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AE Staff Paper No. 96003

March 1996

**Advanced Telecommunications
Technologies in Rural Communities:
Factors Affecting Use¹**

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¹Paper submitted to 35th Annual Meeting of the Southern Regional Science Association, Baltimore, MD, April 11-14, 1996. Financial support from the Rural Policy Research Institute (RUPRI) is gratefully acknowledged.

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ABSTRACT

Recent years have seen increased discussion of the role of telecommunications technologies in rural economic development. This study assesses the level of use of various telecommunications technologies by rural residents and identifies the community characteristics and individual attributes that are conducive to the adoption and use of these technologies. Data are from surveys of nearly 2,000 residents in 20 communities representing 6 states in the Midwest. The study findings reveal relatively high levels of use of a number of telecommunications technologies -- levels which may rival or even exceed urban rates. Higher levels of education and household income were associated with higher levels of use of virtually all technologies examined. Distance from an SMSA was generally positively associated with use, once other factors are taken into account, indicating that rural residents are using telecommunications technologies to overcome distance barriers. The findings also indicate that economic development that involves growth of the service sectors will likely increase the use of telecommunications technologies in rural areas.

Advanced Telecommunications Technologies in Rural Communities:

Factors Affecting Use

INTRODUCTION

The 1980s and 1990s has been a period of economic restructuring throughout the United States, but the effects of economic change have been particularly severe in nonmetropolitan areas (Leistriz and Hamm, 1994). Among the consequences of this economic restructuring have been a widening economic gap between metropolitan (urban) and nonmetropolitan (rural) areas and substantial migration flows from rural to urban areas. For example, in the Great Plains states, more than 80 percent of the rural counties lost population during the 1980s.

With the widespread recognition that much of rural America is confronted with the problems associated with economic restructuring and community decline has come a renewed interest in rural economic development alternatives. One salient aspect of recent discussions of rural economic development possibilities is the prospect that modern telecommunications technology may substantially reduce some of the costs formerly associated with rural areas' isolation from urban centers and markets (Hudson, 1987). A number of observers have reported on successes of telecommunications-linked firms in rural locations (Fulton, 1989; Schmandt et al., 1991; Leistriz, 1993), and some have suggested that telecommunications-based innovations may affect the very nature of regional comparative advantage (Gillespie and Williams, 1988).

Growing awareness that telecommunications is a key to increasing business efficiency and improving access to services, as well as reducing rural isolation generally, has led to extensive discussion and debate regarding the role of telecommunications in rural economic development. Among the issues that have received substantial attention are (1) the role of telecommunications services in economic development (Parker, 1990; Rowley and Porterfield, 1993), (2) the status of telecommunications infrastructure in rural vs. urban areas (Allen et al., 1993; Office of Technology Assessment, 1991; Dillman et al., 1989), and (3) the actions, if any, that state and/or federal government should take to ensure that rural communities have equitable access to state-of-the-art telecommunications services (Schmandt et al., 1991; Dillman, 1991).

While each of these topics is the subject of substantial and continuing debate, a related question has received less attention -- to what extent are residents and businesses in rural areas actually using various telecommunications technologies/capabilities? This is clearly an important question because merely investing in telecommunications infrastructure for rural areas will not ensure economic development in those areas (Parker et al., 1992). Rather, rural residents and businesses must find ways to effectively use the capabilities of modern telecommunications. The purpose of this study is to address these issues by assessing the emerging role of telecommunications in the development and revitalization of rural communities and the community conditions and individual attributes that are conducive to the adoption and utilization of telecommunications technology.

METHODS AND DATA

This study was launched to provide a more definitive benchmark of current use of telecommunications technology and its influence on economic development and quality of life in rural America. It also addresses community attributes and individual characteristics that affect the use of telecommunications technologies/capabilities by rural residents.

Study Communities

Data were collected from residents in 20 rural communities scattered across six states in the Upper Midwest region (Figure 1). Among the study communities, six were located in Nebraska, six in North Dakota, three in Minnesota, two each in Iowa and Kansas, and one in South Dakota. Their average population in 1990 was about 2,600, ranging from 603 in Ray, North Dakota to 6,860 in Blair, Nebraska (Table 1). Their population change from 1980 to 1990 ranged from a 21 percent decrease in Ray, North Dakota to a 10 percent increase in Blackduck, Minnesota, with only 5 out of 20 towns reporting population growth. As is typical for communities in this region, agriculture is an important component of the economic base for each of the towns. However, several reported that manufacturing, tourism, or mining also were important to the local economy.



