TRANSPORTATION AND IOWA'S ECONOMIC FUTURE

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TRANSPORTATION AND IOWA'S ECONOMIC FUTURE

TRANSPORTATION

AND IOWA'S

ECONOMIC FUTURE

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Because several governmental agencies contributed funds to this research, we must point out that the conclusions and recommendations herein may not necessarily reflect the views of these agencies.

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PREFACE

This research effort has involved collaboration between a team of researchers representing two universities and a group of leaders from business and government. The concept of an interactive approach to public policy research has grown out of a multi-year grant from the Northwest Area Foundation to the University of Iowa's Public Policy Center. This grant was an important source of support for this research. An objective of the Northwest Area Foundation has been to foster a new level of collaboration between university researchers and public and private sector leaders. This objective has been supported by the Iowa Business Council, an organization of executive officers (see inside cover) committed to strengthening the quality of life and vitality of the economy in Iowa. The Iowa Business Council has contributed actively and positively to all phases of the research process, in addition to devoting resources to the project.

The research conducted in conjunction with this project also was supported by the U.S. Department of Transportation's University Transportation Centers Program. The Program was created by Congress in 1987 to "contribute to the solution of important regional and national transportation problems." Following a national competition, this program established university-based centers in each of the ten federal regions. The Midwest Transportation Center that funded this project is one of the ten centers; it is a consortium that includes Iowa State University and the University of Iowa. Matching funds were provided in part by the Iowa Department of Transportation, which also rendered staff support on many occasions. Finally, a contribution to this project was made by the University of Minnesota's Hubert H. Humphrey Institute of Public Affairs. The Institute provided resources as a result of having received Congressional funding through the Federal Highway Administration of the U.S. Department of Transportation to explore ways in which transportation can contribute to a stronger, better integrated Midwestern economy.

Throughout the duration of the project, the research team has benefited by its collaboration with a 19-member project advisory committee. This committee helped bring focus to the issues to be addressed, and its members shared their insights throughout the research process. Five subcommittees were formed, each led by a member of the advisory committee and comprised of people well versed on specific areas germane to the project. These subcommittees brought an impressive level of expertise to the project.

An extensive survey was undertaken to gain the input of a large number of businesses that depend on various transportation services. A total of 234 major employment sites responded to this survey giving the research team an accurate picture of the practices, needs, and preferences of diverse businesses across the state. A copy of the survey questionnaire with tabulated responses appears in Appendix A.

A wide range of organizations with interests in transportation were invited to consult with members of the project advisory committee and the research team. The objective of these consultation meetings was to obtain the perspectives of groups with relatively specific concerns regarding transportation services in Iowa. The presentations and answers to questions provided by those who accepted the invitation to participate are summarized in Appendix B.

ACKNOWLEDGMENTS

In the preface, we mention resources devoted to the project by the Northwest Area Foundation; Iowa Business Council; U.S. Department of Transportation, University Transportation Center Program; Iowa Department of Transportation; and University of Minnesota, Hubert H. Humphrey Institute of Public Affairs. All of these organizations have our deep gratitude for their support; they have allowed the project to be given the time and attention it deserved.

Members of the project advisory committee contributed greatly to this research effort. Attendance at all the meetings was nearly 100 percent, and the enthusiasm, support, and commitment we saw was both helpful and inspiring. Our special thanks go to Robert Peterson, Chairman, President and CEO of IBP, Inc. Mr. Peterson led the advisory committee with an open mind and a real desire to search out public policy directions that could strengthen Iowa's economic future. He did so very effectively. We are grateful to Don Willoughby of IBP for his assistance throughout the project.

Advisory committee meetings were convened in the Ruan Transportation Management Systems board room. We thank Larry Miller, Ruan President, for his hospitality and for the quality of our accommodations.

Five members of the project advisory committee—Melvin McMains, Lloyd Mullins, Merlin Plagge, Rose Rennekamp, and Gretchen Tegeler—chaired subcommittees that helped us explore specific topic areas. Subcommittee meetings represented some of the high points of the project, with discussions that were lively and highly substantive. We owe a special thanks to Mel McMains who played an active role in designing the questionnaire sent to numerous large employment sites in Iowa.

Data needs for a project like this are enormous. Among the people who contributed greatly to meeting these needs are George Antle of the U.S. Army Corps of Engineers, Harvey Siegelman of the Iowa Department of Economic Development, and Don Ward and Tom Jackson at the Iowa Department of Transportation. We are grateful to the 234 respondents who took the time to complete the questionnaire on their facility's transportation practices, needs, and preferences. Finally, we appreciate the efforts of the 13 persons who made presentations at our consultation meeting at the State Capitol Building.

Research assistance was provided by four University of Iowa graduate research assistants: Winifred Newcomb, Mark Simonson, Claudia Stevenson, and Charles Webb. Solomon Ghorayeb assisted Professor Michael Crum at Iowa State University. If the performance of these five students on this project is any indication, the future of transportation policy development is in good hands.

Our special thanks go to Professor C. Phillip Baumel who wrote major parts of Chapter 6, Agricultural Transportation. Phil is Iowa's top authority on agricultural transportation economics. We are fortunate to have had his expertise.

Without the efforts of people at the Public Policy Center, this project would not have been possible. Anita Makuluni served in many vital capacities including editor and advisor; she ensured that the text is accessible to a wide audience. Carolyn Goff served as administrative liaison with members of the advisory committee and its subcommittees, making sure that all meetings and other project-related events went smoothly.

To all of the people we have mentioned and those whom we may have missed, our thanks.

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Transportation Commission

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CHAPTER 1

INTRODUCTION

This is a study of how transportation policy can be fashioned to improve Iowa's long-term economic prospects. More than almost any other activity, sound transportation policy is only possible if good decisions are made by leaders in both the public and private sectors. This is because privately owned and operated vehicles or vessels use publicly owned and maintained facilities. Those vehicles or vessels typically pay for this use, so how public facilities are priced is as important a policy consideration as which facilities are provided.

Iowa businesses must compete with their counterparts in other states and nations. To compete effectively, necessary services must be provided in a cost-effective way. If transportation facilities are overbuilt, underbuilt, or improperly priced, the users of those facilities (or other taxpayers) will be less able to compete effectively. Iowa's decision makers must strike a balance between more, better facilities and user charges and taxes that are as low as possible.

Transportation policies that were appropriate for yesterday's economic circumstances in Iowa may not work well today and may be badly out of step with tomorrow's needs. Thus, policy decisions must be anticipatory. To properly consider emerging problems, opportunities, and capabilities, research must play a key role. This project seeks to improve our understanding of the changing nature of transportation demand and supply and to identify public policies that will enable efficient, appropriate responses.

This research focuses on the state rather than local level. The emphasis is on transportation facilities that serve the state and policies to improve the contribution of these facilities to Iowa's economic prospects. We do not address local transportation issues, per se. While these issues are important, they are of a very different nature from those examined here. Also, we do not address air passenger transportation, and railroad operations are examined in the context of specific issues such as agricultural transportation. Airlines respond to market forces: as Iowa's economic fortunes change, so will the level of airline service. Since federal deregulation, market forces have quite directly affected the amount and type of airline service an area receives. Likewise, railroads are now deregulated, and their service patterns are largely a function of corporate decision making. The viability of railroads, however, is substantially affected by public policies related to other, competing modes.

Our focus is on pricing, resource allocation, investment, and other issues that directly affect the performance of public facilities that support transportation of goods and people to and from points in Iowa. We begin in Chapter 2 with an assessment of how Iowa's economy is changing, both functionally and spatially. Commuting patterns and methods of goods movement are discussed. The purpose of this analysis is to provide a context for the exploration of transportation policy issues in subsequent chapters.

In Chapter 3 we establish a framework for evaluating changes in transportation policies, offer a working definition of economic development, and contemplate the role of government policies in making an area more attractive to economic activity. This framework provides a basis for assessing potential transportation improvements by weighing transportation benefits (cost savings) against project costs. We explore several critical issues that need to be considered when evaluating transportation policies. Concepts presented in this chapter are applied in the chapters to follow.

Chapter 4 analyzes public policy options for Iowa's roads and highways. These policy options are intended to help the state compete for economic activity. We first compare the size and condition of Iowa's road system with those of other Midwestern states, focusing on the specific needs of different categories of Iowa roads. We then examine issues of road pricing and financing. Possible changes in the methods for charging road users are assessed, along with new technological advances that enable more fair and effective financing approaches. We examine investment strategies for the state's road system, including an alternative to standard four-lane highways. Finally we discuss the role of advancing technology in making Iowa's road system more productive.

In Chapter 5 we assess alternative investment strategies for major navigational facilities on the upper Mississippi River. First, we describe the current role in Iowa's economy of barges on the Mississippi River and the means used to finance the locks and dams serving these barges. Our analysis of these navigation facilities focuses on a key investment decision: whether their capacity should be increased. Finally, we consider the role that user charges should play in financing the operation and maintenance of locks and dams.

Chapter 6 incorporates Professor C. Phillip Baumel's comprehensive analysis to examine major transportation policy issues in Iowa's agricultural sector. We first present data on the current magnitude of agricultural shipments and the roles of several modes. After focusing on issues related to railroad competitiveness, we turn to an analysis of how Iowa's rural roads should be financed. Finally, we stress the need for joint investment and pricing decisions affecting waterways, railroads, and rural roads.

Chapter 7 examines the current status of freight transportation in Iowa. First, we present the results of an extensive survey of Iowa businesses regarding their use of transportation and their opinions about various policy issues. We then assess a series of issues related to trucking, the mode that transports the largest share of freight into and from the state. We complete the chapter with an assessment of intermodal transportation (the movement of freight by two or more modes in an integrated manner) and its potential for cost-effective shipping to and from businesses in Iowa.

In Chapter 8 we summarize the key findings of this study, offering ten recommendations. These recommendations relate to transportation as a means of facilitating economic development. This collaborative research effort is an attempt to systematically examine a series of intertwined public policy issues that significantly affect the ability of transportation to strengthen Iowa's long-term competitiveness in the worldwide marketplace.

CHAPTER 2

IOWA'S CHANGING ECONOMY

During the past few decades, Iowa has been undergoing substantial change. The state continues to evolve both in terms of its population—composition and location of residence—and its economic base. This evolution has major implications for the types of transportation services that will be necessary and affordable. Before examining the state's transportation system, it is instructive to consider the nature and magnitude of changes occurring within Iowa. It is not the objective of this chapter to provide a comprehensive analysis of the types and levels of transportation the state will need in future years. Rather, this chapter is intended to provide a useful context for an assessment of Iowa's transportation systems.

As a reference for this and subsequent chapters, Figure 2–1 shows the boundaries of Iowa's 99 counties. Metropolitan counties, of which there are 11, are shaded. Names of the state's eight cities with populations over 50,000 are also shown.

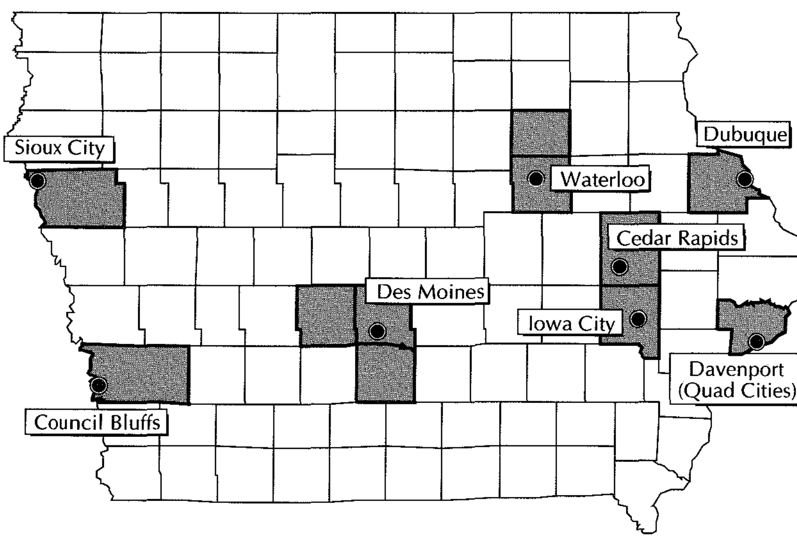

Figure 2–1. Iowa's 99 counties and eight metropolitan areas

POPULATION CHANGES

The population of the state of Iowa fell during the 1980s, after growing for almost all of the twentieth century. This loss in population reflects poor economic conditions in the state during these years. Longer-term changes in where people live within the state, however, may be as significant as statewide changes. Figure 2–2 illustrates some of these longer-term changes, from the vantage point of 1980. The figure shows that most counties in Iowa reached their maximum populations before 1980, and in many cases several decades earlier. Moreover, in 1980 many counties had less than three quarters of the maximum population they had reached at an earlier time. Indeed, six counties had less than half of their maximum population. The 20 counties still growing in 1980 were clustered around large urban centers: Des Moines, Waterloo, Cedar Rapids and Iowa City, Davenport, and Dubuque.

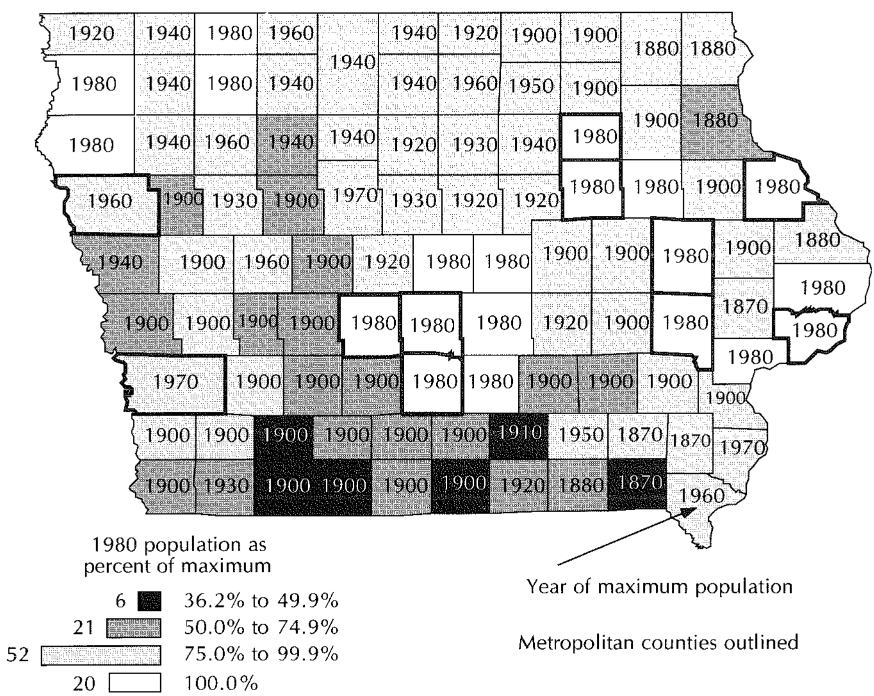

Figure 2–2. County population changes in Iowa up to 1980

Source: Andriot (1983).

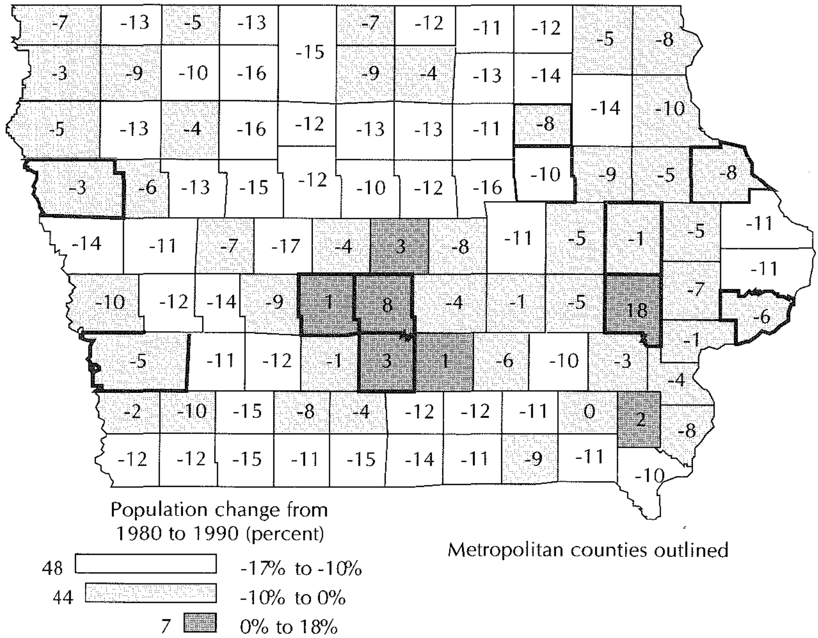

Figure 2–3. Change in Iowa's county populations from 1980 to 1990
(percent)

Sources: Andriot (1983) and Goudy and Burke (1990, pp. 6–8).

