring better technology infrastructure or better jobs to Billings; however, a lack of coordination along with competing interests has allowed the larger goal sometimes to get lost. The economic developers in the region noted that their own information infrastructure, both hardware and software,

was lacking. Even conducting an inventory of what exists is difficult, they said; because of the competitive nature of businesses in this industry, many do not want to divulge this information. A dearth of clear economic development goals and objectives and the lack of an infrastructure inventory for the community preclude any real progress.

3. *A certain density or critical mass is required for information and communications technology (ICT) to work, because of the costs of provision.*

Somewhat true. In the northeastern part of Montana the rural telecommunications cooperatives have wired communities with as few as 20 people in the area with DSL capability. They do receive universal service subsidies and aggregate limited demand.

4. *Technological innovations and advances are reducing the costs of communications and linkages.*

Not clear. The purchase of equipment and hardware has become significantly less expensive in the past few years. But the ongoing maintenance and subscription costs are remaining the same or going up. For example, the Eastern Montana Telemedicine Network (EMTN) cited these costs. In 1993 a certain piece of video equipment that cost $80,000 would now cost $10,000. But telecommunications costs are tariffed by mileage. Monthly network costs from one of their member towns, Miles City, to Billings average $1,270 per month. The total telecommunication costs for EMTN average about $100,000 per year. This has not changed drastically in the years they have been operating.

5. *Institutional mechanisms must be in place to help users deploy the hard infrastructure appropriately.*

True. Currently, it appears that the most ardent users of ICT in Billings are the two local medical institutions, Deaconess Billings Clinic and St. Vincent's Hospital. They both have technologically advanced teleconferencing capabilities and willingly use them. They have senior management recognition of the importance of the technology to the practice and quality of health care. The municipal governments do not appear to use ICT beyond basic tools. Access to hardware and equipment were cited as obstacles.

The Montana State University system, schools and libraries are part of a large statewide effort called the Montana Educational Telecommunications Network (METNET) expands access to educational opportunities, training and hearings. It has also been used to reduce administrative travel costs through video teleconferencing.

6. *Some hierarchical coordination or linkages among national, state, and local governments are important for a community to be truly connected.*

Somewhat true. In Billings, there is not sufficient coordination or cooperation between competing organizations to combine strengths even locally, and their connections to state and federal sources of support are not as strong as they might be if they presented a unified local front.

Montanans are generally disinclined toward government. Leadership from the private sector tends to be more favorably received, though federal government funding and programs have an important role in the background. Deaconess Billings Clinic and its partners have taken the lead on this telemedicine project, but federal grant dollars have been critical at key points.

As another important federal role, universal service subsidies are viewed as critically important and can work to help serve distressed areas with infrastructure. Some estimate the subsidy covers up to 70 percent of the total cost to serve a low-density area, which is otherwise prohibitive. The combination of universal service subsidies and a co-op mentality have served eastern Montana well. However, EMTN officials noted that universal service funds are very slow in getting to the local area.

The E-rate program is used to fund technology infrastructure in public schools. Telephone co-ops in the region hired someone to help make sure the local schools and libraries would get their share from E-rate. One concern in eastern Montana is that ac-

cess to these funds depends on school lunch participation. Many parents in these communities are unwilling to sign their kids up on school lunch programs due to various cultural factors, and the region's population is declining; this puts the region at a disadvantage with respect to obtaining necessary support for infrastructure.

7. *Linkages among government, education and industry are a critical success factor for ICT interventions. State policies and corporate action are important determinants of local "success".*

Mostly false. With the exception of a few specific examples of project-based opportunism that involve collaboration of these three sectors, the Innovation Triangle is not in place in Billings and eastern Montana. The health care sector has taken a leadership role in developing technology infrastructure statewide, but higher education, government, and business are not fully integrated with or actively leveraging this effort and its resulting physical and human infrastructure. To date, the lack of "new economy" vibrancy in Billings can be attributed to various factors, including a regional culture that feels a need to do things independently, a relative lack of state and local government programs for enabling economic growth, and a lack of public and private capital. There are no linkages and common needs identified or pursued among the various sectors of the community.

8. *Infrastructure providers must be partners in assessment and planning, not just the spending, for the intervention to succeed.*

True. The success of the telemedicine program at Deaconess Billings Clinic can be directly attributed to the support of the various rural telecommunications cooperatives, as well as Quest Telecommunications (formerly US West), the service provider for Billings. On numerous occasions, their willingness to work with very small, rural local communities was cited by Deaconess as one of the main reasons their telemedicine program has succeeded. An example given was the current payment schedule from the Universal Service Fund; reimbursements do not come in until up to two years after submittal. Both Quest and the rural cooperatives have been willing to work with the EMTN regarding this situation.

The rural telecommunication cooperatives have been willing partners by also providing someone on staff to work with schools and libraries when Universal Service was implemented to make sure they were able to get their share of the federal E-rate money. The staff member helps them get the multitude of forms completed. It was roundly agreed that due to the rural cooperatives' commitment to lessening the digital divide, service was not an issue. The director of the telemedicine program at Deaconess stated that telemedicine programs in other states tell of horror stories of with their telecommunication companies but that is not something they face. All schools and most hospitals are connected to fiber optic lines.

9. *Work force development is a critical complement to any infrastructure intervention.*

True. One of the key applications for which the telemedicine networks are used is the training of medical professionals. In some cases this training is in how to use technology; for example, Deaconess Billings Clinic applied and received a grant to train emergency medicine technicians, nurses, physician assistants and first responders in multimedia technology as it relates to telehealth.

The broader question of how local work force development is a key determinant of the area's attractiveness as a new economy business location is not being squarely addressed by the local economic development organizations, although the MSU-Billings College of Business is trying to initiate a collaborative forum for discussing such issues.

10. *Because of the long-term and expensive nature of ICT, vision and leadership are critical success factors.*

True. While Billings does not have broad-based community leadership, participation or interest in many areas of policy, leadership emerged from the users and providers of telemedicine to make it happen. The long-term nature of ICT investment for distressed communities is highlighted by the situation in Billings. The leadership appears project-by-project rather than through an overall strategy.

Growth in general is hampered in eastern Montana by a lack of strategic public leadership. Local government is viewed as neither proactive nor good about communicating with businesses. The hospitals have clearly stepped in to provide private leadership on telemedicine. Montana State University at Billings also has brought new leadership to the area, and has begun convening public and private leaders for data sharing and networking. The Dean of the College of Business brought together state and local officials, bankers, publishers, media, real estate and homebuilders, school staff members, the Billings Chamber of Commerce, and staff from the Big Sky Economic Development Authority. They determined that there is no central place for economic development and business information in the region. So MSU is developing a regional database that was scheduled to go on-line in beta version in June 2001. The same focus groups indicated that while high-tech industry was desirable, expanding the local service sector was perhaps more feasible, building upon Billings' strengths as a retail, financial and health center for the entire region.

5. Persons interviewed

Thelma McClosky Armstrong, Program Director
Eastern Montana Telemedicine Network

Dave Espeland, CEO
Fallon Medical Complex, Baker, Montana

Debbie Hernandez, Director
Resource and Community Development
Big Sky Economic Development Authority

Tom Kaiserski, Economic Developer
Beartooth Resource Conservation and
Development Area

Dwight MacKay and Amy Palmer
State Staff, Office of U.S. Senator Conrad Burns

Ramona Maddix, Director
Planning Dept. City of Billings/Yellowstone County

Barbara Nemecek, Dean
College of Business, Montana State University

Sharon Peterson, State Director
Office of U.S. Senator Max Baucus

Art Scibelli, Executive Director
Downtown Billings Partnership Inc.

Jack Sterling, Telecommunications Coordinator
NEMONT Telephone Cooperative

Kristianne Wilson, VP of Strategic Development
Deaconess Billings Clinic

Thomas Yoder, Ph.D., Director
Center for Applied Economic Research
College of Business, Montana State University

John Zauher, Director
St. Vincent's Hospital Telemedicine Program

NORTH CAROLINA

Large-scale Investments to Overcome Backwardness in Eastern North Carolina

1. Context of the North Carolina Case Studies

Thirteen counties in rural "Downeast" North Carolina constitute the "North Carolina's Eastern Region," one of the state's legislatively defined economic development partnership regions. (Included in the boundaries of N.C.'s Eastern Region are Craven, Duplin, Greene, Jones, Lenoir, Pitt, and Wayne Counties.) However, long before the legislature made it official, the area was characterized by a strong sense of place based on more than geographic proximity. These counties share a common industrial heritage dominated by tobacco and textiles production that accounts for the concentration of wealth in a limited number of mid-size towns that are the locations of the tobacco sales and distribution centers and the textile and apparel mills that absorbed the non-farm labor force. They likewise share a growing sense of despair that arises from the rapid erosion of the tradition of family tobacco farms, the departure of the indigenous textile industry to Asia and Mexico, and environmental and economic havoc wrought by two successive years of natural disasters. Fueling this sense of despair are expected losses in the region of $95 million attributed to flood-ruined tobacco crops and the loss of thousands of jobs and millions of dollars in sales and earnings that will result from the recent tobacco settlement.

Leaders are concerned about the region's capacity to absorb the changes that are taking place and to respond to the challenges represented by the knowledge economy and the ICT platform that supports it. Specifically, they cite brain drain, economic restructuring and worker dislocation, low interest among displaced workers in retraining for high-tech jobs, low education levels (on average), a growing proportion of the population that is Hispanic and/or elderly,[1] inadequate/uneven technology infrastructure, inadequate basic infrastructure, the need for more investment capital

[1] Approximately 12 percent of the region's population is older than 65. Between 1990 and 1997, the Hispanic population in the region increased by more than 75 percent (The N.C. Rural Center).

and entrepreneurs, and serious environmental challenges. Recently completed research substantiates their fears: N.C.'s Eastern Region lags the state in the technology intensity of its public sector, percentage of workers employed in technology-intensive businesses, growth in technology-related employment, and average wage and average wage growth.[2]

Their concerns are aggravated by inferiority issues that have marked the region's interactions with the rest of the state. Downeasterners at all levels of society express the opinion that their region has never received appropriate respect from other regions or its share of public resources from the state. Many hold the view that other regions in the state inaccurately brand the east as "under-achieving," "under-privileged," and "undeserving." As a region, the east has responded by mounting and succeeding at some notable efforts to improve the quality of life for the region's residents and to address the region's future economic prospects. Chief among these efforts were locally led and funded efforts to establish and grow the medical school and healthcare complex at East Carolina University.

Knowledge resources: The regional university and its role in economic development

One shining asset in the region is East Carolina University (ECU) in Greenville. Established in 1908 to train teachers in the proximate region, ECU became part of the sixteen-campus University of North Carolina system in 1969. ECU has since become the third largest campus in the system and ranks fifteenth in the nation in the number of teachers graduated each year. Realization of ECU's potential to become the powerful force for economic development throughout the eastern third of North Carolina was strengthened significantly by the establishment of a four-year medical school on the campus in 1977. The campus is estimated to have $1.4 billion in annual economic impact in Pitt County.[3]

Prior to the initiation of efforts to bring medical training to the region, eastern North Carolina had the highest infant mortality, the highest incidence of medically-related draft rejections, and one of the lowest ratios of hospitals and doctors to population in the nation. Since that time ECU has developed into a top-ten center for the education and training of primary care physicians and a national leader in expanding the participation of minority and disadvantaged populations in medicine (ECU ranks third in the United States in the number of African-American medical students). Collaboration between the university and the county in the construction and support of the regional hospital is cited as a model for leveraging health resources. Growth in sponsored research, the establishment of doctoral-level graduate programs in health sciences and the establishment of a technology transfer office to manage intellectual property being generated on the campus all speak to ECU's burgeoning capacity as an economic powerhouse.

Detracting from this capacity is the failure of efforts to date to garner the necessary support to establish an undergraduate degree program in engineering. That limits the extent to which the university can support connectivity enhancement efforts, and more broadly, to support the transition of traditional manufacturing firms to higher technology operations. The vast majority of the region's manufacturers do not have a degreed engineer on staff. In many ways this situation mirrors that which preceded the establishment of the medical school. Strong opposition from other medical schools and regions of the state caused the east to have to fight for ten years and settle for phased development of the medical degree program. Leaders today anticipate a similar fight but are confident that they will prevail in getting the engineering resources needed to support development in their region.

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[2] Figures comparing performance between 1987 and 1998 are found in *Toward the New Economy: High Tech Industry Clusters and Innovation Infrastructure* prepared for Vision 2030 by Edward Feser, University of North Carolina at Chapel Hill.

[3] Brockett, Dick. *Economic Impact of ECU, 2000 Update*. Regional Development Institute, East Carolina University.

Other knowledge resources

Despite the seriousness of the situation facing many of its communities, N.C.'s Eastern Region does have assets relevant to the knowledge economy. In addition to ECU, there are three private colleges and eleven community colleges in the region. Four business incubators and a recently established satellite office of the North Carolina Manufacturing Extension Partnership/Industrial Extension Service provide support to a growing base of entrepreneurial firms. Four military bases are a potential source of skilled personnel and market for e-commerce opportunities.

Connectivity in Eastern North Carolina

The need for targeted efforts to enhance connectivity infrastructure and increase acceptance and use of the technology in rural North Carolina has been well documented.[4] North Carolina ranks forty-fifth among the states in the number of households with a computer, and forty-sixth in households with an Internet connection. The statistics in rural counties are truly dismal, with much of the difference attributed to high connection charges. High-speed connections that cost an average $50 per month in urban areas cost North Carolina's rural residents $230. Recommendations developed by former Governor Jim Hunt's Rural Prosperity Task Force targeted this issue for immediate attention.

Rural Internet Access Authority

The North Carolina General Assembly in its 2000 session approved the creation of the Rural Internet Access Authority (RIAA) to oversee efforts to provide rural areas with high-speed broadband Internet access. The authority's main goals are ambitious: 1) to provide local dial-up Internet access from every telephone exchange in North Carolina within one year; and 2) to provide high-speed Internet access at competitive prices (at least 128K for residential customers and at least 256K for business customers) to all North Carolinians within three years. The authority is established within the state Department of Commerce, with the North Carolina Rural Center providing administrative and professional staff support to the authority. The authority is governed by a 21-member commission, which includes members of state government, business and education leaders, representatives from the state's telecommunications companies, including Internet service providers, rural telephone cooperatives, local telephone exchange and independent telephone companies, commercial wireless communications carriers, and the cable industry.

Other goals of the Rural Internet Access Authority include

- Increasing the ownership of computers, related Web devices and Internet subscriptions throughout the state.
- Providing for two model Telework Centers to be established by January 2002 (Only one quarter of the state's telephone central offices are located in the most economically distressed areas.)
- Providing accurate and current information via the Internet to state residents concerning the availability of telecommunications and Internet services. Also providing updates on future telecommunications and Internet services.
- Developing Internet applications for government agencies that will make receiving services easier and more convenient. These applications can also facilitate the delivery of more comprehensive government programs, including training, education and healthcare.
- Employing open-technology approaches that encourage all potential providers to participate in the implementation of high-speed Internet access.

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[4] See *Falling through the Net* published by the United States Department of Commerce (1999).

- Coordinating activities, conducting and sponsoring research, and recommending and advocating actions, including regulatory and legislative actions, to achieve the authority's goals and objectives.

Funding for the RIAA comes from private sources. One of the commission's first tasks was an inventory of Internet providers and equipment in the state's rural areas, conducted during the fall and winter of 2000–2001.

Some insights from the North Carolina case studies

- **Alienation — A Negative Impact**: Focus groups conducted in eastern N.C. showed that many people find ITC and other technologies intimidating and irrelevant to their lives.[5] Similar sentiments that were common in the equally rural western part of the state have effectively been addressed through the outreach and education efforts that were part of the Connect N.C. project funded by the Appalachian Regional Commission. The need for and potential success of appropriate education efforts in the region and other eastern regions is indicated.

- **Alienation — A Positive Effect:** Cultural, political and economic distance between eastern North Carolina and the rest of the state has contributed to a strong sense of regional identity. This regional identity of being separated from the rest of North Carolina has been leveraged into support for a set of economic development efforts that ultimately work towards bringing eastern North Carolina closer to the rest of the state. Those economic development efforts include regional funding of development efforts at East Carolina University, the ECU Medical School, the GTP, and, most recently, an engineering school at ECU.

- **Regional Universities and Intellectual Property —** Regional universities need to be brought up-to-speed regarding technology transfer. Their inexperience in maters related to intellectual property management and public-private partnerships to encourage entrepreneurship may restrict the institution's contribution to knowledge-based economic development. The lack of good models, standard procedures and processes and the absence of clear policies regarding faculty involvement in spin-off activities creates barriers to the creation of local knowledge-based enterprises.

[5] The UNC Office of Economic Development held focus groups were in each of the seven economic development partnership regions in 1999 in support of the Vision 2030 project.

NORTH CAROLINA

Kinston and Eastern Region

1. Context

In 1999, North Carolina completed Vision 2030, a yearlong, multi-phase exercise in science and technology strategic planning. Encompassed in this effort were a series of region-specific industrial cluster analyses, focus groups and visioning conferences. The effort produced a number of reports, including a final summary document that outlined a suggested legislative agenda related to the use of science and technology for economic development. Included in this agenda were requests developed by each region for targeted initiatives that would best address existing needs and opportunities related to science and technology. Key findings from the Vision 2030 effort that serve to characterize N.C.'s Eastern Region for the purposes of this case study include the following:

- While the medical and applied technology programs at East Carolina University (ECU) are strong sources of regional pride, the absence of an engineering curriculum is an acknowledged impediment to the region's ability to attract and support technology-based enterprises.

- The knowledge economy — and its need for more skilled workers willing to adapt to rapid

Table A.9
Demographics for Lenoir County, North Carolina

Population, 2000	59,648
Median household income, 1997 estimate	$27,982
Educational Attainment, High School or higher, 1990	62.9%
Educational attainment, Bachelor of Science or higher, 1990	11.5%
Poverty rate, 1997 estimate	18.6%
Unemployment rate, 2000 annual	5.5%
Per capita personal income, 1999 estimate	$21,244
Homeownership rate, 2000	67.0%
Percent Ethnicity, 2000	
White	56.5%
African-American	40.4%
Hispanic	3.2%

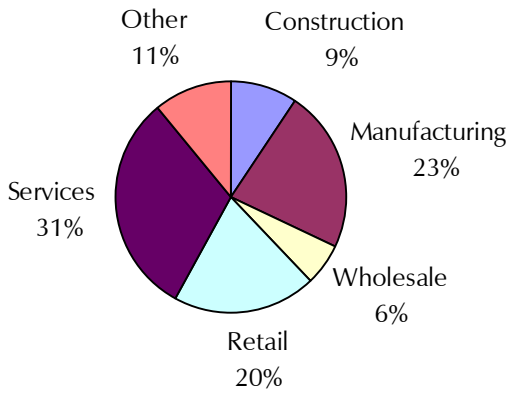
Sources: U.S. Census Bureau, U.S. Department of Labor.

changes through lifelong learning — must be made more relevant and appealing to people who are accustomed to agricultural and traditional manufacturing economies. Many adults in rural areas in the east still feel alienated by the technology revolution.

- Currently N.C.'s Eastern Region has an abundance of entry-level and semi-skilled labor available. At the other end of the spectrum are the more than 12,000 individuals that are separated each year from military installations in the region, many of whom have high-tech skills. The upshot is that the region cannot attract technology-based jobs with the existing indigenous work force and lacks the technology-based firms to employ the more skilled transient work force.

- Support has been requested from the Science and Technology Committee of the North Carolina General Assembly for 1) increasing the affordability and accessibility of T1 lines in the region and 2) development of a comprehensive regional plan for work force development to increase the competitiveness of N.C.'s Eastern Region.

Figure A.7
Lenoir County Business Mix, 1999 estimate



Source: Bureau of Economic Analysis; total full-time and part-time employment by industry.

2. Nature of the Interventions

Two distinct technology-based interventions in N.C.'s Eastern Region were selected for analysis through case study — the Global TransPark and the Telemedicine program at ECU. In neither case is enhanced connectivity the end goal of the project. Rather, high quality, high-speed ICT is a critical means to the unique goals of each project and their common end goal of enhanced regional competitiveness.

The Global TransPark — economic development premise

The North Carolina Global TransPark (N.C. GTP) is envisioned as an air cargo/transportation complex and industrial park designed to meet the present and emerging needs of domestic and international commerce. In the growing global economy companies are adopting just-in-time (JIT) manufacturing and distribution practices to meet customer demand while air cargo shipments are growing at a rate of five times faster than air passenger service. These changes have to be enabled by reliable surface transportation services. The N.C. GTP will be a facility where industry assembles, stockpiles and delivers goods for quick distribution through a huge airport facility that is linked by interstate-quality highways, allowing tenants to reduce inventories and shorten delivery times. The N.C. GTP is designed to create and preserve jobs by allowing North Carolina and the United States to be stronger competitors in the global marketplace.

As the project develops, it is supposed to provide benefits to companies across the state and the southeastern United States as well as to on-site tenants. While the service reach will be broad, its economic development impact will be strongest in the immediately adjacent region. To date, over $81 million has been invested in this project by state and federal government,[6] including $26.8 million from the state legislature since 1991 for operations. Millions more are earmarked for road improvements

[6] Survey results from the Associated Press, publicly released January 13, 2001.

that would benefit the TransPark. Original projections held that the N.C. GTP could provide between 28,000 on-site jobs, indirectly provide 59,000 additional jobs statewide over the next two decades and boost the state's economy by as much as $3.8 billion, at a total cost estimated to be near $160 million for development. Now the projection is for 3,400 jobs by 2009.

The success of similar ventures (e.g., the Alliance TransPark in Ft. Worth and Rickenbacker International Airport in Columbus, Ohio) contributed to initial optimism about the transpark concept. While support for the TransPark remains relatively strong within the region, the undercurrent of skepticism about the N.C. GTP from elsewhere in the state is progressing to open opposition. A recent poll by The Associated Press found that 57 percent of House members and 55 percent of senators who responded said that the project should be scrapped altogether.[7] Politicians from urban areas who point to insufficient progress at the park itself and a serious state budget shortfall as reasons for reducing or stopping state allocations spearhead much of the opposition.

Historical context

During the early 1990s, North Carolina state and local officials sought solutions to address the dwindling economic opportunities present in eastern North Carolina. The eastern part of the state had long been plagued by a combination of economic, social and geographic events that led to economic stagnation. Decline in agriculture, dearth of capital resources, separation from major transport arteries, and a lack of skilled labor presented major obstacles to any economic renewal program. The question became what could be a viable mechanism for turning this vast stretch of tobacco and cornfields into an economically competitive region?

Genesis of the intervention

The N.C. GTP is the brainchild of John Kasarda, director of the Kenan Institute of Private Enterprise, a think tank at the University of North Carolina business school. The concept for the park was a by-product of his interest in how emerging technologies affect economic development. Having finished four "waves" of development — ocean-going ships, river barges, trains, and automobiles — we are now mounting the fifth, according to Kasarda: aviation. Companies are beginning to ship everything from clothing and flowers to buses and cows by plane. Air cargo becomes a critical means to support mass customization, just-in-time manufacturing and global distribution networks. The assumption is that the competitively viable regions will be those that are able to get on top of this fifth wave and ride it successfully into the future.

At a meeting in 1990, Kasarda presented his concept to then-governor Jim Martin and other state legislative leaders, including Henson Barnes, president pro tem of the state senate. Martin and Barnes became convinced that North Carolina could get into the act by building a computer-age industrial complex with a cargo airport and rail and highway connections in the middle. Early visions for the complex were grand. The place would be an automated and computerized system of manufacturing, handling and transportation, allowing businesses to create products and ship them out within a few hours to global markets. The N.C. GTP could be an economic boost to a depressed area of the state, bringing in thousands of jobs over the next two decades and creating a tremendous spin-off economy as manufacturing tenants sprang up around the mile-long runway.

It was this prospect that led Barnes immediately to convene the mayors from the largest Downeast cities to brief them on the TransPark concept. Barnes urged them to form a partnership to develop a competitive proposal to site the transpark in eastern North Carolina. The group met again in Greenville in February 1991 to formalize the partnership among their five respective counties and elect one of the mayors as chair of the "Eastern Air Cargo Exploratory Committee." Eight additional counties accepted the invitation to join the effort that eventually was renamed the North Carolina Global

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[7] See *Legislative skepticism grows on TransPark* (January 13, 2001) by Estes Thompson, The Associated Press.

TransPark Authority. From the beginning, this was viewed as a regional project.

Regional efforts

The seeds of region-based efforts in North Carolina were planted by a 1988–89 highway bond issue that raised money earmarked by regions for the first time. Downeast counties joined efforts to establish transportation corridors from the coast to the state capital. Experience from this event, coupled with a history of collaboration focused on establishing and growing the medical complex in Greenville, contributed to leaders' appreciation of a regionalapproach to economic development. Many of the same leaders that had labored for more than ten years to establish the medical school at ECU joined forced to overcome state and fractional regional opposition to siting an air cargo complex Downeast. Subsequently, it was the very effectiveness of their effort in winning the Global TransPark that led the North Carolina Department of Commerce to remold the organizational structure of its statewide economic development offices into seven geographically defined partnerships. Further positive ripple effects of this regional focus have been the extension of GTP-related environmental planning, zoning and quality standards to the surrounding counties.

To summarize ensuing events, then-governor Jim Martin, who chaired the state airport authority, made site selection something of a contest among interested jurisdictions. Nineteen communities applied for the airport, but the authority's consultants, the Transportation Management Group of Raleigh, recommended that the state consider a military airport. Attention then focused on Seymour Johnson Air Force Base at Goldsboro, until the base commander pointed out that a new runway would interfere with military flight patterns. That opened the door for adjacent Lenoir County to offer the Kinston Regional Jetport. (It should be noted that ill-will generated by the competition for the TransPark is believed to underlie the on-going animosity toward the project expressed in newspapers in the state's larger metropolitan areas and for efforts by leaders from the urban counties to discontinue state funding of the project.)

The Kinston Jetport's underutilized facilities encompasses 1,225 acres and includes the existing tower, terminal building, aviation terminal, landing system, and 7,500 foot runway. The jetport's value is estimated to be $140 million.[8] As part of the deal, the City of Kinston (pop. 26,000) and Lenoir County (pop. 57,000) agreed to provide up to $40 million to pay for water, sewer and natural gas lines. Strong lobbying efforts by the Eastern Air Cargo Exploratory Committee carried the day and the N.C. GTP was born.