Figure 1. Location of Study Communities

Table 1. Study Communities, Selected Attributes

STATE/City	Population			Economic Base	Ethnic Heritage	Distance to			County per Capita Personal Income, '93	County Earnings, '93		County Employment, '93	
	1990	1980	% Change 1980-90			Interstate Highway	State Capital	Nearest SMSA		Ag., For., Mining, % Tot.	For., Mfg. % Tot.	Ag., For., Mining, % Tot.	For., Mfg. % Tot.
-----miles-----													
IOWA:													
Kalona	1,942	1,862	+4.3	Manufacturing Agriculture	German (Amish)	24	124	44	17,337	8.0	20.9	16.0	13.3
Lake Mills	2,143	2,281	-6.0	Manufacturing Agriculture	Norwegian German	11	146	123	17,210	0.7	58.2	9.6	36.2
KANSAS:													
Oberlin	2,197	2,387	-7.9	Agriculture	German	54	324	264	20,730	31.0	3.4	31.1	2.3
Smith Center	2,016	2,240	-10.0	Agriculture	German	100	214	190	17,738	26.5	7.2	30.1	5.8
MINNESOTA:													
Blackduck	718	653	+10.0	Tourism Manufacturing Agriculture	German Norwegian	144	276	144	14,198	0.3	10.7	4.6	7.0
Blue Earth	3,745	4,132	-9.4	Agriculture Food Processing	German Norwegian	2	137	102	16,117	-2.9	23.2	19.0	14.9
Perham	2,075	2,086	-0.1	Tourism Manufacturing Agriculture	German Norwegian	40	202	75	15,785	0.6	14.2	15.8	10.4
NEBRASKA:													
Aurora	3,810	3,717	+2.5	Agriculture Manufacturing	German	4	73	73	18,477	30.4	16.4	21.1	13.0
Blair	6,860	6,418	+6.9	Manufacturing "Bedroom Community"	Danish German	11	79	25	20,098	14.6	7.3	13.0	7.5

- continued -

Table 1. Continued

STATE/City	Population			Economic Base	Ethnic Heritage	Distance to			County per Capita Personal Income, '93	County Earnings, '93		County Employment, '93	
	1990	1980	% Change 1980-90			Interstate Highway	State Capital	Nearest SMSA		Ag., For., Mining, % Tot.	Mfg. % Tot.	Ag., For., Mining, % Tot.	Mfg. % Tot.
Broken Bow	3,778	3,979	-5.1	Agriculture	German English	50	182	182	18,984	29.9	8.5	24.1	6.4
Gordon	1,803	2,165	-16.7	Agriculture	German	116	429	156	17,012	25.1	2.2	26.8	1.8
Red Cloud	1,204	1,300	-7.4	Agriculture	German	63	153	153	19,304	44.5	1.3	25.5	1.3
Sidney	5,959	6,010	-0.9	Manufacturing Retail/distribution Agriculture, Tourism Petroleum	German	5	344	100	20,241	20.5	6.0	16.7	5.6
-----miles-----													
NORTH DAKOTA:													
4 Beulah	3,363	2,908	+15.6	Mining Agriculture	German-Russian	32	80	80	19,796	25.6	0.4	20.6	0.8
Ellendale	1,798	1,967	-8.6	Agriculture	German-Russian	67	167	149	15,842	30.2	5.1	24.2	3.6
Grafton	4,840	5,293	-8.6	Agriculture State Institution	Norwegian	11	308	43	17,006	16.0	3.1	17.9	2.4
Mohall	931	1,049	-11.2	Agriculture Petroleum	German Norwegian	160	174	174	17,304	43.3	0.7	37.8	1.6
Ray	603	766	-21.3	Agriculture Petroleum	Norwegian German	147	210	210	16,975	19.4	2.5	18.7	2.4
Stanley	1,371	1,631	-15.9	Agriculture Petroleum	Norwegian	137	171	171	17,350	32.2	4.8	26.4	3.5
SOUTH DAKOTA:													
Phillip	1,077	1,088	-1.0	Agriculture	Norwegian German	15	92	88	22,341	43.7	7.4	30.8	6.9
Average ^a	2,612	2,697	-4.5			60	194	127	18,236	18.9	11.7	19.4	8.6

^a Unweighted averages.

