Networking the Land: Rural America in the Information Age

The Technology Opportunities Program

United States Department of Commerce
Donald L. Evans
Secretary

National Telecommunications and Information Administration
(NTIA)

Nancy J. Victory
Assistant Secretary for Communications and Information

Bernadette McGuire-Rivera
Associate Administrator
Office of Telecommunications and Information Applications

Stephen J. Downs
Director
Technology Opportunities Program

December 2001

Acknowledgments

The Technology Opportunities Program wishes to thank Christopher Conte, principal writer, staff contributors Judith Sparrow and Donald Druker of NTIA, and others who contributed to this report.

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Introduction:

A Vibrant and Changing Countryside

Rural Americans are no strangers to technological change. From the days of turnpikes, canals, and railroads to the development of modern trucking and shipping, advances in transportation have repeatedly remade the countryside by connecting it to ever-larger national and international markets. Steady advances in farming methods and equipment have spurred some of the most impressive gains in productivity any industry has ever achieved. Television and motion pictures have enabled rural populations to participate in the Nation's political and cultural life. And the automobile and interstate highways have given them new personal freedom while profoundly shaping how they live, work, and play.

Now we are in the midst of a revolution in information technology. Is rural America playing a role in this new period of invention, too? This report offers 10 case studies that begin to answer that question. It describes how people in isolated regions are finding ways to connect to new information networks, both for their social and their economic advancement; how they are using modern information tools to manage their resources — natural and human — more effectively; how telemedicine is improving the

quality and timeliness of their health care; how educators are refining distance learning methods to bring better educational opportunities to people who cannot attend traditional classes on college campuses; and how people are using new technologies to make the arts, which we sometimes assume are the exclusive province of cities, more available in out-of-the-way places.

The projects described here, all supported by grants from the Technology Opportunities Program (TOP), paint a picture of a rural America that is vibrant and changing, yet eager to preserve its heritage. But these are not stories for rural Americans alone. The creative ideas, hard work, and experiences of the many people who have participated in these projects contain lessons that should prove useful to anyone interested in using information technologies to help communities seize control of their own futures and enrich the lives of their people.

Seba Dalkai Boarding School
Navajo Nation

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I. Making the Connection

In the span of less than a decade, the Internet has become ubiquitous; many Americans now take it for granted. Not only are we using regular telephone lines in record numbers for email and web surfing, but high-speed connections are becoming increasingly commonplace in workplaces, schools, libraries and even in a growing number of homes. As a result, it is easy to forget that in some places, basic connectivity — the ability to get online at tolerable cost — still represents a substantial barrier to joining the information society.

Two projects supported by TOP demonstrate how isolated communities are surmounting numerous barriers and getting online. In the sprawling Navajo Nation, where many families lack even basic telephone service, local tribal governments are using satellite connections to connect with the outside world. Though the system is still new, people already are beginning to explore new opportunities for improved lifestyles, increased efficiency, economic advancement, and stronger self-government. Meanwhile, in the rural town of Mayville, North Dakota, a state university is working with local leaders to establish a homegrown technology industry — and thereby hoping to halt a long economic decline produced by the continuing exodus of people from farms. Their experience illustrates how a complex mix of infrastructure, education, and community support help determine the success of modern technology ventures.

The Navajo Nation Goes Online

The next time you feel bad about your commute to work, consider Isabelle Walker. Like many people who live in rural areas, she has more than one job. And until recently, that meant she had to spend a lot of time on the road. As a district leader for three local chapters of the Navajo Nation, she typically had to drive 150 miles round-trip every other day from her home near Flagstaff, Arizona, to the Western Navajo Agency, a regional government headquarters, in Tuba City. On other days, usually about twice a week, her jobs as vice president of the Bird Spring chapter of the nation and as a health board representative to Indian Health Services required her to travel all the way to Window Rock, the Navajo Nation's capital. That's about a 400-mile round trip. All in all, Walker was covering an exhausting 1,200 miles each week.

By last year, the seemingly endless road time was starting to wear thin. Too often, she had trouble getting home to her family in time for dinner. People on her 60-person staff at a regional office of the nation's social services agency were complaining about her long absences (at one point, she went a month without making it to a staff meeting). And the residents of the Bird Spring chapter, who had voted her in as their vice president, were growing impatient too. "People were starting to ask, 'If you're never here, why should we elect you?'" she recalls.

Fortunately, Walker's life as a commuter improved considerably last fall, when the Navajo Nation's 110 local chapters came online. Now, she could email documents she once had to spend hours hand-delivering to government offices in Tuba City and Window Rock. Her weekly commute dropped to 500 miles — still high by the standards of city-dwellers, but not unusual for somebody living in the wide-open spaces of Navajo country. Liberated from many hours in her car, she could spend more time with her family, and concentrate more on her main job—managing a group home for youth. "With today's technology, it makes no sense to drive those distances," she says.

This may not sound particularly exotic to the growing number of Americans who have come to take the Internet, email and even telecommuting for granted. But Walker's story represents a breakthrough for the Navajo Nation, where many families lack even basic telephone service, and Internet connections are extremely rare. Where there is a will, the Navajo experience suggests, there is a technological way to bring even areas with minimal infrastructure into the Internet era.

Surprising Progress

It is hard to imagine a place where the task of providing Internet connections seems more daunting than the Navajo Nation. The nation's 200,000 residents are spread across 25,000 square miles of high plateau in Arizona, New Mexico, Colorado, and Utah. More than half earn incomes below the poverty level, and three out of four households lack telephones. In 1999, the Seba Dalkai Boarding School described the challenges in stark terms when it applied for a grant from the Technology Opportunities Program to connect five local chapters in the 5,000-square mile southwestern corner of the nation. "There are no cable television services, no local radio stations, no local television stations and extremely limited cellular phone services. The ratio of people to residential phone numbers is 49 to one," wrote officials from the school, which is based near Winslow, Arizona. "Internet access . . . is prohibitively expensive. Some tribal institutions on the western side of the Navajo Nation's second largest city paid $17,400 per year for a single, 56-kbps data line to an Internet access point. Institutions have waited two years for the installation of additional services. The telecommunications infrastructure, especially as it pertains to small and isolated institutions, is nonexistent."

Despite such obstacles, change has come faster than the school, or anybody else expected. Soon after the school received a $475,000 TOP grant, StarBand Communications, Inc., which is based in McLean, Virginia, said it could connect all 110 local chapters, not just the five that had been targeted. Project managers jumped at the offer, and last fall StarBand, which says it offers the first "two-way, always-on satellite-delivered Internet access for the consumer market," installed personal computers connected to 24-inch by 36-inch satellite receivers in each chapter headquarters.

Almost overnight, the Navajo Nation was online. The change came so quickly that officials have hardly had a chance to consider what to do with the new technology. But as in other places, many individuals find plenty to do with their new connections. A recent tour of the southern rim of the Navajo Nation gives some clues about what impact Internet connections are having.

A Tour of Isolated Chapters

In Leupp, a chapter near the southwestern corner of the nation, an old dam is failing, and government officials are worried that surrounding lands will be undermined. Rosita Kelly used the Internet to learn about sinkholes in Florida in hopes of demonstrating to chapter residents they should not build in the threatened areas. Kelly also has started to collect price quotes from construction companies to build a new sewage lagoon.

To the east of Leupp, a low, dome-shaped structure painted a dull red to match its surroundings hugs the earth under the big Arizona sky. This is the Bird Springs chapter, which was the first chapter to

get an Internet connection. Inside, receptionist Terri Joe surfs the Internet during quiet times. Her favorite website is collegeclub.com, where she has found scholarship funds that paid for two years of study in health and medical sciences at Northern Pioneer College in Winslow, Arizona. On the day TOP visited her, she had just learned about two more scholarships that could help her achieve her goal of continuing her education at Northern Arizona University in Flagstaff.

While chapters have Internet connections primarily to conduct their own business, they welcome a steady stream of residents who want to check their personal email or surf the web. Hank Willie, who keeps the system operating, has observed many of these personal explorations — people looking for truck parts, for medical information about their cattle and sheep herds, for insurance, for job searches and more. When hoof and mouth disease set off alarms in Europe, Terri Joe helped the Bird Springs grazing official study up on the issue to advise local shepherds. Willie has seen a number of young men use the Internet to register with the Selective Service.

Still farther to the east, Cheryl Chee is working on a web page designed to recount the history of the Greasewood Springs chapter. Tonaya Anderson, who works for the Office of Dine Youth, uses Encarta to look up information for kids on subjects such as ancient African civilizations. According to Anderson, children from the chapter periodically use the chapter's computers to look up the meaning of Navajo words they can't understand. Anderson hopes in her spare time to contact people in the Kiowa Tribe in Oklahoma, from which she is descended.

When TOP visited Greasewood Springs, Barbara Cummings, the chapter's community services coordinator, was helping chapter president Franklin Gishey look for an inexpensive tractor. After five minutes online, she found a used one for sale in Aberdeen, South Dakota, that appeared to meet the chapter's requirements and had an appealing $15,000 asking price. Cummings ventures onto the Internet frequently. She uses email to keep in touch with two nephews who serve in the U.S. armed forces; one is stationed on a U.S. warship and the other is in Kosovo. But Cummings believes the chapter, which has just 1,260 residents, has a much bigger need for networking. Under a 1998 law known as the "Local Governance Act," the Navajo Nation is transferring substantial powers to chapter governments, but the local entities first must demonstrate that they have certain management capabilities. To assume these responsibilities, chapter leaders and staff will need training in everything from account-

ing to how to levy taxes and tap outside sources of funds, Cummings says. Noting how small and isolated the community is, she adds that much of the help will have to come from outside. The chapter is making progress in finding such help: Northern Pioneer College is interested in using the new Internet connection to offer electronic courses to people in the community.

The View From Window Rock

Farther east, in Window Rock, Larry Noble is one of the nation's most avid Internet users. A delegate to the Navajo Nation Council from Steamboat, he maintains email relationships with numerous Navajos who have moved away from the Nation, providing them a link to their native culture and often helping them with their research. He says he learns a great deal from these students in return. Noble, a former sheep herder, says he has spent a great deal of time on the Internet trying to understand why Australian-grown wool sells at much higher prices than wool from sheep raised in Navajo country. The reason, he has learned, is that Australian sheep are better nourished, and hence produce higher quality wool. His studies have convinced Noble that the Navajos have to clamp down on overgrazing.

As more and more Navajos go online, Noble believes, he will use email more. Indeed, he says, in a nation where there are relatively few telephones, and people with telephones often are away from them, email may soon be the most important communications medium, he says. "If I put email through to a person I'm trying to contact, I know I'll get a better response," he says. "With the telephone message, I don't know if the message will get through."

Together, these anecdotes suggest that the Internet is starting to take hold in Navajo country. But the Nation has a long way to go before it is fully wired. Many of those who have tasted the online world want connections to their homes, and the few who have experienced high-bandwidth connections — Larry Noble uses the Nation's T-1 connection from Window Rock — are eager to get high-speed service. Unfortunately, the lack of a strong telephone network slows the spread of the technology, and the unavailability of local, dial-up access in many areas also is a big barrier to expansion of Internet connections (Greasewood Springs Chapter President Franklin Gishey tells a story about how his son hooked onto a Dreamcast video system to gain Internet access — and rolled up a $600 telephone bill for one month).

Next Steps

Still, the Nation's involvement with the Internet is growing every day. The Gates Foundation has installed four new computers with their own satellite-based Internet connection in chapter houses. And Kyril Calsoyas, director of the original TOP grant, is exploring a number of other relatively low-cost options that might increase connectivity in the immediate future. The Greenstar Foundation, which is based in Los Angeles, produces easy-to-install, solar-powered community centers that deliver electricity, pure water, health and education information and a wireless connection to villages in the developing world, for instance. To support such centers, Greenstar helps native peoples record traditional art, music, photography, legends and storytelling for sale over the Internet. The MIT Media Laboratory, meanwhile, has produced "Lincos," or "Little Intelligent Communities," similar packages that combine computer science laboratories, telemedicine units, videoconference centers, and information centers with electronic trade features.

More robust Internet connections cannot come fast enough for Norbert Nez, systems analyst in the Division of Community Development. Nez says local chapters have a growing need for Internet access. "Right now, information is what the chapters need the most," he says. Chapters already need a lot of information about national laws and policies, he says, and they will need much more as they become self-governing. In particular, they will need up-to-date information about land use for issuing permits, planning, protecting archeological sites, laying out roads and other infrastructure, and protecting flood plains, forest areas and grazing lands. One

chapter, Shiprock, already is building its own database of geographic information systems (GIS) data, according to Nez, who says he hopes many more will follow. Nez says he hopes Navajo people ultimately "will be comfortable enough that technology is transparent to them. Anywhere they go, if they need information, they should be able to pull it off a computer."

Despite successes such as the wiring of the chapter houses, Nez admits to feeling overwhelmed at how far the Navajo Nation still has to go to join the information age. Much infrastructure remains to be built, and lack of training remains a huge obstacle. Indeed, he says, many Navajos still don't have a strong idea of all the things they might be able to do with information technology. "Many people are still at the point they think it's more of a toy than something they can put to business use," he says. "And a lot of time people are so overcome they don't even know what to ask."

Still, for the first time ever, a likely candidate for president of the Navajo Nation has established his own website. And changes in the lives of people like Isabelle Walker, Barbara Cummings and Larry Noble suggest the nation has come a long way in a short time. "We're getting there," says Noble. "It's just going to take some time."

Contact Information: Seba Dalkai Boarding School, Inc.

Dr. Kyril Calsoyas
9975 Chestnut Road
Flagstaff, AZ 86604

(520) 714-9422
(520) 714-9422 (fax)
kyrilcalsoyas@earthlink.net

Mayville State University 2

A Technology Center Takes Root on the Prairie

Here is a "dot com" company that has weathered the storm in the e-commerce business just fine: ComMark, Inc., a web-services firm based in Mayville, North Dakota. Launched by two college professors and a student in 1995, it now boasts 19 employees and a half-million-dollar annual payroll. That may not seem like much to high-tech hotbeds like Palo Alto or Seattle, but for Mayville, a town of fewer than 2,000 people planted amid the sprawling wheat, barley, and sugar beet farms of the Red River Valley, it is one of the most promising economic developments in years — proof that the "new economy" can benefit rural areas as well as big cities and suburbs.