Figure 2–3 reflects 1990 Census data showing how the population of Iowa's counties changed during the 1980s. Two changes are particularly noticeable. First, only seven counties, clustered around Des Moines and Iowa City, gained population during the decade. Second, almost half of Iowa's 99 counties lost over 10 percent of their 1980 population, especially those in southern and north central Iowa. Counties losing up to 10 percent of their population are in some cases those surrounding metropolitan areas. Noteworthy, too, is the fact that half of the state's cities with populations over 50,000 lost five or more percent of their residents between 1980 and 1990, after many decades of sustained growth.

In the case of rural counties, the trend of declines in population has been long-standing, continuing, and cumulatively of significant magnitude. Because many of the important decisions on infrastructure development were made around the time many of these counties stopped growing, the current infrastructure may not be well suited to either their current or future needs.

EMPLOYMENT CHANGES

Iowa experienced significant economic changes during the 1980s. The recession that began in the early part of the decade led to a significant decline in employment that was reversed only late in the decade. Additionally, the state's total output per worker fell relative to the nation during the recession and still has not recovered. The jobs that Iowans have are changing. Service and trade industries are expanding their share of total employment, continuing a long-term trend both in the state and nationally. Geographically, job growth is highest in metropolitan areas in Iowa, although rural areas are keeping manufacturing jobs while urban areas are losing them.

Employment and output

In January 1992 there were an estimated 1.46 million employed people living in Iowa (Iowa Department of Economic Development 1992). This figure is based on the monthly household survey used to measure employment and unemployment: people are counted as employed if they have one or more paid jobs and work over one hour per week, are self-employed, or work unpaid in family businesses more than 15 hours per week (Frumkin 1990, p. 225). Figure 2–4 shows how total employment changed in Iowa and the nation between 1975 and 1991. The recession in Iowa in the mid 1980s, in terms of fraction of jobs lost, was much more severe than in the nation, and it lasted much longer. The strong job growth

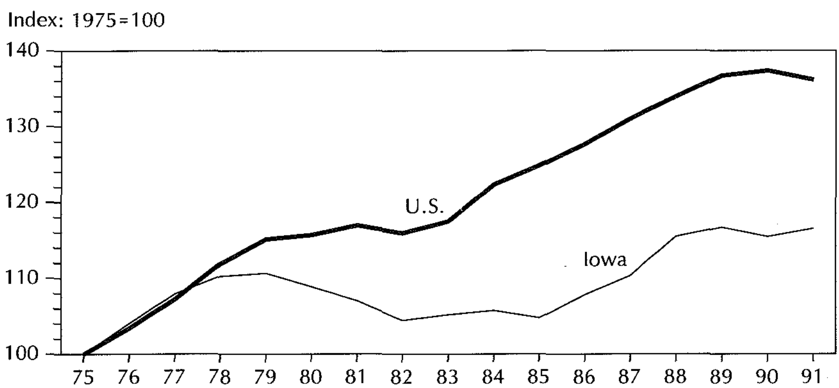

Figure 2–4. Total employment, Iowa and the U.S., 1975–1991

Sources: U.S. Department of Labor Bureau of Labor Statistics (1980, Table 44; 1983, Table 42; 1989b, Table 45; 1991, Table 3; 1992a, Table 3; 1992b, Table A–1) and U.S. Department of Commerce Bureau of the Census (1990, Table 624; 1991b, Table 631).

of the late 1980s has brought total employment in Iowa back above its pre-recession level.

Changes in employment are not the best measure of Iowans' well-being. What is important for long-term prosperity is how productivity and incomes are changing: are we getting more productive as a state and do Iowans have more economic resources? The Bureau of Economic Analysis in the Commerce Department estimates total output for each state on a periodic basis. Although these estimates are difficult to make and are less accurate than national output data, changes in Iowa's gross state product (GSP) over time gives an indication of how the state's economic fortunes are changing. Figure 2–5 shows how real GSP per employed worker varied for Iowa and the nation during the 1980s. In 1989 dollars, total output per worker in Iowa averaged about $40,000 in 1981, approximately the same as for the nation as a whole. The recession in Iowa lowered sharply the GSP per worker, while the national average grew steadily after 1982. By the end of the decade, the average for Iowa was significantly below that for the nation, leaving a gap between the two of about $8,000 per worker.

A similar trend is apparent if we compare per capita incomes in Iowa with the nation during the 1980s. Figure 2–6 shows that incomes in Iowa have fallen from near parity in 1980 to about eight percent less than the national average in 1990. By 1990, Iowa had recovered from the recession of the

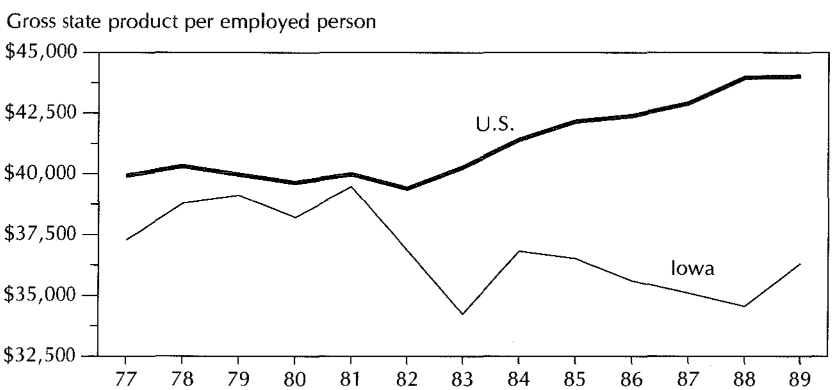

Figure 2–5. Gross state product per employed person, Iowa and the U.S., 1977–1989

(1989 dollars, deflated by implicit price deflator for gross domestic product)

Sources: Trott, Dunbar, and Friedenberg (1991, Table 4) and Executive Office of the President (1992, Table B–3). Employment data as for Figure 2–4.

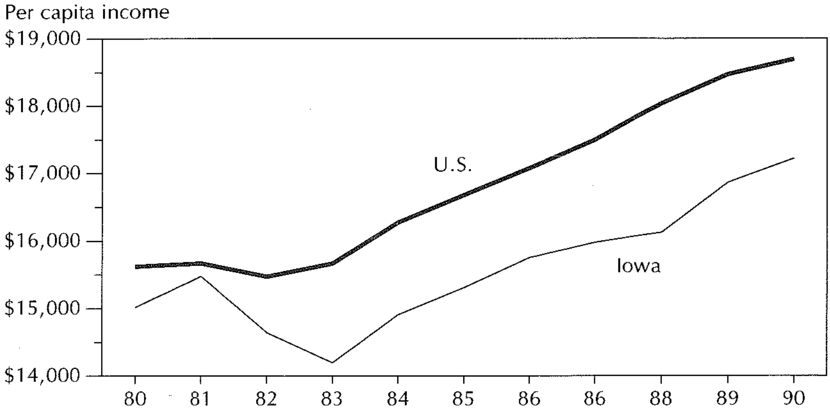

Figure 2–6. Per capita income, Iowa and the U.S., 1980–1990
(1990 dollars, deflated by implicit price deflator for gross domestic product)

Sources: Regional Economic Measurement Division (1991, Table 1) for 1985–1990, U.S. Department of Commerce Bureau of Economic Analysis (1989, pp. 29 and 117) for 1980–1985, and Executive Office of the President (1992, Table B–3).

mid-1980s in terms of employment, but found itself in a weaker relative position than in 1980. Just as total output per worker is now significantly lower than the national average, per capita income also has fallen below national levels. Recently, however, Iowa's per capita income has grown as fast as it has nationally.

Structure and location of employment

Since 1965, the distribution of Iowa's nonagricultural employment across industries has shifted in important ways (Figure 2–7). The service sector had the greatest increase; the manufacturing sector the greatest decrease. In large measure, changes in industry mix in Iowa have paralleled changes at the national level, but have been slightly smaller. From 1965 to 1989, the share of nonagricultural employment in manufacturing dropped from 29.7 percent to 18.0 percent in the nation and from 25.6 percent to 19.1 percent in Iowa. For the same period, the share of employment in the service sector increased from 14.9 percent to 24.8 percent in the nation and from 14.3 percent to 21.6 percent in Iowa.[1]

[1] For a detailed analysis of recent labor market trends in Iowa, see Pogue, Neumann, and Forkenbrock (1991). It is possible that the shift from manufacturing to services may be overstated in some cases. For example, certain manufacturing companies may have increased their use of engineering firms instead of maintaining larger staffs internally.

The location of employment in Iowa has been changing. Significantly, Figure 2–8 shows how the total number of workers over age 16 changed from 1980 to 1990, by county of residence. Statewide, about 42,000 more people had jobs in 1990 than in 1980, despite the state's population loss. Several counties had large job gains, with residents of Polk County having over 25,000 more jobs in 1990 and residents of Johnson County gaining over 11,000 jobs. Fifty-four counties had fewer residents with jobs in 1990 than in 1980, especially in the southern, northwestern, and north-central parts of Iowa.

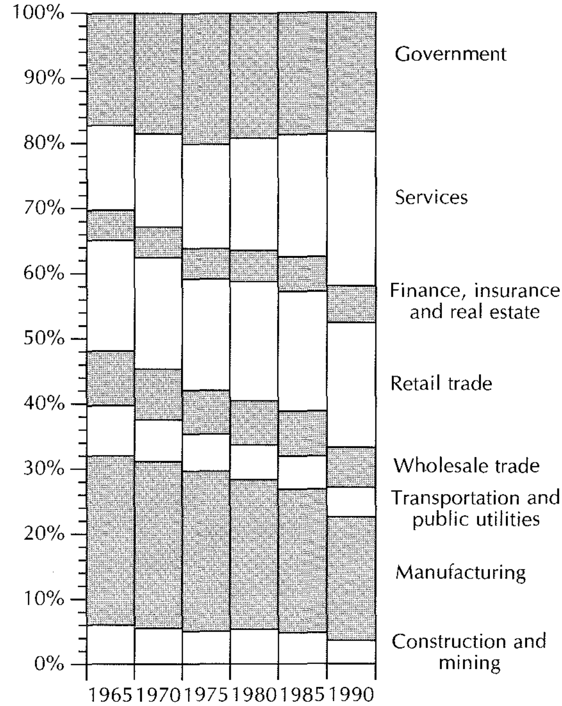

Figure 2–7. Percentage distribution of Iowa's nonagricultural employment, by industry, 1965–1990

Sources: U.S. Department of Labor Bureau of Labor Statistics (1977, pp. 273–278; 1989a, pp. 1004–1026) and Iowa Department of Employment Services (1991).

It should be stressed that these changes reflect how many residents held jobs, but these jobs were not *necessarily* within the county. Some counties had more residents with jobs in 1990 than in 1980 but also far more people with jobs outside the county. For example, Iowa County, just west of Iowa City, gained 12 residents with jobs over the decade, but about 568 more Iowa County residents had jobs outside the county in 1990 than in 1980. This divergence between place of residence and location of employment is becoming significant for many counties, and the economic interdependence of where people live versus where they earn their living is likely to increase. Thus commuting between counties is a growing phenomenon in Iowa.

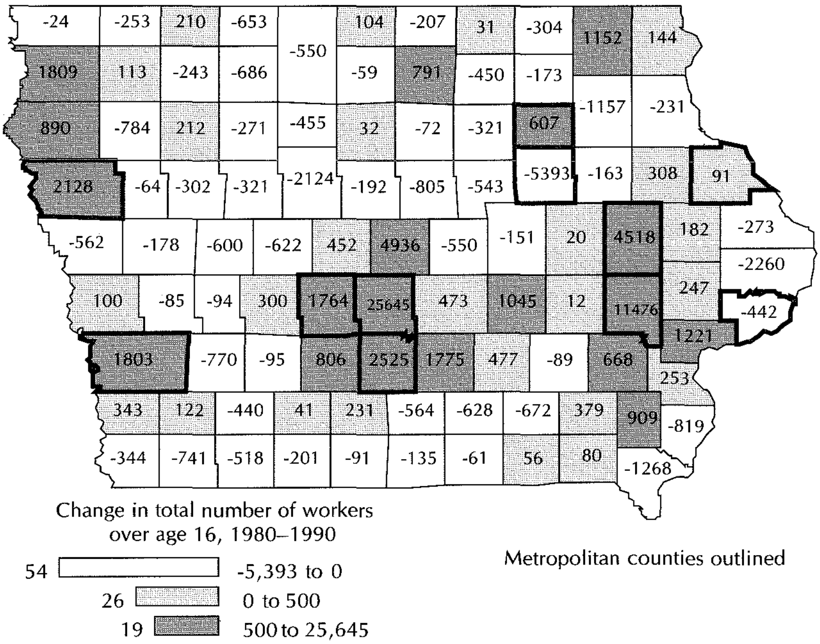

Figure 2–8. Total change in number of employed people over age 16 in Iowa, by county of residence, from 1980 to 1990

Sources: Burke and Goudy (1992, individual reports for Iowa's 99 counties) and U.S. Department of Commerce Bureau of the Census (1983a, Table 174).

Just as manufacturing has become a smaller proportion of all employment in Iowa, the location of manufacturing jobs has changed. The Census Bureau annually counts jobs by location, as distinct from counting workers by residence. Figure 2–9 shows that manufacturing employment has decreased significantly in some metropolitan areas, particularly Waterloo and the Quad Cities (9,328 and 6,909 fewer jobs, respectively). In fact, the 11 metropolitan counties collectively lost 30,207 manufacturing jobs, slightly more than the net loss for the entire state (29,911). The remaining 88 nonmetropolitan counties maintained their number of manufacturing jobs as a group, actually managing a small increase of 296 jobs. Thus, while manufacturing employment in Iowa has diminished, it also has shifted. By and large, these shifts have been accompanied by lower real wage levels. There is evidence, however, that the value added by manufacturing in Iowa has increased. Value added is a more accurate indicator of manufacturing activity; employment is inadequate as a measure of the role manufacturing plays in Iowa's economy.

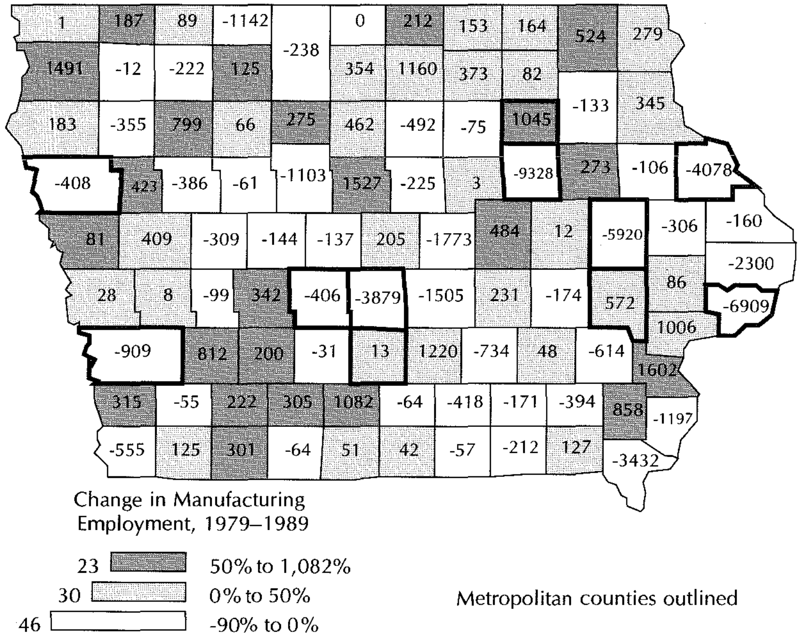

Figure 2–9. Change in manufacturing employment in Iowa, by county, from 1979 to 1989

Sources: County Business Patterns data.
See U.S. Department of Commerce Bureau of the Census (1981; 1991a).

GOODS MOVEMENT

Iowa's farmers and businesses rely on several transportation systems to move commodities and goods into, out of, and within the state. Agriculture makes heavy use of trucks and railroads to move commodities within Iowa, railroads move commodities within the state and to points outside it, and barges carry many agricultural exports from Iowa down the Mississippi River. Transportation use by agriculture is affected by the size of each year's crop, the size of export markets, and the location of markets for corn and soybeans within the United States. The relative use of railroads and barges to move grain long distances depends on geographic location, seasonal factors, and differences in day-to-day pricing. Over the medium term, a recent report has forecast that the amount of commercial grain sales in Iowa from farms to markets both domestic and foreign, will increase by about 36 percent from 1988 to 1993 (McVey, Baumhover, and Baumel 1991, p. 12).

