MARCH–APRIL 2003
NUMBER 225

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

TR NEWS

Rural Passenger Transportation

Models and Strategies

- From Horse Power to Horsepower
- Residential Growth and Travel Needs
- Adapting High Technologies
- Building Intercity Bus Links
- Intermodal Start-ups and Visions

THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine

The Transportation Research Board is a division of the National Research Council, which serves the National Academy of Sciences and the National Academy of Engineering. The Board's mission is to promote innovation and progress in transportation through research. In an objective and interdisciplinary setting, the Board facilitates the sharing of information on transportation practice and policy by researchers and practitioners; stimulates research and offers research management services that promote technical excellence; provides expert advice on transportation policy and programs; and disseminates research results broadly and encourages their implementation. The Board's varied activities annually draw on approximately 4,000 engineers, scientists, and other transportation researchers and practitioners from the public and private sectors and academia, all of whom contribute their expertise in the public interest. The program is supported by state transportation departments, federal agencies including the component administrations of the U.S. Department of Transportation, and other organizations and individuals interested in the development of transportation.

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Cover: Aerial view of rural roadways; insets (*top to bottom*): horses rescue a car stuck in the mud, circa 1920 (*photo courtesy of Texas Department of Transportation*), bus driver uses wireless technology to streamline rural services, and intercity bus provides affordable and accessible travel option to rural residents.

TR NEWS

features articles on innovative and timely research and development activities in all modes of transportation. Brief news items of interest to the transportation community are also included, along with profiles of transportation professionals, meeting announcements, summaries of new publications, and news of Transportation Research Board activities.

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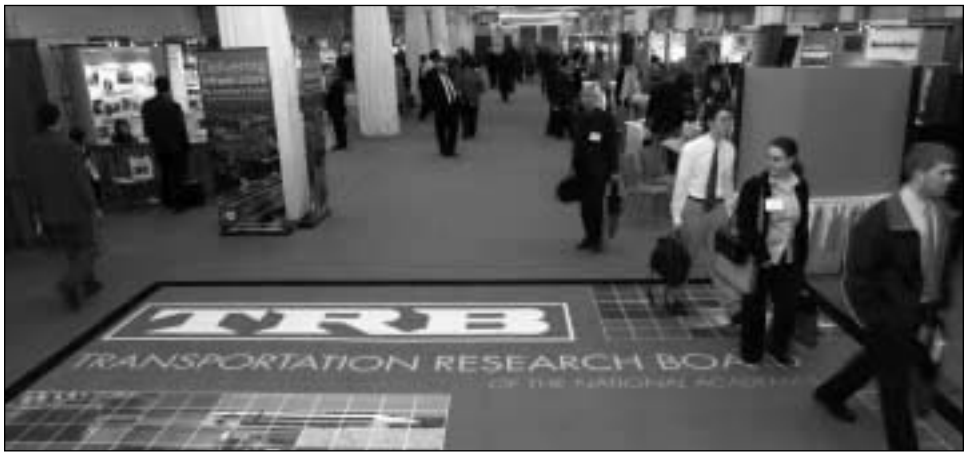
CORRECTION: The correct web address for Maglev Quicklinks, included in the list at the end of the feature article, "Traveling by Magnetic Levitation: New Technology on the Move at Home and Abroad," by Arrigo Mongini, Arnold Kupferman, and John Harding (*TR News*, November–December 2002, pp. 12–18) is faculty.washington.edu/jbs/itrans/maglevq.htm.

Thanks to Jerry Schneider of Innovative Transportation Technologies and professor emeritus, University of Washington, Seattle, for pointing out the typographic error and for creating a link to redirect readers to the updated website.

COMING NEXT ISSUE

The May–June issue will offer feature articles on identifying and championing high-payoff, ready-to-use technologies in transportation; increasing the flexibility of transportation energy sources; methods for preserving the profession's memory; a historical perspective on the critical issues TRB has identified and addressed over three decades; plus photographic highlights from TRB's 82nd Annual Meeting—and more.



TRB's 82nd Annual Meeting, held January 12–16, 2003, in Washington, D.C., featured more than 500 sessions, including 115 sessions that spotlighted four theme issues: Security: One Year Later; Congestion: What Does the Future Hold?; New Tools for Improving Safety; and The Route to Reauthorization.

INTRODUCTION

RURAL PASSENGER TRANSPORTATION

Finding a Way To Get Where They Need To Go

Less visible than suburban or urban transportation, rural passenger transportation in the United States in modes other than privately owned cars has such a low profile that people often respond to the term "rural transportation" by saying, "Oh, I didn't know there was any."

People living in rural areas are supposed to be independent and self-sufficient, capable of providing their own transportation. The Jeffersonian ideal of America as a society of small, independent farmers still may resonate today, but the United States of the first decade of the 21st century bears little resemblance to that ideal. Modern Americans move through an urban and suburban landscape, work in a global marketplace, and seldom acknowlede dependence on others.

Many people in rural areas, however, depend on others to solve their mobility needs. The articles in this issue of *TR News* consider some of the ways rural people get where they need to go.

The first article presents a history of the replacement of horse power by horsepower, the construction of rural roads, and the effect of Interstates in rural areas. The rural transportation past involves the horse, but many farmers and rural residents were quick to replace their beloved horses with cars and trucks.

The allure was powerful—a machine that required much less immediate care, that could travel long distances quickly and without rest, and that could carry heavy loads without complaining. Automobiles were not only practical, but modern and sophisticated, the mark of success and a "cutting-edge" sensibility. They also helped relieve the loneliness and isolation of farm families living outside of towns.

The family car got jolted and stuck in muddy wagon ruts, as did the farm truck carrying the wheat or hogs or apples to pay for the family car and the farm truck. Consequently, interest in farm-to-market roads was high, although rural communities and counties often had to wait for urban areas to receive paved roads first.

Later, rural areas awakened to a new concept for roads when the federal government and state departments of transportation—then more commonly called highway departments—began building the Interstate system. The rural Interstate accelerated the transformation of the family farm—farmers and family members could travel on the Interstate to jobs that supported the farm. Today, nationwide, 84 percent of all farm household income comes from off-farm sources. The horse has moved to a life of leisure as farmers travel modern roads to work long hours off the farm and then more hours on the farm.

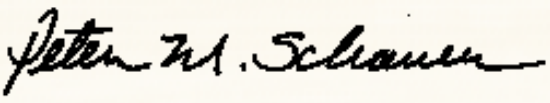
The new demographics of rural areas have implications for transit providers. Sandi Rosenbloom presents an overview of the extensive literature on changes in rural demographics, economics, social structures, technology, and land use. Rosenbloom emphasizes that transit providers will have to be innovative in their approach to service and willing to find opportunities in nontraditional areas of transit service.

In the article, "Intelligent Transportation Systems for Rural Transit: Not Just for Urban Systems Anymore," Carol Schweiger looks at innovative services that deploy intelligent transportation systems in rural areas. She offers some caveats and sketches out the challenges.

Two articles examine another aspect of rural transportation, intercity bus. Fred Fravel, in "Intercity Bus Links: Moving into New Territory," looks at intercity bus transportation's ability to provide small communities and rural areas with affordable travel and access to the goods and services of metropolitan areas. He also describes the intermodal role of intercity bus service, as more rural residents travel to airports by bus.

Craig Lentzsch presents the case for improving intermodal travel. In his Point of View article, "Making the Connections: Strengthening the Nation's Transportation System," he recommends four improvements to rural transportation: seamless connections, the development of intermodal passenger facilities, the creation of an essential bus service program to connect rural communities to airports, and the development of an integrated system of public transportation information.

From the horse to the early car to intermodal travel, rural residents have found a way to get where they need to go. Sometimes they have managed on their own; sometimes they need another way to get there. This issue presents some of the influences, difficulties, and opportunities involved in the trip to town.



Peter Schauer, Peter Schauer Associates

EDITOR'S NOTE: Appreciation is expressed to Peter Schauer and Stephan A. Parker, Senior Program Officer, Cooperative Research Programs, TRB, for their efforts in developing this issue of *TR News*.

RURAL PASSENGER TRANSPORTATION

The Trip to Town

Rural Transportation Patterns and Developments Since 1900

PETER SCHAUER

The author is principal, Peter Schauer Associates, Boonville, Missouri. A member of the TRB Committees on Bus Transit Systems and on Rural Public and Intercity Bus Transportation, he has served on several other TRB transit-related committees. He is also a farmer.

The scenes can be recalled with a few words or musical notes: the Conestoga wagon train trekking steadily west to the land of milk and honey; the "surrey with the fringe on top," with a matched team of dappled horses taking the family to church, under gray oaks draped in Spanish moss; Jesse James making a getaway on his speedy pony; or the family farmer, patiently plowing the fields, working in partnership with his beloved horses or mules.

Whatever the image from America's rural history, the horse is there. Recalling the nation's rural transportation past without including the horse is difficult.

The image is distant and nostalgic. The Jeffersonian ideal of the United States as a society of small, independent farmers resonates today, more than two centuries later. Yet the United States in the first decade of the 21st century bears little resemblance to the Jeffersonian ideal. Modern Americans move through urban and suburban landscapes, working in a global marketplace, enjoying speed, convenience, and the world's resources.

Cars, trucks, and sport utility vehicles have replaced horses, carrying Americans faster and farther. Sometimes, in a nostalgic moment, 21st century Americans imagine how "organic" or simpler it would be to travel in a horse and buggy, but then, after riding around a mall parking lot a few times at Christmas, they motor off to the next mall, glad that the horse and buggy are antique.

Olds Motor Works ad promotes the car as an alternative to the horse, 1901.

Automobile's Allure

The differences between the trip to the mall and the buggy ride provide insight into why farmers were interested in owning a car. Although their horses may have been beloved, farmers found a powerful allure in a machine that required much less immediate care, could travel long distances quickly and without rest, and could carry heavy loads without complaint.

Cars were not only practical but modern and sophisticated, the mark of success and of a cutting-edge sensibility. Cars also helped relieve the loneliness and isolation of farm families living outside of towns. Trips to town had been rare but became commonplace as the cars of dozens of manufacturers jolted across wagon ruts and through the mud.

The farm's truck also got jolted and stuck in the muddy wagon ruts, carrying wheat or hogs or apples to pay for the family car and the farm truck, for the farm, and for the weekly trip to town. Farmers of the late 19th and early 20th century knew they were not self-sufficient but depended on getting produce to market. Consequently, interest in farm-to-market roads was high—rural communities and counties often had to wait while urban roads were being paved first. Some states are still committed to adequate farm-to-market roads, which some groups define as four-lane, divided highways.

Interstate Transformations

Rural areas took up the call for roads when the federal government and state departments of transportation—then commonly called highway departments—began building the Interstate system. Groundbreaking was held in 1956 for the first segment of the National Interstate and Defense Highway in what was then relatively rural eastern Missouri, near St. Charles. Another early segment, from Boonville to Columbia, Missouri, was built in assuredly rural Cooper County.

Interstates accelerated the transformation of the family farm. Farmers and family members could travel on the Interstate to jobs that supported the farm, instead of driving on two-lane roads to support the farm by marketing the produce. National statistics indicate that 84 percent of all farm income now comes from off-farm sources (Figure 1). The horse has moved to a life of leisure while farmers work long hours away from the farm and then more hours on the farm, often at night.

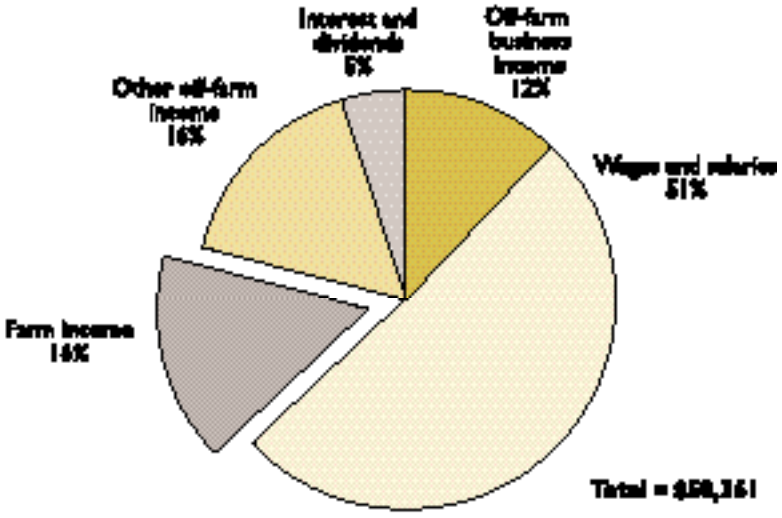


FIGURE 1 Sources of farm income, 1956.
Source: Economic Research Service, U.S. Department of Agriculture

Farmers and Automobiles

The poem on page 7 gives an idea of the requirements for maintaining a living creature as a mode of transportation. Care of a horse required thoughtfulness and a considerable amount of daily work. The work involved in early automobiles, however, was concentrated in pulses of activity:

> If Mr. Smith's car is one of the high, hideous, but efficient Model T Fords of the day, let us watch him for a minute. He climbs in by the right-hand door (for there is no left-hand door by the front seat), reaches over to the wheel, and sets the spark and throttle levers in a position like that of the hands of a clock at 10 minutes to 3. Then, unless he has paid extra for a self-starter, he gets out to crank. Seizing the crank in his right hand carefully (for a friend of his once broke his arm cranking), he slips his left forefinger through a loop of wire that controls the choke. He pulls the loop of wire, he revolves the crank mightily, and as the engine at last roars, he leaps to the trembling running board, leans in, and moves the spark and throttle to 25 minutes of 2. Perhaps he reaches the throttle before the engine falters into silence, but if it is a cold morning, perhaps he does not. (*1*)

Despite such difficulties, farmers—along with millions of other Americans—chose the automobile over the horse. In 1885, only four automobiles were registered in the United States, but by 1915, 2.5 million vehicles were registered, and by 1929, 26.5 million (*2*).

Boonville, Missouri, saw its first motor car in 1901. Ferd Arn, a sporting goods merchant specializing in guns and bicycles, bought a Murray "one lunger," a single-cylinder, wire-wheeled, tiller-steered model. Arn displayed the vehicle—nicknamed the "Devil Buggy"—at local fairs and cruised the back roads of Cooper County, frightening farmers' horses (*3*).