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"This is our hope," says Del Kessler, principal of Mayville's high school. "You can find good, high-paying jobs and still live in North Dakota."

ComMark's success, which has given Mayville a renewed sense of optimism after years of decline in farm employment, demonstrates how information technology could change the face of rural America. It also shows, however, that the promise of a business resurgence will remain unfulfilled unless community leaders join forces, develop a sophisticated understanding of the new economy and, perhaps most important, put in a lot of hard work.

Mayville has good reason to nurture new industry. A continuing revolution in farm-

ing technology has made six out of every seven North Dakota farm jobs obsolete in the last two decades. Consider just one innovation. The traditional seed-planting device, for instance, was 12 feet wide, and it planted crops at a three-miles-per-hour pace; but newer versions seed swaths of land 60 feet wide at seven miles per hour. Innovations like that have set off an exodus from farms, which in turn has undercut what once was a healthy retail trade in towns like Mayville. Half of the stores that lined Main Street in the mid-1970s have vanished, and in recent years, some North Dakotans have even questioned whether the state still can afford institutions like Mayville State University, a land grant college that trains about 750 students for careers in teaching and other occupations.

The Need to Diversify

The people of Mayville know they have to diversify their economy, but until recently there seemed to be no obvious way to accomplish the job. Forty miles from the nearest city and 11 miles from an interstate highway, the town lacks access to the abundant supplies of power and water needed by modern factories. The high cost of transporting raw materials and finished goods keeps large-scale manufacturers away. And weather is a problem, too. Companies are reluctant to set up operations for fear that winter storms will prevent them from making timely deliveries to distant customers over the two-lane roads that link the town to the outside world.

None of these barriers would apply to Internet-based companies, of course. But Mayville had to meet other conditions before it could hope to find high-tech employers. For one thing, it needed a well-trained workforce that could fill the demanding jobs generated by information technology companies. That is where Mayville State University (MSU) came in. Since the mid-1990s, the university has quietly built a reputation as a leader in information technology. In 1997, it became one of the first colleges in the nation to issue laptop computers to all of its students. Teachers and students use the computers in practically all of the university's educational activities, and the university requires each student to meet national standards for information technology skills in his or her chosen field. Any high-tech company interested in moving to Mayville today will find a ready pool of technology-savvy interns, and 135 prospective employees who are graduated each year well versed in information technology.

Mayville needed one more thing to emerge as a rural hub of the new economy: affordable, high-capacity connections to the Internet. That proved a bit trickier. As recently as 1997, townspeople still could not connect to the Internet over regular telephone lines without making long-distance calls. And even though the cost of wiring the town for high-speed communications links would be negligible compared to what Mayville would have to spend to widen its highways or upgrade its power or water systems sufficiently to attract traditional manufacturers, telecommunications providers for years said the town lacked enough customers to justify the investment needed to wire it.

A Business Incubator

That calculation is changing rapidly. One factor is the Traill County Technology Center, which MSU and local economic-development agencies created in 1999 with support from TOP. Housed in two

buildings at the university, the center gives tenants access to a statewide, high-speed telecommunications network at the same competitive rates the university and other state agencies pay under a contract between the state of North Dakota and private telecommunications companies. Moreover, it gives start-up businesses low-cost office space, access to student interns (and hence, a first chance to identify promising future employees), technical support from university faculty and staff, and an opportunity to work alongside like-minded companies

ComMark, whose name stands for "Communications and Marketing," illustrates the kind of synergies the incubator is designed to foster. The company regularly draws on the resources of the university. Once, for instance, when it was short of workers versed in a complex software package known as Cold Fusion, it turned to the university, which quickly established a special training program. MSU benefits from the relationship, too. It looks to ComMark to provide valuable "real-life" experience for students. The company pays these interns less than what full employees earn, but that does not mean it is profiting from cheap labor. The higher cost of training student interns offsets any savings from paying interns lower salaries, according to Lee Kaldor, the company's vice president.

Like many new economy employers, ComMark is looking for lifelong learners — people who can acquire new skills, learn or create new kinds of software, quickly adapt to technological innovations, and respond to fluctuating market demands throughout their careers. It also needs people who can combine diverse disciplines. The company's own founding partners include a business professor and a computer and information systems professor, and it expects its employees to bring both disciplines to bear in their approach to clients. More than simply designing websites, they have to understand their clients' businesses thoroughly, and then help them find new ways to interact with customers. In addition, they have to help businesses use the web to understand their own customers more completely so that they can fine-tune product lines and inventories to reflect changing market conditions. "We have tried to differentiate ourselves from the traditional 'dot com,'" notes Kaldor. "We're much more about using databases and developing business solutions than in putting a pretty face on a company's website."

A Winning Formula

That seems to be a winning formula. In 2000, ComMark contracted with Avenet, a Minneapolis-based company, to design websites that were used by 500 political candidates around the country. After the elections, the company began developing websites for city and county governments and for religious organizations. ComMark also developed a website for "We-Fest," an annual music festival in Minnesota. The festival's sponsors originally thought they might sell a few tickets online, but their low expectations grew much higher after ComMark showed them how they could use its software to increase their overall efficiency. Now, We-Fest uses its ComMark-created website to keep track of all of their sales — including ones made by telephone and in person.

Similarly, ComMark developed an e-commerce site for Agsco Inc., a supplier of agricultural chemicals in the upper Midwest. Besides opening a new avenue to reach customers, the website has helped the company manage its own inventory more effectively. Agsco is so convinced of the value of the tool that it now resells it to agricultural suppliers in 20 states.

ComMark has profited from such successes, and in turn it has rewarded its employees by paying salaries higher than many rural North Dakotans thought possible. The company has hired a number of its student interns into full-time jobs after they graduated from MSU, and it already has brought back one student who had left the state. For leaders who have watched the community's slow decline in recent decades, ComMark's success is a welcome bit of good news. Del Kessler, principal of the local high school, says he sends as many of his students as possible to see ComMark in action, and he has invited Carrie Osland, a local student who now man-

ages a help desk at ComMark, back to the school to tell students what new opportunities are opening up right in town.

"Our students are very traditional," Kessler says. "They just don't see this technological age happening. But a whole world of high-paying jobs is opening up for them."

A Connected Community

Ultimately, the community itself, not the technology center, will determine whether Kessler's optimism is well founded. North Dakota law allows private companies in business incubators to use the state's high-speed communications network for only four years. After that, they must contract for their own telecommunications. To sustain its success, Mayville must attract competitively priced, high-capacity communications services.

On this front, too, the outlook is encouraging — thanks again to Mayville State University. Even before they began issuing laptop computers to students, MSU officials were meeting with community members to stir interest in computers and technology. Later, when community members complained they could not gain Internet access without making long-distance telephone calls, the university created a special Internet class and enrolled a group of community leaders so they could gain dial-up access as students. That led to formation of a "community technology committee," which set out to attract a local Internet service provider to town. It was a hard sell. In 1997, many telecommunications companies doubted that little Mayville would produce enough Internet users to justify the cost of connecting them. "It took a lot of gnashing of teeth and banging heads on walls," recalls Jay Henrickson, who runs MSU's internship program and heads the technology center.

In the end, Polar Communications, a rural telephone cooperative based in Park River, North Dakota, agreed to provide bare-bones, local Internet service. But, saying it needed to sign up 160 customers to cover its $40,000 cost, it demanded that the local economic development commission pledge to pay $10,000 if fewer customers signed up in the first year. At the time, the commission had little more than enough funds to buy stamps and coffee, but their confidence paid off. Polar reached its minimum goal in six months.

Things have changed a lot since 1997. This year, Polar has decided to invest $3 million to bring competitive telephone service, cable television and a range of high-speed Internet connections to every home in Mayville — without any financial guarantees from the community. As a result, "we hope the digital divide issue will be completely resolved within four years," says Keith Stenehjem, MSU's chief information officer.

Looking Ahead

What made the difference? David Dunning, the cooperative's general manager, says he now is convinced that Mayville will prove to be a strong market for telecommunications services. Polar expects to sign up 60 percent of Mayville telephone customers in the next four years, and surveys suggest at least one-quarter will want some kind of Internet connection. What's more, the demand for high-speed links appears likely to grow at a healthy pace. Already, a gasoline company, a grain elevator, and an electronic goods retailer who runs a help-desk for Polar out of a back office say they want high-capacity communications services. The technology center also should catalyze business demand. The director of the county economic development commission has moved into the center, and plans to spend half of his time for the next few years attracting new businesses to it. And Polar, which just four years ago worried about losing $10,000 on providing basic Internet service, donated $6,500 in wiring to the new center at no charge.

That could be just the beginning. As this report went to press, officials at the technology center were negotiating with a California-based defense contractor who wants to open a branch office in

Mayville — a move that would create a minimum of 70 jobs in the community over five years. The incubator, the strong training of MSU graduates, and the palpable enthusiasm for information technology among community leaders all were powerful selling points, according to a company official. "The whole community has really bonded together to make this happen," said the official, who asked not to be identified.

To Gary Hagen, MSU's vice president of academic affairs and a long-time member of Mayville's local economic development commission, this development comes as relief after years of battling out-migration and failing to attract new industry to the town. "We're finally in the game again," says Hagen. "A while ago, we weren't in the game."

Contact Information: Mayville State University

Dr. Keith Stenehjem
330 Third Street, NE
Mayville, ND 58257

(701) 786-4755
(701) 555-1001 (fax)
Stenehjem@mail.masu.nodak.edu
www.trailltechnology.com/

Sevier River Water Users Association

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II. New Tools for Managing Resources

As the experiences of the Navajo Nation and the town of Mayville demonstrate, the well being of rural areas depends on how effectively people manage their most precious resources, natural and human. Two projects described in this chapter look more closely at this issue.

Irrigation provides the lifeblood of farming in Utah's Sevier River basin, but, as in much of the west, there isn't enough water. To improve their lot, farmers will have to find ways to stretch this scarce resource. A project launched by the U.S. Interior Department's Bureau of Reclamation is showing how the timely collection and distribution of information can significantly improve the efficiency of irrigation systems so that farmers get the most out of the limited supply of water. Meanwhile, in coastal Maine, a project is showing how better information systems also can improve the delivery of social services to needy families, improving their chances of achieving self-sufficiency while ensuring that taxpayers and charitable organizations get the best return on their investment in social programs.

A "Virtual" Watershed Saves Real Water

In the arid southwest, where water is so scarce that people sometimes call it "liquid gold," Ray Owens controls a mother lode. As commissioner of the upper basin of Utah's Sevier River, he manages the Otter Creek and Piute reservoirs, which capture precious runoff from nearby mountains each spring so that farmers can irrigate their land during the long, dry summer. There is not a drop of water to spare. If winter snows are deep enough to fill the reservoirs, and if Owens metes out the water judiciously, farmers can successfully raise three crops of hay during the six-month irrigation season. But if winter fails to bring enough snow to the mountains, or if he lets the water run out prematurely, their crops may wither under the relentless sun.

Although the stakes are high and the margin for error is low, Owens' job was, until recently, largely a guessing game. He could carefully add up how much water farmers needed, but once he opened the reservoir gates and sent the life-giving liquid rushing downstream, any number of unpredictable factors — including an evaporation rate that varies with the weather, unpredictable thunderstorms, possible leaks along miles of irrigation canals, and theft — might prove his calculations wrong. To make matters more difficult, he couldn't keep track of the water during its four-day trip to the Vermillion canal east of Richfield, Utah, the last place farmers tap into the river before it passes to the lower basin where a

different commissioner takes charge. "All I could do," Owens says, was wait the four days and "see how much came out at the end." By then, however, it was hard to correct a mistake; if the river was too low to meet the needs of the farmers at the end of the line, they would have to wait another four days before additional water released from the reservoir could reach them — a dry stretch that could leave their crops damaged, if not ruined.

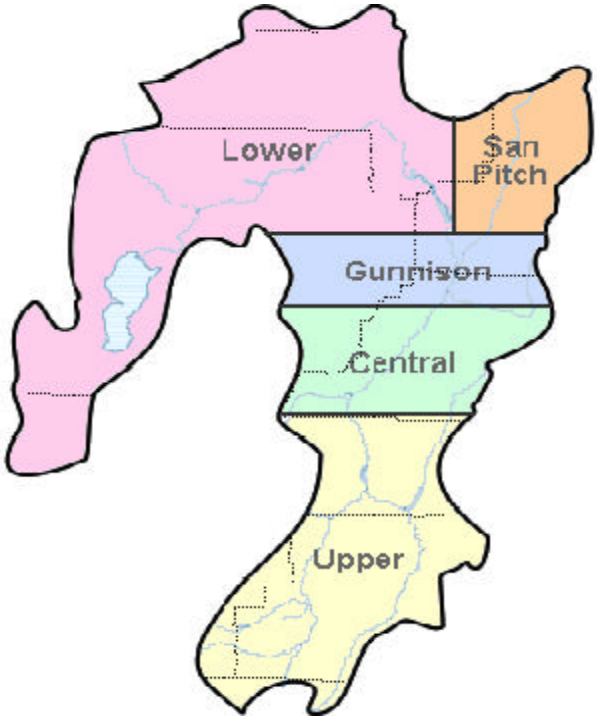
Owens' job has become a lot easier since 2000 — thanks to a new set of tools that are bringing the old art of irrigation into the information age. The U.S. Interior Department's Bureau of Reclamation has worked with the water users to install more than 20 solar-powered monitors that constantly measure water levels and the rate of flow at reservoirs, diversion dams, canals and key points along the river itself. All this information is relayed by radio to a "data hut" built with assistance from the Technology Opportunities Program near Richfield, Utah. There, it is amassed on a website that gives a round-the-clock snapshot of what is happening at every key point on the Sevier River's journey from a high plateau in southern Utah to a dry lake bed in the middle of a broad expanse of desert 225 miles north and west of the river's headwaters.