Manufacturing firms tend to use trucks for most shipments of goods out of Iowa, although railroads are also important for bulk goods. Deregulation of trucking, airlines, and railroads has opened up new transportation options for Iowa's firms, and many use different transportation channels than five or ten years ago. The growth in manufactured exports during the 1980s has changed how Iowa firms reach customers—many use air when once surface transportation would have sufficed. For example, air cargo shipments in Iowa have more than doubled from 1986 to 1990 (Iowa Department of Transportation 1992, p. 45). Finally, the adoption of just-in-time manufacturing inventory control and other modern techniques has changed in complex ways the types of transportation that firms use and need. A firm that supplied distributors weekly by truck five years ago may now use daily air express shipments to replenish only specific items. Such changes affect the mode used, the frequency of use, and the cost of transportation services.

Figure 2–10 provides a summary of how manufacturing freight is transported to and from Iowa. This figure shows the growing and substantial role played by trucking. In 1989, about 40 million tons of freight left Iowa by truck, and 35 million tons of manufactured goods arrived at sites within the state by that mode (unpublished update of 1989 data from the Iowa Motor Truck Association; see also Iowa Motor Truck Association 1991, pp. 10–11). Rail is also an important means of freight transportation, accounting for five million tons of inbound manufactured freight and 11 million tons of outbound manufactured freight in 1989. Generally, rail is used to transport heavy bulk items of low value, like coal and grain. Relatively few finished manufactured goods are delivered by rail. Air and water play smaller roles for manufactured goods. Air is used for smaller, high value goods and for correspondence, while barges are used to ship coal and raw materials. Intermodal transportation (using two or more modes in an integrated manner) is playing an increasingly important role in Iowa; the number of tons shipped intermodally has more than doubled during the past decade.

Each of the several transportation modes plays a unique role in moving produce and goods from and to Iowa. Competition occurs in markets where the attributes of these modes enables them to provide viable service. Iowa depends heavily on trucking, and this underscores the critical importance of roads to the state of Iowa. Road investment and maintenance policies will continue to dictate the ability of various industries within the state to compete in national and international marketplaces.

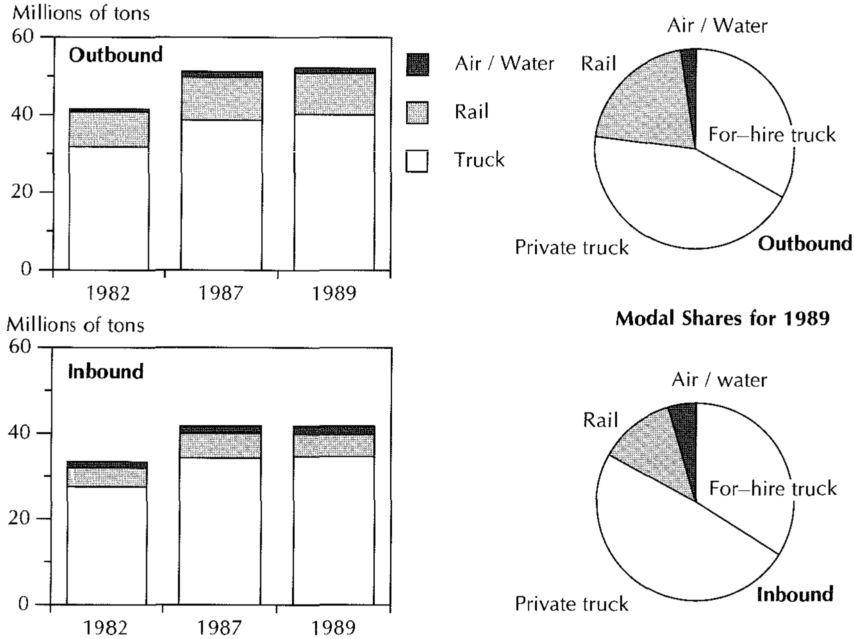

Figure 2–10. Outbound and inbound manufacturing freight for Iowa, 1982, 1987, and 1989, by mode

Sources: Iowa Motor Truck Association (1991) for 1982 and 1987; and unpublished update for 1989.

COMMUTING PATTERNS

Iowa's transportation systems play an important role in bringing together workers and employment opportunities. Table 2–1 shows the means used by commuters to get to work in Iowa and the nation in 1980 and 1990. The table shows that the private automobile has become more important as a means of transportation to work during the 1980s in Iowa. Iowans still have significantly shorter commuting times, on average, than workers nationally, even though the mean travel time edged up five percent to just over 16 minutes from 1980 to 1990. Those Iowans who have long commuting times tend to be clustered around the state's largest metropolitan areas. The private automobile dominates commuting patterns both in Iowa and in the nation. About three quarters of all workers drove alone to work in 1990, and about one eighth more carpooled. In Iowa, the proportion of workers who drove alone in 1990, 73 percent, was sharply up from 1980's figure of 62 percent, reflecting a national trend. Carpooling in Iowa fell

Table 2–1. Distribution of means of transportation to work, Iowa and the U.S., 1980 and 1990
(percent unless otherwise indicated)

	Iowa		United States	
Means of transportation	1980	1990	1980	1990
Drove alone	62.1	73.4	64.4	73.2
Carpool	18.4	11.9	19.7	13.4
Public transportation	1.9	1.2	6.4	5.3
Other means	1.6	0.9	1.6	1.3
Walked or worked at home	16.0	12.5	7.9	6.9
Mean travel time to work, excluding those who worked at home (minutes)	15.4	16.2	21.7	22.4

Sources: U.S. Department of Commerce Bureau of the Census (1983a, Table 6; 1983b, Table 101; 1992) and Burke and Goudy (1992, p. 2).

dramatically during the 1980s, and the low level of public transportation use fell as much in relative terms. While the percentage of employed Iowans who walk to work or work at home has fallen, it remains well above the national figure. This difference reflects both the comparatively large fraction of farmers within the state and the sizable proportion of residents of smaller communities who walk to work.

Travel time to work. The time that workers spend traveling to work varies across Iowa. One way to illustrate how travel patterns vary is to compare the proportion of workers who travel over 30 minutes (about twice the average time) by county. Figure 2–11 shows how significant these "long" commutes are across the state. Overall, about 16 percent of workers in Iowa commute over 30 minutes, so Figure 2–11 separates counties into three groups: those with 16 percent of workers or less traveling 30 minutes, those with between 16 and 25 percent, and those above 25 percent of workers. A number of interesting patterns emerge from this comparison. First, commuting times are generally short in northwest Iowa, with only a few counties having over 16 percent of workers with 30-minute commutes. Second, urban counties also have relatively few long commutes. No more than 14 percent of the workers in Des Moines, Cedar Rapids, the Quad Cities, Iowa City, Dubuque, Waterloo, and Sioux City travel over 30 minutes to work. Third, high proportions of long commutes are concentrated

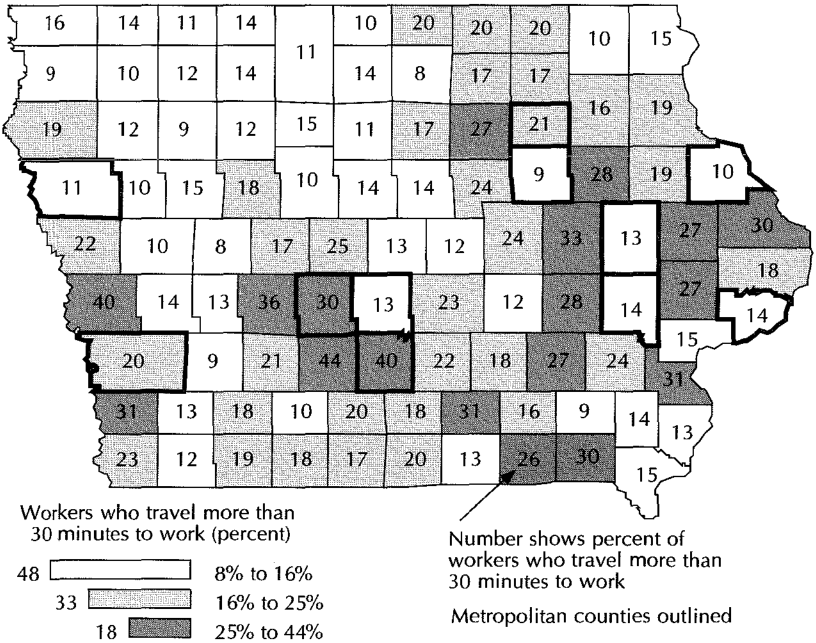

Figure 2–11. Workers who travel over 30 minutes to work in Iowa, by county of residence, 1990
(percent of all who work outside home)

Sources: Burke and Goudy (1992, individual reports for Iowa's 99 counties).

in areas surrounding metropolitan areas: in central Iowa around Des Moines; in eastern Iowa around Waterloo, Cedar Rapids, Iowa City, the Quad Cities, and Dubuque; and in western Iowa from Sioux City to south of the Omaha/Council Bluffs metropolitan area.

Out-of-county commuting. A large number of people in Iowa have jobs that are located outside the county in which they reside. Figure 2–12 shows how the percentage of residents with jobs who work outside their county varied across Iowa in 1990. Statewide, about 18 percent of all employed persons worked outside their county of residence. The 40 counties below this statewide average tend to be in one of three groups: urban counties, such as Polk, Linn, Black Hawk, and Dubuque; rural counties in northwest Iowa; and counties dominated by a large regional center, such as Des Moines County (Burlington), Cerro Gordo (Mason City), and Webster (Fort Dodge). About one quarter of Iowa's counties have significant proportions of out-of-county workers, with more than 30 percent of their residents working elsewhere. In the case of two counties, Dallas and Warren (which are, respectively, directly west and south of Des Moines), over half of their residents work in other counties. In general, the pattern seen earlier with long commuting times is reflected in the counties that have large proportions of commuters. These counties surround metropolitan areas in central and eastern Iowa and opposite Omaha in the western part of the state.

The data do not show exactly where people commute, only where they live. Nevertheless, we can infer the nature of rural commuting patterns because the Census Bureau counts how many residents in each county work in metropolitan counties. Figure 2–12 shows, for nonmetropolitan counties, what percentages of all workers work in a metropolitan county. For example, in Grundy and Tama Counties (southwest of Waterloo), over 30 percent of those employed work outside the county (as shown by shading groups). However, in Grundy County, 22 percent of employed residents work in a metropolitan county, which is likely to be Black Hawk County (Waterloo). In contrast, Tama County has the same high level of commuters, but only eight percent of employed residents work in a metropolitan county. Thus, although counties adjacent to metropolitan areas tend to have large numbers of commuters, not all of them should be assumed to be drawn to larger cities. Intercounty commuting can be just as significant.

Changes in commuting patterns during the 1980s. More people in Iowa commuted outside their county of residence in 1990 than in 1980. In 1990, 225,000 Iowans worked outside their county of residence (including those working in neighboring states), representing 17.1 percent of all workers. In 1980, only 13.7 percent of workers commuted across county borders. This increasing proportion of out-of-county workers has not been evenly spread across the state. Many of the counties with high *absolute* proportions of workers commuting outside the county have shown only small increases in this proportion. Significant increases have tended to be in counties further out from metropolitan areas, but even with these increases, the absolute proportion remains lower than in counties adjacent to metropolitan areas.

In many rural counties, commuting trips are becoming more commonplace; often these trips are quite long. Even though the populations of rural counties are shrinking, increases in commuting trips mean that traffic volumes on parts of Iowa's rural road network have not declined

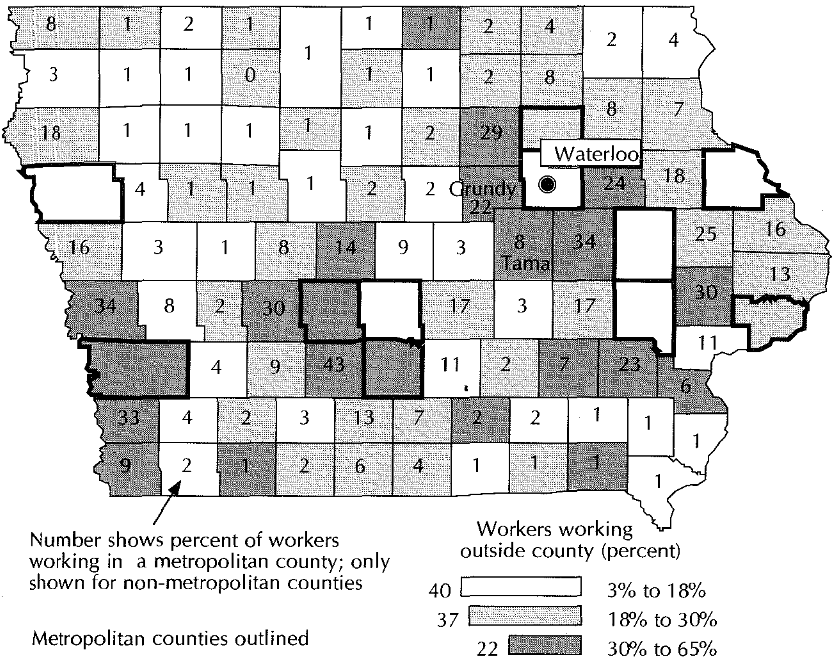

Figure 2–12. Workers employed outside county of residence in Iowa, and percent of workers from nonmetropolitan counties working in metropolitan areas
(percent of all who work outside home)

Sources: Burke and Goudy (1992, individual reports for Iowa's 99 counties).

proportionally. Some of these trips are taken by farmers who have part-time employment off the farm or their spouses who are traveling to jobs. Longer commuting trips also are taken by rural non-farm residents who commute to urban areas.

CONCLUSIONS

Iowa has been greatly changed by the 1980s. The state lost population in the early part of the decade and, against that background, Iowa's population has become increasingly concentrated in the state's largest cities. The recession in the early and mid-1980s led to significant job losses, but the recovery in the late 1980s has made up the losses. Iowa has become less productive on a per capita basis, however, and per capita income has fallen somewhat below the national average. Jobs have followed a similar pattern to overall population, with employment increases most apparent in urban areas. Manufacturing jobs, a notable exception, have been lost in urban areas but maintained in rural areas.

These changes have been accompanied by general changes that affect the state's need for transportation. More people are working outside their county of residence, more people are commuting for longer times, and urban areas appear to be drawing workers from a periphery of counties that surround them. At the same time, manufacturing employment is becoming a little more dispersed and so transportation needs are less likely to vary significantly across the state. The succeeding chapters in this report examine the role various modes play in moving freight, commodities, and people within, to, and from Iowa. The complex changes that the state has gone through reinforce the need for careful evaluation of investment choices—one single policy cannot address Iowa's changing needs.

CHAPTER 3

A FRAMEWORK FOR EVALUATING CHANGES IN TRANSPORTATION SYSTEMS

The relationship between transportation and economic development is both obvious and elusive. We know that good, dependable transportation is an important factor in an area's growth potential. We also know that transportation investments tend to be extremely expensive. Thus, policymakers face difficult and complex decisions regarding these investments. Which modes should be accorded priorities? What investment level is appropriate when future demand patterns are a major unknown? How *should* we consider the economic development effects of potential transportation investments?

A solid framework is needed to answer these and other questions about transportation investments when economic development is a key consideration. In this chapter we present a working definition of economic development and explore the role of transportation in pursuing this policy objective. We examine a series of considerations in using transportation improvements to strengthen the economic competitiveness of a state or other governmental unit. The general concepts presented in this chapter serve as a framework for the chapters that follow.

A DEFINITION OF ECONOMIC DEVELOPMENT

Economic development is best thought of as a process, not an outcome. It is the process through which the income generated within an area increases. Increased income requires either that more resources (land, labor, materials, and capital) be employed in an area, or that existing resources be employed more productively. People have some ability to determine where to work and where to invest their resources. As a general principle, they will deploy resources where the highest income can be earned. Income here is defined more broadly than monetary return alone; it also includes environmental amenities and other quality-of-life factors.

Job growth and economic development

Very often, increases in the number of employees within the state will lead to overall growth in income, the key measure of economic development.

The relationship between employment increases and economic development, however, is imperfect. Development can occur without job expansion, as would be the case if each worker's wage were increased due to productivity gains. A technological breakthrough could lead to increased output per worker, and that could bring about wage hikes. Alternatively, a certain number of comparatively well paying jobs could be replaced by a larger number of poorly paying jobs. The total income generated by the more numerous poorly paying jobs could be less than the total income of the smaller number of well paying jobs. Employment growth is not an adequate measure of economic development.

Import substitutes and growth

Income growth occurs when a state produces more goods and services. When these goods and services are sold outside the state, new income flows in. Conversely, importing goods into Iowa constitutes a leakage of income. It is important, therefore, to substitute Iowa-produced goods for those supplied from out-of-state locations. Doing so increases income within the state. This substitution is facilitated by increasing the quality and cost-effectiveness of Iowa-produced goods.

