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BEYOND THE DIGITAL DIVIDE:

Broadband Internet Use and Rural Development in Pennsylvania

Final Report to the Center for Rural Pennsylvania

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I. Introduction: Moving Beyond the Digital Divide

The concept of a digital divide gained prominence in the 1990s, with the development and dramatic expansion of the Internet. The basic notion reflected the widespread inequality in access to this new technology that was clearly evident. Historically disadvantaged sectors of our society, including people of color, women, those with less education and income, and those living in rural areas, were slower to gain access to the Internet and used it at lower rates than the overall population. As social and economic opportunity in our society is increasingly linked with Internet access, this digital divide is being viewed as a major barrier—another factor reinforcing widespread inequality and poverty. What happens to those without access to the Internet, for instance, when a company only accepts applications online, or a government office shuts down and is replaced by a public website?

Initially, confronting the digital divide was seen simply as a question of having or not having access to the Internet. If the digitally disenfranchised could simply gain access— through public libraries and schools, if not their own homes or through work—the substantial benefits of the Internet would be open to them. Increasingly, however, many analysts have realized that the Internet's potential in promoting social and economic development requires more than access to the technology. Instead, at least two other dimensions of this digital divide are critical. The first dimension is obviously the issue of having the skills required to

actually use the technology—call it technology literacy—including the ability to use information technologies for a range of purposes and the knowledge of how and why information technologies can be used as a key resource. Second, and perhaps more important than access and skills, is the need for appropriate content—content that meets the needs of disenfranchised groups and that is created by those groups (see Servon, 2002).

Understanding the issues of technological literacy and appropriate content, however, is only the first step in moving beyond a simple understanding of a digital divide. The ability to rapidly access information, and to have the right information available, is only one of the aspects of the Internet. The development and widespread diffusion of the Internet has far more profound implications than simply getting better access to information. The Internet, and particularly the development of a broadband Internet, makes possible a whole range of processes and possibilities that could not have been envisioned before.

Harnessing the power of the Internet is an important issue for rural Pennsylvania. The limited availability of advanced telecommunications services has long been a concern of residents, businesses, and institutions in rural areas. Policymakers with rural constituencies have historically shared similar concerns. Over the past several years, trends indicate that telecommunications providers in rural areas are increasingly offering advanced telecommunication services—including broadband Internet services—to their rural customers. While access to technology is still far from universal in rural Pennsylvania, it has become widespread enough for academic researchers and policymakers to move beyond simply arguing that lack of access to the technology is obstructing social and economic development in rural areas. We must now begin asking a new set of questions aimed at understanding the broader implications of the Internet for rural Pennsylvania. How are

people in rural parts of the Commonwealth using broadband access to the Internet? How

does this use differ in different sectors of society, and among different population groups?

How is the use of broadband access shaping opportunities for social and economic

development in rural Pennsylvania? In what ways might state policy and practice help to

improve the use of broadband Internet use?

This report is an attempt to begin to answer these questions. At the core of the

analysis is a distinction between *transactional use* and *transformational use* of the Internet.

For example, when the *Encyclopedia Britannica* is made available on-line, its availability is

more efficient, to a wider audience at a much lower price. This use of the Internet certainly

makes the information in the *Encyclopedia Britannica* more accessible to a wider-range of

people than before—a positive impact of the Internet. But this is a *transactional use* since it

does not fundamentally change the processes involved in producing the encyclopedia. The

editors and authors of the *Encyclopedia Britannica* are the experts and produce the

information, while those who are interested purchase it. But consider, in contrast, what

happened when the on-line free encyclopedia originally known as *nupedia* began to harness

the power of collaborative software that allows any visitor to the website to add, remove, and

otherwise edit and change available content; *wikipedia* was born, with the power to harness

the collective knowledge of literally millions of on-line users. This is clearly a

transformative use of the Internet—it has entirely transformed the process of how

information is produced and who is considered an expert in producing that information.

In this report, the transactional and transformational use of broadband Internet access

is examined in four different sectors important to rural Pennsylvania society: healthcare,

education, government, and small business. In each sector, current types of practices are

examined, as well as activities that may be considered transactional or transformative uses of the technology. While the practices differ across the four sectors, in essence transformational uses are present when the Internet allows users to harness the power of *network* relations, rather than extant hierarchical structures, and when the producers of products and services are using the Internet to actively engage with the final consumers and to allow consumers to customize information production and consumption to meet their own particular needs.

In general, transformational use of broadband Internet access in rural Pennsylvania is hampered by a wide-range of factors. High costs of bandwidth, restrictive policies, lack of education and exposure to technological capabilities, hierarchical power relations with a few dominant actors in each sector and/or lack of coordination among critical actors within the sector, are all factors that limit the use of broadband to more traditional, transactional uses. Nonetheless, in each sector, exciting instances of transformational use point to significant future possibilities. Here, factors that helped enable the transformative use of broadband include human capital, the availability of complementary technologies, participation in vibrant, decentralized social and economic networks, and proximity to others areas with more advanced use of broadband. This suggests that state policy is best developed in a collaborative fashion that involves stakeholders throughout these vibrant networks, and focuses on the diffusion of transformative practice through these networks.

This report is structured in a straightforward fashion. In the next section, basic information on broadband Internet is reviewed, and a description of broadband access and current information about levels of access to broadband in the rural U.S. and in Pennsylvania is provided. Section III is devoted to explaining the methodology followed in gathering information on broadband Internet use, and includes an assessment of best practice around

the country and in the four specific sectors examined in some depth in Pennsylvania: healthcare, government, education, and small business. Section IV provides a review of global best practices in the use of broadband in these four sectors. In Section V, each of these sectors is examined in turn. The final section contains a summary of results across all sectors and provides comment on implications for policy that might help promote more transformational use of broadband Internet.

II. Background: Broadband and Access in Rural Pennsylvania

The concern about the availability of broadband has largely focused on the residential user. There has been substantially less assessment of the availability of broadband services for government, education, healthcare, and business users. In fact, at a recent workshop organized by The Pew Charitable Trusts' Internet and American Life Project (June 27 2006, Washington, D.C.), where the leading service providers, researchers, and market research firms were present, the only identifiable comprehensive study of broadband utilization by mentioned by a workshop member was done in 2000. All participants concluded that this was significantly out of date and lacked applicability to today's situation.

The lack of research on the demand for telecommunications is well known. Many researchers and policymakers comment that if the supply of broadband is evident, what are the rates of utilization of different sectors? Can we conclude that the availability of supply is a sufficient indicator of diffusion? In light of this gap in the literature and research, a study was undertaken of broadband utilization in the healthcare, education, local government, and small business sectors of tourism and manufacturing, to determine characteristics of and barriers to utilization, and to confirm the availability of broadband services in rural parts of the Commonwealth.

What is Broadband Anyway?

Broadband refers to a set of telecommunications capabilities that can support a wide range of frequencies, including video and audio. It can carry multiple signals by dividing the total capacity of the medium into multiple, independent bandwidth channels, where each channel operates only on a specific range of frequencies. It reflects a high-capacity, two-way link between an end user and access network suppliers capable of supporting full-motion, interactive video applications. Often erroneously referred to as a measure of speed of signal, it instead reflects multiple channels of data over a single communications medium. Characteristics of broadband include significantly higher bandwidth capacity than dial-up service, the reliance on some form of packet switching, and supporting "always on" functionality. Several national and international organizations describe bandwidth capacity as reflecting transmission speed of between of 1.5 to 2 Mbps. The National Research Council offers a two-part approach to defining broadband as transmission capacity in the local access link that is sufficient to enable unconstrained usage and not constrain a user's ability to run advanced applications. Moreover, broadband should provide sufficient performance and wide penetration of services to encourage the development of new services and applications (NRC, 2002, as cited in Bauer et al., 2002).

The State of Broadband Availability and Utilization in the U.S. and in Rural Pennsylvania

In this section two recent studies are reviewed that offer up-to-date perspectives on broadband availability nationally across urban and rural areas of the country. A third research project focusing on Pennsylvania provides an intimate understanding of the broad outlines of broadband access and utilization in rural parts of the state. A review of these

studies serves as a backdrop for this project's subsequent assessment of broadband use in non-residential sectors of the state.

The two recent studies, both completed in the spring of 2006, were done by John Horrigan for the Pew Internet and American Life Project, and by the Government Accountability Office for the U.S. government. The two present different, though compatible, perspectives on the availability of broadband services in the U.S. Using different methodologies, both the Pew and the GAO studies conclude that broadband services are increasing in availability in the U.S. They both note differences in utilization rates by age, income, education, and locality. The two studies, though similar, reflect subtle differences in the distribution and utilization of broadband services. The GAO focuses on what Federal Communications Commission data reveal in terms of service coverage. The Pew study emphasizes public uptake of broadband technology and changes in the type of serviced utilized. A quick summary of both is in order as contextual background for this study.

The Pew Foundation Study

The May 2006 Pew Foundation survey study conducted by Princeton Survey Research Associates, a survey research consulting firm, used survey methodology to investigate growth of broadband adoption in the home between 2005 and 2006. This is a reoccurring study started in the early 2000s.

The Pew report was based on the results of two daily tracking surveys on Americans' use of the Internet. Both random digit dial phone surveys were completed by Princeton Survey Research Associates International between November 29 and December 31, 2005, among a sample of 3,011 adults aged 18 and older. The first study examined attitudes toward the Internet. The second survey occurred between February 15 and April 6, 2006, among a

sample of 4,001 adults aged 18 and older. The second survey collected material on broadband adoption. Part of the second survey captured information on demographic groups. A total of 2,822 adults were surveyed with a margin of sampling error of plus or minus 2.0 percentage points. The response rate for the Internet user survey for the February to April panel was 29.8%.

The study highlights the following results:

Evidence of Broadband Coverage and Demographics of Service Users

- Between 2005 and 2006, there was a 40% increase in the number of people with high-speed connections at home. During that period, 84 million adults had high speed Internet connections in the home.

- The rate of increase in adoption doubled from 2004.

- Adoption is reaching down into middle-income households, people of color, persons without a high school education, and seniors. All showed a brisk increase, though from a small base.

- Rural areas also saw a significant increase in the growth of adoption, but the rate of increase lagged behind the national average. Moreover, rural areas have the highest incidence of single provider service, with 35% of rural respondents versus 24% of urban respondents indicating that they had only one available local high-speed provider.

Of particular importance, the percentage of households with broadband service differs significantly between urban and rural areas. Broadband penetration in urban areas is almost

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twice that of rural areas. Suburban areas show even higher rates of penetration compared with urban and rural areas.

Service Type

Departing from past experience, growth in broadband adoption has seen a shift in product penetration between DSL and cable modem. According to the Pew survey, 50% of respondents log on at home using DSL, compared with 41% who use cable modems (Horrigan, 2006). Wireless connections also are growing, but from a very small base. Little penetration of satellite service is evident.

Cost

According to the Pew study, the cost of service has converged between DSL and cable modem. DSL is now less expensive than cable service, contributing to growth in service utilization. The cost of service has declined by 8% since 2004 (Horrigan, 2006). Cost of service is lower in locations where more than one service supplier is available. Price competition between cable and DSL is evident in places where there are multiple providers and is leading to a decrease in overall service cost in these locations. In contrast, the lack of competition is most evident in rural areas, where according to the Pew study 35% of rural households surveyed indicated that only a single service was available to them. In terms of utilization, growth in DSL service use is occurring in the middle- and lower middle-income range of the market.

Reasons for Upgrading to Broadband Services

The majority of respondents indicated that gravitation to broadband services was tied to the benefit of greater bandwidth and therefore more effective information retrieval

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capacity as measured by rate of retrieval. The Pew survey also noted that upgrades were linked to the cost of service.

An interesting development is the evolution in the type of use of broadband. There is growing evidence that users are posting information on the Internet rather than simply using it for data and information retrieval or consumer purchases.

GAO and Broadband Service Availability

In 2005, the Government Accountability Office completed a study of household broadband service utilization and the availability of cable services to those households, in a multi-stage analysis. First, the GAO analyzed the resulting data from a household survey of 3,127 randomly sampled households, about the purchasing behavior of Internet services by households and the availability of cable services to those households. Using data from 1,500 households who responded to the Knowledge Networks/SRI's *The Home Technology Monitor*: *Spring 2005 Ownership and Trend Report,* the GAO estimated factors affecting broadband deployment and factors affecting households' adoption of broadband services. These data were combined with FCC Form 477 data, which tracks broadband service deployment at the zip code level (note the definition of the FCC zip code reflects a modified post office-designated code; see the GAO report for details). The two information sources were combined to develop information about the broadband service options available to a particular household. Using this approach, the GAO estimated that 99% of the country's population lives in 95% of the zip codes that register at least one broadband provider in the area.

Using the survey data, the GAO concluded that approximately 30 million customers or 28% of U.S. households subscribed to broadband service. However, according to the

GAO, this estimation procedure is insufficient to determine whether there are gaps in the availability of broadband in local markets. With this proviso and the noted limitations of this estimate, GAO concluded that broadband utilization, while growing, is still a fraction of the total user population. A significant proportion of the user public still uses dial-up—30% of surveyed households utilized dial-up services, while another 41% did not access the Internet from their home. Similar to the Pew study, the GAO also concluded that Internet users employing broadband were divided almost equally among type of service purchased, DSL, and cable modem services.

Using the FCC data, the GAO concluded that gaps remain in the availability of cost-competitive broadband services in parts of the country. In 83% of the zip codes utilized in conjunction with the FCC 477 data, subscribers indicated service availability by more than one broadband provider; in 40% of the zip codes, subscribers were served by more than five providers of broadband services. Of considerable importance, the GAO noted that FCC data do not represent data about where subscribers are served and where providers have deployed broadband infrastructure. Instead, the FCC data indicated solely that within specific spatial units—FCC modified zip codes, there appears to be at least one service provider. The missing link is the last mile considerations and the fact that zip codes are of varying sizes and population densities, thus diluting the ability to conclude that the presence of one service provider indicates everyone in the zip code has access to service. According to the GAO report, the FCC data does not necessarily provide a highly accurate depiction of broadband deployment in some areas including rural areas.

Local Development District Survey of Broadband Availability in Pennsylvania

The most detailed source of information on broadband availability in the Commonwealth of Pennsylvania is present in a June 2006 draft study for the Local Development Districts (LDDs) of the Appalachian Regional Commission, which together with the Pennsylvania Department of Community and Economic Development sought to determine the existing availability of broadband services in the state and to create scenarios to expand access to broadband (Baker, 2006). Five LDDs (Southwestern Pennsylvania Commission; Southern Alleghenies Planning and Development Commission; SEDA-Council of Governments; Northeastern Pennsylvania Alliance Region; Northern Tier Regional Planning Development Commission) generated comparable survey data of service availability. Two other LDDs, while participating in the study, had an insufficient response rate to be included in the study results. The study areas covered 94% of the geographic areas of the state and 64% of the population.

The study combined a range of information from service providers, users, and other knowledgeable persons to determine the distribution and availability of broadband in rural parts of Pennsylvania. The LDD study emphasized the availability of broadband for economic development purposes. The results provide an important window onto the availability of broadband in rural parts of the state.

The research project had as an objective the identification of broadband services in rural and more underserved parts of the state. A total of 10,000 surveys were distributed; 9,000 residential and 1,000 business properties were surveyed. A 12% response rate was achieved; 5,396 residential and 564 businesses responded to the survey. While this response rate is low by social science standards, taken together the results of the household/residential

component of the survey yield important and reliable information. The much lower response rate of the business respondents indicates the results can be used to build educated guesses about issues relevant to businesses in rural parts of the state, but the results cannot be used in statistical generalization.

Survey Highlights

Residential respondents. Residential survey respondents indicated 85% owned computers and the majority accessed the Internet from their home, work, or another location. Only 18% indicated that they did not use the Internet. The majority of residential respondents made from $35,000–$75,000 per year. A significant percentage of respondents had children at home aged 5–17.

A slight majority of the respondents felt access to the Internet was very important (59%) or important (28%) and use the service for a variety of purposes. Residential respondents indicated that they used the Internet to gather information about travel, healthcare, public services, and entertainment, while two-thirds used the Internet for purchases. Slightly less than half (43%) used the Internet to conduct financial transactions and many used it for communication.

Recognizing the small sample size, for those residential respondents dial-up remains the most common means of Internet access. Given computer ownership and Internet utilization, it is somewhat surprising that the majority of users (60%) still rely on dial-up for Internet access, with another 18% using DSL. The majority of users paid $30 for service access. Half of the population using dial-up indicated that cost was the primary factor limiting their purchase of broadband services. Another 40% indicated that such service was

not available to them. Several respondents indicated that a lack of competition in service providers explained the high cost of available service.

Business respondents. Business respondents were predominantly small firms (58%) with 1–5 persons and annual sales of less than $500,000. The sectoral composition of the respondents mirrored the overall economy, with the largest group of respondents working in the service sector, followed by retail. Business use of the Internet was high (90 % indicated Internet access was critically important or somewhat important), with communications the most frequently cited use. At least half of the businesses indicated using the Internet for financial transactions, while more than two-thirds used the Internet for information acquisition and research.

Internet access methods varied considerably, with one-third of business respondents using dial-up. DSL was the next most widely used access technology (21%) behind dial-up, followed by cable modem (16%). Almost half of businesses indicated their Internet bandwidth was inadequate. The cost of higher speed Internet access was cited by 50% of dial-up users as the reason for continued dial-up usage, while another 42% indicated higher speeds were not available to them.

In summary, according to the LDD-sponsored survey from 2006, businesses do not use high-speed access with the same frequency as do households. The majority of respondents indicated cost was the primary barrier to the purchase of broadband service. While the majority of firms using dial-up indicated that cost of service was the primary inhibitor, 42% indicated that higher speeds did not appear to be available. Thus, while similar to residential respondents who indicated cost was a factor limiting broadband

utilization, businesses seemed even more reluctant to use higher capability services due to cost and lack of competitive service providers.

Summary of the Findings from the Pew, GAO, and LDD Studies on Availability and Utilization of Broadband

- Broadband utilization is a function of demographic characteristics, including: age, income, education, employment history, and local sectoral base of employment.

- Use of broadband services continues to grow and diversify. More sophisticated uses of the Internet are evident in respondents' comments in all three surveys.

- Chief among factors limiting broadband access are cost and availability of service.

- These results echo the findings of Wood and Glasmeier (2003)—supply was not the problem per se. Rather, the area of concern was the narrowness of supply and the concomitant high price of the service. The lack of competition is cited as one explanation for the high cost. Other contributing factors include geographic remoteness and sparse settlement patterns.

The discussion of broadband utilization identified supply of service and price of different modes of service as continuing factors limiting the availability and use of high-speed Internet connection in rural Pennsylvania.

III. Methodology

In this section, the methodology utilized in reviewing best practices and in selecting the in-depth case studies in the four sectors is described.

Comparison of Studies Measuring Broadband Utilization and Review of Best Practices

Originally, the first phase of this research was intended to be a "study of studies" of the contemporary literature on broadband utilization in rural areas known as a meta-analysis.

Meta-analysis takes the existing body of research on a subject of interest and then combines and compares the results of these studies to explore a specific question like ours: what explains the adoption or lack thereof of broadband technology? It is a technique that allows researchers to examine a number of studies simultaneously to identify trends or patterns that can be generalized. These trends then form the basis of new studies that start from a benchmark or a state-of-the-field assessment. It is widely used in epidemiological studies and evidence-based medicine, and it is an increasingly popular method in policy analysis.

A meta-analysis takes a standard measure of effect or size—in this case, broadband utilization—and compares studies interested in the same question but which employ different explanatory variables such as personal characteristics of users, often measured on different scales, to determine effect. In these cases, the correlation itself is the indicator of the effect size.

A comparison of studies requires that the research approach from different investigations is similar in intent. In the case of this study, this minimum requirement was not achieved. There are many studies of broadband uptake, but research designs are overwhelmingly non-statistical in nature and case study in approach. In this case, the amount of variation associated with the cases overwhelms the ability to make generalizations.

This meta-analysis was designed to catalogue the literature on studies that examine the experiences and outcomes of broadband utilization in rural areas and to compare the documentary evidence in support of conclusions derived in these studies. The purpose was to review the similarities and differences in how researchers are studying the use of broadband in rural areas, the particular data they are collecting to conduct their analyses, and the conclusions they are drawing. This was designed to provide a comprehensive overview

of current broadband applications in each of the four user areas (government, education, healthcare, and small business), and to fully inventory the various capability and connectivity constraints that these users can encounter.

In this review of the literature, both academic and popular, it became clear that the study of broadband use is at a much earlier and formative stage than had been anticipated. There are many case studies of interesting projects in the four sectors focused on here. In most cases, however, the specific data gathered in these case studies are highly idiosyncratic, extremely diverse, and in many cases purely exploratory. With the partial exception of e-government, there are no widely accepted metrics for measuring broadband use, much less for determining the *best practices* in any of these sectors.

Thus, the review of broadband use in each of the four sectors (in section IV) should be viewed as a qualitative description of diverse types of broadband Internet use, rather than a scientific evaluation of best practice in the field, which is currently impossible given the early stage of study in this field.