The study communities also differed in their degree of isolation from transportation arteries and centers of economic and political activity. Seven of the 20 study communities were within 15 miles of an interstate highway, but six were 100 miles or more from these transportation arteries. Similarly, four towns were located within 100 miles of the state capitol, while four were more than 300 miles away (Table 1). Another measure of isolation is the distance to the nearest metropolitan area (SMSA). Seven of the study communities were within 100 miles of an SMSA while two were more than 200 miles from one (Table 1).

The communities varied in other aspects as well. County per capita personal income in 1993 averaged \$18,236, ranging from \$14,198 in Beltrami County (Blackduck), Minnesota to \$22,841 in Haakon County (Philip), South Dakota. The portion of total county earnings attributable to the primary sectors (agriculture, forestry, and mining) averaged 18.9 percent in 1993, ranging from -2.9 percent (i.e., negative farm earnings) in Faribault County (Blue Earth), Minnesota to 44.5 percent in Webster County (Red Cloud), Nebraska. Earnings from manufacturing averaged 11.7 percent in 1993, ranging from 0.4 percent in Mercer County (Beulah), North Dakota to 58.2 percent in Winnebago County (Lake Mills), Iowa. The primary (natural resource-based) sectors accounted for 19.4 percent of total county employment, on average, in 1993, with a range from 4.6 percent in Beltrami County, Minnesota to 37.8 percent in Renville County (Mohall), North Dakota. Employment in manufacturing averaged 8.6 percent in 1993, ranging from 0.8 percent in Mercer County, North Dakota to 36.2 percent in Winnebago County, Iowa (Table 1).

Interviews with officials of state economic development agencies, state utility regulatory agencies, and state telephone associations were the principal sources of information in identifying study communities. The communities selected demonstrate diverse levels of telecommunications use. Several were selected for inclusion in the study because they were believed to exemplify innovative uses of telecommunications capabilities (e.g., in health care, telemarketing, etc.). Other towns were selected because they appeared to be more traditional in their use of telecommunications capabilities.

Survey

A mail survey, using the Total Design Method (Dillman, 1978), was used to obtain information from community residents in 1994. Random samples of residents were drawn from each community's telephone directory; therefore, the sample represented residents in the local exchange, not necessarily within the city boundaries. In total, nearly 2,000 resident households returned completed questionnaires for a response rate of 36 percent. While there was no follow-up beyond the second mailing for nonrespondents, the distributional patterns of resident age, educational level, and household income parallel the general population patterns of the communities. Thus, it was concluded that self-selection bias was not an inherent problem and that the sample respondents were representative of the population.

FINDINGS

The study findings are summarized in the sections that follow. First, selected characteristics of the respondents are briefly summarized. Then, the levels of use of various telecommunications technologies by residents are presented. In the third section, the associations between community attributes and individual characteristics and levels of use are examined for the different telecommunications technologies.

Respondent Characteristics

Selected characteristics of the community residents who responded to the survey are summarized in Table 2. The residents' average age was 54 years, and only about 27 percent were age 40 or younger. This population age distribution is typical of rural communities in the Upper Midwest, many of which have been experiencing net outmigration for several decades. Residents reported a relatively long tenure in their communities; the average respondent had lived in their community for 30 years, and only one-fourth had lived there fewer than 12 years.

The residents reported a broad range of formal education. While 8 percent had not completed high school and 31 percent reported that their formal education had ended with high school graduation, about 20 percent were college graduates and 9 percent had obtained advanced degrees. The respondents also reported a variety of occupations. About 43 percent reported full-time wage and salary employment and another 6 percent had part-time jobs. About 20 percent were self-employed, with about half (11.1 percent of all respondents) being farm or ranch operators, while 29.5 percent were retired. The residents' household incomes also covered a relatively wide range: about 12 percent reported that their 1993 household income was \$12,000 or less while another 18 percent had incomes of \$12,000 to \$19,999. On the other hand, about 17 percent reported incomes of \$50,000 or more.

Use of Telecommunications Technologies

Rural community residents were asked to describe their use of selected telecommunications technologies. The highest frequency of use (56 percent) was reported for telephone answering machines/services, where 42 percent of respondents reported regular use and 14 percent use this technology occasionally (Figure 2). Other technologies with a high level of use included facsimile (FAX) machines (48 percent), personal computers (46 percent), cellular phones (27 percent), and computer modems (25 percent). Among the other telecommunications technologies/capabilities, the use rates were lower, but about one respondent in six reported using E-Mail and electronic data transfer while one in ten reported satellite data reception.