ROLE OF GOVERNMENT IN ECONOMIC DEVELOPMENT

Government at the state and local levels can increase the potential for economic development. It can do this either by increasing the perceived returns on resources such as labor and capital or by improving the certainty of these returns. State public policies affect the "business climate" by increasing the value of public services, including transportation infrastructure, relative to taxes on labor, capital, or other resources.

Constraints on state policies

Iowa and all other states are limited in their ability to increase incomes and employment. National and international market forces and public policies largely determine the economic environment within which businesses operate. Worldwide demand for grain and the subsidization policies of other nations will more completely dictate the price of Iowa grain than any actions that government within the state may take.

Similarly, individuals and businesses have strong incentives to make the best use of resources under their control, and they tend to do so. It is difficult for government policies to improve on these decisions in efforts to raise overall income levels. The key is to identify instances in which improvements in such activities as the delivery of public services would alter the way in which individuals and businesses deploy their resources.

Making government a "good buy"

The best strategy for a government in fostering economic development is to provide the "right" services in a cost-effective way. The right services are those generating benefits that exceed their costs (foregone private goods), such that the state's residents would be willing to pay the full cost of the services if they could be sold by government. Even better are state policies that maximize benefits for residents per unit of cost. This means that the limited dollars available to a government should be allocated to projects that collectively yield the greatest net benefits to state residents.

Policy-induced changes in the real incomes of individuals may make some people better off and others worse off. Who gains and who loses depends on the nature of a particular change, such as a type of road improvement, and on how the change is financed. By necessity some persons will be made worse off by a project for which costs exceed total benefits. Government cannot embark on projects that have costs greater than benefits and still be a good buy.

Consider a series of road improvements that a state department of transportation (DOT) could make. Because it does not have the resources to make all of these improvements, it must select among them. If each chosen improvement will produce benefits (typically transportation cost savings) that exceed the associated costs, the DOT will make the state better off. If it selects the projects that together maximize the net benefits (benefits minus costs), it will do the best possible job of increasing incomes within the state. Government in this case is a good buy, and it is thereby promoting economic development.

The issue of fairness

Projects that do generate benefits to society that exceed their costs still may not be good investments. If the distribution of costs and gains is unfair, these projects may contribute to a transfer of income that is viewed as undesirable. Alternatively, projects may be undertaken that benefit a targeted group of people, even though these benefits do not exceed the relevant costs. The justification in this instance is that a desirable transfer of income will take place. When redistribution of income is the central objective, a question should be asked as to whether this project is the most cost-effective way of assisting the targeted group of people.

Transportation investment to foster economic development

To translate the general principles just discussed into workable guidelines for evaluating transportation projects, we consider in greater detail the nature of transportation benefits and costs. Transportation facilities are essentially "tools" for moving goods and people from one place to another. These facilities generate benefits only to the extent that they lower transportation costs.[1] Stated differently, the only way that transportation investments can contribute to economic development is by reducing the cost of moving people or goods.

Types of cost savings

Cost savings due to transportation improvements may be realized in numerous ways. Some of these savings accrue directly to those using the transportation facility, while others are passed on to consumers. Among the key types of cost savings are:

- safety improvements that reduce accident costs due to fatalities, injuries, and property damage;
- reduced travel time both for people and goods (inventory cost savings);
- lower costs of production due to greater certainty of arrival time of inputs, particularly in the case of just-in-time manufacturing;
- decreases in fuel and other vehicle operating costs due to smoother, more efficient conditions;
- revised logistics or agricultural shipping patterns, enabling greater efficiencies; and
- reduced noise or air pollution due to greater ease of movement and the ability to use the appropriate transportation mode.

When examining the ability of any proposed transportation improvement to produce net cost savings, and thus raise overall income levels, values must be assigned to what is being saved. These values include a monetary value per unit of time saved, per life saved due to accident reductions, and so forth. Another key policy variable is the interest rate used to discount benefits (cost savings) in future years to calculate their present value. A considerable amount of research has been conducted on the monetization of benefits, but full consensus has not been reached.[2] This lack of

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1 In other terms, transportation services are intermediate goods used in the production of final goods.

2 In fact, the value of time and value of a life saved have been sources of some controversy. See Wilbur Smith Associates (1992a, Appendix B).

consensus has inhibited precise impact analyses of potential transportation improvements. It also has made comparisons of alternative projects difficult.

Cost savings and societal gains

An important point is that transportation cost savings are true benefits to society. When travelers experience time savings, greater safety, or reduced vehicle operating costs, their gain is not offset by losses to other people. Rather, their gain is indeed a gain to society. Cost reductions act exactly the same as income increases by making more resources available for other purposes. If the effective increase in income brought about by a project exceeds its cost, the project is said to be "efficient." It makes society better off.

Transportation investments can contribute to income gains for society and therefore to economic development only if they are efficient. In many ways the best signal of whether a proposed project would be efficient is whether its users would be willing to pay for it. If users are not willing to pay the full costs of a project, they are effectively saying that the resources devoted to the facility would generate more benefits if invested in other projects.

Not investing in a transportation facility when users would be willing to pay the full costs can inhibit economic development. Substandard roads create the costs associated with traffic congestion and longer than necessary travel times. Similarly, overbuilt infrastructure can deter growth. Facilities put in place at an earlier time may not match today's needs or those anticipated in the future. Shifts in population and business activity, as well as changes in technology and demand, occasionally render infrastructure economically or technologically obsolete. Maintaining facilities for which demand has fallen entails real costs that must be borne by infrastructure users (often, users of other facilities) or by taxpayers generally. Excess infrastructure costs act as a tax on economic activity and are therefore a barrier to economic development.

Cost-effectiveness and efficiency

As just discussed, the widely accepted definition of efficiency is that it implies a project is generating greater total benefits than total costs (i.e., it has a positive discounted present value of net benefits) for society. Building an efficient transportation facility will make society better off. A related but different question is whether a project is the *best possible* means for accomplishing a stated objective. Cost-effectiveness analysis addresses this latter question.

There are several means for accomplishing an objective such as shipping grain to New Orleans. One of these means will be cost-effective. That is, on a unit or on an aggregate basis, one means of attaining the objective will cost less than others. It is important that the alternatives being compared all should be capable of achieving the objective in question and that the full costs of each should be compared. From a societal viewpoint, if one alternative receives a subsidy, it may appear to be the cost-effective solution, but in fact the overall cost to society may be greater than might be the case with another alternative. It also is essential that the objective being pursued is clearly specified.

In the public sector, a cost-effective alternative still may not be efficient, if it does not produce benefits to society that exceed the relevant costs. Thus, efficiency and cost-effectiveness analyses are complementary; together they can guide infrastructure investments toward projects that are indeed capable of spurring economic development by reducing net transportation costs.

Network effects and technology

In the preceding discussion, the point is made that transportation improvements can benefit society by lowering the costs of moving people and goods. A question arises as to whether these lower transportation costs facilitate the adoption of new types of technology. If so, are the resulting gains in profitability directly creditable to the transportation improvement?

Transportation, of course, is one component or factor that is an input into the production of specific goods or services. If the cost of transportation falls relative to other input factors, producers will try to substitute more of it for other factors. The result will be more transportation-intensive production and less use of factors such as warehouses and high rents near strategic locations.[3]

By substituting more transportation, the cost of which has been lowered by the improvement, the overall costs of the business are reduced. By being able to use a different technology that is more transportation intensive, the producing business will enjoy increased profits. These increased profits really are a form of transportation cost savings. Put another way, to use the improved transportation facility, the business would be willing to pay a toll up to an amount equal to its increased profits.

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[3] Strategic locations include those near materials, markets, or labor. Typically, land costs will be less at sites removed from such strategic locations.

As discussed earlier, willingness to pay the cost of a transportation improvement is the only sure way to measure its value.

Impact area and the question of transfers

When assessing the economic development benefits of transportation improvements, especially highways, it is important to look beyond the facility in question. That is, a project's benefit to the state as a whole usually cannot be determined by looking *only* at how it affects transportation costs for those using the highway. For example, upgrading an existing two-lane highway to four lanes may lead some businesses to locate along the upgraded highway. This does not necessarily mean that the project increases business activity in the state as a whole. If the businesses previously were located at other sites within the state or if they would have located at sites on other, existing four-lane highways, then the highway improvement simply diverts activity. The project would then increase income and property values along the upgraded road, but at the expense of owners of property along existing roads and highways. It thus transfers income and wealth from one group of property owners to another rather than fostering economic development for the state.

It may be the case that a major highway upgrade could help stimulate significant economic development along a corridor across a state. The question, though, remains the same, "Will the state experience an increase in net income (economic benefits of the project minus its costs), or will the gains to the improved corridor come at the expense of other locations within the state?"

It is worth emphasizing that for transportation projects undertaken by the Iowa DOT, net economic impacts to the state should be the investment criterion. Focusing on corridor impacts, as advocates of a project may logically tend to do, can lead to redundant projects that move activity around rather than helping to stimulate economic development for the state as a whole.

The issue of transfer effects being viewed separately from efficiency gains (benefits that exceed costs) was a key element in final route selection for the "Avenue of the Saints" (see Forkenbrock and Foster 1990). At question was a route connecting St. Louis, Missouri, and St. Paul, Minnesota. Table 3–1 illustrates how very different conclusions are reached if one treats transfer effects as equal to actual economic benefits. If only efficiency

Table 3–1. Economic impact of four alternative routes
(millions of dollars)

	Alternative Routes			
	1	2	3	4
Capital cost	358.5	417.6	1,317.0	1,092.0
Net present value				
• User cost savings only	74.4	–72.1	–361.1	–633.6
• User cost savings plus transfer effects	513.6	425.3	572.9	–153.2

Source: Wilbur Smith Associates (1990, Table 7–13).

gains due to transportation cost savings are counted, alternative 1 is the obvious choice. It would result in net gains to society of $74.4 million.[4]

If transfer effects are treated as benefits, alternative 3 would be the choice because net benefits plus transfer effects of $572.9 million would exceed the $513.6 million of alternative 1. The larger combined figure for alternative 3 is due to the likelihood of much greater transfer effects: the alternative is greater in length and is redundant with other routes from which businesses would be likely to move. Worth noting is that the capital cost of alternative 3 ($1.317 billion) far exceeds that of alternative 1 ($358.5 million).

The Avenue of the Saints case points to the importance of distinguishing between mere shifts in economic activities and improvements in productivity that yield actual gains in real (net of inflation) income. The key point here is that for a highway investment to contribute to national economic growth, it must significantly reduce transportation costs. *Transfers of economic activity from one location to another within an impact area (state, region, or nation) do not constitute economic growth.*

[4] The $74.4 million is a discounted present value of the net benefits produced by the alternative. A discount rate of ten percent real was used, as prescribed by the U.S. Office of Management and Budget. To calculate the present value of net benefits, the stream of benefits is first calculated. Typically, this is the forecast transportation cost savings on an annual basis. This stream is discounted to reflect the value at the present time of this stream of benefits over the useful life of the improvement. Then, the stream of costs is calculated. The initial capital cost of the project and the annualized operation and maintenance (O&M) costs are discounted, just as were the benefits. The resulting present value of costs is subtracted from the present value of benefits to yield the discounted present value of net benefits.

EVALUATING SYSTEM CHANGES

The general framework just discussed provides a basis for evaluating changes to the transportation systems serving the state of Iowa. It requires that in each case the overall gains to society be compared with the costs of the particular improvement. Changes can either involve investments, generally to add capacity, or disinvestments.[5]

Investments and disinvestments

Use of the efficiency criterion for transportation investments was discussed in the preceding section. Applying this criterion, we can compare a series of types of transportation cost savings to the relevant costs if a given investment were made. Likewise, a possible disinvestment can be contemplated. Suppose that traffic levels on a given road have fallen over the years, perhaps due to a superior highway having been constructed that runs parallel to the road. Losses in transportation service—principally longer times en route for those who now use the road—should be contrasted with reductions in costs. These costs include the present value of the stream of operation and maintenance (O&M) costs plus any capital improvements (e.g., bridge reconstruction) that would be needed to keep the road operational. If the cost savings of downgrading would exceed the losses in user benefits, the road is a good candidate for disinvestment.

Disinvestment is rarely an all or nothing proposition. It may be that the service level of the road (or other facility) could be lowered to better reflect current need. Weight limits on the road could be reduced, and a lower priority for snow removal could be assigned to the road. Likewise, dredging and other operations that keep a river navigable could be reduced if traffic levels on the river no longer warrant the previous levels of expenditure. The point is, disinvestment decisions are fundamentally the same as investment decisions: the benefits of each change should be compared with the costs.

Sunk costs

Costs of upgrading a facility or even keeping it at the current service level should not be based in any way on the original cost of the facility. Because the facility is a sunk cost, prior expenditures on it are in no way relevant to decisions regarding the most appropriate future course of action. For example, suppose that a rail branch line once carried a substantial traffic volume, but over the years traffic on the line has diminished greatly. It

[5] Forkenbrock et al. (1990, Chapter 6) present a framework for evaluating the gains to society of road investments intended to promote local economic development.

would be unwise to argue that because that trackage is still in relatively good condition due to an earlier investment, the rail line should be maintained at a high level to protect this investment.

Many transportation facilities were constructed to meet the needs of an earlier time. With changing technology, population shifts, and different economic circumstances, some of these facilities no longer are as viable as they once were. In some cases these facilities can be allowed to decline to lower levels of performance (e.g., lower functional classifications for lesser traveled roads), and in other cases closure may be the best option. It is unwise to consider the resources devoted to the facility in the past: the benefits and costs of future investments should be the sole basis for choices made at this time. Maintaining obsolete transportation facilities at too high a level is inefficient, and it therefore discourages economic development.

User subsidies and investment levels

Cost savings to current and prospective users of the system are the key benefit to be assessed when changes to a transportation system (e.g., roads, waterways, airports) are contemplated. A tacit assumption of most investment analyses is that the current pricing of the system in question is appropriate. Given this pricing, a certain number of users are willing to pay to travel on it.

In some cases, however, current usage rates result from implicit subsidies, such that users are not being asked to pay the full cost that they impose on the system. If full-cost pricing were the basis for user charges, fewer people or businesses would travel on the transportation system. Fewer travelers might well mean that a different level of future investment would be appropriate.

The key point is that subsidies to particular groups of users of Iowa's transportation systems should be understood and treated explicitly when changes to the systems they use are evaluated. The continued subsidy itself should be assessed as to how well it fits with state policy objectives, including economic development. More to the point of this analysis, the magnitude and incidence of various subsidies to users of transportation systems should be taken into account when determining the willingness of users to pay for improvements to these systems. As was stressed earlier in this chapter, a project is not efficient if users would not be willing to pay its full costs. Such projects make society worse off and should not be undertaken.

Subsidies to current users of transportation systems are important to consider when examining policies regarding investments or other system changes. We provide information on subsidy levels whenever possible throughout our analysis.

Investment level and peak demand

The demand for most transportation facilities is not uniform during all hours of the day, days of the week, or seasons of the year. Urban freeways often are congested during commuting hours, but they have considerable excess capacity during other times of the day. Locks and dams on the Mississippi River experience variations in demand, depending on price levels for commodities and weather.

Occasionally the argument is made that transportation facilities should have sufficient capacity to ensure that no congestion exists at any time. This argument largely is based on the rationale that those traveling during high demand periods experience greater transportation costs, primarily due to increased time en route. A policy question thus arises as to whether the socially optimum level of congestion is zero.

Rarely is it economically efficient to invest at a sufficiently high level to completely eliminate all congestion in cases where demand is much greater at some times than others. The cost of the capacity improvement must be weighed against the reductions in transportation costs for those traveling during congested periods. Those using the facility at other times—when excess capacity already exists—benefit little from the expansion. If the cost savings for those using the facility during high demand periods would not be great enough to offset the cost to society of the expansion, it should not be made. Other solutions should be considered, including peak-period pricing that creates an incentive to travel in lower demand periods, if possible.

Risk and uncertainty

Perhaps the most vexing aspect of transportation investment analysis is uncertainty about future conditions. To make rational decisions about investments in any type of transportation facility, accurate forecasts of its future demand are needed. Unfortunately, long-range forecasts have often been inaccurate enough to raise doubts over the likelihood that great accuracy will ever be achieved.

Because a project's efficiency cannot be absolutely assured, a fundamental issue is whether society should err on the side of overbuilding transportation facilities or on the side of foregoing potentially valuable improvements.

The question is especially germane in less populous areas, where the long-term economic future is particularly unclear. In circumstances where another facility (possibly another mode) could probably meet the forecast demand, a similarly high level of uncertainty is bound to exist.

How much risk should a state or other level of government be willing to take? There is, of course, no general answer. As in portfolio management, there is room for some calculated risk in transportation investments, but even comparatively risky investments should still meet the efficiency test: the *expected* present value of benefits should exceed the expected present value of costs. Investment strategies must be prudent. Highly speculative investments are often based on a faith that an improved transportation facility (e.g., a widened highway), regardless of its placement, will lead to increased economic activity. These investments must be distinguished from those that are less speculative. Analyzing the likelihood of attracting the other factors of production (capital, labor, and materials) necessary to enable growth is as good a place as any to begin.