Case Studies

After reviewing best practice around the globe, this project originally sought to select three different rural communities, and to examine broadband Internet use in those three communities in four different areas: education, healthcare, government, and small business. As the study developed, however, and the meta-analysis was conducted, several issues led to the revision of the case study selection process. First, there is no widely accepted framework for evaluating best practice in broadband *use.* Developing metrics to use in assessing broadband *access* is straightforward and a broad consensus has been developed about the most important factors to analyze when examining broadband access, but no such consensus

has developed about how to analyze broadband *use*. Without such a framework, it is unclear how best to choose particular rural areas for further study. Second, and more importantly, in this review of the literature, it was clear that effective broadband use differs significantly by type of activity and by sector of society. Thus, what would constitute best practice in the healthcare industry might differ dramatically from what would constitute best practice among small businesses or in government. Furthermore, while one region might have best practices in a single sector, it was unlikely that a single region would reflect best practices in all sectors.

Rather than examine broadband Internet use in four of these sectors in three different rural communities, it was decided to study each of the sectors separately, focusing on those rural communities in each sector that would be the most instructive for this analysis. The study criteria and process for selecting each sector, and the way each sectoral case study was selected, are described in the following sections. .

Government

Government is the sector in which detailed measures of best practice in broadband use have been the most developed. This is visible in measurements of the types of information and interactive activities that are possible to perform on the websites of local government. Though there is some variation in the specific measures, broadly, this meta-analysis supports assessing the effectiveness of e-government along four dimensions: a) information dissemination; b) interactive functions, such as permits, licenses, applications, and the like; c) eCommerce, with the ability to pay for government services, taxes, and fines on-line; and d) eDemocracy, with citizens able to use the Internet to provide feedback to elected officials as inputs into policy decisions.

To evaluate the effectiveness of local government websites along these four dimensions, a website evaluation tool was adapted that had been developed as part of a nationwide study of local government websites.[1] The details of the evaluation tool, which include more than 60 individual measures within these broad categories, are provided in the discussion of case study results. The goal was to select websites of 16 county governments that were representative of rural Pennsylvania counties, and 16 local government (boroughs, townships, and municipalities) within those counties that were representative of all municipalities in that county. To select the 16 counties, all rural counties[2] in the state were divided into one of four regions (NW, NE, SE, and SW). Then, within each region, the largest and smallest rural counties (by population) adjacent to urban counties, and the largest and smallest rural counties not adjacent to urban counties, were chosen. The counties selected for analysis are shown in Table 1. Then, within each county, all municipalities (townships, boroughs, and cities) that had a website as of the 2002 Census of Governments were identified. This list of municipalities was also compared with the list of municipalities with websites identified by the Governor's Center for Local Government Services and listed on its website.[3] A random number generator was used to select one of the municipalities within each county for evaluation of their web presence. The specific municipalities, along with the analysis of their web presence, are presented in the case study discussion.

It should be noted that additional local governments within each of the counties have websites, beyond those identified through the 2002 Census of Governments and the Governor's Center for Local Government Services. To check the comprehensiveness of

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[1] Kaylor, Charles, Randy Deshazo and David van Eck (2001), "Gauging e-government: A report on implementing services among American Cities," *Government Information Quarterly* 18, 293–307.

[2] As defined by the Center for Rural Pennsylvania.

[3] http://sites.state.pa.us/govlocal.html?papowerPNavCtr=|30207|#30214

these sources as of 2006, Google searches were conducted for websites of other local governments within each of the selected counties and links were sought to additional sites from the county websites. This search produced no additional sites operated by local governments. This should not be considered a definitive sampling process, and there are possibly other local governments with websites in the counties selected for study here. Any additional ones, however, are likely to have been developed more recently than those local governments identified by the Census and the Governor's Center for Local Government Services. Thus, the local governments considered here are likely to have established experience with running and operating a website.

Education

The sample cases selected in this sector also used the same methodology discussed in the government section—dividing rural counties in the state into four geographical sections (NW, NE, SE, and S), and selecting four rural counties in each region (two adjacent and two nonadjacent to urban areas). For education, one school district was selected per county. In cases in which the first school district selected would not speak with the research team, a second school district was selected in the same county. In the event that an interview could not be conducted with any of the schools in a county, a different county in that region was selected. In total, of the initial 16 county interview targets, interviews were conducted with 12, including substitute counties in cases where no one was available for interviews in the original set of selected counties. The school districts that were interviewed wished to be kept anonymous in this report and hence the participating school districts have not been named.

Table 1. Counties Selected for e-Government Analysis

County Name	Website	2000 Population	Adjacent to Urban County?
Northeast			
Monroe County	http://www.co.monroe.pa.us/	138,687	Yes—Adjacent to Luzerne County
Bradford County	http://www.bradfordcountypa.org/	62,761	Non-adjacent
Montour County	http://www.montourco.org/	18,236	Non-adjacent
Sullivan County	http://www.sullivancounty-pa.us/	6,556	Yes—Adjacent to Luzerne County
Northwest			
Crawford County	http://www.co.crawford.pa.us/	90,366	Yes—Adjacent to Erie County
Venango County	http://www.co.venango.pa.us/	57,565	Non-adjacent
Warren County	http://www.warren-county.net/	43,863	Yes—Adjacent to Erie County
Forest County	http://www.co.forest.pa.us/	4,946	Non-adjacent
Southeast			
Schuylkill County	http://www.co.schuylkill.pa.us/	150,336	Yes—Adjacent to Berks County
Adams County	http://www.adamscounty.us/	91,292	Yes—Adjacent to York County
Mifflin County	http://www.co.mifflin.pa.us/	46,486	Non-adjacent
Snyder County	http://www.snydercounty.org/	37,546	Non-adjacent
Southwest			
Lawrence County	http://www.co.lawrence.pa.us/	94,643	Yes—Adjacent to Beaver County
Somerset County	http://www.co.somerset.pa.us/	80,023	Yes—Adjacent to Westmoreland County
Bedford County	http://bedford.pacounties.org/	49,984	Non-adjacent
Fulton County		14,261	Non-adjacent

A qualitative methodology was used for the education sector case study that involved collecting primary and secondary data. The objective in using primary data was to gather information about existing broadband infrastructure and teaching practices in schools in rural Pennsylvania. This information could then be used to compare current best-practices in the education sector in other parts of the world. Secondary data was collected to provide information about current best practices in the education sector that have transformed

teaching practices and shifted the focus from a teacher-centric approach, where only the

teachers are responsible for framing the course material, to a more student-centric approach

where the students participate in developing course content. The primary data consisted of

information from interviews with the technology officers in selected rural school districts,

while the secondary data included literature reviews and surveys of websites of schools in

many countries and their broadband-based networks across the world that revealed current

teaching practices involving broadband technology.

The initial plan for collecting primary data was to interview technology officers from

16 school districts in rural Pennsylvania. These school districts were selected in four regions

of Pennsylvania using the same methodology as that used in the government sector study. In

each region, two rural counties were identified that were adjacent to urban counties and two

rural counties non-adjacent to urban counties. After the selection of counties, the school

district in each county was identified. The school districts were identified on the basis of

secondary data collected from the National Center for Education Statistics, U.S. Department

of Education[4].

The official website of the NCES provides a *Data Tool* that allows data on all school

districts in the United States to be sorted under various categories. The data on all school

districts in the selected counties in rural Pennsylvania were scanned. The school district that

did not serve a MSA and had the highest number of students eligible for the Free-Lunch and

Reduced-Price Lunch Program was selected for the study. The same methodology was used

in selecting all 16 school districts for this study. In some of the school districts selected in

the northeastern, northwestern, and southeastern regions, the technology officer could not be

reached after repeated attempts over a one-month period. As a result, a replacement school

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[4] National Center for Education Statistics, http://nces.ed.gov/index.asp

district within the same region but in another county was identified and selected for an interview. This procedure, however, did alter the initial choice of counties located adjacent and non-adjacent to urban counties in each region but the selection of school districts based upon highest number of students eligible for Free Lunch and Reduced-Price Lunch was still maintained. A total of 12 interviews in the target 16 school districts were successfully conducted.

The point of contact for the interviews in all school districts was the technology officer with the exception of one school district in which the principal was interviewed because the school district did not have a technology officer. At first, the interview was conducted with the school principal, but answers to many questions regarding the availability of computers, the specifics of the broadband connection, and the type of training modules available to the staff were not known in great detail by that individual. After an initial discussion with principals interviewers were usually transferred to the school district's technology officer for answers to specific questions. After initial conversations with principals, all interviews were conducted thereafter with the technology officer in the school districts. The interview was conducted over the phone using a questionnaire with open-ended questions (see Appendix) that included a variety of topics related to broadband use in the local school district. The technology officer was asked about the extent of the availability of computers and broadband connections in all schools, the use of broadband by teachers and students in the curriculum, and the training provided to them for use of broadband. The answers to each question by all 12 respondents are summarized in this report under categories related to utilization, in order to give a consistent perspective of the current practices being used in school districts in rural Pennsylvania.

Healthcare

Like the education and e-government sectors, a multi-stage assessment of broadband utilization was used in this study. A website assessment using the e-government assessment protocol modified to reflect specific qualities of health care was conducted. In parallel, a sampling procedure was implemented to identify hospitals as possible interview candidates. Over a six-week period, hospitals were contacted and interviews were conducted when possible.

Based on the literature, a set of characteristics was selected that demarcated among hospital services as broadly discussed in the literature; these were then used in an ordinal scoring system to discriminate among websites. This served as a first cut at the analysis of broadband utilization in hospitals.

In the case study of healthcare, the same selection process was used as with the local government and education sectors: identifying four counties per region of the state, and then selecting one hospital facility per county. In some cases there was no hospital facility to speak to. In other cases a hospital facility could be identified but repeated attempts to identify the appropriate contact failed to locate a person in the hospital willing to speak with a member of the project team. Hospital interviews were conducted over a six-week period based on extensive calling and persistent soliciting of participation. The low response rate was attributed to the difficulty of identifying the key person in institutions who could answer questions. A three-step strategy was followed in contacting interviewees. First, phone calls were made to verify the institution and the person to speak with. Next, letters were sent and appointments were set up to conduct phone interviews. When steps 1 and 2 were

accomplished, an interview was conducted. In a number of cases, even with scheduled interviews, meetings could not be concluded with the intended respondent.

Over a six-week period of continuous contact, four interviews were secured with hospital administrators knowledgeable of facility technology practices. Of the 16 counties selected for the case study, 13 counties with hospital facilities were identified as possible interview subjects. An attempt was made to access websites for hospitals in all 13 counties. Three counties had hospitals that did not have individual websites. Of the remaining 10, oral interviews were secured with two hospital Information Technology Officials. Efforts were made to secure interviews with additional healthcare facilities in the remaining counties. Contact was made with two hospitals in two additional counties outside the original 16 selected. These were added to the interview pool. In the end, a total of four interviews were conducted. After selecting the sample, an analysis of healthcare facility broadband utilization was conducted in two stages. In the first stage we conducted assessments of the websites of the major health service providers in our final group of counties (see Table 2). In stage two, Technology Officers or other persons responsible for the implementation of broadband in the major medical facilities in the four counties were contacted. In completing these interviews the hospitals instructed interviewers not to reveal the name of the hospitals or their location. The report on broadband and healthcare thus reflects the desire for anonymity on the part by the hospitals. In the discussion of healthcare, counties referred to by name are those that were part of the website analysis. Since this information is publicly available, it did not present possible disclosure issues.

The evaluation of the hospital websites drew upon the e-Government assessment. The e-Government rating scheme was first examined to identify factors that applied to both

government and healthcare service provision. The websites of target groups were then examined and qualities were identified that were directly linked to broadband utilization. While there were overlaps between e-Government services and healthcare such as payments, maps, schedules, complaint forms, and rules and regulations, video conferencing between doctors and patients and other more interactive services were not evident. The literature on best practices in the health sector also revealed other broadband-enabled metrics currently available in hospitals in other states in the U.S., in urban areas of Pennsylvania, and in other countries. These additional metrics were then compiled into a single survey instrument under separate categories that was used to evaluate the hospitals' websites.

For the evaluation of the websites, a numerical scoring system from 0 to 4 was used, with 0 meaning service not present and 4 meaning that the transaction could be done completely on line (Table 3). According to this scoring system, 0 was assigned if, according to the hospital website, a particular service was not available at all. A score of 1 indicated that some information was present on the website related to a service—e.g., the name of the person to be contacted and/or the address where people could visit to collect more information. A score of 2 indicated that detailed text information was provided for a service and more contact information for relevant officers, such as email addresses or phone numbers, which could be used to get in touch with the hospital without having to travel to the hospital. A 3 was assigned if downloadable forms for various services such as appointments with doctors, job applications, donations, information release forms, etc., were available in addition to the contact information as mentioned for scores 1 and 2. The highest possible score was 4, which was assigned if an entire transaction could be completed online without having to visit the hospital at all. This meant that clients of the hospital could obtain contact

Table 2. Evaluation of Hospital Websites
(created by authors)

Category	Dimension	Adams	Clearfield	Columbia	Crawford	Indiana	Bradford	Greene	Warren	Sullivan	Fulton	Potter	Clarion	Wayne	Cameron	Clearfield
Payments	Bills		2	2	2	1	1			4			1		1	2
	Change Billing Info									4						
	Request Info about Statements									4						
Appointments	Doctors		3	2			1	1		4			1			3
	Nurse															
	Tests			1			2									
	Cancellation															
Communication	Closure of facility															
	Calendar/Event Announcement		3	3	2	2	2		2	4		1			2	3
	Job Announcement		2	3	2	2	2		1	2	2	2	1		2	2
	Health related news		3	3	2	2	1	2		3		2			2	3
	Hospital news		2	2	2	2	4	2	2	2	3	2	2		2	2
Customer service	Schedules (hrs)		2	2	2	2	2	2	2	2	2	2	2		2	2
	Availability of facilities		2	2	2	2	2	2				2	2		2	2
	FAQs		2		3		2			2						2
	specific questions			2	2		2	2								
	Communication Forums															
	Personal ID			4	4	4				4						
	Complaints									4					4	
Audio/video	Tour of hospital						4						3			
	VC with patients									3						
	VC with Doctors									3			3			
	E-meetings															
E-Commerce	On-line bids									1						
	Proposals for e-procurement															
	Shop gifts online				2		4			4						
Applications	Jobs		4	4	4	3	4			4	3	4	2		3	4
	Affirmative Action															
General Information	Rules for privacy		2	2	2	3	2	2	2	2			2		1	2
	Hospital Rules						2			3			4			
	Budget report						3									
	Health Insurance			1	1	1	1			2				1	1	
	No. of Beds			1	2	1	1	2	2							
	Housing		2			1	1			2				1		2
	Directions		2	2	2		2		2	2	2	2	2		4	2
	Donations			2	3	2	4		2	4	3					
Documents	Info release forms		2				1			1			3			2
	Birth Certificate		2													2
	Pre-registration with hospital		4	1	0	2										4
Dept/services	Each Dept		2	2	3	2	3	2		1	2	2	2		2	2
	Other Services (cafetaria, gift shop, chapel)		2	2	2	1	2			2		2			2	2
	Patient Advocacy/Support Groups		2	2	2		2			2	2	2				2
	Staff Finder			4	4	4	2	3		2	2	2	2	2	2	
	Profiles of Staff		3		2	2	2	2		2	1	2	2			3
	Total Points		48	49	52	39	61	22	19	75	22	39	24		32	48

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information for relevant hospital officers, and obtain downloadable forms that may be submitted online so that clients do not have to visit the hospital when a physical examination is not required. For 44 different metrics, the total possible points that could be secured by a hospital was 176, with 4 being the highest score in each metric.

Table 3 Scoring system used to evaluate the Hospital Websites
0- No web site
1- Info present on website
2- Link to relevant contact (phone/email)
3- Downloadable forms available
4- Transaction or other interaction can take place completely online

     (Created by authors)

For the case study of the health sector, four counties in each of the four regions of the NE, NW, SE, and SW were identified—two adjacent to urban counties and two non-adjacent to urban counties. Three of these counties did not have hospital facilities; the other 13 counties had at least one hospital. One hospital from each of these 13 counties was identified for the case study. An evaluation of the websites for these 13 hospitals was attempted. Ten hospitals' websites were evaluated while the remaining three hospitals were not evaluated for this study. In addition, two more hospital websites were evaluated where interviews were conducted with the Technology Officers. A total of 12 hospital websites were evaluated with numerical scores.

Of the 12 sites evaluated, four scored less than 30 or about 17% of total possible points. These were sites with limited functionality and minimal information available. In contrast, two sites—Bradford and Sullivan Counties—both had websites with a high degree of functionality. Sullivan County scored highest and offered online services such as bill payments, job applications, complaints, and appointments. The two top websites also allowed complex searches for doctors and medical specializations. The more developed websites appeared to be associated with larger healthcare organizations (e.g., Health Maintenance Organizations, links to

a teaching hospital, or a hospital system), but this was not uniformly the case. As compared with the education and tourism sectors, quite a few of the hospital websites had video clips on a variety of subjects related to patient safety and major elective surgeries.

Several hospitals had virtual tours, including webcams. This functionality would necessitate hospital clients to have high broadband capability at home to effectively utilize the service because audio-video files tend to be dense and hence require high bandwidth for quick and complete transfer. On many websites, employment-related materials and services were easily accessed. Job vacancies were advertised; interested applicants could download the application forms directly from the websites. In most of the hospitals the application forms could also be filled and submitted online. This functionality was evident in interviews, too, because the hospitals interviewed indicated that the web was used for employment notices and to offer information on the training provided to new recruits in critical occupations such as surgery. In addition, the websites also provided highly detailed information about the job site, working conditions, and other recruitment-related materials. As compared with other sectors, four of the 12 hospitals evaluated in terms of website capability allowed clients to create personal IDs on the website that could be used in accessing the calendar of events and personal information. Finally, seven of the hospitals had well-developed fundraising capabilities that extended from information acquisition to online donations.

When the results of the websites survey for the 12 hospitals in rural Pennsylvania were compared with the best practices evident in the literature, including online activities and interactive functions, the population of hospitals, with one exception, lacked demonstrated utilization of cutting-edge practices. There was little evidence of patient interaction with medical personnel from the homes of the patients through the websites. There was almost no evidence of

interactive functions, such as bill payment, bill status, appointment management for tests and examinations, information release requests, etc. No online monitoring of patients or mention of the availability of this service was found in any of the 12 websites evaluated. Such transformative services were not evident in the evaluation of the websites. With the exception of one hospital, the other 11 hospitals contained no examples of occasions in which patients' needs were served without having physical contact with a hospital staff person. This service was found in urban, wealthier, and more developed counties, as evidenced on the websites of the hospitals located in the urban areas of Pennsylvania.

Small Business

Broadband use in small business clearly differs depending on the nature of the economic enterprise. In manufacturing enterprises, for instance, broadband use is most likely to be critical to their product development and for integration in supplier networks and value chains. For service enterprises, in contrast, broadband use is most likely to be critical for customer relationships and internal efficiencies. Thus, in selecting case studies, the goal was to ensure a range of different types of businesses across both manufacturing and service industries. A decision was made to conduct two different case studies in two different rural industries with the following characteristics: a) a significant number of small and medium businesses; b) signs of competitive advantage (a condition where the business occupied a niche that was viable given the sector in which the firm competed); and c) broadband use critical to the competitive success of firms in the sector but with significant variation between the case studies in the type of industries. The following industries and regions were selected:

a. **Powdered Metal Manufacturing in Northcentral PA:** Northcentral PA has long been known as the powdered metal capital of the world, but in the last decade has faced significant

challenges related to consolidation in the industry and relocation to lower-cost centers in Mexico and China. Nonetheless, there is recent evidence that at least some components of the industry have stabilized in recent years, including among small and medium companies, and broadband use may have been an important component of that.

b. **Tourism along the Route 6 Corridor:** Tourism is dominated in Pennsylvania by small and medium businesses. According to the Tourism Association of America, both domestic and international visitors to Pennsylvania spent nearly $16 billion in the state, supporting more than $5 billion in payroll, and 233,000 jobs.[5] The Route 6 Corridor along the northern tier of the state is less well known than the Poconos, and thus provides a valuable opportunity for examining the contribution of broadband to reaching out to new audience and new markets.

For each of the two sectors, detailed web-based research was conducted on companies and industry-support organizations in each of the two regions. Field research was then conducted in which 2–3 days were spent in each region conducting detailed interviews with business owners, representatives of LDDs in each region, marketing agencies, and local government officials.

IV. Broadband Use by Different Sectors: A Review of Best Practices

IT Use and Local Governments

The use of broadband by local government agencies has progressed significantly in the last five years. While changes are evident, in the U.S. local government lags behind international practices. According to a report published in the UK in 2005 on broadband usage by local government agencies, the U.S. and the UK rank 3rd in such usage. In the U.S., successful application of broadband varies by state; some states are significantly ahead of others in the application of broadband technology.

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[5] http://www.tia.org/researchpubs/year_results.asp

Application of broadband in local government faces numerous challenges. The highly fragmented nature of local governments contributes to the variation in broadband application.