Table 2. Selected Characteristics of Residents, 1994

Item	Units	Value
Age:		
Mean	Years	54.0
Age Distribution:		
30 or less	Percent	7.6
31 to 40	"	19.2
41 to 50	"	19.2
51 to 65	"	24.1
over 65	"	29.9
Size of Household:		
Mean # of persons	Number	2.6
Years Lived in Community:		
Mean	Number	30.3
Education:		
Elementary school	Percent	8.0
High school graduate	"	31.0
Vocational/trade school graduate	"	10.6
Some college	"	21.3
College graduate	"	20.1
Advanced college degree	"	9.0
Occupation:		
Farmer/rancher	"	11.1
Self-employed (non-farm)	"	9.9
Full-time wage and salary employment	"	43.3
Part-time and other	"	6.2
Retired	"	29.5
Household Income, 1993:		
Less than \$12,000	"	12.4
\$12,000 to \$19,999	"	17.6
\$20,000 to \$29,999	"	22.0
\$30,000 to \$39,999	"	18.8
\$40,000 to \$49,999	"	12.5
\$50,000 or more	"	16.6

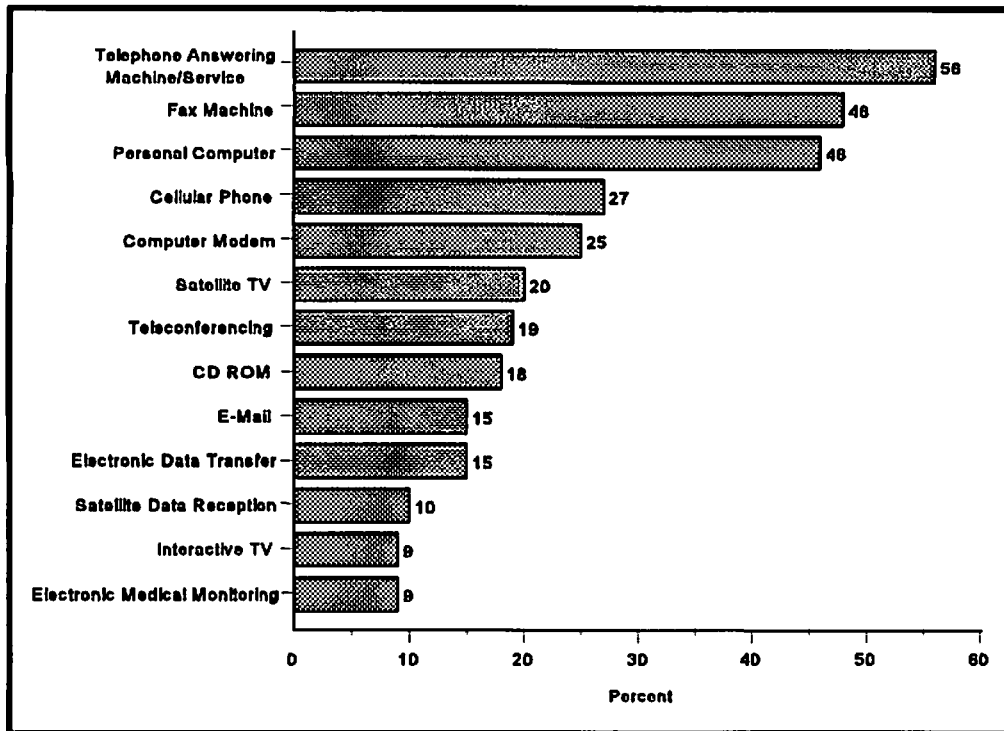


Figure 2. Residents Use of Telecommunication Technologies, 1994

Factors Affecting Levels of Use

Analysis of factors associated with use rates revealed significant differences across educational levels, household income levels, and occupational status. Reported use rates increased significantly with level of formal education (Table 3). For example, 38 percent of college graduates and 42 percent of respondents with advanced degrees reported use of computer modems, compared to only 15 percent of the high school graduates. Similarly, 24 percent of college graduates and 33 percent of respondents with advanced degrees used E-Mail, compared to only 7 percent of high school graduates.