CONCLUSIONS

First of all, in this chapter we argue that a net economic gain, and therefore economic development, should be thought of in terms of increases in real (net of inflation) increases in income. There are limits to what governments can do to spur economic development, but most important is to provide only those services for which residents are willing to pay the full costs. Government should only embark on public projects for which the benefits to society exceed the costs. Iowa should not encourage its political leaders to bring to the state "its share" of nonformula federal transportation funds for projects that are inefficient. The argument that these funds will otherwise go to another state is not sufficient to justify an inefficient project.

Transportation investments have the potential to make an area more competitive for economic activity, provided certain conditions hold. Various types of transportation cost savings increase income, but only if the savings exceed the project's costs. *The only way that transportation investments can contribute to economic development is by reducing the cost of moving people or goods.* Actual net gains to society as a result of transportation cost savings should be distinguished from mere shifts in economic activity that result from changes in relative competitiveness among different locations. Transferring economic activity, in itself, does not bring about economic development.

Very different types of changes in transportation systems can be evaluated in logically consistent ways. Disinvestment decisions are really akin to investment decisions: the question must be contemplated of whether society overall will be better off. The equitability of any transfers in wealth that result from the project or its financing should be considered as well. Existing facilities should not dictate choices for the future because these facilities are sunk costs. They should be maintained if they continue to generate benefits that outweigh their costs, otherwise they should not.

Even with thoughtful analyses of the probable effects of alternative transportation investments, some uncertainty is bound to remain. The key is to manage this uncertainty so that in the aggregate, the state's transportation investments make major contributions to productivity and competitiveness.

CHAPTER 4

ROADS AND HIGHWAYS

Roads and highways are the backbone of Iowa's transportation system. A total of 112,382 miles of roads serve Iowa, 92 percent of which are in rural areas. In this chapter, we examine the critical public policy choices facing this extensive and vital resource. We first compare the size and general condition of the road system in Iowa with road systems in other Midwestern states. Then we address two key policy issues: how should the use of Iowa's roads be priced, and how should travelers be charged for their use of these roads? We examine the road investment issues facing Iowa: where resources should be directed, ways of determining the level to which roads should be upgraded, and the role of economic development in investment decisions. Finally, we assess the potential for advanced technology in making Iowa's road system more productive.

IOWA'S ROAD SYSTEM

Roads within the state of Iowa are separated into three categories: primary, county, and municipal. The Iowa Department of Transportation (Iowa DOT) has principal responsibility for the state's 10,096 miles of primary roads. This category includes interstate highways and arterial highways. While most primary roads are in rural areas, there are about 1,100 miles of urban extensions within the state's incorporated communities. Iowa's 89,468 miles of county roads are the responsibility of the 99 counties; this category includes farm-to-market roads and secondary roads. County roads range from connector roads that carry comparatively high traffic volumes to very low-volume roads that serve small numbers of farms. Municipal streets and roads, of which there are 12,818 miles, are the concern of incorporated communities. This category includes all streets and roads within communities that are not part of the primary road system.

To place the size and condition of the state's road system in perspective, we first compare it to those of eight other Midwestern states. We then focus on Iowa's road system, analyzing its needs for investment and reinvestment. This initial discussion establishes a context for later analyses of public policy issues regarding roads.

Comparative analysis of road systems

In this analysis, we use eight states as a comparison group for Iowa. They include Illinois, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, and Wisconsin. Not only are these states in the same region, they also compete with Iowa for economic activity. In making comparisons, we concentrate on

- interstate highways that connect metropolitan areas,
- arterial highways that link smaller urban areas, and
- rural connector roads that serve as the link between highways and lower volume local roads that provide access to individual residences and businesses.

Figure 4–1 provides a comparison of Midwestern states' road mileages by type and location of road. It is clear that more heavily urbanized states like Illinois have greater total mileages than rural states like the Dakotas; urbanized states also have greater shares of these mileages within cities. Iowa's very extensive rural road network is quite typical of rural Midwestern states.

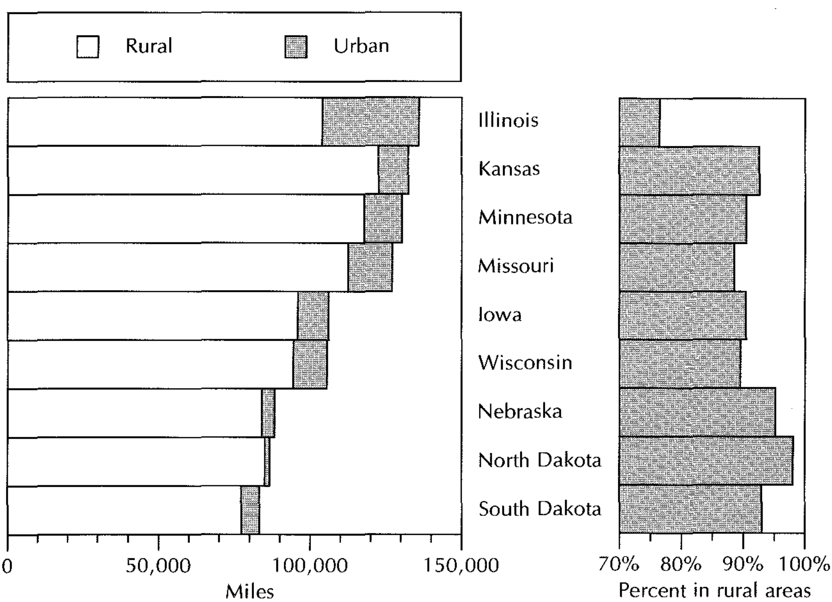

Figure 4–1. Distribution of road mileage by type in Midwestern states, 1990

Source: Federal Highway Administration (1991, Table HM–20).

Comparative vehicle densities among the nine Midwestern states are shown in Figure 4–2. The figure shows that most Midwestern states have fewer total vehicles and total automobiles per mile of roadway than is the national norm. Automobile densities in Iowa, Minnesota, and Missouri are only about half to two thirds of the national average, and are even lower in the other six states. The real message in Figure 4–2 is that states with relatively low population densities also tend to have lower vehicle ownership densities. This is true even though, on balance, vehicle ownership per capita is higher in rural areas than in metropolitan areas. Because Iowa has comparatively low vehicle densities, it is not surprising that the state's roads have rather low vehicle miles of travel (VMT) per day.

Pavement Condition. A road network's quality of service depends in part on the condition of the road surface itself. We can compare present serviceability ratings (PSRs) to approximate differences in pavement condition. A PSR is a numerical value ranging from zero to five, reflecting poor pavement conditions at the lower end of the scale and very good pavement conditions at the higher end. Although PSRs are to some degree subjective rather than objective measures of actual pavement quality, we can use them to gain a *general* sense of comparative conditions among

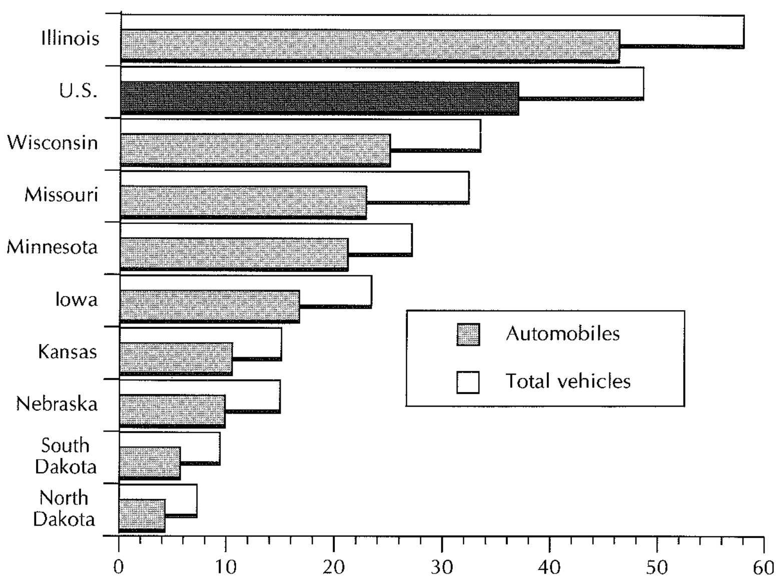

Figure 4–2. Automobiles and total vehicles per mile of road, 1990

Source: Federal Highway Administration (1991, Tables HM–20 and MV–1).

states' highways. The U.S. Department of Transportation reports comparative ratings for all urban and rural road classifications except local roads. These data cover about one third of Midwestern states' road systems by mileage—roads that carry between 80 and 90 percent of the traffic in these states.

Figure 4–3 shows how pavement conditions vary for rural interstate highways in the Midwest. Iowa ranks fourth in terms of the proportion of its interstate miles that are in good condition (PSR above 3.5). The proportion of Iowa's rural interstate highways that are in bad condition (PSR below 2.5) is fairly small. Figure 4–4 shows the same comparison for rural arterial highways. There are about seven to eight thousand miles of rural arterial highways in most Midwestern states, compared to about 600 miles of interstate highways. For these arterial highways, Iowa ranks low in terms of the proportion in good condition, but the proportion in bad condition (PSR below 2.0) is again fairly small.

The comparative PSR figures tell us that Iowa's roads and highways tend to be in good but not excellent condition. Iowa's arterial roads are not

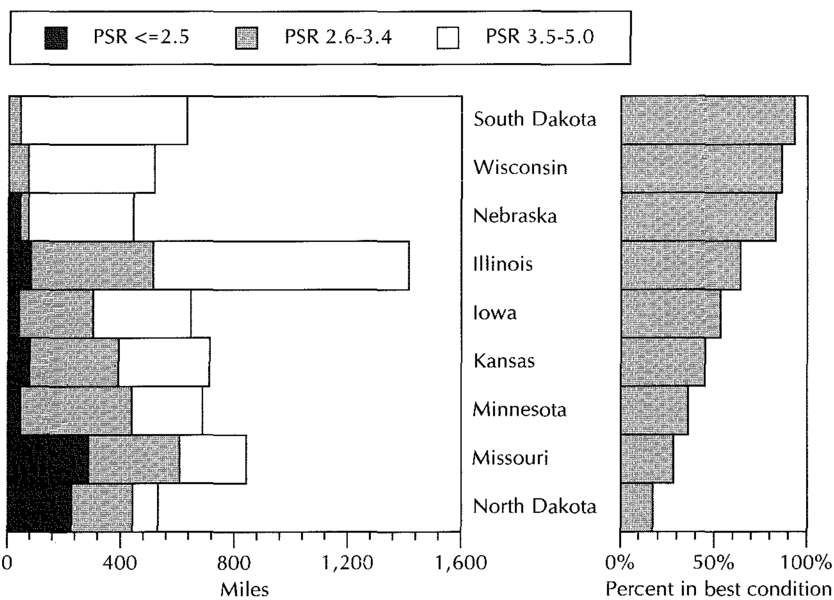

Figure 4–3. Distribution of rural interstate mileage by present serviceability rating (PSR), 1990

Source: Federal Highway Administration (1991, Table HM–63).

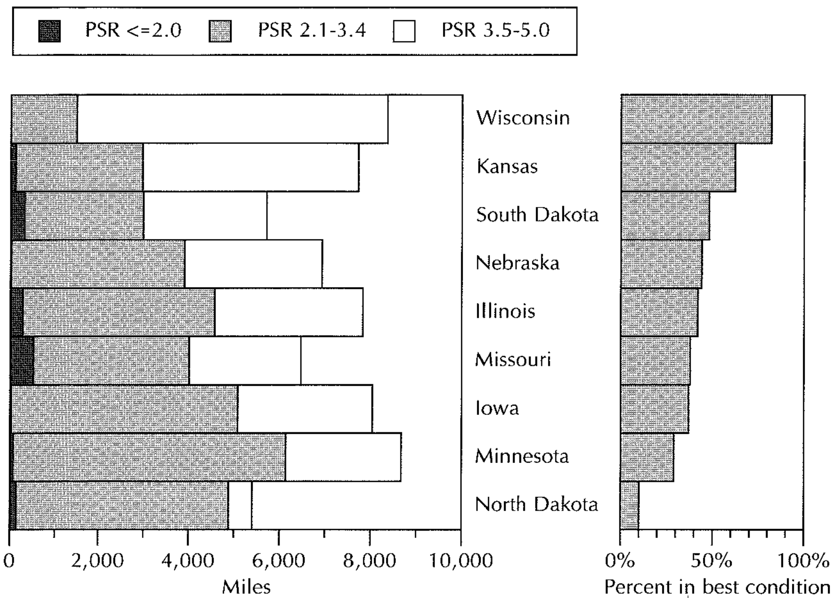

Figure 4–4. Distribution of rural arterial mileage by present serviceability rating (PSR), 1990

Source: Federal Highway Administration (1991, Table HM–63).

among the best maintained in the region, but few are in very poor condition. There is little evidence that the condition of Iowa's rural road network in any significant way places the state in a disadvantageous competitive position.

Traffic congestion. The quality of service offered by a highway network also depends on the level of traffic congestion. We can judge the relative effect of congestion in the Midwest by comparing volume-service flow ratios. These ratios reflect peak hour conditions and thus approximate the extent of congestion. In essence, the volume-service flow ratio compares the volume of traffic to the capacity of the highway: a ratio of one would indicate that traffic volume equals the highway's capacity. The U.S. Department of Transportation reports five classes of volume-service flow ratios, varying from below 21 percent, indicating little or no congestion, to above 95 percent, indicating heavy congestion (Federal Highway Administration 1991). Table 4–1 shows how congestion on Iowa's roads compares to the Midwest and the nation for interstates and rural arterial highways.

Table 4–1. Congestion of interstates and rural arterial highways in Iowa, the Midwest, and the nation, based on volume-to-capacity ratios, 1989
(percent)

	Urban interstates			Rural Interstates			Rural arterials		
Ratio	Iowa	Midwest	U.S.	Iowa	Midwest	U.S.	Iowa	Midwest	U.S.
< 0.21	4	8	4	26	28	28	76	62	48
0.21–0.40	37	19	14	46	46	34	24	30	36
0.41–0.70	44	28	29	28	19	26	0	7	13
0.71–0.79	2	6	9	0	2	4	0	1	1
0.80–0.95	8	15	13	0	3	4	0	0	1
Over 0.95	5	24	31	0	2	4	0	0	1
Total	100	100	100	100	100	100	100	100	100

Source: Federal Highway Administration (1990, Table HM–61).

Traffic congestion in Iowa is significantly lower than in other states in the Midwest and the nation. Only 15 percent of Iowa's urban interstate highways have a volume-service flow ratio above 0.70, compared to 45 percent in the Midwest and 53 percent in the nation.[1] Missouri has the largest proportion of urban interstates with high congestion (67 percent), while North Dakota has none. A similar if less pronounced pattern holds for all urban and rural roads on the Federal Aid System in Iowa, as well as for rural interstates. No rural interstate miles in Iowa had congestion in 1989; this is perhaps not surprising, but it is still significantly better than the Midwest generally or the nation as a whole. The transportation costs associated with congestion are severe in some parts of the United States; congestion adversely impacts these areas' economies both by extending time en route and by making the time of arrival less certain. By its comparative lack of congestion, Iowa has a competitive advantage in this important dimension of transportation.

1 A recent report focusing on urban traffic congestion has considered the question of what measures can be used to define congestion. With respect to the volume-service flow ratio, a value of 0.80 has been suggested as a threshold for congestion (U.S. General Accounting Office 1989, p. 41).

Status of Iowa's roads

Having provided a general overview of how Iowa's roads compare to those in neighboring states, we now examine in more detail how conditions vary across the state's roads. The Iowa DOT assesses the condition of all segments of the state's primary road category using a set of sufficiency ratings. The method used to develop these ratings for rural segments of primary roads is shown in Figure 4–5. A similar approach is used for municipal and suburban portions of the primary road category, with different factors used that are more appropriate for each.