According to research summarized by researchers at the Massachusetts Institute of Technology (MIT), the number of local governments with a presence on the web has increased from 5% in 1999 to 29% in 2004 (Gillette et al 2003). A survey of local government websites reveals a common problem: large volumes of information are provided to citizens in a non-user-friendly manner. Few local government websites offer interactive communication. Users cannot avail themselves of services through the websites of local agencies. Websites often lack time-saving interfaces. There are exceptions—many counties in Texas and Michigan, for example, have introduced online services like motor vehicle registration and payment, an Internet-based juror registration system, properties listed for sale, and police and crime information. These services offer users greater flexibility and time savings through greatly enhanced operation.

Broadband usage for disaster management is growing in intensity. Broadband connections can allow Emergency Response Teams to react much faster and are increasingly providing access to better information and resources at a quicker pace. Broadband connections allow voice over IP (VoIP), emails with large attachments, video streaming, GIS data access, etc. Such detailed information helps foster emergency evacuation programs among agencies. Much of the information exchanged will also help to document each event better.

One suggestion to reduce the adverse effects of government fragmentation on the efficient and cost-effective use of broadband for the delivery of government services is that government agencies should consolidate their demand for broadband, and pool demand like an anchor tenant (Gillett, Lehr, and Osorio, 2003). By pooling demand, the private sector is encouraged to adopt standards of practice that are the same, making it easier for ISPs to provide

broadband connections at a low cost even in rural areas. The Keystone Communication Project in Pennsylvania also provides 'geographic cost averaging' such that broadband connections are available at the same cost throughout the state.

Another example of the pooling of demand is a collaborative effort by academic institutions in Virginia. The Blacksburg Electronic Village (BEV) was set up by Virginia Tech to conduct community outreach programs. The BEV streams video recordings of legal proceedings of government meetings to create greater awareness among local people. This service has created a 'community network' that allows greater accumulation of data. In other communities 'municipal networks' have been created by local people to make broadband available for community use. These examples provide access data and also communicate for education, healthcare, and counseling purposes.

IT Use and the Education Sector

The education sector has seen considerable advances in the use of broadband. Broadband is being used to enable students and teachers to share information on various subjects such as physical and natural sciences, social studies, cultural exchanges, etc. Information is being shared in a variety of ways, including video conferencing, news recordings, and live demos based on real-time video or streaming uploaded programs.

Broadband connections are essential for teaching practices that go significantly beyond the text book. In several schools districts around the world, the curriculum has been re-structured to make it more interactive, so that students can communicate with their counterparts in other parts of their country or even across the globe. Rather than teaching history lessons from the text book, teachers are using innovative techniques. One example is "claymation". Using this technique, students can make figures out of clay and enact the history of a certain

period (e.g., the Incas, Aztecs), which is then recorded in front of a video camera. This recording can either be video-conferenced real-time with students in other schools or uploaded to a website so that other schools can stream it at a later date, according to a course schedule.

A popular subject that is amenable to Internet distribution is nature and its peculiarities in different parts of the globe. Weather patterns, physical features, and the flora and fauna of a certain place may be explained via the Web to students across the world. This not only keeps the students interested in their curriculum but also exposes them to a world outside their own.

Another example of a successful Internet-enabled project is found in Israel, where religious tolerance is being fostered among children by enabling them to interact with students of different faiths in different countries. The students interact with other students through video conferencing and are learning about a different culture.

Teachers are being encouraged to go beyond traditional text books and introduce students to the virtual world where more information is available at a quicker pace and at a more economical price. Online tutorials have been created (Atomiclearning.com) to educate teachers about how to use the World Wide Web on particular topics to conduct their classes. The subjects range from math, science, and social studies, to sports, photography, and animation. Teachers are provided with access to the World Wide Web from their school through broadband. In Singapore, all students and teachers from the fourth grade on are provided with email accounts so that they may communicate with each other and learn to use the Internet.

Students are also encouraged to go online to refer to websites that contain information useful to them in school projects. They are provided with video cameras, if required, to record local happenings and make short films that resemble a News telecast. In Italy, education is a basic right and has to be made available to all children. This right extends to access to

broadband, which is treated as a universal service for individuals who are unable to access broadband through existing institutional contexts.

The UK has one of the most advanced broadband networks, connecting schools in support of interactive education activities. In the UK, legislation mandated that all schools be connected to the Internet by broadband by the end of 2006. Ireland also is following suit, seeking to have all schools wired with broadband. Italy has also made extensive efforts to ensure that broadband is available to education institutions. Singapore is very advanced in making broadband available for academic purposes. The educational system is well equipped to share information and knowledge.

In the UK, connectivity formed the basis of redistributing resources to outlying and poorer parts of the country. A network was developed to link schools in one of the poor regions of the Northeast. The East of England Broadband Network (E2BN) collaborated with British Telecom and introduced broadband to this under-privileged area. It funded schools in several counties, like Sussex, to buy the equipment and subscribe to broadband connections. With Internet technology and through broadband connectivity, the schools introduced an innovative method of teaching; overall, the academic performance of the schools increased and visible signs of better student outcomes are evident.

IT and the Healthcare Industry

Information technology is being integrated into the healthcare industry by the application of sophisticated Hospital Information Systems (HIS)[6]. These systems are in the early stage of adoption by healthcare providers and adoption varies considerably across location, size of organization, and health service specialization. The goal of the paperless hospital and the seamlessly integrated health service system is still some time off. In most cases, a lengthy paper

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[6] (http://whitepaper.informationweek.com/cmpinformationweek/search/browse/1132/1132.jsp).

trail still follows a patient through healthcare service engagement, even for the most routine of procedures and practices. Nonetheless, changing regulations and the drive for efficiency are fueling IT applications in healthcare.

The initial push toward integration and connectivity occurred when original PC-based information solutions to medical record management became obsolete. According to industry experts, 'the midsized hospital's PC-based solution, which seemed like a bargain at the time of purchase, could not be easily upgraded to handle evolving needs such as compliance with the Health Insurance Portability and Accountability Act (HIPAA).[7] Thus, there was an obvious stimulus for change. Over the last five years, most healthcare providers have transitioned to using more sophisticated HISs implemented through local networks. Information is now accessible at every terminal, thereby considerably reducing the time required to complete tasks. Staff and doctors may now make more informed decisions.

The introduction of IT in healthcare is responding to the need for cost containment and efficiency. The push/pull relationship commonly seen in industry between a product or piece of information and the user of that information is more complex in the healthcare sector because of the role of third-party payers and the growing complexity of service. Whereas in most businesses a customer "pulls" things towards themselves, while a producer "pushes" things toward customers, in the case of healthcare, intermediaries are pressing adoption of new technologies to achieve a variety of complex, sometimes conflicting, goals, such as higher quality and more personalized healthcare and low-cost health service provision.

Research by vendors of software applications for the healthcare sector indicates that ICT is now being used in all facets of healthcare-related work to maximize the efficiency of workers

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[7] http://www.sun.com/br/healthcare_714/article_smarter.html

in hospital/healthcare centers. Increasingly in hospital settings, staff members, from doctors to administrative staff, share information using LAN connections within the workplace.

The use of the Internet within the healthcare center is also widening the prospects of hospital management to communicate with people outside a specific hospital context. The quicker transfer of data and information ensures that the best healthcare service is being provided to customers. The Internet for HISs is used for the following:

1. Enhancing personal private communications among healthcare staffs using electronic mail service (e-mail);

2. Transferring clinical information about patients between two hospitals or clinics for consultations or decision support using file transfer protocol(FTP) or e-mail;

3. Retrieving up-to-date medical information with world wide web (WWW), Gopher, WAIS and database retrieval services;

4. Fostering discussions among healthcare providers and researchers using NetNews, electronic mailing list, and real-time video chat system like CUSeeMe (http://www.ambitweb.com/cuseeme/cuseeme.html);

5. Using various electronic text books distributed throughout the world;

6. Sharing of common knowledge or data that can be used among several hospitals; and

7. Conducting tele-surgery from remote locations.

The last usage—tele-surgery—is still a comparatively new service and few hospitals have introduced it. This kind of advanced medical procedure, supervised from remote locations, requires extremely high precision not just in implementing the surgery, but also in conveying information in real time. Such a quick transfer of information can only be done through the use of broadband. However, broadband usage in hospitals and healthcare centers is still quite low,

especially in rural areas (http://www.healthcare-informatics.com/issues/2001/07_01/stammer.htm). It is often restricted to only certain departments (e.g., admissions). Cost factors are also involved in introducing T1 lines in all areas. The infrastructure might not be available or the cost per month may be too high for small hospitals.

In general, the literature on broadband usage in healthcare indicates that ICT is being incorporated into the healthcare industry, but with certain limitations. Some of these limitations are listed below:

- Advanced IT applications primarily reflect enhanced communication among staff and doctors within and outside the hospital/health center.

- Practices such as teleconsultation, telemonitoring, and teletreatment are becoming popular and enable people to communicate internationally, but the number of hospitals engaged in these practices is still quite limited. The spatial distribution, size of the organization, and education of the staff affects the availability and utilization of broadband.

- Anecdotal evidence suggests that some healthcare settings are using the Internet and broadband for commercial functions, such as ordering supplies, recruiting people, outsourcing labor, etc.

- The discourse about HISs reflects the impact of different types of technology used and the optimization of information transfer among healthcare professionals (doctors and staff). Discussion about how to involve the patient/customer to minimize travel or visitation is absent.

IT and the Small Business Sector

The small business sector has adopted the use of broadband in many of its practices. Broadband is being used to improve efficiency, productivity, customer relations, and other services. An analysis of websites that track the use and importance of broadband by the small business sector reveals that broadband usage by these firms has increased over the last few years. And yet, the clear advantages of broadband use over older modes of service such as dial-up are not as distinct as in the health and education sectors. A discussion of best practices using broadband in the small business sector can shed more light on this issue.

Broadband connectivity has enabled small businesses to obtain information about how they conduct business and also avail themselves of services that might help the entrepreneur to expand without increasing size. Small entrepreneurs operate with a limited budget and business expansion might be profitable but limited by today's budget for telecom services. With broadband availability, entrepreneurs can restructure business procedures by connecting office computers with an Intranet while making data and information accessible by employees.

Broadband has opened many avenues of collaboration. With broadband it is possible for people to work from home. Some small businesses referenced as examples of benefiting from broadband use IT for media communications, veterinary agencies, recreation spots, etc. A small media firm in London with only six employees has managed to expand its business through the use of broadband.

Another example of the successful use of broadband is a small veterinary agency in the UK. With all computers now connected, the workers can access data from anywhere. This makes them more efficient, and they do not have to maintain paper records, reducing the

accumulation of paper within the office. Also, videoconferencing has enabled veterinary

surgeons to consult with each other during an operation and view the surgery online.

The recreation industry has also benefited considerably from the use of broadband. Small

cafes and diners have recorded an increase in sales when they offered wireless broadband

connection to patrons during their waiting time. Doing so involves a small investment but the

recurring increase in sales more than compensates for it. Other recreation places, such as the

Shedds Aquarium in Chicago, have introduced broadband to connect all of their computers and

prevent fraud by using secured websites to prevent hacking. Online services would prevent

illegal activity from taking place. Also, in the case of Shedds, all tanks within the aquarium may

be monitored for temperature using a broadband connection.

Broadband connections are a pre-requisite for all ecommerce and online marketing.

Small businesses that do not have the infrastructure to set up big showrooms often resort to

online marketing. They can upload their catalogues and accept online orders. Credit card

transactions are essential in conducting online business. This would not be possible without

broadband connections. Customer satisfaction can also be gauged by requesting feedbacks and

post-sale support can also be provided through email. Small businesses stand to gain in several

ways by adopting broadband connections and profits can be raised with the use of technology.

In the case of rural Pennsylvania, broadband use by small businesses can be extremely

beneficial, enabling the provision of services to a larger clientele. The demographics of rural

Pennsylvania show that the population is becoming increasingly more aged, with young people

moving out to bigger cities in Pennsylvania or other states. This aged population requires

medical assistance that can be provided by healthcare agencies that can send their workers to

visit patients. Also, insurance brokers can personally visit their clients when required and still

have all data accessible through hand-held devices that are connected to the Internet via broadband. In this way, clients are satisfied that they do not have to leave home and workers are also at ease because all necessary data are accessible to them remotely.

Another interesting feature of rural Pennsylvania is that tourism is a big business in many counties (as seen during the county website update). We have already looked at how broadband benefits the recreation industry. Hotels also benefit if they have a web presence. Tourists can see what services are offered at the hotel, learn about local tariffs, and identify places for sight-seeing. This allows more people to travel to these tourist places with confirmed travel plans. The recreation industry can thus benefit a great deal by adopting broadband to conduct its business in rural Pennsylvania and elsewhere.

V. Case Studies of Business and Institutional Broadband Use

To this point in the analysis, the focus has been on the macro-scale as an understanding of best practices in rural broadband use is sought through the meta-analysis, and on broadly assessing Pennsylvania's levels of development by interviewing a range of experts around the state. To develop a deeper understanding of the processes rural communities are going through in utilizing broadband access, including understanding the challenges they face and the ways they've achieved whatever successes they have achieved, it was necessary to dig deeper. Thus, a detailed case study analysis was conducted of broadband use in four broad different sectors of rural society: government, education, healthcare, and small business.

e-Government

The focus in analyzing the effectiveness of broadband use in government was on external communication, rather than on internal processes. According to meta-analysis, this is a widely

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used approach in assessing e-government. Kaylor et al. (2001)[8] provided a useful working definition of e-government:

> E-government…is taken to be the ability for anyone visiting the [government] website to communicate and/or interact with the [government] via Internet in any way more sophisticated than a simply email letter to the generic…email address provided at the site. (Kaylor et al., 2001, p. 297)

To assess the ability of rural Pennsylvanians to interact with their local government (both county and municipality[9]) via the Internet, selected websites (see Table 4) were evaluated based on a series of functional dimensions that included the following (see section III of this report for a description of the methodology used in gathering information on IT and e-Government):

- *Online Payments*: Including taxes, fines, permits, registrations, and fees for services

- *Registration:* For facilities, or voter registration (where appropriate)

- *Permits:* Building and parking

- *Customer Service*: Action requests; code enforcement; payment histories; schedules (hrs); utility; information requests; individual ID for e–alerts/personal info

- *Communication*: Incidental closures; emergency management; road closures/detours, calendar/announcement of events

- *Licenses:* Dog, small business, hunting, fishing, marriage

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[8] Kaylor, Charles, Randy Deshazo and David van Eck (2001), "Gauging e-government: A report on implementing services among American Cities," *Government Information Quarterly* 18, 293-307.
[9] Please note that in using the term municipality, we include all classes, including boroughs, towns, townships and cities.

- *Images:* GIS online, plat maps, document management systems

- *Audio/Video*: Streaming video of council meetings; video walk–through directions to depts./facilities; video-conference proceedings over long distance

- *Documents*: Minutes of meetings; county code, county charter, budget report; downloadable forms

- *Applications*: Job applications; bidder applications

- *e–Procurement*: Bids online; proposals online

- *Miscellaneous*: Property assessment history look-up; zoning look-up; on-line survey polls; conversation forums: community resources; school districts; townships and municipalities; directions and transportation

    For each item, the websites examined were given a rating of 0–4, based on the following assessment:

- 0—Not Present on Website

- 1—Basic Information Present on Website

- 2—Link to Relevant Contact (phone/email)

- 3—Downloadable Form Available

- 4—Transaction or Other Interaction Can Take Place Completely Online

    All of these activities can be thought of as essentially transactional uses of the Internet. They reflect more efficient mechanisms for disseminating information about government functions and allowing for standard transactions around government services (such as paying for licenses or bidding on government contracts).

The meta–analysis did turn up some examples of more transformational uses of broadband Internet that broadly fall under the category of e–democracy. In some cities around the country, broadband connections are being used to create new decision–making processes that empower citizens to become more involved in local governance and policy making processes. In this project, no incidences of such transformative uses of the Internet were found in the review of case study city and county websites.

Table 4. Municipalities Identified as Having Websites, by County

Source		Source	
2002 Census of Governments	**PA Gov. Listing***	**2002 Census of Governments**	**PA Gov. Listing***
ADAMS COUNTY		MONROE COUNTY	
Carroll Valley Borough	Borough of Carroll Valley	Barrett Township	Barrett Twp.
Franklin Township	City of Gettysburg	Coolbaugh Township	Stroudsburg Boro.
Latimore Township	Conewago Township	East Stroudsburg Borough	Tunkhannock Twp.
	Latimore Township	Jackson Township	Chestnut Hill Twp.
BEDFORD COUNTY		Middle Smithfield Township	Stroud Twp.
None	None	Paradise Township	
BRADFORD COUNTY		Pocono Township	
Athens Borough	None	Smithfield Township	
Ridgebury Township		Stroud Township	
Sayre Borough	_	Stroudsburg Borough	
CRAWFORD COUNTY		**Tobyhanna Township**	
Cochranton Borough	City of Titusville	Tunkhannock Township	_
Sadsbury Township	Cochranton Borough	MONTOUR COUNTY	
Titusville City	_	**Danville Borough**	None
FOREST COUNTY		SCHUYLKILL COUNTY	
None	None	**Norwegian Township**	Mahonoy City
FULTON COUNTY	None	Pottsville City	City of Pottsville
None	None	SNYDER COUNTY	
LAWRENCE COUNTY		**Selinsgrove Borough**	None
New Castle City	City of New Castle	Shamokin Dam Borough	_
MIFFLIN COUNTY		SOMERSET COUNTY	
None	None	Conemaugh Township	Conemaugh Twp.
		Indian Lake Borough	Somerset Boro.
		Somerset Borough	_
		SULLIVAN COUNTY	
		Eagles Mere Borough	Dushore Boro.
		VENANGO COUNTY	
		Franklin City	Franklin
		WARREN COUNTY	
		Warren City	None

* from : http://sites.state.pa.us/govlocal.html?papowerPNavCtr=|30207|#30214

Counties

Among the counties analyzed, these web-ratings varied from a high of 59 in Mifflin County to a low of 0 in Fulton County, which did not have a website (see Figure 1). Note that the interpretation of this scale should be primarily relative—measuring websites against each other—rather than absolute. In other words, a rating of 59 is not a measure out of some absolute maximum value, but it does represent greater level of functionality and interaction than a lower rating among the group surveyed. It is difficult from this type of analysis to know what factors help determine the level of ratings. It appears, for example, that being close to an urban county makes a difference in this e-score rating. Three of the top four counties (Mifflin, Adams and Schuylkill) are in the southeastern quadrant of Pennsylvania, which is in a mixed urban-rural region of the state and subject to the influence the greater Philadelphia Metropolitan Area and has more influence from urban areas in southcentral PA as well. Similarly, five of the top seven counties (Adams, Schuylkill, Crawford, Lawrence, and Monroe) are classified as being adjacent to an urban county. At the same time, being adjacent to an urban area is no guarantee of a higher e-score. Sullivan County, which is adjacent Luzerne County in the Wilkes-Barre/Scranton area, had the lowest e-score (aside from Fulton County, which did not have a website), while Warren County, which is adjacent to Erie, also has a relatively low score. Nonetheless, it does appear that there is some spillover effect[10] from urban areas, with those county government websites with higher ratings being predominantly close to urban counties.

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[10] Here we refer to spillover effect as the influence that adjacency and proximity have on the likelihood that a Internet transactional capability of a local government is evident in a rural county adjacent to an urban county.
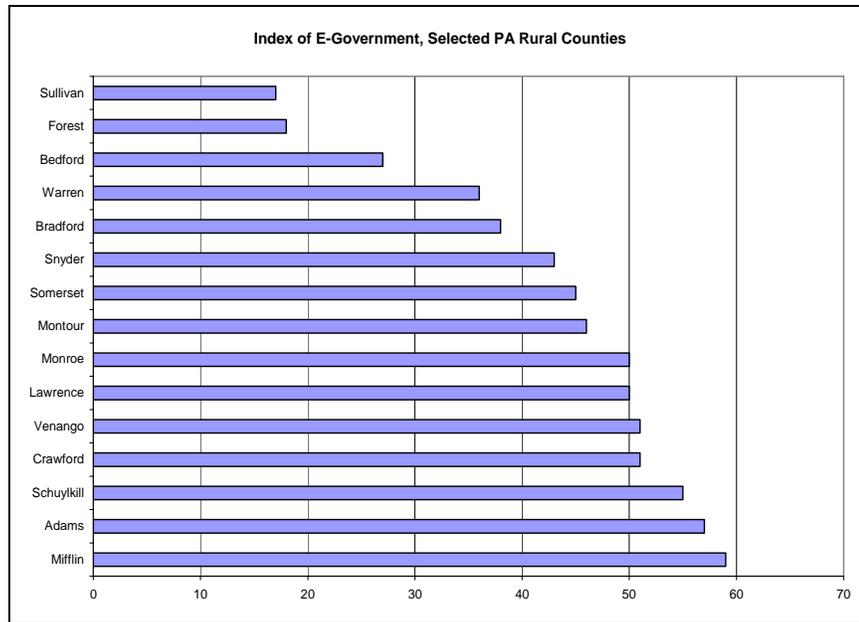
Figure 1. Index of e-Government, Selected PA Rural Counties
(calculated by authors)

Population size also seems to have an important relationship to e-government score (see Figure 2). The adjacent chart shows e-government score by population. It clearly shows a strong relationship between the number of people in the county and the total e-government score. A few counties do not follow this pattern completely. For instance, the highest scoring county, Mifflin County, only had a population of 46,486 (in 2000).