Use of the various technologies also tended to rise substantially with the household income of respondents (Table 4). Affordability likely is a factor in explaining this relationship, although not necessarily a dominant one. For instance, use of satellite TV (a relatively high-cost technology) shows less variation among income groups than many of the other technologies.

Table 3. Residents' Use of Telecommunications Technologies by Highest Level of Education Achieved, 1994

Technology	Percent of Residents Using the Technology by Highest Level of Formal Education						
	Elementary School	High School Graduate	Vocational/Trade School Graduate	Some College	College Graduate	Advanced College Degree	All Resident Average
	-----percent-----						
Telephone Answering Machine ¹	22	48	62	61	68	73	56
Fax Machine ¹	16	38	48	51	63	71	48
Personal Computer ¹	10	28	52	51	68	76	46
6 Cellular Phone ¹	9	22	23	28	38	36	27
Computer Modem ¹	4	15	26	27	38	42	25
Satellite TV ²	11	18	22	22	22	24	20
CD Rom ¹	4	9	13	16	30	39	18
Electronic Data Transfer ¹	2	8	13	17	23	30	15
E-Mail ¹	1	7	14	18	24	33	15

¹Significantly different across level of formal education at the .01 level of significance based on Chi Square test.

²Significantly different across level of formal education at the .05 level of significance based on Chi Square test.

Table 4. Residents' Use of Telecommunications Technologies by Level of Household Income, 1994

Technology	Percent of Residents Using the Technology by Level of Household Income					
	Under \$12,000	\$12,000 to 19,999	\$20,000 to 29,999	\$30,000 to 39,000	\$40,000 to 49,000	\$50,000 or More
	----- percent -----					
Telephone Answering Machine ¹	30	42	54	66	70	74
Fax Machine ¹	15	30	46	60	65	74
Personal Computer ¹	11	30	44	58	67	71
Cellular Phone ¹	14	17	21	32	36	44
⁰¹ Computer Modem ¹	5	15	20	31	39	42
Satellite TV ¹	10	16	17	28	23	28
CD Rom ¹	4	8	14	23	25	34
Satellite Data Reception ¹	4	5	8	12	14	15
E-Mail ¹	4	9	10	18	22	31

¹Significantly different across level of household income at the .01 level of significance based on Chi Square test.

Another explanation may be that use patterns for most of the technologies reflect the vocational characteristics of the higher income households and/or their training and experience in using the information that can be received through use of the technologies.

When variations in use are compared among occupational groups, substantial and consistent differences between retired households and other groups are noted (Table 5). For most of the technologies, use rates for nonretired households were two to three times those reported by retired households. Farm and ranch households reported the highest rates of use for satellite data reception and satellite TV. Their use rates for the other technologies were generally much higher than those of retired households, but somewhat lower than those reported by the nonfarm self-employed and those with full-time wage and salary employment.

An index of residents' overall use of telecommunications technologies was developed by allocating each respondent 0 to 3 points according to their degree of use of each of 15 different technologies (including the 9 reported in Tables 3-5). Thus, the possible index values ranged from 0 (for a respondent who had *never heard of* any of the technologies) to 45 (for a respondent who reported *regular use* of each one). The actual use index values ranged from 0 to 40, averaging 17.3; about half of the observations fell between 13 and 22. When the residents' use index scores were averaged by community, the community scores ranged from 15.1 to 19.4.

Correlations between use index scores and a number of individual and community characteristics are shown in Table 6. The respondents' age was negatively correlated while their income and education levels were positively correlated with the use index score, and all of these correlations were significant at the 1 percent level. Community population and population change also were positively correlated with use index, indicating that larger towns and those with growing populations tended to have higher use index scores, other things being equal. (Because respondents' occupation was a categorical variable which entered the models as a 0-1 dummy, correlation coefficients were not computed for occupation.)

Communities that were located farther from interstate highways and SMSAs tended to have somewhat lower use index values, other things being equal (Table 6). The community's per capita income level was positively associated with use index, while the percentage of an area's earnings or employment associated with the natural resource based sectors and/or manufacturing was negatively associated with use.