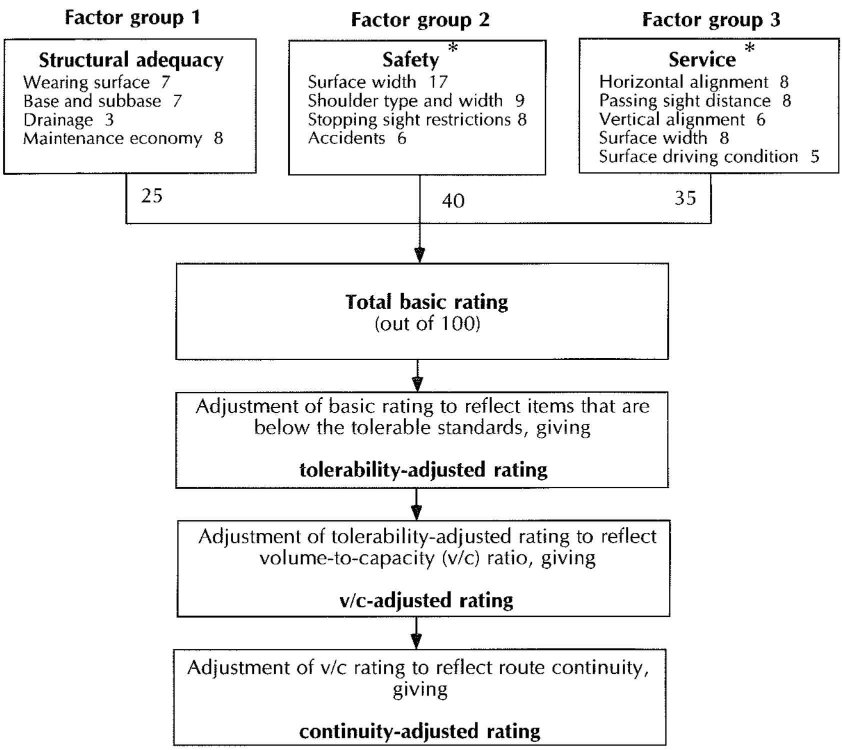

Figure 4–5. Factors and weightings used by Iowa Department of Transportation to develop rural primary highway sufficiency ratings

* These factors are for rural sections of the primary road system; different factors are used for municipal and suburban sections.

Source: Iowa Department of Transportation
Office of Advance Planning (1992, pp. 1–10).

The Iowa DOT's approach is similar to that applied in most other states; it is based on the concept of a "tolerable standard." A tolerable standard is defined as "the minimum prudent condition, geometric or structural, which can exist without being in need of upgrading" (Iowa Department of Transportation Office of Advance Planning 1992, p. 1). For each of the 13 factors considered within three groups (structural adequacy, safety, and service), the tolerable standard is set at one half of the maximum points possible. The rating for a segment of road is found by assigning a score to each factor and aggregating these scores into a basic composite rating. If this basic rating is below 50 (out of a possible 100), the segment is considered in need of upgrading.

Three kinds of adjustments can be made to this basic rating. The first adjustment reduces the basic rating if any of the scores on the components are below the tolerable standard. A second adjustment reflects the volume-to-capacity (v/c) ratio for the road segment. Roads with lower ratios have their tolerability adjustment ratings increased (lower traffic volumes effectively lower the need for upgrading). The third adjustment allows for differences between the segment's v/c ratio and that of the road section of which it is a part. It adjusts upward if the rating of the individual segment is higher than the weighted average of the overall section. The final result is a "continuity-adjusted rating," and it is this rating that is used to assess the condition of segments of the state's primary road system.

Of the 8,601 miles of rural primary highways in Iowa, 74 percent had continuity-adjusted ratings above 50 (i.e., above the tolerable standard) in 1992. To take average daily traffic (ADT) more directly into account, we weighted the continuity-adjusted ratings for each mile of road by the volume of traffic it carries. The results were encouraging: the heavily traveled parts of the primary road category are clearly in the best condition. Over one third of the rural primary road category is in good condition when weighted by ADT, versus only six percent when system mileage is considered alone. About one fifth of the system, by either measure, is below the tolerable standard.

Needs analysis of Iowa's roads

State departments of transportation periodically conduct "needs" studies to assess the condition of their road systems and to estimate the cost of making necessary improvements. Needs studies have advanced over the years from melodramatic efforts to acquire more funding to rather sophisticated evaluations of financial requirements to achieve specific standards and levels of service. Levels of service for road segments are dictated by their functional classification and the traffic volumes they serve.

The Iowa DOT has recently completed a needs study for the state's highways, roads, and streets for the next 20 years (Iowa Department of Transportation Office of Advance Planning 1991b). The study was conducted in five steps:

- classify each road segment;
- develop design guidelines for each classification;
- collect data on the current condition of each road segment;
- compare the current and forecast conditions of road segments to design guidelines and suggest timing and types of improvements needed to correct any deficiencies identified; and
- estimate the cost of making these improvements, allowing for regional variations within the state and including maintenance and administrative costs.

Over the 20-year period of the forecast, the Iowa DOT has estimated that the total cost, in 1990 dollars, of keeping the entire road system above appropriate design standards would be $27.2 billion (Iowa Department of Transportation Office of Advance Planning 1991b, Table 1). The DOT has also forecast the amount of revenue that would be available to meet these needs at the state, county, and municipal levels. These revenue forecasts are based on assumptions that basic policy decisions at the state and federal level will not change concerning fuel tax levels and distribution formulas. Using this approach, the Iowa DOT has estimated that revenues over the 20-year period will total $18 billion, about two thirds of the forecast need.

Figure 4–6 shows the needs and likely resources for each category of the system. Given the uncertainties inherent in any projection of this kind, and given the fact that the need estimate is in essence an "ideal" target, the forecast is reasonably positive. At the municipal and state levels, forecast revenues are about three quarters or more of forecast needs. In broad terms, it should be possible to make the majority of needed improvements to these road categories over the next two decades. For counties, however, the outlook is more troublesome. With revenues only projected to meet half of the identified needs, it is unlikely that the gap can be accommodated without making significant changes to system size, maintenance standards, or revenue sources.

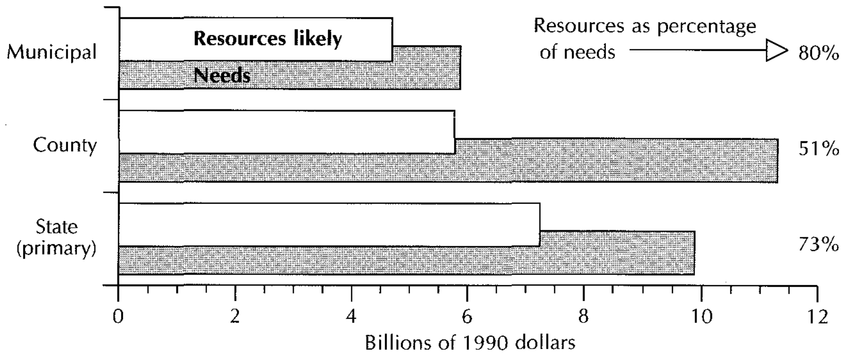

Figure 4–6. Comparison of forecast needs and resources for roads in Iowa, 1990–2009, by road category

Source: Iowa Department of Transportation
Office of Advance Planning (1991b, Table 5).

Figure 4–7 clearly illustrates the combined effects on needs of system size and traffic volumes for each road category. When we compare the need per mile, counties are forecast to need about $6,000 annually for each mile of road. In contrast, state primary roads are forecast to need about $50,000 per mile. The differential concentration of traffic on each system changes this relationship. When need is compared to vehicle-miles of travel (VMT), primary roads need about four cents per VMT annually; county roads need over four times as much.

Repair, reconstruction, and maintenance of bridge structures are major elements of total estimated needs for county roads. One quarter of all needs in the county road category relate to bridges, compared to only seven percent of municipal needs. It is estimated that about $2.8 billion will be needed for rural structures over the next 20 years, an annual cost of $140 million in 1990 dollars. To put this cost in perspective, the total county share of the Road Use Tax Fund (RUTF) in Iowa in 1991 is slightly over $200 million. Thus, on average, almost three quarters of all state allocations to counties for road spending over the next 20 years could be taken up by bridge repairs alone.

Summary

Because of the relatively uniform fertility of Iowa's soils, its settlement patterns have been scattered. These scattered settlement patterns have led

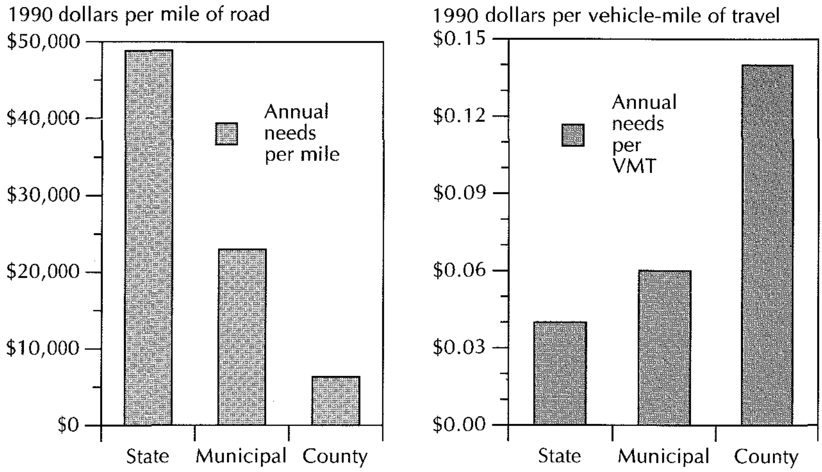

Figure 4–7. Estimated annual needs for highway improvements in Iowa, 1990–2009, by road category*

* Cost in 1990 dollars for 20 years, divided by 20.

Sources: Iowa Department of Transportation Office of Advance Planning (1991b, Table 5) and Iowa Department of Transportation Bureau of Transportation Safety (1991, p. 5).

to the construction of a large, 112,382-mile road system. This road system is vital to Iowa's economy, and it represents the state's largest infrastructural holding. The quality and performance of Iowa's road system are highly important in their own right, but how Iowa's road system compares with the road systems of other Midwestern states affects Iowa's economic competitiveness. Our comparative analysis suggests that, relative to those in its neighboring states, Iowa's rural primary roads generally are in good but not excellent condition. One area of comparative advantage for Iowa is its near absence of traffic congestion.

Looming in future years are major "4R" projects (so-called because they involve resurfacing, restoration, rehabilitation, and reconstruction). Based on the Iowa DOT's latest needs study, $27.2 billion in 4R projects will be required over the next 20 years. Revenues are not forecast to be sufficient to defray the costs of all needs. Thus, Iowa faces important public policy choices in the way it prices the use of its roads and how it invests in these roads.

ROAD PRICING AND FINANCING

One of the most important public policy issues in transportation is road pricing. The type and amount of user charges assigned to the operators of various categories of vehicles will greatly affect use patterns, revenue available to finance improvements, and fairness. An interdependency thus exists between road pricing and the level of road investment. Given present and forecast traffic volumes on a road, an improvement would be efficient if the cost savings it would produce exceed the relevant capital and maintenance costs (see Chapter 3). But if use of the road is subsidized such that less than the full cost of its use is charged, traffic volumes will be "artificially" high. These higher volumes would lead to an overstatement of the benefits that would result if the road improvement were made.[2]

The best way to consider the long-term need for road investments is to begin by examining the appropriate level of user charges. To determine an appropriate level, we must establish accurate cost responsibilities for each class of vehicle using the state's roads. Then we can assign to its users the fees necessary to fund the desired road system.

Cost responsibilities

For road use to be efficiently priced, each user must be asked to pay his or her marginal or incremental cost. Less technically, each traveler creates costs that would not have arisen if a particular trip had not been taken. The traveler should be made aware of these costs as a basis for deciding whether to make the trip.

It is important to draw a distinction between fixed and variable costs. Fixed costs do not vary whether or not a particular trip is taken. One example of a fixed cost is road signs. Such costs should be assigned to travelers as average costs; that is, the total cost of providing signs should be divided by the number of trips past the signs. Each traveler would then pay the average per-trip cost of the signs. Variable costs depend on several factors, including the type of vehicle and the number of other vehicles on the roadway. Ideally, on each trip the traveler would be assigned the appropriate marginal cost based on the variable costs generated by that trip. The sum of this marginal cost and the appropriate average cost is the total cost responsibility of the vehicle for that trip.

[2] Schwieterman (1992) has argued that implicit subsidies to heavy vehicles are passed on to consumers as lower prices. As a result, shippers switch from rail to truck, even in cases where rail might be more efficient from a societal perspective. Additionally, shippers transport more freight than is economically justified.

While the concept of cost responsibility is reasonably simple, measuring the marginal cost of the use of different types of roads by vehicles of varying sizes and weights is very complex. Particularly complex is the basis for charging heavy vehicles. It is well known that damage to roads increases more than proportionally with the weight per axle of a vehicle. We should stress that the exact relationship between axle weight and damage, and hence the marginal cost of the vehicle's use of a road, has been the subject of much disagreement. One recent study has suggested that costs related to road wear rise with the third power of axle weight (Small, Winston, and Evans 1989, p. 11).[3] This implies that an axle of an 80,000-pound semitrailer truck damages roads about 1,000 times as much as a car. Their research has led the authors to assert that essentially all use-related structural damage of roads is caused by heavy vehicles.

Implications for user charges. The work of Small, Winston, and Evans leads to the conclusion that if road pricing were more closely based on the costs imposed upon the road system by vehicles, the resulting system of user charges would be quite different from the current system. These authors have concluded that a five-axle semitrailer truck weighing 33,000 pounds pays over seven times its fair share per mile traveled on rural highways; an 80,000-pound semitrailer truck configured similarly pays only a third of its fair share (Tables 3–4 and 3–5). The fair rate per mile for the latter vehicle would be about 14 cents per mile on rural highways, the authors contend.

There are two ways to reduce the cost per mile of operating a heavy truck on intercity highways. One is to configure the truck with more axles. Because it is not the weight of the vehicle that matters, but rather the axle weights, it follows that if more axles are used to support a given weight, pavement damage will be reduced dramatically. For example, Small, Winston, and Evans (Table 3–5) have concluded that the appropriate user charge for an 80,000-pound six-axle semitrailer truck would be 41 percent less than for a five-axle semitrailer truck of the same weight. A second way to reduce the cost per mile would be to pave highways with thicker slabs that are capable of supporting the weight of heavier vehicles. The same authors have estimated that if current pavement on intercity routes were

[3] An earlier study by the American Association of State Highway Officials (AASHO) concluded that a fourth power relationship exists (see Highway Research Board 1962). AASHO was the predecessor of the American Association of State Highway and Transportation Officials (AASHTO), an organization of state departments of transportation. Its several committees work toward standards and procedures to the mutual benefit of its members.

the optimal thickness, user charges for heavier vehicles could be reduced and still be sufficient to fully cover the costs imposed by these vehicles (Table 3–11). When pavement thickness is increased, its ability to withstand high axle weights increases far more than proportionally.

Investment policy implications. Recent research suggests that if the number of axles on heavy vehicles is increased and if intercity networks are built with thicker pavements, it is highly likely that transportation costs will decrease. Small, Winston, and Evans (Table 3–7) have estimated that a national system of improved highways would make it possible to save $7.7 billion annually in operating costs (in 1982 dollars). Of this, about three quarters of a billion dollars in cost savings would be enjoyed by trucking companies. Savings to trucking companies would result from reduced user charges related to pavement maintenance expenses, despite their need to pay the additional capital cost of the thicker pavement initially. Longer-term maintenance costs borne by heavy trucks would be reduced sharply. For example, these authors (p. 44) have estimated that the charge based on marginal cost for an 80,000-pound, five-axle semitrailer truck (the most common configuration) would be decreased from 14.46 to 3.90 cents per vehicle mile.

The implications for Iowa of an optimal pavement investment policy are significant. As rehabilitation cycles occur, paving a designated heavy truck highway system at a thickness that minimizes the sum of initial capital and long-term maintenance costs could pay good dividends. Together with user charges that escalate with axle weights, this policy has the potential to substantially reduce the state's long-term transportation costs. As vehicle monitoring technology (discussed later in this chapter) advances, it will become possible to fine-tune use pricing and thereby encourage heavy trucks to use the routes paved to adequately support their axle weights. It is significant that the Iowa DOT currently has a policy of adding an extra inch of thickness to the design standard when repairing interstate highways.

Cost-based user charges

The most fair and efficient road user charge structure would be one based on the marginal cost of this use. If users of Iowa's roads actually were charged on the basis of marginal cost, two important public policy objectives would be pursued:

- operators of heavy vehicles would have an incentive to take more directly into account the damage to roads when they configure and load their vehicles and

- shippers would be encouraged to make modal choices that reflect the true cost to society because the cost of road use would be more accurately reflected in shipping rates.

If it could be designed properly, a method of charging road users that is based on marginal cost would be superior to current methods. After discussing how Iowa charges for the use of its road system, we examine the desirable attributes of an improved, cost-based user charge approach and suggest an agenda to make it feasible.