The absolute size of a county's budget also has a relationship to the e-government score (see Figure 3). The adjacent chart shows the relationship between a county's total budget in 2004 and their e-government score. Interestingly, it seems that it is absolute budget, not per capita budget, which makes a difference. Comparing e-government score to per-capita budget (chart not shown) reveals no regular pattern or perhaps a slight negative relationship between per-capita revenue and e-government score.

Within the sub-categories of the e-government rating, the individual item that was the most common across all websites was the availability of downloadable forms. Across all 16 counties, this had the highest average rating of 2.8. Other functions that were relatively widespread across the counties included voter registration information (2.0), information on community resources (1.9), dog licenses (1.8) and information on schedule/hours (1.6). Table 5 shows all municipalities with websites in selected Pennsylvania counties.

County E-Gov Score by Population
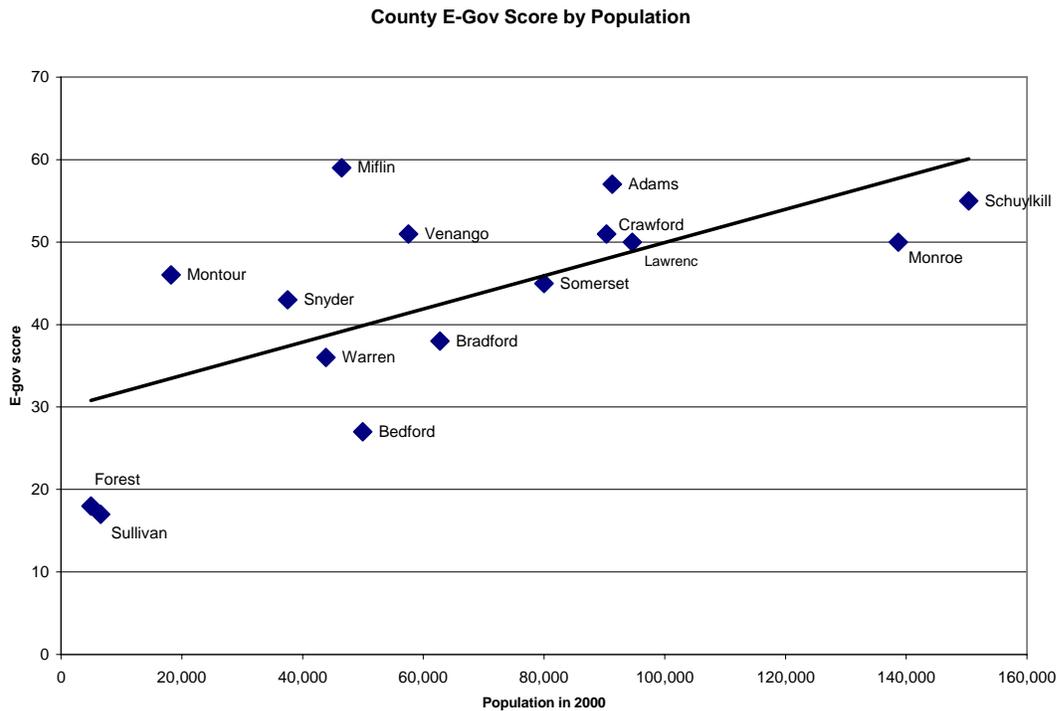
Figure 2. e-Government Score by Population (calculated by authors)

County E-Gov Score by Total Revenue
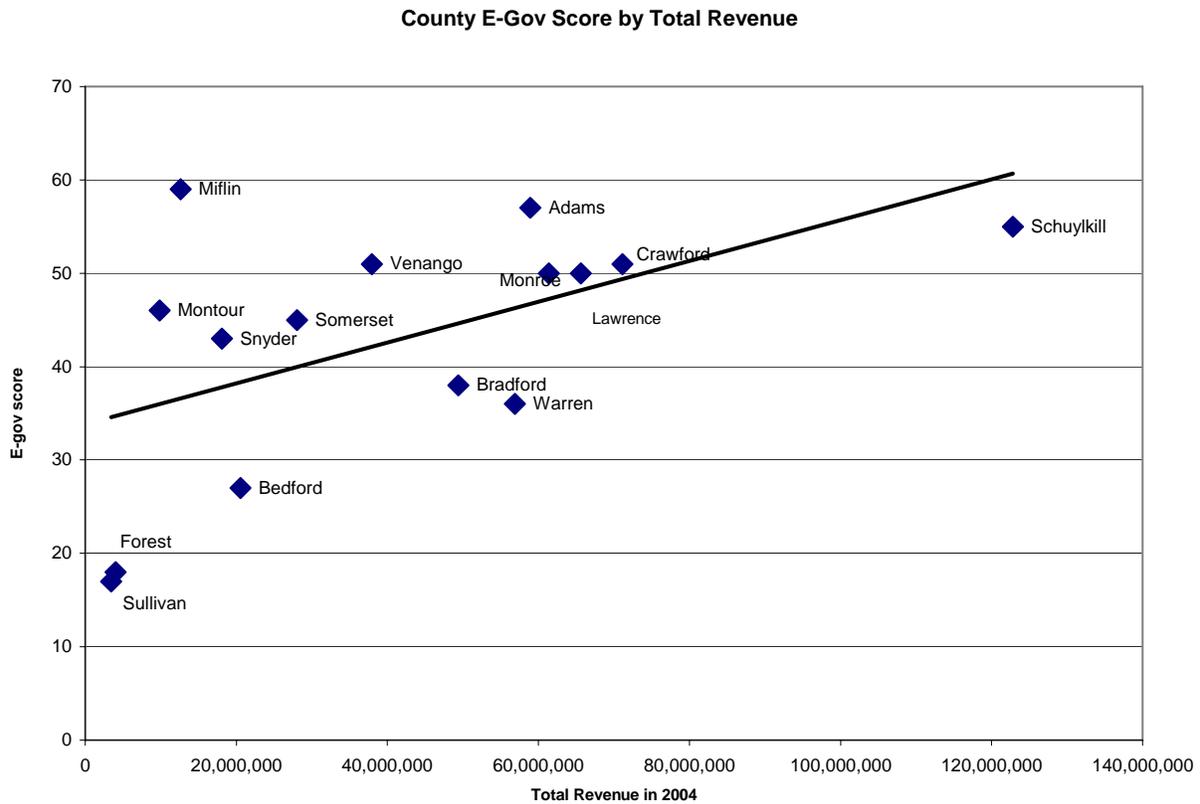
Figure 3: E-Government Score by Total Revenue

Municipality[11]

In analyzing the quality of e-government services among municipal governments (including boroughs, townships and cities), the most striking finding was how little local governments in rural Pennsylvania use the Internet at all. In four of the counties selected, not a single municipality (including townships, boroughs, and cities) had a website at all, as of the 2002 Census. In another five counties, only one municipality within the county had a website in 2002. Overall, only 6.9% of the municipalities within the selected

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[11] In assessing use of the Internet by municipalities, we use presence or absence of a website as our indicator. This approach was used in parallel with the other case studies and following the practice of other researchers studying broadband utilization b local government. This is an imperfect measure, however it allows for comparability across sites and a necessary prerequisite for transactional interaction with local governments.

counties had a website. If Monroe County were taken out of the sample, this would drop

to 4.6% of all municipalities.

Table 5. Municipalities with Website, Selected Pennsylvania Counties

County Name	Region of the State	Municipalities		
		Total	With Websites	% with Websites
Adams County	SE	34	3	8.8%
Bedford County	SW	38	0	0.0%
Bradford County	NE	51	3	5.9%
Crawford County	NW	51	3	5.9%
Forest County	NW	9	0	0.0%
Fulton County	SW	13	0	0.0%
Lawrence County	SW	27	1	3.7%
Mifflin County	SE	16	0	0.0%
Monroe County	NE	20	12	60.0%
Montour County	NE	11	1	9.1%
Schuylkill County	SE	67	2	3.0%
Snyder County	SE	21	2	9.5%
Somerset County	SW	50	3	6.0%
Sullivan County	NE	13	1	7.7%
Venango County	NW	31	1	3.2%
Warren County	NW	27	1	3.7%
TOTAL		479	33	6.9%

Source: 2002 U.S. Census of Governments

Monroe County is a true outlier in this study, with a total of 12 out of 20

municipalities in the county having a website as of 2002. Monroe County is in the midst

of the Pocono Mountains, which is a major tourist destination in the state. Quite possibly

the high level of Internet presence there reflects the importance of the Internet in driving

tourist traffic and the importance of tourism to the region's economy (see the Route 6

case study in this report).

Of the 12 municipalities rated, Somerset Borough in Somerset County was the

highest, with a rating of 49. The lowest was Norwegian Township in Schuylkill County,

with a rating of 6. No relationship could be discerned between these e-government

ratings and either the size of the municipality's population or its location. For example, Carroll Valley, in Adams County, rated quite high in the municipality ratings, and as a county adjacent to York, there are possibly high levels of urban spillover effects. Norwegian Township, in contrast, in Schuylkill County, scored extremely low, and yet it is also adjacent to an urban county. Similarly, the population size in the municipalities ranged from a high of 26,309 in the city of New Castle (Lawrence County), to a low of 153 in Eagles Mere (Sullivan County), but there was no relationship between the size of the population and e-government rating. Given the overall low level of Internet usage in municipalities, and the highly fragmented structure of local government in Pennsylvania (making it difficult to interpret, for example, population size of a municipality within its broader geographic context), it is likely that a significant amount of e-government is driven by a set of factors that could only be captured through more detailed qualitative and quantitative research.

Summary

Tables 6 and 7 provide detailed ratings of all county websites. Among the counties analyzed, use of the Internet for transactional purposes varied considerably across the sampled counties. It appears, for example, that being close to an urban county makes a difference in the quality of Internet interaction possible in counties. At the same time, being adjacent to an urban area is no guarantee of high transactional capability. Population size also seems to have an important relationship to e-government score. It clearly shows a strong relationship between the number of people in the county and the total e-government score. The absolute size of a county's budget also has a relationship to the e-government score. Interestingly, it seems that it is absolute budget, not per-

capita budget, which makes a difference. Within the sub-categories of the e-government rating, the individual item that was the most common across all websites was the availability of downloadable forms.

In analyzing the quality of e-government services among municipal governments (including boroughs, townships and cities), the most striking finding was how little local governments in rural Pennsylvania use the Internet at all as measured by the availability of a website. The exception, a county with a strong tourism economy, had a high level Internet presence. No relationship could be discerned between these e-government ratings and either the size of the municipality's population or its location. Similarly, there was no relationship between the size of the population and e-government rating. Given the overall low level of Internet usage in municipalities, and the highly fragmented structure of local government in Pennsylvania (making it difficult to interpret, for example, population size of a municipality within its broader geographic context), it is likely that a significant amount of e-government is driven by a set of factors that could only be captured through more detailed qualitative and quantitative research.

Table 6. Ratings of Government Websites in Selected Counties in Pennsylvania

Category	Dimension	Mifflin	Adams	Schuyl-kill	Craw-ford	Venan-go	Law-rence	Monroe	Mon-tour	Somer-set	Snyder	Bradford	Warren	Bedford	Forest	Sullivan	Fulton
	Population	46,486	91,292	150,336	90,366	57,565	94,643	138,687	18,236	80,023	37,546	62,761	43,863	49,984	4,946	6,556	14,261
	TOTAL	59	57	55	51	51	50	50	46	45	43	38	36	27	18	17	0
Payments	Taxes	2	2	2	2	1	3	2	2			2				1	1
	Fines							2									
	Permits								1		2						
	Registrations			3													
	Fees (services)		2	2	1	1	1		1	1	2		1			1	
Regis-tration	Facilities								2			2					
	Voter	3	3	2	3	3	3	2	2		1	2	4	3		1	
Permits	Building	2	3				3				3	3		3			
	Parking	2															
Customer service	Action requests (complaints)	2		3	3		3						3	3	3		
	Code enforcement	4							2			1					
	Payment Histories																
	Schedules (hrs)	2	2	2	2	1	2	1	1	2	2	2	2	2	2	1	
	Utility Information requests	2	2	3	2	2	3	4	2		2	2				1	
	Individual ID for eAlerts/personal info	4	4					4	4		4			4			
Commu-nication	Incidental closure								1								
	Emergency Mgmt Road closure/detour		1	2	2	2	2		2	4	1	2	2	2		1	1
	Calendar/Announcement of event	1		2	1	1	4	4	1		4	2					
Licenses	Dog	3	3		3	3	3	2	2	3		2			3		1
	Small Business (Bingo)		3														
	Hunting		2		3	3	3	2	2	4		2					1
	Fishing		2		3	3	3	2	2	4		2					1
	Marriage					1		1			1	1				1	1
Images	GIS online	4	1	4		2	1	2	2	2	4		2				
	Plat maps	4	3	4				0		2						0	
	Document Mgmt System	4		4	1	2	1	1	2		2						

Category	Dimension	Mifflin	Adams	Schuyl-kill	Craw-ford	Venan-go	Law-rence	Monroe	Mon-tour	Somer-set	Snyder	Bradford	Warren	Bedford	Forest	Sullivan	Fulton
	Population	46,486	91,292	150,336	90,366	57,565	94,643	138,687	18,236	80,023	37,546	62,761	43,863	49,984	4,946	6,556	14,261
	TOTAL	59	57	55	51	51	50	50	46	45	43	38	36	27	18	17	0
Payments	Taxes	2	2	2	2	1	3	2	2			2				1	1
	Fines							2									
	Permits								1		2						
	Registrations			3													
	Fees (services)		2	2	1	1	1		1	1	2		1			1	
Regis-tration	Facilities								2			2					
	Voter	3	3	2	3	3	3	2	2		1	2	4	3	1		
Permits	Building	2	3				3				3	3		3			
	Parking	2															
Customer service	Action requests (complaints)	2		3	3		3						3	3	3		
	Code enforcement	4							2			1					
	Payment Histories																
	Schedules (hrs)	2	2	2	2	1	2	1	1	2	2	2	2	2	2	1	
	Utility Information requests	2	2	3	2	2	3	4	2		2	2				1	
	Individual ID for eAlerts/personal info	4	4					4	4			4			4		
Commu-nication	Incidental closure								1								
	Emergency Mgmt		1	2	2	2	2		2	4	1	2	2	2	1	1	
	Road closure/detour Calendar/Announcement of event	1			2	1	1	4	4	1	4	2					
Licenses	Dog	3	3		3	3	3	2	2	3		2		3			1
	Small Business (Bingo)		3														
	Hunting		2		3	3	3	2	2	4		2					1
	Fishing		2		3	3	3	2	2	4		2					1
	Marriage					1		1			1	1				1	1
Images	GIS online	4	1	4		2	1	2	2	2	4		2				
	Plat maps	4	3	4				0		2						0	
	Document Mgmt System	4		4	1	2	1	1	2		2						

Category	Item															
Audio /Video	Streaming video of council meetings				4											
	Video-walk through directions to depts/facilities	1		4	4		2			2					2	
	Video-conf of proceedings over long distance							4								
Docs	Minutes of meetings	1	1				1	1						1	1	
	County Code	1	1		1	1	1		1	1	1	1	1			
	County Charter							1			1	1				1
	Budget report		2		1	3		3				1				
	Downloadable forms	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Applica- tions	Job applications		3			2	3			4		3		1		
	Bidder applications			3												
E- procurem ent	Bids online					4										
	Proposals online					3										
Misc.	Property assessment history look up				4	2	2	1	2	2	1		2			
	Zoning look up	4	2	4	1		1	1		2	4	1	2			1
	Online survey polls	4			4								4			
	Conversation forums		4							4						
	Community resources	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	School districts		2			2		2						2	1	
	Townships and municipalities	2	2	2		2	2		2		2		4		2	
	Directions and transportation	2	2	2	2	2	2	2	2		2	1	2			2

Legend

Monroe: http://www.co.monroe.pa.us/monroe/site/default.asp?afpNav=|&tx=0

Sullivan: http://www.sullivancounty-pa.us/

Montour: http://www.montourco.org/montour/cwp/view.asp?a=3&Q=404225&montourNav=|

Bradford: http://www.bradfordcountypa.org/

Venango: http://www.co.venango.pa.us/Home/Index.htm

Crawford: http://www.co.crawford.pa.us/

Schuylkill: http://www.co.schuylkill.pa.us/

Adams: http://www.adamscounty.us/adams/site/default.asp

Mifflin: http://www.co.mifflin.pa.us/mifflin/site/default.asp

Snyder: http://www.snydercounty.org/snyder/site/default.asp

0-not present on website

1-Information present on website

2-Link to relevant contact (phone/email)

3-Downloadable forms available

4-Transaction or other interaction can take place completely online

Website URLs of Counties Surveyed

Lawrence: http://www.co.lawrence.pa.us/

Somerset: http://www.co.somerset.pa.us/

Bedford: http://bedford.pacounties.org/bedford/site/default.asp

Warren: http://www.warren-county.net/

Forest: http://www.co.forest.pa.us/

Table 7. Ratings of Government Websites in Selected Municipalities in Pennsylvania

Category	Dimension	Somerset Boro	Carroll Valley	Ridgebury Twp	Selins-grove	Franklin	Toby–hanna twp	Danville	New Castle	Cochran-ton Boro	Eagles Mere	Warren	Norwe-gian Twp
County		Somerset	Adams	Bradford	Snyder	Venango	Monroe	Montour	Lawrence	Crawford	Sullivan	Warren	Schuylkill
	Total Points	49	46	37	34	33	30	26	24	22	20	19	6
Payments	Utilities	3										1	
	Taxes	2		2			1			1		2	
	Fees (services)	1	2	2			2	2		2			1
Regis-tration	Facilities (business)		2	4			3						
Permits	Building	3	3	2	3		3	1				1	
	Parking	3	3		1								
Customer service	Action requests (complaints)	2	3	2	3	3							
	Code enforcement	1		2		1			2				
	Payment Histories												
	Schedules (hrs)	2	2	2	2	2		2	2	2		2	
	Utility	1	2	1	1	2	1	1	1	1			1
	Information requests	2	2				2		2		2		
	Individual ID for eAlerts/personal info	4							4				
Commu-nication	Incidental closure												
	Emergency Mgmt	4	2	2	4	1	2	2	1	1	2	2	
	Road closure/detour		1										
	Calendar/Announcement of event	2	2	1	2	2	2	1	2		2	2	1
Images	GIS online			1	1				1	1	2		
	Plat maps												
Audio /Video	Streaming video of City council meetings		4							1			
	Video or still image tour of town	4											
Documents	Minutes of meetings	1	1	1			1				1		
	Legal Code	1	1	1	1	2	1	1	1	1		1	
	Legal Charter		1	1			1	1	1	1			
	Budget report						1	1					
	Downloadable forms	3	3	3	3	3	3				3		
	Job applications			1		3	1						

Category	Dimension												
Misc.	Property assessment history look up												
	Zoning look up					1		2					
	Online survey polls		4		4								
	Conversation forums		3							4			
	Community resources	2	2	2	2	2	2	2	2	2	2	2	1
	School districts				2	2			2	2			
	Directions and transportation				1	2			2				
	Recycling	4		2	2	1	1	2	1			1	1
	Community Organizations/events	2		2	2	2					2	2	1
	Recreation services info		2	2		2	2	2	2	2	2	2	
	Message board	2	1	1		2	1	1	1	1	2	2	1

*Some local government websites that did not have any entries for certain dimensions were removed from the table above but are listed below

Legend

0-not present on website
1-Information present on website
2-Link to relevant contact (phone/email)
3-Downloadable forms available
4-Transaction or other interaction can take place completely online

Payments	Fines
	Permits
	Registrations
Registration	Voter
Licenses	Bike, Dog, Taxi, Small Business (Bingo), Hunting, Fishing, Marriage
Audio/Video	Video-walk through directions to depts./facilities
	Video-conf of proceedings over long distance
E-procurement	Bids on-line
	Proposals online

Website URLs of Local Governments Surveyed

Carroll Valley: http://www.carrollvalley.org/
Ridgebury Township: http://www.ridgeburytownship.com/
Cochranton Boro: http://www.cochrantonboro.org/main
New Castle: http://www.newcastlepa.org/
Tobyhanna twp: http://www.tobyhannatownship.org/
Danville: http://www.danvilleboro.org/mon-danville/site/default.asp
Norwegian Twp: http://norwegiantownship.com/
Selinsgrove: http://www.selinsgrove.org/
Somerset Boro: http://www.somersetborough.com/
Eagles Mere: http://www.eaglesmere.org/
Franklin: http://www.franklinpennsylvania.us/
Warren: http://www.cityofwarrenpa.org/

Education Case Study

As discussed in the section on the uses of broadband in education, the range of uses is quite broad and extends from very basic applications, such as the search for new information, to long distance co-teaching with classrooms and schools halfway around the world. In this section, the factors that influence the utilization of broadband in the education sector are discussed. A continuum of factors is examined that, on the one hand, enable utilization of the technology for basic functions while, on the other hand, result in or support the realization of the transformative potential of new technology applications. The focus here is first on the overlapping networks that shape the application of new technology to the experience of education. Transactional activities are discussed that primarily enhance efficiency, followed by a discussion of factors that transform the educational experience.