Evolution of the effort

From the beginning it was recognized that this was a long-range development effort that would require considerable investment of social, financial and political capital. What has evolved is a rather complicated network of groups responsible for various aspects of the project's development. Cross-membership among the groups ensures on-going linkage between the N.C. GTP and broader economic development efforts in the region. The organizations and their specific area of responsibility are summarized below:

- **Global TransPark Authority —** oversight of total N.C. GTP development effort and day-to-day management of facility operations.

- **Global TransPark Foundation** — a private group led by some of the region's wealthiest individuals that raises private funds to support development of specific aspects of the N.C. GTP and to help recruit tenants to the N.C. GTP.

- **N.C.'s Eastern Region Development Commission** — established by the state legislature in 1994 to oversee economic develop-

[8] www.ncgtp.com/organizations.htm

ment efforts in N.C.'s Eastern Region. The Commission has 39 members, giving each member county three representatives that are appointed by the county commissions of the respective member county. The Commission established a fixed-term license plate fee to generate a self-sustaining economic development fund that has been leveraged many times over to support specific projects in the region. The Commission is restricted from using this fund to invest directly in the N.C. GTP, thereby ensuring that the benefits of regionalism are dispersed among all member counties.

Education resources

N.C.'s Eastern Regional Partnership includes a representative from both ECU and one of the community colleges in the region on its economic development committee. This is relatively uncommon among the seven economic development partnerships and points to the acknowledged role educational institutions are expected to play in the economic development efforts in the region. Other educational resources at these and other regional institutions are specified below.

- **East Carolina University** — ECU conducts a regular series of roundtables on selected issues that draws participation from industry government and all levels of education. The ECU Regional Development Institute, established in 1964, is an effective catalyst for change that provides a flexible bridge between the university's resources and the organizations in the region that need assistance to accomplish the economic development aspects of their respective missions. RDS has provided extensive research and market analyses for N.C. GTP in support of its various applications and public relations needs.

- **Community College Consortium** — A consortium of eleven community colleges representing thirteen counties partnered with ECU and industry to fund the recently completed Education Training Center. This was the first-ever collaborative effort to develop a shared technology resource and training center. This represents a significant policy shift for the North Carolina Community College System to leverage scarce strategic resources by following a "center of excellence" strategy to spread technology investments among several campuses. The ETC is the first application of this policy. The focus of this Center will be in logistics, packaging and related curriculums that support JIT manufacture, processing and distribution. The colleges will respond to firms locating in their service area with customized industry training programs that utilize the ETC.

Connectivity resources

N.C. GTP will have international telecommunications links, an electronic data interchange (EDI) system, satellite connections and an internal freight-tracking system. A connection to the national fiber-optic network that will provide tenants with access to a variety of communications technologies, including a double fiber optic loop, is being provided by Sprint and Carolink. Already the N.C. GTP Commission links its office in each of the thirteen-member counties, forming the backbone of an interregional network.

The EDA-funded vision: A "seamless environment"

What separates North Carolina's project from other efforts to utilize cargo airports to spur economic development (e.g., Texas, Ohio, Nebraska, Washington, Arkansas) is the proposed innovative infrastructure that ensures manufacturers will have support networks of transportation, telecommunications, services and knowledge centers. The N.C. GTP plan calls for a sophisticated merging of just-in-time (JIT) manufacturing and surface transportation systems with global air freight systems to create a fully integrated process of accelerated manufacturing and dis-

tribution of goods regionally, nationally, and globally. Completing the picture is a state-of-the-art work force training capability to prepare entering and existing workers in logistics and other technical skills areas need to support N.C. GTP tenants.

3. Impacts of the Interventions

The reality:
Project infrastructure and current status

- **Airport facilities** — N.C. GTP development plans call for a 15,300-acre industrial center and transportation complex featuring state-of-the art technology and communications capabilities. Phase I of the runway extension is complete; Phase II is underway to lengthen the runway to 11,500 feet to accommodate a fully loaded 747 freighter aircraft. Construction is underway on a new hangar and office facility to support general aviation requirements. The GTP Foundation provided $500,000 in private sector funding for the construction of the facility. An unusual aspect of Global TransPark's design is the location of manufacturing facilities adjacent to the airport, allowing aircraft to literally park at a factory's door. Status, Feb. 2002: Runway extension is complete, but less than the entire length is open.

- **Transportation —** Kinston is located within reach of Interstate Highways 95, 40, 85, 26, and 77, affording tenants access to markets throughout the east coast, midwest, and south. The state of North Carolina has committed to building improved highway access points, and the park itself will have an extensive system of internal roads. Both CSX and Norfolk Southern will offer on-site rail service, and international shippers will have connections via rail or truck to the ports of Wilmington and Morehead City, N.C., one hour away from Kinston. Status: Improvements to U.S. 258 that serve the N.C. GTP is almost complete. The first phase of the long-awaited $100 million Crescent Connector project is underway, eventually leading to interstate quality connection from N.C. GTP to I-95. An additional $482 million is on the state Department of Transportation books for completion of this connection.

- **A Foreign Trade Zone** is considered a prerequisite for international businesses, precluding potential customs impediments. Status: Foreign Trade Zone status is secured and being utilized by firms in nearby communities.

- **On-site processing facilities —** N.C. GTP will have a Customs Clearance Center and a central cargo-processing center featuring advanced materials-handling technologies and facilities for handling perishable products and live animals. Plans also call for a sophisticated internal cargo-transportation system to shuttle cargo between tenants and the central processing center. Status: A $3 million funding hurdle is said to be all that prevents the completion of the cargo facility. Given the scale of the total investment to date, this seems like a rather small hurdle. The fact that it remains an obstacle illustrates both the levels of distress of the region and the lack of risk any individual or group is willing to assume on behalf of the project at this point.

- **Education Training Center —** Eleven community colleges, elements of the University of North Carolina system, industry and state and federal government collaborated to leverage resources needed to develop a state-of-the-art technology education and training center. The facility was constructed with funds from the EDA that were matched by an appropriation from the state legislature, augmented by ICT industry contributions. Support for the N.C. GTP among college presidents is strong; they view the TransPark

as 1) the region's transportation system to foreign markets, and 2) a catalyst for increased cooperation and coordination among the colleges. According to the presidents, the indirect impact the N.C. GTP already has on their campus development strategies is expected to become more direct and mutually beneficial. They expect the ETC to be a magnet that attracts industry to locate close to the skilled labor supply it will generate. Status: ETC opened its doors in Summer 2000 and welcomed its first two-year class in a new associated degree program in Global Logistics Technology in Winter 2000. This program will use the Global Positioning System technology to track products throughout the world.

Criticisms of N.C. GTP progress to date

So far the TransPark has attracted two businesses. Mountain Air Cargo, employing 100 people, came in August 1996. In November 1999, Segrave Aviation, a 45-employee air charter service, announced it was moving operations to the airport. In the nine years since its conception, the project has garnered at least $40 million in state funding. In 1998, Federal Express chose Greensboro over Kinston to locate a regional hub. (Speculation in some quarters holds that Kinston was never a serious contender for the hub and was considered only in deference to a request from Governor Hunt's office.) The Federal Express project would have turned a 300-acre field into a $300 million complex employing 1,500 people.[9] This major failure and slower-than-expected tenant recruitment have been attributed to the following criticisms of the project:

- **High-risk isolation** — N.C. GTP is too removed from major urban population/industry centers. Competing air cargo facilities in larger urban areas are moving ahead, even as potential tenants continue to explore a less-risky alternative of siting on available land near established airports in Greensboro, Charlotte and Raleigh.

- **Logistically infeasible** — Airplanes from nearby military bases may hamper operations and environmental problems preclude the success of the N.C. GTP.

- **Excessive delays** — A second runway may not open until 2010.

- **Under funding and diversion of scarce resources** — Detractors estimate that the N.C. GTP has siphoned $200 million from other roads/infrastructure and industry recruitment opportunities in the region. Funds already allocated/requested for the N.C. GTP road projects are insufficient/uncertain.

- **Failure to appreciate fully the environmental evaluation process** — Approximately two years were wasted by the planning group's failure to understand the scale and scope of effort required by the environmental impact analysis. Some community leaders cite this problem as the single largest hurdle the project has faced.

Relationship between the intervention and other economic development efforts in the region

Four different reports document the expected economic impact of the N.C. GTP (the N.C. GTP Master plan, the N.C. GTP Environmental Impact Study, the Rural Prosperity Task Force and the Regional Development Service's comparison of the development of the Research Triangle Park and the N.C. GTP. While the number of actual jobs that can be attributed to the N.C. GTP itself has yet to begin to meet expecta-

[9] It should be noted that the Federal Express project in Greensboro has engendered vociferous opposition from local communities that would be disrupted by the development at the Triad Airport. The project has yet to be initiated and its prospects for success are questionable.

tions, there is evidence of significant positive short- and long-term economic impacts throughout the region.

- **Catalyst for regional development —** The coalition of leaders from industry, education and the region's governmental groups led efforts to enable the region to impose a $5 license plate fee on the region's residents for a period of five years. The Eastern Region Development Commission administers the fees that are pooled in a self-perpetuating fund that is used to make competitive economic development grants and loans throughout the region. Returns from these grants and loans are reinvested in the fund; they are restricted from being used to directly fund development of the N.C. GTP itself.

- **N.C. GTP projected regional impact —** The Regional Development Institute projects that the N.C. GTP affects the regional economy in the following ways: creation of 34,698 non-construction jobs; 21,852 direct and 50,463 indirect construction jobs; $1.03 billion direct spending and $1.35 billion indirect spending (e.g., goods and services investment and consumer spending); and $1.889 billion in direct and indirect earnings.[10]

- **Environmental conservation** — Initial concerns from vocal environmental action groups (e.g., Neuse River Keepers) have largely been addressed to the point where the N.C. GTP is now considered a model for how to conduct an environmental impact study. N.C. GTP met all requirements by October 1998, and obtained the 404 permit to begin construction of the jetway extension. Nearly 5,000 acres of the N.C. GTP have been "mitigated" in exchange for development of up to 871 aces of wetlands in the TransPark.

- **Disaster relief activities** — N.C. GTP offered real-time proof of its potential to serve as a disaster relief command center during Hurricane Floyd and related flooding (1999). The N.C. GTP hosted over 2,000 emergency personnel and had over 500 sorties flown from its airfield to relief centers throughout eastern North Carolina. One idea being floated to link the resources of the N.C. GTP and the ECU telemedicine program is to create a National Preparedness and Response Center to provide airborne and truck relief to eastern North Carolina and beyond.

- **Industry support** — N.C. GTP has a goal to support the transition of the region's tobacco and low-value commodity agriculture base to higher value-added crops. The important Carolina Farm Show exhibited at the N.C. GTP in the first of a multi-year contract in October 2000. This show offered a significant boost to the Lenoir County economy and offers the N.C. GTP a regular opportunity to highlight its operations to one of its primary target client groups.

4. Other Comments and Insights

Lessons learned

1) **High level political support is necessary but not sufficient —** Long-term projects need broad-based support that runs deeper than politics. Although two successive governors have actively supported the N.C. GTP, the project faces peril with each new election.

2) **The value of public relations —** Long-term projects requiring massive resources require on-going and broad-based support. N.C. GTP

[10] *North Carolina's Global TransPark — Comparisons of the Past — Prospects for Growth* (March 2000). In response to a legislative directive, the ECU Regional Development Services developed an analysis comparing the development of the Research Triangle Park and that of the N.C. Global TransPark.

leaders acknowledge their failure to build and communicate a compelling case for the shared benefits that a TransPark in eastern North Carolina can have for the rest of the state. Although leaders have been able to sustain strong support for the N.C. GTP within N.C.'s Eastern Region, opposition from key elements in other regions has escalated over time to the point that continued state-level funding looks very uncertain.

3) **The value of tangible symbols of progress** — Buildings and other tangible elements of an initiative are not only vital to the physical development of a project but are equally important to sustaining the social commitment to the development process. Long-term projects demand the development, use and communication of phased success metrics on a regular basis to shape and sustain the public and political support needed to take the project to completion.

4) **The value may be in the process rather than the product** — The scale, scope and span of large projects may result in diverse benefits that are outgrowths of an initiative and these benefits may persist even if the project that birthed them does not prove successful. Evaluation of potential projects should include deliberate attention to secondary benefits that are possible outcomes of the effort to complete the proposed primary project.

5. *Testing the Study Hypotheses*

1. Enabling infrastructure (roads, water, sewer, etc.) is necessary, but not sufficient to assure the effectiveness of technology infrastructure investment.

True. The TransPark concept is based on the application of state-of-the-art ICT to the inter-modal transport of goods throughout the world. While the validity of the concept as envisioned for the Kinston facility has yet to be adequately demonstrated, it is certainly true that either ICT or conventional enabling infrastructure alone will not be sufficient to accomplish the goals of the Global TransPark effort.

GTP represents the marriage of old and new economy infrastructure. The resulting hybrid turns out to be even more unique than even the early advocates of the project imagined. The more visible aspects of success will be tangible, physical infrastructure and a growing number of tenants. The ICT elements that will give GTP a competitive edge and enhance its economic impact will be both less visible and less generally understood by stakeholders in the region.

2. Investments in technology infrastructure must be part of a larger local planning process to succeed.

False. The scale of the GTP effort, the need to integrate work force training and the significant departure from usual land-use planning efforts point to the need for a broader perspective to realize the GTP goals. The effort has been an experiment in regionalization of development efforts that from the outset has required the development of novel practices and partnerships. One result has been a stronger sense of shared destiny and common purpose than previously characterized the region. Another result has been enactment of policies allowing communities in the region to attach a fee on automobile tags that is designated exclusively for economic development purposes.

3. A certain density or critical mass is required for information and communications technology (ICT) to work, because of the costs of provision.

Somewhat true. For reasons more related to political goodwill than short-term economics, GTP already has in place dual high-speed fiber optic systems (Sprint and Carolink). This has been a high visibility project with strong support in both the legislative and administrative branches of state government. The result appears to be an under-utilized resource with capacity that could (but is yet to) be leveraged

to raise the connectivity of surrounding areas. So while ICT is certainly in place, it cannot be said to be working in any capacity utilization sense.

4. Technological innovations and advances are reducing the costs of communications and linkages.

False. This statement summarizes a basic premise of the GTP concept — regions will compete largely upon how well they are "linked" via technology. While the image evoked for the GTP is one of stronger external linkages, the best evidence to date that this statement is true involves internal communications and linkages. As a direct result of the extended effort to get the GTP approved, funded and established in eastern North Carolina, thirteen counties now have a tangible basis for identifying themselves as part of an economic development region. Innovative structures, policies and advanced communications devices form a platform for addressing common needs and opportunities. Effectively, the cost of cooperation and coordination has been reduced.

5. Institutional mechanisms must be in place to help users deploy the hard infrastructure appropriately.

True. While it is true that these mechanisms must be in place, it is not yet proven that they contribute to success. ICT is critical to the eventual success of the venture, but it will be the timing and manner in which GTP's traditional infrastructure is deployed that will determine whether the region even gets to enter the game. The number and types of regulatory and licensing hurdles that must be managed to enable GTP to bring all the necessary elements online is daunting. Institutional resources familiar with the structure and requirements of external agencies responsible for the various permits, etc. are needed to ensure that another two years is not squandered obtaining necessary clearances from state and federal agencies.

6. Some hierarchical coordination or linkages among national, state and local governments are important for a community to be truly connected.

Mostly false. The highly structured permitting processes required for the development of GTP is a good example of the value of coordination/linkages among the various levels of government. Area leaders worked closely with state and local agencies to identify and address information needs and actions necessary to the environmental permitting process. The end result is that while the permitting/impact process delayed other aspects of development for two years, two years is an unusually expeditious period for this sort of project. Similarly, discussions related to the permitting/impact process facilitated development of local communication channels that turned potential opponents into supporters and allowed time for smarter land-use planning to evolve on the local level.

7. Linkages among government, education and industry are a critical success factor for ICT interventions. State policies and corporate action are important determinants of local "success."

Mostly false. It is almost certain that the GTP would have never made it to the drawing board without strong support from influential elements of North Carolina's government, education and industry sectors. ICT providers agreed to bring connectivity to the GTP at the request of state government and local industry leaders. Local government leaders recognized and adopted the GTP as a concept around which a critical mass of resources of all sorts could be attracted to overcome systemic inadequacies in the regions' ability to attract and grow industries with a future in the new economy.

8. Infrastructure providers must be partners in assessment and planning, not just the spending, for the intervention to succeed.

True. The critical missing infrastructure elements impeding the further development of GTP relate to ground transportation. In North Carolina it is the state Department of Transportation that assigns priorities to road projects. To date, its decision-makers have not bought into the argument that the GTP de-

serves to be moved very far up the list. When disadvantaged communities are in direct competition for scarce resources with larger, more influential communities it will be difficult for them to win. Leaders at the GTP recognize that a critical task facing them is one of educating members of the transportation board and other opinion leaders throughout the state of the benefits that GTP will bring to firms located all across North Carolina. In retrospect, GTP leaders wish that they had involved key individual on the transportation planning board in their own planning activities at an earlier stage.

9. *Work force development is a critical complement to any infrastructure intervention.*

Mostly false. The critical importance of work force development to the ability of GTP to enhance economic development is evidenced by the decision to make the Education and Training Center (ETC) the first tangible component of the GTP. The existing inadequacies of the work force are cited as the reason previous efforts to recruit competitively in logistics-related arenas have failed. GTP and ETC leaders recognize the need to make the pace at which the work force training program develops coincident with the rate at which jobs materialize.

10. *Because of the long-term and expensive nature of ICT, vision and leadership are critical success factors.*

False. Vision and leadership, maintained over several years and in direct competition with other regions in the state, are exactly what has taken the GTP to the point it is at today. The broad base of leadership has contributed to the project's sustainability. Yet, we have not classified this as a "success." The bottom line is that leadership is necessary but not

6. Persons Interviewed

Lonnie Blizzard, Director President (former)
Lenoir County Community College
N.C. GTP Education Training Center

Paul Busick, Administrative President
Global TransPark Authority

John Chaffey, Director
Pitt County Economic Development Commission

Robert Clark, Director
Kinston City Planning Office

J.D. Faust, Lobbyist/Consultant
Former Deputy State Treasurer

Bill Harper, Activist
Craven County Tax Payers Association, and
Citizens Against Trashy Services

Dan Oliver
Carolina Power and Light

Hal Plonck
1) Chairman (former) N.C. GTP Commission
2) Mayor (former) of Goldsboro
3) Superintendent (former) of Wayne County Schools

Charles Russell, President
Pitt County Community College

Jim Sughrue, Vice President Communications
Global TransPark Authority

NORTH CAROLINA

Greenville and Eastern North Carolina

1. Context

Telemedicine offers a rich variety of services and uses that are of benefit to healthcare in rural America. The importance of telemedicine programs is that they develop and utilize a technology network to link healthcare providers like hospitals and health departments, transport information quickly, conduct medical specialty consultations without patients having to travel great distances, and use physicians more efficiently. The ECU telemedicine program's primary purpose is to extend the reach of quality medical care to traditionally under-served populations in eastern North Carolina. ECU's telemedicine program personifies the ideal application of technology to serve rural populations by leveraging the resources of a relatively young and small medical school and regional medical center to provide education and clinical services to over 1,000,000 people in a 14,000 square mile area.

There are many challenges in providing healthcare to rural areas. In North Carolina they include a high poverty rate, very high infant mortality rates, high incidence of diabetes, poverty-related mental disorders, substance abuse, family violence and developmental disorders. Out-migration of college-educated natives and an influx of retirees is resulting in an overall increase in demand by an aging population for healthcare services in a region that is already seriously under-served. Twenty-seven of the region's 29 counties have been designated as Medically Under-served Areas (MUAs); the ratio of population to

Table A.10
Demographics for Pitt County, North Carolina

Population, 2000	133,798
Median household income, 1997 estimate	$31,987
Educational Attainment, High School or higher, 1990	71.0%
Educational attainment, Bachelor of Science or higher, 1990	21.9%
Poverty rate, 1997 estimate	17.7%
Unemployment rate, 2000 annual	4.7%
Per capita personal income, 1999 estimate	$23,239
Homeownership rate, 2000	58.1%
Percent Ethnicity, 2000	
White	62.1%
African-American	33.6%
Hispanic	3.2%

Sources: U.S. Census Bureau, U.S. Department of Labor.

primary care physicians in the region is 2,189:1, compared to 1,391:1 for the United States. Compounding the health and demographic challenges of the region is its geography. The region is bounded on the east by the Outer Banks, with the mainland laying to the west divided by large sounds and estuaries. Further inland lay marshes and swamps — land travel can be circuitous and slow.

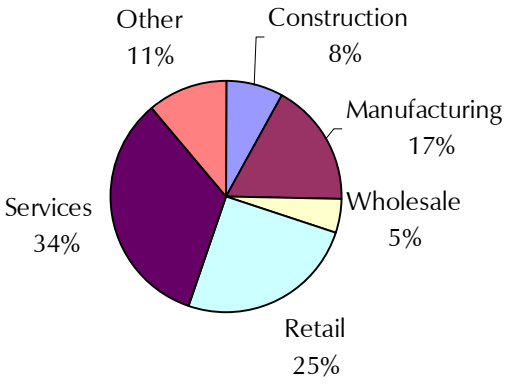
These challenges are being met by the telemedicine and distance-learning programs at East Carolina University. The ECU School of Medicine and its Center for Health Sciences Communication (CHSC) have considerable experience in both distance learning and telemedicine. The distance-learning program at ECU began in 1989 over the North Carolina Information Highway (NCIH), a statewide network that links major universities in North Carolina. ECU's Continuing Medical Education programs are delivered to rural health professionals at their place of work. This helps reduce professional isolation and provides a means to maintain credentials, without time away from work.

Telemedicine consultations began in late 1992 when Central Prison, the State's largest maximum-security prison, contracted for the most pragmatic of reasons: they wished to reduce operating costs by minimizing the number of inmate visits to local emergency rooms. The prison initially approached the more proximate medical schools at the University of North Carolina at Chapel Hill and Duke University, but both declined to participate. The director of ECU's CHSC did not. Reflecting both his personal entrepreneurial spirit and the relatively decentralized decision-making culture that characterized ECU, the director accepted the challenge, considering it as an demonstration project. A contract was struck with Central Prison and telemedicine at ECU was born. As it evolved, telemedicine did not replace the need for emergency room visits, but its benefits have been proven for other applications targeting inmates; Central Prison remains an active node on ECU's network.

The general feeling among those interviewed is that the telemedicine network would not have grown at the pace and extent it has into rural North Carolina communities if either UNC-CH or Duke Medical schools had accepted the request from Central Prison. ECU's rural service mission and the capabilities of ICT technology have made the effort a success. More than a match between missions and technology, it was the unlikely confluence of history, serendipity and individual personalities that resulted in the development of this program at this particular medical school.

To begin, the director of the CHSC came to his job in Health Science Communications with training in neither science nor communications. Rather, he was a musician and artist who had been most seriously engaged in the production of independent rock videos. He brought to his job both an entrepreneurial spirit and an appreciation for the technical and practical uses of videos and television for outreach. Beyond that, family ties to the region contributed to his sense of commitment to the institution and its mission. The culture and relatively flat organizational structure at ECU neither stymied his talents nor impeded his experimental, risk-taking approach to communications. The medical school is young enough that many of its current leaders are the very pioneering risk takers that left established schools to establish a new medical school in the middle of a former tobacco field in eastern North Carolina. The road to telemedicine had already been

Figure A.8
Pitt County Business Mix, 1999 estimate



Source: Bureau of Economic Analysis; total full-time and part-time employment by industry.

blazed in a sense by the NCIH, which promoted and enabled the concept of leveraging public investments at institutions across North Carolina through the use of ICT. The fact that the experiment was proposed to address the needs of an under-served prison population completes this story; motive, opportunity and means all came together to make telemedicine at ECU happen.

ECU has developed a very advanced telecommunications infrastructure for telemedicine and has conducted consultations in thirty-four different medical specialties. Telemedicine in eastern North Carolina supports life-saving efforts by rural emergency departments that are often under-staffed at night. Telemedicine provides backup clinical support in rural communities that have difficulty recruiting and retaining a full range of medical practitioners. Telemedicine also plays in important role in ECU's Rural Family Medicine Residency Program, which graduated its first four participants in the summer of 2000. The program allows residents to spend their first year of training at Pitt County Memorial Hospital and the remaining two years at rural hospitals in the outlying rural communities of Ahoskie or Williamston while still having access to the expertise of university physicians more than thirty miles away. Program officials hope that at the end of their training, the residents will want to stay in those towns to practice.

ECU has built working models of telemedicine for application in homes, schools and small clinical practices. ECU has implemented a diabetic retinopathy-screening program for tackling the high rate of diabetes in the region. This innovative program uses a mobile digital retina camera, which allows rural clinics to do screenings and catch diseases at an early stage. ECU has also implemented a telecardiology program for young children with heart problems. These are just a few of the telemedicine programs developed by ECU to serve rural N.C.

2. *Nature of the Intervention*

Education resources

- **East Carolina University** — ECU's telemedicine program depends heavily upon its links with both the medical school and the broader university campus to support its operations and on-going expansion. Although NCIH linkages provided by the NCIH enable consultation with medical specialists at other North Carolina medical schools, it is the medical specialists at ECU that provide the majority of consults. Additional support is provided by the applied technology and communication programs on the main campus.

- **Pitt County Community College** (PCCC) — PCCC and other community colleges in the area are linked to the telemedicine program through the NCIH. It has been suggested that distance education and training courses in telemedicine could be delivered to the community colleges for incorporation into their nursing curriculums. PCCC already has in place thirteen medically related training programs that distinquish PCCC within the North Carolina Community College System.

- **Telemedicine Training** — The Advanced Telemedicine Training Program is designed to increase the understanding of operational, technical, and administrative issues associated with on-line learning and remote healthcare delivery. Training sessions are held on-site at the ECU Telemedicine Center in the Brody Medical Sciences Building. Attendees get a behind-the-scenes perspective of an operational production telemedicine facility and research prototyping lab and participate in hands-on demonstrations of clinical diagnostic tools and interactive video systems. Attendance is limited to eight indi-

viduals to allow one-on-one discussions with experienced telemedicine staff and clinicians. Three tracks are offered (administrative, technical, and clinical) on a monthly basis, as well as the opportunity to customize a curriculum based on a specific project need.