The influence of these variables on the use index was further explored using multiple regression analysis. Two regression models were estimated using ordinary least squares (OLS) techniques. In Model 1, the individual and community variables just discussed were considered for inclusion; variables were required to be significant at the 0.1 level to be included in the model. The individual characteristics, age, income, and education, were all significant at the 1 percent (0.01) level (Table 6). The regression coefficients indicate that an additional year of age decreases a respondent's expected use value by about 0.1 unit, while an additional level of education (see Table 2) increases the use index value by 0.9 units and an additional level of income results in an increase of the use index value by 1.3 units, on average. Two occupational

Table 5. Residents' Use of Telecommunications Technologies by Occupation Status of Household, 1994

Technology	Percent of Residents Using the Technology by Occupational Status of Household					
	Retired	Self-employed (Farming/Ranching)	Self-employed (Non-farm)	Full-time Salaried/Wage	Part-time Salaried/Wage	Other
	----- <i>percent</i> -----					
Telephone Answering Machine ¹	32	58	78	67	44	63
Fax Machine ¹	20	44	67	64	33	29
Personal Computer ¹	17	48	61	64	27	48
Cellular Phone ¹	14	32	46	31	15	18
Computer Modem ¹	8	18	32	36	20	29
Satellite TV ¹	13	32	21	23	13	10
CD Rom Machine ¹	4	14	24	26	9	13
Satellite Data Reception ¹	4	23	9	11	2	4
E-Mail ¹	3	9	18	25	12	17

¹Significantly different across level of occupational status at the .01 level of significance based on Chi Square.

Table 6. Correlation Coefficients and Regression Parameters for Related Individual and Community Characteristics and Attitude Measures to Residents' Use Index

Variable	Correlation Coefficient	Regression Coefficients	
		Model 1	Model 2
Individual Characteristics:			
Age	-0.467*	-0.099*	-0.101*
Income	0.482*	1.291*	1.162*
Education	0.424*	0.946*	0.843*
Occupation:			
Farmer/rancher	--	a	a
Self-employed (nonfarm)	--	0.965**	1.858*
Full-time wage and salary employment	--	a	0.917**
Part-time and other	--	--	--
Retired	--	-0.666*	a
Community Characteristics:			
Population, 1990	0.153*	0.0004*	0.0003*
Population percent change, 1980-90	0.068*	-0.0490**	a
Distance to:			
Interstate highway	-0.091*	a	a
State Capital	-0.009	a	a
Nearest SMSA	-0.060**	0.010**	0.014*
Per Capita Income, 1993	0.092*	a	a
Percent of Earnings from:			
Agriculture and mining	-0.043***	a	a
Manufacturing	-0.044***	a	-0.031*
Percentage of Employment in:			
Agriculture, forestry, and mining	-0.064*	a	a
Agriculture, forestry, mining, and mfg.	-0.094*	-0.037***	a
Respondents' Evaluation of:			
Local telephone company	0.258*	--	0.718*
Local adult education/training	0.219*	--	0.399*
Intercept	--	13.920	9.588
R ²	--	0.395	0.402

* Significant at .01 level

** Significant at .05 level

*** Significant at .10 level

a Did not enter equation

-- Not included in the model

categories had a significant influence on the use value. Self-employed respondents had use index values that were almost 1 unit higher, on average, than the benchmark group (part-time and other) while the retired group had values that were about 0.7 units lower.

Among the community characteristics, population was significant at the 1 percent level, while population change, with a negative coefficient, was significant at the 5 percent level. Thus, a community with 1,000 more residents would have a use index value about 0.4 units larger than another community that was the same in other respects, while a population increase of 10 percent from 1980 to 1990 would lead to a 0.5 unit decrease in the use index. Distance to the nearest SMSA was significant at the 5 percent level; a 100 mile increase in distance would lead to about 1 unit increase in the index value. The percentage of employment in agriculture, forestry, mining, and manufacturing was negatively related to use, but only significant at the 10 percent level. Overall, the equation explained about 39.5 percent of the variation in use index values ($R^2 = 0.395$).

Model 2 was similar to Model 1 except that two attitudinal variables were allowed to enter the model. These were respondents' evaluation of the local telephone company and their evaluation of local adult education and training. These variables both entered the model with positive coefficients and both were significant at the 1 percent level. The individual and community variables in Model 2 were similar to Model 1 with the following exceptions:

1. Full-time employment entered Model 2, replacing Retired.
2. Population change did not enter Model 2.
3. Percent of earnings in manufacturing entered Model 2, replacing percent of employment in agriculture, forestry, mining, and manufacturing.