Less Guesswork

The new "virtual watershed" has taken a lot of the guesswork out of managing the basin's water supply. Instead of having to wait four days to determine how to adjust gates controlling the flow from the top reservoir in the basin, Owens now can constantly track the water all the way from the canal to the end of his section of the river and beyond. Any time the flow diverges from what farmers need, he can use a system of remote controls to fine-tune the rate at which water flows from reservoirs into the river and canals.

The instant calibration of water flows has made a huge difference to the farmers who depend on the river for their livelihood. "The river used to run dry about once a month," recalls Ivan Cowley, who operates a 900-acre farm near the Vermillion canal. "But that hasn't happened once since this started." Cowley said he never knew for sure how much water he would receive to water his crops until it flowed around a bend in the river just above Vermillion canal. But now, he says, "I can see the whole river in five minutes. I know exactly what's coming. This is the greatest thing that has ever happened here."

The Sevier Valley, about 100 miles south of Salt Lake City, illustrates just how important water is in the southwest. Mountains rising on either side of the valley are a harsh, monochromatic brown, dotted with dull spots of sagebrush. But the valley between them, nourished by the river and a network of canals that branch from it, is an inviting patchwork of green alfalfa, grains, pastures and cornfields. The mountains collect about 40 inches of precipitation a year, mostly in the form of winter snowfall. Without that



snow, the valley would be barren: it averages a foot of rain a year.

Irrigation may be nearing its limits, however. The most effective dams, reservoirs, irrigation ca-

nals and flood detention basins have already been developed, and environmental restrictions make construction of major new water projects unlikely. "New methods of managing water resources have become a necessity," says Roger Hansen, activity manager in the Provo, Utah, office of the Bureau of Reclamation.

Measuring the Benefits

Hansen and his colleague, Arlen Hilton, worked with a team that included web-site developer StoneFly Technology, Utah State University and others to develop the real-time monitoring and control system for the Sevier Basin. They have won invitations to present their ideas from as far away as China. The project managers are reluctant to make specific claims for how far the virtual watershed can stretch the basin's limited water supply. Too many variables — fluctuations in annual rainfall, for instance — make a controlled experiment impossible, he says. But people who depend on water day-to-day in the Sevier Valley are less reticent. Ivan Cowley, who serves as president of both the Sevier River Water Users Association and the Otter Creek Reservoir Company, estimates the project could be conserving as much as 12 percent of the basin's water supply a year.

In the past, Cowley explains, every time the Sevier River would run dry, the Vermillion Canal would dry up, too. Its soil would become more porous, so that it would absorb more water when it refilled than if it had stayed wet continuously. What's more, water managers, fearing the wrath of farmers unable to water their crops, often tended to overshoot their target, sending more water downstream than was needed. The excess would flow over the Vermillion Dam, lost forever to the farmers of the upper basin.

Russell Anderson, who manages two large canals from his home in Richfield, agrees that the new system is saving a substantial amount of water. In the past, Anderson had just two opportunities a day to adjust the gates controlling how much water flowed from the river into his canals. A "water master," usually a farmer with many other things to do, would walk the canal early in the morning and again at the end of the day. Also known as a "ditch rider," he would clear away any debris from the diversion channel and reset the gates to whatever height Anderson ordered. If conditions changed between these visits—say, farmers on the canal decided they wanted less water—Anderson had no choice but to wait for the water master's next rounds to have the

gates adjusted. Now, though, he can make the changes instantaneously with a few strokes on his computer. What's more, a remote camera enables him to actually see the diversion structure, so that he can double-check the gate setting or check for any accumulation of debris or vandalism. And if the water flow diverges from his target while he is asleep or away, the system will trigger an automatic telephone call to his cell phone or his home telephone. "My girlfriend," as Anderson calls the female voice that delivers the warning, "won't stop calling until she gets me."

With all of these features, Anderson says he now adjusts the gates numerous times a day, rather than just twice. As a result, he says, the "shrink"—the amount of water he loses in the canals—has dropped in half, from 41 percent of the water he diverts from the river to 21 percent.

Anderson believes the increased efficiency of the irrigation system already is paying dividends to farmers: since the system of remote monitoring and control was installed, he said, they have been planting more corn and alfalfa, which require a lot of water but fetch higher prices, and less barley, which grows better in dry conditions but is less profitable.

The End of the Line

The system hasn't been in place long enough for experts to verify such a trend, but farmers agree the system may be improving their decisions about what—and when— to plant. That may be especially important in the lower basin, where the high plateaus of the upper basin give way to a low-lying, windswept expanse. In this part of the basin, sand dunes form in fields that aren't irrigated, and farmers operate closer to the edge. For them, being able to predict early in the season how much water will be available late in the year could be invaluable, according to Jim Walker, the lower basin's water commissioner. Normally, farmers water their farms until the water supply runs out. In a dry year, then, the third hay crop is the most likely one to fail. But late-season crops tend to have more protein, and hence, are more valuable. The virtual watershed may enable farmers to predict with greater certainty when there will be enough water for just two hay crops, so that they can forego the middle crop in order to save precious water for the more profitable third one, Walker says.

Farmers in the lower basin face other challenges unfamiliar to their counterparts upstream. Generally, by the time water reaches them, it already has watered other crops higher in the basin, gaining in salt content in the process. As a result, farmers are forced to pump ground water into their canals to make sure the irrigation water doesn't harm their crops. Trevor Hughes, a former professor at Utah State University, says data from real-time monitoring for salt content could be fed into to a mathematical model that balances the cost of pumping ground water against market prices for farm produce to tell farmers when it is cost effective to "sweeten" the water and irrigate rather than let the water flow on downstream.

Other elaborations of the project are in the works. The water users and Utah's State Climatologist have installed weather stations at four points in the basin that give farmers information that could increase the efficiency of the system even further. A farmer who sees storm clouds forming at a point upstream, for instance, might be able to forego irrigation — and thereby save water — knowing that Mother Nature would soon be watering his crops. Meanwhile, kayakers and fishermen also have expressed an interest in using the system to monitor river and reservoir conditions.

What's Next?

The system also may come in handy on those rare occasions when the Sevier River floods. "We could monitor the frequency of lightening strikes to predict when we are going to have unintended flows from thunderstorms," says Hughes. That, in turn, would enable water managers to open floodgates in a timelier manner. Jim Walker, the lower basin commissioner, believes severe floods also might be handled differently. In 1983, a spillway from the

DMAD reservoir in the lower basin gave way during an unusual flood, causing serious damage to the town of Deseret and leaving farmers without an effective irrigation system for two weeks. Ironically, that led many farmers, including Walker, to lose crops later for lack of water. Walker subsequently learned that officials higher up the river had been releasing pressure from higher reservoirs, a move that had increased pressure on the reservoir that ultimately failed. "If that happened today, I would be able to see what they're doing," Walker says. "I'm not saying I could have changed what they did, but at least I would have been able to argue they should keep more of that water."

Many water users are enthusiastic about modern information technology, though. Russell Anderson, the canal manager in Richfield, now says he feels like he is "blind after being able to see" whenever the new system goes down and he has to go back to the old way of doing business. Anderson says he wants the system to be refined to project in advance what water levels will be at various points on the river after he releases various amounts of reservoir water. Beyond that, he says, "I foresee a merge with canal automation and the web to the point I can wear a device right here behind my ear. All I have to do is think, 'What is the gate set at? One hundred feet.' Then I think, 'It should be at 95-feet, and the gate goes down.'"

On this last point, he has his tongue planted in his cheek. Or does he?

Contact Information: Sevier River Water Users Association

Mr. Roger Hansen
302 East 1860 South
Provo, UT 84606

(301) 555-1000
(301) 555-1001 (fax)
rhansen@uc.usbr.gov
sevierriver.org

Coastal Economic Development Corporation

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Better Information System Improves Social Services

Visitors who enter the Coastal Economic Development Corporation (CEDC) just outside Bath, Maine, find themselves in a large lobby that serves as the hub for an assortment of social service programs. Arrayed in a rough semicircle around the lobby are a workforce development center where clients can get help landing jobs, an energy assistance program that helps poor families obtain home heating oil, and a program that provides food assistance and nutrition counseling to women with young children. Also within easy reach are caseworkers who assist families with housing problems, a team of counselors who help troubled families develop long-range strategies for achieving economic self-sufficiency, and a branch of the United Way.

None of these programs is new, but their placement within easy reach of the lobby reflects a potentially revolutionary idea. Instead of delivering services to needy families piecemeal, why not consolidate them in a way that might have a much more profound effect? Currently, when families seek help, they have to negotiate a maze of overlapping and duplicative application procedures, eligibility requirements, and rules. Worse yet is if the challenges these families face are interconnected. The existing system addresses each problem in isolation, preventing families from securing enough help to attain real permanent progress.

If the service bureaucracy could be streamlined and families could get help addressing their various problems simultaneously, service providers believe, families would stand a much better chance of achieving lasting improvement in their lives. What's more, administrative costs would go down and society would get more for the dollars it spends on categorical programs.

Such coordination of service programs could make an especially big difference in rural regions, where people and service agencies are widely dispersed. In Maine, for instance, nearly 85 percent of the people live in rural areas that have virtually no public transportation. For families, the sheer challenge of traveling from agency to agency enormously complicates the task of finding needed services. Agencies, meanwhile, have a harder time discerning families' needs and providing appropriate assistance when their clients are far-flung and difficult to contact.

Where to Begin?

Consolidation may sound like an excellent idea, but achieving it has proven to be very challenging. Individual social programs have grown up independently for many years, and now have well established rules, regulations and bureaucracies behind them. In 1999, CEDC, a non-profit community action agency, decided to tackle the issue by consolidating not agencies or programs, but the information they all need. Specifically, the agency used a three-year grant from the Technology Opportunities Program to develop computer software that ultimately will enable it to screen clients simultaneously for all the programs the agency operates, measure these people's progress in achieving basic life goals, and collect data that will help the agency better understand its community and evaluate its own effectiveness.

Known as ICAPS, or Integrated Community Action Program System, the software is the linchpin of a sweeping effort to provide more comprehensive — and hence, more effective — services to low-income families. "In the past, we were always dealing with pieces of families," explains Jessica Harnar, CEDC's executive director. For years, she watched needy families get help from one categorical program — perhaps getting desperately needed heating oil or food — only to show up later needing some other emergency assistance. Because their underlying problems were never addressed systematically, many families seemed to lurch from crisis to crisis. "If we really believe in our mission to help people achieve economic stability, we need to take a holistic approach," Harnar says.

Harnar and her staff know they face a difficult task. So far, they have only brought a few of CEDC's own programs into the ICAPS system. And while CEDC houses a number of different programs, many others are scattered among different agencies and different geographical locations—mental health agencies, shelters for the homeless and abused, rape crisis and suicide prevention centers, legal assistance offices, substance abuse programs, adult education facilities, special programs for the elderly, health care facilities and more. Moreover, even agencies that share the same geographic location can be held apart by their own distinct rules and procedures. Still, CEDC's efforts already have caught the attention of state officials seeking to overhaul Maine's social service system, and the lessons the agency is learning could prove useful to a host of similar projects around the country.

Start Small, But Think Big

One of the first lessons is that sponsors of information technology projects should start small, but think big. It is no easy task to review the information needs of countless individual programs, consolidate them into a single questionnaire, and then write software that will use that information to determine automatically whether an individual is eligible for separate programs. To make the task manageable, CEDC began by designing a set of questions that would enable it to gather basic demographic information about clients. Then, it developed a questionnaire that could be used to determine eligibility

for a single, relatively straightforward home-improvement lending program.

With that experience under its belt, the agency next developed a new questionnaire for its Family Development Case Management program, which will be key to the effort to create a unified service-delivery program. Unlike categorical programs that deliver specific services, the family-development program strives to view clients as whole people, assessing all of their needs and then helping them find a range of services that will improve their lives. Accordingly, the "family security assessment," as the questionnaire developed for the program is known, turns the typical client interview on its head. Instead of asking questions to determine whether the client meets a predetermined set of eligibility criteria, it begins by assessing clients' needs, and then it looks for services that might help meet them. "The [software] helps change our focus and how we approach people," says Catherine McConnell, manager of CEDC's community services program.

The family security questionnaire gauges clients' status in 15 different areas — shelter, nutrition, physical health, mental health, alcohol or substance abuse, employment, income and money management skills, adult education, children's education, parenting skills, family relationships, transportation, child-care, legal issues and spirituality. It then suggests steps counselors can take to address areas where clients are deemed at risk. Using the software, counselors work with clients to develop detailed "action plans," and they subsequently track clients' progress toward achieving the specific goals they set.

CEDC picked the programmers for its software carefully. "We needed programmers who could conceptualize the whole delivery system," says Harnar. "The job was a big challenge for them, but it enriched their work." Just as important as the ability of the programmers was where they worked. CEDC deliberately sought out programmers in Maine's Department of Labor, knowing they would be developing similar tools for the various programs that agency operates. Having the same programmers almost guarantees that CEDC eventually will be able to screen its clients for Labor Department programs, moving the agency a step closer to its goal of creating a seamless service network. "We wanted to make sure that whatever we developed eventually could be linked with the state," says Harnar.

The strategy appears to be paying off: the Labor Department is looking at adopting ICAPS for the Women, Infants and Children food and nutrition program. Meanwhile, CEDC is slowly but surely expanding ICAPS to cover more of its own programs. This summer, it added the Low Income Home Energy Assistance Program to the system, and it plans next to bring in the Head Start program that serves low-income pre-schoolers. Ultimately, says Harnar, clients will be able to come to any CEDC program and be screened and referred to any other service for which they qualify. "There will be no wrong doors," she says.

Signs of Progress

Although using the new software requires change, and change often arouses resistance, Harnar says different groups readily see the advantages of ICAPS once it is explained to them. Among the first to applaud the idea are clients themselves, for whom a common intake process could save time and streamline their visits.

The new system should increase efficiency. A spreadsheet prepared by CEDC when it first started planning ICAPS showed that the agency collected 55 percent of all its data on clients more than once. That suggests the agency can achieve substantial savings simply by eliminating redundant data-collection efforts. Moreover, because ICAPS creates mechanisms for tracking clients' progress through the social services system, it eventually will enable CEDC and its funders to determine far more accurately than is currently possible how effective various programs are. In addition, Harnar says, the system will increase general public understanding of the difficulties faced by low-income people. "Society and funding sources tend to assume that the prob-

lems people face can be taken care of in six months," she says. "We have to collect information that explains the complexity of the problem."