Connectivity resources/infrastructure

The program still uses the NCIH to connect it to various sites in the network. Another major factor in the ultimate form and success of the program relates to the decision made approximately nine-to-twelve months into the program's operations to use T1 lines to expand service to other sites that were not part of the NCIH. This was against the advice of state technology leaders to adopt a T10 backbone to extend the network. In the words of one local leader, they "decided not to bite off more than they could chew." This turned out to be fortunate choice; efforts to use T10 lines to extend related heath services in the Charlotte area proved to be too expensive.

As it has evolved, the technical team at ECU has integrated advanced telecommunications technologies into a homogeneous network that its leaders think is the most flexible telemedicine network in the country. This hybrid network of microwave, T1, ATM, ISDN and Internet video allows for deployment of the most cost-effective technology to each site. With four distance-learning rooms spread around campus and four custom telemedicine suites, any site on any network can be connected to any of the eight rooms on campus.

The microwave network provides full duplex connections statewide to approximately 40 sites with three discrete channels of audio, video and data. The ATM/SONET network is part of the NCIH, with 200 distance-learning sites, and eleven telemedicine sites. The network is connected to six rural hospitals and four medical centers in the region and supports both telemedicine and distance learning programs. These different networks are integrated into a large hybrid network called REACH-TV (Rural Eastern Carolina Health Television). The REACH-TV Network is made up of ATM, T1, microwave, ISDN, and POTS (plain old telephone service) communication links spread out over the state of North Carolina. REACH-TV and the telemedicine training program conduct courses, seminars and continuing medical education, and manage a wide variety of videoconferences over each of these networks.

The ECU telemedicine program tests and develops technology resources, networking and patient information management skills, scheduling tools and the infrastructure for next-generation telemedicine networks. The quality of these capabilities was recognized by the National Science Foundation in its award of a large grant to study the use of the next-generation Internet in telemedicine applications.

ECU is beginning to test and implement virtual reality tools into the telemedicine environment and to expand telemedicine into the home with its new teleHome care program.

Relation of the intervention to broader economic development efforts in the region

It seems obvious that the health status of a region's population should be one of the prime measures to differentiate levels of distress. Efforts to improve an area's health status have historically focused on improving health education, improving access, and reducing the patient/provider ratio. Telemedicine can address all of these goals in a flexible, customized and cost-effective manner. According to the Dean of the Medical School, telemedicine has become a vital part of the school. It helps ECU reach out to deliver its knowledge to the region, educate the region, and assist practitioners in the region to maintain their patients locally. The goal is to use telemedicine to improve health, not just healthcare, in eastern North Carolina.

Tourism and the recruitment of retirees are pivotal elements of economic development strategies in many eastern North Carolina counties. Telemedicine directly supports these strategic efforts by offering tourists and retirees proximity and access to high-quality healthcare. For example, the telemedicine program and Weyerhauser Corporation are examining the possibility of establishing pre-sell network links between a proposed retirement community and

the telemedicine center. These linkages are expected to improve the attractiveness of the community to the target populations.

3. Impacts of the Interventions

The growing economic impact of ECU's telemedicine program in eastern North Carolina and beyond is best illustrated by the following brief descriptions of the efforts in which the program has been involved.

- **Regional health service impact** — Telemedicine offers a variety of services and uses that are of benefit to healthcare in rural America. ECU's telemedicine program has begun to apply this technology to serve rural populations by providing education and clinical services to over 1,000,000 people in a 14,000 square-mile area. ECU began conducting telemedicine consultations in 1992 and by the end of 2000 completed over 3,000 consultations in 34 different specialties of medicine over its REACH-TV Network.

- **Disaster relief** — ECU's Telemedicine Program responded immediately to the widespread devastation created by Hurricane Floyd (1999). United States Forest Service helicopters lifted telemedicine equipment and personnel to isolated emergency shelters where they established links with ECU and conducted crash telemedicine training courses to volunteer clinical staffs. Experience gained from this effort is the foundation for a developing knowledge base that ECU will be applying to global disaster relief efforts.

- **National presence and impact** — The National Institutes of Health and the National Medical Library jointly awarded ECU's telemedicine program a competitive grant for $4.6 million to study biomechanical applications of the next-generation Internet.

- **International presence and impact: Operation Strong Angel —** In July 2000 the ECU's Telemedicine Center joined the United States Navy, the navies of seven Pacific Rim countries, and the International Red Cross in a simulated disaster. Strong Angel was designed to develop and test a global emergency response system operating in an austere environment lacking water, electricity or human habitation. Promising results point to important applications of the next-generation Internet.

- **Technology transfer: 1) Spin-off firms —** There is growing interest in developing and commercializing technologies associated with the telemedicine program. Telemedicine Technologies Co. is one such joint venture between private investors and ECU created to offer training and consulting services in telemedicine. **2) Training —** Collaborative efforts between Telemedicine Technologies Co. and the ECU telemedicine program have extended virtual and on-site training in telemedicine operations to more than 300 people from fourteen countries.

- **National recognition** — ECU was cited by Telehealth Medicine as one of the top-ten telemedicine programs in the nation.

4. Other Comments and Insights

Lessons learned

- **The value of adaptive flexibility —** Telemedicine is an example of an immature technology for which the full scope of applications could not be anticipated at the point it was adopted by ECU. This situation places a particular premium on flexibility in various aspects of development and implementation, allowing the fit between the technology and its applications to evolve.

- **Even revolutionary technologies are better adopted incrementally —** Empiricism has a major role in social and economic change. ECU Medical School leaders advised not to "bite off pieces that are not too big" when dealing with technology. They cite as flawed the philosophy of going as high tech as possible; innovative applications of relatively simple technologies can have significant effects.

- **A time and place for entrepreneurs —** Startups, whether a private sector corporation or a public-sector economic development initiative, benefit from having an energizing entrepreneurial guiding spirit in the earliest stages of development. The director of the ECU telemedicine program has been such as person. He has provided vision, leadership, commitment, charisma, and a willingness to take risks that have fueled the ECU program's growth. The private sector model holds that the skills needed for subsequent levels of organizational development may be very different. While some entrepreneurs may be interested in managing maturing organizations with ever more complex networks of organizational relationships, many decide to apply their special skills to new challenges in other startups. The important lesson is that of the need to match leadership skills with the stage of the initiative.

- **The importance of compatible cultures —** The entrepreneurial culture that imbues both ECU's medical school and the telemedicine program that it incubated is strong. Telemedicine did not, and perhaps could not take root at more established, traditional medical schools in North Carolina. That points to the need to deliberately consider the match between the dominant culture of the initiative under consideration and the organizations that will be required to support it.

- **Higher-level policy and regulatory obstacles may interfere with optimization of the intervention** — Health service delivery is a good example of a category of economic development efforts that almost inevitably bump up against multiple levels of policy and regulatory hurdles. The success of the ECU telemedicine program's efforts to become a truly regional asset with services extending to the tidewater area of Virginia hinges in part on the ability to get around malpractice insurance policies that are only effective in one state. Other issues precluding the optimization of telemedicine's benefits include the need for uniform reimbursement for telemedicine services, uniform Medicaid reimbursement in all states, and more federal funding for clinical efficacy and effectiveness studies for telemedicine. Risks posed by existing regulations/policies should be factored into analyses of alternative initiatives.

5. Testing the Study Hypotheses

1. *Enabling infrastructure (roads, water, sewer, etc.) is necessary, but not sufficient to assure the effectiveness of technology infrastructure investment.*

True. Telemedicine represents an excellent example of how technology can be used to bring scarce resources to remote areas to leverage technology investments. It is not the absence of adequate roads, water, sewer, etc that causes the inadequacy of healthcare in many disadvantaged communities, but the inadequacy of the intellectual resources needed to bring the level of care up to an acceptable standard. Less tangible quality-of-life issues, including the availability of a peer community of professional colleagues to provide the desired intellectual stimulation, accounts for part of the difficulty remote and disadvantaged communities have in attracting and retaining high-quality healthcare providers. ICT makes it possible for rural healthcare providers to

have a virtual link to an intellectual and professional network.

2. *Investments in technology infrastructure must be part of a larger local planning process to succeed.*

Mostly true. The initial impetus for the ECU telemedicine effort was a desire for cost savings in the treatment of prisoners in correctional facilities located in areas of North Carolina distant from Greenville. It was only after legal and other issues pointed to problems with this application of telemedicine that alternative uses of the technology were considered. Through trial and error, ECU is figuring out how best to apply this technology in rural communities. The success to date reflects the strategic niche filled by this particular medical institution — namely training doctors for rural healthcare practice. There most likely would not have been the necessary level of internal or external (grants/appropriations) support for the telemedicine experiment if this degree of fit were not present. This region, however has not had as strong a coordinated planning effort as others in this study.

3. *A certain density or critical mass is required for information and communications technology (ICT) to work, because of the costs of provision.*

True. Telemedicine makes the most economic sense when it utilizes the existing concentration of intellectual and professional resources, such as are found at a medical teaching facility. Attendant investments in video and service delivery/monitoring equipment also argue for operations that meet a certain minimum scale/scope of coverage. In any event, it is unlikely that the direct returns on this service will cover the operating costs. Rather, telemedicine should be viewed as part of the service function of the institution and as a tool to link rural doctors and their patients to the facility for their non-routine healthcare needs.

4. *Technological innovations and advances are reducing the costs of communications and linkages.*

True. The primary healthcare argument for telemedicine is that is improves the quality and quantity of care and effectively reduces the long-term costs of managing chronic problems. Innovative monitoring systems linked to traditional communications devices, such as telephones, are making it possible to get real-time and trend data on patients from their homes or local providers' offices. The ability to link high-tech and low-tech communications devices makes it possible to extend the range of the technological innovations in a cost-effective manner.

5. *Institutional mechanisms must be in place to help users deploy the hard infrastructure appropriately.*

True. Medical and healthcare delivery is highly structured and regulated. Without appropriate knowledge of and attention to these defining aspects of the healthcare environment it would not be possible to develop alternative ICT-based delivery mechanisms.

6. *Some hierarchical coordination or linkages among national, state and local governments are important for a community to be truly connected.*

Somewhat true. Currently, basic education and monitoring services of telemedicine can be accessed via fairly low-tech delivery options (e.g., telephone and video). Emerging, highly sophisticated critical care applications will require greater coordination and rationalization of standards among local delivery providers and the healthcare specialists at state and national healthcare institutions. Ability to digitize radiology results and conduct virtual diagnosis offers patients in remote locations incredible access to the best services of leading centers throughout the world. Downstream it is not difficult to envision world-class surgeons utilizing the real-time, uninterrupted communication capacities being developed for the next generation Internet to perform remote controlled robotic surgery in standard surgical centers in rural surgery centers.

7. *Linkages among government, education and industry are a critical success factor for ICT interventions. State policies and corporate action are important determinants of local "success."*

True. Again, the highly regulated nature of the healthcare delivery industry points to the need to tailor the particulars of healthcare delivery and education services via telemedicine technology to meet the requirements of the various regulatory entities at national and state levels. This extends to third party payment systems that need to buy into the value of telemedicine services.

8. *Infrastructure providers must be partners in assessment and planning, not just the spending, for the intervention to succeed.*

Mostly true. Existing standard applications of telemedicine make use of existing ICT to deliver services. Anticipated applications are more sophisticated and may require more and earlier linkage with ICT designers and providers. The need to optimize coverage and minimize costs points to opportunities for ICT providers to contribute positively to telemedicine delivery planning efforts.

9. *Work force development is a critical complement to any infrastructure intervention.*

True. A particularly important element of the ECU telemedicine program is the training and certification modules it has developed. Telemedicine administrators and practitioners from throughout the country come to Greenville for a weeklong immersion in telemedicine practice. One of ECU's first technology spin-offs has been a company that promotes and manages telemedicine training programs conducted at ECU.

10. *Because of the long-term and expensive nature of ICT, vision and leadership are critical success factors.*

True. There are two distinct aspects the leadership/vision issue as it applied to the development of telemedicine at ECU. The fact that it began at all is a combination of serendipity and entrepreneurship. The director of the hospital's PR and communication department was someone with a history in the production of television and rock videos that gave him the technical expertise to appreciate and work video/film technology. His entrepreneurial and creative skills matched well with the fairly high tolerance for program innovation that characterized ECU's young medical school. The combination of a strong champion with an environment open to novelty and experimentation made it possible that this program would be given a chance to evolve. As explained earlier, the initial vision of inmate treatment was transmuted to a rural care delivery system that better fit the larger institution's identified market niche after the fact.

6. Persons Interviewed

David Balch, Director
Center for Health Science Communications

John Chaffee, Director
Pitt County Economic Development Commission

Albert DeLia

Tom Irons, Associate Vice Chancellor Health Sciences
East Carolina Medical School and
Pitt County Memorial Hospital

Mack Simpson, Acting Director
Regional Development Center

Bob Watson, Director, Marketing
Telemedicine Technology Co.

Jordan Wichard, Publisher
Daily Reflector,
Greenville/Rocky Mount Telegram

PENNSYLVANIA

Connectivity to Arrest Decline in the Keystone State

1. Context of the Pennsylvania Case Studies

Pennsylvania is one of the largest states in the nation, ranking fifth in both population and gross state product.[1] The composition of its economy mirrors the national economy. As the birthplace of electricity, the computer and the Internet, Pennsylvania has a strong high-tech heritage. Many biotechnological breakthroughs, such as the first polio vaccine, also emerged in Pennsylvania laboratories. Table A.11 shows some of the impressive facts about this state.

Despite its rich history of technological breakthroughs, Pennsylvania's economy was driven by traditional smokestack manufacturing industries and coal mining until 20 years ago. After being hard hit by recession in the early 1980s, Pennsylvania took a new approach to economic development by launching efforts to strengthen its position in technology-intensive industries. When its major manufacturing sectors (electrical machinery and needle trades), which comprised about 36 percent of the state's manufacturing employment, lost 68 percent of their jobs due to the recession, the Pennsylvania MILRITE Council, a state level organization of business, labor, and government leaders, began to discuss possible strategies for state economic development policy.

Two major features are at the heart of Pennsylvania's science and technology policy: 1) a well-developed technology development vehicle, the Ben Franklin Partnership Program; and 2) a well-developed and highly utilized statewide infor-

Table A.11
Pennsylvania Facts

- One of eight biotechnology firms in the U.S. are located in Pennsylvania.
- Pennsylvania is second in the nation in pharmaceutical employment.
- Pennsylvania ranks fourth in the nation in the number of research and development facilities.
- Pennsylvania is fourth in the nation in the number of doctoral scientists and engineers.
- There are nearly 40 Nobel Prize Winners at research institutions in the Philadelphia region.

[1] U.S. Census Bureau.

mation network. The 15-member Ben Franklin/Industrial Resource Centers Partnership Board is responsible for the Ben Franklin Partnership Program. The Governor's Office of Administration/Office for Information Technology (OIT) oversees the development of information networks across the state.

Pennsylvania has focused on two major strategies in developing its science and technology policy: 1) supporting technology development and utilization; and 2) exploiting information technology.

Supporting technology development and utilization

Ben Franklin Partnership Program: Following emphasis on market mechanisms in the Reagan administration, Republican Governor Richard Thornburgh and legislative members of the MILRITE Council introduced the Advanced Technology Job Creation Act. It aimed at promoting the development of advanced technology and assisting emerging high-tech companies as a way to create a business environment conducive to private-sector companies. That approach allowed the government to minimize its direct involvement and to use resource pooling rather than relying solely on public appropriations. The legislation became the foundation of the Ben Franklin Partnership Program, introduced with the belief that the state government could support small technology start-ups and facilitate the cooperation between industries and universities to help solve firms' problems. It was the first technology-driven economic development program of this kind in the nation. The program was designed to provide financial support for early-stage, high-tech venture companies, for R&D activities, and to stimulate the transfer of technology, commercialization of research, and integration of advanced technology into mature industries.

The program is implemented around four **Ben Franklin Technology Centers** (BFTCs), which are located in Pittsburgh, Bethlehem, Philadelphia, and University Park. They serve as business partners to manufacturing and high-tech industries in Pennsylvania. As independently operated nonprofit organizations, BFTCs provide financial and technical assistance for new technology ventures, new product development projects, technology commercialization, and work force training. However, the focus of funding varies widely among the four centers. For example, one center spends over 70 percent of its funding for technology development activities, while at another center, more money goes toward product and process development. The highly decentralized and independent organizational structure allows each center to be responsive to the specific economic development needs of the region it serves. There are two major technology development programs administrated by BFTCs.

1) **The Seed Venture Capital program** was established in 1984 to finance early-stage startup companies in Pennsylvania. The creation of the fund was prompted by several studies in 1982 and 1983 confirming the shortage of venture capital in Pennsylvania. The reason for the shortage was simply unavailability of funds due to conservative banking practices in Pennsylvania. The private sector capital market could not provide enough funding for early stage start-up companies, and Seed Venture Capital was created in response to this gap. The funds provide equity and other types of financial support to startups, which must raise 3:1 matching funds. These funds distributed up to $50 million to over 40 companies until the early 1990s.

2) **The Challenge Grant program** was designed to provide financial support for small businesses seeking to develop a new technology or a new product. Typically the grant ranges from $5,000 to $100,000 and often has a royalty payback provision.

The Industrial Resource Center (IRC) program was founded in 1988 to help companies adopt proven technologies to increase their competitiveness. Composed of eight private and nonprofit economic development corporations, IRC provides financial and technical support to Pennsylvania's manufacturers to improve their technologies and operations. IRC

and BFTC complement each other: the former's services are focused on short-term projects that utilize existing technologies, while the latter focuses on longer-term technology development projects.

R&D tax incentives: Pennsylvania has taken aggressive steps to provide tax benefits for high-tech industry, to stimulate R&D activities and technological innovations. The state offers employers a 10 percent tax credit for new R&D investments and provides a $1,000 tax credit per newly created job for companies that focus on the development of technology. Pennsylvania also eliminated its 6 percent computer service sales tax to encourage companies to invest more in computer-related technology.

Plans for the next century: Pennsylvania's biggest concern is how to be a high-tech leader in the twenty-first century. The Commonwealth's vision and its strategic planning for the new millennium are described in the recently published *Technology 21 Initiative Report*. The initiative was developed to seek industry input regarding the role of state government in helping Pennsylvania high-tech businesses remain competitive. The major recommendations of the committee are to:

- Develop a technology-focused marketing to promote state's image as a high-tech state.
- Attract or expand anchor firms that serve as the primary catalyst for a technology-intensive economy.
- Establish a public/private joint fund that enables young high-tech firms to become engines of growth.
- Seek opportunities to make Pennsylvania a laboratory for the next generation of technology, particularly information technology service and products.
- Develop a system to supply technically knowledgeable and skilled workers.
- Establish a true technology-intensive business climate.
- Establish a research and technology network among research institutions, universities, and industries.

Exploiting information technology

Pennsylvania has demonstrated its awareness of the importance of information technology by implementing aggressive information technology programs. The intensive utilization of information technology has made a significant contribution to strengthening the competitiveness of Pennsylvania's economy. For example, a proactive public-private partnership referred to as Team Pennsylvania developed the Business Resource Network. That is a statewide information network providing efficient and effective access to Pennsylvania's business assets, business assistance programs, education system and any other information on Pennsylvania that might be helpful for a business. The OA/OIT have played an important role in statewide information network development. The most noticeable efforts of the OIT are found in the development of statewide information networks and database systems. Some examples of those efforts are:

- A high-speed fiber-optic network development plan (Metropolitan Area Network) in 1993, which interconnects all the computing resources in a metropolitan area. The new network has a data transmission speed 10,000 times faster than the previous technology, and it is expected to save tremendous amounts of money and paperwork for state agencies.
- The Commonwealth of Pennsylvania IntraNET, which makes key business information readily accessible.
- Link-to-Learn, a three-year, $132 million technology-based education initiative, is an-

other good example of Pennsylvania's special attention to information technology and its utilization. The program improves educational technology, trains teachers and interconnects classrooms to build the statewide and community-based Pennsylvania Education Network.

- The Technology Atlas for a New Pennsylvania was created by OIT as the nation's first digital atlas of technological resources. The project catalogued the spatial distribution of every technological resource at schools, colleges, libraries, museums, hospitals, government agencies, utilities and telecommunications companies in Pennsylvania.

Together these programs have launched Pennsylvania to a position of prominence in technological circles, primarily for the biosciences.

Work force development

Pennsylvania's **Unified Plan for Workforce Investment** provides a good example of the many dimensions that are essential for work force development. The state recognized that high illiteracy rates and other basic skill deficiencies impede the ability of some Pennsylvanians to take advantage of the economic opportunities that are unfolding in the state. The plan is designed both to close the skills gap and address the labor shortages of the state's most promising industries. Some of the key aspects of the unified plan include

- Literacy improvement;
- Enhanced basic skill attainment;
- Scholarships to encourage students to pursue careers in high technology;
- Internships with technology companies;
- Customized job training programs; and
- Programs for special populations, including adults reentering the work force or otherwise in transition, welfare recipients, disabled persons, and older workers.

Through a series of professionally facilitated sessions, Pennsylvania business leaders generated ideas for how the Commonwealth could best support business growth and retention. Among the ideas generated in the work force development area were to:

- Offer tax incentives for businesses that train their work forces.
- Provide teaching resources such as computer based training materials, since small and medium sized businesses lack internal resources for training.
- Improve Pennsylvania's basic and secondary educational systems so that a high school degree means mastery of basic skills.
- Plug the brain drain by encouraging young people to start their careers in Pennsylvania while encouraging recent graduates to return.
- Encourage more collaboration between business and education to acknowledge that businesses are customers of the education community.
- Create work-based learning opportunities for young people and new entrants to the work force so they can learn how to be effective in the modern workplace.

Information Technology Work force Development (ITWD) is a statewide, competitive funding initiative designed to enable higher education institutions to attract, retain and graduate information technology students with the knowledge and skills that match the needs of Pennsylvania employers. Twenty-six higher education institutions received funds through this program. These funds directly serve more than

8,400 prospective and current IT students, more than 250 higher education faculty, and 2,600 Pennsylvania K–12 students and teachers.

Employment in information technology in Pennsylvania is growing at a faster rate than overall employment.[2] The ITWD funds proposals that enable higher education institutions to implement curricular changes, resource improvements, and/or special programs that will attract, retain, and graduate information technology students with the knowledge and skills that match the needs of IT employers. Proposals must demonstrate understanding of the IT employment environment in Pennsylvania, and they must represent sustainable efforts that show strong evidence of institutional and departmental leadership and commitment.

The funding initiative gives preference to proposals that strengthen relationships between businesses hiring IT employees, higher education institutions producing IT graduates, and K–12 institutions providing primary and secondary education in science and technology. This funding initiative is primarily intended to support five types of activities:

- Curriculum alignment;
- Faculty professional development;
- Infrastructure improvement;
- Educational access; and
- Student recruitment and retention.

The **Customized Job Training (CJT) Program** is a tool to support the educational training of working Pennsylvanians. CJT funds are available for projects that will result in full-time employment opportunities, significant wage improvements and the retention of otherwise lost jobs. The CJT Program is designed primarily to assist companies that are developing and implementing new training initiatives that will promote companies' growth and competitiveness.

The 2001–2002 fiscal year's funding is divided into the following areas to support the many and varied training projects:

1) Customized Job Training (CJT) — Eligible companies and company consortia can access funds through local education agencies (LEAs) to assist with higher level or advanced training that is not covered under the guaranteed free training program (GFT) and will result in new or upgraded employment opportunities.

2) Guaranteed Free Training (GFT) — Up to $450 per employee is available to improve basic skill levels. Examples of basic skills training include, but are not limited to: communication and teamwork; problem solving; quality assurance; business operations; computers; product and process control; workplace behavior skills; blueprint reading; and machine maintenance. On-the-job orientation and adult literacy activities are not eligible activities under basic skills training.

3) Information Technology Training — Up to $700 per employee to train new or existing employees who are information technology professionals, or front-line employees or supervisors of manufacturing companies receiving applied manufacturing technology training is available through the information technology training portion of GFT. Examples of information technology training include, but are not limited to: e-business/commerce; technology support; information security; database development; software engineering; computer programming; network administration; systems analysts; management information systems; Web site design & development; applied manufacturing technol-

[2] Commonwealth of Pennsylvania's Bureau of Research and Statistics.

ogy i.e. CAD, CNC, PLC. For technology subject areas listed above, introductory level training does not qualify, but may be eligible under Basics Skills Training. In addition, word processing, spreadsheet and graphics software training are considered basic skills.

PENNSYLVANIA

Scranton/Wilkes-Barre/Hazleton

1. Context

Scranton, Wilkes-Barre, and Hazleton, Pennsylvania (and other smaller communities in the Northeast Pennsylvania economic region) are like many declining Frost Belt cities. Scranton, which was the largest city in the region, has seen its population drop steadily for more than 50 years, from a high in the 1930s of 143,433, to a current (2000) population of approximately 71,500.[3] Moreover, the out-migration has been selective, with younger Scrantonians leaving, and an increasingly elderly population remaining. In 1990, Scranton's median age of 37.2 years ranked the city as the ninety-ninth oldest of 1,134 jurisdictions with data in the United States. Half of the top 100-oldest communities were in Florida, California, and Arizona, where retirees tend to settle, so

Table A.12
Demographics for Luzerne and Lackawanna Counties, Pennsylvania

	Luzerne	Lackawanna
Population, 2000	319,250	213,295
Median household income, 1997 estimate	$32,463	$32,536
Educational Attainment, High School or higher, 1990	72.0%	73.3%
Educational attainment, Bachelor of Science or higher, 1990	13.1%	14.8%
Poverty rate, 1997 estimate	10.8%	10.9%
Unemployment rate, 2000 annual	5.3%	4.3%
Per capita personal income, 1999 estimate	$24,873	$25,471
Homeownership rate, 2000	70.3%	67.6%
Percent Ethnicity, 2000		
White	96.6%	96.7%
African-American	1.7%	1.3%
Hispanic	1.2%	1.4%

Sources: U.S. Census Bureau, U.S. Department of Labor.