Tapping the Market

The horses would have to get used to the devil buggies, for as car manufacturing techniques improved and new models were offered, the demand for cars increased and sales methods grew more sophisticated. To tap a mass market, manufacturers developed a financing system, which remains largely

Oldsmobile ad from 1902 contrasts the hassles of managing a horse with the smart ease and elegance of the automobile.

Illustration from a 1935 Gulf Refining Company ad, depicting the plight of a 1901 automobiler: "Gasoline? Mister, there's not a drop for miles."

Advertisement circa 1917 illustrates the need for farm tractors, with soldiers (and farm horses) marching off to World War I, leaving the elderly and women to ensure the nation's food supply.

unchanged: "By 1925 over two-thirds of the new cars purchased each year were bought on credit" (*2*).

The advertising industry also played a part in convincing people that the days of the horse were over. Oldsmobile ran an ad in 1901 under the headline, "The Passing of the Horse": "The silent horsepower of this runabout is measurable, dependable, and spontaneous. The horsepower generated by supplies of hay and oats is variable, uncertain, and irresponsive. There is nothing to watch but the road when you drive the Oldsmobile, the best thing on wheels" (*4*).

The next year's ad was more boastful, claiming that "nature made a mistake in giving the horse brains. Science did better and made the Oldsmobile mechanically perfect, presupposing brains in its owner." The illustration showed one man trying to catch his uncooperative horse, while in another panel, a smug-looking couple whirled by in their Oldsmobile (*4*). Well aware of the personalities of horses and mules, farmers could have discounted these reasons to buy cars.

Meanwhile, networks of gasoline filling stations developed to meet the demand of cutting-edge travelers. According to a 1935 advertisement, "In 1901…motoring was a sport that called for bold spirits and stout legs. If a driver ran out of gasoline on the road,…the only source was the 'garage' of the period, often a livery stable [that]…serviced both horses and horseless carriages. Gasoline was a precious fuel, doled out from a barrel that rested on the stable rafters." The ad noted that "gasoline filling stations have become as numerous as the horse troughs of a more leisurely era."

Farmers wanted to modernize farm operations as much as possible to produce more and become more efficient in a time of declining farm prices. The Roaring Twenties did not swing well for farmers, who fell further and further behind as prices plummeted from World War I heights (*1*).

Improving Quality of Life

Moreover, farmers already were acquainted with the advantages of mechanical equipment. Cyrus McCormick had patented the horse-drawn Virginia Reaper in 1834 and "was among the first to offer… direct credit for buying his machinery," allowing American farmers to "improve the quality of their lives and create larger, more profitable farms" (*5*). Manufacturers of steam-powered and then gasoline- and diesel-powered farm equipment filled the marketplace in the late 19th and early 20th centuries as farmers learned the advantages of mechanization and buying on credit.

Farmers read advertisements and articles about the latest innovations in the many magazines and newspapers devoted to agriculture (*5*). A 1910 article in *The Breeder's Gazette* reported that the progress of many agricultural innovations, especially in traction and mechanized plowing, had spread "contrary to the usual order of things,…making an eastward progress across the continent…from the limitless prairie field of the bonanza farm to the restricted fenced acreage of the diversified farm" (*6*).

An advertisement for Minneapolis-Moline tractors stated that "your standard of living has increased in direct proportion to the extent to which you have mechanized, and this is true the world over" (*5*). To capture both the farm power market and the automobile market, Minneapolis-Moline offered the "Comfortractor," designed to pull a three- to four-bottom plow and travel 40 mph on the highway (*5*).

But perhaps the most salient reason to mechanize was World War I. The "boys" went to the front and took the farm horses with them: "The military leadership…didn't consider trucks reliable and decided to use only horses to move their implements

The Horse's Prayer*

Feed me, water me, and care for me,
And when the day's work is done,
Provide me with a clean shelter, a clean dry bed,
And a stall wide enough for me to lie down in comfort.
Be always gentle with me, and talk to me;
Your voice often means more to me than the reins.
Pat me sometimes that I may serve you
The more gladly and learn to love thee.
Do not jerk the reins,
And do not whip me when going uphill.
Never strike, beat, or kick me
When I do not understand what you mean,
But give me a chance to understand you.
Watch me, and if I fail to do your bidding,
See if something is wrong
With my harness, or my feet.
Don't draw the straps too tight.
Give me freedom to move my head.
If you insist on me wearing blinkers
To keep me from looking around, at least
See to it that they do not press against my eyes.
Don't make my load too heavy,
And don't leave me tied up in the rain.
Have me well shod,
Examine my teeth when I do not eat—
I may have an ulcerated tooth—
And that, you know, is painful enough.
Do not tie my head in an unnatural position,
Or take away my best defense against flies
By cutting off my tail.
I cannot tell you when I'm thirsty
So please give me pure cold water frequently.
Do all you can to protect me from the sun
And throw a cover over me
When I am standing out in the cold.
Don't force an ice-cold bit into my mouth,
But warm it first
In some warm water, or in your hands.
I always try to do cheerfully
The work you require of me.
And day and night
I stand for hours waiting for you.
And finally, my master,
When my useful strength is gone,
Do not turn me out to starve or freeze,
Or sell me to a cruel owner
To be slowly tortured and starved to death.
But do thou, my master, take my life
In the kindest way.
And your God will reward you here and hereafter.
You may not think me irreverent
If I ask you this in the name of
Him who was born in a stable.
—*A. E. Fisher*

*From Keegan, T. *The Heavy Horse: Its Harness and Harness Decoration.* A. S. Barnes and Company, New York, 1973.

From Paige-Detroit Motor Car Company brochure: Paige Phaeton climbs Uniontown Mountain, Pennsylvania, reaching a speed of 30 mph at the summit.

of war. The mortality rate for wartime horses was high and the farmers returning from war realized they needed replacements for their lost horse-power" (*5*). Mechanical power in the form of tractors was the solution for the lack of horse power during and after the war.

A magazine advertisement for Parrett tractors, circa 1917, addresses this need: "One man with a Parrett can do more than two or three men with horses." The illustration shows a woman driving the tractor, under the watchful eye of the patriarch farmer.

The desirability of a mechanical means of transportation, the availability of financial credit, the arrival of modern advertising, the proliferation of farm publications, the need to innovate to produce more farm products in a time of falling prices, a shortage of horses, and the simple appeal of the new and modern all converged, and rural people readily loved and quickly adopted the automobile. The next need was for a road to drive on.

A farmer hitches a team of horses to rescue a car stuck in the mud on a rural road, circa 1920.

Photo: Texas Department of Transportation

Farm-to-Market Roads

Another familiar scene is the old photograph of a bemused farmer with a team of horses, pulling a car out of a mud hole in the road. The rural road system was not systematic. Typically, farmers and neighbors would patch together a passable route to the nearest town.

Some thought this was a good way to build a road and save money. In a February 2, 1895, letter to the editor of *Indiana Farmer*, a resident of Hancock County, Indiana, proposed that the county could supply the gravel, and people living along the road could spread the gravel on the roadway: "They can thus make a road in two or three years and be out no money, saving the [county] expenses" (*7*).

Kimble County, Texas, presents a case study of rural conditions in the early 20th century: "[In] 1917, the trail to Sonora, the only route from Junction to the west, had washed out, becoming, as one chronicler put it, a 'quagmire' so 'hopeless that even a single horse had difficulty getting through.'…Junction's citizens organized a work party along the lines of a barn-raising, with every man bringing his own pick and shovel" (*8*).

Yet in 1918, despite poverty and isolation, with no paved roads, nor "any semblance of a system of roads [connecting] to the outside world," Kimble County had 200 motor vehicles (*8*). The county's opinion leaders "recognized that Junction and Kimble County had reached an important milestone; that it either must go forward or be lost in the shuffle of progress. Their only hope was to give the county some modern roads and to provide access to the markets of the state. They decided to pass a $150,000 bond issue to finance road construction" (*8*). In two years, a network of roads covered the county.

Railroad Efforts

Railroads were an important ally in rural areas' efforts to develop roads. Railroads were interested in expanding the system of roads to link towns to cities and to serve as feeder routes, bringing rural produce to market and returning manufactured products to the farm. Railroads set the pattern followed by the car and road:

> Before the proliferation of railroad lines in 1900, westerners outside urban centers usually made only one or two yearly trips to a general store in

> the nearest town. There they would purchase goods in large quantities, often from a limited selection. But as the railroads introduced a greater variety of goods, shopkeepers established a larger number of specialty stores in towns and cities that served as points of distribution. This development, in addition to increasing ease of transportation, led ranchers to make more frequent trips to town, bringing them into closer contact with…urban life. (*9*)

Southern Pacific in California and other railroads supported the good roads campaign. Encouraged by the California State Automobile Association (formed in 1900) and by other boosters, the California legislature authorized bond issues in 1909 for the construction of a paved state highway system. By the late 1920s, "paved roads and repair shops and filling stations had become so plentiful that the motorist might sally forth for the day without fear of being stuck in a mudhole, or stranded without benefit of gasoline, or crippled by a dead spark plug" (*1*).

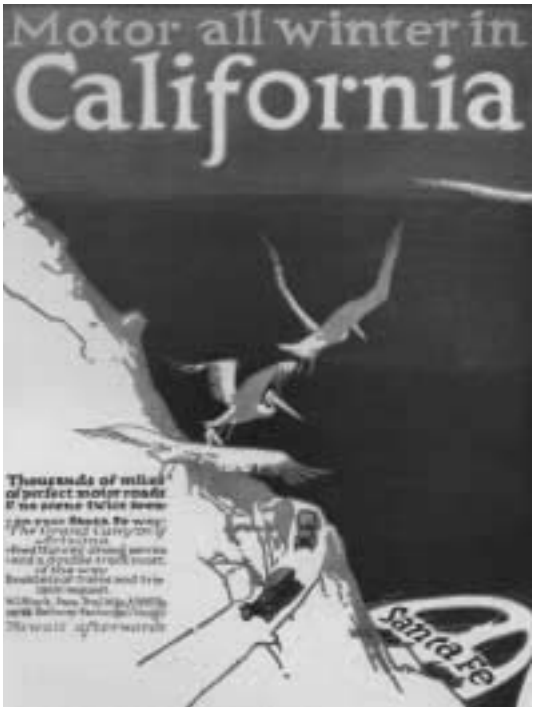
Touring the Country

Car manufacturers produced elaborate advertising brochures on how to go on an automobile vacation, reassuring tourists that everything would be all right. The Paige and Jewett Lines, manufacturers of automobiles, produced a brochure proclaiming that "Beautiful Historical New England—The Cool Lake Country—Sunny California—Every Summer or Winter Playground Is Now Within Your Reach." The company's trip consultant, Brownie, "after driving a Jewett 8,000 miles over all kinds of Wisconsin roads…is qualified to give reliable advice on what you may expect of Jewett performance and Paige-Jewett service."

Vacation trips of 500 hundred miles in two days were no longer dreams but had become reality. Less than 50 years later, 500 miles in one day would be possible on an Interstate.

Road Building Boom

In the early 1900s, long-delayed road and bridge projects that had failed for lack of financing were proposed again under the promise of the new, automobile-centered prosperity. Groups in Boonville, for example, had tried since 1896 to finance the construction of a bridge across the Missouri River, with no success, but "with the advent of automobiles after the turn of the century…a state and national road building movement began, including the formation of the National Old Trails Association, which was promoting a transcontinental highway" (*3*).



Santa Fe Railway ad promoting tourism by train and automobile, from *St. Nicholas* magazine, December 1917.

The proposed route (now U.S. Highway 40) would link St. Louis and Kansas City, crossing the Missouri River at Boonville. Plans were for a private corporation to raise funds and build a toll bridge, but the plans changed when boosters learned that state and federal legislation authorizing road construction barred tolls on roads receiving federal money.

As a result, half the money was raised from county bonds and from stock subscribers in the Old Trails Bridge Company and the other half was federal. The bridge was completed in 1924, with a day-long celebration, featuring a parade, poems, and almost 4,000 cars driving over the bridge (*3*). The local newspaper's "Souvenir Bridge Number" gives a hint of the fervor:

"Brownie," who drove 8,000 miles on Wisconsin roads and provided "Tour Tips" for Paige and Jewett.

Rural motoring graphic from *Motor Travel: A Magazine for Automobile Owners*, February 1926.

> Yes, bridge, we believe in you. You symbolize strength and epitomize progress. You are emblematic of enterprise. Thus far our acme of achievement, you are to continue our greatest urge to action. "Forward," not finished, is our watchword.
>
> On this Independence Day 1924, you, great, free highway Bridge, are dedicated to the service of all the people. For all time you shall stand and proclaim: "Where there is an enduring monument, there is also a builder's dream." (*3*)

But before the end of the 20th century, highway builders detonated the Boonville Bridge and replaced the aged metal structure with a concrete span.

The residents of Boonville were not the only ones who thought their highway project would endure for all time. "Mississippi Completes Her New Highways" was the title of an article in the December–January 1939 issue of *The Highway Traveler*, reporting that "construction work is now in the latter stages on the through highways in a $90,000,000 super-transportation network. In less than four years…Mississippi has replaced dirt and gravel with concrete and asphalt, building for motorists and bus passengers a thoroughly modern set of speedways, arrow-straight and table-smooth" (*10*). But Mississippi and other states were far from completing "super-transportation networks."

Again, convergent factors were leading to the next major phase in rural transportation, a road system suitable for automobiles: the dream of the first transcontinental highway, the railroads' need to supply manufactured products to a more dispersed population, and the urge to travel more miles faster. These factors related not only to the physical advantages of the new technology but also to the urge to disperse to every habitable corner as fast as possible and helped to create the Interstate system.

Farms and Interstates

The links between the farm and the new Interstate system had roots in the early decades of the 20th century:

> Like many another American machine developers, today's road builders got their start down on the farm. Shortly after the turn of the century, a young man named Benjamin Holt began producing the first crawler (endless chain) tractors as a prime mover for farm equipment. In the road-building boom that followed the growth of the auto industry, the crawler tractor moved off the farm and onto the highway. (*11*)

Early machines—including the early cars and farm machinery—were considered unreliable and were sometimes left to rust on the side of the road when broken, but improvements came rapidly. Horse and mule teams became obsolete, despite sabotage: "Rival muleskinners added to the tractor's troubles by loosening its bolts at night, pouring sugar into the gas tanks and sand into the gearboxes. Then Holt and other companies thought of attaching a metal blade to the tractor's nose, and the versatile bulldozer was born (a salesman is supposed to have said: 'That'll bulldoze 'em!')" (*11*).