CEDC's own employees also are key stakeholders. Harnar believes they can be shown that the new system will make them more effective. Technology, she says, will allow employees to spend less time doing paperwork and more time working directly with clients. "If we didn't have this technology, the changes we want can't happen," she argues. "The system would collapse under the weight of paper and pencil."

Technology won't magically produce a unified service system all by itself, however. In Maine, a special task force spent more than two years looking at ways of bringing diverse agencies together to provide "integrated case management" for troubled children. Its final report, issued in December, 2000, recommended a system that closely resembles CEDC's own procedures: a lead case manager, it said, should be named to bring all relevant service providers together to work with a family on developing a comprehensive plan for improving its situation.

The task force initially intended to explore how to develop a unified data system like ICAPS. But it shied away from that goal. The effort would have drained too much of its energies from other concerns — including the need to develop a client consent form that would enable different agencies to share information about clients without violating their confidentiality obligations, and even more challenging, the need to teach caseworkers from different disciplines how to work together. Moreover, several government agencies that participated in the task force had recently spent substantial sums developing their own information systems, and thus were reluctant to consider developing a new one from scratch — especially since CEDC was well along in demonstrating the concept.

Still, it is generally agreed that future efforts to expand on the concept of integrated case management will require some effort to streamline and consolidate information systems. Members of the Maine task force, for instance, talked about a "federated system," in which separate agencies would be able to exchange data even if they don't merge their systems entirely. Whatever approach to consolidating or coordinating information systems is taken in the future, one thing is sure: lessons being learned at places like CEDC will come in handy.

Contact Information: Coastal Economic Development Corporation

Ms. Jessica M. Harnar
34 Wing Farm Parkway
Bath, ME 04530

(207) 442-7963
jessica.harnar@state.me.us

Regional Medical Center at Lubec

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III. Improving Rural Health Care

Telemedicine, the use of communications technologies to deliver health care services to people at remote locations, has obvious appeal in rural areas, where the population is widely scattered and doctors — especially specialists — are in short supply. TOP has supported a variety of projects designed to make this possibility a reality. The two projects profiled here shed light on two issues. First, they show that telemedicine isn't a single technology; rather, it is a variety of tools — including video-telephones, more sophisticated teleconferencing equipment and space-age units that can monitor everything from pulmonary conditions to blood pressure. More important, these two projects suggest that while technology makes telemedicine possible, human relationships are what make it work.

Initially, the projects appear quite different. In one, a small medical center is spearheading a growing effort to bring better medical care to rural areas. In the other, a major trauma hospital is playing the lead role in improving the practice of emergency medicine in a large rural region. But the projects have more in common than they have differences. In each case, success depends less on technical proficiency than on good will, hard work and a sincere desire to apply technology in a way that benefits everybody.

A Telemedicine Network Takes Shape

Joyce F. sits in her living room in Calais, Maine, and looks at two large bookshelves lined with the pictures of her seven grown children. "They all got an education," she says, with obvious pride. Those pictures are an aging mother's anchor, reminders of who she is and how much she has accomplished in a long life. But her continuing ability to enjoy them in a living room packed with other pictures and memorabilia depends on one other item: a small black box that sits unobtrusively next to the telephone.

It is a videoconferencing device. Connected to a regular telephone line and featuring a monitor about the size of a post-card, it enables Joyce to see and hear a nurse who visits her electronically every day. Though Joyce's voice is frail, the nurse has no trouble hearing her when she calls. In just a few minutes, she sees how Joyce is doing, makes sure she is taking her medicines, and, perhaps, takes some of the loneliness out of Joyce's solitary day.

It may not seem like much, but this link to the outside world has kept Joyce happily in her home longer than anybody would have thought possible. A year ago, the Eastern Area Office on Aging in northeastern Maine had just about concluded that she couldn't manage on her own any more. She suffers from diabetes and first-stage Alzheimers disease, and her ability to follow a

fairly rigorous schedule for taking her medications was in doubt. But the little black box has brought her the help she needs, enabling her to stay in a familiar setting full of reminders of her life. Besides enhancing the quality of her life, that probably has strengthened her in the fight against Alzheimers.

The little black box is one piece of an ambitious telemedicine project that is changing the face of health care in rural Maine. With support from the Technology Opportunities Program, the Regional Medical Center at Lubec has installed equipment that allows nurses from two vast counties in northeastern Maine to make electronic home visits to ailing people who otherwise might have to be institutionalized. At the same time, the medical center has been providing more sophisticated teleconferencing equipment to link specialists in urbanized areas with patients, doctors, and other professionals in smaller, regional medical facilities. Although the project is less than three years old, it is rapidly growing into a statewide network, bringing together not only medical care facilities but also institutions as varied as mental hospitals and law enforcement agencies.

Three Tools

The Regional Medical Center at Lubec didn't exactly set out to build a statewide network. Rather, it perceived a need in its own back yard. "We saw that our own clients were having trouble getting services," says Ken Schmidt, the facility's senior executive officer. Lubec, the easternmost town in the United States, lies on the Maine seacoast in Washington County, an almost entirely wooded expanse of 2,628 square miles that are almost as isolated as they are beautiful. The nearest major hospital and medical specialists are between two and three hours away in Bangor, Maine. The adjacent county, Aroostook County, is the largest county east of the Mississippi — and one of the most rural. With 80,000 people dispersed over 6,400 square miles, it has just 12.5 people per square mile.

Compounding the challenge that distance poses for health-care providers, the region has notoriously severe weather. Aroostook County, for instance, averages 110 inches of snow per year.

In this environment, the simple act of going to see a doctor or nurse can be so arduous that many residents — especially people with chronic illnesses — often fail to make appointments. As in other areas, visiting nurses provide routine health monitoring and care to homebound patients. But with even a single home visit often requiring two or three hours of driving, they are stretched thin. They cannot always keep pace with the demand, especially when patients seek help after hours.

The medical center is using three types of telemedicine tools to help overcome these obstacles. The simplest is the little black box used in homes of patients like Joyce. These patients don't need much; they simply need somebody to check up on them. Some have to be reminded to take their medicines on schedule. "Medication compliance is one of our biggest issues," notes Carol Carew, director of Home Telemedicine for the center. Others need to have wounds inspected to make sure they are healing correctly. Still others need advice on everything from tending to hospice patients to caring for newborn babies. Many of the beneficiaries are psychiatric patients. In a brief telemedicine visit to check whether they are taking their medicines, nurses can look for little clues that something is awry. If a patient answers a call with disheveled hair, for instance, that may be an early indication that his condition is deteriorating. By catching problems and getting help early, nurses are keeping patients at home and out of the hospital.

The center deploys more sophisticated home-based telemedicine units for other patients, including people with heart or pulmonary disease. These devices typically have video screens, tools to read blood pressure and stethoscopes. The stethoscopes, developed to monitor astronauts' hearts from space, actually deliver higher quality readings than a doctor gets listening to a person's heart in-person using a traditional stethoscope. Some home-monitoring stations also have oximeters and glucometers, which measure oxygen saturation and sugar levels in the

blood, respectively. With this array of tools, nurses are monitoring patients with diabetes, chronic heart or respiratory conditions and hypertension. They are checking up on patients just discharged from hospitals following cardiac surgery (a valuable service because insurers are requiring such patients to go home earlier than in the past). Medical center staffers estimate the telemedicine units are reducing costly after-hours visits to patients' homes, emergency room visits by home-care patients and re-hospitalizations by 10 percent.

The third tool in the medical center's arsenal is not even a telemedicine device, strictly speaking. It is a high-speed videoconferencing system that allows specialists in urban areas to consult with patients and other doctors in outlying clinics. Although patients still must travel to larger, urban hospitals for major procedures like surgery or initial psychiatric treatment, videoconferencing enables them to get routine follow-up care in local medical centers nearer to home. It also gives local doctors a great deal of support. They need all the help they can get. Washington and Aroostook Counties have just 76 and 127 physicians per 100,000 residents, respectively (the statewide average in Maine is 175 physicians per 100,000 people). Moreover, these counties have a disproportionate number of new doctors who, by the very nature of their rural practices, have to generalize more than city doctors — and hence, may be less familiar with specific maladies than their urban counterparts.

There is little question that videoconferencing has improved the quality of services to many residents of rural areas. Consider Dr. Charles Alexander, a gerontologist at Maine Coast Memorial Hospital in Ellsworth, Maine. One of his jobs is to evaluate patients suspected of suffering dementia. For rural patients, he traditionally had to settle for reviewing the results of tests that nurses and social workers administered in the patients' homes. But now, these patients can go to rural clinics near their homes, and visit Dr. Alexander via videoconferencing. That approach represents a huge improvement. Patients with dementia and their families have coping mechanisms that can mask the underlying medical problems, according to Dr. Alexander. A spouse, for instance, might almost reflexively answer a difficult question for a confused person — a behavior that may not show up on paper but is readily apparent to a specialist who can observe the patient and his surroundings. "One look is worth a thousand words," says Dr. Alexander.

Teleconferencing has improved the treatment of such patients as well, he adds. Much of the treatment of dementia involves helping families of people who have the disease learn how to deal with stress and to work together to handle the situation. But in today's busy world, it is almost impossible to get entire families to drive many hours to meet with gerontologists like Dr. Alexander. With videoconferencing, however, it is easier to assemble families because they simply have to travel to a local clinic or doctor's office.

Making It Happen

Despite all the arguments in favor of using telemedicine in rural areas, it has not always been an easy sell. Among other obstacles, some visiting nurses believe the aim is to eliminate their jobs, and some rural doctors fear big-city specialists will take away their patients. Managers of the Maine project have gone to considerable lengths to alleviate such concerns. The key, they believe, is to persuade doctors to embrace telemedicine themselves.

As a first step, they strive to demonstrate that doctors needn't feel threatened. "We make it clear we are not trying to break referral patterns," says Carew. The project also recommends putting teleconferencing equipment in specialists' offices, rather than in the hospitals where they practice, so that it will be more convenient for them to use the equipment. But most important, the center enlists doctors to promote use of the equipment with other doctors. Only a doctor can persuade another doctor that telemedicine works, and help assuage concerns doctors might have about malpractice and other issues, suggests Dr. Arvind Patel, the regional center's medical director. "The key to getting doctors on

board is working with them on a peer-to-peer basis," he says. In addition, officials from the medical center are serving on a statewide task force that is exploring other concerns, such as how doctors can be reimbursed for telemedicine visits and how various hospitals can streamline the cumbersome process of granting privileges to doctors who may not be physically present.

While these issues are thorny, there is a growing sense in Maine that telemedicine is the wave of the future — as demonstrated by a growing number of organizations lining up outside the regional center's door seeking help developing their own teleconferencing capabilities. For instance:

- The Maine Department of Mental Health wants to use videoconferencing to improve treatment of people facing emotional crises. Bachelors-degree social workers currently man most rural crisis programs. With videoconferencing, these field workers could consult with psychiatrists on difficult cases.

- Similarly, local sheriffs departments, which frequently are the first authorities to have contact with disturbed individuals, would like to establish electronic links with mental health professionals to facilitate psychiatric evaluations.

- The Department of Mental Health believes teleconferencing could be used to help patients in mental hospitals maintain ties to their communities so that they can assimilate better after they are discharged.

- The state's Department of Corrections hopes to use teleconferencing to help teenagers in detention homes develop social networks in their communities that could keep them from foundering when they return home.

- The state's Department of Human Services sees a role for teleconferencing in helping children who are temporarily placed in foster homes maintain some relationship with their own parents.

- A private service organization plans to carry teleconferencing equipment on a boat it uses to bring services to the roughly 4,000 people who live on ten islands off the coast of northern Maine.

- Another private organization would like to provide translation services to help all Maine hospitals communicate with non-English speaking patients. Hospitals have legal responsibility to provide such services, but in a state like Maine, few hospitals, if any, can afford to hire translators by themselves.

The list goes on. "As you start collaborating, people start coming out with more and more ideas," says Dr. Patel. "Even we didn't envisage the level of applications that are coming out."

It takes more than a good idea to make telemedicine work, though. Before a new service can be added, staff from the regional center must work with specialists to develop protocols for electronic medical visits. They must learn what the specialists need. They must train people not only in the use of technology, but in the specific conditions that must be met for successful teleconferencing consultations—including such issues as how should a patient be presented, what should the lighting be, and what information should be collected in advance. "It's very laborious," says Schmidt. But, he predicts, the number of sites the regional center has helped connect to the network — about 100 in the spring of 2001 — will more than double by the end of 2002.

And like others who have experience with telemedicine, he expects to see entirely new services added to the mix.

What is the outer limit? Dr. Daniel Nadeau, an endocrinologist based at Eastern Maine Medical Center in Bangor, Maine, believes personalities may determine the answer to that question more than the actual medical requirements. "It takes synergy between the people involved to make it work well," he explains. Still, Dr. Nadeau says some specialties may be more suited to telemedicine than others. He cites fields like endocrinology, dermatology and psychiatry, which require little hands-on examination or treatment of patients. "Most of the information you need you can get by talking with the patient and looking at lab results," he notes. On the other hand, he laughs, surgery may not lend itself to telemedicine as readily.

He may be right. Then again, turn to the next chapter.

Contact Information: Regional Medical Center at Lubec

Mr. Kenneth Schmidt
South Lubec Road
RR #2, Box 380
Lubec, ME 04652

(207) 733-5541
Kschmidt@nemaine.com
www.rmcl.org

University of Vermont and State Agricultural College

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Specialists Help Rural Clinics Handle Emergencies

Rural life may be free of some of the tension and frustrations of city dwelling, but it also can be more dangerous. While about one-third of Americans live in rural areas, for instance, 57 percent of all deaths from motor vehicle accidents occur outside cities. A similar pattern holds for the other leading causes of traumatic death — suicide, homicide, and falls. Overall, rural residents are almost 50 percent more likely to die from trauma than city residents.