[3] U.S. Census Bureau.

Scranton is, indeed, among the more elderly non-retirement places in the country. The residents largely have fled out of the region, rather than to the suburbs, since the surrounding (Lackawanna) and adjacent (Luzerne) counties also have lost population over time and since the 1990 census. (Lackawanna County declined from 219,039 to 213,295, and Luzerne County from 328,149 to 319,250 in the last decennium.)

Scranton's industrialization began in the mid-nineteenth century with the discovery in the Lackawanna and Wyoming valleys of two key ingredients of iron, which was in growing demand nationally: iron ore and coal. In fact, Northeast Pennsylvania possessed the world's largest deposit of anthracite, the hardest and cleanest-burning variety of coal. From the 1840s, iron ore and coal mining activity increased in the Lackawanna valley, and iron mills were built to produce iron products for export. At one point, Scranton was the nation's second largest producer of iron.[4] Wilkes-Barre and Hazleton were less based on iron production (though there was one large iron works in Wilkes-Barre), but like Scranton, had large coal interests. In 1857, Charles Stagmaier began to brew beer in Wilkes-Barre, and by the early twentieth century his brewery was among the biggest in the east. Wilkes-Barre also had the advantage of a navigable river (the Susquehanna). Both Wilkes-Barre and Scranton developed textile and apparel businesses in the early part of the twentieth century. Hazleton's first industry was forest products, but that gave way to coal-related activity in the mid-nineteenth century. The Hazleton[5] economy did not diversify as much as the larger municipalities in the region did in the early years.

Figure A.9
Lackawanna County Business Mix, 1999 estimate

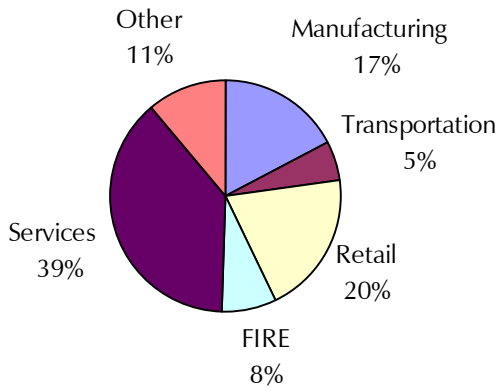
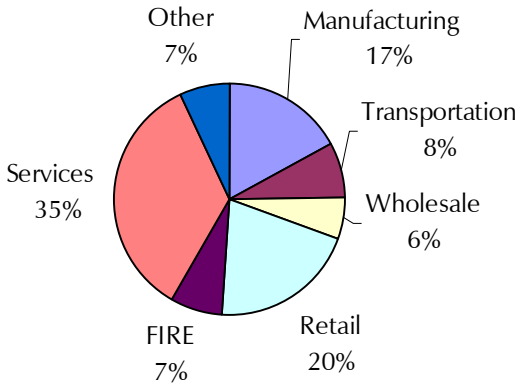


Figure A.10
Luzerne County Business Mix, 1999 estimate



Source: Bureau of Economic Analysis; total full-time and part-time employment by industry.

Northeast Pennsylvania has a rich railway history, too detailed to review here.[6] From the mid-nineteenth century, many railroad companies extended service in the region, including the Erie; New York, Ontario & Western; Jersey Central; St. Lawrence & Hudson; Delaware, Lackawanna & Western; Delaware & Hudson; Danville, Hazleton & Wilkes-Barre; Catawissa; and Pennsylvania. The railways were instrumental in getting coal and finished goods to market, and for passenger service to New York, Philadelphia, and points west and north. The railways also brought a large influx of entrepreneurs and capital in several industrial sectors.

The Great Depression affected the region's growth as the demand for coal and iron plummeted. The economy revived during the Second World War, as local factories produced both coal and munitions. After the War, the downward economic spiral continued, however, as trucking replaced railroads as the primary means of commercial transport, and other varieties of coal proved less costly to mine (soft

[4] Scranton Chamber of Commerce.

[5] Hazleton is technically in the Conyngham, not the Wyoming valley.

[6] See www.northeast.railfan.net/scranton.html.

coal, found closer to the surface in West Virginia and western states could be more easily strip-mined). The unemployment rate hit 30 percent in the late 1940s.[7] The region also lost its competitive advantage in textiles and apparel in the middle of the twentieth century as companies fled to the less-unionized south.

In the 1950s, public and private agencies mobilized to help revive the flagging economy. The Scranton Plan developed by the Scranton Chamber of Commerce helped pool public and private resources. A number of CDCs and public development organizations were created to address such specialized needs as industrial development (Scranton Lackawanna Industrial Building Company or SLIBCO), community banking (Lackawanna Industrial Fund Enterprises or LIFE), and downtown development (MetroAction). Over the next 30 years these organizations, along with local amenities, helped bring a variety of new industries to Scranton. Similar efforts took shape in Luzerne County, as well. For example, CAN DO was established in Hazleton in 1956. It is recognized as a national leader in economic development, attracting more than 270 industrial and office developments, 21 million square feet of buildings worth more than $534 million, and bringing in more than 11,000 jobs. The Wilkes-Barre Industrial Fund owns, develops and manages area business parks and assists with plans for new investment or company locations. The organization also handles business financing programs for industrial loans (coordinating efforts with state and local officials) and manages properties. The Committee for Economic Growth's (CEG) goal is to create new jobs while striving to diversify Greater Wilkes-Barre's economy, increase capital investment, broaden the tax base and encourage and support business growth. The CEG came into being in February 1983. The work of CEG is supported through investments by the local business community. More than 300 area businesses have made financial investments to support national marketing efforts.

Current economic conditions

Our study area for this case is a subset of the Scranton/Wilkes-Barre/Hazleton MSA. The MSA consists of four counties: Lackawanna, Luzerne, Columbia, and Wyoming. The Bloomsburg case study was within Columbia County. Here, we focus on Lackawanna and Luzerne. Much of the government's data, however, is for the entire MSA. Northeastern Pennsylvania has typically fared worse than the state (and the nation) in employment performance. Even during the expansion of the 1990s, the region's overall performance was worse than the state's, although Scranton's was better than Wilkes-Barre's and Hazleton's. The story reverses a bit in 2001; Wilkes-Barre's performance improves, while Scranton's worsens.

Twenty percent of employment is in manufacturing, which is mostly traditional rather than high tech. Twenty-four percent is in wholesale and retail trade, which is highly cyclical. Between 1989 and 1998, employment in the Scranton MSA grew by 4.4 percent, mostly due to increased jobs in services (21.6 percent increase in employment), FIRE, transportation and public utilities. Manufacturing employment fell by 16.3 percent.

Educational attainment and compensation levels also are less in the MSA than in the state as a whole, and other comparison areas. Just over 73 percent of Scranton's population has a high school degree or higher compared to 74.7 percent for the state.[8] In 2000, the average annual pay in the Scranton MSA was $27,742 and the state average annual pay was $34,000.[9]

The region has considerable challenges in terms of its historical dependence on low-value manufacturing and coal mining. The entrepreneurial activity that occurred in the late eighteenth and early nineteenth century did not continue into the middle and late century, and now, there are fewer of the ingredients necessary for that type of activity. The local economic climate has created a large amount of out-migration of local talent from the secondary and post-secondary education institutions in the region.

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[7] U.S. Department of Labor, Bureau of Labor Statistics.

[8] U.S. Census Bureau.

[9] U.S. Department of Labor, Bureau of Labor Statistics.

The region, however, has several comparative advantages, including a quality transportation infrastructure and access, a network of good post-secondary educational institutions, a hardworking, well-skilled labor force, and a cadre of committed business leaders.

Emerging industries and future prospects[10]

Five sectors have experienced measurable growth and clustering in the region and/or can be considered as potential sources of economic activity in the next decade:

- *Health services* have experienced high growth with a considerable number of start-ups. Most of this activity is in the local market, however, where there are good linkages. It is under-performing relative to the sector nationally.

- *Printing and publishing* also has experienced some growth and labor clustering. Unlike health services, it has good links to the national economy, evidenced by a greater-than-expected local share of growth. The drawback of this sector is that its output is generally low-valued, and consequently, it pays relatively low wages.

- *Electronics* has strong growth and pays relatively high wages. The sector has good potential but is not sufficiently diversified and currently lacks strong linkages to the national economy.

- *Transportation services* also have seen considerable growth and labor clustering, particularly in shipping/delivery that employs Internet and just-in-time (advanced logistics) technology. This may be the sector with the most potential for Northeast Pennsylvania due to the region's proximity to major northeastern United States markets and its well-developed interstate highway network. Interstate 80 connects the region to New York and points west. Interstate 84 connects Scranton (and traffic from the south and west) to New England, bypassing New York. Interstate 81 connects the region to the south and north, to Canada. The Pennsylvania Turnpike (now Interstate 276) provides easy access to Philadelphia.

- *Call centers and information technology (IT)* is included as a separate sector with potential for the region, even though it comprises several of the sectors already mentioned, namely advanced logistics and electronics. Much of the activity in this sector in Northeast Pennsylvania has been in the development of call centers, information storage and retrieval, data processing, and some manufacturing of IT products, which mostly pay lower-than-average wages. The central question — which is the premise of the intervention to be discussed below — is whether the IT base that is established in the region can be used to launch higher value IT activity, such as imaging, Web-based marketing, e-commerce management systems, and even the development and production of new, higher-value IT products.

2. *Nature of the Intervention*

The innovation we studied is referred to as the "Great Valley Technology Alliance" (GVTA). It is a partnership among the Chambers of Commerce in Scranton, Wilkes-Barre, and Hazleton, to "grow a knowledge-based regional economy with good wages and rewarding careers in a vibrant, attractive community" (GVTA document). The partnership is significant because it is the largest and most meaningful initiative ever begun that crosses county lines. Even though the MSA long has combined Luzerne and Lackawanna

[10] Feser, E. J. 1999. *Regional Growth and Industry Clusters in the Scranton-Wilkes-Barre-Hazelton Metrpolitan Area*. November. Prepared for Battelle Memorial Institute, Columbus, Ohio.

Counties as a single labor market area (along with Columbia and Wyoming Counties) and the economic histories of the two valleys (Lackawanna and Wyoming) are similar, there has been relatively little interaction between them, economically or politically. The past has been characterized more by competition than cooperation. In fact, Lackawanna County was developed from a part of Luzerne County in 1878, and was the last of Pennsylvania's 67 counties to be incorporated.[11] One interviewee remarked that Scrantonians severed Lackawanna County from Luzerne as a political power move, though we have not been able to corroborate that with written documentary evidence. The inter-connectedness of Lackawanna and Luzerne can be seen in 1990 commuting data — nearly 5,200 people living in Lackawanna County commuted to Luzerne County to work.[12] The next highest destination for those living in Lackawanna is only 2,740. On the flip side, 7,033 people who live in Luzerne County commute to Lackawanna County and the next highest destination is only 4,591.

The conceptual framework for the GVTA was developed by Battelle Memorial Institute consultants in December 1999 for a regional steering committee that consisted of 16 business, academic, and civic leaders. The plan included strategic initiatives in six areas:

- *Grow the information technology sector*, especially new media and E-commerce. This would be accomplished by encouraging IT start-ups and attracting existing IT companies to relocate, and by helping local companies become more IT-intensive. A key component of the strategy is an Information Technology Institute, weaving together the IT strengths in the region's universities and private companies. The Institute would have symbolic importance, and would coordinate and stimulate education and training of IT professionals, and be a base for IT-related R&D.

- *Invest in IT infrastructure,* including an IT business incubator a multi-tenant accelerator, passenger rail service to New York and more air service.

- *Improve entrepreneurial resources*, including the creation of an angel investors and mentoring network, an innovation fund, and a mechanism to publicize entrepreneurial successes.

- *Work to retain and attract knowledge workers,* by expanding appropriate programs of graduate instruction, instituting more internship and cooperative programs and better job placement/career development services, and enhancements to encourage college graduates to stay in the region.

- *Enhance the quality of life* to retain and attract "footloose" knowledge businesses and workers, by building stronger downtown amenities, creating young professionals associations, connecting better the civic and higher education resources that provide intellectual and cultural programs, and exploiting opportunities for outdoor recreation in the region.

- *Assist existing industries* by developing a manufacturing technology network and addressing the needs of existing and emerging clusters.

The resources to achieve some of these strategies are available through existing region-based or Commonwealth of Pennsylvania programs (such as the Ben Franklin Partnership). For others, new resources and programs need to be identified and created.

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[11] See www.rootsweb.com/~palackaw.

[12] U.S. Census Bureau.

3. *Impacts of the Intervention*

This case raises the question: is the GVTA an appropriate strategy for Northeast Pennsylvania to follow? In particular, is the concept appropriate given the region's resources and trends in the national/global economy? And, are the necessary resources in place to make the strategy successful? Since the plan was hatched at the end of 1999 and is still in the start-up phase, we do not have results from it yet, so this analysis is more prospective than it is retrospective.

We proceed by addressing each of the questions posed above. First, we discuss IT as a strategy in general, and for a market such as Northeast Pennsylvania. Then we apply our observations from field visits to the hypotheses that are common to all the cases.

The general concept: building an ITC ladder

In his "Clusters of Innovation" project, Michael Porter and his colleagues collected and analyzed data from around the United States and conducted case studies of eight regions, in order to identify existing and emerging industrial clusters. One of his conclusions was that the IT cluster was ubiquitous — existing in a large number of regions.[13]

It is hard to imagine big and small, growing and declining, sophisticated and parochial communities all having the same IT sector. Indeed, they do not. There are many different kinds of IT clusters, in terms of the types of businesses they include, and their "knowledge content" or level of sophistication. Silicon Valley, New York and Boston, for example, house the headquarters and R&D operations of major IT companies. Some regions have concentrations of software development facilities (for example, Bangalore, India). Smaller, less developed regions may have businesses that manufacture IT equipment.

Northeast Pennsylvania now houses a variety of lower- to medium-skilled IT type companies, including call centers, data storage and retrieval, and some component manufacturing. Among the call centers are the J.C. Penney catalogue center and several marketing companies. Diversified Information Technologies was a traditional document storage company that began to scan and store electronic images, and now holds major accounts nationally, employing 275 workers in Scranton. Manufacturing firms include a cable fabricator, a Corning photonics plant and another German-owned precision glass facility. There is a common assortment of IT consulting, systems integration and training companies in the region. We identified some software development activity, but far less than in other regions of comparable size.

These facilities do not employ a large number of high-end engineers and scientists, especially in product development and process innovation activities. There is little, if any, R&D within the local universities related to these businesses. The German-owned company said it filled its need for doctoral-level personnel from outside the region.

The question is whether this level of IT-related activity can be ramped up, to become more knowledge-intensive, employing more graduate-level workers who engage in more R&D that lead to the development of new products and processes. For that to happen, the facilities that are already in the region will have to become more R&D-intensive, and other knowledge-intensive and R&D-oriented businesses will have to locate in the region. Both of those require a ready supply of properly trained workers and the good quality of life necessary to attract and retain footloose workers. It also requires the appropriate soft and hard infrastructure.

There is some of the necessary knowledge infrastructure in the region. For example, the local universities and colleges are expanding their offerings in IT-related areas. There are at least two incubator facilities in the pipeline or started — in Carbondale, and in Scranton, sponsored by the Royal Technology Group, a division of the University of Scranton. And, there is a Northeastern Pennsylvania Technology Council to promote higher-level IT activities. The Great Valley Technology initiative is based on the assumption that these resources are not sufficient to move the region up the IT ladder. GVTA is designed to bring more focus on the region and fill critical gaps.

[13] Porter, Michael. *Clusters of Innovation: Regional Foundations of US Competitiveness.* Washington, D.C.: Council on Competitiveness. 2001.

4. Testing the Study Hypotheses

In Scranton/Wilkes-Barre/Hazleton, as in the other sites, we ask ten questions as a way to ascertain whether the intervention is, or is likely to be, "successful" and has promise elsewhere. The questions are presented in the form of statements, or hypotheses. We respond to each statement using the field-visit material as evidence.

1. *Enabling infrastructure is necessary, but not sufficient, to assure the effectiveness of technology infrastructure investment.*

Interviewees minced no words that the area suffers from poor quality air transportation. Chamber of Commerce officials, business executives and government leaders independently observed that the thinness of air service from the local airport (AVP) is a disincentive for high-tech businesses that require connectivity. One CEO of a major high-tech company in the region noted that he has to use a driver to take him to New York to get to his parent company in Europe, and has a difficult time recruiting knowledge workers who perceive the area to be "off the beaten track."

The region currently also lacks passenger rail service anywhere. Interviewees believed that convenient and affordable rail service to New York City (which was available in the 1950s) would make the region more attractive to young knowledge workers from New York and New Jersey who would trade off immediate access to cosmopolitan amenities for the lower cost of living, scenic beauty, and family-orientation of Northeastern Pennsylvania — as long as they could make excursions into NYC.[14]

A critical factor in the Northeast Pennsylvania case is local government operations. We note that here as a type of enabling (soft) infrastructure because it does not fit neatly under our other topics. Scranton's local government has a record of poor fiscal performance — to the extent that the Pennsylvania Economy League now has oversight. The quality of local services is perceived as deteriorating, and the level of local taxes is high.[15] A corporate CEO, whose business is not within the city limits, suggested that incoming businesses have a strong disinclination to locate in Scranton because of the political and economic situation there.[16]

Other types of traditional infrastructure are readily available in the region. All communities are adequately served by gas lines and electricity (through Pennsylvania Power and Light). There is an ample water supply at reasonable rates. And because of such slow population growth (or population loss), there is not a strain on wastewater and sewage treatment capacity. There also appears to be a ready supply of developable land, through such programs as SLIBCO. There was also discussion of the Commonwealth's Keystone Industrial Zone program that makes development of sites in particularly depressed locations attractive to businesses.

Our conclusion from all of our interviews is that the region is stronger in the type of infrastructure appropriate for the old, twentieth century economy, than for the new, twenty-first century economy. To compete for increasingly footloose business whose alternative locations span the globe, the region needs better air service, a perception of connectedness with major cultural and financial centers (to create the right "quality-of-life"[17]), and an efficient local government that provides quality services at reasonable tax rates.

This creates a serious threat to the success of any plan, since they are deficits that are difficult to eliminate. To a large degree, the expansion of air service

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[14] We take a bit of a critical view of this since there already is inexpensive, regular bus service from Scranton Wilkes-Barre and Hazleton to New York and Philadelphia. We appreciate the symbolic significance of a rail link, but are uncertain how much a difference passenger rail service would make.

[15] Several interviewees also referred to "endemic corruption" while another used the word "venality." An economic development professional joked that in Scranton, economic development is defined as a dollar of state aid coming into the community and being passed around to twenty people, who all feel richer.

[16] We include that only as a single opinion, we do not have sufficient evidence to verify the factual basis of the claim.

[17] Florida, Richard. 2000. *The Economic Geography of Talent.*

is a "Catch-22" — a region needs growth to convince airlines to expand service, and the expansion of service is necessary for further growth. The local fiscal situation is driven, in part, by demographics and the structure of local government in Pennsylvania, which also are exogenous to local policy makers. The relatively aged population creates strains on the social service system. The relatively depressed land market keeps property values down, which requires higher rates to generate property tax revenues. The large number of municipalities in each of the counties arguably creates inefficiencies through what Michael Danielson, Robert Wood, and other scholars have called wasteful duplication and overlap in governance and service provision.[18] Vested interests and political inertia make a change, such as consolidation, unlikely.

We are reminded of the what happened in Cleveland, Ohio in the late 1970s and 1980s. Bankrupt and written off, the public and private sectors pulled together to reverse the city's fortunes. Strong leadership by Mayor Dennis Kucinich, fiscal austerity measures, and large-scale investments earned Cleveland the moniker of "Comeback City." Of course, Cleveland is larger than Scranton, but the case illustrates that major obstacles can be overcome with concerted action.

2. *Investments in technology infrastructure must be part of a larger local planning process to succeed.*

This is one of the tenets of the GVTA initiative. The plan calls for the development of a training center, R&D space and incubators in a central location. There are no plans to incorporate fiber cable or microwave transmitters, and other ITC infrastructure because the region already is well served.

3. *A certain density or critical mass is required for information and communications technology to work, because of the costs of provision.*

The Ridge administration produced a "Technology Atlas" that contains a large amount of information by county on the availability and use of ICT software and hardware.[19] Our summary interpretation of the data is that Lackawanna and Luzerne Counties hold their own by most measures among counties in their general size class, but still is less well connected than the major urban areas. Interviewees confirmed that the area had good quality ITC infrastructure, including a POP site. Bell of Pennsylvania is a major player.

4. *Technological innovations and advances are reducing the costs of communications and linkages.*

Not applicable for this case.

5. *Institutional mechanisms must be in place to help users deploy the hard infrastructure appropriately.*

This absence of appropriate institutional mechanisms is what the GVTA is trying to address. The very formation of a bi-county steering committee for the Alliance was a monumental step. The definition of the appropriate geographic scope required hard choices by the GVTA leadership. For example, some community leaders advocated using the Economic Development Council of Northeast Pennsylvania (EDCNEPA) planning area as the planning area for the GVTA. (The EDCNEPA has since been renamed the Northeast Pennsylvania Alliance.) The Alliance carries out its mission within a seven-county region of Northeastern Pennsylvania as one of seven such regional entities in the Commonwealth. The region is composed of Carbon, Lackawanna, Luzerne, Monroe, Pike, Schuylkill, and Wayne Counties, with a total population of 950,000 and land area of over 4,400 square miles. This area includes the Pocono mountain counties that have experienced spillover growth from New York-New Jersey. The GVTA leadership believed that an area that large would be hard to manage and to create the more tailored effort that they foresaw.

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[18] Danielson, Michael. 1966. *Metropolitan Politics: A Reader.* Little Brown, Boston. Wood, Robert Caldwell. 1961. *1,400 Governments: the Political Economy of the New York Metropolitan Region.* Harvard University Press, Cambridge.

[19] See www.technology.state.pa.us/atlas.

The formation of GVTA as a new institutional entity was bold, not only because it was not aligned with the old, entrenched development council, but also because it was largely a private sector effort that was separate from the individual chambers of commerce and private development organizations, like Hazleton's CAN-DO.[20] The institutions of higher learning that are included are largely private (including church-related). The elected officials with whom we spoke were generally supportive of the effort, but clearly were not driving it.

The Commonwealth of Pennsylvania is another key institutional player. The Ben Franklin Partnership, whose regional office is in Bethlehem at Lehigh University, provides funds for capital projects, as well as technical assistance. The BFP staff has been involved in the GVTA project from the beginning. The Pennyslvania Department of Community and Economic Development also has been party to the project, though has not played much of a role to date.

6. *Some hierarchical coordination or linkages among national, state and local governments are important for a community to be truly "connected."*

We observed much better connections between the GVTA apparatus and state government than between it and the local governments in the region. The steering committee has no representatives from any local government or state agency. However, the Lackawanna and Luzerne County boards of commissioners, as well as the Lackawanna County Industrial Development Authority, Pennsylvania Department of Community and Economic Development, and United States EDA, have provided financial support. The connection at the state level is helped by the fact that the chair of the steering committee, William W. Scranton, III, is a former Lieutenant Governor, and a descendent of Scranton's founding family.

The state connection is likely to become more important in the future. Seed capital funding is expected from the Pennsylvania Technological Investment Authority (PTIA). Several interviewees also discussed the importance of the Keystone Opportunity Zone designations as possible sites for new businesses. State support also is critical for universities and community colleges, and in providing tax credits for R&D and community improvement investments.

7. *Linkages among government, education, and industry are a critical success factor for ICT interventions. State policies and corporate actions are important determinants of local "success."*

This promises to be a key element for the GVTA initiative. The region does not have an intensive or extensive research university. Table A.13 shows the institutions of higher education in the GVTA region.

Table A.13
Institutions of Higher Education

Institution	Carnegie Foundation Classification
Baptist Bible Seminary	Specialized: faith-based
College Miseracordia	Masters I
Johnson Technical Institute	Associate
Keystone College	Associate*
Kings College	Masters II
Lackawanna Junior College	Associate
Luzerne County Community College	Associate
Marywood University	Masters I
Penn State University — Scranton, Wilkes-Barre and Hazleton campuses	**
University of Scranton	Masters I
Wilkes University	Masters I

* Recently became a four-year baccalaureate institution.

** Not considered separately by Carnegie Foundation. Each campus confers a few four-year degrees and sends most students to Penn State main campus after two years.

[20] CAN DO (Community Area New Development Organization), coordinates programs to attract new and diverse industries through economic development initiatives. It was established in 1956 by the private sector; see www.hazletoncando.com/about2k/history2k.asp.

To overcome the small size of these colleges, and their limited resources, the GVTA has been working with the local colleges — especially the masters-level institutions — to create a large virtual university in the region, where students could cross-enroll and faculty and resources could be shared.

The strength of the college system is in the production of lower-level technicians and entry-level engineers in such areas as electronic engineering technology, information science and technology, business, and more traditional academic fields. Some graduate-level research is conducted, but most of the funds received have been set-aside or non-competitive. We know of no new technology or patents flowing from these colleges.

While there are no first-rate universities in this two-county area, one could argue that the Great Valley is strategically located near more top research universities than almost any other region. The area is an hour from Lehigh University; an hour and a half from Penn State's main campus; and two hours from Cornell, Princeton, Columbia, Penn, and NYU. Carnegie-Mellon — a global leader in IT education — is four hours away. A challenge for the region is to link in some meaningful ways with these universities that are so close.

8. Infrastructure providers must be a partner in assessment and planning, not just the spending, for the intervention to succeed.

Because GVTA is an IT development initiative designed to bring to the region companies that use advanced telecommunications networks in different ways, the quality and quantity of IT infrastructure is an essential component. Moreover, it is important for IT providers to be involved in marketing to prospective companies.

This seems to have been realized by the leadership of the initiative. The thirteen-person steering committee includes a vice president of ALLTEL and the president of Commonwealth Telephone. Other telcom companies are active, including Verizon, Lucent, Adelphia, Northeast Communications and others.