In the 1950s, farm equipment manufacturers, faced with declining sales, expanded into road build-

Cover of booklet celebrating the dedication of the Boonville-Rocheport-Columbia, Missouri, section of Interstate 70, October 1960.

ing, assuring themselves a long, healthy future—not only were the Interstates under construction, but many of the earlier roads needed extensive repair. The National System of Interstate and Defense Highways brought rural and urban areas closer by easing travel. The system was so effective that today, truly rural areas mostly can be found only far from the Interstates.

Extending Development

Until the late 1990s, the easternmost undeveloped yet developable interchange—clover-leaf and decked interchanges are not developable—was Exit 111 on Interstate 70, just west of the Missouri River. All exits east of the river had some commercial or other development. The east-west Interstate system does not appear truly rural—that is, without development—until west of Kansas City. All Interstates are gaining commercial or other development contiguous to their full length.

When the Interstates were being built, most people were not concerned about development, unless their towns were being bypassed or they lived in the path of construction. The highway's convenience meant inconvenience for some: "A classic case of inconvenience occurred when a new road cut a farmer's privy from his house, forcing him either to build a new one or make an 8-mile trip and pay a toll. He built a new one" (*11*). The story may be amusing, but the experience of neighborhoods and farms divided by Interstates is not.

In October 1960 the Missouri State Highway Commission opened the Boonville-Rocheport-Columbia section of Interstate 70. The 35-mile segment was then the state's longest continuous stretch of Interstate. The Commission published a booklet, "Interstate 70 in Central Missouri: A Link Is Forged in a Chain of Progress," at the dedication, listing various statistics, including the construction cost, $14,601,742, and the right-of-way cost, $1,105,421. The booklet, however, included no poems and no claims of the road being for "all time."

Drawing Sprawl

The newly opened Interstates were so empty that older automobile drivers in central Missouri reminisce about driving 100 mph down the middle of the two lanes, past the small towns that had depended on the old highways and on the trade patterns that had formed. Towns now worried about losing the tourist business, not the farm business.

By the 1950s the Jeffersonian ideal was only a glimmer. For towns on the Old Trail Highways, the dollars spent by people driving through were most important. When Boonville citizens protested in 1955 that the new National Defense Highway would pass 4 miles to the south, "the Highway Commission contended that abandoning [the] original plan in favor of [Boonville's], which would bring the bypass about three miles closer to the town, would cost the state…$300,000, and [was] not convinced that… would alleviate the trade problem" (*3*).

The highway was built as planned, businesses closed, and the town sprawled out toward the Interstate. Rural residents once had built roads to bring themselves and their goods to town, but now people were building towns to reach the roads.

Costs of Progress

Rural road development has followed a general progression from no road to barn-raising road, county road, booster road, state highway, and the climax—the federal Interstate. In retrospect, the progression seems inevitable.

To many, the sequence represents progress, upward mobility, prosperity, and a better life with less drudgery and more leisure. Farmers knew that the latest technologies, mechanization, the automobile, and better roads could lead to a better life.

Now, however, the benefits seem less certain. The costs of a rural society built around the car are known: the isolation of the elderly, youth, and low-income citizens who have limited or no access to the automobile; and a land use pattern that demands the use of one mode of travel above all others. These costs were unimagined 100 years ago, when the focus was on the hope and the glory of progress.

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The Changing Demographics of Rural America

What Are the Implications for Transportation Providers?

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Rural areas have undergone substantial change in the past three decades. Some have grown into major agricultural centers, some have turned into suburban "bedroom" communities, and others have been transformed, sometimes unwillingly, from residential enclaves into major employment centers. Still others have become an integral part of a tightly knit metropolitan economic system. With all these changes have come significant alterations in travel patterns and resources.

These changes pose substantial problems for transit operators organizing services. The Transit Cooperative Research Program (TCRP) originated Project B-22, New Paradigms for Rural and Small Urban Transit Service Delivery,* to identify the societal trends challenging rural communities and transportation providers. The study reviewed the literature on five major categories of trends: demographic, economic, social, technology, and land use.

Demographic Trends

The changes that have occurred in rural areas in the past 50 years have surprised and confounded analysts. The single largest demographic factor was the reversal in the 1990s of decades of rural population losses (Figure 1). Both older and younger people were drawn to rural areas by amenities and the promise of a rural life style. As a result, rural counties away from big cities grew faster than those adjacent to large metropolitan areas. At the same time, rural counties adjacent to metropolitan areas also grew, pushed by "sprawl" and workers' desire to find cheaper housing.

These patterns have increased the diversity of the population in many rural areas, for example, with nontraditional residents, such as immigrants, as well as with highly educated citizens. The migration of older retirees has created two distinct groups of older residents in rural areas—those who are aging in place and those who have moved after retirement. Many rural areas are the home of a growing number of poor or near-poor—those aging in place, racial minorities (particularly Native Americans and African Americans), female-headed families and households, and those without access to employment opportunities because of a lack of education, skills, or mobility.

Population Changes

The population in rural areas grew steadily and substantially in the 1990s, in contrast to the migration pattern of the previous four decades (*1*). Although growth was not uniform, most rural counties experienced substantial growth between 1990 and 1997 (Figure 1). In the fastest-growing region of the country, the West, rural growth rates outstripped metropolitan growth rates. Every category of rural county had more population growth in the 1990s than in the 1980s.

Migration accounted for 61 percent of rural population growth from 1990 to 1996. Even in the few counties with a higher rate of deaths than births—mostly retirement communities—migration often offset the death losses (2). Migration into rural areas was highest among people ages 26 to 30, and the rate for 1- to 17-year-olds was second highest, indicating that young families with children are seeking the same rural amenities attractive to retirees.

Nonetheless, the rural elderly population in 21 of 26 U.S. regions grew more from aging-in-place between 1980 and 1990 than from migration. As a

* www4.trb.org/trbn/crp.sf/All+Projects/TCRP+B-22

result, in some rural communities—particularly those dependent on mining and farming—older people constitute a substantial portion of the population. Older people are concentrated in rural areas—in 1990, 31 percent of all Americans over 60 years old lived in rural areas, and the rate of growth of the older population was more than twice as fast as that for total rural population growth.

Although rural areas are predominantly white, minority populations in rural areas are growing at almost seven times the growth rate of whites. Minority populations in rural areas tend to be concentrated geographically. For example, almost 75 percent of rural African Americans live in the South Atlantic and East South Central regions, and nearly 75 percent of Hispanics live in the West South Central and Mountain regions.

Hispanic counties grew by almost 17 percent between 1990 and 1997—double the national rural growth rate. Hispanic migrants to nonmetropolitan areas are developing "other modes of nonmetro settlement, thus increasing the number of communities where they comprise a significant portion of the population" (*3*). Although the number of Hispanics settling in rural areas is not yet high, many seem likely to settle permanently and go on to other occupations.

Causes of Change

Until the 1970s, urban proximity primarily determined rural population growth. In the past few decades, however, several noneconomic variables have exerted influence.

In the past 20 years, amenities—such as pleasant scenery, a slow pace of living, temperate year-round climate, warm and sunny winters, low humidity, and proximity to lakes or the ocean—have attracted both younger and older people to rural areas. Figure 2 shows the size and location of growing rural counties that were not adjacent to larger metropolitan areas. Rural retirement has been an incredibly important force in some counties, generally the high-amenity areas in the South and West. The retirees who migrate to these communities are usually healthier, younger, wealthier, and more likely to be married than the typical retiree.

Rural counties with amenities are also likely to see population growth among young, educated people. Technology, including the automobile, has provided many families with the choice of living far from population centers. Some younger people migrate in search of cheaper housing; this may explain the weak link between population growth and employment growth in high-amenity counties.

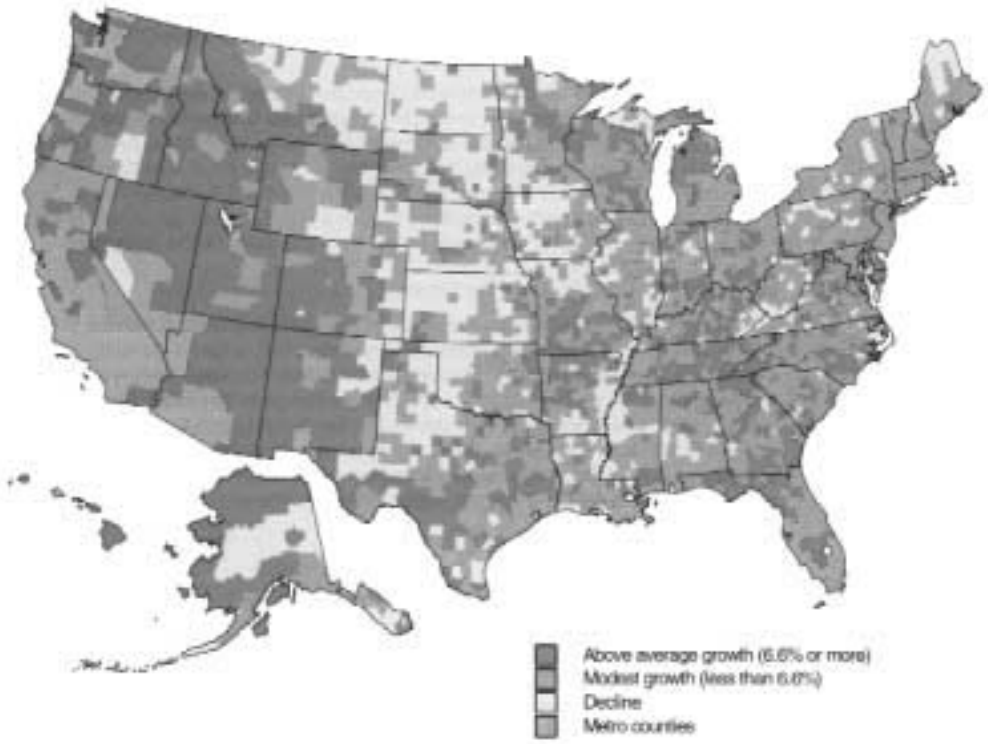

FIGURE 1 Nonmetro population change, 1990–1997.
Source: Rural Development Perspectives, Vol. 9, No. 2, p. 22.

FIGURE 2 Growing rural counties not adjacent to larger metropolitan areas, 1990.
Source: *Rural Development Perspectives*, Vol. 12, No. 2, p. 34.

The long commute is "an integral part" of rural life (*4*). Some rural areas have attracted lower-income migrants with apartments converted from abandoned stores, so that "some small villages have become *de facto* low-income housing sites" (*4*).

Economic Trends

Rural economies have been turning away from agriculture, forestry, and mining for decades. By 1980, three times as many rural workers were employed in manufacturing as in agriculture. Rural areas have been building local manufacturing bases while supporting service industries, such as tourism and retirement services.

A decreased demand for agricultural goods, an increase in productivity, and an abundance of farm labor have led to changes in rural economic trends.

Many rural areas are seeking retirement migration to expand and diversify their economies. Some areas, including many Indian nations, have relied on local amenities or gaming opportunities to create jobs in food services and the hospitality industry.

Some rural areas are focusing on more profitable aspects of the service industry as their economies shift, for example, to "back office" functions such as telemarketing or phone sales. Others have seen migrants of all ages start or bring small service businesses into the community, such as website construction and software development. Other areas are courting prisons.

Diversifying Economies

In the past 20 years, the demand for many agricultural goods and natural resources has declined even as productivity has increased:

> Improvements in technology, crop science, and farm management have all boosted output while reducing the need for labor. Productivity growth has, in turn, led to farm consolidation, declining farm numbers, decreases in farming employment, and consequently a surplus of farm labor. (*5*, p. 18)

There has been a gradual shift from land-based businesses to manufacturing.

As a result, rural economies have been moving from land-based industries to manufacturing and service industries. Manufacturing has been a key element in the economic structure of many rural areas since World War II. Recent U.S. Department of Agriculture studies suggest that rural areas can and do attract newer, high-tech firms despite the challenge of finding workers with the necessary skills.

Sources of Growth

Although manufacturing employs nearly 17 percent of the nonmetro workforce, the service sector employs more than half of all nonmetro workers. Nonmetro services related to recreation, retirement, and natural amenities—as well as to financial, insurance, real estate, and retail businesses—have emerged as important new sources of nonmetro employment.

The adoption of technology will play a role in the growth of the rural service sector; service firms may not need to be near major waterways or railroads but can connect via the information superhighway. Corporations are locating operations such as telemarketing, data processing, financial transactions, customer support services, and others into rural areas where energy costs are low, skilled office labor is available, wage expectations are lower, rent is lower, and a nonunion political climate is common (*6*).

Retirees are another source of rural economic growth. Some of the poorest southern states, like Alabama, South Carolina, and Arkansas, have developed aggressive economic development plans targeting older people. This may not be a sustainable economic development strategy, however, since retirees create service-sector jobs, which tend to be low-wage and low-skill (*7*). Several studies suggest that it would be more cost-effective to attract industry—even low-paying manufacturing.

Casinos and riverboat gambling have grown dramatically in rural areas, taking advantage of the availability of low-cost labor, natural resources, and access to cities. Strikingly, the opening and closing of these enterprises may create "major changes in county employment without commensurate changes in population," as "workers may commute rather than move to the counties where jobs are" (*8*).

Only recently has prison construction begun to create measurable increases in rural employment. From 1980 to 1991, 56 percent of new prison facilities were built in rural areas, in contrast to only 38 percent before 1980 (*9*).

Other Trends

Family Roles and Structures

Family roles and structures are rapidly changing in rural areas. Rural women now delay marriage longer, do not remain married, have fewer children, and are more likely to have children when unmarried than in the past. In some areas, births to unmarried teenagers account for a greater percentage of all births in rural than in urban areas. Aging also has brought profound changes—rural older people are more likely to be women and to live alone than their urban counterparts.

Changing demographics in rural areas include an increase in women joining the work force, delaying marriage, and having fewer children, and more single-parent families.

Women have accounted for almost all the growth in the rural labor force in the 1980s, and even women with small children are as likely as comparable men to be in the paid labor force. Nonetheless, poverty persists in rural areas, because most of the women work in low-paying occupations.

Both single-parent and married-couple families are more likely to be poor or near-poor in rural than in urban areas. Many rural families lift themselves out of poverty with multiple workers and multiple jobs.