Networks

The education sector consists of many small networks of people connected by interdependence and interrelations and the roles they play in providing good quality education to students. In studying the education sector, three small networks were identified. The first of these networks was the telecom service providers, which include the ISP, Intermediate Units, private vendors of Internet-based educational resources, and the Pennsylvania Department of Education. The second network included facilitators— all school support staff, such as the technology officer and administrative staff. The third network included the users, educators, and students. Maximizing the opportunities offered by broadband to the delivery of education requires transforming the current methods of imparting education through cooperation across the three networks.

Transactional Activities

Although the three networks within the education sector are independent, they do not operate in isolation. Members of one network interact with and are important sources of support and encouragement for other members of the network. For instance, the technology officer for the school district interacts with the Intermediate Units and the ISPs to buy bandwidth and then trains the administrative staff and the teachers to explore the various capabilities made possible by access to this bandwidth. These interactions within and between the networks are transactional activities that are fundamental to technology uptake and adaptation. However, interactions are vertically structured. The group with the greatest authority functions as a gate keeper and regulates who along the chain is empowered to respond. This hierarchy can reduce the possibility of local-level innovation and initiative.

Teaching Methods

The data from the case studies show that with the exception of one school district, 11 of the 12 schools interviewed used broadband to enhance current teaching practices. With the availability of broadband in the schools, the teachers can supplement traditional classroom teaching methods with technological aids. Thus, in addition to the textbook, the teacher now has the opportunity to introduce variety into classroom lessons by showing a video clip on the subject of the day. Real-time exposure to information content on the Internet demonstrates the capabilities and information retrieval opportunities available from the World Wide Web. This is an especially important spillover from real-time utilization of the Internet, particularly given that many students

may have computers in the home, but only dial-up service, and thus limited capacity to explore some of the more bandwidth-intensive features of the Internet.

However, it is important to note that although teachers have the facility to use information from the Internet during instructional activities, the bandwidth in most of the schools interviewed is not sufficient to access the Internet real time for instruction in the classroom. Heavy transfer of data over limited bandwidth causes delays in download time and may often limit access to websites. In the absence of sufficient bandwidth, teachers are required to download relevant information and save it on a disk before class to ensure against delays during class time.

Teachers now use several Internet-based programs and software available via broadband to enhance the educational experience in the classroom. Social science teachers, more often than science teachers, supplement classroom teaching with online material. These online materials are available from private vendors such as United Data Streaming, which is owned by the Discovery Channel. Video clips downloaded from its website may be shown to the students. Compass Odyssey and Carnegie Learning are examples of private programs used to aid science and math classes.

In addition to these online programs, another method of instruction is video conferencing, although this method is very seldom used. One school district in Pennsylvania interviewed for this project is using video conferencing to connect with a museum in New York in order to show the students artifacts. Though a powerful teaching tool, this method is not interactive. It only involves one-way video streaming with voice communication conducted over the phone. Optimal use of this technology requires bandwidth in excess of that currently available. Thus, although broadband does

support more interactive lessons, current bandwidth is only sufficient to supplement traditional classroom teaching methods.

Administrative Work

As informed during the interviews, access to broadband in schools has markedly improved the administrative efficiency of the staff. Many schools have established an Intranet that is used by teachers and staff for emailing and for maintaining an online database. In some schools teachers are encouraged to maintain records of grades and attendance in electronic form. Several school districts operate an online database system in which teachers can enter the grades and attendance for each student. In one of the schools that was interviewed the database can be accessed remotely, i.e., from the teacher's home, if any changes need to be made to the records. This type of system also makes it easier for students to access their grades. In another school district the students are provided with an ID to use on the school's Intranet; they keep this ID until they graduate from the school. With it they can access their grades and keep a record from primary school on.

In another school district an electronic database is being set up to maintain grade records. It will be accessible not only to teachers but to the parents of the students, too. When completed, the three groups will be able to pull up information about a child's progress in school. Parents will be able to view comments from the teachers without having to engage the teacher in person. The database will be accessible from home via the Internet.

Teacher-centric vs. Student-centric Teaching Methods

With the introduction of broadband in schools, the Internet now allows teachers to download and incorporate new material into their lectures. This new capability has yet to invoke a change in the general practice of education in many schools in rural Pennsylvania. With the introduction of broadband, relations between teachers and students have remained the same. The teachers use broadband to supplement their classroom teaching while the students use the Internet only to do research for assignments. Advanced technology-assisted teaching methods are not exercised and classroom teaching has not evolved toward a more student-centric model of interaction and performance. In contrast, this trend has become popular in other parts of the world, like the UK, where broadband-enabled teaching methods are transforming traditional teaching methods.

Transformational Activities

Broadband access has enabled pedagogical transformation in the education sector in places where sufficiently high bandwidth has been made available to students and teachers. The high bandwidth provides new opportunities for changing and improving teaching and learning methods in schools. Traditional classroom teaching methods are now supplemented with greater use of multimedia and students are becoming more involved in the overall exchange of knowledge. These transformations are dependent on a variety of enabling and constraining factors. Some of these are discussed in greater detail below.

Interactive Learning

Interactive learning is a transformational pedagogy that brings together various groups of people at geographic distances. Such interaction takes place through video conferencing. The substantial volumes of audio and video exchange during video conferencing require a large bandwidth. In the past, dial-up services limited this type of activity. With the introduction of broadband it is possible for two or more groups of students to interact and learn from each other's experience.

Case studies of the school districts in rural Pennsylvania reveal no school as of yet using video conferencing for interactive learning in the classroom. When asked why the method had not yet been utilized, most interviewees said that they did not have sufficient bandwidth to support such a class. They also indicated that the conference technology was expensive and therefore unavailable. Three school districts said they did have the bandwidth but no initiative had been taken to establish such a class.

Self-directed Learning

The use of broadband has been incorporated by the teachers into the curriculum in all school districts studied in Pennsylvania except one school district. Social science teachers are more likely to use the technology compared to teachers of mathematics and science. Using this type of technology is the responsibility of the teacher. The field data show no evidence of student participation in curriculum development. At this point Internet technology is assisting teachers in adding variety to the classroom. As yet, students are not involved in using the Internet to help plan the curriculum. Students do engage in aspects of self-learning through the use of the Internet—some in computer labs where they engage in research on the Internet. Research contributes to classroom projects

and individual learning. Lab time generally comprises a small amount of total time in school.

Creators of Teaching Material

In schools where broadband has been successfully used to transform the educational experience from a teacher-centric to a student-centric learning process, the students are not just the receivers of information—they also create material that can be used in teaching. In Pennsylvania, one school district has initiated using technology to enable the students to create material that can be shared via the Internet. Music lessons are being recorded by the students and posted on the Internet for Podcasts. Anyone can access these lessons and performances on the Internet. The students are also being taught editing skills using software like Adobe Premiere so that they can make their own movies and post them for Podcasts. Current Pennsylvania government policies restrict students from making educational films freely. This transformation has been introduced in this school district by the technology officer, who encourages students to explore newer avenues for learning.

Distributed Learning

Broadband has facilitated distributed learning by allowing many more people to take advantage of educational institutions, even if they cannot be physically present at the institution or school. In rural Pennsylvania bandwidth limitations have so far prevented distance learning. In two cases interviewed schools indicated bandwidth is being expanded and the school is planning to offer classes online allowing students the ability to take courses from their home. This capacity will enable students to attend school part-time, and is targeted at students who have illnesses or other conditions that limit their

regular attendance at the public school. In one school district meritorious high school students are allowed to take courses for college credit from the local college. These credits can be taken online from their school.

In another school district, the technology officer mentioned that all members of the local Intermediate Unit are connected through an intranet called a 'cloud'. This 'cloud' enables them to share a higher bandwidth among themselves and thus enables the transfer of larger files. Using this shared resource, this district is planning to offer additional language classes without adding more language teachers. Small demand for language courses often inhibits the diversity of language offerings. Using the Internet, the school district will be able to offer more variety to smaller size classes. Using video conferencing technology, interested students will be able to connect to another school in the district within the 'cloud' to take additional languages. This plan was in the pipeline when the interview was conducted and was supposed to begin in fall 2006.

These transformations are not easy to undertake and are dependent on numerous factors that both enable and restrict the ability to pursue these opportunities. These factors are discussed in the next sections.

Enabling Factors

In the education sector, two main enabling factors promote transformation: human capital and complementary technology.

Human Capital

Human capital is an important enabling factor that can aid in the transformation of traditional practices. Successful implementation of new technology requires members in the three networks to work in tandem to improve the learning experience. The principal

and teachers in the school need to be forward-thinking and open to adopting technology to enhance their teaching methods. This requires training in the use of the new technology and multimedia available online. In most cases, the technology officer is responsible for training the staff and the teachers.

The interview data for this project shows that in nine of the twelve school districts interviewed the training of teachers to use the technology lags behind the availability of technology and is not necessarily a part of training schemes in school districts. The teachers are primarily expected to learn to use the technology on their own. They have to take the initiative to request for training or help from the technology officer of their school district. Given time constraints and the absence of tutorial assistance, teachers often lack the motivation to become self sufficient with the technology let alone use it to pursue a transformational trajectory in their teaching. The teachers are provided training by private vendors when new Internet-based teaching programs are introduced in the school, but this training program is not repeated on a regular basis for new teachers or refresher courses for experienced teachers. If the teachers require help with certain programs, then they are trained by the technology officer in their school district on a one-on-one basis. In two of the school districts that were interviewed, the Intermediate Units they were members of provided some training to the teachers on the use of the Internet in preparing lectures. However, this was not conducted on a regular basis (e.g., every school year). With ever-expanding opportunities and possibilities available on the Internet to restructure classroom teaching material, it is necessary for teachers to be updated on the variety of supplemental information and teaching aids they can use. (When possible, many teachers seek training from private vendors whose online

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programs they will be using. When available, they also seek training from the technology

officer.) Overall, the interviews identified a serious shortage of training opportunities for

teachers to become not just conversant but adventurous with new technologies. With the

exception of one school district, none had a comprehensive training program for the

teachers and staff; most conduct training sessions on an as-needed basis. On the other

hand, the school district that does conduct a regular training program is quite advanced in

the use of technology in the classroom. Conversations with these schools suggest a

correlation between the availability of regular training and the improvement of curricula

in schools. Providing training not only gives teachers the necessary skills to use the

technology for conventional purposes, but may spur them on to try new and varied

approaches to education.

The interviews conducted for this project suggest a gap in the availability of

administrative personnel in the use of Internet technology. In one school district there

has not been a technology officer for the last 18 months. Most of the technology and

hardware support is provided by a technician who maintains the current computer

infrastructure. In the absence of a technology officer, the school district is dependent on

its Intermediate Unit to upgrade its technology and broadband connection, which often

takes much longer than if the school could upgrade by itself. On the other hand, an

adequate number of staff and the training provided to them could help to develop the

technology available in the school district. Interviews identified an interesting example

of how training helps the staff perform job functions better. In one school district, the

staff took training from the Pennsylvania Department of Education on how to write grant

applications. This training program was conducted over the Internet, and was therefore

available to staff. The staff then utilized this training to apply for funds to improve the

technology available in the school and they were granted the funds. These funds were

used to buy more bandwidth to enable higher-end technical operations. Thus, it can be

said that investment in human capital in the school creates a better environment for

learning and has positive spillover effects on the overall mission of the district.

Complementary Technology

To enable a technologically advanced learning environment, it is important to

have good human capital but at the same time it is also necessary to have supporting

technology that enables the use of online services. High bandwidth is essential to ensure

that large audio and video files can be transferred smoothly and in a timely fashion. This

is particularly important in real time as class periods are short and limited bandwidth

means that downloading files can take awhile, which is frustrating for both teachers and

students. Absolute size of capacity is essential for a school to be comprehensively

connected. The more people use the technology, the greater the demands for bandwidth.

Thus, bandwidth truly is a rate-limiting resource because the existing T1 broadband

connection most of the school districts interviewed have is insufficient for classroom

utilization. To encourage usage that progresses beyond basic usage requires that

connections are sufficient to cater to the needs of all members of a school's educational

team. Only a few school districts interviewed were capable of providing bandwidth on

demand. Thus the interest of the staff and their willingness to upgrade their usage is

limited. The connections need to be fast enough to cater to everyone's needs.

Incorporating online material in class also requires technology equipment. While

all schools had at least a PC for most teachers in each classroom, PCs in classrooms for

student usage were not always adequate. One-third of the schools had no computer in classrooms for student use. Instead, mobile labs were provided. While certainly better than no technology, the lack of fixed technology in classrooms prevents teachers from engaging students in online interactive lessons, even if they want to. In several school districts, projector availability was limited; hence, teachers could not show live video unless a projector had been reserved prior to class. A lack of technology resources inhibits spontaneous learning—one well-recognized measure of transformative usage.

Constraining Factors

Restrictive Policy

Institutional constraints are apparent and can hamper the introduction and utilization of Internet-based broadband-enabled technology. One constraint is restrictive government policy that regulates student participation in online activities. In one case we were told that students could not participate in interactive learning due to the Family Educational Rights and Privacy Act (FERPA). This Act prohibits publishing or posting pictures of the students on any public space without the permission of their parent. As a result, students eager to make short films for lessons are unable to do so freely since students are not allowed to spontaneously be a part of the video. Today, videos created by students can only contain the picture of the teacher. Only audio files of music lessons and recitals are allowed to be posted, with limitations. Even if sufficient bandwidth is available in a school district to post short films made by the students on the Internet, such a policy constrains students' creativity in improving their learning environment.

High Cost of Bandwidth

Another factor that has been a serious constraining factor in making higher

bandwidth available in rural school districts is the high cost of bandwidth. Only 3 of the

total number of school districts interviewed had upgraded from a T1 line, which provides

only 1.5 mbps. This is insufficient to conduct video conferencing or to allow video

streaming online. Teachers' ability to introduce new methods of teaching in class is

limited by this lack of availability. According to four rural districts, this problem is being

addressed with government funds available through their Intermediate Unit to buy better

technology and bandwidth starting from the school year 2006–07.

Summary

In conclusion, the networks in the education sector in rural Pennsylvania interact

to enhance the education system through better technology-enabled teaching and learning

methods. However, these practices remain limited in scope, acting more as supplements

to traditional teaching practices than offering the opportunity to transform the educational

experience from a teacher-centric to a student-centric learning environment. Gaps in

human capital and complementary technology must be overcome to move Internet

utilization to a higher level in line with global best practices. It is no longer sufficient to

compare U.S. schools with other schools nationally, particularly because global standards

are being set in countries around the world (e.g., the UK, parts of Asia).

Healthcare Case Study

As seen in the review of existing studies of broadband applications in healthcare,

there is a substantial range of applications from very basic administrative functions to

advanced applications of telemedicine. As noted by Bauer et al. (2002), the range of

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applications varies considerably some more and less dependent on broadband availability. Table 8 suggests that there is both a range of applications and a range of required technologies to enable telemedicine.

In the case study of the healthcare sector, the general application of broadband and information technology revealed a continually changing environment in which organizational issues within hospitals and the regulatory environment in which hospitals must operate are both driving utilization of IT-related services and placing severe constraints on what can actually be done due to privacy concerns. Hospitals were selected as the unit of analysis primarily because the literature predominantly focused on the application of broadband in these medical units. Hospitals also were selected as units of analysis because their character could be discriminated from other types of medical facility. Another reason is that to the extent that they are present, a medical institution is usually at the center of communities. The following analysis consists of two levels of information: to the extent possible, an analysis of websites of hospitals in the counties selected for study; and to the extent possible, interviews were conducted with technology personnel in a nonrepresentative sample of hospitals in the same counties. The website analysis followed a similar logic to that of the e-government analysis.

Interviews with hospitals were attempted in a similar manner to the education sector, however, with a substantially lower response rate as mentioned above. In this report, the interview findings, though suggestive of the experience of the healthcare sector, cannot be generalized. A conclusion of this report refers to the need for a more systematic assessment of broadband utilization in sectors such as healthcare where changes in the industry are occurring rapidly and technology demands identified in the

Table 8

Forms of telemedicine and their bandwidth requirements

Applications	Minimum Network Requirement	Supplementary Devices / Resources
Telediagnosis	POTS	-Telephone, mail, email or fax
Teledermatology	POTS	-Telephone, mail, email or fax, video display units with high resolution image data if necessary
Teleultrasound (Telesonography)	-4 or 6 ISDN lines for cardiology real-time motion video (256 or 384Kbps)	1. Experts with extensive information regarding the overall state of the patient, moderate operator, and an expert for reading images at once 2. Devices, PACS, MM tools, video display units, audio & video codecs, VC conference management tools, electronic board, microphones, speakers, ultrasound device, remote control, control board
Telemonitoring	-56K, BRI ISDN, fractional T-1 -ATM, DSL in case real-time multimedia communication is needed	1.An expert who monitors the sent biosignals and image data 2. Devices: blood pressure monitors, pulmonary function monitors, electronic stethoscope, tele-EKG (Electrocardiogram), tele-echocardiography and ultrasound systems, untegrated light, video camera platforms, dermascope, 1-CCD camera, dental cameras
Teleconsultation	-At least fractional T-1 -ATM, DSL or cable network	1.High resolution visual data and video display units for patient monitoring 2. Videoconferencing systems and interactive video room systems 3. Computer-supported teleconferencing systems
Teleradiology	-ATM	-PACS (Picture Archiving and Communication Systems), high-resolution monitors, connectivity system, frame grabbers, compression techniques for heavy loaded image or video data, store-and-forward systems (audio and video capture card, camera, microphone, and image management software)

POTS: Plain old telephone service

BRI ISDN: Basic Rate Interface Integrated Services Digital Network

ATM: Asynchronous Transfer Mode

DSL: Digital Subscriber Line

literature are increasing over time even as costs are rising for technology applications in healthcare.

In the following discussion, a continuum of factors is examined that, on the one hand, enable utilization of the technology for basic functions while, on the other hand,

result in or support the realization of the transformative potential of new technology applications. The focus here is first on the overlapping networks that shape the application of new technology to the experience of health care. Transactional activities are discussed that primarily enhance efficiency, followed by a discussion of factors that transform the health care experience.

Networks

In examining the networks of actors involved in the demand for utilization of broadband services in the hospital sector, a range of network participants was identified from the literature and from the interviews conducted. These networks are not meant to be universal nor are levels described meant to be mutually exclusive. The intent in using the concept of a network is to highlight the embedded nature of determinants of technology uptake in the hospital sector and to learn about factors that seemed to encourage or discourage the use of broadband technology. In this case the network was multi-scalar in nature, from the most proximate--that of the hospital itself--to higher in scale and more removed from the hospital, taking into account the community and the larger world of medicine and hospital practice. The concept of network here serves as a heuristic or tool to aid in explanation.

Due to the regulatory and community context of a hospital, the network in which it is embedded is complex. The complexity of the network is due to the number of participants in it and the number of scales of operation. At the immediate level of the hospital there is the medical staff, including doctors and nurses, and support personnel, including administrators. Depending on the setting there also are medical students, community members working as volunteers, and of course the patients. At the

community level, a second network exists and includes the Internet Service Provider, other utilities involved in possible information services, social service agencies, religious organizations, local public officials, and citizen groups concerned about the quality of local healthcare. At a still higher level is a third network that includes regulatory functions, suppliers, critical care services (life flight), partner service providers, and professional organizations. In some cases there is another level of the network in which extra-local, sometimes national, organizations interact with local hospitals. Across the networks, patients' rights of privacy are paramount. Standards of performance also are cross-network in effect. Thus, the demand for broadband service is very high, but the fragmented nature of the environment, the overlapping but distinct networks, and the number of actors have major implications for both broadband usage and IT applications.

Transactional Environment

Hospitals are transaction-intensive environments from employee registration and intake, to various testing and medial assessment activities, including radiology, other imagery activities, hematology and other activities that could include distant service provision conducted over the Internet. In addition, there is a constant stream of information both in and out of a hospital, engaging local, regional, and national organizations. As pointed out in Table 10, a very large range of transactions are facilitated and in some cases require distant interactions. In our interviews we found that the hospitals shared many qualities. All hospitals offered cancer treatment and wellness services, and three offered advanced radiology services. Two had facilities off site and one is part of a network. Three of the four offered long-term services and two operated elder care facilities. All indicated that they consult with physicians at distant healthcare

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facilities and one noted that proximity to a metro area made possible regular consultation with specialists in the nearby metro area.

Using the list of services identified by Bauer et al. (2002) as activities supported by broadband capability, the interviews revealed that the four hospitals lacked sufficient Internet connectivity to accomplish many of these services. For example, while doctors uniformly used the Internet for clinical applications, which included doctor-to-doctor interaction and remote consultation between doctors, more advanced services such as remote surgery were not possible given the services currently available to the hospital. None of the four hospitals used the Internet to monitor the elderly, to conduct telepsychiatry, or to offer prison telemedicine. The four hospitals noted that the available Internet services were effective for educational purposes. All four hospitals reported that their Internet service was effective in allowing Internet consultation of databases and other medical library resources, but that the services were not very effective for prescriptions or appointment booking. (See Table 11.)