9. Work force development is a critical complement to any infrastructure intervention.

Northeastern Pennsylvania seems to have an adequate supply of entry-level workers, suitable for the lower-level IT jobs that now exist. Efforts are underway to expand technical training and degree programs in information technology-related fields, for entering students and displaced workers. The technical/community colleges in Pennsylvania, generally, and in the Great Valley region, in particular, are not as well developed as in North Carolina, for example. They currently serve a relatively small number of students. (Luzerne County Community College is the largest of the technical schools.) The universities also currently graduate a relatively small number of engineers and advanced technical experts, and do not grant doctorates.[21]

Our interviews suggest that the region will be able to supply IT businesses with an adequate number of lower- and middle-level workers, but has a ways to go in the training of graduate-level, research-oriented workers, and entrepreneurs. Those types of workers are essential for the region to move up the IT ladder.

10. Because of the long-term and expensive nature of ICT, vision and leadership are critical success factors.

Right now, such vision and leadership seem to be in place, but we are unsure about the stability of the leadership structure. To date, Mr. Scranton; the leadership of the Scranton, Wilkes-Barre, and Hazleton Chambers of Commerce; and other business people in the two-county area, have pulled together to move the idea forward. They have worked effectively with each other and with representatives of the Ben Franklin Partnership, Commonwealth of Pennsylvania and United States EDA, to secure funds.

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[21] Tim McNulty indicated that Pennsylvania generally has been slow to adapt its work force training. Its community colleges have been used more as feeders to university system than for customized job training.

We have not seen much leadership from elected officials in the region. And we wonder how broad the support for the initiative is, among organized labor and the general public.

5. Persons Interviewed

Anna Cervanek, Director, Community Relations
Bell of Pennsylvania (now Verizon)

Steve Brouck
Wilkes-Barre Chamber of Commerce

Bruce Jennings, President
Schott Glass, Inc., Pittston, Pennsylvania

Mark Lang, Gerry Ephault
Ben Franklin Partnership, Lehigh University

Richard Beasely
Pennsylvania Power and Light

Glenn Pellino, V.P.
University of Scranton

William W. Scranton, III, President
GVTA

Raymond Angeli, President
Lackawanna Junior College

Howard Grossman, Director
Economic Development Council of NEPA

Jane Thyren, Mary Kay Warner
Diversified Information Technologies, Scranton

Tim McNulty, Executive Deputy Secretary
Pennsylvania Department of Community
and Economic Development

PENNSYLVANIA

Bloomsburg, Columbia County

1. Context

Bloomsburg is a town of 12,439 inhabitants in east central Pennsylvania, located along the Susquehanna River on Interstate 80. It is the seat of Columbia County which has a population of approximately 64,000.[22]

Adjacent to Columbia County, Montour County has a population of approximately 18,000, including the town of Danville, which is home to a large tertiary care medical complex (Geisinger Medical Center). There is little interaction between the two counties.

Columbia County is within the Northeast Pennsylvania MSA, and Bloomsburg looks toward Wilkes-Barre for higher-level business services. It also uses the Wilkes-Barre/Scranton airport for intercity air travel. Bloomsburg is approximately 2.5 hours by car from New York City, but has experienced relatively little spillover growth from that region, especially compared to the more eastern counties of the Commonwealth. One interviewee remarked that Hazleton (the next largest town east of Bloomsburg along the Interstate) intercepts most of the last wave of New York émigrés (with the exception of a few artists; see below).

Bloomsburg University, part of the 14-campus Pennsylvania state college system, enrolls approximately 7,500 students in 82 degree programs with over 800 employees.

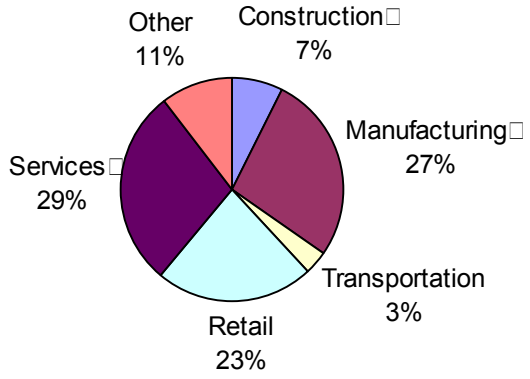
Table A.14
Demographics for Columbia County, Pennsylvania

Population, 2000	64,151
Median household income, 1997 estimate	$33,201
Educational Attainment, High School or higher, 1990	73.1%
Educational attainment, Bachelor of Science or higher, 1990	12.5%
Poverty rate, 1997 estimate	10.5%
Unemployment rate, 2000 annual	5.5%
Per capita personal income, 1999 estimate	$21,705
Homeownership rate, 2000	72.4%
Percent Ethnicity, 2000	
White	97.6%
African-American	0.8%
Hispanic	0.9%

Sources: U.S. Census Bureau, U.S. Department of Labor.

[22] U.S. Census Bureau.

Figure A.11
Columbia County Business Mix, 1999 estimate



Source: Bureau of Economic Analysis; total full-time and part-time employment by industry.

Bloomsburg was settled in the eighteenth century as an outpost against Indians. It grew in the early nineteenth century after the discovery of iron ore. By the end of the Civil War, the iron ore was depleted, but textile mills moved into the area. The largest, Magee Carpet, is still in operation, but its ownership and product line have changed.

Today, the area has various small manufacturing enterprises. Overall, 35 percent of the county's employment is in manufacturing,[23] which is considerably higher than the national average. Table A.15 shows the largest non-governmental employers in the county, in rank order. There is still a cluster of textile- or apparel-related companies as well as a concentration of food-related businesses.

The economic indicators for Bloomsburg and Columbia County are mixed. The county's per capita income in 1999 was 75.8 percent of the Commonwealth's level.[24] Its unemployment rate (5.5 percent) in 2000 was 1.3 percentage points higher than Pennsylvania's.[25] While these show a relatively weak economy, the community did not appear distressed. The university pays its employees well, leading to higher-end residential development. The housing stock generally appeared in good shape, and the downtown historic district was well maintained. One interviewee noted, however, a growing problem of downtown vacancies. We observed casually that low living costs seemed to offset the lower wages.

We also observed the development of a small artistic community — artists from New York as well as from throughout the country who started a community theater in the late 1970s and who sought more space, quieter living and lower costs. We were told by several interviewees that area natives who had left the area, and then risen within a company located elsewhere, wanted to return to Bloomsburg. Most prominent among these people are graduates of Bloomsburg University's program in instructional technology. They have worked for such companies as Cigna and JPL. Some work for Eduneering Corporation, which was founded in Bloomsburg, then moved to New Hope, Pennsylvania.

2. *Nature of the Intervention*

Bloomsburg is a case study of a pioneering effort by a small town, outside a major conurbation, to get onto the information superhighway. It also is a study of an individual with vision and persistence. The major questions we address within the case study are whether the programs put in place were appro-

Table A.15
Columbia County's Largest Non-governmental Employers

Star-Kist Foods, Inc. (F)	Bloomsburg Mills, Inc. (T)
Wise Foods, Inc. (F)	Milco Industries (T)
Berwick Hospital Corporation	Wal-Mart Associates, Inc.
Magee Rieter Automotive Systems (T)	Press Enterprise, Inc.
David J. Thompson Mailing Corp.	Benton Foundry Inc.
Kawneer Company, Inc.	Lady Ester Lingerie Corporation (T)
Weis Markets, Inc. (F)	Bloomsburg Carpet Industries (T)
R.R. Donnelley & Sons	Ore Ida Foods, Inc. (F)
Deluxe Homes of PA, Inc	

(T) = textile- or apparel-related company, (F)= food-related business.

[23] U.S. Census Bureau.

[24] U.S. Department of Labor, Bureau of Economic Analysis.

[25] U.S. Department of Labor, Bureau of Labor Statistics.

priate and effective, and whether an individual's vision and persistence are enough to overcome the considerable political, cultural, and economic barriers that face towns like Bloomsburg. The program we went to Bloomsburg to investigate is referred to as BTC3R: Bloomsburg Telecommunications Consortium for Columbia County and Region. The idea for BTC3R goes back more than 15 years. The 1987 Strategic Management Plan for the town (which began to be written in 1985) identified the shift from manufacturing to information and service businesses as a high priority, requiring "[better] reading and writing skills, computer skills, and retraining of some workers who formerly held jobs in manufacturing." It called on the school system, Vo-Tech and Bloomsburg University to provide leadership and training. The plan also said the following:

> "Opportunities for an expansion of our information/service base may exist because of Bell Telephone, the nearby Comsat facility, the cable system, and the University's communications facility. Bloomsburg should devise a plan on telecommunication."

The plan called for the establishment of a mechanism "for ensuring interaction among (telecommunications) users, possible users, and providers so that information can be disseminated and new uses explored."

The seeds sown in the 1987 Strategic Plan were fertilized in three 1990 papers. "Telecommunications Concept for the Town of Bloomsburg" refers to the "electronic highway" and notes that "a rural community, physically well-positioned with access to transportation systems and heavily dependent upon manufacturing for its economic health, faces decline — or at least stagnation — if it is bypassed by the telecommunication pathways necessary to attract dynamic new information-based business and enhance existing business. . . ." The particular challenge, according to the author, is to overcome the consequences of deregulation in the telecommunications sector, which "mitigate[s] against the likelihood of commercial telecommunication providers making the latest advanced communication capabilities (high-speed digital circuits, ISDN, compressed video transmission, etc.) easily available to rural areas."

The concept paper draws from a companion 1990 document, commissioned by the town government and the university to Dovetail Systems Corporation, and financed partially by a grant from Pennsylvania's Ben Franklin Partnership, entitled "Telecommunications Opportunities for Bloomsburg." It proposed an $800,000 expenditure to construct and operate a high-capacity digital connection from Bloomsburg to Harrisburg (the state capital, 75 miles south-southwest), which would then serve as Bloomsburg's gateway to the rest of the world, via AT&T, MCI, and Sprint. The connection would be made via 45 mps microwave capable of carrying high-speed data, high-resolution graphics and compressed video. The link would be used, in part, by Bloomsburg University to provide distance learning to the Harrisburg University Center. That, too, was a pioneering idea at the time. The Dovetail report also proposed upgrades to Bloomsburg University's campus fiber optic system, partnerships with the local TV cable franchise (Service Electric Cable) and Bell of Pennsylvania (later Bell Atlantic, now Verizon) to carry data, to connect public school buildings to the cable system and enable homebound education, and to create a planning and coordinating organization to plan and implement cable-based programming.

The Dovetail Systems Corporation paper was followed by consultant Dr. Graham S. Toft's (Indianapolis, Indiana) document entitled "Exploration of Business Growth Using a Telecommunications Strategy for Bloomsburg" (September 1990). Also responsible for authoring the town's Strategic Plan, Toft identified immediate business recruiting targets that would find access to the information superhighway attractive, namely, data processing services; technical, vocational, and data processing correspondence schools; and to a lesser extent, insurance record centers and catalogue, mail order and telemarketing operations. As in the case of the Great Valley Initiative in Scranton/Wilkes-Barre ten years later (see the companion report), Toft identified a transition path to higher-skilled and better-paid ICT employment, in-

cluding software and computer programming; management, consulting, and public relations; information retrieval services; and commercial and non-commercial research. Toft concludes with an implementation strategy that includes intelligence gathering, production of promotional material, creation of a local strike force, and further planning and organizational development.

The importance of further planning and organizational development around ICT became a recurring theme in Bloomsburg in the early 1990s. The town's 1991 Strategic Management Plan Update included an action item to develop a communications plan, possibly utilizing telecommunications, "to keep individuals and . . . various organizations, such as educational and governmental institutions, health and human service providers, chamber of commerce, economic development, etc. informed." The 1991 plan also recognized the need for a telecommunications coordinator "familiar with the technology and the need to develop a collaborative effort between various town groups."

The ICT proposals being made in Bloomsburg in the late 1980s and early 1990s did not generate universal enthusiasm. One interviewee referred to the local Chamber of Commerce at the time as "an obstacle." Most energy was still being focused on industrial development and what we refer to in this report as "enabling" infrastructure. One individual (town administrator Gerry Depo) continued to keep the elements of an ITC strategy on the town's agenda. Finally, in 1993, Depo was able to line up enough support to launch the Bloomsburg Telecommunications Consortium for Columbia County and Region, Inc. (BTC3R). In particular, he mobilized Columbia County commissioners Bill Soberick and Leroy Diehl, as well as key business and community leaders, to support the initiative. BTC3R's purpose was to "provide . . . voice, data, and video communications services to enable the reception, transmittal and exchange of information; and to implement a community-generated program access to cable television" (from Article 1 of the bylaws).

BTC3R's membership included government, education, health care, business, and public library entities that have voting rights, and non-voting affiliates, who are representatives of telecommunications, electronic, or multi-media entities (from Article 3 of the bylaws). Key members of the consortium include the town of Bloomsburg, Columbia County, Bloomsburg University, Bloomsburg Area School District, Columbia/Montour Vocational-Technical School, Geisinger Medical Center and the local Bloomsburg hospital, the agency on aging, visiting nurse association, and the public library.

During its existence, the consortium identified a variety of projects that fall under the rubric of ICT:

- A system of government access kiosks that provide enhanced government services to the public.
- A wideband LAN that allows data, voice, and full-motion video to be transmitted among consortium institutions for improved services through shared telecommunications resources.
- Additional satellite downlinks around the region to allow videoconferencing.
- Cable access television facilities to provide public, education, and government access television programming.
- A library community multi-media resource center that provides on-line and multi-media facilities and production services.
- A community services workstation network to implement shared local, county, state and federal social services.
- A medical link network for rural health care delivery to the elderly and home-based populations.
- An enhanced BSN network (computer bulletin board service with Japan), allowing citi-

zens to email and send graphics and video internationally.

- Connectivity between county offices, school district facilities, and the Vo-tech school to the state system of higher education network, PREPnet, Panet the Internet and other networks.

- Better in-service training via an improved training center (the Magee Center).

- Connectivity for the rural Pennsylvania arts network in seventeen counties in Northeast Pennsylvania to an arts database.

- Construction of an additional tower to beam into remote areas of the region.

- Fiber optic links between Bloomsburg area schools that connect all six school districts within the county.

These initiatives, in various stages of completion, were woven together as part of a $1,817,920 proposal to the National Telecommunication and Information Administration (NTIA) and the United States Department of Commerce to create a "Rural Area Network" (RAN). The proposal defines the RAN as "an open reconfigurable public switched network of local terminals and audio/video service centers that will be shared through the Consortium [i.e., BTC3R]." BTC3R was unsuccessful in obtaining the grant.

However, BTC3R was recently successful in receiving funding assistance in the amount of $254,000 from a new Pennsylvania program — The Pennsylvania Technology Investment Authority — to develop a community technology center.

The latest proposal (June 2000) to be submitted to the Ben Franklin program, is for a Community Technology Center, intended to satisfy four needs: 1) basic computer literacy of the general population, 2) computer literacy within businesses/organizations, 3) more office automation by small entrepreneurial companies, including greater use of e-commerce, and 4) high-level support for e-learning companies located in the Bloomsburg area, due, in part, to the presence of Bloomsburg University's highly regarded program in instructional technology. The proposal calls for the creation of an office to provide technical assistance and training, a business incubator, and a multi-purpose meeting facility. Its underlying purpose is to "aggregate demand" for a telecommunications provider to provide broadband services.

3. Impacts of the Intervention

The general question is: did BTC3R "work?" Is it a model that can or should be replicated elsewhere? We address that question in two ways — by applying our observations from the field against the expectations established by the leaders in Bloomsburg, and then, by showing the importance of what we have identified as "critical success factors," for Bloomsburg and the other cases.

BTC3R against expectations

The individuals in Bloomsburg who were pushing BTC3R (referred to below as "advocates") were using it as a mechanism for raising community awareness of the importance of ITC in the 1990s and early twenty-first century, and as a means for focusing some local ITC initiatives. The advocates' hope was that this heightened awareness and consequent policy action would bring renewed economic development to a place that the information age threatened to leave behind.

We observed a fairly widespread recognition within local government and the business community of the ITC initiatives. The local newspaper (The Press-Enterprise) reported on BTC3R and its activities periodically and the Bloomsburg University magazine ran several stories, including a feature story about its media tech program. How much coverage is "enough" is a matter of opinion. Advocates were critical of the local press for not covering BTC3R more favorably, for example.

Several interviewees noted such accomplishments of BTC3R as "its ability to survive time," "its success in getting people to work together," and "its

development of cross-cutting themes" (interview with Michael Vavrek).

Due, in large part, to proselytizing by Gerry Depo in Harrisburg and elsewhere around the state, and in some national ITC circles, Bloomsburg's efforts received external recognition. In February 1996, BTC3R was represented at the Commonwealth of Pennsylvania Stakeholder Assembly, convened by the Lieutenant Governor to help design the state's ITC policy (memo by Michael Vavrek, April 8, 1996). Then, in April 1996, the Central Pennsylvania Forum for the Future joined BTC3R to create additional telecommunications-focused synergy for regional development. The Forum represents an eleven-county area stretching considerably beyond the Bloomsburg environs (Vavrek memo, April 8, 1996).

Bloomsburg University's instructional technology program (including the Institute for Interactive Technologies) also has received external recognition — from other colleges in the state system, the Ben Franklin Partnership, and IT companies who recruit its graduates and support its research.

We did not observe much of a reversal of Bloomsburg's economic fortunes as a consequence of BTC3R and its activities. Despite efforts to keep Main Street as a viable business district, there are now more vacancies than in any of the past twenty years. The number of new business announcements also has been low, despite a generally good economy in the broader region, in part, because Columbia County lacks developed sites for industrial development. At least one company, Eduneering, opened an establishment in Bloomsburg to be near the University.

The positive developments we did observe did not necessarily owe themselves to the initiative. Most important has been the reinvention of one of Bloomsburg's oldest and largest companies — Magee Carpet. Just when traditional carpet weaving was dying, the company was bought by a Swiss firm (Rieter), renamed Magee Rieter, and changed into a producer of full molded automobile floor systems. Carpets are part of that system, but so too are electrical harnesses, acoustical and heat management, anti-vibration, and other more advanced systems. Magee Rieter supplies General Motors using just-in-time production, which requires a state-of-the-art information system. Its 700 employees cover a wide range of technical skills, including electrical technicians and CAD engineers. The company's president indicated that the workers he needs are not produced in sufficient numbers in the region; the company employs workers from as far as an hour away, and provides more on-the-job training than Magee Rieter would like. The president noted that the locally produced engineers initially lack the sophistication to function effectively in Detroit, Japan, or other far-flung places where the company's buyers and suppliers are located.

There is a new call center in the area — the ICT Group, Inc. BTC3R was not a factor in having the group locate in Bloomsburg other than Depo's relationship with state telecom providers. The company is putting in its own fiber optic cable, for example.

Of course, we did not conduct any systematic analysis, and it is altogether possible that the county would have been in worse shape had it not been for the initiative. And, we sense some spin-off potential. The interviewees from the Institute for Interactive Technologies noted some start-ups by students, though not locally. The level of new product and process development is so low that the university does not have any intellectual property policies in place. The interviewees noted that the absence of a local incubator impedes entrepreneurship.

4. Testing the Study Hypotheses

In Bloomsburg, as in the other sites, we ask ten questions as a way to ascertain whether the intervention was "successful" and has promise elsewhere. The questions are presented in the form of statements, or hypotheses. We respond to each statement using the field-visit material as evidence.

1. *Enabling infrastructure is necessary, but not sufficient, to assure the effectiveness of technology infrastructure investment.*

True. "Enabling infrastructure" typically refers to such utilities as water, sewer, electricity, gas, high-

ways, airports and rail. Our field interviews painted a mixed picture about the adequacy of roads, water, sewer treatment, electricity and gas in Columbia County, for accommodating new development by ICT or non-ICT businesses. Bloomsburg has a favorable location, directly on U.S. Interstate 80 and within 20 miles of Interstate 81. U.S. 11 is a direct route, as well, to Harrisburg. Bloomsburg is within three hours driving distance to New York and Philadelphia and less than two hours to Scranton, Allentown, and Harrisburg. As a consequence if its location, Bloomsburg also can serve as a gateway to north central Pennsylvania.

None of the interviewees characterized water, sewer and electricity as "inadequate," but several suggested potential problems. Two million gallons of water were reported to be spilling into the sewer system daily, for example, creating capacity problems, and electric capacity was characterized as "marginal," as evidenced by periodic (if not frequent) interruptions in service. (One customer of Pennsylvania Power and Light (PP&L) noted three disruptions in a six-month period, one lasting up to ten hours.) We were struck with most interviewees' observation that basic telecommunication infrastructure was not a problem in Columbia County. The closest point of presence (POP) is in Scranton, but large companies that use the Internet and high-speed connectivity indicated that access and cost were not a problem. PenTel Data's affiliate (Service Electric) provides ten-megabyte fiber, and Bloomsburg is the head end of its network. At least one company (Magee Rieter) uses real time digital communications extensively with its global partners, without any significant problems. Interviews of seventy companies, by Governor Ridge's *Team Pennsylvania* resulted in no complaints about telecommunications capacity in the region. One interviewee noted that DSL or ADSL from Bell of Pennsylvania is still two to three years off, so that technology is not available locally.

Two infrastructure problems were pointed out by several interviewees: the severe shortage of developed or developable land for industrial uses, and the poor availability of air transportation. Apparently, the county does not have the resources to acquire and develop land for industrial use, meaning that companies that use ICT — especially those with a large footprint — would not have a suitable place to locate. The towns against which Bloomsburg competes not only have more land, but also, more affordable land. Industrial sites were selling for $35,000 to $40,000 per acre in Hazleton, for example, and for $50,000 per acre in Columbia County.[26]

The closest commercial airport is between Wilkes-Barre and Scranton (approximately 45 minutes away). That facility (AVP) only has two carriers and principally serves New York, Philadelphia and Pittsburgh, mostly with commuter aircraft. Several interviewees said that they preferred to hire drivers to take them to and from New York and Philadelphia airports for most business travel. We were told, as well, that the municipal airport in Bloomsburg was inadequate. We were told that one local employer (Pella Windows) recently closed their operations in Bloomsburg, in part, because of the airport.[27]

We conclude from our field visit that the problems noted above are impeding the implementation of an ICT strategy, which confirms this hypothesis.

2. *Investments in technology infrastructure must be part of a larger local planning process to succeed.*

Mostly true. BTC3R is itself a planning exercise, so the question here is really whether BTC3R was well integrated within a larger planning effort in the area or in the region. In short, the answer is "no." If this hypothesis holds, the negative answer would account for a lack of success of BT3CR.

In the course of our field visit we were told about several regional and sub-state planning efforts that seemed uncoordinated. BTC3R was not part of the Chamber of Commerce. It also was separate from the work of the Columbia County Economic Development Alliance and the Columbia-Montour Eco-

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[26] There are facilities in downtown Bloomsburg for CTC conversion — one 45,000 sq. ft., the other 80,000 sq. ft.

[27] Bloomsburg Airport is in line for runway extension from 2,700 feet to 4,200 feet, however, this has been going on with FAA for the last 15 years.

nomic Development Council. The state department of community and economic development worked with businesses interested in locating in the region (including running the Keystone Opportunity Zone program), not always in concert with local planners. We heard criticisms of the local planning apparatus as not having any "big plans," not engaging sufficiently in marketing (there was not an equivalent group to Penn Southeast and Penn Southwest. The local COG (SEDA) encompassed eleven counties, covering much of central Pennsylvania.

Our judgment is that several of the important players belong to the Consortium nominally, and have not made it a central organizing focus of their own economic development efforts. In any case, investments in telecommunications have proceeded in Columbia County quite outside the efforts of BTC3R and other formal planning efforts. As a consequence of such initiatives as SusqueNet, and investments by private providers such as Bell Atlantic, PenTel Data, and Adelphia (cable), the region has been adequately wired. The state has induced that activity by aggregating demand, so that the private sector has a certain and sizable client base. The Ridge administration also provided link-to-learn grants to the schools for "edu-net."

3. *A certain density or critical mass is required for information and communications technology to work, because of the costs of provision.*

Somewhat true. Demand aggregation was mentioned several times, as a way to get a sufficient customer base of IT users. Since this was done from Harrisburg, local interviewees worried that it amounted to a lost degree of freedom (leverage) for Bloomsburg.

The Ridge administration produced a "Technology Atlas" that contains a large amount of information by county on the availability and use of ICT software and hardware. Our summary interpretation of the data is that Columbia County holds its own by most measures among counties in its general size class, but still is less well connected than the major urban areas.

4. *Technological innovations and advances are reducing the costs of communications and linkages.*

True. This was demonstrated in at least three places: the library, Bloomsburg University's instructional media program, and in a private business (Magee Rieter).

5. *Institutional mechanisms must be in place to help users deploy the hard infrastructure appropriately*

True. Education and training, and consciousness-raising, are among the elements of the BTC3R strategy. The very identification of BTC3R as a need in Columbia County confirms this as an axiom.

6. *Some hierarchical coordination or linkages among national, state and local governments are important for a community to be truly "connected."*

Somewhat true. Part of the BTC3R plan was to connect to a hub in Harrisburg that would serve as the gateway to the world. The Adelphia cable backbone is an important part of the plan. We noted above the importance of link-to-learn, to the school system.

7. *Linkages among government, education and industry are a critical success factor for ICT interventions. State policies and corporate actions are important determinants of local "success."*

Somewhat true. The most developed (if not "successful", which we eschew because of its subjective nature) aspects of BTC3R that we have observed to date include the connection of schools to the Internet and the delivery of Bloomsburg University courses to a statewide audience. Both of these required local and state government and education interaction. The planning itself, and the newly proposed technology center, also required partnership with the Commonwealth's Ben Franklin Partnership program.

On the corporate side, the evidence is mixed. Private providers, such as Bell Atlantic, have not been closely involved with BTC3R. But Bell did contrib-

ute cash to the library in its capital campaign (though the contribution was small). Gerry Depo would say that "effective" linkage, not just linkage, is key, however, he is now quite complimentary of the Commonwealth's effort to assist in the aggregation of demand to leverage local competition but critical of key community participants being picked off by the competitive marketplace and by the "siloed" state and national programs.

8. *Infrastructure providers must be a partner in assessment and planning, not just the spending, for the intervention to succeed.*

Mostly False. This did not happen in Bloomsburg. There is a disconnect between the providers and the local planning for ICT, as typified by BTC3R.

9. *Work force development is a critical complement to any infrastructure intervention.*

True. The whole thrust of BTC3R is to make the work force (as part of the general citizenry) more aware of the opportunities and requirements of an information society. The shortage of trained technicians was noted by several interviewees, most notably Magee Rieter, which wanted to hire more local people.