The elderly (age 65 and older) are a significant percentage of the rural poor. Rural elderly have lower incomes than the elderly in metro areas. Rural elderly are more likely to own their own homes, but the homes are worth less and tend to have more physical problems than those in urban areas.

Technology Revolution

The potential of the technology revolution for rural areas is great. But rural areas that lag in adopting new technology and infrastructure will be at a disadvantage in attracting or keeping new business (*10*, p. 1-1).

Competition and deregulation in the communications industry could help narrow the urban-rural gap. Some analysts believe that if satellite and cellular technology continues to drop in price and extend rural coverage, that gap may decrease, assisted also by new arrangements, such as cable television with Internet access.

Technological innovation also promises benefits to rural transportation—some systems have already adopted cutting-edge technology, such as automatic vehicle location, digital communication, computer-aided dispatch and scheduling software, electronic fare cards, cellular communications, and Internet connections. But it is not clear that many or most rural transit systems will benefit from technological improvements, because users rarely have the time, energy, or resources to purchase and correctly use appropriate technology. The adoption of new transit technologies in rural areas likely will be slow and uneven, driven more by the type of assistance and training provided by the states and federal government than by potential efficiency gains or cost savings.

Advances in innovative technology, like the Global Positioning System, may help transit providers provide more and better services, promoting business expansion and providing economic benefits to rural areas.

Land Use Links

Most of these societal trends are linked to changes in land use patterns. The outward expansion of homes and industries into rural areas is likely to continue, bringing a wider variety of jobs, services, and facilities closer to rural residents. These land use and economic patterns may create spatial concentrations of manufacturing and other jobs in rural areas that could be served by rural transit services (*11*, p. 1040).

Land use patterns are also influenced by residential choice. This movement of housing as well as jobs into or near rural or small urban areas has been termed "rural sprawl" (*12*).

Some land use changes have created disadvantages—for example, small rural communities becoming polycentric, losing the central business district to strip malls and shops with parking (*13*). When new services develop in areas outside the central business district and away from the community's principal activity areas, walking to the services becomes difficult. Rural residents therefore often face greater travel distances and low densities, raising the demand for automobile travel and making it difficult for transit operators to provide cost-effective, competitive services. This in turn widens the mobility gap for residents without easy access to an automobile. (*14*)

Transportation Implications

These demographic trends in rural America profoundly affect the following:

- The organization, location, and concentration of commercial and industrial activities in rural and adjacent metropolitan areas;
- The movement of people in and between rural, small urban, and metropolitan areas;
- The parameters of rural and urban labor areas;
- The ways in which rural and urban households and businesses conduct activities and interact;
- The ability of rural and small urban households and businesses to substitute other activities for travel; and

◆ The capacity of public and private systems to respond effectively and efficiently to changing rural and small urban travel needs and patterns.

These trends have created a complex set of rural mobility needs. The influx of both younger and older people—with different needs, abilities, and resources—plays out in changing travel patterns. Older people, ethnic minorities, poor families, and the increasing participation of women in the labor force have increased the need for mobility, even as the number of family and community resources to meet those needs may be declining.

There is a greater variety of home-to-work commutes, some centered in rural areas and others destined for metro regions. Many rural residents commute long distances, some to suburban and central city jobs, others to rural jobs in different counties. At the same time, growing rural manufacturing and large-scale tourism and casinos have created employment concentrations that not only provide a work-trip focus within rural areas but also draw workers from adjacent rural and metro areas.

The larger shift to a service economy also creates greater variability in the timing and scheduling of work and other trips in rural areas. Only a minority of service-sector workers commute during traditional morning and afternoon peaks; many work different hours on different days. Moreover, working multiple jobs, which has helped some rural families rise above the poverty level, creates more complex and complicated travel patterns.

Strategic Plans

The goal of the research under TCRP Project B-22 was to suggest how rural transit operators could respond to the major societal changes that affect the provision of traditional transit services in rural areas. At the same time, some trends offer the opportunity for operators to view themselves in new ways, to meet current and changing needs more effectively, without sacrificing traditional concerns for serving disadvantaged rural residents.

The TCRP project concluded that rural operators must think differently about how, when, why, and where they provide services. Transit operators should begin critical strategic planning to move away from providing direct services to contracting with others to provide services, and from buying equipment and vehicles to leasing. The research also suggested that rural operators who adopt new service paradigms are more likely to apply innovative ideas and to generate innovative strategies to meet the changing needs of their communities.

Acknowledgments

The data presented in this article were compiled from a vast literature; for full details and citations, please refer to TCRP Project B-22 (*15*). The ideas, opinions, and recommendations expressed in this article are strictly the author's.

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Website

Economic Research Service, U.S. Department of Agriculture
http://www.ers.usda.gov/Briefing

Intelligent Transportation Systems for Rural Transit

Not Just for Urban Systems Anymore

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The deployment and use of technology in rural transit is on the increase. Many intelligent transportation systems (ITS) technologies developed for urban transit are applicable to rural transit, with several caveats.

First, the different operating characteristics of rural public transit must be taken into consideration. For example, vehicles may be housed far from the agency's operations or dispatch center. Moreover, the unique nature of the rural agency's customers may require, for example, specially-equipped vehicles for travelers with disabilities. The technologies used for urban transit therefore must add features to accommodate rural agency needs.

Second, the staff of rural transit agencies often have multiple responsibilities, making it difficult to learn about new technology and to assume sole responsibility for successful deployment. Agencies also may not be ready to embrace new technology.

Third, limited funding does not always allow the procurement of expensive ITS technology. Although the costs for many ITS technologies are decreasing, not all are affordable for a rural transit agency. Rural transit agencies, therefore, may have to look for lower-cost solutions after identifying the need for a technology.

To meet these challenges, the Federal Transit Administration (FTA), the ITS Joint Program Office (JPO) of the U.S. Department of Transportation (DOT), the Transportation Research Board (TRB), and several states have sponsored a series of projects to guide rural transit agencies in considering the most appropriate and affordable technologies.

The Capital Area Rural Transportation System (CARTS), Austin, Texas, uses Lower Colorado River Authority's trunked radio system to facilitate demand-responsive transportation.

PHOTO: MULTISYSTEMS

Deployment Challenges

Why does rural transit pose significant technological challenges? Clues are found in such factors as the service area, service coordination, communications infrastructure, fleet size, and level of service.

Service Area

Rural transit agencies often serve large areas, with long distances between stops, or between pick-ups and drop-offs in demand-responsive service. As a result, attending immediately to a problem that arises on the road is difficult. Urban areas have shorter travel distances, so that assisting a vehicle or passenger in need is easier.

Because trip lengths are longer in rural than in urban areas, rescheduling trips when an incident occurs may not be possible. In demand-responsive service, for example, if a transit vehicle takes a customer two hours to a medical appointment, the vehicle may have to wait until the customer finishes, instead of leaving to provide other trips. Time and distance factors make "real time" scheduling difficult.

Service Coordination

Health and human services agencies often provide transportation for clients. Most of these services have a small number of vehicles that are not frequently used—for example, a van may be in service only two hours a day to transport elderly clients to and from a senior center. The challenge of coordinating services and resources among the transit agency and other providers is longstanding. ITS can facilitate coordination.

Communications Infrastructure

Rural areas often lack communications infrastructure. Communications issues specific to transit in rural areas include coverage areas for transit radio systems and the lack of wireless communications services.

Fleet Size

Although ITS technologies may solve several problems associated with operating rural transit services, rural transit agencies cannot fund the solutions alone. There are no economies of scale, for example, when an agency only needs to purchase 10 pieces of equipment, such as mobile data terminals. Some rural agencies have formed groups to procure equipment and services cooperatively in numbers that achieve some economies of scale.

Level of Service

Rural transit agencies do not have the resources to provide the level of service typical of urban agencies. Rural services may be infrequent and may not always address the transportation needs of residents and travelers. Services must resolve the following issues:

- The temporal mismatch between when the customer wants or needs transit service and when the transit agency can provide service;
- The spatial mismatch between where the customer wants or needs to go and where the transit agency provides service;
- The demands of customer convenience in terms of transit access, payment methods, and trip chaining (traveling to multiple destinations in one trip); and
- The application of technologies that could provide better customer information, facilitate payment and reservations, and increase service reliability.

Lessons from Successes

Three projects have helped to resolve these issues with practical advice derived from successful ITS deployment in rural transit. ITS JPO and FTA sponsored two projects to examine best practices in rural transit ITS, one focusing on planning guidance and the other on in-depth technical guidance. The Transit Cooperative Research Program (TCRP) sponsored a third guidance document.

PHOTO: MULTISYSTEMS

Mobile data terminal deployed by St. Johns, Marion, and Putnam Counties in Florida.

PHOTO: MULTISYSTEMS

Centralized call intake and scheduling unit at CARTS.

The first project, conducted by Multisystems (under contract to Science Applications International Corporation) with assistance from KFH Group, was a comprehensive study that selected five of the most successful applications of ITS in rural transit, conducted in-depth assessments of the applications, and synthesized the results into practical considerations (*1*).

Briefly, the five case studies highlighted the following:

- The Capital Area Rural Transportation System (CARTS) in Austin, Texas, which partnered with the Lower Colorado River Authority to integrate a state-of-the-art radio system with automated demand-responsive transportation scheduling software;[1]
- St. Johns County, Marion County, and Putnam County, Florida, which applied automated scheduling, automatic vehicle location (AVL), mobile data terminals, and geographic information systems to provide transit services more efficiently and effectively;[2]
- The Public Transportation Programs Bureau, a division of the New Mexico State Highway and Transportation Department, which developed the Client Referral, Ridership, and Financial Tracking (CRRAFT) system;[3]
- Ottumwa Transit Authority in Ottumwa, Iowa, which developed a unique application for pretrip vehicle inspection, along with communications and AVL; and

[1] http://www.ridecarts.com and http://www.lcra.org/community/telecom.html

[2] http://www11.myflorida.com/ctd/a%20web%20page%20layout/3%20program%20information/g%200%20ITS project.htm

[3] http://www.unm.edu/%7Eatr/crraft1-8-03.pdf

◆ River Valley Transit in Williamsport, Pennsylvania, which devised an AVL and communications solution to help customers find the right vehicle in the new Transit Centre and to direct drivers to the correct bay in the facility.

The final report thoroughly documents each of these initiatives, with detailed information in the following categories:

◆ Project or system background and history;
◆ Project goals and objectives;
◆ Description of the application and technology;
◆ Design, operations, and performance;
◆ Project costs and revenue sources;
◆ Considerations and best practices; and
◆ Future plans.

The report also provides practical advice in project planning, procurement, technology application, installation and implementation, and operations, and defines the benefits that have been realized. Perhaps the most important benefits for rural agencies from ITS are the increases in

◆ Collaboration among agencies;
◆ Transit visibility in the community and increased customer confidence;
◆ Vehicle productivity and operational efficiency;
◆ Safety and security for passengers and drivers; and
◆ Accessibility of services for persons with disabilities.

The project results will ensure that rural transit agencies have the detailed information necessary to pursue technology deployment.

PHOTO: MULTISYSTEMS

Use of dispatcher screen has improved communications and vehicle location at Ottumwa Transit Authority, Iowa.

The second project has been providing critical information to rural agencies since the publication of the final report (2). Authored by staff at Harvard Design and Mapping, the report identifies rural transit agencies that have applied best practices in implementing technology. The report also traces out a process to plan and implement technology in rural transit, illustrating best practices with the example of a transit agency embarking on a technology needs assessment and the subsequent implementation.

The third project produced *TCRP Report 76: Guidebook for Selecting Appropriate Technology Systems for Small Urban and Rural Public Transportation Operators* (3). The report

> provides guidance to public transportation managers and other professionals in the selection of technology that is appropriate for the needs, size, and type of their operations. The guidebook can be useful in the procurement of technologies, such as off-the-shelf computer software, as well as systems, such as automatic vehicle location (AVL) systems. The principal guidance tool is a taxonomy—a series of tables that provide important "technology screening" information to transit professionals based on the characteristics of their transit systems that are most important in determining technology efficacy. (3)

Beyond Examples

These projects have provided necessary guidance for rural and small urban transit agencies, but other ongoing institutional and technical challenges also are being addressed in the field.

Institutional Initiatives

Multiple-Agency Purchasing

Financing the purchase, deployment, and operation of ITS in a rural transit agency is a challenge, but not always because of a lack of federal funding for capital equipment. Often a rural transit agency purchases equipment in small quantities, which leads to higher prices and sometimes to a smaller number of interested vendors. Coordination of service and procurement, an institutional issue, is key to addressing the problem.

In a project recently conducted for Iowa DOT by TranSystems, Multisystems, and Intelligent Wireless Systems, to develop a statewide transit ITS deployment plan for rural and small urban transit systems, the cost–benefit analysis pointed to purchasing several of these needed technologies for several agencies at once, instead of individually.

Various approaches were explored to support multiple-agency procurement, including Iowa DOT acting as the procuring agency.[4] Coordination with other service providers and transportation agencies, however, also involves a related subject—service.

Although the issue has been discussed vigorously for the past 25 years, coordinating service among rural transit agencies and health and human services agencies is a challenge. For example, many agencies are not highly computerized, and if any one compiles schedules manually, coordinating service becomes difficult. Technology must facilitate service integration and coordination.

Coordination among agencies to purchase the same ITS equipment and software can reduce the per-unit cost of ITS items and can ensure the sharing of information and coordination of services much more easily than if all have different equipment and software. For example, the Greater Attleboro–Taunton Regional Transportation Authority and Cape Cod Regional Transportation Authority, both in Massachusetts, collaborated to purchase equipment; and in the Arrowhead region of northern Minnesota, two rural transit agencies, the state highway patrol, and the local district of the state department of transportation made joint equipment and software purchases.[5]

The marketplace for ITS technologies for rural transit agencies is complex. Most of the larger vendors have experience providing equipment, software, and services to urban transit systems, and some of the smaller vendors do not have experience with transit or with all the types of transit services offered by a rural transit agency. With more and more vendors entering the marketplace, rural transit agencies must consider this issue when procuring ITS technologies.

Joining the Architecture

FTA's recently issued National ITS Architecture Policy on Transit Projects compels all transit agencies to be involved in Regional ITS Architecture activities. Rural agencies, however, either are not aware of the activities, or the organizers and stakeholders are not aware of the rural agencies and of the importance of agency involvement.