Transformational Experiences

An analysis of information gleaned from the interviews showed hospitals' understanding of the ways in which the Internet could transform services provided in the medical field. Many of the current limitations are tied to a lack of human resources required to automate and animate certain capabilities. To offer online registration and bookings requires programming services that are expensive and not universally available. More advanced medical services associated with remote consultancies also required more sophisticated service packages. While doctors and service providers could imagine ways

that current services could be improved, all required more effective telecommunications services.

Constraining Factors

Uniformly, in the four interviews the absence of bandwidth and its price were seen as important constraints on utilization of the Internet for medical applications in hospital settings. Another factor considered important in the rate of Internet usage was the age of the doctor. In two of the interviews, administrators indicated that the demand for and application of broadband Internet capacity was related to the age of the medical professional using it. Doctors under the age of 50 were more likely to have come in contact with the Internet and a range of uses of the Internet as part of medical school training. The more time that had elapsed from time in medical school, the lower the doctor's contact with and utilization of the Internet.

Enabling Factors

The literature and to some degree the interviews highlight factors that improve the quality of broadband enabled medical service functions. Being in a network did seem to encourage and support more complex IT applications. While anecdotal, based on the website analysis and the four interviews, there was some suggestion that in medical facilities that were in proximity to a metro area or were part of a medical service network, there was a greater willingness by doctors' to consult with other medical practitioners. This was particularly true given proximity to medical school-related personnel. See Table 9.

Table 9. Summary of Hospital Broadband Service Utilization to Complete Health Service Activity

Application	Survey Questions Drawn	Hospital 1 Results	Hospital 2 Results	Hospital 3 Results	Hospital 4 Results
Clinical Applications in General (Doctor to Doctor)	B1, B2, B4, B5, B6, B7	Good	Fair	Good	Good
Remote Surgery, Telepresence Surgery (Doctor to Doctor)	N/A	N/A	N/A	N/A	N/A
Remote Monitoring (Doctor/Nurse to Patient)	B9, B10, B11	Poor	Poor	Good	Poor
Remote Consultation (Doctor to Doctor)	B5	Fair	Good	Good	Poor
Teleradiology, Filmless Radiology, (Doctor to Doctor)	B1, B2, B3	Good	Poor	Good	Fair
Independent Living of Elderly (Doctor/Nurse to Patient)	N/A	N/A	N/A	N/A	N/A
Telepsychiatry (Doctor to Patient)	N/A	N/A	N/A	N/A	N/A
Prison Telemedicine (Doctor to Patient)	N/A	N/A	N/A	N/A	N/A
School Telemedicine (Doctor to Patient)	N/A	N/A	N/A	N/A	N/A
Education and Professional Development (Doctor to Student)	C1-C6	Good	Fair	Good	Fair
Electronic Health Records (Doctor to Database)	B1, B5, B6	Good	Fair	Good	Fair
Online Databases (Doctor to Database)	B1, B5, B6	Fair	Fair	Good	Fair
Online Appointment Booking (Doctor to Database)	B1, B10	Fair	Poor	Fair	Fair
Electronic Prescriptions (Doctor to Database)	B1, B10	Fair	Poor	Fair	Fair

In the interviews, information technology staff or administrator were asked to rate the extent of Internet use in conducting a variety of medically related activities identified in the literature. The rating was a subjective assessment of the hospital's performance vis-à-vis broadband utilization for advanced IT-enabled healthcare services. The small

sample size and diversity of hospital organizations interviewed made assessment of differences between transactional and transformative activities problematic. While the literature review clearly highlighted examples of both qualities, our interviews were not sufficiently representative to make conclusive assessments of the degree that broadband utilization in hospitals in rural Pennsylvania had enabled the transition from transactional to transformative utilization. The four interviews suggest that the hospitals are generally able to use the technology for transactional purposes with less demonstrated transformational usage.

Generalizations from these findings relative to rural healthcare as whole should be made with caution. These four interviews only indicate that certain practices found in the medical services sector in other places and reported in the literature did not appear to be practiced in the hospitals that participated in this study. Furthermore, given the lack of a universally accepted metric of service use level, much less service quality in the hospital sector, the results of this discussion must be viewed as subjective indicators and not statistical indicators of conditions and practices in rural PA.

Summary

There has been extensive growth in the use of broadband-enabled services in hospitals. The new technology has allowed willing doctors to move toward evidence-based medicine. One IT administrator mentioned that the hospital was a member of a healthcare alliance of 13 hospitals in rural Pennsylvania that have banded together, including Chief Financial Officers, Chief Information Officers, and Radiologists, to address issues related to technology utilization. This association has been important in sharing information and discussing problems that affect all participants.

Small Businesses Case Study: Powdered Metal Broadband Utilization

Background

North Central Pennsylvania, despite being a predominantly rural area, has become known for its strength in industrial manufacturing, particularly the powdered metal industry. At its in the late 1980s, Pennsylvania produced 40% of the country's powdered metal (PM) parts, with the majority of this production occurring in the 6-county region centered on the towns of Ridgway and St. Mary's (Benner, 2005). The continued importance of the fabricated metal products industry to the region is evident in the fact that, in 2005, manufacturing still accounted for 43% of all jobs in Elk County and 27% in Jefferson County. See Figure 4.
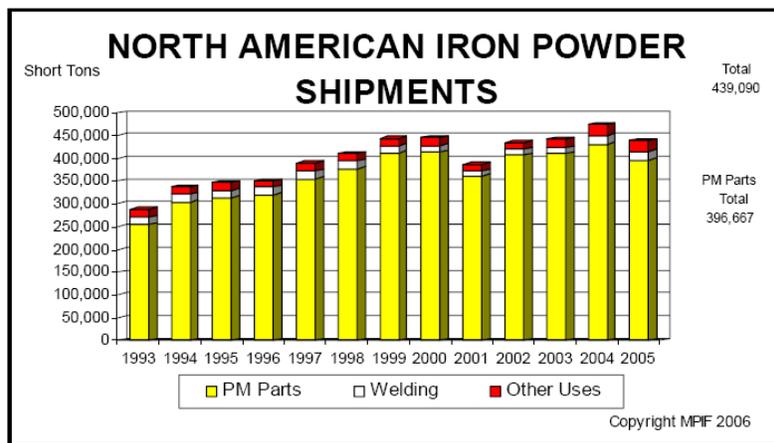
Figure 4. North American Iron Powder Shipments

Source: Daver, Edul and Trombino, C. James (2006) State of the PM Industry in North America-2006 (Metal Powder Industries Federation: Princeton, NJ).
http://www.mpif.org/introPM/stateindustry06.pdf

The region was most dramatically affected by displacement in the 1980s, as powdered metal manufacturers moved to the U.S. South, and to Mexico, often following the 1st and 2nd tier automotive parts suppliers that are their major customers. Through the 1990s, employment in the region stabilized and even grew modestly overall, but

manufacturing employees continued to experience layoffs, a trend that was exacerbated in the 2001 recession. Economic development officials in the region report that many manufacturing companies have expanded hiring in recent years, reflecting an upturn in the industry overall. Recent upheaval in the U.S. auto industry, however, led to a decrease in total shipments in 2005. The region's powdered metal industry is threatened by significant structural changes as well. Since the early 1990s, there has been significant consolidation in the industry, with an increasing number of local firms being bought out by global corporations such as GKN and Metaldyne. As part of this consolidation process, manufacturing of PM parts has increasingly diffused across the U.S., and expanded in Europe and Mexico and increasingly in China. As a result, northcentral PA is losing its prominence in the global industry[12].

Future growth in the industry will depend on two main factors. The first is technology improvements, including the use of new materials and production processes that will allow parts with greater density and durability. This greater fatigue strength will expand applications of PM parts in automotive transmission, engines and the chassis. The second major factor will be the expansion of the PM parts final market beyond the auto industry to other industries, including other small motors (lawn mowers, generators, etc.), manufacturing tools, medical instruments, and so on.

Many factors could continue to keep PM manufacturing employment in the region, including rapid global growth in the industry, a well trained workforce, good economic development and workforce development partnerships in the region, and ties with Pennsylvania State University, one of the leading research centers on new materials

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[12] See Ben Franklin Technology Center of Central and Northern Pennsylvania (1999), *Technology 21 Advanced Materials Cluster Report: Powder Metals Industry.*

and innovative PM product development in the world. But it is unclear at the moment how well many firms in the region are likely innovate in the face of major structural changes in the industry. Many of the small firms that still remain in the PM industry in the region are private, family-owned firms. Their economic future will in part lie in their ability to identify new markets for their products, both in the automobile parts industry and in new industries, and to develop new parts and production processes that can meet these new products.

According to interviews with key informants in the region, the use of broadband Internet access is potentially a critical component in finding and responding to these new markets. Broadband is also potentially valuable for integration with research and technical assistance networks, through Pennsylvania State University (both the DuBois and University Park Campuses), the North-Central PA Regional Planning and Development Commission, and the Ben Franklin Technology Partners.

Broadband Internet Network

The core actors within the network related to broadband Internet use in the Powdered Metal industry in the region include the following.

Powdered Metal Firms*:* Obviously the PM companies themselves are the core of the network. Elk County has a total of 142 firms in the manufacturing sector, while Jefferson County has another 100. Most of these are related to the PM industry.

Customers*:* The auto industry is the largest end-user of PM parts, accounting for an estimated 70% of the final market in 1997[13]. The Big 3 U.S. auto makers average 41–45 pounds of PM parts in their vehicles, which is significantly more than many of the

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[13] Ben Franklin Technology Center of Central and Northern Pennsylvania (1999), *Technology 21 Advanced Materials Cluster Report: Powder Metals Industry* (unpublished manuscript).

foreign transplant vehicles increasingly being manufactured in the U.S., which average only 25–30 pounds[14]. With the decline of U.S. firms and growth in foreign companies, part of the challenge for PM firms in Pennsylvania is to integrate with new auto suppliers, and to contribute to the growth in use of PM parts in these new foreign transplants. In addition, markets in a range of other industries are growing, including:

- Abrasives—polishing and grinding wheels

- Manufacturing—cutting and drilling tools (using hard metals)

- Electric and magnetic devices—magnets, soft magnetic cores, batteries

- Medical and dental—prostheses, amalgams

- Aerospace—motors, heat shields, structural parts

- Welding—solder, electrodes

- Energy—electrodes, fuel cells

- Abrasives—polishing wheels

- Other—porous filters, bearings, sporting goods, etc.

Thus, one of the critical factors in the PM industry is the extent to which firms in North Central Pennsylvania are finding and communicating with new customers in these other growing markets.

Sales Representatives or Brokers: Several of the small PM firms interviewed utilize brokers to represent their products to potential customers.

Industry Associations: Industry associations are an important way for PM companies to stay abreast of changes in the industry, and to network for new markets and

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[14] Metal Powder Industries Federation (2006), *State of the PM Industry in North America 2006* http://www.mpif.org/IntroPM/pmindustry.asp?linkid=6 (accessed October 27, 2006).

research. The key industry associations are the Metal Powder Industries Federation[15], which is actually a federation of six associations representing different components of the overall PM industry, and the local affiliate, which is the West Pennsylvania Chapter of the Association of Powder Metal Industries (APMI).

North Central Pennsylvania Regional Planning and Development Commission: NCPRPDC is the Local Development District that covers the core area of PM manufacturing in the area. As an economic development and workforce development agency, it provides critical assistance to the industry in the area. This has included creating the Industrial Technical Education Center (ITEC) which focuses on certificate-level training programs in applied skills for the PM industry, including die setting, welding, machinist technology and industrial electronics. It also has created a for-profit arm that directly provides Internet service to a four-county area (Elk, Potter, Clearfield, Cameron).

Pennsylvania State University: Penn State has a variety of programs and research institutes that are critical for the PM industry. Penn State DuBois operates an associate's degree program in Materials Engineering. People graduating from this program typically go to work at a technician's level in area firms. Since the mid-1990s, this program has typically graduated 3–15 people a year, with a strong network of graduates helping to strengthen networks in the region.[16] The DuBois campus also has a continuing education program that conducts customized contract training programs on-site for the employees of PM firms in the region. Established training programs include a range of quality &

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[15] http://www.mpif.org/
[16] http://www.ds.psu.edu/AcademicAffairs/Programs/MATE/Default.htm

process improvement, technical skills, and leadership & management programs.[17] The

University Park campus of Penn State has one of the world's leading departments of

materials science, with a strong program in powdered metals and sintered products.

Many people with B.S. degrees from this program do not necessarily go to work in PM

firms themselves, but frequently go work for consulting firms, or with automotive firms

(i.e., clients of PM parts firms), which typically pay higher salaries and where their

knowledge of the science and technology is still quite useful. In 2000, the Center for

Innovative Sintered Products[18] was established to promote innovation research and

design of PM products and to help commercialize those innovations by working with

firms in the industry. Though the center works with firms throughout the world, and is

thus not particularly focused on Pennsylvania, a significant number of Pennsylvania firms

are members of the Center. It does provide a valuable global resource on the cutting edge

of research and design of new products in the industry, with training at the Ph.D. level.

     Other Technical Assistance Providers*:* Other important institutions that provide

assistance to PM firms in the area include the Ben Franklin Technology Center of Central

and Northern Pennsylvania[19], and small business support programs (such as the Small

Business Development Center at Clarion University[20]).

     ISPs*:* The primary providers of Internet services in the area are North Central

Internet (with Internet backbone service from Telco[21]), Sting Communications[22],

Adelphia (now owned by Comcast), Zito Media[23] (a locally owned firm described as a

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[17] http://www.ds.psu.edu/ContinuingEd/On_SiteContractTraining.htm
[18] www.cisp.psu.edu
[19] http://www.cnp.benfranklin.org/
[20] http://www.clarion.edu/sbdc/
[21] http://www.telco.com/
[22] http://www.stingcom.com/
[23] http://www.zitomedia.com/

"spin-off from Adelphia"), St. Marys Cable[24] and Alltel[25]. All provide high-speed Internet access to at least some areas in the region.

Transactional Use of Broadband

Broadband first became widely available in the area about 4–5 years ago. Most of the broadband use in the PM industry involves improving the effectiveness or efficiency of existing business practice related to internal operations, marketing, supply chain integration, and researching new business opportunities.

Supply-Chain Integration*:* In the past, when PM firms in the area had to exchange data with their customers, they would use dedicated EDI (electronic data interchange) systems in which they sent files via dial-up connections that could take hours to complete. Broadband now allows quicker and more direct communication with customers in the supply chain. One company interviewed described how two of its largest customers now have password-protected log-on systems that allow them to directly access current orders, specifications, and updates. Even in cases where integration simply involves sending files back and forth, the more complex designs generally result in larger file sizes. During product development, design proposals are sent back and forth several times, either by email or FTP. Speeding up this process of interaction between producers and customers has increased the pace of new product development, too. One company interviewed claimed that in the past year, they had developed 100 new parts, whereas a more typical year in the past would have been six new parts per year.

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[24] http://www.stmaryscable.com/
[25] http://www.alltel.com/

Researching new markets: One of the key elements of a business strategy in PM is to find new markets. Companies in the region are using the Internet to do research on potential new markets by identifying parts that are currently machine-tooled, and figuring out how to make them from powdered metal. PM parts are generally much cheaper and more efficient than machine-tooled. Interviews uncovered an example of a cap for a compressor that had been machine-tooled by another company out of a block of metal 3 inches square. It typically took them 6–8 minutes to produce, with all the cutting, grinding, and polishing, and half of the material was lost as waste. The company purchasing the part paid $8 each. The PM company interviewed was able to make the part through PM processes in 10 seconds, at a total cost of less than $1 per part. They could sell it to the customer for $5/part. One company estimated that about half of its new customers came from 'trolling' the Internet and contacting prospective firms. This includes finding clients in India and China.

Minimizing costs of supplies: Firms in the region are using broadband to monitor prices on key inputs (e.g., energy, or powder materials) in order to buy in bulk or pre-buy when prices are lower. Similarly, firms are getting prices for various parts, shipping costs, and inputs off the web, allowing them to select the lowest cost provider.

Business operations: Firms with broadband access are using the Internet for basic business operations, from ordering parts, to doing on-line banking, and so on. Some have also started using the state of Pennsylvania's on-line system for tax withholding on employee paychecks. There has also been some initial movement of broadband directly into production processes. Most modern powder metal presses are outfitted with Ethernet connections. This allows press manufacturers to communicate remotely with the press

for diagnostic purposes. This type of communication is obviously severely limited by dial-up connection. Most businesses in the area, however, still have older machinery and so the use of this kind of remote diagnostics and operations is limited, but increasing as companies upgrade.

Transformative Use of the Internet

In studies of broadband use in large businesses, real transformation occurs when the business realizes the potential of broadband to facilitate organizational restructuring, driving more decision making and autonomy to lower levels of the firm, and allowing for collaborative learning processes among teams of people who use information technologies to help them monitor and improve their own performances[26]. This reflexive, collaborative learning process allows the firm to dramatically improve productivity and to innovate new products and production processes. Small firms tend to have much flatter hierarchies, but the same principles apply. Transformative use of information technologies should empower individuals, including front-line workers, and facilitate collaborative learning processes that drive innovation. This would be particularly transformative if it allowed collaboration across firm boundaries.

Signs of transformative broadband use in the region were limited in the small firms visited. Computers were being used by management, with little use by production workers, and most of the machinery in the small businesses visited was older, without direct Internet connections. The owner of one firm interviewed described experimenting with a computer inventory and tracking system that was directly operated by production

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[26] See for example Brynjolfsson, Erik and Hitt, Lorin (2000), "Beyond Computation: Information Technology, Organizational Transformation and Business Performance", *Journal of Economic Perspectives,* 14:4, 23-48, and Brynjolfsson, Erik, Hitt, Lorin M. and Shinkyu Yang (2002), "Intangible Assets: Computers and Organizational Capital," *Brookings Papers on Economic Activity*: Macroeconomics (1): 137-199.

workers. But the system was based on manual entry, and when the dust in the production room started damaging the unprotected computer placed there, the company stopped the experiment: "…the [production] guys were happy with the paper system."

One firm that seemed to be moving towards more transformative uses of broadband technology was Horizon Technology[27]. The company was founded in 2000. Most of the core staff used to work at another small, family-owned PM business called Windfall Products, which had been bought out, first by MascoTech and then Metaldyne. Windfall Products has most of its business in the auto industry, but the founders of Horizon were not interested in prioritizing work in that sector of the industry, which has low margins, large production runs, and high levels of fluctuations. Instead, they focused on smaller niche markets, including fly-wheels for small motors (e.g., lawn mowers, generators), compressors, steel in chain saws, and a range of other products. Their production machines were primarily new technology, and thus most had direct Internet connectivity. At least two of the machines in their operations are actually owned by other collaborative firms:

- They got their largest press, a $1 million "510", after one of their clients needed a part that could not be made in the smaller "210" machine they had. In a collaborative relationship with the client, the client purchased the press but housed it in Horizon's facilities. The press run for the client uses about half the press's capacity, freeing up the other half for other new product runs.

- They also have a new high temperature furnace that is actually owned by Abbot Furnace Company[28]. Abbot needed the furnace for some R&D work it was

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[27] http://www.horizontechnology.biz/
[28] http://www.abbottfurnace.com/

doing, but Horizon negotiated to have it housed in its facilities for Horizon's use as well.

The exact nature of the collaborative work being done between these firms was not clear from the interviews. What was clear that with these Internet-enabled machines, including the ability to access machine functioning remotely, broadband use was involved in their collaborative work. It is also possible to network the presses and furnaces together with a LAN, rather than through the Internet. For larger companies with many machines, such internal networking would be important, especially in maintaining quality systems. But at the moment, Internet networking was adequate.

The company also made use of the Internet for webinars and training for its staff, learning from on-line multimedia trainings (e.g., for new software, or new technologies) and conference presentations.

Enabling Factors

Even with the limited transactional use of broadband in the area, it is clear that the Internet has the potential to contribute substantially to job growth and economic performance in the industry. Firms interviewed were identifying significant numbers of new clients through web research, and developing new products based on the collaborative sharing of product design specifications with customers, in which the use of broadband has sped up product turnaround times significantly.

Beyond simply having access to broadband services, key enabling factors included the skills required to search and navigate on the web, as well as the knowledge of how to find potential new clients or identify potential new products and market niches. Another major enabling factor, where it exists, is through collaborative networks in the

region. These business and social ties are created through production processes, through economic development networks built by the North Central Pennsylvania Regional Planning and Development Commission, and through the local chapter of the APMI. Sharing of information through these networks is helpful in disseminating new ideas about the use of broadband.