Bloomsburg University's Magee Center is a member of the consortium and serves as Bloomsburg University's gateway to the public for extension courses at the university. But that is not the same as technical or community college instruction, which is not readily available in the Columbia County area. Students tend to travel to Williamsport (PennTech College) and Nanticoke (Luzerne County Community College) for such technical training, and that was identified as a "problem" locally.[28]

10. *Because of the long-term and expensive nature of ICT, vision and leadership are critical success factors.*

True. This case study is a story as much about the vision and leadership of one individual, Gerry Depo, as it is about the intervention itself. Depo saw the challenges of the "new economy" — especially for more rural communities — well before others in the United States did (in any location and in any occupation). He has remained steadfast in his advocacy of BTC3R. He has successfully leveraged others in the community to participate. We are convinced that none of what is percolating in Columbia County regarding ICT would have happened without Mr. Depo.

In response to the major questions this Report wanted to address — whether the programs put in were appropriate and effective, and whether an individual's vision and persistence are enough to overcome the considerable political, cultural and economic barriers that face towns like Bloomsburg — the answer seems to be yes, to whether they were appropriate; no, to whether they were effective — and, regarding the persistence of an individual . . . time will tell — although time is running out.

5. Persons Interviewed

Ed Edwards, President
Columbia Alliance for Economic Growth
President, Bloomsburg Area Chamber of Commerce

Leroy Diehl, Member
Columbia County Board of County Commissioners

Hal Pratt, Head Librarian
Bloomsburg Public Library

Kathleen Mulligan, Member
Bloomsburg Board of Education

Dr. Tim Phillips, Director
Institute for Instructional Technology
Bloomsburg University

[28] Berwick (12 miles to the east) is developing a training center in a converted downtown building for Luzerne County Community College training.

Prof. Karl Kapp
Institute for Instructional Technology
Bloomsburg University

Michael Vavrek, President
Bloomsburg Telecommunications Consortium
for Columbia County and Region
Dean, Bloomsburg University Continuing
and Distance Education

Michael Katerman, CEO
Magee Rieter Co.

Gerry Depo
Bloomsburg Town Administrator

PENNSYLVANIA

Meadville/Crawford County

1. Context

Meadville, Pennsylvania experienced a severe economic downturn in the 1980s when several of its major employers closed down almost simultaneously. These included Conrail's closing of its Maintenance of Way Railroad Yard (1,000 jobs), the relocation of Talon Industries (Zipper) Inc.'s manufacturing operations (2,500 jobs) in 1983, and the closing of Avetek Fibers (the successor to FMC, the successor to American Viscose), with a loss of 4,000 jobs. Unemployment rose to an estimated 22 percent of the region's labor force of between 35,000 and 40,000.[29]

Most recent measures show improvement in the area's economy but it still lags behind statewide averages. For example, the Crawford County unemployment rate was 5.0 percent in April 2000, compared with the statewide total of 3.6 percent; total county population has remained static at 88,000 since 1980; and there is concern about the high share of "low-wage" jobs.

Table A.16
Demographics for Crawford County

Population, 2000	90,366
Median household income, 1997 estimate	$31,749
Educational Attainment, High School or higher, 1990	74.1%
Educational attainment, Bachelor of Science or higher, 1990	11.8%
Poverty rate, 1997 estimate	13.5%
Unemployment rate, 2000 annual	5.5%
Per capita personal income, 1999 estimate	$21,318
Homeownership rate, 2000	75.5%
Percent Ethnicity, 2000	
White	97.0%
African-American	1.6%
Hispanic	0.6%

Sources: U.S. Census Bureau, U.S. Department of Labor.

2. Nature of the Intervention

The specific telecommunications intervention studied was the Regional Link-to-Learn Training Center, which is operated by the Crawford County Regional Alliance. The Center, located in the Crawford County Industrial Park, is a

[29] U.S. Department of Labor, Bureau of Labor Statistics.

physical facility equipped with 20 workstations, server, audio, video, interactive communications, and software application support. The Center's facilities are made available on a fee basis (with and without technical support) to a broad cross-section of organizations for a gamut of training programs within Crawford County and neighboring areas.

In a broader, indeed strategic sense, the role and impact of the Center is best understood in terms of:

- An interlocking set of organizations and facilities that synergistically leverage each others' revenue-generating capabilities, resources and facilities;

- The networking of these organizations with a host of economic, social service and educational institutions in Crawford County and the surrounding region; and

- Longstanding, community-based efforts to revitalize the economy and quality of life of the Meadville area, supplemented by pockets of computer-based expertise and entrepreneurial ("grantsmanship") skills.

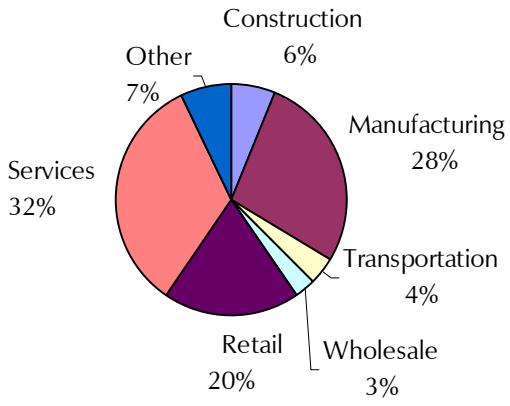
Undergirding these relationships is what several local interviewees termed the area's reputation for cooperation. A monthly roundtable of representatives of community groups has been in operation for 17 years, with 20 to 30 individuals getting together monthly to discuss local needs and activities. The group includes local political officials (e.g., county commissioners), economic development, educational, human service and health care providers — in effect, almost all sectors except the school system. The Crawford County Development Corporation functions in a secretariat role.

The Crawford County Regional Alliance (CCRA), which operates the Link-to-Learn (L2L) Training Center, was formed in 1997, as a 501(c) 3 organization, "in response to the regional need for improving computer and technological literacy, encouraging local business retention and attracting new opportunities." Although formally an independent not-for-profit corporation, CCRA, in fact, is an adjunct of the Crawford County Development Corporation, Crawford County's lead economic development agency. ("The CCRA utilizes the staff of the CCDC through a management agreement between the two corporations.")

The Crawford County Development Corporation (CCDC) was established in 1991 as the successor to other economic development and urban redevelopment organizations that date back to the 1950s. CCDC, with a current staff of 40, describes itself as providing one-stop shopping for a range of business development activities. Its major activities relate to the development of industrial and commercial space. CCDC owns or controls and estimated 2.2 million square feet of industrial and commercial buildings in the Greater Meadville area. Included in these holdings is the Crawford County Industrial Park, a 1.4 million square foot industrial park that formerly was the site of Avetek's operations. The park is now 50 percent renovated with 21 businesses. The park is also the site of the Bainbridge Technology Center, within which CCRA and L2L are located.

This emphasis on spatial proximity is important because part of CCDC's strategy for further economic development is to have L2L serve as a magnet to attract increasingly high-tech firms to the industrial park. Whereas much of the space in the park has

Figure A.12
Crawford County Business Mix, 1999 estimate



Source: Bureau of Economic Analysis; total full-time and part-time employment by industry.

been subdivided (and leased) to serve the need of light manufacturing and some service firms, a section is now being refurbished to attract firms for which the training and technology facilities of the Link-to-Learn Center would be attracting influences.

CCRA grew out of strategic planning by CCRA to expand its revenue base and scope of activities from "real estate development" — renovation, sale and lease of buildings and facilities it purchased or received as gifts from firms that closed their plants in Meadville — into new functional (and fundable) areas. Based on her discussions with community participants in CCDC's activities, several of whom are experts in computer systems and programming, Maryann Martin, CCDC's Director of Grants Administration, proposed an initiative in technology. Martin wrote the key proposals that led to establishment of the CCRA, and remains the driving force behind its activities, both in the community and in efforts to secure external funds. Reflecting the overlap between CCDC and CCRA, Martin is currently Chief Executive Officer, CCRA, as well as keeping her former position with CCDC.

CCRA was created in part because of legal questions about whether its sources of funding and activities would infringe on the tax-exempt status of CCDC. CCRA's stated objectives are twofold:

1) Foster mutual working relationships with and among leaders from the private and public sectors for the purpose of developing the necessary Alliances that will support and guide CCRA with each project and/or program; and

2) Review and determine what specific technologies, network systems and/or services meet the requirements of the community as defined by it and then to obtain the resources to acquire and implement it.

In part, too, CCRA was created to "enhance GREMLAN as a key resource in the northwest Pennsylvania region and to develop a Regional Conference/Training Communications Center at the Crawford County Industrial Park." GREMLAN (Greater Meadville Area Local Access Network) arose from local initiatives to improve interactive communication between citizens of the Greater Meadville area and their local governments, to provide a marketing tool for local business and industry, and to encourage computer literacy among local citizens.

The Link-to-Learn Training Center is essentially a 500-square-foot technology test-bed facility located in William J. Bainbridge Technology Center. In addition to state-of-the-art telecommunications infrastructure (e.g., Sun and Cisco Systems equipment), L2L also operates GREMLAN. It has been financed through several grant programs totaling approximately $500,000 and approximately $275,000 of investments by CCDC and CCRA.

In 1991, the City of Meadville, the Township of Vernon, and the Township of West Mead each contributed about $10,000 as seed money for GREMLAN; technical design and implementation was accomplished through the services of local volunteers. By 1996, the scope of services provided by GREMLAN had reached a level that the three municipalities determined could no longer be run on a voluntary basis. In December 1996, the three municipalities and CCDC entered into an agreement for CCDC to acquire GREMLAN's hardware and software, and to operate it at the Bainbridge Technology Center.

Acquisition and upgrading of GREMLAN in the Bainbridge Center, operated by CCRA, are described as "one segment of an overall strategy to facilitate leading edge information and communications technology for Crawford County and the northeast region of Pennsylvania." Contributions to the upgrading of GREMLAN have come from Armstrong Cable Services and ALLTEL Pennsylvania, Inc. The evolution of the L2L Center out of GREMLAN highlights the strong "grassroots" community support for telecommunications-related activities in the areas and the distinctive contribution of local residents in its design and operation.

Reflective of another source of synergy surrounding L2L's impact, the first tenant in the Bainbridge Center, in 1992, was the National Institute of Flexible Manufacturing, now the Precision

Manufacturing Institute. PMI provides technical training for the region's tool industry It was established to offset shortages in skilled labor for the region's firms but now provides entry-level training as well. PMI estimates that it offers firms a cost-effective way to provide the training needed to accommodate the increasing technical sophistication of modern machine tools, the revival of the industry, and the aging of the existing labor force. The synergies arise from planned expansions of the Bainbridge center's classroom and meeting facilities that, in combination with use of L2L's telecommunications facilities, would facilitate training of larger groups.

The Link-to-Learn Training Center is a computer laboratory with state-of-the-art telecommunications and multimedia equipment, staffed by a full-time technical assistant, who is the 19-year-old son of one of the key designers of the GREMLAN system, and the owner of Griffin Data Systems, which has the contract to manage the center's equipment.

The Center's facilities are available on a heavily subsidized basis, with a substantial (but not yet determined) portion of its fixed and variable costs underwritten by a variety of federal and state government agency grants. These grants were the result of Martin's assiduous and entrepreneurial efforts in seeking out funding sources and writing proposals, private firms and other sources.

Initial funding for L2L came from Ben Franklin Technology Partners,[30] which awarded $100,000 to CCRA to build L2L's core facilities. High and repeated credit is also given by CCRA to the United States Economic Development Administration for its support in establishing L2L. EDA funds, approximately $500,000, permitted CCRA to renovate sections of what was otherwise an industrial shell within the Industrial Park into a habitable, nicely furnished center and to acquire some equipment. Our informants described EDA's major contribution as its financial support, an estimated $3.3 million, toward the physical renovation of the Industrial Park, which has made it a functional site for industrial and service firms.

The Center is targeted at a mix of several private and public-sector actors, who effectively encompass the range of economic, health and human service, environmental, educational and entertainment/recreational organizations and activities in Crawford County, and to an increasing degree, nearby counties. From the perspective of prospective users, the Center is attractive for several reasons. These include

- the technical quality of its facilities;
- the availability of full-time support staff to support the activities of trainers and trainees during training sessions;
- its openness to having clients bring in their own trainers and software; and
- low cost.

CCDC, CCRA or our other site contacts did not indicate any concern about the Center's operations competing with the private sector. Rather, because the Center itself does not provide training, it is seen as providing the "hardware/infrastructure" that enables or expands the market for other training providers.

Indeed, a striking feature of the Center, again understood in conjunction with CCRA and CCDC's operation and the space available at the Industrial Park, is that it has served as the infrastructure nucleus about which other regional economic development actors, especially regional universities, have gathered. Thus Gannon University has two on-site representatives of its Small Business Development Center at CCRA, and the Northwest Pennsylvania Technical Institute, a public post-secondary technical training institute and branch of the Erie County Technical Institute, conducts its classes in the Bainbridge Center, as well.

The major issue surrounding the Link-to-Learn Center's operations is the discontent of some (un-

[30] The Ben Franklin program no longer funds capacity-building initiatives, such as L2L. Rather, its current criteria and priorities emphasize capital and support of start-up firms. CCRA apparently has been unsuccessful recently in its proposals to Ben Franklin.

known) number of industrial firms in the region (most likely from the tool and dye industry) about what they perceive to be the Center's lack of attention to their needs. (This discontent was expressed in an unsigned letter to the case-study research leader.) The Center reports that it is aware of this discontent and is planning to meet with representatives of these firms to improve relationships. It does note, for its part, that part of the discontent represents the attitude of the industry that the Center was established primarily to serve its needs, which is not consistent with CCRA's view that the Center is intended to serve multiple Crawford County needs and users.

3. Impacts of the Intervention

The activities of CCRA and the Regional Link-to-Learn Center need to be seen in the context of Meadville's longstanding economic development activities, CCDC's strategies, and the operations of the Crawford County Industrial Park. L2L serves an extensive array of private sector and public-sector organizations. The following set of impacts is taken from anecdotes offered by a group interviewed on Monday, August 8, 2000.

Crawford County's PennDOT unit was described to be ahead of other regional PennDOT offices in building computer capacity among its middle managers, thanks in part to access to L2L. PennDOT has 131 employees in the region. As part of an ongoing statewide agency initiative ("Agility") to devolve and decentralize responsibility and authority and to strengthen partnerships with local governments, the regional unit is seeking to upgrade the computer expertise of its foreman and assistant managers. They expect to provide all managers with laptops to do on-site data entry and assessments. They may use L2L for video-conferencing, which would save travel to Harrisburg. The regional unit formerly sent its managers to a computer training facility elsewhere in Pennsylvania, but finds L2L much more convenient. To date, they have held four separate training courses, which were described as having worked out well.

The French Creek Outdoor Learning Center provides environmental education and training to high school teachers and students in the region's schools, as well as a set of related environmental activities. The Outdoor Center has used L2L in this training, receiving "wonderful help" from CCRA staff. L2L invoices the Outdoor Center for the hours it uses the facility, and it invoices the schools. The Outdoor Center has used a combination of community-based grants and Pennsylvania Department of Public Education environmental grants to train teachers how to use digital cameras, make PowerPoint presentations, construct Web pages and use laptops, all with a view toward making outdoor education available on the Internet.

The Outdoor Center has also run computer camps for 5- to 7- and 9- to 12-year-olds. The Outdoor Center has bused school-age children in from the small, rural towns around Meadville to learn about computers. (Several interviewees noted that Meadville and L2L had begun to serve as a form of "computer literacy node for students, teachers and other residents of the surrounding region).

The Ben Franklin Transformation Business Services Network is a funded project of Ben Franklin Technology Partners(the region's Ben Franklin Partnership program); its employees are Penn State University employees. BF Technology Partners provides capital to start-up firms, but does little to supply supporting services. The Network is thus charged with working with (high-tech) entrepreneurs, especially start-up firms, although it also offers them personal business experience and brokers the region's services to establish firms. The Network main office is located in downtown Erie but has eight units statewide.

The goal of the Network manager interviewed for this case study has been to increase the computer and software skills of the entrepreneurs and key personnel of start-up firms in the region around Meadville. In February 2000, he canvassed the region's facilities in computer training. L2L was exactly what he was looking for: it was a start-of-the art facility; it had flexible and reasonable pricing; and it was geographically neutral for his nine-county region. (An underlying theme in many of the inter-

views was the reluctance to travel to Erie for services, the likely consequence of a long history of relationships among area jurisdictions.)

The Network has held several training programs at L2L, with good success. Our informant said the L2L facility is "outstanding," the staff is knowledgeable and flexible. Very positive feedback about the training and the facility has also been received from participants and from the professional trainers.

Firms other than Ben Franklin-funded firms have been invited to and have participated in these sessions. A nominal amount ($12) is charged each participant. Monthly sessions are now planned and will likely expand the scope of training from specific software packages to general business skills (e.g., sales, personnel). The training sessions provide more than skills. L2L facilities provide for on-site catering; lunchtime discussions among participants provide added opportunities for peer learning and the building of business relationships.

Another successful application of L2L is to library needs. There is also a federation of nine libraries and two reading centers in Crawford County. The shared goal of the library federation and L2L is to get high-speed Internet service to the county's rural areas. An obstacle to achieving this goal is that three different telephone companies and five cable systems serve the county. Considerable unevenness thus exists in access of various libraries to telecommunication services: some are connected to the Internet by high-speed modem while others have slower access.

The Meadville Public Library has traditionally been a technological innovator. In 1993, it was the first in Pennsylvania to offer free email to library users, as well as offering free training on use of the Internet at the library and its branches. In 1995, it was the first to have a cable modem; Crawford County is one of only two counties in Pennsylvania with a dedicated library tax; it thus has one of the highest levels of per capita expenditures on libraries.

L2L supplements the library's programs. The Meadville library offers basic, beginner courses at no charge. A more advanced, four-hour class in the use of the Internet is offered every two to three months at L2L, at a charge of $20. Enrollment (20) fills the lab's capacity. A cross-section of the county's population has taken the class. Close connections[31] exist between the library and L2L; its director sits on CCRA's board.

Another benefit of L2L is that its infrastructure permits business firms to access government documents using the library's services. (The specific example cited was that of a firm seeking information on rules on exports.)

Crawford County Emergency Services has responsibility for a wide range of emergency services, including 911 calls and hazardous materials. EMS (whose director sits on CCRA's board) is a constantly challenged to maintain the computer skills of its staff. It is heavily dependent on specialized software (e.g., GIS, management techniques), and is constantly confronting the problem of how to arrange for training as this software is enhanced. In a recent case, training on a key software package was offered only in Rockville, Maryland. The cost per person would have been $2,000, too high a price tag for commissioners to sanction, particularly because it involves out-of-state travel.

L2L enabled EMS to bring the trainers to Crawford County. EMS services in neighboring counties were confronted with the same problem, and they created a critical mass of demand (10 counties/30 individuals) to invite the trainers to Meadville. The trainers were reported as at first skeptical that the region had adequate facilities, but then overwhelmed by L2L's quality. Both trainers and trainees were highly pleased with the training.

Meadville is now expected through L2L to become the center for regional training across a spectrum of emergency service units (e.g., the 30 fire departments in the county face new demands for reporting fires to the state, leading to a new for training on the relevant software). L2L's capability to ac-

[31] These connections were discussed at a recent meeting of the National Rural Telecommunications Association meeting; the report is described in a Pennsylvania Library Association article, July 2000.

commodate diverse software is described as "unique."

4. Other Comments and Insights

Reflective of the "local" character of many of these efforts and the networking evident among organizations, the Outdoor Center director's initiatives in environmental education started when she was a student at Allegheny College; close ties now exist between French Creek, Allegheny, each of Crawford County's three school districts, and CCDC.

5. Testing the Study Hypotheses

1. *Enabling infrastructure (roads, water, sewer, etc.) is necessary, but not sufficient to assure the effectiveness of technology infrastructure investment.*

True. The Link to Learning Center is located in a rebuilt factory complex. EDA's funds for renovation of this facility helped make it habitable and suitable for a higher-tech reuse. The enabling infrastructure was thus necessary, and then the cooperation of local organizations assured the effectiveness of the technology infrastructure investment. The CCDC and CCRA took the remodeled shell and, with the contributions of others, created a useful regional resource.

2. *Investments in technology infrastructure must be part of a larger local planning process to succeed.*

True. There is impressive close cooperation among local public, private and non-governmental organizations in this area, who recognize that with limited resources it is important for technology infrastructure investments to be part of a larger local plan. The Crawford County Development Corporation oversees the Crawford County Regional Alliance, which operates the learning lab. These two organizations, along with the towns of Meadville, Vernon, and Mead, combined resources to further their common goals through technology infrastructure. They believe that their joint investments in one shared program will help each to realize goals including improving computer literacy and marketing local businesses better than they could have alone.

3. *A certain density or critical mass is required for information and communications technology (ICT) to work, because of the costs of provision.*

True. The industrial park houses the Bainbridge Center and 21 other businesses. There are classroom and meeting facilities within the Bainbridge Center, as well as PMI, CCRA, and L2L. Also, L2L continues to attract other regional economic development actors, especially the regional's higher education institutions, to the park. The concentration of companies using the ICT helps establish the critical mass necessary to recoup provision costs. L2L itself provides economies of scale and scope for multiple types of training opportunities for a regionally dispersed population and set of governmental services, which find travel either to Pittsburgh or Erie too expensive or politically awkward.

4. *Technological innovations and advances are reducing the costs of communications and linkages.*

True. L2L reduces costs for users by making their telecom equipment available to the community on a fee basis and by hosting outside trainers. L2L and Bainbridge's facilities provide lower-cost, centrally located training facilities for regional public-service organizations. However, it is not clear whether the cost savings are attributable just to economies of scale or technological innovation as well.

5. *Institutional mechanisms must be in place to help users deploy the hard infrastructure appropriately.*

True. As L2L is a learning lab, the user training is interwoven with the hardware in this case. CCRA is the entrepreneur, operator, and landlord for L2L. It has full-time staff available to support training sessions and to operate GREMLAN.

6. *Some hierarchical coordination or linkages among national, state, and local governments are important for a community to be truly connected.*

Mostly false. L2L is part of a county-level operation and linkages to the state or federal government programs were not salient. The region has, however, benefited from the Commonwealth's efforts to provide computers and Internet access to libraries.

7. *Linkages among government, education and industry are a critical success factor for ICT interventions. State policies and corporate action are important determinants of local "success."*

True. In this case linkages were less than "critical," because this was largely a county initiative. But state support complemented local efforts. PennDOT and the Department of Public Education have contributed to the success of L2L by using it for training sessions for their employees in the region. Also, a regional university has representatives from SBDC at Bainbridge and a branch of one technical institute offers classes there. Industry provided some background support and contributed to upgrading GREMLAN. Pennsylvania is home to cable giant Adelphia, and there is a growing information technology (e.g., cable provision) industry in the region, which means considerable local expertise.

8. *Infrastructure providers must be partners in assessment and planning, not just the spending, for the intervention to succeed.*

True. CCDC, as the owner of the industrial park, would be the infrastructure provider. They partner with CCRA for joint spending (GREMLAN) and staff sharing, and are involved with the monthly roundtable assessment and planning with community representatives.

9. *Work force development is a critical complement to any infrastructure intervention.*

True. For L2L this is true in two ways. First, L2L was developed in good part to provide labor force training. The center offers work force development programs that would otherwise be too expensive. For example, because of L2L, CCEMS was able to offer software training that previously required traveling to Maryland. Second, set-up and operation of the center has been facilitated by the availability of local talent.

10. *Because of the long-term and expensive nature of ICT, vision and leadership are critical success factors.*

True. Strong, visionary, capable leadership exists for CCDC, which spills over to L2L. Maryann Martin, CEO of CCRA, wrote the proposals that led to its establishment, and she remains a driving force behind its activities in community and in securing funds.

TEXAS

Willacy County

1. Context

Willacy County is one of several distressed rural counties in the Rio Grande Valley, which includes the metropolitan area of McAllen, Harlingen, Brownsville, Texas, and Monterrey, Mexico. The Texas side of the Valley joined the United States in 1848 through the Treaty of Guadalupe-Hidalgo. The town of Raymondville is the Willacy County seat and 37 miles from the Mexican border. The county's population of 20,000 is 87 percent Hispanic.[1]

While the Harlingen and McAllen metro areas have outpaced the national average and grown 25 percent or more over the last ten years, Raymondville's population of 9,000 has not grown since 1952. It is an example of a rural adjacent community where proximity to a growing area has not yet translated to measurable economic advantage. Its poverty rate has persisted at about 40 percent or more,[2] and its unemployment rate has hovered around 20 percent (18.4 percent in 1999, 23.3 percent in 1997).[3] Parts of Willacy, Cameron, Hildalgo and Starr Counties are a federally designated multi-jurisdictional Empowerment Zone for the Rio Grande Valley.

Raymondville and Willacy County have had an agriculturally based econ-

Table A.17
Demographics for Willacy County, Texas

Population, 2000	20,082
Median household income, 1997 estimate	$18,616
Educational Attainment, High School or higher, 1990	42.9%
Educational attainment, Bachelor of Science or higher, 1990	8.8%
Poverty rate, 1997 estimate	39.7%
Unemployment rate, 2000 annual	15.5%
Per capita personal income, 1999 estimate	$12,746
Homeownership rate, 2000	77.3%
Percent Ethnicity, 2000	
White	70.4%
African-American	2.2%
Hispanic	85.7%

Sources: U.S. Census Bureau, U.S. Department of Labor.

1 U.S. Census Bureau, www.census.gov.

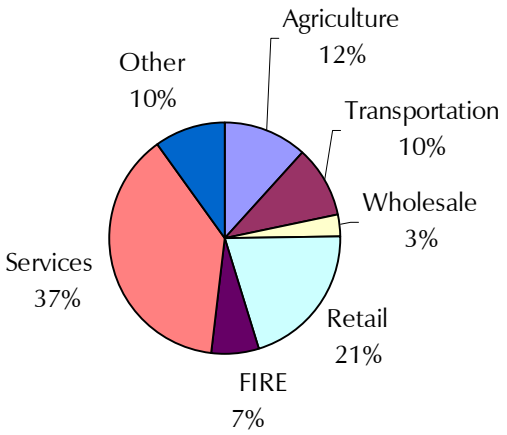
2 U.S. Census Bureau, www.census.gov/hhes/www/poverty.html.