Because they are relatively small in terms of personnel and number of vehicles, most rural transit agencies have not kept up with ITS activities that traditionally have involved highway departments or state DOTs. Organizations such as the Community Transportation Association of America are providing more ways for agencies to keep informed about ITS activities, as well as to educate organizers and stakeholders in ITS architecture activities about rural transit's presence and importance.

Stretching Personnel

Rural transit agencies often do not have personnel with the technical expertise to procure and deploy ITS technologies, and often personnel who have the technical expertise do not have the time for the project. As a result, an ITS procurement or deployment takes longer to accomplish or may not be considered at all.

This issue can be addressed by hiring consultants or seeking peer technical assistance. For example, the ITS Peer-to-Peer Program offers free technical assistance to agencies that are considering, procuring, or deploying ITS technologies.

Technical Concerns

Data Management

Data collection and management may be routine in larger transit agencies but often are not in smaller rural agencies. The labor and computer resources necessary to collect and manage data are limited, and ITS technologies can generate large quantities of data.

Larger transit agencies are moving toward data warehouse concepts for data collection and management, which require considerable resources. The National Transit Institute's Data Management course, which is being piloted in early 2003, is addressing this issue for smaller agencies.[6]

Automation

The automation of some transit agency functions may improve operations and customer service, but automating other customer-service related functions may confuse and alienate customers. For example, an automated reservations system that requires use of a touch-tone keypad to enter information may be difficult for an elderly person or someone with disabilities. Other technologies, however, such as interactive voice response (IVR), can facilitate the use of automation by people who would not ordinarily embrace technology.

Yet customers may not have access to some automated systems in rural areas. For example, some rural residents do not have telephones, making it impossible to access a reservations system or to receive an automated call-back from the agency's reservations and scheduling system to confirm a trip. The transit agency could provide a device, such as a pager, to receive call-backs, but the device may be cost-prohibitive.

[4] http://www.iatransit.com/links/its/final_report.pdf

[5] http://www.dot.state.mn.us/guidestar/projects/artic.html

[6] http://www.ntionline.com/CourseInfo.asp?CourseNumber=ITS11

Photo: Multisystems

Dynamic message sign in River Valley Transit Centre, Williamsport, Pennsylvania, includes site map (*left*), bus bay numbers (*center*), and bus status information (*right*).

Another technical issue also involves automation—customer addresses, such as Rural Free Delivery or Indian reservation residences, may not appear on commercially available maps. Vehicle operators need to be able to find these customers. Navigation devices that provide driving directions are a solution only if the address is in the database. Collecting address information may require coordination with public safety organizations, such as emergency management services (911).

Transmitting Data

The communications infrastructure in rural areas is an issue for transit, because many ITS technologies that could be useful rely on communications. For example, deployment of an AVL system requires infrastructure to transmit vehicle location data from the vehicle to the dispatch center.

If the infrastructure is not sound and has gaps in coverage, the vehicle location data or emergency alarm message may not be sent or received by dispatch. This is not only a transit issue. Several rural regions can collaborate to solve the problem by procuring and using a single, integrated communications system that can accommodate several transportation agencies at once.

Signals Ahead

Projects sponsored by FTA, ITS JPO, TRB, and several states have documented the best practices in deploying rural transit ITS and are providing much-needed guidance to many rural transit agencies considering technology to improve operations and customer service. One new project that will provide an ongoing dialogue is the "Rural ITS Transit Success Electronic Story Booklet," an Internet forum for reporting and sharing experiences in the deployment of rural transit ITS.

Another important project is a federal operational test to demonstrate and evaluate innovative approaches to integrating transit ITS technologies and available information technology systems. The test will help to improve coordination of subsidized transportation services in rural areas among multiple transit operators.

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www.nawgits.com

Surveying the Issues

Conference on Rural Bus Transportation a Continuing Success

RANDY ISAACS

Comments from the more than 320 attendees at the 15th National Rural Public and Intercity Bus Conference, October 28–30, 2002, in Huron, Ohio, included praise for the program's "cutting-edge information" from "excellent speakers." Sponsored by the Transportation Research Board (TRB), the Federal Transit Administration (FTA), and the Ohio Department of Transportation, the research conference for rural and intercity bus transportation featured formal papers, presentations, workshops, roundtables, and general sessions—as well as high levels of energy and enthusiasm from presenters and attendees.

The conference series began in 1975, meeting annually at first, and now is scheduled every other year. TRB's Rural Public and Intercity Bus Transportation Committee plans and conducts the conferences in a variety of locations around the country to maximize the involvement of local operators.

The Ohio conference offered six "routes," each with a variety of practical topics:

- *Small System Management* led to workshops on excellence, vehicle maintenance for small systems, performance measurement for transit system design, safety management resources, facility construction, and cost allocation models.
- *Intercity Bus* covered statewide service planning, compliance with the Americans with Disabilities Act, intermodal service cooperation and facilities in rural areas, publicly funded capital procurement, and motorcoach safety and security.
- *Rural Transit Policy Making* considered transit policy through action, management reviews that are more than compliance tests, lessons from the FTA Administrator Award Winners, a discussion with FTA's chief counsel on upcoming changes in rural transportation policy, new rural and intercity bus products from the Transit Cooperative Research Program, and the design and implementation of state policy.
- *Quality Service* included sessions on developing security and emergency preparedness plans, employee development through training, strategies and tools for a better management team, building community support for rural transit systems, and rural transportation research.
- The *Changing Face of Rural America* presented the role of volunteers and faith-based organizations in rural transportation services, changing demographics, and the impact of the 2000 census on rural public transit.
- *Bus in the Sky* featured such topics as managing the technology process, statewide initiatives, local applications of intelligent transportation systems, new technologies in intermodal and freight transportation, and the effects of the 511 traveler information service.

In addition, roundtable sessions covered the FTA programs, state transit and bus associations, drugs and alcohol, the Rural Transit Assistance Program, and new technologies. General sessions presented the changing paradigms in local public transportation systems, intermodalism in America, and reauthorization of the Transportation Equity Act for the 21st Century, among other topics.

Plans for the 16th national conference are under way, tentatively for October 2004 in Roanoke, Virginia. For future updates, check the calendar listings on the TRB website, www4.trb.org/trb/calendar.nsf.

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RURAL PASSENGER TRANSPORTATION

Intercity Bus Links

Moving into New Territory

FREDERIC D. FRAVEL

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Intercity bus transportation is integral to the nation's surface transportation network and is particularly important to smaller communities and rural areas. Intercity buses link smaller communities within a region and also link those communities to larger urban areas that offer services and opportunities otherwise not available. Intercity bus transportation also plays a critical role for smaller communities without air or passenger rail travel options—for many rural residents, intercity bus is a more affordable option than air or rail.

The 1991 introduction of federal funding for intercity bus service in rural areas marked a change in policy and made intercity bus service one element in a wider approach to maintaining and improving rural public transit. Acknowledging the role of intercity buses in rural areas and realizing the industry's financial problems after deregulation, Congress included federal funding for rural intercity bus service in the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) and continued the funding in 1998 with the Transportation Equity Act for the 21st Century (TEA-21).

Some states have used the federal funds to support and improve intercity bus services; others have determined that intercity bus service needs are being met without the federal subsidy. Many states have struggled to find effective ways to support and improve rural intercity bus transportation. Little information has been available about the range of intercity bus projects that states have undertaken and supported.

The Transit Cooperative Research Program (TCRP) therefore commissioned research to identify strategies for initiating, preserving, and enhancing effective rural intercity bus transportation. TCRP Report 79, *Effective Approaches to Meeting Rural Intercity Bus Transportation Needs*,[1] presents the results and serves as a resource for state program managers and other transportation planners and policy makers involved in supporting and improving intercity services in rural areas.

Intercity Bus Industry

Despite a turbulent adjustment to the deregulated environment created by the Bus Regulatory Reform Act (BRRA) in 1982, the regular-route bus industry is thriving, and ridership is growing. The market for scheduled bus service continues to be stable and sizable.

Unlike Amtrak and local transit, intercity bus services are without a general program of public subsidy.[2] Services rely on passenger fare revenue to cover operating and capital costs and to generate an adequate return on investment to attract capital for growth.

Size

The carriers involved in the intercity regular-route industry operate between 5,000 and 8,000 over-the-road buses (OTRBs).[3] Of these carriers, 12 are classified by the U.S. Department of Transportation (DOT) as Class I, averaging $5.3 million in annual revenues over a three-year period.

Class I carriers served approximately 30.3 million regular-route intercity passengers in 2001, not including charter, special, or commuter passengers (*1*). In comparison, Amtrak carried approximately 23.5 million intercity passengers in FY 2001 (2). The regular-route service ridership of Greyhound Lines increased from 15.9 million boardings in 1994 to 25.4 million in 2000.

[1] http://gulliver.trb.org/publications/tcrp/tcrp_rpt_79.pdf

[2] Specialized programs provide some assistance for the intercity bus industry, including exemption from a portion of the federal motor fuel tax, Section 5311(f) assistance for rural services, the Rural Accessibility Program to help with the capital and training costs of meeting Americans with Disabilities Act requirements, and grants for bus security from the Transportation Security Administration.

[3] The low estimate of 5,000 coaches is from TCRP Project J-06(33), The Cost of Meeting Accessibility Requirements for Over-the-Road Buses (KFH Group, April 2000, pp. 3-8 and 3-12) and is based on survey and published analysis of fleet data. The high estimate of 8,000 coaches is from the American Bus Association (ABA), Motorcoach 2000 Census (R. Banks & Associates, Inc., July 2000, p. 11) and is based on an extrapolation from a survey of ABA member firms.

Vermont Transit, a Greyhound subsidiary, serves Manchester (New Hampshire) Airport, as well as Logan Airport and Amtrak's South Station in Boston, Massachusetts.

Bus package express is another benefit of intercity bus service that is important to rural areas. Estimated bus package express revenue, however, has declined from a high of $259 million in 1981 to $124 million in 1999 (3).

Structure

The *Official National Motorcoach Guide*[4]—commonly known as "Russell's Guide"—publishes the schedules of approximately 100 bus operators in the regular-route intercity industry. In addition, other private bus firms offer scheduled service.

The major intercity bus operators include not only Greyhound Lines and its affiliates, but independent firms associated with the Trailways National Bus System and others, including a substantial number operated by Coach USA. Through the National Bus Traffic Association's interline arrangements, and with Russell's Guide as the common schedule book, these intercity carriers constitute a nationwide network.

Intercity Bus Travel

Passenger Characteristics

The intercity bus network fills a unique niche. Providing the only scheduled intercity service to many rural communities, intercity buses also offer low fares and travel options for persons without an available personal vehicle.

[4] Published monthly by Russell's Guides, Inc., the guide shows timetables for all regular-route bus carriers that submit information and pay the required fee. Analogous to the *Official Airline Guide* or Amtrak National Timetable, the guide is indexed by place name, so that users can find timetables of service by looking up a particular city or location.

Intercity bus passengers tend to be more transit-dependent than passengers of other intercity modes. Data from the Bureau of Transportation Statistics' American Travel Survey of 1995 show that regular-route intercity bus riders are

- More likely to be under 24 years old or over 60 years old than travelers on other modes,
- More likely to have lower household incomes than those using other intercity modes, and
- Less likely to have a vehicle—about 30 percent have no vehicle.

Most intercity bus trips are made for the purpose of visiting friends and relatives, or for other social or recreational purposes.

Service Coverage

Despite the abandonment of routes and the cutbacks in other services during the decade following deregulation, intercity bus service is still much more widely available than other common carrier modes. Data on the number of points served by intercity bus vary:

- According to the American Bus Association, the total regular-route bus industry serves about 4,274 points, including flagstops (*4*).
- A count of the number of points listed in Russell's Guide produces an estimate of 5,500 points with intercity bus service.
- Greyhound, the largest national carrier, serves about 2,600 locations or 1,800 sales points (*5*).

All of these estimates compare favorably with 655 certified airports for scheduled operations of aircraft seating more than 30 passengers, according to 1999 data (*6*), and with 515 Amtrak stations (*2*). Although intercity bus service reaches at least 4,274 points, the network had served 15,000 points before deregulation through the BRRA (*7*, p. 3).

Rural Role

In 1989, Greyhound Lines performed an internal study to evaluate the Rural Connection Program by quantifying the traffic originating in or destined to rural areas. The study found that approximately one-third of Greyhound regular-route riders had at least one trip that ended in a rural area. At that time, 62 percent of Greyhound agencies were in urban areas. No similar analysis has been performed since, but the same general pattern likely holds.

A study performed for U.S. DOT assessed access to intercity transportation—air, rail passenger, and bus—using national population data and a geographic information system (*8*). The study found that intercity bus services provided the greatest extent of coverage, serving 73 percent of the 3,551 qualifying census places with populations between 2,500 and 50,000 and with some type of intercity service; in comparison, air travel provided coverage for 69 percent, and rail passenger services for 36 percent.

These findings suggest not only that intercity bus service is more widespread in rural areas, but also that many rural and small urban places do not have adequate access to intercity transportation.

Accessibility

Privately-owned OTRBs must provide accessible service as described in the Americans with Disabilities Act (ADA) Final Rule issued September 24, 1998.[5] The ADA regulations already covered private and public operators of other vehicle types and public operators of OTRBs. In general, large firms with more than $5.3 million in annual revenues that provide fixed-route, fixed-schedule services were required to purchase accessible OTRBs beginning October 2000, to make 50 percent of the fleet accessible by 2006, and 100 percent by 2012. In the interim, carriers must provide accessible service on 48 hours advance notice.

With Section 5311(f) rural assistance funds, Polk County, Florida, provides the InterCity Transit service (in Winter Haven), reaching into remote areas.

Federal Funding

ISTEA introduced federal funding for intercity bus services in 1992; the framers of the legislation had determined that intercity bus needs were primarily rural. TEA-21 continued the funding provisions, setting 15 percent of the Section 5311(f) rural assistance funds to states for intercity bus transportation—unless the state governor annually certifies that intercity bus needs already are being met.

The Federal Transit Administration (FTA) accepts partial certification for states that want to spend some, but not all, of the 15 percent share for rural intercity bus projects. In the history of the program, approximately 20 to 25 states have certified each year that there were no unmet rural intercity needs, although the list of states varies year to year (Table 1).

Eligible uses for the Section 5311(f) funds include the following:

- Operating assistance for intercity services by public or private entities;
- Developing rural feeder services to intercity lines;
- Capital grants for intercity bus shelters, terminals, vehicles, or equipment—including accessibility equipment; and

Planning and marketing for intercity bus services.