This equation explained 40.2 percent of the variance of use index values.

To more fully assess the influence of various characteristics on respondents' use of telecommunications technologies, multiple discriminant analysis was employed. Discriminant analysis is similar to multiple regression except that the dependent variable is group membership (McLachlan, 1992). In this case, respondents who reported using a given technology, either regularly or occasionally, were assigned to one group (users) while those who did not use the technology were assigned to the other. The stepwise discriminant analysis technique was then used to determine which of a group of potential explanatory variables were statistically significant in differentiating group membership. In this analysis, respondents' age, education, income, occupation, household size, and state of residence were used as possible explanatory variables, together with the community characteristics summarized in Table 1. Explanatory variables were required to be significant at the 0.1 (10 percent) level to be included in the discriminant function.

The results of the discriminant analysis indicated that household income was statistically significant in explaining use of all of the nine most frequently used technologies (Table 7). Income had a positive effect on use rates for all nine of these technologies when other household and individual attributes were held constant. Education was statistically significant in explaining use rates for eight of the nine technologies (all but satellite TV), and in all cases education level and use level were positively associated. Age, on the other hand, was statistically significant for seven of the nine technologies and had a negative association with use rate for each (i.e., older individuals were less likely to use each technology, other things being equal).

Other variables had less consistent associations with use rates. Household size was statistically significant in explaining use levels for three of the nine technologies (Table 7). It was positively associated with use of a personal computer but negatively associated with use of a telephone answering machine and with electronic data transfer. Employment as a farm or ranch operator was positively associated with use of cellular phones and satellite TV but negatively associated with use of a computer modem. Self-employment in a nonfarm occupation was positively associated with use of telephone answering machines, cellular phones, and FAX machines, but negatively related to use of E-Mail and electronic data transfer.

Community characteristics also played a role in explaining the use of a number of technologies. Community population entered three of the nine discriminant functions, always with a positive relationship with use. Population change (1980-90) entered five equations, in each case with a negative association with use. The percentage of county earnings or employment associated with the natural resource-based sectors (agriculture, forestry, and mining) was significant in three equations, with a negative relationship to use in each. Among the distance measures, distance to the nearest SMSA was the only one to enter the discriminant functions, with a positive influence on use of computer modems and satellite TV but a negative association with use of cellular phones.

A final set of variables that were allowed to enter the discriminant functions were the state where the respondent lives. The rationale for including these variables was that they would capture influences of state policy or other state-specific factors on the use of telecommunications technologies. State variables entered the discriminant functions for six of the nine technologies. The *Nebraska* state variable entered the equations for telephone answering and cellular phone, with a positive association in each case (Table 7). The *Iowa* variable entered three equations, with a negative association to use in two of these. The *Kansas* and *Minnesota* state variables each entered one of the discriminant functions. These results appear to indicate that state policy may play a significant role in influencing the rate of adoption of some technologies. However, the reader is cautioned that these results are based on a sample that included only a few communities in each state (e.g., only two in Iowa and two in Kansas). More research on this topic would be desirable.

The discriminant functions formed from the various explanatory variables were reasonably effective in correctly classifying the sample observations (Table 7). For eight of the

Table 7. Variables That Explain Community Residents' Use of Telecommunications Technologies