Inhibiting Factors

Despite the clear benefits of broadband Internet use, the transformative use of broadband in the area seems quite limited, and many firms are using broadband to improve the efficiency of simple business functions. Part of the reason for this has to do with the overall structure of the industry. In contrast to tourism, which is highly decentralized, PM is increasingly dominated by large, multi-national firms that are all presumably using the latest technologies and integrating production at a global scale. Without interviewing local divisions of these multi-national firms, there is no basis for comparing broadband use in the small firm sample with best practice in the larger firm sector. But the small firms interviewed generally saw those large MNCs as competitors, not collaborators, and no one mentioned collaborative business relationships with those larger firms.

This is in significant contrast to the tourism sector, where even the large, multi-national firms within the Route 6 area have some mutual interest in collaborating with efforts to promote the region. Thus, for example, the Pocono Mountain Visitors Bureau was able to get the Pocono Ramada Inn and the Hampton Inn in Lehighton (a division of Hilton) to integrate their own reservation systems with the on-line system developed by the PMVB.

Small Business Case Study: Route 6 Tourism Association and Broadband Use in

Northern Pennsylvania

The potential of broadband Internet use in transforming opportunities for small

business in the tourism sector is perhaps best understood through a story of a particular

business in rural Pennsylvania. Jay Roush and his wife Sharon run a bed & breakfast in

the small town of Port Allegany. Located only 17 miles from Coudersport and the

headquarters of Adelphia, Port Allegany has surprisingly good broadband access for a

town of its size in the region. The B&B offers free wireless high-speed Internet to all

their customers. As a former Adelphia employee, Sharon also has a decent Internet

knowledge herself, and perhaps more importantly, the drive and motivation to learn

things about broadband use that she does not already know. She has taken the lead in

integrating broadband Internet use into the business operations of *The Inn on Maple*

Street, the name of their B&B.

Sharon learned web development skills and designed the website for their B&B herself.[29] Though not fancy, the site is attractive, with lots of photographs and detailed information on most anything a potential customer might have questions about, including photos

and descriptions of the different rooms available for rent; photos and descriptions of

[29] www.theinnonmaplestreet.com

common rooms; descriptions of special packages and upcoming special events; detailed policies (e.g., pets welcome); rates; directions; a direct connection to a map of their location on maps.yahoo.com; even a detailed form-based guest book that requests visitors (to both the website and the B&B) to leave detailed feedback and comments on their experiences. With the ability to design her own website, Sharon can modify the site at will, and she keeps it updated with events in the area and seasonal specials.

On a more advanced level, Sharon has set-up a reservations system using www.webervations.com. For only $80 a year with no commission charges or booking fees, this service is a simple way to allow direct Internet bookings. Potential clients can either select a particular date and check availability, or view the availability in all rooms through any 2-week window (see adjacent screenshot). Jay and Sharon have also worked to advertise their B&B throughout numerous networks on the Internet, including the PA Route 6 Association[30], the Potter County Visitors Bureau[31], Port Allegany Chamber of Commerce, Allegheny National Forest Vacation Bureau[32], Pennsylvania Visitors Network[33], Travel and Tourism in Pennsylvania[34], Pennsylvania Tourism & Lodging Association[35], Pennsylvania's Inns[36], Smethport Chamber of Commerce[37], Visit North West Pennsylvania[38], and Bed, Breakfasts & Biking[39]. But *The Inn on Maple Street* isn't simply a member of these various associations and websites—Sharon actively tracks the contribution of each of these associations in driving traffic to her website. Using a web-

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[30] www.paroute6.com
[31] http://www.visitpottercounty.com/
[32] http://www.visitanf.com/
[33] http://www.pavisnet.com/
[34] http://www.visitpa.com/visitpa/home.pa
[35] http://www.patourism.org/
[36] http://www.painns.com/
[37] http://www.smethportchamber.com/
[38] http://www.visitnwpa.com
[39] http://www.bbbiking.com/

statistics service provided by www.thecounter.com for only $21.95/year, Sharon is not only able to see how many people visit their website and when, but she is also able to see the referring website. In this way she can track which memberships or advertising efforts are the most effective, or even which types of searches on Google are helping to direct web-traffic their way, giving her insights into how the wording on her website might attract more traffic.

In many ways, *The Inn on Maple Street* represents the most advanced application of broadband Internet use among small accommodation sites along Route 6. And yet, it also represents some of the greatest challenges facing the further development of broadband use in the region, namely individual and fragmented efforts to expand broadband use that have yet to become integrated into regional marketing, trip-planning, and reservation systems. Potter County, for example, is the site of the headquarters of the PA Route 6 Association, and yet *The Inn on Maple Street* is the only B&B in the county with a website that has an online reservation system. Throughout the PA Route 6 area, use of broadband among service providers is highly uneven, and many lack the skills, experience, or motivation to make effective use of broadband access. While there are examples of exemplary broadband use throughout the region, organizational fragmentation and incompatible technologies create barriers to more effective broadband use.

In what follows, the value of broadband Internet use for tourism in general and the PA Route 6 area in particular, is highlighted; the specific uses of broadband Internet access are reviewed; and some of the major challenges identified by people in the region to expanding their use of broadband are discussed. These challenges should not be seen

as factors preventing expansion and diffusion of more effective broadband Internet use—people in the tourism industry throughout the region recognize these challenges and are working valiantly to try to overcome them. Yet the challenges remain significant.

Tourism and Broadband Internet Use

The 2005 Annual Report of the Pennsylvania Tourism Office[40] provides ample evidence of the importance of tourism to Pennsylvania's economy, and the growing success of Pennsylvania in attracting leisure visitors. A few highlights from the report include the following:

- Pennsylvania hosted 106 million leisure visitors in 2005, up 23% from 2000.

- The Pennsylvania Travel Industry supported 573,411 jobs in 2004, with two-thirds of these jobs providing direct services to visitors

- In 2005, Pennsylvania's leisure and hospitality industry generated nearly 10,000 new jobs, accounting for 15% of all new jobs in that year.

Detailed statistics on expenditure by region are not readily available, but it seems clear that many of the tourism dollars are attracted to urban parts of the state, with Philadelphia and the surrounding areas attracting the largest share of the portion. Philadelphia, for example, had the highest hotel occupancy rate in the state in 2005, at 69.7%, while the Pennsylvania Wilds region had an occupancy rate of only 52.1%.

At a state level, it is clear that Internet access has become a critical part of the industry. The VisitPa.com website had nearly 5.9 million visitors in 2005, growing 939% from 2003. The Travel Industry Association of America reported in 2000 that two-thirds of online travelers (past-year travelers who currently use the Internet) had used the

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[40] mediaroom.visitpa.com/files/**tourism**annual**report**06.pdf -

Internet to make travel plans in the last year. This represents nearly 60 million people, up from 48 million in 1999.[41] According to Mathilda Sheptek, Deputy Executive Director of the Pocono Mountains Vacation Bureau:

> . . . the bottom line is that for the traveler today, the Internet…is the most important tool they use to learn about, plan, and book vacation. That is THE tool….Now when we advertise in traditional media, the message is to go the website or call. No one really writes anymore. You don't get written inquiries. You're driving people to the website or our call center (interview, June 29, 2006).

Route 6 Tourism Association and the Northern PA Tourism Network

The core of the tourism case study was the Route 6 Tourism Association. Route 6 itself is part of the U.S. highway system, and runs nearly all the way across the country, running east from Route 395 in Bishop, California to Provincetown, Massachusetts on Cape Cod, for a total of 3,205 miles.[42] For 440 miles, Route 6 runs through northern Pennsylvania, through some of the most scenic and remote parts of the state. To understand the current status and potential future uses of broadband Internet access to promote tourism in the region requires an understanding of the various actors that form part of the tourism network in the region. These include the following:

Individual Tourist Promotion Agencies (TPAs): Tourist Promotion Agencies, sometimes referred to as Convention and Visitors Bureaus, are typically membership-based organizations, though they also receive funding from hotel occupancy taxes. There are a total of 9 tourist promotion agencies, covering a total of 11 counties, in the Route 6 area in Northern Pennsylvania. They are, from east to west:

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[41] http://www.tia.org/travel/Internetuse.asp
[42] http://en.wikipedia.org/wiki/U.S._Highway_6

- *The Pocono Mountains Vacation Bureau (PMVB)[43]:* The PMVB represents Pike County and Wayne County on Route 6, along with Carbon and Monroe Counties south of Route 6 in the Poconos). It is the oldest and largest of the TPAs along with route. It was founded in 1934 and has its own in-house call center with 17 lines. The Poconos has been established as a tourist destination for well over a century, with the primary attractions related to scenic beauty and outdoor recreation activities.

- *The Lackawanna County Convention and Visitors Bureau[44]:* Located in Scranton, this TPA just represents Lackawanna County, and thus is entirely within the Route 6 area. While the county does have some scenic attractions, the primary emphasis of tourism is historic legacy, including coal, steam locomotives and electric trolley museums.

- *The Endless Mountains Visitors Bureau[45]:* With offices in Tunkhannock, Pennsylvania, this TPA is located only 25 miles away from the Lackawanna County TPA. It represents two counties that are part of the Route 6 area (Bradford and Wyoming) and two counties that are outside that area (Sullivan and Susquehanna). Tourist attractions in this area are primarily related to the region's natural endowments: "Our hottest commodity is Mother Nature" is proudly proclaimed on their website.

- *The Tioga County Visitors Bureau[46]:* As the home of the 50-mile-long gorge of the Pennsylvania Grand Canyon, and located in the middle of Route 6 across the

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[43] http://www.800poconos.com/
[44] http://www.visitnepa.org/
[45] http://www.endlessmountains.org/
[46] http://www.visittiogapa.com/

state, Tioga County often receives visitors from both ends of the state. It is a single-county TPA with offices in Wellsboro.

- *The Potter County Visitors Association[47]:* Located in Coudersport, the motto of the county clearly signifies the attractions in the area: "God's Country: Untouched, Unspoiled, Untamed".

- *The Allegheny National Forest Visitors Bureau[48]:* This TPA is located in Bradford and officially represents only McKean County, yet it has chosen the branding of the *Allegheny National Forest* as the best-known attraction within the region. It represents a single county despite the fact that the Allegheny National Forest also extends to Warren County to the west, and Forest and Elk Counties to the south.

- *The Warren County Visitors Bureau[49]:* Located in Warren, this TPA highlights the region as "Kinzua Country in the Allegheny National Forest", emphasizing the Kinzua Dam Recreation Area. Surprisingly, however, the website does not mention one of the major attractions of "Kinzua Country", the historic Kinzua Viaduct, a 301-foot high, 2,500-long railroad bridge, which when it was built in 1882 was "acclaimed the highest and longest railroad viaduct in the entire world"[50] Though a tornado in 2002 toppled the viaduct, it remains an important historical landmark and tourist attraction. Presumably the Warren County Visitor's Bureau does not advertise it because the bridge itself is just across the

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[47] http://www.visitpottercounty.com/
[48] http://www.visitanf.com/
[49] http://www.wcvb.net/
[50] http://www.visitanf.com/ see also http://www.dcnr.state.pa.us/stateParks/parks/kinzuabridge.aspx

county border in McKean County—a perfect example of the lack of integration along the corridor.

- *The Crawford County Convention and Visitors Bureau[51]:* Located in Meadville, the CCCVB coordinates much of its marketing as part of the 4-county PA Great Lakes Region (including Crawford, Erie, Mercer and Venango Counties), yet its membership is based entirely in the single county.

- *The Erie Area Convention and Visitors Bureau[52]:* This is also a single-county TPA, located in Erie, which emphasizes many of the urban and lake-side attractions, alongside the attractions of the more rural parts of the country.

PA Route 6 Tourist Association: This association emerged in the mid-1990s in an effort to coordinate tourism promotion in the region. It has its origins in discussions between the various local tourism promotion agencies in northern Pennsylvania. The Pennsylvania Association of Convention and Visitors Bureaus[53] holds workshops twice a year for its members. At one workshop held in the fall in DuBois, all TPAs along Route 6 gathered to talk about the possibility of branding Route 6 as a tourist attraction. Out of this effort came the PA Route 6 Tourist Association.[54] A total of 9 different TPAs represent 11 counties that are part of the association. Each TPA pays $4,000/year to support the association, which initially was just an association without staff, but now has an Executive Director and one support staff. The association also gets money from DCED, and raises some funds through ads, sales, guides and the like. It currently has a

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[51] http://www.visitcrawford.org/
[52] http://www.visiteriepa.com/
[53] http://www.pacvb.org/
[54] http://www.paroute6.com/

total budget of about $200,000. The lead staff of the 9 TPAs constitute the board of directors of the association.

PA Route 6 Heritage Corporation: In 2003, the PA Route 6 Tourism Association also catalyzed the creation of the PA Route 6 Heritage Corporation, with the mission of preserving, enhancing, and promoting the transportation heritage of the region while sustaining and enhancing the small rural communities linked by the highway. The leadership of the Heritage Corporation includes: a representative from each county (ranges from county commissioner, planners, local business people, etc.); representatives from four other heritage areas along the route, representatives of the four LDDs along the route, and the president of the PA Route 6 Tourism Association.

Local service providers and attractions: Each local TPA includes membership of literally hundreds of local restaurants, B&Bs, hotels, and other tourist attractions. Effective use of broadband only occurs when these service providers are integrated into the Internet network as well.

PA Tourism Office: This office within the Pennsylvania Department of Community and Economic Development is responsible for overall promotion of tourism development in the state, including developing marketing campaigns, working with local TPAs to promote tourism in the area, providing assistance on the use of technology, and developing overall strategic policy for tourism in the state. While the state coordinates a significant amount of tourism marketing through the Pennsylvania Tourism Office, and the visitPA.com website, for rural areas especially much of the tourism marketing is conducted by the decentralized Tourism Promotion Agencies. It is a highly decentralized system, with significant autonomy at the local level.

Other network actors*:* While the above organizations and businesses are the core of the tourism Internet network, a range of other entities also are integrated to varying degrees into broadband Internet use in the region. These include:

- *Local technical consultants*, which vary depending on the region in the state.

- *National technical consultants*, such as cvbtv.com, webervations.com, www.travelhero.com and others, that provide technical consultation, web-design, and reservations services for TPAs throughout the state.

- *Internet Service Providers*, which again vary depending on the particular region.

- *Local Development Districts*[55]: LDDs help local areas gain access to broadband services, and provide economic and workforce development assistance in their areas, as well as provide a liaison to sources of funding from state and federal sources. There are four LDDs whose areas overlap with the PA Route 6 area: North Central Pennsylvania Regional Planning and Development Commission[56]; Northeastern Pennsylvania Alliance[57]; Northern Tier Regional Planning and Development Commission[58]; and the Northwest Commission.[59]

- *Marketing Media Outlets*: There are a wide range of online, printed, TV, video and radio outlets that are critical for tourism marketing. Increasingly these outlets are expecting broadband integration (e.g., such as sending/receiving large files, including photos and video clips) with the sites they write about.

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[55] LDDs were created in 1965 by the Appalachian Regional Commission as multi-county organizations to serve as liaisons to the federal and state governments for local areas throughout Appalachia.
[56] http://web2.ncentral.com/ncprpdc/
[57] http://www.nepa-alliance.org/
[58] http://www.northerntier.org/
[59] http://www.nwcommission.org/

Thus, an examination of the rural tourism Internet network in northern Pennsylvania reveals it to be a highly decentralized and fragmented system with literally thousands of different enterprises and organizations. Despite the complexity, there are signs of innovative use of broadband along the Route 6 corridor.

Transactional Use

A variety of activities are now taking place with the use of broadband services that we might term 'transactional'—they improve the efficiency and effectiveness of processes that existed in the tourism sector prior to the use of broadband. These 'transactional' uses of broadband do not include any new, 'transformational' processes made possible by the most developed broadband applications, but they help increase the effectiveness and efficiency of many processes that are critical to the success of tourism in rural parts of Pennsylvania. Key transactional processes in the use of broadband in tourism include the following:

Communication between TPA and members*:* The core of tourism promotion along the Route 6 corridor is related to the ability of the TPAs and their members to effectively communicate with each other about a whole range of types of information, including character of attractions, important events, and availability of space. Without Internet access, this communication is limited to one-to-one interactions (phone calls or in-person visits) and periodic newsletters and letters. Email communication, even without broadband, allows for more frequent and rapid communication to a large number of people. Thus, for example, TPAs can now send daily or weekly email notices to the majority of their members, announcing upcoming events or new marketing opportunities. According to the TPA directors interviewed, the majority of the individual providers in

their area use email as become their primary means of communicating with their members. This quote from Linda Devlin, of the Allegheny National Forest TPA, is an example:

> We communicate primarily through email…only 6 out of 156 members
> don't have email. We do email blasts with current issues, educational
> opportunities, advertising opportunities, press pieces that we want them to
> know about, a feature story we want them to know about, so members can
> know what is going on.[60]

The majority of rural Internet users, however, do not use broadband, including presumably many of the individual members of TPAs. Thus, the TPAs are currently largely constrained to using mostly text messages, rather than large pdf or image files. It is unclear at this stage, however, whether the lack of broadband use, or some other set of factors, is the primary constraint on better communication. According to Lori Copp from the Tioga County TPA, "We're constantly sending out email announcements [to our members] but the hardest thing at this point is getting people to read their email and to respond. It is getting harder—people are inundated with information everyday."[61]

Information dissemination via the Internet: Obviously one of the most basic first steps in taking advantage of the technological capacities provided by the Internet is simply to gain a web presence for tourism through developing a website. While it is possible to set up and maintain a website with dial-up services, the importance of photos and complex, visually attractive graphics in the tourism sector increasingly require broadband access to handle the large files associated with attractive websites. The

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[60] Interview, June 29, 2006
[61] Interview, June 30, 2006

seemingly straightforward function of developing a website, however, has multiple

dimensions to it, related both to the large number of individual attractions and service

providers along the Route 6 corridor, and the process involved in maintaining and

upgrading websites to accurately reflect information and events in the region. TPAs that

are trying to market the Route 6 area are ultimately at least somewhat dependent on the

extent to which individual service providers in their region are developing and utilizing

their own websites. As mentioned in the example of *The Inn on Maple Street*, the

information available on any individual website may range from a simple static single-

page, through more complex sites with multiple, static pages, to more detailed websites

with information that is updated regularly to reflect new events or changing attractions.

The ability of individual providers to have a more dynamic and attractive website

depends in part on the Internet capacities of the individual website operators themselves.

TPAs and LDDs in northern Pennsylvania have limited resources in providing training

and technical assistance to these individual providers. Technical consultants provide

another outlet for individual service providers to gain assistance in designing and

maintaining websites, but these services are too expensive for many small providers to

utilize. There are significant differences, too, in the types of services that technical

consultants may provide. For instance, Linda Devlin from the Allegheny National Forest

Visitors Bureau[62] described working with a web design consultant to develop their

website using a newspaper system called Publicus Online Publishing System. This

system allows them to do their own web updates without knowing HTML code. With a

little bit of training, they have learned to write their own text, upload their own photos,

update event calendars, update providers' information, and create new web-links without

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[62] http://www.visitanf.com/

having any HTML coding skills. This is an important cost saver when the alternative is to hire a web consultant to update the website.

Marketing and branding: Marketing is obviously at the core of tourism promotion, and tourism promoters along Route 6 are increasingly using the Internet in their marketing efforts, beyond simply having a website that might attract visitors. This is especially effective when the advertising can be targeted to individuals who are particularly interested in the Route 6 area. The Allegheny National Forest Vacation Bureau, for instance, does banner advertising on sites that are centered in nearby target markets (e.g., newspapers in Cleveland, Pittsburgh, Erie, Rochester). These pop-up ads typically are linked with some contest (e.g., a free weekend stay at a local attraction) that requires people to sign-up and fill out basic information on their interests. This then provides information about people interested in the area for future advertising to targeted audiences via email. Similarly, many travel media sign-up through travel promotion agencies to receive daily email announcements. By tapping into these specialized marketing channels, TPAs can more effectively market the Route 6 product in a non-expensive but still targeted way.

Part of the challenge in the region, however, lies in the fact that the Route 6 corridor is simply one way of 'branding' the attractions in the area. Each of the individual TPAs also brands the attractions in their areas based on other features (e.g., Poconos, Allegheny Forest, Grand Canyon of Pennsylvania, "God's Country"), and most are involved in other collaborative marketing and branding efforts (e.g., Pennsylvania Wilds, PA Great Lakes Region, Artisan Trail, etc.). The effectiveness of these various branding efforts depends in part on the collaboration between different entities (not just

TPAs, but the various service providers in their areas), the attractiveness of specific websites devoted to the different branding efforts, and the effectiveness of web-links between the different branding/marketing sites and the specific attractions in each area linked with those particular branding. Again, it is the network relationship that is important.

Event advertising: Advertising specific events in some ways is simply one aspect of the marketing described above. But marketing events (ranging from small music performances or poetry readings at local cafes that may vary on a week-to-week basis, to large-scale concerts, rallies, or fairs that may take months to plans) is more complex, since the information changes more rapidly and involves multiple information providers. Most TPAs in the region have a calendar of events on their website that they will update on an ongoing basis as they learn about new events. But these same events are also ideally advertised on individual provider's websites, as well as a range of other websites (e.g., www.visitpa.com, or www.paroute6.com). Who adds information about new events, or modifies information on existing events? Often this is simply done through labor-intensive processes of different individuals modifying multiple different websites, yet it is also possible to develop systems in which a single database of events is maintained in one place, and multiple websites draw on that database to advertise events in a particular area. At the moment, that level of integration in the region seems to be minimal.