The FTA guidelines extend flexibility if other program requirements are met. States, local transit operators, and carriers have benefited from this flexibility—and from other federal and state funding sources—to maintain and improve rural intercity services. Illustrative examples follow.[6]

Operations

Traditional intercity bus service. Indiana has used Section 5311(f) funding to support the operation of Greyhound intercity services on two routes in the north central area. The region lost all intercity service when a carrier went bankrupt, but a local

[5] 49 CFR, Parts 27, 37, and 38, 1996.

[6] TCRP Report 79 provides additional examples of rural intercity bus projects of all types, with more detail on the implementation, the benefits, and the pitfalls.

feasibility study identified potential ridership and the need for operating assistance.

Indiana subsidizes portions of the services that operate to and from points out of state. The state also provides the local share of the operating grant, contracting directly with Greyhound. Ridership has grown to the levels predicted.

Feeder service by a rural transit provider. South Central Arkansas Transit, operated by the Central Arkansas Development Council (CADC) in Malvern, Arkansas, provides intercity service using Section 5311(f) funds. CADC is both the Greyhound agent in Malvern and a connecting point with Greyhound services at other locations along a route from El Dorado.

The service operates a 20-passenger bus twice a day, funded through a combination of Greyhound assistance, Section 5311(f) operating assistance, ticket commission revenue, and agency funds. The service is listed in Russell's Guide[7] and is included in Greyhound's national telephone and Internet information system. Ridership has increased, and the service is considered a success. Extensions to connect with additional Greyhound routes are in planning.

Capital Projects

Intermodal and intercity terminals. Several states and localities have used a variety of funding sources to construct and improve intercity and intermodal terminals. Texas DOT has focused much of its Section 5311(f) funding on the improvement of passenger facilities; private carriers as well as public entities are eligible.

A striking example is the recently opened intermodal terminal in San Marcos, Texas, developed by the Capital Area Rural Transportation System (CARTS). The terminal serves as the hub for local transit routes, as the Greyhound station (CARTS is the Greyhound agent), and as an Amtrak stop. Greyhound provided the local matching funds for the intercity portion of the facility, in exchange for 10 years of rent. Carriers in Texas also have used funding under this program to upgrade terminals to meet ADA requirements.

Another example is the Trailways station in Concord, New Hampshire (see sidebar, page 28). Jointly developed by the carrier and the state using Congestion Mitigation and Air Quality Improvement (CMAQ) and state capital funding, the attractive, modern terminal has a 273-space park-and-ride lot. The carrier pays the operating expenses for the facility, which is heavily used by travelers to Logan Airport and Boston. Vermont Transit, Peter Pan Trailways, and the local Capital Area Transit also serve the

[7] Table 478.

TABLE 1 States and Territories Certifying No Unmet Rural Intercity Bus Need Under Section 5311(f) Program (1996–2000)

State	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000
Alabama	Yes	Yes			
Arkansas	Partial	Partial	Yes	Partial	Partial
Colorado	Yes	Partial	Yes	Yes	Partial
Connecticut	Yes	Yes	Yes	Yes	Yes
Florida	Yes				
Hawaii	Yes	Yes	Yes	Yes	
Illinois	Partial	Partial	Partial		
Indiana	Yes	Yes	Yes		Yes
Kansas	Partial			Partial	Partial
Louisiana	Yes	Yes	Yes	Yes	
Maryland	Yes	Yes	Yes	Yes	Yes
Minnesota				Yes	Yes
Missouri	Partial			Yes	Yes
Nebraska	Partial			Yes	Yes
New Hampshire	Partial	Partial	Yes	Partial	Partial
New Jersey	Yes	Yes	Yes	Yes	
North Carolina	Yes		Yes	Yes	Yes
Ohio	Partial	Partial	Partial	Yes	Yes
Oklahoma	Yes	Yes	Yes	Yes	Yes
Puerto Rico	Yes				
Rhode Island	Yes	Yes	Yes	Yes	Yes
South Carolina	Yes	Yes	Yes	Yes	Yes
South Dakota	Yes	Yes	Yes	Yes	Yes
Tennessee	Yes	Yes	Yes	Yes	Yes
Texas	Partial				
Utah	Yes	Yes	Yes		
Vermont	Yes	Yes		Yes	Yes
Virginia	Yes	Yes	Yes	Yes	Yes
West Virginia	Yes	Yes	Yes	Yes	Yes
Wisconsin	Partial	Partial	Yes	Partial	Partial
Total-Full or Partial	**29+Guam**	**22**	**21**	**23**	**21**

Notes: Yes — the state/territory certified that there were no unmet rural intercity bus needs and did not spend any of the 15% allocation for rural intercity bus projects.

Partial — the state/territory certified that there were limited unmet rural intercity needs not requiring the full 15% allocation. Less than the full 15% allocation was spent on rural intercity projects.

Source: Trends in the Section 5311 Program: Annual Status Report, Fiscal Year 2000. Office of Program Management, Federal Transit Administration

facility, which has been so successful that the major problem is the need for additional parking.

Vehicle capital. Several states have used state, Section 5311(f), or CMAQ funds for vehicle capital, sometimes providing funds to rural transit operators to purchase vehicles for regional intercity or feeder service and sometimes providing funds to intercity carriers.

Michigan has provided vehicle capital to intercity carriers since 1976, and the program now supplies coaches to regular route carriers for a nominal lease fee, to support scheduled, accessible services. Georgia applies Section 5311(f) funds to purchase coaches for scheduled services by Greyhound Lines and Southeastern Stages. New Hampshire has used CMAQ funding to purchase accessible coaches for C & J Trailways and Concord Trailways on routes within the state and connecting to Logan Airport and Boston.

Accessibility. With the implementation of the final rule on accessibility for OTRBs operated by private for-profit firms, several states have provided funding assistance to regular-route carriers for the incremental cost of wheelchair lifts and related accessibility equipment, both to support the service and to speed implementation. Pennsylvania, Texas, and California specifically have provided such funding, and New York has provided state

Fredericksburg, Virginia, is rebuilding the Greyhound station into an intermodal transfer point for the local transit system and intercity bus service.

Rural Bus Stop to Airport Runway

Intermodal Role for Intercity Bus Services

Intercity bus services have developed a new role linking rural and small urban communities with major airports. The services connecting rural New England with Boston's Logan Airport and with the Manchester, New Hampshire, airport are prime examples.

Because Logan Airport has been constrained in handling increases in automobile access, Massport, the airport owner, has supported development of bus access, including its own Logan Express bus services from park-and-ride lots in greater Boston. Many travelers from rural New England reach Logan on buses operated by Concord Trailways (northern and central New Hampshire and Maine), Dartmouth Coach (the Hanover–Lebanon area of New Hampshire), Greyhound affiliate Vermont Transit, and C & J Trailways (eastern New Hampshire).

The development of attractive, high-quality terminals and park-and-ride lots has supported these services:

- The New Hampshire Department of Transportation has used federal Congestion Mitigation and Air Quality Improvement (CMAQ) funding to build bus terminals with park-and-ride lots in Concord and Portsmouth—the carriers provide frequent, direct service to Logan Airport without operating assistance.
- Dartmouth Coach has built its own terminal and park-and-ride lot in Lebanon, New Hampshire.
- Vermont Transit also has linked communities with Manchester Airport, a gateway to northern New England.

The success of these connectors demonstrates that intercity bus service can attract automobile users and link rural areas to hub airports—the key is frequent service, plus an attractive and safe bus facility and park-and-ride lot.

Greyhound Lines is promoting intercity bus service as a link between rural areas and the air system:

- The company offers direct service to 21 airports across the country under the brand name *FlightLink*, which includes the Vermont Transit services.
- Greyhound's Rockford Coach Lines provides 15 daily round trips between Rockford, Illinois, and Chicago O'Hare airport.
- In some cases, Greyhound has established terminal facilities in the airport. Melbourne, Florida, and South Bend, Indiana, are two examples of airports with Greyhound terminals.
- In Colorado, Greyhound has used rural assistance funding to support an intercity bus ticket counter at Denver Airport for connections to bus service to smaller towns and rural areas.
- Greyhound also provides detailed directions on its website for connecting between airlines and bus routes—even for airports that do not yet have a direct intercity bus connection.

Airport planners are beginning to take advantage of bus service as a feeder mode. The Branson–Springfield, Missouri, airport recently opened a bus terminal as part of the main passenger terminal, allowing direct connections for airline passengers to the charter, tour, and scheduled buses to tourist destinations in Branson. Luggage is checked directly to or from the bus, and the bus boarding area is indoors, directly connected to the airline services.

funding to match federal funds extended to state carriers under the Rural Transportation Accessibility Incentive Program.

Trailblazer signs. Many states also have instituted programs to place signs on state highways identifying the location of intercity bus terminals.

Other capital. The flexibility of the federal programs has allowed states to fund other types of capital projects, including computers and software for agents in rural areas in Michigan and Massachusetts and preventive maintenance in Iowa.

Marketing and Planning

Planning studies. States have used Section 5311(f) and other funds to support planning studies, including statewide intercity bus plans, facility inventories and plans, and feasibility studies for routes or regions.

Marketing assistance. The programs have funded market research on rural services, including the development and distribution of informational and promotional materials. In Iowa and Minnesota, Jefferson Lines assembled focus groups to identify market needs for service development and strategies for the marketing of rural intercity transit. Peter Pan Bus Lines used Section 5311(f) funding in Massachusetts to develop a computerized data system and call center with information about intercity bus services and local transit connections.

Ongoing Role

The intercity bus industry recognizes the advantage of links among carriers, as well as with Amtrak and regional rail services, with rural feeders, and with local urban transit. As the only general public mode linking most rural and urban areas, intercity bus is a logical and important link in the surface transportation network. Assistance through federal, state, and local programs can ensure the continuing role of intercity bus service in this network.

Intermodal station in San Marcos, Texas, links Greyhound, CARTS (the local rural public transit service), Amtrak, and taxis.

New Hampshire Department of Transportation built the Concord station, with a park-and-ride lot, local rural and small urban transit, intercity bus service, and frequent service to airports and to the Amtrak station in Boston, Massachusetts.

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POINT OF VIEW

Making the Connections

Strengthening the Nation's Transportation System

CRAIG LENTZSCH

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NOTE: *Point of View features opinions of contributing authors on transportation issues. The views expressed are not necessarily those of TRB or* TR News. *Readers are encouraged to comment in a letter to the editor on the issues and opinions presented.*

How to make transportation connections is perhaps the second most important issue facing transportation policy makers today, after safety and security. Transportation in the 21st century means connections, and the word of the future is intermodalism.

A synonym for connections, intermodal is the modern word for the ancient experience at a crossroads. Progress, prosperity, and economic development always flourished at a crossroads, and transportation connections are the foundation for growth and the key to our nation's progress.

Intermodalism creates choices. Making connections and having choices is especially important for rural America. Intercity bus often provides the only passenger service and package delivery for many rural communities. The creation of connections and the development of choices for rural America should be a priority.

Without these connections, cities and citizens stand to lose. Cities stand to lose economic benefits as regional hubs, and citizens lose the ability to travel from rural to urban centers, which limits access to jobs, education, and health care. Transportation connections are key to our nation's ability to grow. Intercity bus plays a vital role in supporting the nation.

Benefits of Intermodalism

The problem with equating crossroads and connections is that, historically, the connections were often to the same mode. In the United States, the modes of transportation developed independently, producing barriers of distance, funding, and attitude.

For many, these barriers have meant a lack of public transportation alternatives to the private automobile or to staying home. For the individual traveler, intermodal transportation centers can provide a place to move from one public transportation service to another and from one mode to another.

But intermodal transportation also serves communities, rural and urban, large and small. Again, the success of larger cities as regional centers depends on good transportation connections with the surrounding rural and suburban areas. The success of rural communities relies on access to the services available in hub cities, like health care, education, entertainment, and jobs.

To quantify the economic impact of transportation centers on cities and towns of all sizes, the Great American Station Foundation conducted a study in 1999 (*1*), showing that intermodal transportation centers attract other development—retail, commercial, and residential (Table 1). Communities with intermodal centers experience increases in jobs, household income, property values, and property taxes collected. A public transportation orientation for large urban centers and small towns can help revitalize downtown areas.

Building intermodal transportation connections is important to individuals and communities, and

TABLE 1 Economic Impact of Adding an Intermodal Facility (*1*)

City Size (Population)	Increased Employment	Increased Household Income	Increased Property Values (in millions)
Less than 50,000	45 - 325	$80 - $345	$5 - $60
50,001 to 100,000	115 - 825	$85 - $460	$10 - $65
100,001 to 250,000	170 - 975	$140 - $575	$15 - $90
250,001 to 500,000	190 - 1,025	$155 - $870	$15 - $150
500,001 to 2,000,000	260 - 1,435	$175 - $1,055	$25 - $205

NOTE: Cities with population exceeding 2 million were excluded from the analysis.

Everett Station in Washington State is an intermodal, educational, and employment services hub.

intercity bus is an essential part of intermodal transportation. Earlier this year, Federal Transit Administrator Jennifer Dorn encouraged state planners to include intercity bus in the transportation planning process (2).

There are good reasons for this advice. First, intercity bus service is flexible because it goes wherever roads are. Bus routes can be expanded quickly and inexpensively.

Motorcoaches also contribute to highway safety. The U.S. Department of Transportation has described intercity bus travel as the safest mode, compared with cars, trucks, trains, planes, and other commercial vehicles. According to a study for the Federal Motor Carrier Safety Administration, passenger carriers are the surface transportation safety leaders (3).

Moreover, travel by bus—as by any mode of public transportation—contributes to improving the environment by taking cars off the road, reducing congestion, and improving air quality. The average Greyhound bus, for example, takes about 16 cars off the road and emits 25 times less carbon monoxide per gallon of fuel than a single car.

Flexibility, safety, and a positive impact on the environment are all important, but intercity bus has a direct economic benefit to cities and towns planning intermodal projects, because bus passengers spend money. According to a 2001 study, intercity bus customers brought more than $180 million into the economy of Boston, Massachusetts (4). In New York, the economic impact of intercity bus travelers approaches $1 billion.

A February 2002 American Bus Association Economic Impact Study supports this conclusion for the entire motorcoach industry (5). A historical or cultural destination, like Washington, D.C., can expect spending of more than $12,000 per bus for an average two-night bus tour; for a rural destination, like Lancaster, Pennsylvania, the expected total is more than $9,000 per bus.