Technology	Explanatory Variables (relationship)								Percent of Observations Correctly Classified
	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth	
Telephone Answering Machine/Service	Age [*] (-)	Income [*] (+)	Household size [*] (-)	Self-employment (non-farm) [*] (+)	Education [*] (+)	State-- Nebraska ^{**} (+)	--	--	69.3
Personal Computer	Age [*] (-)	Education [*] (+)	Income [*] (+)	Household size [*] (+)	State-- Iowa ^{**} (-)	Earning ratio-- ag., forestry, & mining (-)	Population change, 1980-90 ^{**} (-)	--	76.4
Computer Modem	Income [*] (+)	Age [*] (-)	Education [*] (+)	Self-employment (farm/ranch) [*] (-)	State-- Iowa ^{**} (+)	Population change, 1980-90 ^{***} (-)	Population, 1990 [*] (+)	Distance to nearest SMSA ^{***} (+)	66.6
Cellular Phone	Income [*] (+)	Age [*] (-)	Self-employment (non-farm) [*] (+)	State-- Nebraska [*] (+)	State-- Kansas [*] (+)	Self-employment (farm/ranch) ^{**} (+)	Education ^{**} (+)	Distance to nearest SMSA ^{***} (-)	65.9
CD Rom	Education [*] (+)	Age [*] (-)	Income [*] (+)	Employment ratio-- ag., forestry, & mining ^{***} (-)	--	--	--	--	68.4
E-Mail	Education [*] (+)	Full-time wage & salary emp. [*] (+)	Income [*] (+)	Population, 1990 [*] (+)	Occupation-- retired (-)	Self-employment (farm/ranch) (-)	--	--	68.9
Fax Machine	Income [*] (+)	Age [*] (-)	Education [*] (+)	Occupation-- retired [*] (-)	Population change, 1980-90 [*] (-)	State-- Iowa ^{***} (-)	Self-employment (non-farm) ^{***} (-)	Full-time wage & salary emp. ^{***} (+)	71.8
Electronic Data Transfer	Education [*] (+)	Full-time wage & salary emp. [*] (+)	Income [*] (+)	Self-employment (non-farm) ^{**} (-)	Population change, 1980-90 ^{***} (-)	Population, 1990 ^{**} (+)	State-- Minnesota [*] (+)	Household size ^{***} (-)	65.8
Satellite TV	Income [*] (+)	Self-employment (farm/ranch) [*] (+)	Age ^{**} (-)	Distance to nearest SMSA ^{**} (+)	Earning Ratio-- ag., forestry, & mining ^{**} (-)	--	--	--	58.3

*Significant at .01 percent level.

**Significant at .05 percent level.

***Significant at .1 percent level.

nine technologies, the discriminant functions correctly classified at least 65 percent of the observations. The lowest rate of correct classification was 58 percent for satellite TV.

Conclusions and Implications

Growing awareness that advanced telecommunications technologies may be a key to increasing business efficiency and improving access to services, as well as reducing rural isolation generally, has led to extensive discussion of the role of telecommunications in economic development. This study examines the utilization of telecommunications technologies by residents of 20 rural communities in 6 states in the midwestern United States. One of the salient findings of the analysis is the relatively high degree of use of various telecommunications technologies by the respondents. For example, 56 percent of residents reported using telephone answering machines/services either regularly or occasionally, 48 percent reported using FAX machines, 46 percent used personal computers, and 25 percent used computer modems. It appears that the levels of use among these rural residents may equal or even exceed those of urban residents. (For example, a recent estimate for the U.S. as a whole is that one-third of all homes have computers and 40 percent of the home computer owners have modems [Burgess et al., 1995]. Although not a direct comparison, the rates of use reported in this survey seem to imply at least similar levels of use of these two technologies.)

The analysis of factors affecting residents' use of the different telecommunications technologies revealed that higher levels of education and household income were associated with higher levels of use of virtually all of the technologies examined. Older residents and particularly those who were retired had lower rates of use of most technologies. Farm and ranch residents reported the highest use of satellite data reception and satellite TV, but their use rates for other technologies were generally lower than those for nonfarm, nonretired households.

Distance to the nearest SMSA generally was positively related to use of telecommunications technologies, once other factors had been taken into account. In other words, the farther the community from the nearest SMSA, the more likely its residents were to use these technologies. This would indicate that rural community residents are using telecommunications technologies to overcome distance barriers.

The extent to which a community's economy is dependent on the natural resource-based industries and/or manufacturing was generally negatively related to telecommunications use. This suggests that not only do advanced telecommunications technologies often enable communities to achieve economic diversification by enabling exported service activities to prosper in rural areas but also that economic and community development that involves growth of the service sectors will likely increase the use of telecommunications services.

Rural residents included in the study exhibited a positive relationship between use level and the respondent's rating of the local telephone company. These relationships serve to point

out the key role of the local telecommunications provider in enabling rural residents and businesses to take advantage of telecommunications potentials. Similarly, the strong positive associations between use level and respondent's rating of local adult education and training support the importance of training and skills development to enable rural communities to more fully utilize advanced telecommunications technologies.

In summary, use of telecommunications technologies is progressing rapidly in rural areas of the U.S. heartland. The levels of use may rival or even exceed urban rates as rural people strive to overcome the costs of geographic isolation. A variety of factors, both individual and collective, appear to be creating a rather complex mosaic of usage by rural people. As service sectors become a larger share of local economies, it is likely that growth in the use of telecommunication technologies in rural areas will continue.

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