3 Bureau of Labor Statistics, stats.bls.gov.

omy for their entire recorded history, once supporting several large and many small ranches. The local economy has suffered directly with the national decline in agriculture. There are fewer, but larger farms as agri-business has supplanted the family farm. Handpicked crops including carrots and onions have relocated to Mexico where the labor is considerably less expensive. Currently local farmers are growing sugar cane, cotton, sorghum, and watermelon all year round, and more recently kenaf, a fiber crop. Manufacturing employment in 1997 was only 100 people or 5 percent of the labor force, and most of that was in apparel.[4] The largest local employers are public schools and prisons. Nearly 70 percent of the private sector employment is in services and retail. The county includes a small port village, Port Mansfield, on the Gulf of Mexico, viewed locally as a possible future node for entrepreneurial development.

Because it was settled as farm and ranch land, Willacy County has a sparsely populated development pattern, with only 33 persons per square mile across its 597 square miles. (That compares with a density of 233 for Hidalgo County, where McAllen is, for example.) The costs to provide infrastructure of any kind are therefore quite high. The city recently completed a new wastewater plant but notes that some upgrades are needed to the water plant.

Figure A.13
Willacy County Business Mix, 1999 estimate



Source: Bureau of Economic Analysis; total full-time and part-time employment by industry.

Fortunately, the terrain is relatively flat, and Willacy County is now served by four-lane roads (notably Interstate 37) to Harlingen and McAllen, where many residents commute for jobs and shopping. McAllen had the highest per capita retail sales in the United States in 1999, due primarily to its proximity and appeal to 2 million Mexicans within 50 miles.

Willacy County is well situated in terms of other transportation infrastructure, as well. Raymondville is only 25 miles to the Harlingen international airport, 49 miles to the deepwater port at Brownsville, and less than 40 miles to an international bridge to Mexico. However, there is no good bus system to Harlingen, and most low income people have unreliable cars, at best, which makes getting a GED or other skills training very difficult for the unemployed.

Although the city manager of Raymondville is interested in economic development, and there is a county industrial foundation with several dedicated volunteers, local leaders have acknowledged the need to hire a full-time economic developer for the county and city. McAllen and Harlingen use the revenue from their two-cent city sales tax to pay for their economic developers. Although Raymondville also has that tax, its small retail base generates little revenue. One reason for the low retail base is a local shortage of suitable housing, which pushes some of those employed in Raymondville to live outside the area.

The area's current economic development prospects include a kenaf factory, two new prisons and a spaceport. A kenaf plant, employing as many as 300 people, could process locally grown kenaf into paper fiber. A 500-bed prison is expected to generate 150 new jobs that pay $7–$8 an hour. The second prison, a federal facility with 1,500 beds, would pay $10–$11 an hour. The city sees prisons as good revenue builders because sales tax revenues doubled over the five years when the first prison was introduced. The spaceport in the northern end of the county near the Kings Ranch would be a private facility for the launching and retrieval of unmanned

[4] U.S. Census Bureau: Economic Census

spacecrafts. It is expected to create 5,000 construction and 2,000 permanent jobs, though it is likely a few years off.

Regionally, the Valley economy is currently and likely to continue to be based on agriculture, tourism (including ecotourism), retail sales, warehousing/distribution, and manufacturing, all of which are driven in part by the considerable growth in Mexico following the introduction of NAFTA. One of our informants said that Professor George Kozmetsky of the University of Texas at Austin sees the entire South Texas region is as a four-point diamond of university hubs that includes Austin, Pan American, Brownsville, and Monterrey. UT-Pan American applied to EDA for a planning grant on this initiative. The idea was to tie together Austin's need for manpower to the Valley, where there is plentiful but untrained labor.

According to two informed interviewees (contacted separately) in the region, Willacy County's greatest barrier to economic development is the low skill and education level of its labor force. There is a high dropout rate, as kids feel pressure to work on farms to help the family get by, and a brain drain of the brightest children to larger cities. The population is poor, with 90 percent of students on subsidized lunches. That makes it difficult to support investment in better facilities and teachers, and the districts are small.

The area has a corresponding need to strengthen its knowledge infrastructure of schools, colleges, libraries and hospitals. There is no local hospital but there are several small clinics. Although Raymondville has four colleges within 30 miles, there is no strong local sense of connectivity to them or their importance as a tool for elevating the economic development prospects of Valley communities. The community colleges in the area have begun to offer distance-learning programs for Willacy and other rural counties in the region. Public school officials are being aggressive in wiring the schools and accessing federal and state grant sources to support various connectivity initiatives.

Despite these important efforts, there is very little conscious leadership or strategic vision to connect local government, business and higher education in the region. The understanding of how these partnerships might be critical for sustained economic development seems limited as well. There is some project-centered opportunism, for instance, related to the spaceport and the training that would be required.

By contrast, Harlingen and McAllen in the 1990s have poured substantial resources into planning and economic development and have seen earnings and income growth outpace the national average. According to one informant, increases in incomes can be attributed to large increase sin funds budgeted for border schools by the state as part of the Southern Texas Border Initiative. The proximity of these two growing cities and Mexico may offer the most promising economic development opportunities for Willacy County.

2. Nature of the Intervention

In early 1998, the local telephone cooperative, Valley Telephone Cooperative, Inc. (VTCI), installed a Local Area Network (LAN) and provided high-speed Internet access via digital subscriber (DSL) lines to public schools in San Perlita, San Isidro and La Sara at an affordable rate to the customers. These lines, 700 kilobits per second (kbps), provide half the bandwidth of a T1, which is more than sufficient speed for the schools' use. The cost of these DSLs was originally $126 per month and as of May 2000 was only $90 per month. The schools were thrilled and picked up using it right away. Otherwise, to get T1 lines, the school districts would have had to pay approximately $3,000 per month — $1,000 per month for the leased (distance-based) T1 to Harlingen and $2,000 for the transport cost.

VTCI has invested $30 million over the last seven years in its fiber optic network. VTCI's service area covers 7,300 square miles of the Rio Grande Valley, including most of Willacy County, except the town of Raymondville, which is served by GTE. It has 17 central office telephone exchanges. As of May 2000, VTCI had 6,500 telephone access lines, or less than one customer per square mile. Many rural telephone co-ops serve one to three customers per square mile,

so this is one of the least dense service areas in the United States. Internet access at high-speed, which normally is restricted to within two miles of the central office, is being delivered by VTCI to customers more than 30 miles away.

To achieve this, VTCI had to be creative with existing technology. The design of most systems is geared toward urban, denser areas. VTCI had to adapt existing equipment for use with a smaller number of subscribers. They created "mini" central offices throughout their service area. For example, they installed an xDSL modem in a remote cabinet along the side of a quiet country road, 33.8 miles away and connected via a TI line from the Fowlerton central office. The xDSL shelf was built with equipment from PairGain Technologies Inc., of Tustin, California.[5] This shelf is normally put in the central office, but VTCI extended it with a digital loop carrier (DLC), a device designed to extend central office functions to remote sites, purchased from Advanced Fibre Communications (AFC) of Petaluma, California. The customer's home, located another 10,000 feet away, receives high-speed data service from the cabinet over copper lines.

So far, because of the low density of the area, only a few xDSL/DLC sites are serving more than one customer. At a cost of $900 per shelf, it will take some time to get a return on these investments. But the xDSL outlay is significantly less than the cost of alternative broadband networks, such as coaxial or hybrid fiber coax networks. The cabinets, which can hold 12 cards, but typically have only one or two installed, and thus have the capacity to serve additional customers.

VTCI had 20 DSL customers the first year, 30 the second year, and in early June 2000, 87. The split between residential and institutional users was 65/25. Many ranches and farms list one line as a business, so the typical classification may be misleading. The users have been very enthusiastic about the enhanced service and speed of the lines.

VTCI officials note that they dismissed wireless as a possible technology option because of its higher cost. They would have to spend approximately $100,000 to acquire land and build fencing and a tower, before they could even install the electronics. In addition, the technology for broadband wireless is still being developed.

Although the technology was not the limiting factor in the Willacy County case, cost recovery is still a problem and must be viewed as a long-term prospect (VTCI says it will take seven years). VTCI wanted to keep DSL service under $100 as an attractive price point. The total price a single customer pays for the DSL service is $66 per month: $36 for the line charge (set by the NECA tariff board) and $30 for the Internet service. That is one of the lowest charges in the United States. For Internet service to businesses or other customers (such as the schools) with more than four users, the cost is $90 per month, or three times the residential rate. This is for guaranteed speed of 640k. The true cost of the line charge only (the $36 portion) without universal service subsidies is about $200/month.

Two-thirds of VTCI's expenses come from support from the Universal Service fund, which disburses 73 cents per access line to VTCI now. Even with these subsidies, VTCI was losing about $60,000 per year on this DSL service (as of June 2000). In the first two years, it lost $150,000 and $240,000, respectively, after subsidies. The true current cost without subsidy is equivalent to losing $120,000 per year.

VTCI provided DSL in a very rural area, according to its general manager, "because we knew it could be done." It also has a different structure from a regional bell company. VTCI is a co-op, whose members are the owners and subscribers. Like many other co-ops in the United States, VTCI was established to serve areas not seen as feasible by GTE and Southwestern Bell. Its intention is service, not profit. When the 1996 Federal Telecommunications Act stated that rural areas would get affordable Internet service, VCTI management took that mandate seriously.

VTCI long has been progressive in this area. VTCI helped bring Valley from rotary service only in 1990 to high-speed fiber optics in the last decade. VTCI

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[5] PairGain EtherPhone and Megabit Modem RADSL (rate adaptive DSL) units for remote installations.

first became an Internet Service Provider (ISP) in March 1996, to fill a void locally. VTCI decided to offer Internet service in its telephone service area because they and others could not get local access from other providers. It is not a profitable part of the business but helped open a market.

Other ventures that demonstrate the enterprising nature of this telco include

- VTCI entered the long-distance market by buying second-hand switches for its line network. VTCI can compete with the big telcos for long-distance customers because it kept its startup costs low and used nearby line connections with Mexico.

- VTCI is offering long-distance service to Mexico that is 30 percent cheaper for residential and 50 percent for business than other carriers.

- VTCI built a point of presence in San Antonio and is selling Internet service to Mexican companies.

- Several years ago, when the FCC started auctioning off cellular territory, VTCI negotiated with Southwestern Bell that in return for giving up VTCI's claim on cellular territory, it would become a substantial financial investor in three of Bell's service areas, one metropolitan and two rural, to help them build a wireless network. This investment has netted VTCI $10.5 million in revenue to date.

These other ventures have helped contribute to a healthy bottom line for the overall company, whose equity-to-debt ratio is 68/32. In some cases, the profits of these ventures cannot be used to expand high-speed service to rural areas, however. Some of VTCI's service is regulated (as a telephone company), some is not and is more flexible (as an ISP). Companies cannot cross-subsidize within a regulated function, for example, by subsidizing DSL services with charges to telephone customers. Nonetheless, the solid finances of VTCI and its parent company overall have inclined its board to be more progressive with investments such as DSL that are losing money even after subsidies.

VCTI has now completed its infrastructure investment in Willacy County, but intends to expand further in its Rio Grande Valley service area. VTCI also wants to migrate some of its modem users to a low-end (256K) DSL (which is only $5 higher than having a modem and a second line) because the holding times of modems are causing large strains on the central offices. The DSL is better, as well because it can be used for voice and Internet simultaneously. Unfortunately however, VTCI's subsidy from USF is line-based, so it is good for a second phone line rather than the additional cost of DSL.

3. Impacts of the Intervention

DSL users in Willacy County love the high-speed service, but the number of users is small. The DSL investment has yet to spur any clear job creation, except at VTCI, which has added 20 staff in the last two years; it now employs a total of 70 people in its Raymondville office.

The high-speed Internet access is supporting additional investment at the margins, for a few small companies. One farm and ranch supply company owner in San Isidro said the service allows him to sell internationally over the Web. E-commerce constitutes 10 to 15 percent of his $2 million in sales. An oil field logging and development company in Mirando uses it for communications with its partners and customers.

In the near term, the most noticeable impacts of the DSL service are likely to be in the public schools, where students can now have all the advantages of the Internet that they lacked before. One school official said that there is no DSL service yet in any of the cities around the area except Willacy County, and local schools have had it for two years. VTCI also developed a distance-learning and interactive video network among four South Texas school districts that has tremendous potential. However, as a San Perlita official noted, though the technology is there and VTCI supports it, the distance learning lab has been

underutilized because there are not enough teachers/resources to do the necessary programming. They have the same problem on the other end at South Texas Community College. Teachers say it takes about twice the prep time to do a distance-learning course, and they lack the resources, once the initial grant ran out.

There is also a Raymondville Instructional Center (RIC) that provides GEDs, dropout and recovery services to about 40 people outside the schools. The RIC has T1 service to UT-Pan American, courtesy of VTCI. UT-Brownsville is putting in a learning center in Port Mansfield, taking advantage of the DSL service there. A regional telehealth initiative that includes the area clinics and hospitals and VTCI was proposed to the Texas Infrastructure Fund (TIF); that grant is pending.

Locals believe that the distance learning capability and Internet access provided by the telecom services from VTCI could help address the serious lack of local personnel and services related to both education and health. To achieve that end, the universities in the region need to train more teachers in distance learning course design and delivery to address a real shortage. In addition, though Raymondville High School has a one-room distance learning facility, it is not being used. It needs to have extended hours to serve people in the evenings.

Several interviewees believe that the strong telecom service should be helpful in marketing Willacy County to businesses, but that it is not yet being leveraged as a strategic asset by local leaders. In particular, they suggested targeting small businesses with only five to 15 people in San Antonio and Austin that need high-speed access and want the quality of life outside an urban area, perhaps most appealing in Port Mansfield. There is a small enclave of very bright young adults in Port Mansfield who are heavy users of the Internet and are developing Web pages for themselves and companies in the Valley. The challenge will be to have enough of an IT community for them to interact with others like them. La Grange, Texas, a very small town, was cited as an example of a place that offered high bandwidth at very low prices to spur economic development.

Since VTCI is losing money on the investment, however, its management needs to be integrally involved in any strategy for expanding the number of DSL business customers to locate them where the fixed investments have already been made.

In addition, there may be some good e-commerce opportunities for import/export, perhaps working with the public schools and the prison as the county's largest two employers. E-commerce with Mexican based companies or other partnerships related to the border economy might be profitable; some companies strongly prefer to do business in the United States but need to work closely with the large corporations south of the border.

4. Testing the Study Hypotheses

1. *Enabling infrastructure (roads, water, sewer, etc.) is necessary but not sufficient to assure the effectiveness of technology infrastructure investment.*

True. Phones and electricity were not introduced until the 1950s and 1960s, but Willacy County now has the full panoply of enabling infrastructure. Road access is very good. The lack of economic development is for other reasons.

2. *Investments in technology infrastructure must be part of a larger local planning process to succeed.*

False. So far, the high-speed Internet offered in the areas around Raymondville is viewed favorably but is not integral to any local or regional leadership strategy. In fact, the telecom infrastructure is better than in the adjacent metro areas but is not being leveraged for economic development advantage. Connectivity includes not just the technology but also the communications among people. The best opportunities for economic development may be regional, not just local — Raymondville is very close to fast-growing economies in McAllen and Monterrey, and could be the beneficiary of the Cross Border Institute for Regional Development (CBIRD), a bi-national

initiative to produce and convert knowledge to value in the South Texas/North Mexico border region. [6]

3. A certain density or critical mass is required for information and communications technology (ICT) to work, because of the costs of provision.

False. Some providers are able to serve low-density areas with infrastructure, by adapting or scaling down systems that are designed for high-density uses. A telephone cooperative such as Valley Telephone views this investment differently than a traditional telco would, because it is owned by its users and has a long-term interest in serving them.

However, it is true that without critical mass of demand, subsidies or other approaches are necessary to develop ICT resources. Without heavy universal service subsidies, Valley Telephone would not be serving the very low-density areas of the Rio Grande Valley.

4. Technological innovations and advances are reducing the costs of communications and linkages.

True, but not to the point where these investments are cost-effective in very rural areas without universal service subsidies. Telecom advances are increasing the *options* for telecom providers to serve underserved areas. Some of these advances (e.g., cellular technology) can be profit-making opportunities to help the bottom line of the overall business and thus board willingness to invest at a loss. The cost of providing IT infrastructure to low-density areas remains extremely high. The combination of universal service subsidies, a co-op mentality, a healthy bottom line from other investments, and a literal interpretation of the mandate from the 1996 Telecom Act to serve underserved areas convinced VTCI to make the investment in DSL for the Rio Grande Valley anyway.

5. Institutional mechanisms must be in place to help users deploy the hard infrastructure appropriately.

Somewhat true. In Willacy County, most of the current users of the high-speed lines are the public school systems, which are committed to providing the necessary training to students. The institutional mechanisms to assist businesses are considerably weaker. The City of Raymondville applied for a grant from the North American Development Bank for e-commerce training for small business owners, but the grant was not awarded.

6. Some hierarchical coordination or linkages among national, state and local governments are important for a community to be truly "connected."

True. We did not observe Raymondville/Willacy County to have strong ongoing linkages to funding and other resources from state and federal government agencies, though the public schools are opportunistic with respect to certain grant funds.

7. Linkages among government, education and industry are a critical success factor for ICT interventions. State policies and corporate actions are important determinants of local "success."

Mostly false. Raymondville/Willacy County has somewhat weak linkages now and has yet to capitalize on the economic development opportunity of the infrastructure. There are reasonably good linkages between the telecom provider and education at the K–12 level (a key customer), but the higher education linkages need strengthening. The local government applauds but does not have strong leadership to market the new asset. There is a very small private employer base in the County and therefore that is a missing source of support for the effort. Linkages to universities in the region should be strengthened as well. EDA awarded a $1M grant in August 2001 to start a Center for Border Studies at the University of Texas-Pan American.

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[6] Kozmetsky, George. *Building 21st Century Texas Partnerships for Economic Development*. Texas Department of Economic Development Conference: Economic Development for the 21st Century. Austin, Texas. Doubletree Hotel, 1 Nov. 1999.

8. *Infrastructure providers must be a partner in assessment and planning, not just the spending, for the intervention to succeed.*

True. In the case of Willacy County, the infrastructure provider is more proactive than the economic development leadership in assessment, planning, vision, and willingness to make long-term investments.

9. *Work force development is a critical complement to any infrastructure intervention.*

Somewhat true. The lack of skilled work force and economic development leadership are and will continue to be the reasons there has been very little business growth or job creation there, regardless of available Internet service. A recent strategic plan for Harlingen determined that technical training and better science and math education were critical for the Valley. Some of the high school students who now have access to the broadband service are designing Web pages and realizing personal success, but there is no concerted effort to turn students into businesspersons. Some linkages to the community college and public university exist, but they are not focused strategically. This area also lacks some of the amenities that the companies who might appreciate low-cost high-speed Internet access would seek.

10. *Because of the long-term and expensive nature of ICT, vision and leadership are critical success factors.*

True. Leadership sometimes comes from the private sector rather than government. The telecom provider has vision and leadership on its staff and board, and otherwise would not have made the investment in such a rural area. The local government, chamber and EDC have not demonstrated the vision and leadership to market and capitalize on the asset, and to address some of the other challenges of the area.

5. Contacts

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WASHINGTON

Seattle/King County

1. Context

Seattle, home to Microsoft, Boeing, and other leading twenty-first century companies, still has areas that lag far behind in their economic and technological progress. In particular, several inner city neighborhoods have concentrations of poverty and high unemployment, especially among youths who have dropped out of school, often because they failed to see the "relevance" of what they were being taught. Seattle illustrates what has become known as the "digital divide" — islands of backwardness within a sea of technological advancement and the reality of the poorest and least educated members of society being left further and further behind.[1]

Overall, Seattle has some impressive statistics: the percentage of graduating students completing high school in 2000 was higher than most major cities (93 percent compared to 78 percent, 75 percent, and 87 percent in New York, Miami, and San Francisco, respectively). It also sends a high percentage of its graduates to four-year colleges (36 percent in 2000, compared to 33 and 23 percent in New York and Miami, and 40 percent in San Francisco). Two of

Table A.18
Demographics for King County, Washington

Population, 2000	1,737,034
Median household income, 1997 estimate	$51,300
Educational Attainment, High School or higher, 1990	88.2%
Educational attainment, Bachelor of Science or higher, 1990	32.8%
Poverty rate, 1997 estimate	8.0%
Unemployment rate, 2000 annual	3.6%
Per capita personal income, 1999 estimate	$44,719
Homeownership rate, 2000	59.8%
Percent Ethnicity, 2000	
White	75.7%
African-American	5.4%
Hispanic	5.5%

Sources: U.S. Census Bureau, U.S. Department of Labor.

[1] In a local survey of 600 households, 50 to 60 percent had Internet access, but there were significant differences in terms of income, age, and ethnicity. The city's Department of Information Technology came up with a new survey that included a broader range of technology impact indicators, like the size of connection, computer literacy levels, etc.

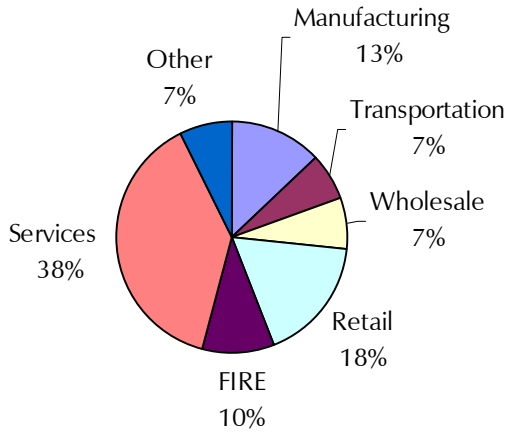
the city's 12 public high schools, serving the higher-income neighborhoods, had dropout rates of only 4.6 and 5.7 percent in 2000. At the same time, however, the high schools serving the city's poorest areas (West Seattle and Ranier Beach) had dropout rates of 32 and 29 percent.[2] Unemployment, poverty rates and the incidence of crime similarly vary among Seattle's census tracts.[3]

Of course, the digital divide is undesirable because it violates the long-held and widely accepted American principle of equal opportunity. But since Seattle has such a well-developed IT sector, there is a large demand for IT workers. It is difficult and costly to import workers from elsewhere for those jobs. If the digital divide can be crossed, more of the needed supply could come from within the region, which has profound implications for economic development.

2. *The Interventions*

Several initiatives underway in the Seattle metro area are intended to bridge the digital divide, by targeting "at-risk" teenagers, women and other citizens who are not in the economic mainstream. The intervention we selected for primary study was an entrepreneurial project focused on helping disadvantaged youths become both consumers and authors of technology. During the course of our visit, we learned about other initiatives in the region, including a technology alliance, a technology matching fund, and training programs.

Figure A.14
King County Business Mix, 1999 estimate



Source: Bureau of Economic Analysis; total full-time and part-time employment by industry.

Luversa Sullivan: transforming disadvantaged youths into technology authors

This case focuses as much on a person as it does an intervention. The subject is Luversa Sullivan, a grassroots, techno-activist who is responsible for several new organizations in the Seattle metro area. Ms. Sullivan received a degree in computer programming from UCLA in 1982, in the early years of the computer revolution. She was among a very small number of African-Americans and women to go into the field at that time. She moved to Seattle thereafter to work as a junior programmer in Honeywell's marine systems division.

Sullivan observed that women and minorities had access neither to the burgeoning ICT technology, nor to the training that would qualify them for jobs in the industry. She started the Women's Community Impact Consortium (WCIC) in 1993. Among other things, she contracted with the local YWCA to expose homeless women of all ages to computers and teach them basic skills that would prepare them better for the work force.

In the early 1990s, the University of Washington (UW), Apple Computers, Boeing, and Microsoft forged a partnership, with the intent to teach computer-related skills to a diverse group of people, including the Hispanic community on the east side of Seattle. Representatives from the extension program in UW's School of Education, on behalf of the consortium, asked Sullivan to develop a curriculum for technology and personnel development. Sullivan consented, with the stipulation that she also teach and get some salary support.

Sullivan observed that the UW-Apple-Boeing-Microsoft initiative still was not reaching the people most in need, but rather, mostly white males, who

[2] Data from Seattle Public Schools Web site, which provides access to each high school's annual report.

[3] Based on author's review of 1990 and preliminary 2000 census reports.

were motivated and had computers at home. She was particularly concerned about what educators referred to as "at-risk youths" — mostly high school-aged boys of color from low-income households, who were dropping out of school and/or joining gangs. She believed that those individuals were able to learn, indeed, may be very bright, but were discouraged about their future prospects and were not being instructed in ways that captured their interest. She bet that computer training would resonate well with them and make them better students and more productive citizens.

So, using her own resources, she opened a training center in her basement, called the Institute of Electronic Design. Initially, the institute had but one computer, and even in later years the computers were cobbled together with donated parts and volunteer labor. She developed an approach that recognized and built on the latent strengths of her target clientele — their leadership potential, as evidenced by their street activities, and their creativity, especially with video and music media. She developed a curriculum that stressed leadership, teamwork, media sensitivity, intellectual property rights and the development of programming skills to create multimedia CD-ROMs (games, advertising, and entertainment) — referred to as "technology authoring." She also arranged internships for her students with the well-known tech companies in the region. Ms. Sullivan coined two phrases that governed her work: "each one, teach one," and "lift as you climb." The first refers to the necessity to take each person on his/her own merits, and develop personal skills according to his/her interests and abilities. The second refers to the importance of teaching the students to become teachers themselves, not only to take responsibility for others who are "at risk," but also, to enable her to reach as many people as possible.

Recognizing the need to tap into more resources to expand the size of her program, Sullivan applied for 501(c)3 nonprofit status in 1994, which was awarded in 1995. That qualified her institute for United Way funds and contributions from donors whose gifts could be written off their taxes. Sullivan also solicited financial support from USWest, Microsoft and other private tech companies. And, former students started to give resources back to the institute.

A $135,000 grant from the United States Economic Development Administration in 1997 was critical for the success of Sullivan's enterprise. The grant paid her salary and expenses for a year, enabling her to quit her day job and devote all her energies to the institute. Her goals were to improve the curriculum and its documentation, so the model could be exported to high schools in King, Pierce, and Snohomish Counties (Seattle is in King County; the other two complete the metropolitan area.)