Amtrak Thruway allows rural travelers to make bus and rail connections through a single source.

Hawthorne Transportation Center has revitalized the Minneapolis, Minnesota, downtown area, offering bus and transit connections to rural communities, public parking, and municipal offices.

Intermodal Solutions

A few examples of successful stations and centers illustrate the benefits of intermodalism:

◆ Located 30 miles in a rural setting north of Seattle, Washington, the town of Everett has built a $45 million intermodal facility for Greyhound, Amtrak, Northwestern Trailways, Sound Transit, and Everett Community Transit. The building also houses on-site classes for area students from five different universities, and residents have access to job search and training from WorkSource Everett, a career development service, and from the state's Employment Security Department.

◆ Suburban areas served by transit also can benefit from intermodal collaboration. In July, Greyhound joined Maryland Rail Commuter (MARC), a division of the Maryland Transit Administration (MTA), and the local transit provider in a new facility in Frederick. Under the agreement, Greyhound agents sell tickets for both bus and rail, expanding the hours that MARC commuters can buy train tickets and helping MTA realize cost savings.

◆ The Hawthorne Transportation Center in Minneapolis, Minnesota, demonstrates how a center can revitalize a downtown area and benefit the surrounding rural communities. The regional hub was built in part with rural transportation funds, in response to a principal need of rural residents—to get to Minneapolis.

Completed in 2000, the $25 million downtown center has a five-level parking garage that links to the city's extensive pedestrian skyway system and connects to the historic Orpheum Theater. The eight-level brick building houses the city's Metro Transit, charter bus operations, Greyhound, Jefferson Lines, and Lorenzo Bus, as well as facilities for municipal offices.

◆ Rural residents sometimes need innovative connections to the intercity bus network, like the service operated by the South Central Arkansas Transit (SCAT) in cooperation with Greyhound. For several years, residents of several south central Arkansas counties have accessed fixed-route and demand-responsive SCAT service from towns like Magnolia, El Dorado, Camden, and Fordyce—which do not have sufficient traffic for regular Greyhound service—to connecting Greyhound routes. SCAT used Transportation Equity Act for the 21st Century (TEA-21) Section 5311(f) rural assistance grants for capital and operating expenses, and Greyhound pays a fixed cost per mile to help meet the requirements for a local match.

◆ Intercity bus links from rural and suburban areas to intermodal connections in hub cities can be developed quickly and inexpensively. Greyhound's Quicklink brand of commuter service operates from Mt. Laurel, New Jersey, to New York City, and from Northeast Sacramento, California, to the Bay Area.

Most recently, Quicklink began serving Macon, Georgia, to Atlanta. Greyhound partnered with the Georgia Regional Transportation Authority (GRTA) to combine intercity bus expertise and private capital for a needed service at reduced cost to Georgia taxpayers. GRTA pays only $1 per mile for access to Greyhound's resources; full contracting would have cost more than $2.50 per mile.

Quicklink gives Macon and Forsythe residents better access to jobs, education, medical care, and recreation and helps address congestion and environmental issues for the greater Atlanta area. The bus service will build the market for commuter rail; Greyhound plans to redeploy the assets at no cost to Georgians when rail becomes available.

◆ Finally, customers from nonrail cities can link to rail through Amtrak Thruway, an Amtrak-Greyhound partnership that serves more than 90 communities nationwide. Amtrak sells and markets Greyhound service on 35 routes to serve more than

Georgia Regional Transportation Authority, in partnership with Greyhound Quicklink, operates intercity buses between Macon and Atlanta, with plans to develop a market for commuter rail.

50,000 customers per year. The Amtrak ticket includes a portion of the trip on Greyhound. The arrangement has improved options for rural travelers and has allowed them to make connections through a single source.

Common to these projects is that intercity bus provides the connections, made possible by state dollars and federal financial support through TEA-21. The financial support has facilitated the cooperation and coordination necessary to create the connections.

Creating an Intermodal System

The reauthorization of TEA-21 this year gives Congress the opportunity to ensure that intermodal projects reach the level necessary to create an integrated public transportation system. Congress must find new, additional funding to meet the transportation infrastructure needs. A significant portion of that new money should support the development of intermodal transportation centers—$100 million annually should be made available for rural, urban, and suburban facilities.

Thousands of rural communities are remote from essential air service and need options for connecting people to distant air and rail systems. With improved airport access, intercity bus—which already serves many of these communities—could offer more connections with relatively little federal support. To promote these links, Congress should create an essential bus service program, with annual funding of up to $35 million.

If public transportation is to become an effective alternative to the private automobile, a nationwide, integrated public transportation information system is needed to guide customers from origin to destination. A single telephone call or Internet link could reach a source of information on fares, schedules, and locations for all forms of public transportation. Congress should provide up to $20 million annually for a coordinated federal effort to operate such a system.

The goal should be for Congress to create a transportation system that promotes access, efficiency, safety, mobility, economic growth and trade, national security, protection of the natural environment, and the enhancement of human welfare. The nation must tap into the strengths of the individual modes and integrate them into a seamless transportation system. Connections, choices, coordination, and cooperation will create an intermodal system for the 21st century.

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Ronald W. Eck

West Virginia University

"I define research in the broadest sense as not only the development of new knowledge but also seeing to it that the new knowledge is implemented where appropriate," states Ronald W. Eck, Professor of Civil Engineering, West Virginia University (WVU), and Director, West Virginia Transportation Technology Transfer Center. "I tell my students that good research must involve the end user."

Eck's research has focused on three main areas: traffic safety and operations in mountainous terrain, nonmotorized transportation, and technology transfer. Research projects have addressed the use of natural brines as a snow and ice control agent in West Virginia, problems faced by older drivers in rapidly developing areas of Appalachia, and superelevation rates to accommodate trucks on steep grades and sharp curves.

"My research in winter maintenance illustrates why linking researchers and practitioners is important," says Eck. "In the mid-1980s, we had researched the use of natural brines in West Virginia as a snow and ice control agent. We examined, evaluated, and assessed until we successfully identified situations in which natural brines could be used cost-effectively in winter maintenance. However, because of one unsuccessful field test, the concept never moved forward."

"Innovation helps make better use of available resources, which are always limited. The synergism that results from this approach is a win-win situation for both the researcher and the practitioner."

But the idea was not forgotten, he recalls: "Changes that occurred over a period of years provided an opportunity to reconsider the concept: the Strategic Highway Research Program had demonstrated the benefits of the anti-icing concept and had given credibility to using liquids in winter maintenance, and we had started developing working relationships with municipal road and street personnel around the state."

Those working relationships generated conversations about the high cost of salt and the difficulties associated with removing ice pack from pavements; Eck and his researchers went back to their original work with brines. They obtained funding for a demonstration project in which they helped supply three communities with equipment that could prewet the salt with natural brines when discharged from the truck. The results exceeded the researchers' expectations: all three communities reduced their salt consumption, one by 30 percent. The demonstration project is over, and all three communities are not only still using the brines but also have expanded their use.

"The lessons from this example are many," asserts Eck. "For one, don't give up on a good idea. Failures happen in research but if a concept is sound, it can be tweaked and changed and made to work."

He elaborates: "Innovation helps make better use of available resources, which are always limited. The synergism that results from this approach is a win-win situation for both the researcher and the practitioner."

Recently, Eck developed and offered a course at WVU on pedestrian and bicycle transportation, drawing students from programs in civil engineering, recreation and parks, public administration, and community medicine. He also conducts walkable communities workshops throughout West Virginia.

For the last several years, Eck has been an active participant in the West Virginia Community Design Team program and has participated in 15 community visits. The program involves multidisciplinary teams of volunteer professionals who visit communities for two days, gathering information and then synthesizing suggestions to help communities plan for the future.

Throughout his career, Eck has been active in professional and technical societies: the Transportation Research Board (TRB), the Institute of Transportation Engineers (ITE), the American Society of Civil Engineers, and the American Society for Engineering Education (ASEE). In 1990, he received the ASEE Civil Engineering Division's George K. Wadlin Distinguished Service Award. He recently was named the 2002 recipient of the President's Award of the Ohio Section of ITE, and he has received the WVU Foundation Award for outstanding teaching.

Eck's involvement with TRB began in 1972, when he attended his first TRB Annual Meeting as a graduate student; he was "hooked" and has attended every Annual Meeting since. Recently, Eck completed his term as cochair of the Task Force on Transportation Needs of National Parks and Public Lands. He is a member of the Steering Committee for the Eighth International Conference on Low-Volume Roads. Previously, he was chair of the Steering Committee for the Seventh International Conference on Low-Volume Roads, and from 1990 to 1996 he chaired the standing Committee on Low-Volume Roads. Eck has served on several other TRB committees, addressing topics on operational effects of geometrics, user information systems, and railroad–highway grade crossings, and has contributed his expertise to several National Cooperative Highway Research Program project panels.

Eck received bachelor's and doctorate degrees in engineering at Clemson University.

Larry W. Emig

Kansas Department of Transportation

"Drive as if your life depends on it," says safe driving advocate Larry W. Emig, cocreator of the annual national "Put the Brakes on Fatalities Day," and Chief, Bureau of Local Projects, Kansas Department of Transportation (DOT).

Emig, an engineer with Kansas DOT, helped create the national "Put the Brakes on Fatalities Day" because he believes that although some crashes are "freakish," in most cases the driver can make a difference. The idea for the national event came to him at a Transportation Research Board (TRB) Annual Meeting in the early 1990s over a cup of coffee with Mel Larsen, Emig's mentor and a member of the National Society of Professional Engineers (NSPE)—they agreed that something needed to be done to draw attention to the large number of people who die on roadways each year.

"Programs like 'Put the Brakes on Fatalities Day' will provide us a day where there will be a reduction in fatalities; of course, our goal is a day where there will be no fatalities."

"It was my hope that if we could create a day like the Great American Smokeout, we could draw attention with a national campaign to address driving-related fatalities—the driver, roadway, and vehicle are all involved when fatalities occur, and by addressing each, we can begin to reduce fatalities," said Emig.

"I give a great deal of credit to the Professional Engineers in Government and NSPE, who helped initiate the idea. E. Dean Carlson, former president of the American Association of State Highway and Transportation Officials (AASHTO), Robin Mayer, National Highway Traffic Safety Administration (NHTSA), and Anthony Kane, former Federal Highway Administration (FHWA) Executive Director, also offered their support to make the event happen," Emig notes.

The annual event, inaugurated October 10, 2001, involves more than 40 national engineering and safety organizations, including NSPE; federal, state, and local government agencies, such as the U.S. DOT, NHTSA, and FHWA; and private-sector companies. The campaign includes demonstrations, message display boards, featured speakers, contests, information distribution, radio and newspaper announcements, and other initiatives that promote four basic ideas:

- Drive courteously and defensively;
- Know the rules of the road for each method of transportation, and obey all signs and signals;
- Wear protective gear—for example, seat belts or helmets; and
- Don't speed, don't drive while impaired or distracted, and don't drive in an aggressive manner.

"Programs like 'Put the Brakes on Fatalities Day' will provide us a day where there will be a reduction in fatalities; of course, our goal is a day where there will be no fatalities," says Emig.

Emig joined Kansas DOT in 1966 and spent one year in the engineering training program. In 1967, he started working in the Department of Planning, and after five years he moved to the Department of Secondary Roads, Bureau of Rural and Urban Development, which later became the Bureau of Local Projects.

In his current role, he is responsible for managing the county and city portions of Kansas DOT's improvement program for roads, streets, and bridges; the program includes the federal-aid projects administered under the Non-National Highway System and the Local Road and Street Plan, as well as certain projects assigned under the state-aided Local Partnership Program.

Emig is active in many organizations, including NSPE, the Kansas Society of Professional Engineers (KSPE), the American Society of Civil Engineers (ASCE), AASHTO, the American Road and Transportation Builders Association, and TRB. He serves TRB as a member of the Committee on Low-Volume Roads and of the Steering Committee for the Eighth International Conference on Low-Volume Roads, which takes place in June 2003. He has served previously on the Steering Committees for the Sixth and Seventh International Conferences on Low-Volume Roads.

In 2002, Emig was honored with KSPE's Outstanding Engineer of the Year Award and Kansas State University's ASCE Chi Epsilon Chapter National Honor Member Award. For his role in the creation of "Put the Brakes on Fatalities Day," he received the AASHTO 2001 Special Award of Merit.

A native of Kansas, Emig earned his bachelor's and master's degrees from Kansas State University.

Superpave Comes to Town

As Superpave® becomes the standard for hot-mix asphalt design and materials selection at more and more transportation agencies, many suppliers no longer are providing other mixes. As a result, many cities, counties, and agencies responsible for building and maintaining miles of local and low-volume roadways must change long-established practice. TRB and several of its partners are addressing the questions and issues that arise from the changeover to Superpave through workshops and conferences, as well as training materials and courses.

Local and low-volume roads were the focus of two sessions and a display in the exhibit hall at the Asphalt Pavement Alliance Asphalt Pavement Conference: Superpave 2003, March 17–19 in Nashville, Tennessee. The exhibit booth featured opportunities to "Ask the Expert," to hear specific advice from people experienced in using Superpave at the local level. Experts included Martin Barker, City of Albuquerque, New Mexico; E. Ray Brown, the National Center for Asphalt Technology; Jeff Graf, Maryland Paving, Inc.; Michael Heitzman, Iowa Department of Transportation (DOT); Larry Michael, Maryland State Highway Administration; and Rodger Young, Colorado Asphalt Pavement Association.

An upcoming program, "Superpave for Low-Volume Roads: An Introductory Workshop," will precede the 8th International Conference on Low-Volume Roads (LVR8) in Reno, Nevada, June 22–25, 2003. Sponsored by TRB, LVR8 will be hosted by the Local Technical Assistance Program Center at the University of Nevada, Reno; by the National Laboratory for Materials and Structural Models at Costa Rica University; and by the Nevada DOT. Detailed information about the LVR8 conference and the workshop on Superpave is available at www4.trb.org/trb/calendar.nsf/web/lvr8 or at www.t2.unr.edu/conference.

Academy Elects TRB Volunteers

The National Academy of Engineering, part of the National Academies, has elected two TRB volunteers to membership, recognizing "outstanding contributions to engineering theory and practice":

Robert E. Fenton, Professor Emeritus, Department of Electrical Engineering, Ohio State University, was recognized for pioneering systems research and engineering on the design and operation of automated highway systems. Fenton has served on TRB's Committee on Communications.