Shortcomings of current methods. Like nearly all other states, Iowa relies primarily on motor fuel taxes and registration fees to charge vehicles for the use of its roads. The convention of fuel taxes and registration fees is long-standing. Currently, Iowa assesses a 20 cent per gallon tax on gasoline and a 22.5 cent per gallon tax on diesel fuel. The state also assesses a registration fee that varies with the value and weight of a vehicle. Together, Iowa's diesel fuel tax and registration fee result in an average per-mile charge for an 80,000-pound, five-axle semitrailer truck of about six cents, depending on the assumptions used.[4]

Arguments against the common practice of assigning registration fees and motor fuel taxes to charge heavy vehicles for road use have been summarized by Snell (1989). He has pointed out that registration fees are inequitable: a vehicle traveling 100,000 miles per year pays the same fee as an identical vehicle traveling only 10,000 miles per year. Thus, one vehicle pays a per mile registration fee that is ten times that paid by the other (p. 12). Thus, while the per-mile marginal cost of road use does not vary with the number of miles traveled, the registration fee varies greatly. Stated differently, for the registration fee to be high enough to be effective in charging high-mileage vehicles, it would have to be so large as to be confiscatory for lower-mileage vehicles.

The motor fuel tax has the advantage of being directly related to the actual number of miles traveled. It is also easy to collect. Yet many analysts, including Snell, have argued that fuel consumption does not increase proportionally with vehicle weight (or axle weight). For example, an Oregon study has concluded that an 80,000-pound truck imposes a per mile cost to the road system that is at least 16 times greater than that of an automobile (Coulter 1984, p. 28). This type of truck, however, pays only

4 The American Trucking Associations has estimated the figure to be 6.3 cents per mile, based on an average of 80,000 miles per vehicle annually, with Iowa user charge rates applied to all miles, regardless of where they occur.

about four times the motor fuel tax because it achieves about six miles per gallon versus about 24 miles per gallon for the automobile.

With respect to heavy vehicles, the motor fuel tax creates serious inequities and perverse incentives. An 80,000-pound five-axle semitrailer truck imposes costs that are substantially greater (34 times, according to Small, Winston, and Evans, Table 3–4) than a similarly configured vehicle weighing 33,000 pounds. Yet the lighter truck only achieves about one more mile per gallon, so it pays about 17 percent less in motor fuel tax per mile traveled than the 80,000-pound truck. Furthermore, as noted earlier, the appropriate user charge for a six-axle semitrailer truck is much lower than for a five-axle semitrailer truck of the same weight. Yet the two vehicles pay essentially the same fuel tax. Finally, the marginal cost of operating a heavy vehicle on a highway with thick pavement is dramatically less than if the same vehicle is operated on a road with low weight-bearing capacity. The fuel tax paid would be nearly the same, however, regardless of which road is used. In short, a very imperfect relationship exists between the amount of fuel tax paid and the cost generated by a particular vehicle.

Six states now use a third approach to charging heavy vehicles for road use: weight-distance taxes.[5] This approach involves assigning a per-mile cost factor to vehicles based on their registered weight. This cost factor is multiplied by the number of miles traveled over a period of time. While conceptually sound, weight-distance taxation has been difficult to administer. For one thing, we do not know precisely what the per mile cost factors should be for vehicles of various weights and configurations (i.e., number of axles). Also, it is unfair to charge a vehicle a cost factor based on its maximum allowable weight when the vehicle is operating at a much lower weight. To be equitable, cost factors would have to vary with the weight on each trip, and monitoring these varying weights would be difficult. Finally, evasion of weight-distance taxes is a problem. If a state has many points of entry, as Iowa does, it would be administratively difficult to monitor all of these points. High administrative costs have contributed to the decisions by five states to abandon this approach in the past few years. Thus, weight-distance taxation has many practical difficulties.

Desirable attributes of a cost-based system. Moving from current approaches for charging operators of heavy vehicles for their use of Iowa's roads to one based on marginal cost pricing would improve both efficiency

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[5] Weight-distance taxes are examined in a recent study by the Congressional Budget Office (1992, Chapter 2). See also Federal Highway Administration (1988).

and equity. For this approach to constitute good policy, however, it must avoid the pitfalls just discussed. Specifically, it must have several attributes:

- **Responsiveness.** In the case of many heavy trucks, the gross weight tends to vary considerably during normal operations. This is especially true of less-than-truckload carriers (see Chapter 7) where the frequent loading and discharging of cargo results in a vehicle weight that is variable and rarely at the maximum for which the vehicle is registered. Ideally, a cost-based user charge system should be able to accommodate these changes in weight and therefore marginal cost. Because the exact weight of a heavy vehicle at all points on a given journey would be extremely difficult to ascertain, fair approximations would be necessary.
- **Enforceability.** Evasion of user charges is a continuing problem, especially with weight-distance taxes. Two elements are key in minimizing evasion: multistate cooperation and use of advanced technologies. Multistate approaches to heavy vehicle user charges make it more difficult to avoid payment by failing to report entry into a particular state.[6] Regarding advanced technologies, major advances are occurring in the development of automatic vehicle identification (AVI) and weigh-in-motion systems. Together these technologies enable unobtrusive, cost-based pricing on highways so equipped. AVI allows positive identification of a vehicle as it passes an interrogation station. Weigh-in-motion scales can be used in conjunction with AVI technology to record a vehicle's axle weight as it passes over various points along a highway at normal operating speeds.
- **Acceptable administrative costs.** Currently, interstate trucking operations must obtain myriad permits and comply with diverse reporting requirements. Generally speaking, relatively complex approaches that more directly take cost responsibilities into account involve higher administrative costs than simpler, but less fair, approaches. One of the most promising ways to lower administrative costs is for numerous states to standardize approaches to charging heavy vehicles. Doing so could enable trucks to travel through many states with minimal disruption. Additionally, using data from AVI technology, billing for road use could be electronic; trucking companies would receive a billing statement each month based on AVI data.

[6] It is quite likely, however, that the problem of evasion is greater with intrastate operations than those involving travel between states.

An agenda for Iowa. It is clear that more work is needed before Iowa could adopt an approach to charging heavy vehicles that is based on marginal cost. Given the major shortcomings of current approaches, however, a strong argument can be made for working toward cost-based pricing of road use. Several key elements would help make this approach feasible:

- **Technical progress.** Continued work is needed to enable AVI and weigh-in-motion systems to support cost-based user charges in Iowa. AVI has been implemented in Oklahoma, Arizona, and New Mexico. Using a small, inexpensive device attached to the windscreen, a vehicle's identification number and other data can be provided. The Oklahoma Turnpike Authority uses this technology for automated toll collection and billing across its system, and the results have been excellent. Iowa already has an experimental weigh-in-motion scale on Interstate 80 west of Des Moines. As more scales are installed, it will become possible to assign an appropriate cost-based factor to an electronically identified vehicle at numerous points along a route.
- **Definition of cost responsibilities.** For a cost-based road pricing approach to be equitable, we need a clear understanding of cost responsibilities for vehicles with different weights and numbers of axles. We also need to know more about the relationship between road attributes and vehicle cost responsibilities. While a completely definitive cost responsibility study has yet to be completed, dynamic computer simulation models are contributing to a growing understanding of the causes of pavement wear.[7] Continued research on the relationship between axle weight and pavement damage should be a top priority for the state of Iowa, perhaps in cooperation with other states.
- **Multistate cooperation.** Experience has shown that any form of road pricing works best when states cooperate fully. Real progress has been made in multistate agreements for reciprocity in registration fees and motor fuel tax reimbursements. A multistate and preferably national approach to cost-based user charges could enhance productivity of the trucking sector and enable efficient pricing. It also would prevent any short-term losses in competitiveness due to user charges that are out of balance with those of other states. Iowa should fully support multistate efforts to design and implement cost-based user charges.

In summary, it would not yet be feasible for Iowa to implement an approach to charging operators of heavy vehicles on the basis of marginal

[7] A good summary of current research on the interaction between vehicle weight and pavement damage appears in Trapani and Scheffey (1989).

cost. Before this would be good policy, more progress in several key areas is needed. Iowa's policymakers, their counterparts in other states, and leaders in the trucking industry should work together to ensure that an efficient and fair approach is developed.[8]

Equity in registration fees

A final road pricing issue that is important to Iowa also relates to equity of user charges among classes of vehicles. If the objective is to facilitate functioning markets for transportation services, a strong argument can be made against cross-subsidies among classes of vehicles. Iowa currently maintains one such cross-subsidy from cars to pickup trucks. In Iowa, registration fees for cars are based on the weight of the car and the value when new. This fee is then reduced as the car becomes older. The registration fee for pickup trucks weighing three tons or less is much lower, and it remains flat for ten years.

The net effect of these different registration fee policies for cars versus pickup trucks is depicted in Figure 4–8. Through the first eight years, a car will pay $588 more in annual registration fees than a pickup truck of identical weight and value when new.[9] As the two vehicles become more than eight years old, the registration fee for the car will decrease to a level slightly below that of the pickup truck, so that at 15 years, the car will have paid registration fees totaling $392 more than the pickup truck. Because pickup trucks tend to remain registered for more years than cars (Iowa Department of Transportation Office of Vehicle Registration 1992), the amount of cross-subsidy from cars to trucks is increased slightly. The key point is simply that a cross-subsidy exists between different types of vehicles of the same weight and value. On the basis of both fairness and efficiency, the two registration fee schedules should be made equal.

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[8] A variety of approaches to marginal cost pricing of road use by heavy vehicles could be designed. One possibility would be to substantially increase the tax on diesel fuel and then issue rebates to operators of vehicles that would be overcharged. To do this, AVI and weigh-in-motion technologies could be used to record travel on major routes with good load-bearing abilities. The data so recorded would serve as a basis for rebates that would be issued automatically. Those operating vehicles with extra axles (and thus lighter axle weights) could be among the recipients of rebates. This approach clearly would encourage lower axle weights and proportionally more travel on appropriate highways. We should stress, however, that the key to successful implementation would be a multistate program and an accepted scientific basis for cost responsibilities.

[9] Actually, the higher registration fee for newer cars is a form of personal property tax, and it is deductible as such when filing state and federal income tax returns. This deductibility reduces the effective amount of overpayment for cars relative to pickup trucks.

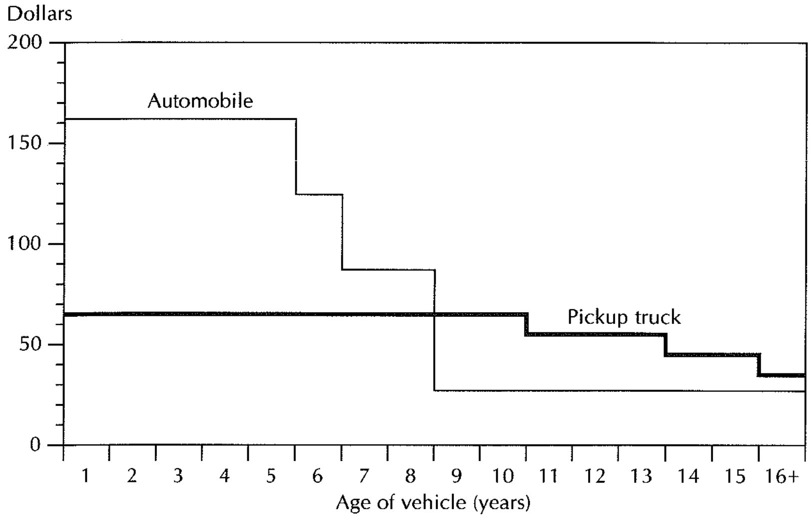

Figure 4–8. Comparison of annual registration fee in Iowa for an automobile and pickup truck, both of initial value $15,000 and 3,000 lb. weight, by age of vehicle

INVESTMENT STRATEGIES

Iowa's system of highways, roads, and streets is by far its most valuable capital asset. The state spends in excess of a billion dollars per year maintaining and upgrading this system. Yet many needs go unmet. As mentioned earlier, the most recent analysis by the Iowa DOT of needed repairs and improvements to roads and bridges has placed the figure at $27.2 billion over the next 20 years. One of the most difficult public policy choices facing the state of Iowa is that of road investment strategy: when should roads be upgraded, maintained at current levels, or allowed to decline to a lower level of service?

Objectives of road investments

To make rational decisions regarding road investments (and disinvestments), certain fundamental objectives must be prioritized and the trade-offs among them recognized. These objectives include:

- **Economic efficiency.** This objective would apply available resources to minimize transportation costs to the traveling public as a whole. It would result in the "biggest bang for the buck" by improving roads where traffic volumes warrant.

- **Local area development.** Alternatively, resources could be applied to assist specific areas of the state. Iowa's RISE (Revitalize Iowa's Sound Economy) program accepts requests from local governments to improve roads in efforts to lure economic activity to the state (see Foster, Forkenbrock, and Pogue 1991).
- **Maintain status quo.** Resources could be deployed to maintain the state's current road system as well as possible. This would include roads that once played more central roles in the state's economy but now carry relatively little traffic.
- **Pursue specific goals.** Yet another possibility would be to place specific policy goals on a higher plane. One such goal might be tourism: roads that carry less traffic than ordinarily required for them to be upgraded would be improved because they enhance access to tourism sites.

The point to be emphasized is that all four objectives cannot be maximized simultaneously because some are incompatible. In Chapter 3 we argued that economic efficiency should be the primary objective at the state level, with other objectives being pursued only with the realization that some loss in overall state efficiency will result. Maximizing economic efficiency will reduce transportation costs by the greatest possible amount, thereby strengthening Iowa's economic competitiveness. For this reason, economic efficiency should be the benchmark for evaluating all road investment decisions; any departures from this objective should be clearly recognized as such.

The road system and cross-subsidization

Funds to construct, maintain, and rehabilitate Iowa's road system flow through the state's Road Use Tax Fund (RUTF) which is managed by the Iowa DOT. These funds come from the state's share of federal funds (from the federal motor fuel tax and other sources); the state motor fuel tax, registration fee, sales tax on vehicles (called the "use" tax), and drivers license fee; and local property tax receipts. A legislatively-formulated allocation procedure distributes the RUTF to the three basic categories of roads within the state: primary (including interstate highways), county (including secondary and farm-to-market roads), and municipal. Currently, the RUTF formula distributes 47.5 percent to primary roads, 32.5 percent to county roads, and 20 percent to municipal streets and roads.[10]

[10] The current RUTF formula was mandated by the Iowa legislature in 1988. Prior to that, 45 percent was distributed to primary roads, 37 percent to county roads, and 18 percent to municipal streets and roads.

Table 4–2 shows that traffic volumes on average are dramatically (30 times) higher on Iowa's primary roads than on county roads. Yet the number of miles of county roads is almost nine times greater. A long-standing public policy issue in Iowa is the extent to which cross-subsidization should occur among the three categories of roads. Table 4–3 shows the approximate extent of cross-subsidization.[11] If there were no cross-subsidization, user charges collected from travelers on each category of road would be spent entirely on that category. As the table shows, however, users of primary roads pay over $125 million more per year in state user charges than is spent on primary roads. Municipal streets and roads receive an amount quite close to what is paid in user charges. The county road category, however, receives over $91 million per year more in RUTF allocations than its users pay into the fund.

Table 4–2. System mileage and vehicle miles traveled by category of road, 1990

Road category	System mileage*	Vehicle miles traveled (VMT)	VMT per system mile
Primary	10,094	14,064,000,000	1,393,302
County	89,468	3,995,000,000	44,652
Municipal	12,818	5,106,000,000	398,346
Total	112,380	23,165,000,000	206,130

* The system mileages in this table are for 1990; the mileages for 1992 we report elsewhere differ slightly.

Source: Iowa Department of Transportation Bureau of Transportation Safety (1991, p. 5).

The extent to which investment can occur in any of Iowa's three categories of roads is directly related to the funds allocated to each category by the RUTF formula. Thus, a central question arises: *should* Iowa cross-subsidize lower volume county roads with user charges collected from those traveling on primary roads? To answer this question, we must consider the impact of doing so on Iowa's long-term economic competitiveness.

[11] Table 4–2 only shows the distribution of state funds. Federal funds also are distributed to the three categories of roads in keeping with federal directives. We should stress that this table is only an approximation of how state resources are collected and distributed.

Table 4–3. Approximate cross-subsidies among road categories, 1990
(dollars)

Road category	RUTF allocation	User tax revenue*	Difference
Primary	317,100,000†	442,159,000	–125,059,000
County	206,900,000‡	115,096,000	91,804,000
Municipal	113,200,000§	116,345,000	–3,145,000
Miscellaneous	36,400,000	—	36,400,000
Total	673,600,000	673,600,000	0

* User tax revenue for each road category was estimated by taking into account the VMT for each vehicle classification and applying average fuel efficiency and appropriate fuel tax rates. Added to this amount for each vehicle classification were total registration fees times the fraction of total vehicle miles operated on each road category. Use (sales) taxes and driver license fees were assigned to each category in the same proportions as registration fees.