Accidents in rural areas frequently go undiscovered for longer periods than ones in more populated cities and suburbs. Ambulances often have to transport rural accident victims longer distances over slower roads before they can be treated. Rural areas frequently rely on volunteer rescue squads that are not as well trained than their urban peers, and rural hospitals have fewer trauma specialists.

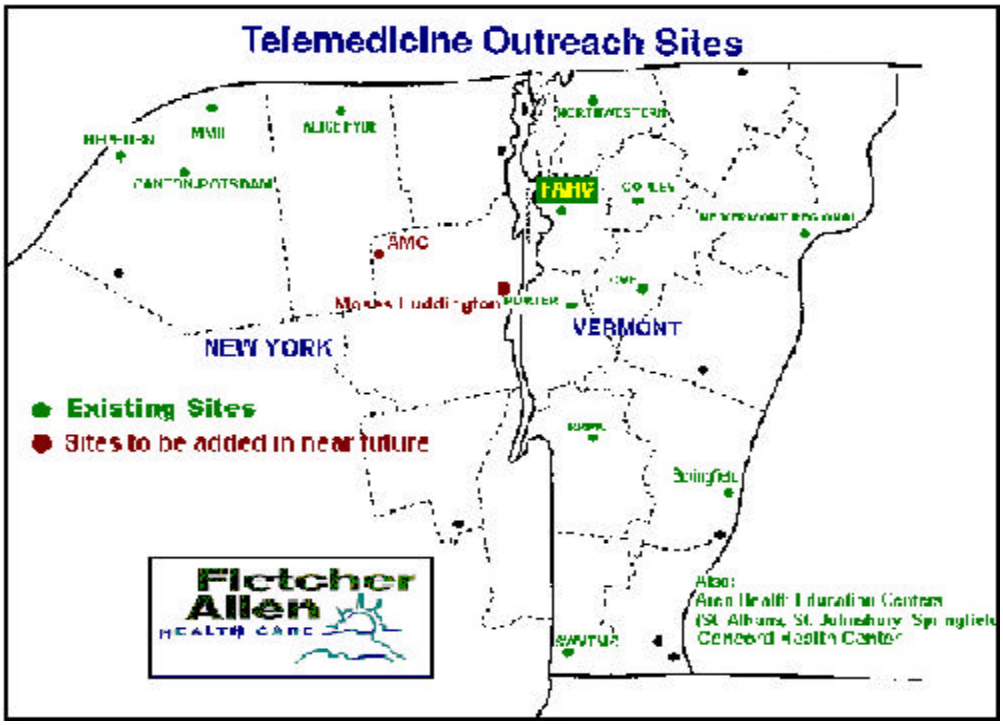
No single strategy can address all these issues, but the University of Vermont's Fletcher Allen Health Care hospital in Burlington, Vermont, hopes telecommunications offers at least part of the answer. With help from the Technology Opportunities Program, it has installed videoconferencing workstations in its own facilities, in the homes of three of its trauma specialists and in the emergency rooms of four rural hospitals in Vermont and upstate New York. With these tools, the

doctors in Burlington now can participate in the crucial, initial decisions about treating accident victims in outlying areas.

It may take some time to measure the impact of the system, but it already has won converts among many of the doctors who have used it. "When I was first asked to participate in this project, I was not too excited about it," admits Fred Rogers, Director of Trauma at Fletcher Allen. "But as we got the system up and started doing our first few consults, it became readily apparent this was allowing me to be transported right into [remote hospitals'] emergency rooms. In a couple of cases, we have had a significant — possibly even life-saving — impact."

of the latest emergency procedures. These remote hospitals routinely transfer their most serious trauma cases to Fletcher Allen, but ambulances sometimes need three hours or more to deliver patients over treacherous roads and past obstacles like the Adirondack and Green Mountain ranges and Lake Champlain. In addition, helicopters often are not a meaningful alternative because adverse weather keeps them grounded almost one-third of the time, and even when the weather is good, flight crews can be hard to assemble on short notice.

All these factors reduce the chances that trauma victims will reach specialists during the first crucial hour after their accidents — a period called



The "Golden Hour"

Upstate New York and northern New England are a good setting to test whether telemedicine can improve care for rural accident victims. Fletcher Allen is the only top-rated, or Level 1, trauma center in the region. Smaller hospitals in outlying areas lack the most advanced facilities, and their staffs do not see enough trauma victims to be well practiced in all

the "golden hour" because it is so important in determining how such patients ultimately fare. The University of Vermont's "teletrauma" project, as it is known, increases victims' chances by enabling specialists to see them within minutes of the time they first arrive at local hospitals. Using both a ceiling mounted camera and microphone and an eye-level camera, Burlington-based specialists can pan the distant emergency rooms, zoom in on patients, read

monitors and x-rays, and talk with doctors and other medical personnel on the scene.

In emergencies, when every second counts, being able to see a patient and his doctors in real-time makes a world of difference, according to doctors. "I do a fair number of consults over the telephone, and they are remarkably unsatisfactory," says Barry Heath, Director of the Pediatric Intensive Care Unit at Fletcher Allen. He was one of the first Burlington doctors to use the system, advising physicians at a remote hospital who were trying to resuscitate a little girl after she had suddenly stopped breathing and her heart had stopped beating. "This makes a remarkable difference," Dr. Heath recalls. "I could see the child, and correct their technique in ventilation and cardiac compressions. I could watch the [electrocardiogram] monitor. I could read the chest x-ray."

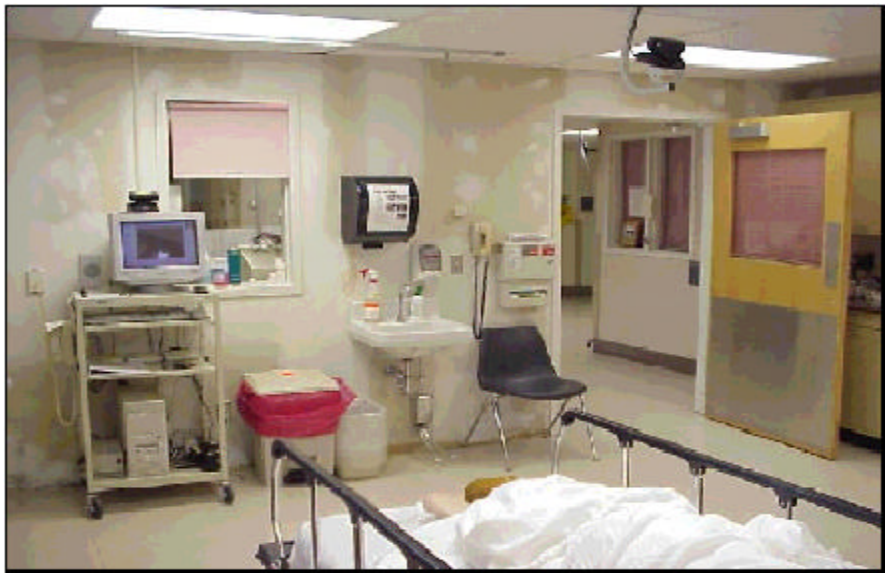
The connection was so vivid that Dr. Heath reflexively reached out at one point to perform a procedure himself. "It was very intense," he says.

Trauma chief Rogers agrees that videoconferencing represents a great advance over consultations by telephone. Usually, when a rural doctor calls a specialist in Burlington for advice, he has to leave his patient. He then shares only the information he decides is relevant, giving a "static" — and possibly out-of-date — assessment of what could be a rapidly changing situation. However, with the videoconferencing system, the expert in Burlington can see everything the local doctor sees, noting changes as they occur and quite possibly observing factors the remote doctor may not think to mention.

Dr. Rogers recalls one case where doctors at a remote hospital were eager to perform a CAT scan of a patient with a severe head injury. But Dr. Rogers, noting that the patient's blood pressure was dropping, advised them first to perform a procedure that enabled them to find — and stop — internal bleeding that would have killed the patient if it had gone undetected. In another case, doctors at an outlying hospital were having trouble inserting a breathing tube to save the victim of a motorcycle accident. Dr. Rogers urged them to open an airway surgically, but they were reluctant because none had performed the procedure in 20 years. Dr. Rogers walked one of his remote colleagues through the process step-by-step, probably saving the man's life.

City Doctors, Country Doctors

Although it may sound revolutionary, surgical telemedicine actually represents less of a departure from current trauma-care procedures than one might expect, according to Dr. Michael Ricci, a vascular surgeon at Fletcher Allen and leader of the project. When the victim of a serious accident is brought into the Burlington hospital, he typically is treated by a whole team, led by a doctor who stands at the foot of a patient's bed, Dr. Ricci notes. The team leader typically doesn't even lay hands on the patient because he has to avoid becoming so engrossed in any one procedure that he loses sight of the overall situation. However, with adequate



videoconferencing tools, the leader can do his job just as well from a remote site as if he were in the room, Dr. Ricci suggests. "There isn't a lot of difference between what we do with videoconferencing and what we do in the medical center," he says.

But how do doctors at the smaller, remote hospitals feel about the system? One concern often voiced about distance medicine is that a few specialists in urban areas will push rural doctors aside. Participants in the University of Vermont project acknowledge that some rural doctors have grumbled about the possibility specialists in Burlington will second-guess the care they give. At times, they believe, such fears have even led rural doctors to refuse to use the technology.

But such cases seem to be relatively rare. More often, rural doctors appear to be happy to get advice from specialists who have more experience with trauma cases than they do. In fact, more than 90 percent of doctors in outlying hospitals say the teletrauma consultations have improved patient care, and more than half say videoconferencing represents a marked improvement over telephone consultations, according to a survey conducted by the Fletcher Allen team.

"I'm happy with the care I give, but I realize there are only certain things we can do here," says Dr. Suhail Daye, a general surgeon at Massena Memorial Hospital in New York. "It never hurts to have the opinion of somebody who deals with more trauma cases."

Trauma care often requires tough judgment calls, Dr. Daye notes. Should doctors operate to stop internal bleeding before transporting a victim to Burlington? And if they do operate, should they attempt the difficult task of stopping the bleeding, or should they simply pack gauze around the wound? These are "gray areas," and there are no simple rules. But the more experience a surgeon has, the better the chances he will make the right call. Moreover, since many trauma victims ultimately are transferred to Fletcher Allen once they are stabilized, the patients benefit if their doctors in Burlington are familiar with their situation even before they arrive there, Dr. Daye adds.

Far from feeling that the city doctors are encroaching on him, Dr. Daye believes the videoconferencing system has helped him professionally. He can use the system to participate in "grand rounds" — conferences Fletcher Allen holds on a variety of topics — and in "morbidity and mortality" conferences where doctors at the Burlington hospital discuss how specific cases were handled. "It makes you feel like you're part of the mainstream again, that you aren't too far from what's current," says Dr. Daye. As a result, he says, he feels less tempted to leave Massena for a more urban area where he could have more contact with other professionals.

Education Builds Bridges

Fletcher Allen is a teaching hospital, and providing opportunities for continuing education to doctors like Dr. Daye is one of its core missions. In fact, it has used its new videoconferencing links to rural hospitals to provide educational opportunities not only to doctors in outlying areas, but also to local emergency medical technicians and ambulance crews. Doctors in Burlington already have taught classes to technicians at remote sites in such topics as burns, eye trauma and dealing with victims of cold water drowning. While the doctors donate their time to provide such instruction, Fletcher Allen staff put considerable energy into helping them prepare high-quality multimedia presentations, complete with numerous photographs and PowerPoint slides.

The classes clearly are of value to rural ambulance crews, many of whom are volunteers and work on such small crews that they would have difficulty getting away long enough to Burlington for such training. But significantly, the classes also help Fletcher Allen promote the use of videoconferencing in real-life trauma situations. "People naturally are apprehensive about this at first," notes Mike Caputo, director of the telemedicine program at Fletcher Allen. "It's new, it's technology, and it's untested.

Education programs help people get over their apprehension and start to see the quality of information that can be shared." What's more, the personal relationships developed in classes come in handy later, when real emergencies arise. "In an emergency, people know who they are dealing with," Caputo notes. "They say, 'Hey, I know Dr. Smith at Fletcher Allen.'"

Caputo, for one, expects telemedicine applications to grow greatly in number and variety in the years ahead. What new applications does he foresee? Right now, Fletcher Allen is exploring the idea of putting wireless telemedicine units in ambulances. That should give general practitioners in local hospitals and specialists in Burlington an even greater opportunity than they now have to intervene early in the "golden hour."

Contact Information: University of Vermont and State Agricultural College College of Medicine

Dr. Michael Ricci
Clinical Director of Telemedicine
340 Waterman Bldg.
Burlington, VT 05405

(802) 656-4216
michael.ricci@uvm.edu
www.vtmednet.org/telemedicine

Marshall University

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IV. New Approaches to Distance Learning

Educational institutions play a pivotal role in today's information society. That is at least as true in rural areas as in cities and suburbs. This report already has shown how an enterprising state university in North Dakota is spearheading a drive to use the Internet as an engine to diversify the rural economy, and how a university hospital in Vermont is bringing the latest advances in emergency medicine to outlying regions. This chapter offers two case studies of how rural universities are using new technologies in their core activity — education. In West Virginia, Marshall University is experimenting with techniques that could make distance education more personal — and hence, more like face-to-face learning. Back in the Great Plains, meanwhile, North Dakota State University is using modern communications technology to adapt its extension service to meet the needs of a rural society with a rapidly changing, and ever more complex economy.

Both universities are experimenting with broadband videoconferencing. But their ultimate aim is to change the way people organize their jobs and relate to each other. In Marshall's case, new videoconferencing tools are giving professors a new way to teach, while for NDSU, they are creating opportunities for extension agents to extend their reach and offer far more advanced services than was possible in a day of slower communications.

Electronic Education with a Personal Touch

Robert B., a counselor at Tug Valley High School and Varney Elementary School in Mingo County, West Virginia, wants to earn a doctorate so he can become a school administrator. But with two small children and an elderly parent, he cannot easily quit his job to attend graduate school. Neither can he work part time and commute back and forth to graduate school. On a good driving day, West Virginia University, where he wants to study, is a four-and-half hour drive from his home in Gilbert, a town of 500 people snuggled in the sparsely populated southern part of the rugged Appalachian state. For drivers who encounter bad weather or find themselves stuck behind any of the slow trucks that regularly haul coal along the region's narrow, mountain roads, the trip can stretch much longer.