Richard N. Wright III, director (retired), Building and Fire Research Laboratory, National Institute for Standards and Technology, was cited for the development of standards, for sustained leadership in building research, and for representing the U.S. building industry and research community worldwide. He has provided peer review for a series of letter reports produced by the Special Programs Division's Committee on Improved Concrete Pavement for Federal-Aid Highways.

IN MEMORIAM

George Terrell Lathrop, 1935–2003

A nationally recognized expert in the field of transportation planning, George Terrell ("Terry") Lathrop was instrumental in advancing the integration of transportation and land use planning for Charlotte, North Carolina, and introduced state-of-the-art transportation modeling to help design the city's road and transit systems. His career in roads and transportation was influenced by his father, head of transportation for American Enka, and by summer jobs on North Carolina's Highway Department survey teams.

For much of his career, Lathrop was a consultant on transportation planning and an adjunct professor and visiting lecturer on civil engineering and transportation planning at the University of North Carolina at Chapel Hill and Charlotte and at Duke University. In 1984, he assumed responsibilities as Deputy Director of the City of Charlotte's Department of Transportation, serving until his retirement in 2001. Earlier in his career, from 1962 to 1966, he worked as Principal Urban Planner and Head of Research with the Bureau of Planning, New York State Department of Public Works.

Lathrop was active with TRB, serving as a member or chair of many committees, task forces, and project panels for more than 30 years, including those on strategic management, transportation and land development, and transportation modeling research needs.

"Terry will be greatly missed for his insight into transportation issues, his ability to identify critical points, and his sense of humor and fun at TRB events," said Mark Norman, Director, TRB Technical Activities Division.

Cooperative Research Programs News

Improving Cement Specifications and Test Protocols

"Processing additions"—such as granulated blast furnace slag, limestone, and fly ash—are interground with clinker in the manufacture of some portland cements to improve manufacturing efficiency. These additions may boost product quality, reduce carbon dioxide emissions and energy requirements during the cement manufacturing process, and provide economic and environmental benefits.

Recently, however, considerable debate has arisen over the effects of processing additions on cement and concrete properties and on the performance and durability of highway pavements and structures. Current specifications do not address consistently the use of the additions in cement manufacturing. Further research is needed to assess the effects and to develop recommendations that will improve cement specifications and test protocols with regard to processing additions.

Construction Technology Laboratories, Inc., of Skokie, Illinois, has been awarded a $649,924, 36-month contract (NCHRP Project 18-11, FY 2002) to recommend potential improvements to cement specifications and test protocols to determine the acceptability of cements with processing additions. The research will deal with inorganic processing additions, but not with the organic grinding aids commonly used in cement manufacture. The findings of this research will provide guidance on the use of these cements in highway concrete.

CALENDAR

TRB Meetings
2003

April

28–30 9th International Bridge Management Conference
Orlando, Florida
Frank Lisle

May

18–21 Statewide Transportation Planning Conference: Making Connections
Florida Keys, Florida
Kimberly Fisher

June

22–25 8th International Conference on Low-Volume Roads
Reno, Nevada
G. P. Jayaprakash

30 Subcommittee on Railroad Operational Safety
Baltimore, Maryland
Richard Pain

July

11 Data Analysis Working Group (DAWG) Forum on Pavement Performance Data Analysis
Guimarael, Portugal
A. Robert Raab

13–18 Joint Summer Meeting of the Planning, Economics, Finance, Freight, and Management Committees
Portland, Oregon
Kimberly Fisher

13–18 28th Annual Summer Ports, Waterways, Freight, and International Trade Conference
Portland, Oregon
Joedy Cambridge

15–17 10th AASHTO and TRB Maintenance Management Conference*
Duluth, Minnesota
Frank Lisle

20–23 42nd Annual Workshop on Transportation Law
New Orleans, Louisiana
James McDaniel

23–26 Highway Capacity and Quality of Service Committee Midyear Meeting and Conference
Buckhead, Georgia
Richard Cunard

27–30 2nd Urban Street Symposium
Anaheim, California
Richard Cunard

September

25–29 International Conference on Pavement Performance, Data Analysis, and Design Applications*
Columbus, Ohio
G. P. Jayaprakash, Stephen Maher, Frederick Hejl

October

28–29 5th National Conference on Asset Management: Moving from Thought to Practice
Seattle, Washington
Thomas Palmerlee

November

16–18 9th National Light Rail Transit Conference*
Portland, Oregon
Peter Shaw

2004

January

11–15 TRB 83rd Annual Meeting
Washington, D.C.
Mark Norman

April

13–17 5th International Conference on Case Histories in Geotechnical Engineering*
New York, New York
G. P. Jayaprakash

May

5–8 5th International Conference on Cracking in Pavements: Risk Assessment and Prevention*
Limoges, France
Frank Lisle

23–26 10th International Conference on Mobility and Transport for Elderly and Disabled People
Hamamatsu, Japan
Claire Felbinger

July

21–24 Highway Capacity and Quality of Service Committee Midyear Meeting and Conference
State College, Pennsylvania
Richard Cunard

August

29–Sept. 1 Sixth National Meeting on Access Management
Kansas City, Missouri
Kimberly Fisher

September

19–22 2nd International Conference on Accelerated Pavement Testing*
Minneapolis, Minnesota
Stephen Maher

19–22 2nd International Conference on Bridge Maintenance, Safety and Management (IABMAS '04)*
Kyoto, Japan
Frank Lisle

October

19–24 6th International Conference on Managing Pavements*
Brisbane, Queensland, Australia
Stephen Maher

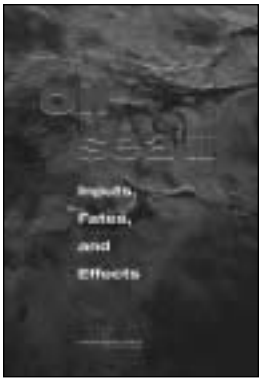
Additional information on TRB conferences and workshops, including calls for abstracts, registration and hotel information, lists of cosponsors, and links to conference websites, is available online (www.TRB.org/trb/calendar). Registration and hotel information usually is available 2 to 3 months in advance. For information, contact the individual listed at 202-334-2934, fax 202-334-2003, or e-mail lkarson@nas.edu/.

*TRB is cosponsor of the meeting.

Advanced Modeling for Transit Operations and Service Planning

William H. K. Lam and Michael G. H. Bell, eds. Pergamon. Elsevier Science, Ltd., The Netherlands: 2003; $90, hardcover; ISBN 0-08-044206-4; 345 pp.

This book is devoted to improving transit operations and service planning through new technologies and advanced modeling techniques. By providing case studies on the outcomes of these techniques and methods, the book assists transit professionals in resolving practical issues in the implementation of intelligent transportation systems and in improving urban public transportation. Topics covered include frequency-based transit route choice models, models for optimizing transit fares, schedule-based transit assignment models, and more.



Oil in the Seas III: Inputs, Fates, and Effects

Ocean Studies Board and Marine Board, National Research Council. The National Academies Press, Washington, D.C.: 2003; $54.95, hardcover; ISBN 0-309-08438-5; 280 pp.

This resource presents estimates of oil pollutant discharges into marine waters, including an evaluation of the methods for assessing petroleum loads and a discussion about the concerns these loads represent. Through close-up looks at the Exxon *Valdez* spill and other notable discharge events, the text identifies important research questions and offers recommendations for better analysis of—and more effective measures against—pollutant discharges. The study examines

Input—where the discharges come from, including the role of two-stroke engines used on recreational craft;

Behavior or fate—how oil moving through the marine environment is affected by processes such as evaporation; and

Effects—what is known about the effects of petroleum hydrocarbons on marine ecosystems.

An update on a problem of international importance, this book will be of interest to energy policy makers, industry officials and managers, engineers and researchers, and marine environment advocates.

Hybrid Vehicle Propulsion

C. M. Jefferson and R. H. Barnard. WIT Press, Billerica, Massachusetts: 2002; $107, hardcover; ISBN 1-85312-887-2; 150 pp.

Recent progress in the development of a range of hybrid vehicles is reviewed, from small cars to buses and light rail vehicles, including the results of field trials and operational experience. Tables, graphs, and black-and-white photographs illustrate the text. Contents include hybrid propulsion configurations, energy storage options, power and energy requirements, and control strategies.

TRB PUBLICATIONS

Maintenance of Pavements and Structures
Transportation Research Record 1795

Pavements are the subject of Part 1 of this two-part volume. Papers examine case studies on cost-effective preventive maintenance, the physicochemical analysis of bituminous crack sealants, a 10-year field performance evaluation of a joint resealing project, and the performance of Louisiana's Chip and Seal Microsurfacing Program. Part 2 explores structures, with papers addressing phenomena and conditions in bridge decks that confound ground-penetrating radar data analysis; a durability evaluation of concrete crack repair systems; estimating agency cost of maintenance, repair, and rehabilitation of Florida bridges; and testing a calcium nitrate corrosion inhibitor in concrete.

2002; 87 pp.; TRB affiliates, $25.50; nonaffiliates, $34. Subscriber category: maintenance (IIIC).

Geometric Design and the Effects on Traffic Operations 2002
Transportation Research Record 1796

Research results are reported on issues related to the influence of vertical alignment on horizontal curve perception, the three-dimensional approach to illustrating esthetic concepts for highway design, and a method to calculate the sight distance available to drivers at skewed intersections. Also examined are freeway on-ramp design criteria for ramp meters with queue detectors and the operational effects of U-turns as alternatives to direct left turns from driveways.

2002; 96 pp.; TRB affiliates, $25.50; nonaffiliates, $34. Subscriber category: highway and facility design (IIA).

Hydrology, Hydraulics, and Water Quality; Roadside Safety Features 2002
Transportation Research Record 1797

Papers focus on clear-water scour at bridge contractions in cohesive soils, geospatial distribution of metal elements in transportation–land use surficial soils, clear-water abutment scour prediction for simple and complex channels, vehicle impacts in V-shaped ditches, and critical impact points for transitions and terminals.

2002; 112 pp.; TRB affiliates, $27; nonaffiliates, $36. Subscriber category: safety and human performance (IVB).

Concrete 2002
Transportation Research Record 1798
This volume tracks studies on fatigue damage in roller-compacted pavement foundation with recycled aggregate and waste plastic strips, the influence of key parameters on quality of dry-mix shotcrete, alkali-silica reactivity resistance of high-volume fly ash cementitious systems, and heat removal from mass concrete footing.

2002; 63 pp.; TRB affiliates, $21.75; nonaffiliates, $29. Subscriber category: materials and construction (IIIB).

Transit: Planning and Development, Management and Performance, Marketing and Fare Policy
Transportation Research Record 1799
Topics include policies and practices for cost-effective transit investments, multimodal transit service with heterogeneous travelers, international perspectives on the changing structure of the urban bus market, and transit path-choice models that use revealed preference and stated preference data. Case studies include papers on bus patronage in Great Britain and an urban transport strategy for Colombo, Sri Lanka.

2002; 113 pp.; TRB affiliates, $27; nonaffiliates, $36. Subscriber category: public transit (VI).

Intelligent Transportation Systems and Vehicle–Highway Automation 2002
Transportation Research Record 1800
Research reports cover the intertechnology effects in intelligent transportation systems, a genetic algorithm-based optimization approach and generic tool for calibrating traffic microscopic simulation parameters, transmitted bandwidth and bit error probability of safety warning systems, functional requirements for an in-vehicle dilemma zone warning system at signalized intersections, and the effects of adaptive cruise control systems on highway traffic flow capacity.

2002; 99 pp.; TRB affiliates, $25.50; nonaffiliates, $34. Subscriber category: highway operations, capacity, and traffic control (IV).

Traffic Control Devices, Visibility, and Rail–Highway Grade Crossings 2002
Transportation Research Record 1801
Papers present information on roundabout warrants, assessments and improvements of safety at Finnish railway–road grade crossings, retroreflective material specifications and on-road sign performance, and a computational vision model to assess work-zone conspicuity.

2002; 86 pp.; TRB affiliates, $25.50; nonaffiliates, $34. Subscriber category: highway operations, capacity, and traffic control (IVA).

Traffic Flow Theory and Highway Capacity 2002
Transportation Research Record 1802
Multimodal corridor level-of-service analysis, development of highway congestion index with fuzzy set models, empirical features of congested patterns at highway bottlenecks, and the design and implementation of a control-theory-based microscopic traffic flow model are among the topics discussed.

2002; 270 pp.; TRB affiliates, $54; nonaffiliates, $72. Subscriber category: highway operations, capacity, and traffic control (IVA).

Human Performance: Models, Intelligent Vehicle Initiative, Traveler Advisory and Information Systems
Transportation Research Record 1803
Human performance issues examined in this volume include behavior adaptation to lane departure warnings, drivers' understanding of overhead freeway exit guide signs, traveler response to new dynamic information systems, and driver braking responses in a high-fidelity simulator and on a test track.

2002; 109 pp.; TRB affiliates, $27; nonaffiliates, $36. Subscriber category: safety and human performance (IVB).

Transportation Data and Information Technology Research
Transportation Research Record 1804
Research papers consider travel-time estimates obtained from intelligent transportation systems and instrumented test vehicles, the cleaning of matched license plate data, design characteristics of national travel surveys, spatial behavioral data, and techniques for building multijurisdictional geographic information system platforms for transportation analysis.

2002; 223 pp.; TRB affiliates, $49.50; nonaffiliates, $66. Subscriber category: planning and administration (IA).

Bridge Life-Cycle Cost Analysis
NCHRP Report 483
This two-part Report aids in decision-making about the repair or selection of cost-effective alternatives for the preservation of bridge assets. Part I establishes guidelines and procedures for bridge life-cycle costing; Part II outlines the life-cycle costing concept, identifies data sources, and explains the methodology. *CRP-CD-26* contains appendixes; a user's manual; a guidance manual; and bridge life-cycle cost analysis software, which weighs agency and user costs and enables the user to consider vulnerability and uncertainty in the analysis. The Report and CD are companions to the American Association of State Highway and Transportation Officials' network-based Bridge Management System.

2003; 126 pp. + CD-ROM; TRB affiliates, $23.25; nonaffiliates, $31. Subscriber category: bridges, other structures, and hydraulics and hydrology (IIC).

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