In 1997, Sullivan added to her repertoire what she called "IT All-Stars." She recruited professionals from the private sector and university to work with high school students and teachers to develop a technology product (such as interactive CD-ROMs, electronic devices, tutorials on watershed technology, and music CDs) for a regionwide, juried competition.[4] The in-school mentoring took place from November to March. Then, the products were judged at an event held at Microsoft's headquarters. The initial partners in the All-Stars project were Microsoft, United States EDA, UW, and her own WCIC. Later, the Northwest Center for Emerging Technologies (NWCET) was added.

The competition is now an annual event, with two boards of advisers: one board consists mainly of educators, while the other, the brain trust, includes Microsoft, Digital Harmony, Unisys and EMP (Experience Music Partners) as members. The superintendent of schools and the boards jointly approach the schools to participate in the program. In the first year, only the predominantly white schools applied, but by the second year, other schools also joined in and the mostly white schools dropped out.

Over the last decade, Luversa Sullivan has had remarkable success (see section 3 below), most of the

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[4] Sullivan developed judging criteria based on a survey of technology firms conducted by NWCET. Based on responses, significant weights were put on collaboration, creation, robustness, impact on communities, and team skills. The judges were from the private technology firms.

time operating with a shoestring budget. She has worn the hats of teacher, mentor, social worker, temporary parent and gateway to the future to low-income young children in west Seattle.

Developing family IT literacy and access

Private tech companies (notably AT&T, Microsoft, Cisco, and Gateway); the City of Seattle (including the public schools, public library, the housing authority, and the departments of information technology and parks and recreation); the Chinese information and service center; the WCIC; and a nonprofit organization, "Connect," jointly sponsor the Community Technology Alliance. That provides funding for Community Technology Centers (CTCs) around the city, in community centers, schools, housing projects and social service agencies,[5] to ensure sufficient capacity, quality and well-maintained equipment, ongoing technical support, and collaboration among the centers.[6] Among other things, the CTCs provide computers with Internet access to neighborhood households who cannot afford it themselves. Clients are trained to use the Internet to access information and resources, including distance education programs and employment services.[7]

Each of the alliance partners brings something different to the table. The corporate partners have contributed financial resources, technical infrastructure, and expert assistance. For example, the Gates Foundation's contributed $23 million to the school district for IT enhancements. "Connect" provides technology and budget/financial program development, and business operational support. WCIC provides training. The Alliance also has received funding (a $300,000 grant) from the United States Department of Education.

The city plays a particularly important role in this innovative alliance. The centers are located in city- or school district-owned facilities. The Seattle Public Library provides fiscal and administrative coordination for the alliance. It manages the grant funds and provides office space for the project coordinator. In addition, it also provides lab-based train-the-trainer workshops and Web access to a library of curriculum support materials.

Three main committees oversee the work of the alliance: a steering committee, technology committee and program committee. The steering committee ensures that the program and policy directions are followed and the programs are aligned with local community needs. The technology committee implements and oversees project activities focused on achieving lab capacity and technical support objectives; it has established baseline capacity standards in each of the CTCs. The program committee's role is to explore various programming partnerships to enhance the quality and diversity of program offerings at CTC. They have recently completed an inventory and assessment of current program offerings at the seven CTC sites.

Another crosscutting group is the Citizens' Telecommunications and Technology Advisory Board (CTTAB), made up of business and civic groups, neighborhood organizations, and citizens' groups. The CTTAB — which grew out of the cable board — works to achieve a technology-healthy community with the following attributes:

- Information technology is enhancing the local economy.
- Access to technological tools is equitable and affordable.
- Information technology needs are being met and applied to solving social issues.
- Technology is promoting relationship-building and community development.
- Use of technology supports the sustainability of quality of life.

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[5] The participating CTCs are South Park Community Center, Garfield Community Center, Yesler Terrace Community Center, New Holly neighborhood campus, the Chinese information and service center, and several schools.

[6] Performance report, 2000.

[7] City of Seattle press release, Sept 28, 2000.

The CTTAB established the Technology Matching Fund (TMF) in 1997 as a central component of the City of Seattle's citizen technology literacy and access program. The funds for TMF projects came from cable franchise revenues ($700,000, through the CTTAB), matched with $1.6 million worth of contributions from the community in the form of volunteer labor, donated materials, professional services, and cash.

The funded projects provide Seattle's citizens with access to computers and other information technology, increase information technology literacy, and encourage information technology applications that support neighborhood planning and action. The fund provides cash to Seattle organizations and neighborhood groups for citizen-driven technology literacy and access projects. The TMF is designed to build community capacity by encouraging creative uses of technology (City of Seattle, 2000). The projects include cross-neighborhood or citywide projects, public access projects, projects that provide or enhance services to limited English speakers and projects that increase marketing. There are small (less than $5,000) and large capacity (up to $50,000) projects. The average TMF grant is $30,000.

The city itself has sponsored programs to increase computer literacy. It negotiated with AT&T, for example, to donate 500 cable modems to enable the city to provide more public access terminals, and with Gateway to donate standard platforms. And, several public agencies, the Seattle School District and UW have formed a consortium to install fiber optic cable in an effort to increase aggregate demand. The city also has been behind the development of an "experience museum" where kids and young adults can get hands-on experience with IT and high-tech equipment. Finally, the "citizen's literacy and access fund" runs a number of technology literacy and access projects, including neighborhood technology forums; a seniors' access; a training project called "Access for All;" an information-age education campaign; an information technology impact indicator project; and a "connected neighborhood" pilot project.

Now there are 110 public access points in Seattle, located in variety of facilities, such as libraries, nonprofits, city facilities, and public housing projects. But these technical centers vary in terms of infrastructure. The city is grappling with how to create sustainable assets and how to integrate service delivery and access to technology.

Developing skill standards for the IT work force

Seattle and other markets with a high concentration of IT companies have a constant shortage of skilled IT workers. The University of Washington trains hundreds of software developers and programmers each year, but cannot fill the gap of trained workers alone. The 32 community and technical colleges in Washington state have stepped up their training efforts. A National Science Foundation (NSF) grant established the NW Center for Emerging Technologies (NCWET) within the Bellevue Community College to help develop a larger IT work force for Seattle. (The NWCET is one of 12 NSF-funded centers around the U.S.[8]) The grant was for six years, ending in 2001.

NWCET develops skill standards and helps design new curricula and professional certification programs. NWCET also encourages more diverse participation in the IT work force, by providing financial support and mentors to WCIC. And, NWCET works to make children more aware of the information technology revolution, in part through a Web site called www.cybercareers.org.

The Web site is a joint activity between the NWCET and Trish Millanes Dziko, who was previously the diversity consultant at Microsoft, and co-founder of the Technology Access Foundation. That foundation runs a rigorous after-school program to teach young individuals how to be technology employees. It is affiliated with community organizations of color but concentrates only on African-American youths.

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[8] Though all the centers share a concentration in technology, each center is a separate entity with a well-defined specialization. For example, the center where we conducted the interview is well known for high-tech IT programming and Web page design.

3. Impacts of the Intervention

Between its inception in 1993 and 2000, the Women's Community Impact Consortium (WCIC) placed about 500 students in various multi-media technology firms in and around Seattle. Luversa Sullivan says it has been a tough journey, but the successes of such former students as Mario Mason, Stephanie Wong, and Josh Stores gives her a sense of accomplishment.

Mario Mason was a young gang member when Sullivan first met him. She realized that Mario was unusually talented and had a high capacity for learning. She involved him in her institute; training him in technology authoring and giving him access to the network she developed. Today, he is a Microsoft-certified systems engineer.

Sullivan's impact has been felt not only among her students in WCIC and her institute, but also across the Seattle metropolitan area. WCIC started out with women but today reaches many diverse groups of people. Ms. Sullivan says that diversity gives her credibility. She continues to expand her activities. For example, she now organizes a cyber camp for young and old students. She contracts with Seattle Central Community College to develop new programs for technology and education. Sullivan also works with Evergreen State College, which helps people who would not be accepted in a traditional university/college. Sullivan's reach extends beyond the borders of the United States: she has traveled to Ghana and South Africa to develop peer education programs.

Some barriers still remain. Sullivan recognizes the need to get even more corporate buy-in for her efforts, and she understands that her organization is not sufficiently institutionalized; it is very much a one-woman show. She is working now with three partners to further consolidate her program. Territorial Resources is paying for a grant-writer. A non-profit assistance center is contracting with consultants to do the financial planning, while 'Stone Soup' is paying to write a strategic business plan.

The efforts of the school system and city to increase computer literacy also have met with some success. The school system developed a district-wide strategic plan and has received funds from the Gates Foundation to implement it. The schools have made great strides in curriculum building; though there are problems in paying teachers to keep facilities open after-hours. A city-sponsored computer give-away program to fund additional training programs in West Seattle has helped about 1,000 individuals so far but wants to do considerably more.

In general, City officials working on addressing the digital divide say they are severely understaffed, and they would like three to four additional people to help with technical and financial planning, marketing the alliance and for business development.

4. Testing Hypotheses

1. *Enabling infrastructure is necessary, but not sufficient, to assure the effectiveness of technology infrastructure investment.*

True. Seattle is one of the best-wired cities in the United States so all of the IT infrastructure was pretty much already in place. What was key to getting the WCIC participants to their training and work was the Seattle public transit system. Most of the WCIC participants are low-income and do not have private transportation.

Seattle has a good airport, adequate water, wastewater treatment and electricity. It is among the "more developed" of the cities in our sample.

2. *Investments in technology infrastructure must be part of a larger local planning process to succeed.*

This is **true** to an extent. On the one hand there is a high-level Director of IT position within the city government, filled by David Keys, that works tirelessly to be a facilitator of all that goes on in the IT sector in Seattle. Keys is the one central contact person to whom anyone seeking information about IT can go. The office has been involved with promoting IT literacy in the school system.

On the other hand, there have been several different IT initiatives undertaken and sponsored by different groups in Seattle within the last couple of years

and there has been little active coordination among these groups. Even though they are all working toward the same general goal, it has been serendipitous that none of them have really crossed paths and duplicated efforts unnecessarily. By happenstance and informal networks they have achieved a well-balanced plan of attack.

3. *A certain density or critical mass is required for information and communication technology to work, because of the high cost of provision.*

True. Because Seattle is one of the largest centers of IT and high-tech business in the United States, density has never really been an issue in Seattle. There is no shortage of infrastructure, high-end talent or mentors for IT education programs.

4. *Technological innovations and advances are reducing the costs of communications and linkages.*

Not applicable to this case.

5. *Institutional mechanisms must be in place to help users deploy the hard infrastructure appropriately.*

True. The WCIC is a great example of an organization that took full advantage of the institutional mechanisms surrounding it to achieve its goals. It was able to tap into local elementary schools, high schools, community colleges, universities, private corporations and even federal agencies such as the Economic Development Administration to implement its programs. Even though Ms. Sullivan started out with very limited means, she had the drive and know-how to leverage her ideas into formal agreements with local institutions.

The school district and community college system also have played a pivotal role in delivering IT literacy programs.

6. *Some hierarchical coordination or linkages among national, state and local governments are important for a community to be truly "connected."*

True. In the WCIC example, Ms. Sullivan played the role of coordinator extremely well. She worked with various levels of government from local all the way to federal and also coordinated efforts from various educational institutions that normally do not communicate, such as the K–12 system and community colleges and universities. A relatively seamless environment and cooperative situation exists between the city and county government in Seattle. The reason for this is that neither one focuses on business attraction, which by its very nature causes competition. Both governments realized that the enhancement of local businesses and workers needed to be addressed and that workers cross political boundaries all the time so the governments better be in this together.

7. *Linkages among government, education, and industry are a critical success factor for ICT interventions. State policies and corporate actions are important determinants of local "success."*

True. This case study is replete with examples of how the University of Washington, Bellevue Community College, Seattle Public Schools, the City of Seattle and Kings County, and private companies all have played critical roles contributing to overall success, and most important, working together to achieve desired ends.

The state of Washington seems to be playing a less prominent role. Certainly it provides funds to the university and community colleges. But most of the initiative has come from the city and the grass roots.

8. *Infrastructure providers must be a partner in assessment and planning, not just the spending, for the intervention to succeed.*

True. Corporate donors of infrastructure have been very involved with the planning of their donations. For example, when Microsoft donated computers to the school district, it also was involved in the curriculum decisions on how to best utilize the equipment. Similarly, Intel funded an IT clubhouse for kids,

and also got involved in the programming. And private donors and mentors played a prominent role in Sullivan's IT All-Stars.

9. Work force development is a critical complement to any infrastructure intervention.

True. The biggest reason corporations, as well as local government, have bought into ICT interventions in Seattle is the realization that there is a very acute shortage of entry-level IT workers in the area. Currently there are efforts being made as early as the primary school level all the way through post-secondary education institutions to increase the "IT literacy" of Seattle. Microsoft and the Gates Foundation are providing computers and mentors in grade schools, high schools and community colleges to increase IT literacy. The city puts $3 million a year into the local Vo-tech institutions to help train low-income, 21–45 year olds who have low education levels. Microsoft puts 70 volunteers into this effort as well.

Traditionally, the community colleges in Seattle had been oriented toward preparing students for further baccalaureate study at one of the many local four-year institutions. However, with the realization that there was an acute shortage of entry level IT workers in Seattle, the city had to get involved with the community colleges to re-tool them for training purposes and not just baccalaureate preparation.

10. Because of the long-term and expensive nature of ICT, vision and leadership are critical success factors.

True. Ms. Sullivan is a classic model of a grassroots visionary and activist that recognized a gap in an industry (entry level IT workers) and had a vision of how to fill that gap. She was the catalyst that got other efforts off the ground. She showed corporations that it is possible to successfully train underprivileged kids from the inner city and make them reliable and valuable employees. Also, the elected leadership in the city and county governments understood the importance of IT and was willing to provide financial support for ICT interventions.

5. Contacts and Sources

Daria B. Cal, Project Coordinator
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APPENDIX B

Measures of Technology Infrastructure and Community Distress

At the outset of the study, the researchers reviewed available measures of both technology infrastructure and community distress, and then shared these inventories with an expert panel before selecting sites and developing case study protocols. The initial inventory of ways to measure technology infrastructure is shown in Table B-1, and the one for community distress is shown in Table B-2. The expert panel, assembled for a meeting with OED and EDA staff in Washington DC in December 1999, included the following people:

Name	Affiliation
Bob Askew	Norfolk State University
Rich Bendis	Kansas Technology Enterprise Corporation
Herb Crenshaw	BellSouth
John Cyr	North Central Kansas Regional Planning
Gerry Depo	Town Manager of Bloomsburg, PA
Ronald C. Kysiak	Evanston Inventure
Dr. J. Gilbert Leal	Texas State Technical College
Jane Patterson	North Carolina Board of Science and Technology
Linda Riley	New Mexico State Dept. of Industrial Engineering
Robert Skinner	Transportation Research Board
Ken Thornton	IBM Worldwide Government Industries

Table B.1: Inventory of Measures of the Presence of Technology Infrastructure

Category	Construct	Measures	Source
HARDWARE	***Computer usage***	Spending on office computing technology, electronic components, computing equipment, communications services and data processing. Raw figures and relative to industry sales. Similar data for federal expenditures.	Congressional Budget Office, "Current Investments in Innovations in the Information Technology Sector: Statistical Background," April 1999
		Number of sites using large scale computing and computing capacity within a region.	Greenstein, Shane, Mercedes Lizardo, and Pablo Spiller, "The Evolution of Advanced Large Scale Infrastructure in the United States," NBER working paper 5929, Feb. 1997
		Percentage of households with computers.	U.S. Department of Commerce, *Falling Through the Net: A Survey of the Have and Have-Nots* , July 1995; and *Defining the Digital Divide* , July 1999.
		Recent report has responses from 501 counties on the amount of technology usage within county government.	National Association of Counties, "Technology in America's Counties"
		Access to telemedicine in Montana.	Capalbo, Susan and Christine Hegem, *Rural Development Perspectives* , vol. 14, no. 3
		Amount of computerization in production technologies (based on ERS Rural Manufacturing Survey)	Gale, Frederick, "Is There A Rural-Urban Technology Gap," USDA Ag. Info Bulletin 736-01
	Telecommu-nications usage	Access to telecommunications in Wyoming and Colorado. Telecommunications network characteristics, long-distance service, amount of wireless, internet service, cable TV, government networks to public schools.	McMahon, Kathleen and Priscilla Salant, "Strategic Planning for Telecommuni-cations in Rural Communities," *Rural Development Perspectives* , vol 14. no. 3
		Percentage of households with modem, telephone.	U.S. Department of Commerce, *Falling Through the Net: A Survey of the Have and Have-Nots* , July 1995; and *Defining the Digital Divide* , July 1999.
		Amount of telecommunications in office (based on ERS Rural Manufacturing Survey).	Gale, Frederick, "Is There a Rural-Urban Technology Gap," USDA Ag. Info Bulletin 736-01
		The Information Sector (sector 51) of the 1997 Economic Census comprises establishments engaged in the following processes: a) producing and distributing information and cultural products; and b) providing the means to transmit or distribute these products.	Census of Information, released October 1999

Category	Construct	Measures	Source
HARDWARE (continued)	***Availability of local exchange networks***	Access to telecommunications in Wyoming and Colorado. Local exchange carriers, telecommunications network characteristics.	McMahon, Kathleen and Priscilla Salant, "Strategic Planning for Telecommunications in Rural Communities," *Rural Development Perspectives* , vol 14. no. 3
		Investments in fiber optic cable.	Greenstein, Shane and Pablo Spiller, "Estimating Welfare Effects of Digital Infrastructure," NBER working paper 5770, Sep. 1996
		Miles of fiber optic cable used by the local exchange carrier within a region.	Greenstein, Shane, Mercedes Lizardo, and Pablo Spiller, "The Evolution of Advanced Large Scale Infrastructure in the United States," NBER working paper 5929, Feb. 1997
	Internet connectivity	Access to telecommunications in Wyoming and Colorado. Includes internet service.	McMahon, Kathleen and Priscilla Salant, "Strategic Planning for Telecommunications in Rural Communities," *Rural Development Perspectives* , vol 14. no. 3
		Scorecard for each state that includes classrooms with internet, teachers with email, adults on internet, number of dot-coms.	Progressive Policy Institute, *The State New Economy Index*
	Cable connectivity	Access to telecommunications in Wyoming and Colorado. Includes cable TV.	McMahon, Kathleen and Priscilla Salant, "Strategic Planning for Telecommunications in Rural Communities," *Rural Development Perspectives* , vol 14. no. 3
	Use of satellite and microwave technology	Availability and/or use.	?
KNOWLEDGE INTENSIVE INSTITUTIONS AND ORGANIZATIONS	***Presence of knowledge institutions***	Colleges, universities and research centers	Various
	Presence of knowledge-related businesses	High tech industries are defined as industries that spend an above-average amount of money on R&D and employ an above-average number of high tech professionals.	Milken Institute, *America's high-tech* . www.milken-inst.org
		High tech industries are defined as those in the top third of R&D to sales ratios.	USDOC, Office of Technology Policy, Carl Shepherd.
		County-level data on the number of high-tech establishments.	Goetz, Stephan J. "County- Level Determinants of High-Technology Firm Locations: 1988-94," TVA Rural Studies working paper
	Presence of information-intensive industries	The Information Sector (sector 51) of the 1997 Economic Census comprises establishments engaged in the following processes: a) producing and distributing information and cultural products; and b) providing the means to transmit or distribute these products.	Census of Information, released October 1999

Table B.1: Inventory of Measures of the Presence of Technology Infrastructure, *continued*

Category	Construct	Measures	Source
KNOWLEDGE RELATED ACTIVITIES	***Amount of R&D***	Percent of GDP in R&D, technology balance of payments.	OECD, several papers
		Technology development program for the state of Kansas.	Kansas Technology Enterprise Corporation(KTEC)
		Percentage of employees within firm that are engaged in R&D.	Bureau of Labor Statistics
		High tech industries are defined as industries in the top third of R&D to sales ratios.	USDOC, Office of Technology Policy, Carl Shepherd.
		Scorecard for each state that includes R&D.	Progressive Policy Institute, *The State New Economy Index*
	Number of start-ups	Technology development program for the state of Kansas.	Kansas Technology Enterprise Corporation (KTEC)
	Number of patents	Scorecard for each state that includes patents.	Progressive Policy Institute, *The State New Economy Index*
		Number of patents.	OECD, several papers
	Amount of venture capital	Scorecard for each state that includes dynamism (IPOs, Churn, Gazelles), venture capital.	Progressive Policy Institute, *The State New Economy Index*
AVAILABILITY OF KNOWLEDGE WORKERS	***High-tech workers***	High tech industries are defined as industries that spend an above average amount of money on R&D and employ an above average number of high tech professionals.	Milken Institute, *America's high-tech* . www.milken-inst.org
		Enabling technologies — amount of training, organizational structure (macro level)	Werner Clement, Gerhard Hammerer and Karl Schwarz, "Measuring Intangible Investment," OECD 1998.
		Scorecard for each state that includes knowledge jobs (office jobs, professional jobs, education level), innovation infrastructure (high-tech workers, scientists, and engineers).	Progressive Policy Institute, *The State New Economy Index*
		Presence of scientists and engineers.	Various
		Availability of science and technology education.	Various
		Amount of human resource expenditures in science and technology (macro level).	OECD, several papers

After we reviewed this initial matrix with the expert panel, they suggested that the following measures also be considered:

- Report cards for the states and/or state innovation indices
- Value added agriculture
- Institutions to support investment in science and technology
- The level of e-commerce among non-IT businesses
- Production technology use that helps drive IT and R&D
- The penetration of technology; i.e., the number of switching stations that have DSL or ADSL
- The amount of broadband network (not necessarily fiber)
- Technology centers that foster entrepreneurial growth - real and virtual
- Incubators and appropriate physical resources
- Workforce development/education
- The existence of a local technology plan
- Intellectual property
- Community knowledge base/ affiliation with knowledge institutions
- Penetration and availability of technology in schools, at all levels

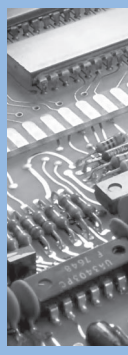
Table B.2
Definitions of Community Distress

Category	Measure	Source
Low income/ earnings	Per capita income below 80 percent of the national average	Economic Development Administration
	A non-metro county qualified as displaying signs of economic distress when it had at least 2 of the following 5 characteristics:· • *lowest 20 percent of all counties by 1990 per capita income*· • *lowest 20 percent of all counties by 1990 earnings per wage and salary job* · • highest 20 percent of all counties by 1991 unemployment rate· • *highest 20 percent of all counties by 1989 poverty rate*· • experienced both net out migration and more births than deaths during 1986-1988	Ghelfi, Linda, April 1993. Ag. Info. Bulletin, "Rural Economic Disadvantage."
	In bottom 20% of per capita income in 1960, 1970, 1980, and 1990	U.S. Department of Agriculture (USDA) definitions and data sources
	Distressed communities are defined as: (1) any city in a metropolitan area which has a median household income of under 70% of the median income for the entire metropolitan area; (2) any census block group in a metropolitan area or contiguous block groups with a population of at least 2,500 which has a median household income of under 70% of the median income for the entire metropolitan area; (3) any city not located in a metropolitan area which has a median household income of under 70% of the median income for the entire non-metropolitan area of the state; or (4) any census block group or contiguous block groups with a population of at least 2,500 not located in a metropolitan area which has a median household income of under 70% of the median income for the entire non-metropolitan area of the state	Missouri (HB 1656)
High unemployment	Unemployment rate one or more percentage points higher than the national average	Economic Development Administration
	A non-metro county qualified as displaying signs of economic distress when it had at least 2 of the following 5 characteristics:· • lowest 20 percent of all counties by 1990 per capita income· • lowest 20 percent of all counties by 1990 earnings per wage and salary job· • *highest 20 percent of all counties by 1991 unemployment rate* · • highest 20 percent of all counties by 1989 poverty rate· • experienced both net out migration and more births than deaths during 1986-1988	Ghelfi, Linda, April 1993. Ag. Info. Bulletin, "Rural Economic Disadvantage."
	Empowerment zones designate areas of pervasive poverty, *unemployment* , and general distress	Enterprise communities and empowerment zones HUD/USDA, neighborhood networks
	Distressed community — concentrated *joblessness* and poverty, along with the lack of hope that accompany those symptoms of distress.	HUD, "UDAG eligible jurisdiction"
Population loss	Product of the rate of population change and the out-migration rate, calculated for labor market areas.	Edward J. Feser and Stuart H. Sweeney, "Out-migration, Population Decline, and Regional Economic Distress," EDA project #99-07-13792, January 1999.
	A non-metro county qualified as displaying signs of economic distress when it had at least 2 of the following 5 characteristics:· • lowest 20 percent of all counties by 1990 per capita income· • lowest 20 percent of all counties by 1990 earnings per wage and salary job· • highest 20 percent of all counties by 1991 unemployment rate· • highest 20 percent of all counties by 1989 poverty rate· • *experienced both net out migration and more births than deaths during 1986-1988*	Ghelfi, Linda, April 1993. Ag. Info. Bulletin, "Rural Economic Disadvantage."

Category	Measure	Source
Structural decline	Persistent poverty — in bottom 20% of per capital income in 1960, 1970, 1980, and 1990.	USDA definitions and data sources
Welfare dependence	Transfer dependent — income transfers from federal government accounted for 25% of total income from 1987-1989	USDA definitions and data sources
Pockets of poverty and/or income disparities	Empowerment zones designate areas of *pervasive poverty* , unemployment, and general distress	Enterprise communities and empowerment zones HUD/USDA, neighborhood networks
	Pockets of poverty — areas with concentrated joblessness and poverty, along with the lack of hope that accompanies those symptoms of distress. Gini indices of wealth or income distribution	HUD, "UDAG eligible jurisdiction" Various
Health	Infant mortality, morbidity, days lost to illness, etc.	Various
Poor institutional capacity	Ability of local institutions to access federal, state and foundation grants and /or private capital for infrastructure investments	Various

The expert panel's suggested additions to these measures of distress included:

- Low educational attainment (and relation to income)
- Poor workforce readiness
- Inadequate amenities
- Weak leadership/leadership capacity



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