Multi-media advertising: Broadband applications for information-sharing include the development of video-clips, audio-clips, live web-cams, and 360-degree photo imaging. Little evidence was found that these applications are being used along the

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Route 6 corridor to any great extent, but there are signs of experimentation. Individual

providers along the route have developed some applications in each of these areas, such

as ski areas using web-cams to show snow conditions, or restaurants or individual hotels

using 360-degree photo imaging to help give visitors a better visual picture of their

facilities. Similarly, the TPAs in the area have begun experimenting with these multi-

media channels. The Allegheny National Forest Visitor's Bureau, for example, created a

video travellog for McKean County for a TV advertising campaign, but they have

subsequently made it available via streaming video on their website. The Pocono

Mountains Visitors Bureau has linked to "Foliage Cams" provided by the state Tourism

Office that show images of fall foliage in select sites around the state.[63] Overall, though,

there is limited use of multi-media.

Transformative Use

Transformative use of broadband in the tourism sector is centered around

empowering the consumer to plan all aspects of their travel, from gathering information

on possible attractions, to booking reservations.

Search capabilities and facilitating consumer research*:* One of the most

important aspects of the Internet is the increasing power it gives to individual consumers

to research possible attractions along Route 6. Simply having a website allows some

level of access. Having a well-organized website, with clear links to different types of

service providers (things to do, places to eat, places to stay, etc.) is important, too. Yet

this still involves simply provider-structured knowledge—information ordered and

structured in the way chosen by the provider or TPA. With the development of search

functions, the consumer begins to be empowered by their ability to find exactly the type

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[63] For example, http://www.fallinpa.com/fallinpa/fallFoliage.jsp?section=bushkill

of information they are looking for. At the moment, only the Pocono Mountains, Tioga, and Erie County TPAs have search capabilities.

Online booking: The next step beyond a customer being able to search for the information they want is the ability to actually book a reservation online. Some individual service providers throughout the region accept online reservations, but in many parts of the route, such services are rare. In Potter County, for instance, only one B&B allows online reservations. In the Allegheny National Forest Visitor Bureau area, two branches of national hotel chains allow online reservations, but no other facilities do.

The Tioga County Visitors Bureau has developed a searchable database that allows customers to see the availability of lodging on any dates, and it is sortable by type of accommodation (hotel/motels, bed & breakfasts, cabins & getaways, camping). It was developed by a local programmer in Wellsboro, working in cooperation with Epix Internet Services, an ISP in northeastern Pennsylvania. The system requires individual providers to enter information directly, so the database is only as accurate as the individual providers themselves. It is structured, however, so that whoever updated their listings most recently comes up first in searches on the system, as a way to provide an incentive for accommodation providers to keep the system updated. The system, however, does not allow online bookings—customers still have to contact individual service providers by phone to make a reservation.

Currently, only the Pocono Mountains TPA has been able to develop an online booking system that links most of the lodging providers in their area. It developed this service using the software and support services of www.bookingcenter.com. This service allows anyone to enter in the dates they are interested in, and the number of customers,

and the database returns all establishments that have availability. It is possible to view only particular types (e.g., just hotels, or just B&Bs), and to sort by price. Once the selection is made, it is possible to actually book and pay for the reservation online, similar to a Travelocity or Orbitz.com system. This system also has a useful 'trip planner' function, which integrates the accommodations and events calendar and allows customers to create a custom itinerary that can be saved and printed at the customer's convenience

Developing such a reservation system requires integration among all (or at least a substantial majority) of accommodation providers in the area, as well as the resources to develop the database and query system. This is challenging enough within a single TPA. Ideally, for the Route 6 marketing and branding to be more effective, it would be ideal to have an integrated reservation system throughout the region. To do this, however, would require having everyone in the region utilize the same software system, or at least able to integrate the different reservations systems together. This significant organizational and technological challenge is further exacerbated by the different resources of TPAs throughout the region—none of the other TPAs are likely to be able to afford the system that the Pocono Mountains Vacation Bureau uses, at least not without additional support.

Interactive mapping: The reservation system used by the Pocono Mountains Vacation Bureau is useful, but it still does not allow customers to search by city or location. The system does have the ability to map locations of individual accommodation sites, one place at a time, but this still limits the ability of the customer to easily see where different accommodation options are located or to search for particular sites by location. This may not be a problem within relatively small areas. To have an effective

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reservation system for the entire Route 6 corridor, however, customers need to be able to plan a multi-day trip knowing where particular accommodation sites are located and to search by particular cities, or to at least see the distance from one accommodation site to the next. Terri Dennison, Executive Director of the PA Route 6 Tourism Association, hopes to develop an interactive mapping function that would allow for this:

> I want people to be able to say, hey, I'm staying in Milford, I can search and find the hotel I want to stay in, and then the next day, say I want to drive 50 miles, I can find out what is next 50 miles away and pick that. Or say, I want to drive to Scranton, how far is that and what can I see along the way. I want to be able to create my own itinerary and then map it.

Developing such a function, however, is still in the future.

Enabling Factors

According to the interviews, one of the most important enabling factors facilitating use of broadband in the tourism sector is simply education about the potential of Internet access. Many of the applications that would facilitate improved transformative use of the Internet, such as on-line web reservations systems, are relatively simple to use. Many small B&B operators could make better use of such web reservation systems with a relatively small investment in education and marketing. Where such education has been provided by tourism promotion bureaus, or where individuals have taken the initiative themselves, it is relatively easy to gain access to these services. Similarly, where rural providers have managed to find local people with relatively basic

web design skills, they have been able to develop active websites that are able to be updated with new events on a regular basis. Other transformative functions, however, such as interactive mapping and integration of reservation systems, are more complex and require greater integration.

Inhibiting Factors

One of the greatest inhibiting factors to greater adoption of transformative practices in the tourism sector is the challenge of integrating multiple different technical systems in order to enable on-line reservations systems. Such systems require linking together literally hundreds of individual websites, with centralized reservations systems, and linking into these systems from multiple different tourism promotion boards in the region. With each tourism promotion board free to pursue their own technical systems for putting such systems in place, integrating across the entire Route 6 area will be difficult.

Summary

Broadband utilization by businesses is growing through time. Research and anecdotal evidence suggest that business usage of broadband services lags significantly behind household usage. To some extent, this is the result of the cost of service, but equally compelling, businesses often find that broadband services are a necessary but not sufficient condition for business success. Business usage of broadband services varies significantly by industry. In the Powdered Metal industry case study, small businesses were using the Internet primarily to identify new market opportunities, reduce cost of supplies, and communicate more effectively within supply-chain networks. Occasionally new uses develop in response to a change in the market or regulatory environment. Yet

within the industry there seemed to be much less incidence of transformative uses of the Internet—uses that that might allow new forms of collaboration between firms or between physically distant employees of the same firm. Perhaps more importantly, few of the interviewees in the PM sector understood the potentially transformative uses of the Internet for their business. Firms in the tourism sector, in contrast, could clearly see the transformative potential of broadband Internet services. Most of the interviewees articulated various aspects of the ways that broadband could empower customers to book their own tours and more effectively understand regional attractions through applications such as interactive mapping and locational search functions. Here, the problems of lack of transformational use were not rooted in lack of awareness, but instead were rooted in fragmentation, individualism, and lack of coordination, along with limited skills.

VI. Conclusion

FCC and Pew Foundation research reports indicate that broadband availability is still an issue for many places in the U.S., especially in areas where landscape and population density act as inhibitors to market development. There is still debate about a lack of data that are sufficiently detailed and sensitive to provide an accurate portrayal of service availability. Rural residents are the least likely to use broadband and are the most limited in terms of access to broadband service at an affordable price. A third perspective specific to Pennsylvania, provided by the Local Development Districts of the Appalachian Regional Commission, indicates that service cost and to some extent actual availability are constraining broadband utilization. The LDD study, one of the few that provides current information on firm utilization of broadband, indicates that firms use broadband to a lesser degree than households. Lack of utilization is due to cost and to

some extent lack of knowledge about the opportunities associated with broadband services. Cost may be even more an issue for small businesses, particularly given the manner in which costs are allocated in the commercial sector.

An exhaustive review of the literature, including grey material[64], government reports, industry studies, and service advertisements, offers a perspective that by and large suggests that broadband services are primarily used for transactional purposes. Across the sector studies, transactional usage is the most frequently noted capability enabled by the availability of broadband. It is making search processes easier and more efficient, reducing the need for face transactions and in many instances reducing the need for travel. Far less frequently observed is the utilization of broadband for transformative purposes. In each sector studied, transformative usage is clearly tied to empowering and enabling users to undertake an action not otherwise possible with other known technology or forms of interaction. Proactive governmentalities are critical to the successful uptake of broadband technologies. Government is often a key enabling factor in the availability and utilization of broadband, primarily through legislative action that creates opportunities and in some cases constructs constraints through mandates which dictate that technology and services be provided. The role of government as an enabling and encouraging agent is particularly evident in the education and healthcare sectors. Some uses clearly have their limits, such as telesurgery, which requires excellent broadband capability, but more importantly the entire healthcare system has to be

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[64] Grey material is a term used to identify a class of information/documentation/material that constitutes reporting about an issue or condition, but that is not formally published and widely accessible to interested parties.

optimized to conduct complex medical procedures across long distances and without face-to-face contact.

Broadband utilization by businesses is growing through time. Research and anecdotal evidence suggests business usage of broadband services lags significantly behind household usage. To some extent this is the result of the cost of service, but equally compelling, businesses often find that broadband services are a necessary but not sufficient condition for business success. Business usage of broadband services varies significantly by industry. In the Powdered Metal industry case study, small businesses were using the Internet primarily to identify new market opportunities, reduce cost of supplies, and communicate more effectively within supply-chain networks. Occasionally new uses develop in response to a change in the market or regulatory environment. Yet within the industry there seemed to be much less incidence of transformative uses of the Internet—uses that that might allow new forms of collaboration between firms or between physically distant employees of the same firm. Perhaps more importantly, few of the interviewees in the PM sector understood the potentially transformative uses of the Internet for their business. Firms in the tourism sector, in contrast, could clearly see the transformative potential of broadband Internet services. Most of the interviewees articulated various aspects of the ways that broadband could empower customers to book their own tours and more effectively understand regional attractions through applications such as interactive mapping and locational search functions. Here, the problems of lack of transformational use were not rooted in lack of awareness, but instead were rooted in fragmentation, individualism, and lack of coordination, along with limited skills.

Education is clearly benefiting from the availability of broadband services. Students in schools with available broadband can conduct sophisticated searches for information, communicate with students in other locations, and engage in real-time virtual realities. Basically, the Internet adds the outside world to what can otherwise be isolated locations. At the same time, such capability requires considerable investment in infrastructure and ongoing technology support and training access to optimize the use of technologies. Across the spectrum of functions, broadband enhances education for both students and staff. Of importance is the challenge of ensuring that technology is up-to-date and that continuous broadband service is available. Access to the Internet as made available through broadband has a huge capacity to transform the learning experience, opening up the educational system to greater involvement of students and parents in curriculum development and other realms of community learning.

As with the majority of applications, broadband services require an ongoing infusion of human capital to achieve successful implementation and to maintain service quality. This requires a high level of resources allocated to ongoing training of teachers and support staff. At the same time, fundamental technical requirements in the form of bandwidth inhibit the usage of all opportunities available and afforded by broadband technologies.

Healthcare in many ways offers a compelling context in which to deploy broadband services. Configured correctly with the help of broadband services, IT infrastructure can provide patients and other users of healthcare access to huge amounts of information, treatment management services, as well as direct engagement with medical personnel. The implementation of such a level of service is more about the

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willingness of the practitioner to use the technology than the presence or absence of the service capability itself. Interviews reported consistently that the age of the medical practitioner was the best predictor of service utilization. "Under the age of 50" was a prevalent refrain heard from IT administrators commenting on factors limiting IT uptake. Another factor correlated with high-level service utilization was membership in a health maintenance organization in which multiple locations created a ready benefit from effective communication capability. The need to communicate across service activities almost necessitated the availability of broadband.

Transformational usage of the Internet is still in its infancy. Companies are developing an awareness of how broadband-enabled capability can literally restructure the firm and its market, and product and its approach to business. Full acceptance of the efficacy of broadband requires significant investment by the entrepreneur in a profound shift to a learning organization. This jump is both challenging and costly; for many firms, it is fraught with uncertainty and perceived high levels of risk. Without transformational planning, however, firms will continue to use the Internet as just one more step not too far away from existing practice.

In sum, broadband offers many opportunities for transformational evolution on the part of all organizations that come in contact with and have reason to use the technology. Costs and absolute availability of service are still important issues. Generational constraints are somewhat mitigated by the prospect of training, but user-friendly services and equipment are still major hurdles to broad-based broadband utilization. Clearly, countries around the world are pushing new technology onto society in a big way, paid for by the government and seen as a universal right and necessary

capability to play in today's global economic game. While technology is necessary and not sufficient to ensure an economic future of opportunity and enhanced creativity, the absence of high-level connectivity is seen increasingly worldwide as a significant burden on future development.

VII. Policy Considerations

The major policy recommendation is the need to design programs that are sector-specific and linked to specific challenges facing individual sectors. There is no silver bullet or single solution to the challenge of broadband utilization. As the results of this study demonstrate, unique sectoral experiences call forth the need for realistic rollout of broadband by sector. A single solution to the problem of uptake is simply not evident or likely to emerge. Instead, multiple targets are required.

The majority of broadband applications that emerged during the course of this study reflect transactional interactions. Few cases of transformational interactions were evident. And yet, policy must consider ways to facilitate broadband deployment to do more than doing the same thing, only slightly better or with less face-to-face contact. The power of the Internet is not just that it assists in the performance of existing activities more efficiently. It is what it can enable us to do that matters.

With regard to specific sectors, in education teachers must be provided with the tools, training and have access to the required support staff to truly take advantage of the capabilities of broadband services. To go beyond information acquisition to information internalization will require changing the manner in which people are educated. To do so will require considerable technical support and new reward structures that encourage and facilitate teachers' uptake of this new capability.

In the field of public health, there are significant opportunities to change and augment the way public health and health services are generally provided. The aim of interventions and policy programming should be to enable the consumer to have greater access to healthcare in more efficient and effective forms. Healthcare record-keeping is still not electronic. Transmission of patient information occurs via paper. This is just a few of the several areas in which public policy and public resources and market stimuli all should be brought to bear to make healthcare services a 21st-century capability.

Business and small business in particular needs incentives and specific programming to alter status quo behavior. The cost of changing practices is high on a one-off basis. Policies should be developed to encourage groups of firms in the same sector to take up these new technologies and capabilities. Efforts to stimulate clusters of like groups offer ample opportunities to piggy-back on existing efforts to optimize firm practices.

There is a huge opportunity to facilitate the integration of new technology across a host of sectors. Tourism offers an example of the significant need to integrate services across groups of firms by making transparent and efficient the utilization of services such as online booking. Basically, users have to be able to plan a trip, plot a course, and solve all of the planning issues for travel using any one of the state's regional tourism websites. Optimization is the watchword; this requires cooperation across groups that currently are only loosely confederated and largely go it alone in service provision.

e-Government has so much to offer, and yet is likely to be an area in which innovation is slow to develop. Incentives and identification of joint projects can significantly influence the evolution of e-government toward actions that empower

residents and businesses to learn to use the evolving technology platform. In the optimal situation, government should act as an intermediary and facilitator of broadband utilization.

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*All websites were accessed between the period 6/1/06 and 10/31/06 unless mentioned otherwise.

Appendix

Instruments

- **Healthcare Sector Questionnaire**

- **Education Sector Questionnaire**

- **Powdered Metals Industry Questionnaire**

- **Tourism Industry Questionnaire**

Healthcare Sector Questionnaire

A. Availability of broadband in the health centers and hospitals

1) Is there broadband connection within the hospital?

2) If yes, what is the speed?

3) Who is the provider of the broadband?

4) Who all have access to the broadband connection?

5) Have there been any problems in the last 3 months with regard to the connectivity?

B. Use of broadband within the hospital

1) Could you list the various different uses that broadband is utilized within the hospital?

2) Is broadband used for sharing information and communicating with medical practitioners in other health centers about a specific case?

3) Do you transfer heavy data/image files online to/from other hospitals/health centers for analysis?

4) Do you utilize video-conferencing for communicating with medical practitioners in other parts of the country and the world?

5) Do you provide online services to your staff for accessing medical data remotely?

6) Are facilities made available to doctors for doing research on the Internet for immediate information?

7) Does your staff utilize online facilities for communicating with each other while on the job? (e.g., Intranet)

8) Are online services used for ordering supplies for the hospital?

9) Do you provide medical services to your clients that involve real time communication and can be accessed online? (e.g., Physician consultation, communications with the nurse, etc.)

10) Do you provide support services to your clients that can be accessed online?

11) What is the kind of growth that you have seen in the last 1 year for people using online services for medical consultation and support services?

12) Is there any specific age group that utilizes these services more?

C. Use of broadband for education

1) Is the broadband used in any way for education purposes?

2) What ways is it used?

3) Are there any benefits of using broadband and online communication methods for education in the medical field?

4) Has the quality of medical education improved now that it is easier to communicate with medical practitioners/professors across the world?

5) Has your institution developed any network with other institutes/organizations to share classes/demos/medical techniques so that students in all the network-institutes can learn together?

6) Is your institute trying to set up any such network or collaboration with other institutes for online teaching or collaboration between medical practitioners?

D. Problems of using broadband

1) Do you think there might be security problems in transferring data online?

2) Have you faced any such problem ever?

Education Sector Questionnaire

A. Availability of computers and broadband

1) Do you have computers in your school for students to use?

2) If yes, what is the ratio of the number of students per machine?

3) Are the computers connected to the Internet?

4) If yes, is it a broadband Internet connection?

5) What is the speed of the broadband connection?

6) Who is your service provider?

7) Do you have any problems with the quality of the connection (like slow speed, browsers getting hung, etc.)?

8) Since when do you have broadband connection in your school?

9) What is the cost of broadband connection in your school and homes in your area?

10) What percentage of houses have broadband connection in your area?

B. Use of broadband by teachers

1) Do the teachers supplement their classroom teaching methods with the Internet?

2) If yes, how do they do so? Examples.

3) Has the curriculum been changed in any way to include greater use of broadband by the teachers and the students?

4) Can you think of any class where the teacher might have used online audio-video files or direct interaction like video conferencing for educational purposes?

5) For which subjects do the teachers use broadband most often, if they do?

C. Use of broadband by students

1) Do the students have time allocated during school hours for working on the Internet?

2) If yes, is this time used for instruction/teaching or for doing homework or for any other purposes?

3) What kind of exercises/assignments are they given that require broadband access?

4) Are the students given any assignments/exercises for homework which requires broadband access at home?

5) Are the students encouraged to use the Internet for research or more information during their spare time?

6) Can you think of examples where students collaborated with students in other non-local institutions, other high schools?

D. Training for teachers and students

1) Is there any training program for the teachers to learn the use of advanced hardware and software?

2) Is there any training program for the students to learn the use of advanced hardware and software?

3) If yes, are these training sessions held in the school or in any other place?

4) What is the frequency of these training sessions?

5) Can you mention any training program that was provided in the last 6 months to the teachers or the students?

6) What was it on?

7) Is the use of broadband in your schools the subject of evaluation? Are here regular updates planned for programs to maintain state of technology applications?

8) Has your school ever applied for a grant for improving the technology in your school?

Powdered Metals Industry Questionnaire

1 Background

    1.1 Broadband Internet?

        1.1.1 History of development

        1.1.2 Main uses (marketing, transactions, supply-chain integration, etc.)

2 New Business Opportunities

    2.1 Internal--What kind of internal improvements have you experienced with the use

    of broadband?

        2.1.1 Efficiencies

        2.1.2 Innovation in Process/products?

    2.2 External—What new external business opportunity have become available

    through the use of broadband

        2.2.1 New Customer Access?

        2.2.2 Value-chain integration?

3 Human Resource Development

    3.1 Are there new HR practices and management practices that have been made

    possible through the use of broadband (e.g. On-line Training?)

4 Economic Development Assistance

    4.1 Does broadband help you in any way make connections to economic development

    assistance? Help in identifying new markets, for instance?

5 Business Networking

    5.1 What kind of linkages with other firms in the area of been possible through the

    use of broadband?

Tourism Industry Questionnaire

1Background

1.1 Broadband Internet?

1.2 History of development

1.3 Main uses (marketing, transactions, supply-chain integration, etc.)

2 New Business Opportunities

2.1 Internal--What kind of internal improvements have you experienced with the use of broadband?

(a) Efficiencies

(b) Innovation in process/products?

2.2External—What new external business opportunity have become available through the use of broadband

(c) New customer access?

(d) Value-chain integration?

3Human Resource Development

3.1Are there new HR practices and management practices that have been made possible through the use of broadband (e.g. On-line Training?)

4Economic Development Assistance

4.1Does broadband help you in any way make connections to economic development assistance? Help in identifying new markets, for instance?

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