Despite such obstacles, Robert has managed to keep his job, work toward his degree and even teach a graduate-level course in counseling — all while staying in Gilbert. The key: a combination of Internet-based courses and live classes beamed to an interactive classroom at Gilbert's Larry Joe Harless Community Center. "This center allows me to continue my studies and my employment as a school counselor, without having to relocate," says a pleased Robert. "It is my hope that this center can continue to grow and be used by the people of this area."

As Robert's experience demonstrates, distance education is more than just another

modern convenience for people who live in rural areas. It can be the best hope for personal advancement in a world where education increasingly determines economic and social success. What's more, it can be a lifeline for entire rural communities like Gilbert, which face a continuing struggle to attract and keep professionals.

But what is the best way to deliver education to these far-flung students and communities? Skeptics question whether either of the two leading models — Internet-based courses or large-scale multimedia classrooms with high-speed video connections — are as effective as old-fashioned face-to-face discourse between teachers and students. In response to such concerns, Marshall University, which established the computer center where Robert studies, is experimenting with a third, middle way to bring learning opportunities to rural communities.

The "Old Way": Internet and Interactive Television

Marshall, which is based in Huntington, West Virginia, has more than an academic interest in distance-learning technology. West Virginia has the smallest proportion of high school graduates who go on to college in the nation. The distance between outlying areas and colleges, along with the high cost of higher education and cultural barriers, discourage many prospective students. In addition, adults often find their opportunities to return to school limited by demanding job schedules and family obligations. The lack of educational opportunities complicates efforts by the state to attract new employers; West Virginia's unemployment rate was 5.3 percent in May 2001, compared to 4.5 percent nationwide. Yet communities like Gilbert have trouble filling even existing professional jobs. At the beginning of the 2000-2001 school year, for instance, school districts around the state had nearly 200 teaching positions they couldn't fill due to a lack of qualified applicants.

To turn this situation around, schools like Marshall have to find ways to make education more accessible to students in outlying areas. Like many universities, Marshall has invested heavily in developing Internet-based courses, which are accessible anywhere and anytime, and generally can be conveyed over regular telephone lines. Because such courses allow students to learn at their own pace and on their own schedules, they have proven especially popular with stay-at-home mothers and mid-career professionals. And even some students who live on campus take advantage of the ability to set their own pace.

Critics say Internet-based learning lacks an essential ingredient, though: personal interaction with professors and peers. Students are divided on the issue. "I thought there would be a loss in the classroom atmosphere by not meeting on a regular weekly schedule, but that hasn't happened at all," says Donna B., who lives near the small town of Marlinton, West Virginia, and is working on an advanced degree in education at Marshall University Graduate College. "Through the use of chat rooms and email, we keep in touch and help each other out just like real life."

Robert, while insisting that the benefits of online learning outweigh the limitations, has a different view. "My only regret is that the distance courses that I have taken often lacked community," he says. "Frequently, my colleagues are voices over a phone or print on a screen. Maybe this is a good thing — I don't know. It does force me to be a bit more exacting in my assignments than I would normally be in a traditional classroom. I must admit, however, that I sometimes get lazy and rush to post on a particular topic thinking that no one will read, remember or care what I have said."

Gary Anderson, a chemistry professor at Marshall, says online classes work well for highly motivated students. He recently had a student in a semester-long online course who mastered the material and passed the final exam in just three weeks, for instance. But Anderson worries about less able students, though. "Some of our really good students are taking great advantage of e-courses," he says. "But we don't get as much done with borderline students. The C- and D-level kids may need the interaction in class to get through."

The Need for a Personal Touch

Meanwhile, even some of the most enthusiastic advocates of electronic courses see other reasons for at least some face-to-face contact among students and professors. Teresa Eagle, an assistant professor of leadership studies at Marshall University Graduate College, says her students insist on meeting their professors and peers in person because they are eager to build networks of personal contacts that will help them advance their careers. In addition, Eagle notes, professors have found they can advise students much more effectively if they know them personally. Direct personal contact is especially important at the beginning of a relationship, when nonverbal cues give important evidence about how well various messages are being received and understood, according to Eagle. "When I know a student already, there's no problem using email or the web, but when students are first coming into the program, they aren't comfortable communicating that way," she says. "If I can establish some kind of physical relationship, things go better."

While many members of the Marshall community agree that face-to-face meetings are still important, there traditionally haven't been many easy ways of accomplishing that other than having students get in cars and make the long drive to Huntington. Marshall does offer classes via interactive television, delivered via high-speed telephone line from Marshall's Huntington campus to five special classrooms established around the state. The system has obvious appeal to the university, enabling a single professor to reach perhaps as many as five times as many students as he could in a single lecture room on campus (the typical interactive video classroom can accommodate about 50 students). What's more, interactive television does bring some of the experience of the large lecture course to remote locations.

Reaction to these classrooms has been mixed, at best, though. While they enable professors to employ a wide range of media, including slides, film clips and photographs, and while students from remote locations can ask questions or participate in discussions, the technology is generally seen as difficult to master. Students at remote sites complain that professors tend to forget them, while instructors say they have difficulty engaging far-away students. The sense of alienation is especially acute for reticent students. Some are reluctant to speak up during an interactive video session because when they do, the camera will focus automatically on them, and stay trained on them until some other sound prompts it to move on.

"The criticism we get back a lot is that they are very cold and impersonal," says Arnold Miller, a Marshall assistant vice president in charge of information technology. "People will accept it if that's the only way they can get the education, but there is not tremendous acceptance, especially from people who like a lot of interaction."

A New One-Room Schoolhouse

Miller hopes to combine the flexibility and self-pacing of Internet-based courses with a more effective system of real-time audio and visual communications. In his vision, students still will be able to go online to find course materials, syllabi, calendars, descriptions of assignments, bulletin boards with announcements, and chat groups. More important, they will find a rich supply of substantive information, including not only text written by their professors but also documents, pictures, and video clips. In fact, Miller hopes to digitize the university's extensive video collection so that it can be delivered directly to student desktops. At the same time, though, students will be able visit their professors face-to-face and participate in small group discussions, using either cameras mounted on their computer monitors or a teleconferencing system that is as easy to use as a television (indeed, it is operated by hand-held remote controls).

Miller calls this new system "the one-room school house," because, like that traditional educational system, it is designed to allow self-paced, individualized learning while creating a sense of integration and community often said to be lacking in distance learning. With support from the Technology Opportunities Program, Marshall has established these modern day one-room school houses on its own campus, at the graduate college campus an hour away in Charleston, at the community center in Gilbert, at a regional campus north of Huntington in Point Pleasant, West Virginia, and at a vocational-technical school. He also has plans to set up additional ones in two high schools and a union hall. And if Miller has his way, similar one-room schoolhouses eventually will be established in such institutions as hospitals, prisons and juvenile detention centers as well.

Will they work? The start-up phase has had its share of technical glitches and disappointments. For one thing, the cost of connecting Marshall's traditional distance-learning classrooms and its new workstations — different technologies sold by different vendors — has proven to be prohibitive. Still, thanks to a lot of hard work, the personal computer-mounted cameras and the small-scale videoconferencing systems are up and running. Now that the project managers have laid this groundwork, Marshall faces an even bigger challenge — persuading its faculty to use the new system. "We have not been able to throw enough resources at trying to get people to use this resource," says Miller. "I've had a hard time getting people to experiment with it."

It Takes Work

His experience points to an obvious, but often overlooked, fact about the relationship between technology and education: technology doesn't serve up new learning opportunities automatically or effortlessly. "It's no less work than regular classes — it takes a lot of time and effort," says Donna Spindel, who teaches a popular course on early American history at Marshall. Spindel says preparing written lectures for online classes can be more difficult than writing and delivering traditional, oral ones. "You can't leave anything ambiguous," she explains. Other steps add to the workload. To be effective, online courses have to incorporate portraits, artwork, film clips and other non-text materials, she says. And professors have to try to stimulate discussion. Spindel, for instance, poses questions every week for students to discuss on a course bulletin board.

Brian Morgan, an assistant professor in the integrated sciences department at Marshall, says teachers need training to use distance-learning tools, whether the old-model ones or Miller's one-room schoolhouses. In traditional interactive television classrooms, for instance, professors have to learn how to use document cameras and take advantage of other visual tools, how to use remote cameras and how to make sure that they include students at distant locations in their classes. But students also need to learn how to use the system, according to Morgan, who earned his masters degree taking nothing by interactive television courses. "As students, we weren't given instructions on how to use the technology," he says.

Ultimately, Miller's hope of recreating the one-room schoolhouse in modern, rural West Virginia will depend on much more than increasing the familiarity of professors and students with technology. It will require both developing new ideas about how they should spend their time and relating to each other. Indeed, as Miller sees it, the activity that most identifies professors — the lecture — could all but disappear in the new, one-room schoolhouse. Many of the materials that teachers currently rehash year after year could be preserved as text or video and played to students on their computers. Freed from the need to prepare similar lectures every year, professors could spend more time doing research, updating their lessons and interacting with students.

"We're trying to produce a mechanism that will free the academicians to be not just deliverers of information, but teachers," says Miller. But, he acknowledges, many professors are reluctant to buy into this vision. Anderson, the chemistry professor agrees. Right now, the faculty view of new technology is "very mixed," he says. Some believe it's workable, many are still waiting for proof that it works, and a few "are plain scared it will put them out of a job."

That fear, while understandable, is probably misplaced. Rural West Virginians clearly need new educational opportunities, and that means more teachers, not fewer. The one-room schoolhouses are now in place. With some imagination from teachers and students, they should become even more effective and exciting places to learn in the years ahead.

Contact Information:
Marshall University
Research Corporation
Information Technology

Mr. Arnold R. Miller
400 Hal Greer Blvd.
212 Gullikson Hall
Huntington, WV 25706

(304) 696-2677
miller@marshall.edu
www.marshall.edu/computing

North Dakota State University 8

An Extension Service Enters the Information Age

Conjuring up images of that famous first telephone call in which Alexander Graham Bell spoke into a receiver to ask his assistant, "Please come here," Mike Miller, a research extension scientist in Minot, North Dakota, recently placed a sick-looking canola leaf on a microscopic slide viewer attached to a video camera. Instantly, the magnified image appeared on monitors at North Dakota State University (NDSU) in Fargo, 300 miles away. After tinkering a while, Miller was able to transmit a picture clear enough to tell quite a story. "You could see constriction in the leaf stem, indicating disease," he says. "And you could see the bite marks of a flea beetle."

For farmers in sparsely populated North Dakota, the ability to send such images could mean the difference between saving and losing entire crops. Like farmers across the country, many of North Dakota's 30,500 farmers live and work hundreds of miles away from the small handful of experts who can help them diagnose crops struck by unfamiliar maladies. Traditionally, the only practical way to identify the source of a problem—and determine how to address it — was to ship samples of afflicted plants to a diagnostic laboratory in Fargo, on the state's eastern border. The answer typically would come back a week or two later, but by then, it might be too late. Farmers hit by the orange blossom wheat midge, for instance, have as little as two days to identify and exterminate the pest if they hope to

save their crops. With videoconferencing, the answers could come back in a matter of hours rather than days or weeks, greatly increasing farmers' chances of bringing more crops to a successful harvest.

Miller's exercise in what Jay Fisher, director of NDSU's Minot Research Extension Center, calls "tele-plant medicine" is just one of many new opportunities officials at NDSU see in store as videoconferencing links the university's main campus in Fargo with its 52 county extension offices and eight research extension centers (including Minot) scattered across the state. Launched in October 2000 when the Technology Opportunities Program provided funds to link four regional extension offices to the university's main campus in Fargo, the system already has grown to include several branches. One of these offices alone has used it to provide training for pesticide applicators, to instruct a group of people how to assess the credibility of Internet sources, and to demonstrate digital photography to a group from South Dakota. Under the TOP grant, NDSU is developing a curriculum to train farmers at remote sites on how to manage risk in everything from production and marketing to financial and legal aspects of managing their farms.

As in many other institutions, officials at the North Dakota extension service are using new communications tools to offer a richer array of services to the public. But to take full advantage of that opportunity, service officials say, they must reorganize their own staff, and that requires giving employees new incentives and new training. This, then, is a story about how information technology could help strengthen the farm economy, and how the extension service is working to change itself so that it can realize its full potential.

A Pivotal Time

The TOP grant comes at a time when the extension service's job is getting harder than ever. Agriculture, which accounts for 38 percent of North Dakota's economy, has become a far more diverse and complex business than it was 20 or 30 years ago. Farmers who once raised mostly wheat and barley now produce sugar beets, soybeans, rye, flaxseed, navy beans, sunflowers, and honey as well. Whole new crops like canola have sprung up in response to consumer demand for healthier foods. Thanks to advances in technology, North Dakota farmers now produce a substantial amount of corn despite the state's relatively short growing season. They also are actively developing niche markets — raising bison used in upscale restaurants on the east and west coasts, for instance. And they are seeking to increase their earnings by processing, rather than merely raising, some of their crops. One farm cooperative, the Dakota Growers Pasta Co., is now the third largest pasta maker in the United States. "Agriculture isn't dying, it's changing," says David Saxowsky, an associate professor in the NDSU Department of Agricultural Economics and manager of the TOP grant.

At the same time, farmers face new risks. Not only do they have to learn new ways to protect themselves against price fluctuations, they also have to keep closer watch on changing market conditions in the U.S. and around the world. "The educational demands being placed on us are growing exponentially," says Cole Gustafson, director of the North Dakota Agricultural Experiment Station.

New demands on the farming sector mean new pressures on the extension service. Now, more than ever, it is difficult to provide all the expert assistance farmers need. Traditionally, most extension service agents have been generalists, a fact that is not surprising since they have to field requests for help or advice on everything from pest control to business management, from youth problems to local economic development. The need to be all things to all people is especially true in the most rural counties, which frequently have only one extension agent.

Of course, local extensions agents can refer questions to outside experts, but that is not always an effective alternative. "We are thin in the ranks of experts," explains Morris Davidson, director of the extension service's northeast district. The service has just two PhD-level agronomists and two PhD-level

plant pathologists to serve the whole state, he notes. It has just one field specialist in pest control. This expert and Stevan Sagaser, a horticulturist based in Grand Forks County in the northeastern corner of the state, receive far more requests for help than they can handle. To manage their time, they perform a crude sort of triage: requests for assistance that require too much "windshield time" — that is, hours spent driving to distant locations — tend to get turned down.

Demands on Institutions

Once fully developed, the videoconferencing system could reduce windshield time and mileage costs to zero, enabling specialists to extend their reach without leaving their offices. In addition, it should enable them to provide much more intensive services than ever before. That is a matter of simple arithmetic. In the past, an expert in Fargo would have to drive five hours each way to meet with a group of farmers in Minot for perhaps just one hour. But using video network, the same expert can hold eleven one-hour meetings with that group in the same amount of time. "This will enable us to take our programming to the next level," notes Gustafson.

North Dakota farmers clearly are hungry for the greater learning opportunities such a system will make possible. All across the state, groups of farmers have come together in "risk management groups" or "marketing clubs" dedicated to increasing their knowledge about the many complex issues farmers must face today. There currently are about 50 such groups, each with 10 to 20 members. And, they are serious about learning. Well into this spring's busy planting season, many were meeting twice a week, exploring topics as varied as the use of options trading to hedge against risks associated with fluctuating commodity prices, strategies for doing business with grain marketing companies, opportunities presented by overseas markets and more.

These groups represent just one set of claims on the extension service's resources. As North Dakota's economy grows more diverse, the service increasingly is being called on to make other aspects of the university's diverse programs — including business, pharmacy, engineering and architecture — more accessible to communities. It also faces rising demand for services to youth and families as the farm population drops and the number of people living in cities like Fargo and Grand Forks increases.

All this suggests that reducing windshield time won't be enough. The only way to meet the rising demand for educational services will be to increase the supply of experts available throughout the system. And the only way to do that, given constraints on staffing, will be for more extension agents to specialize and then use electronic communications to share what they know. The university's ability to achieve the full potential of the new videoconferencing network, in short, will depend on how effectively it can reorganize and retrain extension service staff.

Preparing People

Of course, changing people can be more difficult than installing new technology. The university is tackling the manpower challenge on several fronts. First, it offers each employee $1,000 a year to enhance his or her professional skills through training. "This is one area where you don't want to cut corners," says Pat Jensen, vice president and dean for agricultural affairs. Second, the extension service has decided to require each extension service employee to choose an area of spe-

cialization, which will be included among certain "core competencies" he or she is expected to achieve.

Finally, because some employees might feel threatened by such a requirement, officials stress that it be seen more as an opportunity than a source of pressure at performance-review time. "We need to describe this in a positive way to staff," says Morris Davidson, the extension service's northeast district director. "Right now, they feel inadequate. They are besieged. We have to show them that we can enhance their efficiency and lighten their load by letting them focus."

Already, extension service employees are rising to the university's challenge. An agent in Burke County, whose population dropped 25 percent in the 1990s, now works with the U.S. Soil and Conservation Service to improve its technology capabilities. Another agent, in Walsh County, has built himself a statewide reputation by becoming an expert in organic farming. In Langdon, a group of research extension economists are working with economic development groups and some farmers to explore the possibilities of creating an environmental tourism industry. Technology will enable these officials to share the fruits of their labors throughout the state, not just in the particular regions where they work.

This is just the beginning. "This is going to turn the way we deliver information upside down," predicts Sharon Anderson, director of the NDSU Extension Service. "It's what's going to allow 52 [extension] offices to assist the citizens of North Dakota and beyond."

Contact Information:
North Dakota State University
NDSU Extension Service

Mr. David Saxowsky
Department of Agriculture Communication
P.O. Box 5655
Fargo, ND 58105-5655

(701) 231-7470
(701) 231-7044 (fax)
dmsaxows@ndsuext.nodak.edu

www.ag.ndsu.nodak.edu/agcomm/videoconf/videoconferencing.html

Virtual Chautauqua

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V. Technology and the Arts

In the early 20th century, technological change helped overwhelm one of the most exciting educational opportunities then available to rural Americans on their own turf: the Chautauqua. These 19th century forums brought lectures, concerts, plays and children's activities to out-of-the-way places, but they could not compete with the motion picture. Today, newer technologies like the Internet could have the opposite effect. Rather than undermining cultural institutions that benefit rural areas, they can enrich the lives of people who live outside cities.

Two projects supported by the Technology Opportunities Program demonstrate how new technologies can help increase educational and cultural opportunities in rural areas. The Virtual Chautauqua, which takes its name from those much-celebrated cultural festivals of a century ago, use video and audio streaming technology to bring the performing arts — music, dance, poetry and storytelling — into rural classrooms in Colorado. Dance Partners, a project of Minneapolis-based Ballet Arts Minnesota, is using videoconferencing to bring dance education to remote communities.

Performing Artists Find a New Outlet

Colorado's expansive plains and majestic mountains draw a rich mix of poets, musicians, theater groups, and storytellers. But many of the state's people are so widely dispersed that they cannot take advantage of all the cultural opportunities the state offers. At the same time, many of the artists who are drawn to the state's trademark red rock and quaking aspens have trouble amassing enough viewers to support their work. In 1998, a diverse group of partners came together to explore whether the Internet could be used to introduce Colorado's performing artists to a broader audience. The partners, who were led by the University of Colorado at Boulder and funded in part by the Technologies Opportunity Program, sought to bring the artists' work to a group especially unlikely to see them any other way — students in rural classrooms.

The plan was audacious in its scope, bringing together public access television and radio broadcasters, scores of artists and a number of educational organizations. Perhaps not surprisingly, it had some successes and some disappointments. But along the way, it learned valuable lessons about technology, the arts and education — lessons that the partners and their supporters are putting into effect today.

Streaming Audio and Video

The project's main tool, "streaming," was relatively new in 1998, especially for nonprofit organizations. Previously, audio and video

data had to be stored in enormous files and then downloaded to personal computers, which had to have the right software to play it. Streaming technology simplified the process. With it, data could be transmitted piecemeal to viewers, who could watch it has they received it. The Virtual Chautauqua project, as it was known, demonstrated that streaming audio and video could be used to put artistic performances before the public. During the two-year span of the project, two public access television stations and a broadcaster that serves the blind recorded and edited 130 audio and visual tapes depicting the work of 60 Colorado performing artists. A community network built the project's web page as well as web pages for the individual artists, which it linked to the digitized clips.

The clips, still available on the Virtual Chautauqua's Web site, offer a rich array of music, stories, poetry and theater. From deep in the Rocky Mountains came the Celtic Singers of Grand Valley, while the front range's Geraldina Lawson told stories that brought to life what it is like to grow up as a Latino woman in the American southwest. Lakeland guitarist Neil Haverstick used a "microtonal," or 34-tone scale to create a unique musical blend of the Middle East and the American west, while Fort Collins percussionists Aaron Stone and Erik Meyer beat their drums and explained the role of rhythm in our lives. The clips also showed Boulder's Frequent Flyer Productions, whose dancers perform from swings suspended above the stage; it showcased the work of composer John Yankee, who writes original choral works for the Telluride choral society; and it put a spotlight on otherwise obscure arts organizations like the Creede Repertory Theater, which produces seven plays each summer in the San Juan Mountains of southern Colorado.

The quality of the clips is uneven. Some — especially poetry and storytelling — are accessible and compelling. Others, which require more sophisticated recording techniques and higher bandwidth, are less effective. In part, that reflected the high level of technical sophistication required to produce effective video clips of the performing arts. Some live performances, the project sponsors noted, lacked proper lighting and framing when they were recorded. In addition, limitations to existing computers and networks were a problem, according to the sponsors. Streaming works best with relatively high-bandwidth connections — DSL (at 256 kbps) or higher — and users should have 400 megahertz processors or higher. But many end users still rely on 28.8 kbps and 56.6 kbps modems and older processors that don't have the capacity to receive video streams without interruptions or irritating "net congestion" messages. Even schools with high-capacity T-1 lines complained of choppy transmissions, as increases in their Internet usage cut down the bandwidth available for streaming media.

Still, it was a substantial accomplishment to make a wide variety of clips available over the Internet. Three-quarters of the artists featured on the website said they probably wouldn't have any performance clip online without the project's assistance. More than one-third reported an increase in contacts with audience members as a result of their participation in the project, and 21 percent said they had more contacts with artists and other professionals. What's more, the project seemed to strike a responsive chord with the target audience. Field notes taken during a March, 2000, visit to a participating elementary school captured some of the excitement rural schoolchildren felt. The notes read:

"They would watch and wait, usually only for a few seconds. Then a smile would spread across their faces, as their eyes got bigger. 'I can hear it.' Then a head would begin to bob. A little boy kept time to the guitar music with his pencil on the desk. 'Teacher, teacher, help me.' 'I want to see the dancer on my computer like she has on her computer. Help me get the dancers.' 'Mira, mira!'…`I want to see another one. How do I see another one?' 'I want to see the dancers again. I want to hear the guitar again.' 'I don't like this one. I want to hear a different one.'"

Sustaining the Effort

As with all projects supported by grants, one of Virtual Chautauqua's biggest challenges was to find ways to continue its work after its TOP funding ran out. At first, that appeared to be a stiff challenge. Many of the artists, while glad to have their work on the Internet, seemed unclear about what they expected to gain from the project. Most already used email and the Internet to arrange gigs, talk to other artists, and to find new pieces of music, new programs, and new grants. They approached the project with "low expectations," according to researcher Mike Anderson. "Their ideology can be summarized thusly: [the Internet] is cutting-edge, everyone is going there so it's where you want to be, and I'm ambivalent about it."

To succeed in the long run, the Virtual Chautauqua had to overcome this ambivalence — and that meant demonstrating to artists and the public that the endeavor was worth continuing, even to the point of supporting it financially. Virtual Chautauqua's sponsors believe they have found a formula for achieving that goal. It's called *artistsregister.com*, an online arts community launched in 1999 by the Western States Arts Federation (WESTAF) and the Colorado Council on the Arts. Beginning in the fall of 2001, this increasingly well-known website will be the new home for the performing arts clips generated by Virtual Chautauqua — and, sponsors hope, many more like them.

If Virtual Chautauqua was unclear about what benefits it would confer to artists, *artistsregister.com* explicitly states what it will do for them — help them market their work to private collectors, gallery owners, interior designers, corporate art buyers, public art administrators, and the general public. The partnership with Virtual Chautauqua marks a major expansion for *artistsregister.com.* It previously featured just visual artists. But just as it has build a solid reputation as a crossroads for the visual arts, it now hopes to be seen as a site where "arts presenters" — places that host artistic performances — can find promising talent to fill their schedules.

Artistsregister.com hopes to become self-sustaining, but it is not a for-profit venture. Still, it has several strengths Virtual Chautauqua would have trouble matching. First is its proven ability to attract a sizeable audience. Currently, the Web site features some 1,400 artists, mostly from Colorado, Arizona, and New Mexico. That critical mass helps attract a bevy of private collectors, gallery owners, interior designers, corporate art buyers, public art administrators, and art enthusiasts. In 2000, more than 100,000 people visited the Web site. Behind this reputation lies considerable sophistication about marketing. WESTAF has devoted a great deal of effort to designing the website to ensure that it appears high on lists generated by search engines. In addition, it advertises the website aggressively in newspapers, arts magazines and at arts fairs and festivals. And it issues press releases when it introduces new artists.

Perhaps most important, WESTAF has committed a great deal of energy — and resources — to making the *artistsregister.com* Web site an Internet venue to which people will return repeatedly. The site has a number of useful features, including curated exhibits, a sophisticated search engine, a tool that lets viewers create their own collections of works they like, chat rooms, and articles for artists on professional development. Most recently, it added an online ordering and purchase system that enables artists to sell their work electronically.

All this costs money — especially the process of continually updating and improving the web page. But WESTAF predicts that a combination of contributions from state arts agencies and modest fees paid by artists ($100 a year at most) will soon cover the project's operating costs. "There's no question the artists are getting value from the site," says Erin Trapp, WESTAF's deputy director. She predicts the website will be particularly valuable to performing artists eager to arrange bookings outside their immediate vicinity. The video clips produced by Virtual Chautauqua will give potential hosts enough of an idea about a group to decide whether to pursue a possible relationship, she says. To the artists, the website represents in inexpensive marketing tool; press kits, the traditional tool for such marketing efforts lack the immediacy of video and can be prohibitively expensive to produce (as much as $50 for each kit).

"Artistregister has huge leverage, and a bigger, fancier platform," says Kelleen Zubick, associate director of the Colorado Council on the Arts. She praises Virtual Chautauqua for launching a large group of performance artists on the web, and then finding an outlet that will give them a better chance of reaping tangible rewards in the future. "I commend them very much for not holding on to their turf, but looking around and asking who has the capacity to do what's needed," she says.

Advancing Education

Virtual Chautauqua's arrangement with artistsregister.com will free it to concentrate on the other half of its mission — bringing the performing arts into classrooms. On this front, the project learned that developing resources for teachers to use in their classrooms is no easy task. It takes a lot of work and ingenuity.

Initially, project sponsors hoped that teachers themselves would be able to sift through the database of performing-arts clips, selecting ones around which they could devise "tours" for students. "Teachers could select and save a collection of clips, and include directions and questions for students as they watched and listened to the clips," wrote Mary Virnoche, the project's research director in a report to TOP. But several barriers — including conflicting pressures and demands from parents and school administrators, a general low priority put on the arts in school curricula, and a lack of time, training, interest, and support — kept teachers from using the clips as fully as sponsors hoped.

The project sought to address some of these concerns by offering honoraria to teachers who would participate, providing technology training and hiring a "curator" to write descriptions of the clips to help teachers identify the ones that would be use-

ful to them. Still, much of the material remained too raw for busy teachers to convert to use in the classroom. As Virnoche put it, "the long list of options to choose remained an obstacle."

Toward the end of the grant period, sponsors concluded that an entirely different approach might work better. The education director of the Denver Center for the Performing Arts suggested developing entire "units" for teachers. The result: so far, Virtual Chautauqua has produced two complete learning units, one on Africa for first graders, and the other on Shakespeare's *Macbeth* for older students. Both units offer complete learning packages, complete with basic materials, suggested activities for students and notes for teachers. And, both integrate aspects of the performing arts into the lesson plans. The Africa unit, for instance, includes a sections on drums in which students actually can hear drums being played; and the *Macbeth* unit includes a step-by-step description, complete with photographs, of how artists at the Colorado Shakespeare Festival created a prosthetic severed head for use in an actual performance.

The project hopes to help teachers create other such units in the future. In addition, it is working with two poets who have been hired to serve as artists in residence at six Colorado high schools. Virtual Chautauqua's role will be to help artists use technology. Part of the poets' mission, which Virtual Chautauqua will pursue in its own efforts to develop learning units, will be to tie lesson plans to specific curriculum standards established for Colorado schools.

So the work continues, sometimes with new players and sometimes with old players doing new things. Step by step, though, new tools are emerging that promise to create new outlets for rural artists and increase exposure to the arts among rural children. "Technology is definitely a way of reducing the distance between the rural areas of Colorado and cities," says the Colorado Council on the Arts' Kelleen Zubick.

Contact Information:
University of Colorado at Boulder
School of Journalism and Mass Communication

Mr. Bruce Henderson
Campus Box 478 UCB
Boulder, CO 80309

(303) 492-4558
(303) 492-9069 (fax)
Bruce.Henderson@colorado.edu
www.virtualchautauqua.org

Dance Partners

10

A New Kind of Studio: A New Art Form?

Can telecommunications match the direct, personal experience that comes from a live artistic event? Maybe not, but some experiments suggest today's teleconferencing tools may be a closer substitute for person-to-person contact than anybody would have thought possible just a few years ago. If so, people in rural areas soon may have opportunities to participate in the performing arts in ways that previously were available only in big cities. Indeed, they may pioneer entirely new art forms.

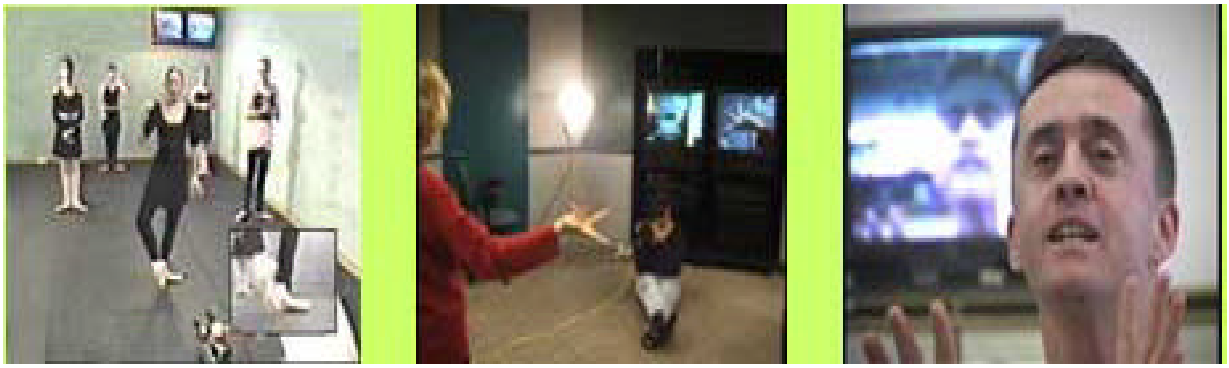
Dance Partners, a consortium of the dance school Ballet Arts Minnesota, the media-production company Beyond Broadcast, and a consulting firm called artservices & co., has been using teleconferencing equipment to provide dance lessons to students at a distance. Preliminary indications are that the process works remarkably well. But you may have to see it to believe it.

Picture a traditional dance studio. Now, take away the wall-length mirror that normally lines the front of a dance studio. In its place, put two television monitors; one shows you and the room where you are, and the other shows a remote studio that is similarly equipped. Put two monitors at the back of the studio so that you also can see your own studio and the remote studio when you are facing in that direction. (Ideally, you should have monitors along the sides of the room as well, but

you can get by without these). In addition to the stationary camera at the front of the room, put another at the back, and find a cameraman who understands dance to operate a third, mobile one. This will enable you and your distant instructor to watch your dance from various viewpoints.

Now, start dancing. On one monitor, you see yourself, much as you would have watched yourself in the mirror of a traditional studio. A "switcher" alternates that image with one shot from the back of the room or from the mobile camera, so you can watch yourself dance from different vantage points. Meanwhile, the second monitor shows the instructor watching from his or her distant studio. Like you, the instructor faces two monitors — one shows what you are doing, and the other shows the instructor's own studio.

Suppose the instructor does not like what he or she sees. He stops you, and approaches the monitor that carriers your image. You see him approach your image, "touching," say, your arm, and demonstrating how it should be held higher, lower or in a different configuration. You respond to the instructions until your position corresponds to what the instructor wants. Again, now, from the top…five, six, seven, eight…



This all may sound odd, since we are not accustomed to thinking of television as so interactive or tactile. But early experiments suggest dance really can be taught using this system. In the first test of the idea, Erin D., then a 16-year old dance student from Golden Valley, Minnesota, received ballet instructions from Stephanie Valencia Kierlin, a teacher in La Crescent, Minnesota, more than 200 miles away. Explaining the *port de bras*, or the precise positioning of the arms, Kierlin approached the monitor and with her finger traced the path Erin's arm should follow. Erin watched the instructor "touch" her arms on her monitor and point to where they should move. The student responded until the movement matched what Kierlin wanted to see.

"At times it felt like the flat surface of the television monitor could have muscles in it, and I could arrange them and fix them," Kierlin recalls.

A Needed Service

In their proposal to launch the distance-dance project, Dance Partners argued that the stakes are very high, especially for Americans who live in rural areas. "Dance permeates our national culture and consciousness," they noted. "Movement sells. Our airwaves are lathered with layers of hip-hop, middle-of-the-road rock, swing, nostalgic country ballads that raise social movements. Every major newspaper and magazine has focused on the recent movement craze."

Despite the importance of dance, opportunities for dance education are few and far between, especially in rural areas. The 50 largest dance companies in the United States are concentrated in ten of the nation's largest cities, according to Dance Partners. Of the roughly 4,000 people gainfully employed as dancers, most perform and teach in urban areas. And even in Minneapolis, Dance Partners' base, only 1 out of 10 schools offers any dance instruction. "For some reason," Dance Partners wrote

in its proposal, "dance educators are slow to recognize that the pervasiveness of dance in everyday life makes this medium an effective tool for reaching into communities."

Purists may object that teleconferencing is no substitute for face-to-face instruction in an art as physical as dance. People who have experimented with the system disagree, however. In fact, they believe teleconferencing actually may have some advantages over traditional dance training. For one thing, viewing one's image on a monitor is, in ways, more telling than looking in a mirror. "You're so used to seeing yourself in a mirror, you see what you want to see," notes Marcia Chapman, executive director of Ballet Arts Minnesota. "With a camera, you're much more vulnerable."

That may be especially true when the monitor shows the view from the hand-held camera or the camera mounted at the back of the room. In both cases, the dancer sees an image he or she does not normally see by looking in the mirror. And, especially in the case of the hand-held camera, the cameraman's perspective is introduced, allowing the dancer to see himself or herself as someone else might. In many ways, Chapman adds, the monitor gives the dancer a truer picture of what an audience would see. While the mirror reflects a close-up image, the monitor shows one that is smaller, resembling what a person who is seated some distance from the dancer would see, she explains.

Using the New Tool

That is not to say learning dance by teleconferencing is easy. Listening to a distant teacher and following instructions delivered electronically rather than in person requires close attention and concentration. Chris Aiken, a renowned improvisation teacher, used the system to teach students simultaneously in Minneapolis and in Ohio University hundreds of miles away. He taught the first class in Minneapolis, and a month later taught the same group of students from the Ohio studio. Students felt they had very good experiences both when Aiken was with them in the studio and when he taught from afar. Interestingly, while some preferred having him in the studio with them, some said the learning experience actually was better when the saw him on the monitor. "They had to go beyond what they usually learn in the classroom," Chapman explains. "They had to stretch themselves mentally."

As that example suggests, learning from a remote teacher does require some adjustments. For one thing, as any user of teleconferencing knows, you have to learn to look into the camera when talking so that the person in the other studio sees you as addressing them. Getting to know your fellow dancers also is important; like other people who have used teleconferencing, participants in the Dance Partners project say the system works much more effectively if the users have some personal bond. So project leaders are careful to begin distance-dance sessions with introductions. "It's very important you get to know each other in advance, to know each other's space," says Chapman. "The more you know each other, the more you can make it work."

Camera people also need special skills. This requires an understanding of both dance and of the dancers' needs. But perhaps most important, dancers, accustomed to thinking of television as something they passively watch, have to learn how to use the television monitors actively as tools.

"Sometimes, the switcher makes decisions about how to switch, but we need students and

teachers to say what they need to see," says Margo Berg, project manager for Ballet Arts Minnesota. "It's not television. We need students to break down barriers. We need students to say, `I need to see it from another angle.'" For many students, that requires quite an adjustment. "It's a whole different way to experience dance," says Drummond. "In ballet, you usually keep pretty quiet. But this forces you to speak up."

Democratizing Dance

Dance Partners see videoconferencing as a tool for democratizing dance instruction. Improvisation instructor Aiken spent a day working with impaired students at the Brainerd School District in Minnesota exploring the possibilities, and Bonnie Kriha, the district's special education coordinator, sees great potential. "We're always looking for ac-

tivities that can enrich kids' lives, particularly with motor movement," she says. "And this could connect them with kids in cities. It could lead to new friendships." Ballet Arts Minnesota's Chapman similarly believes that inner-city children and senior citizens groups might enjoy the opportunity to share the experience of dance. For both groups, she says, "dance is part of their culture. It's a wonderful way to communicate, to tell who you are and what you are."

This suggests that distance dance ultimately may involve much more than conveying expertise from the handful of experts in cities to disadvantaged groups and rural areas. Early experiments suggest that combining videoconferencing with dance ultimately could evolve into a whole new art form — one involving dancers interacting via television monitors with the active — and creative — involvement of camera people and switchers. It's too early to predict what the resulting art form will look like. Indeed, even capturing the resulting performances for viewers may be a challenge. But the possibilities are intriguing.

This, you truly would have to see to believe. Student Erin D. in Minneapolis tried it with students in Ohio. "We had a set of steps, and we pieced them together into our own short dance creation with partners from the other state," she says. After a practice session, the dancers began relating, reacting and responding through dance to the live images of dancers hundreds of miles away. "Here we were, working with someone on Ohio, creating a dance with someone in Ohio," the young dancer says. "It was really amazing."

Contact Information: Ballet Arts Minnesota Dance Partners

Ms. Marcia Chapman
121 West Franklin Avenue
3rd Floor
Minneapolis, MN 55404

(612) 870-2692
www.dancepartners.org/index.htm

Conclusion:

Lessons for All

The projects described in this report are successful in part because they all sprang from grass-roots efforts by people throughout rural America to improve their own lives and shape their own futures. But in the process, they have accomplished much more: they have generated a rich body of experience that offers lessons to people not only in rural areas, but in urban and suburban parts of the country as well.

The Navajo people, for instance, have demonstrated that with hard work, imagination, and flexibility, even the most difficult barriers to getting connected can be bridged. As the Navajos have shown, communications technology is changing so rapidly that problems that seemed intractable yesterday almost certainly will become manageable tomorrow. Mayville State University (MSU), meanwhile, is showing that areas in danger of being left behind can participate in the new information economy — and that major institutions, especially universities, play a crucial role in assuring that they do. Like MSU, universities and other institutions can demonstrate the value of information technology, train a workforce and populace to take advantage of it, and help aggregate sufficient demand to attract modern communications services to out-of-the-way places.

The Sevier River Water Users Association and the Coastal Economic Development Corporation demonstrate that information itself is a key community asset. In Utah, the collection and distribution of timely information about the supply and flow of water through an entire river basin is enabling farmers to stretch a precious but limited resource farther than ever seemed possible. And in Maine, the careful collection and distribution of information about an even more precious community asset — people — is enabling agencies to improve their services and greatly increase the chances that social programs will produce lasting benefits for clients and society as a whole.

The Regional Medical Center at Lubec and the University of Vermont's Fletcher Allen Health Care hospital represent important chapters in a growing encyclopedia of knowledge about telemedicine. But in a field already dominated by technology, one of the most valuable lessons they offer is decidedly non-technical. In both projects, the key to success in telemedicine is the successful cultivation of human relationships — in this case, relationships among doctors and other care providers who must overcome fears and learn new ways to cooperate. Indeed, officials in tiny and isolated Lubec have become statewide leaders in telemedicine. They owe their growing stature in large part to their emphasis on building trust, their assiduous encouragement of openness and sharing, and their willingness to eschew any efforts at self-aggrandizement.

Marshall University and North Dakota State University offer another kind of insight. Like other projects described in this report, they are demonstrating that technology can help institutions improve how they serve the public — Marshall by offering teachers a new way to relate to students, and NDSU by giving extension agents a chance to improve themselves and better help their communities. But they also demonstrate that institutions must change themselves in order to realize their newfound potential. Others eager to use technology should pay close attention to the challenges these universities face, and to the ideas they produce for producing institutional change.

Finally, Virtual Chautauqua and Dance Partners, besides exploring how to make the arts more accessible in rural areas, offer insights into how to plan and manage new technology projects. Virtual Chautauqua demonstrates that a project sometimes succeeds not by perpetuating itself, but by learning from its experience and selflessly applying those lessons in the future. Dance Partners, for its part, reflects the kind of creativity, commitment, flexibility, and imagination required to take a seemingly outlandish idea and make it happen. Like dance itself, these qualities make experimentation with information technology continuously exciting and uplifting.