† This figure includes 47.5 percent of the RUTF after $86.0 million in "off-the-top" allocations are removed, plus one half of the RISE set-aside ($13.1 million) and all of the State Patrol budget ($23.5 million). Off-the-top funds include RISE, the State Patrol, and $36.4 million that cannot be allocated to the three road categories; these funds are removed before the remaining RUTF resources are allocated via the formula. (RISE is a state-level program for road improvements intended to foster local economic development.)

‡ Included in this figure are 32.5 percent of the RUTF after "off-the-top" allocations plus one quarter of the RISE set-aside ($6.5 million).

§ This figure includes 20.0 percent of the RUTF after "off-the-top" allocations plus one quarter of the RISE set-aside ($6.5 million).

An efficient allocation of RUTF resources would reduce transportation costs within Iowa the most. This would mean spending more funds, regardless of where they were collected, on routes where the potential for transportation cost savings is greatest. On roads where traffic volumes are comparatively heavy, more of an opportunity exists to bring about cost savings because more people are in a position to experience these savings. This argues for allocating a preponderance of RUTF resources to more heavily traveled routes, and that is generally the practice of the Iowa DOT within the limits of the legislatively determined RUTF formula.

There are two perspectives regarding the extent to which lower volume roads should be cross-subsidized. One argues that the road system should be thought of precisely that way: as a system. Lower volume county roads act as collection and distribution elements, and primary roads more often act as line-haul elements. According to this perspective, lower volume roads do not need to be constructed to the same specifications as high-volume roads, but they do need to adequately serve those traveling on them. Because of the multiplicity of origins and destinations in Iowa—a relatively evenly settled, but sparse, state—the county road network is bound to be larger in terms of mileage.

The other perspective argues that for Iowa to be maximally competitive in national and international markets, it must concentrate on connections with out-of-state destinations. Expenditures on lower volume county roads, it is argued, represent a drag on the state's ability to offer fast, efficient routes to these markets. Thus, if those who travel on low-volume roads want a higher level of service, they should supplement RUTF resources to make the needed investment and provide maintenance.

While some cross-subsidization is possible without serious efficiency consequences, it is excessive to redistribute $125 million per year from the vitally important primary road category. It is true that removing all cross-subsidies to the county road network would have serious consequences for rural commuters and farmers alike. On the other hand, these cross-subsidies work against the state's ability to compete. We recommend that the magnitude of cross-subsidies among Iowa's road categories be reduced. As funds are allocated at the state and county levels, the consequences for Iowa's long-term economic competitiveness should be a central consideration.

System continuity should be a key element of resource allocation policy. In particular, the distribution of funds within the county road category should strengthen the ability to support commercial and industrial shipment between counties and improve connectivity to primary roads.

Upgrading primary roads: super-two highways

Recently, two analyses were conducted for the Iowa DOT to determine the appropriate level of investment for what are now two-lane roads. In both cases the study teams concluded that upgrading to four-lane divided highways, at least in the short run, was not economically justifiable (see Wilbur Smith Associates 1992a; 1992b). Instead, both studies found that upgrading to what might be termed "super-two" lane roads would be the efficient solution. In neither case were the current or forecast traffic volumes sufficient to produce transportation cost savings that would exceed the cost of upgrading to four lanes. Significantly, both analyses showed that most of the economic gains that would be realized from a four-lane highway would also be obtained if the road were upgraded to a super-two highway.

We have attached the term "super-two" to two-lane highways that have substantial upgrades. As of now, there is no such road category in Iowa, but the key features often are found on highways within the state. These features include:

- two paved travel lanes 12–15 feet wide;
- ten-foot shoulders, completely paved or having at least a three-foot strip of asphalt and the rest gravel, with a 33-foot clear zone in rural areas;
- a geometric design normally found on four-lane highways, as follows:
  - a design speed of 70 miles per hour (mph) except in areas of rolling hills where the design speed is 60 mph,
  - maximum grades of three degrees,
  - vertical clearances of at least 16 feet, and
  - bridges that exceed the road width by three feet on each side;
- passing lanes approximately every five miles;
- bypasses around smaller communities whenever possible; and
- turn lanes and acceleration lanes at intersections where conditions warrant.

Super-two highways are based on AASHTO guidelines recommended for rural arterial highways. They are superior to conventional two-lane roads (ten- to 12-foot travel lanes, six- to ten-foot gravel shoulders, and maximum grades of five degrees), and they have other features listed above that facilitate improved traffic movement. Where increases in traffic are forecast, it is possible to purchase a sufficiently wide right-of-way to allow a divided four-lane highway to be constructed at a later date. The super-two highway would then serve as half of the eventual four-lane highway.

The capital costs of upgrading a two-lane road to a super-two highway were estimated in the two recent Iowa studies to be approximately 40 percent of the costs of a four-lane highway, and the average annual maintenance costs were about half as great (Wilbur Smith Associates

1992a; 1992b).[12] While both studies found that greater transportation cost savings would result from a four-lane highway, the net benefits to society were greater for the super-two alternative in each case. It is noteworthy that the state could build approximately two and a half times the mileage of super-two highways as four-lane highways with a given budget.

Economic development and super-two highways. Most communities have a strong desire to be served by a four-lane highway. As a result, local leaders frequently exert pressure on state DOTs to upgrade two-lane highways. Frequently the argument is made that businesses strongly prefer communities with four-lane access. Is there an economic development justification for four-lane highways even if they are not economically justifiable on the basis of the transportation cost savings that would result?

In Chapter 3 we assert that the only way in which a transportation improvement can foster local economic development is by lowering transportation costs. By doing so, the improvement helps the locality to attract mobile economic activity because at the margin, the cost of doing business there has been reduced relative to other, unchanged locations. Both of the recent Iowa investment studies found that the preponderance of business relocations to the improved highway corridor would come from other Iowa locations (about 82 percent). This being the case, the state would stand to gain very little overall from the standpoint of economic development, even with the four-lane alternative. When taking into account transfers of economic activity into the state, the results of the analysis remained unchanged: the most positive impact for the state would result if the super-two alternative were selected.

An investment strategy for Iowa. Recent empirical evidence corroborates our theoretical analysis in Chapter 3: constructing a high-capacity roadway where current or forecast traffic volumes do not warrant it will not contribute to a stronger state economy. At best, an overbuilt highway will encourage mostly roadside businesses (motels, restaurants, service stations, and the like) to relocate along the route. The corridor may experience some economic growth, but by and large what growth occurs will be at the expense of other locations *within Iowa*.

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[12] More specifically, the super-two alternatives cost about 40 percent as much as a 55 mph four-lane divided highway, termed an "expressway." An interstate-standard 65 mph "freeway" with grade-separated crossings would cost about five times as much as a super-two highway. Essentially the same unit cost figures were obtained in another study by the Minnesota Department of Transportation (1992, p. 8).

This suggests that roads should be upgraded when and only when forecast traffic volumes are high enough to warrant the necessary capital investment. As average daily traffic (ADT) figures approach 4,000 vehicles per day, upgrading to a super-two highway is worthy of evaluation. If prospects for continued local growth are favorable, a wide enough right-of-way should be purchased to allow the eventual construction of a divided four-lane highway. Generally, a four-lane highway is feasible when ADT figures reach six to seven thousand vehicles.

In short, there is no evidence, theoretical or empirical, to suggest that local economic development will be fostered by constructing four-lane highways in areas with relatively low traffic volumes. A much more promising strategy is to view super-two highways as interim steps toward the possible construction of four-lane highways at a later date. The Iowa DOT's stated objective of moving toward an improved commercial highway network that would connect Iowa communities with out-of-state markets (see Iowa Department of Transportation Office of Advance Planning 1991a) would be well served if super-two highways were constructed where traffic volumes justify. Iowa should add to its 380 miles of noninterstate four-lane highways only in cases where traffic is sufficient to offer the potential for sizable economic gains through transportation cost savings.

Scenic byways

The promotion of tourism is one aspect of the argument that investments should be made in roads to promote economic development. Generally it is not argued, however, that the roads on scenic byways should be upgraded to higher standards than normally would be the case for their particular traffic volume.[13] The expense would be too great for the reductions in transportation costs that would result. Rather, the types of improvements that are contemplated include marking designated routes and adding amenities along these routes. Amenities might include landscaping control or management, provision of opportunities for variety and leisure in motoring, upgraded safety features, and protection of aesthetic or cultural values (Purinton and Hoel 1991, p. 135).

In order to evaluate the economic feasibility of improving designated scenic byways, one must determine how many trips along these routes are undertaken because the routes are scenic byways. More specifically, it

[13] The Iowa Department of Economic Development believes that encouraging out-of-state travelers to leave interstate highways and travel Iowa's rural two-lane roads is good for tourism. These roads allow visitors to see what is unique about the state.

would be useful to know how many travelers on scenic byways within Iowa would spend less time (and money) in the state were it not for these scenic byways. In this way, the incremental income gain to the state could be compared with the cost of designating, improving, and advertising Iowa's scenic byways.[14]

Only these new tourists constitute economic gain to the state. The roadside expenditures of Iowans and other travelers who change their routing to these areas, but would journey within the state regardless of whether scenic byways exist, do not constitute a net gain. They would still purchase fuel, food, and lodging elsewhere within the state, so in their case the net effect is a transfer from those who otherwise would have served the travelers to those along the scenic byway. Measuring these effects would require careful surveys of travelers on scenic byways.

A prudent approach to establishing a system of scenic byways in Iowa is to begin with a few particularly opportune routes. They should be designated with special signs and marketed in the state's tourism promotion materials. After a period of time, a survey should be conducted, whereby travelers on the routes are asked how the designation affected their travel decisions. Based on the findings of this survey, a more informed decision could be made whether to devote further resources to a scenic byway program.

Maintenance versus expansion

Investment usually connotes expansion or other capacity enhancements of the road system. Yet caring for the vital parts of Iowa's existing road system through 4R projects (resurfacing, restoration, rehabilitation, and reconstruction) is also an investment. Skewing road investments excessively toward capacity enhancements would lead to disinvestment of roads important to Iowa's long-term economic competitiveness. As discussed earlier in this chapter, the resources needed to keep the existing road system above appropriate design standards over the next 20 years are expected to outstrip available resources by about $9 billion. Capacity enhancements on any given road should be balanced against the incremental benefits of applying these funds to additional 4R projects.

[14] The U.S. Travel Data Center (1991, p. 6) has estimated that travelers in Iowa (including Iowans themselves) spend $2.3 billion each year while traveling away from home overnight. It is impossible to say how much of these expenditures were made by tourists generally or those traveling along what may be regarded as scenic byways in particular.

ROLE OF ADVANCING TECHNOLOGY

Intelligent vehicle highway systems (IVHS) represent a wide range of new technologies that are being researched and developed for future modes of transportation. They include automatic vehicle identification (AVI) and weigh-in-motion, as discussed earlier in this chapter. Ultimately, the value of IVHS is in its ability to reduce transportation costs. How cost-effective it will be and how soon the various types of IVHS technology will be on line are not yet fully known. Given its possible importance in reducing transportation costs in Iowa and the uncertainty surrounding certain technologies, the state's strategy regarding IVHS should be carefully evaluated.

An overview of IVHS

In its simplest form, IVHS provides useful data to the driver, such as his or her current location. At the other end of the continuum are sophisticated guidance systems which control vehicles on a highway by computer, with the driver simply selecting a destination. Because of advances in computer information technology, the emphasis in IVHS currently is on providing real-time information to the driver or to a central control facility.

IVHS can be divided into four functional categories (see Euler 1990):

- advanced traffic management systems (ATMS),
- advanced travel information systems (ATIS),
- commercial vehicle operations (CVO), and
- advanced vehicle control systems (AVCS).

Each category is not a separate, independent technology, but rather a series of elements that collectively integrate the highway, vehicle, and driver into a single interactive system (Transportation Research Board 1991, p. 9).

Advanced traffic management systems (ATMS). Examples of ATMS applications include traffic flow controls that are able to detect and respond quickly to incidents such as accidents or traffic congestion. Such responses might be to announce accident locations on public information systems, automatically retime traffic lights for better flow rates, or meter and control access on freeway ramps. ATMS works in real-time, collecting information from surveillance and detection systems along the roadside and feeding the information to a central control facility. A number of cities now have various forms of ATMS, and the available technology is advancing quickly.

Advanced traveler information systems (ATIS). These systems use both audio and visual methods to assist drivers in choosing routes, selecting the quickest alternative, and avoiding problem areas. ATIS also is used to announce accidents, weather conditions, recommended speeds, and whether high occupancy lane restrictions exist. Experimental applications of on-board computers with maps and present position indicators are underway with rental cars in Orlando, Florida. Eventually "yellow pages" functions will inform drivers of fuel stations and other motorist services.

Commercial vehicle operations (CVO). The objective of CVO technology is to increase the efficiency of freight shippers. Communications to the driver include information on routing, scheduling, and pick-up and delivery times. Other applications include automatic toll collection and automatic registration checks, both of which reduce the time en route, thereby increasing productivity. CVO technology also facilitates size and weight enforcement, permit administration, and traffic rerouting by governmental agencies.

Advanced vehicle control systems (AVCS). Automatic control of vehicles is a long-range concept that probably will not be seen for a number of years. The advanced electronic highway would take control of vehicles once they enter the freeway. Cars would then travel in platoons, which are groups of vehicles moving at moderately high speeds and separated by only a short distance. With AVCS, highways would have substantially greater capacities and safety margins. Earlier versions of AVCS, already being tested, warn a driver who is following too closely, or they automatically engage brakes.

Potential for Iowa

Three benefits can result from the application of various types of IVHS (Willis 1990, pp. 73–74). One is congestion mitigation, but this is unlikely to be a major benefit to most locations in Iowa. A second is improved safety. Simpler forms of AVCS that reduce the likelihood of rear-end accidents would be of benefit to Iowa as much as to other locations, so vehicles sold everywhere are likely to be equipped with this technology. The third benefit of IVHS is productivity enhancements, and it is this benefit that should be of particular interest in Iowa.

Earlier in the chapter, the benefits of AVI technology were discussed. One of the leading manufacturers of AVI equipment already has sold about

10,000 units, including 5,000 to Schneider National, one of the nation's two largest for-hire truckload (TL) companies (Willis 1990, pp. 81–82). The advantages of this equipment are many, including precise knowledge of the location of vehicles. This allows the closest available vehicle to replace one with mechanical difficulties and ensure the on-time arrival of time-sensitive shipments. According to Willis (p. 83), the productivity gains experienced by AVI users include:

- a 10 to 20 percent reduction in empty miles traveled,
- a 75 percent reduction in average idle time between loads, and
- one to 1.5 additional loads per truck unit per month.

AVI technology could potentially enhance the productivity of both the public and private sectors. Important benefits to trucking companies include reductions in delays at weigh stations and the ability to pay tolls without stopping the vehicle. For government agencies, personnel costs for user charge collection are reduced, and distance-based pricing becomes technologically feasible. The state of Iowa should work with other states and the trucking industry to establish an AVI capability. A spirit of cooperation in supplying the needed public infrastructure and compatible private vehicle equipment is essential (Sobey 1990, p. 40; Transportation Research Board 1991, p. 476).

CONCLUSIONS AND POLICY CHOICES

This chapter has examined the major public policy issues affecting the ability of Iowa's road system to enhance the state's long-term economic competitiveness. Compared with other Midwestern states, Iowa's road system is in good, but not excellent, condition. Fortunately, the best roads tend to be those that have higher traffic volumes. It is clear, however, that Iowa will experience serious fiscal pressure in coming years as the state balances the extent and quality of its road system with the amount of resources available.

Two key policy mechanisms would ensure that Iowa's road system is capable of supporting long-term economic growth: pricing strategies and investment practices. One important step is to adopt a pricing strategy that reflects the marginal cost of a given trip based on road type and vehicle design. The fairness of a road pricing structure based on marginal cost will become less of a concern as the scientific relationship between axle weight and pavement damage becomes more completely understood. With technical advances in automatic vehicle identification (AVI) and weigh-in-motion scales, cost-based pricing is becoming increasingly feasible. A major advantage of this pricing strategy is that businesses operating heavy vehicles have an incentive to configure these vehicles with comparatively low axle weights. Lower axle weights could lengthen the pavement life of Iowa's highways.

How future investments are made in Iowa's road system will largely determine the road system's long-term quality. An important public policy issue is the extent of cross-subsidies among the state's three road categories: primary, county, and municipal. Currently, users of primary roads—the state's main link with out-of-state markets—pay about $125 million more in user charges than is spent on this category of roads. Some magnitude of cross-subsidy from primary roads to county roads can be defended on the basis of system continuity; however, current subsidies of county roads account for over a quarter of the user charges flowing into the primary road category. In the interest of long-term economic competitiveness, the amount of cross-subsidy should be reduced.

Another way to enhance the state's competitiveness is by investing in super-two highways. Although these upgraded two-lane highways cost only about 40 percent as much as a four-lane (noninterstate) expressway, they produce many of the same economic benefits. Their enhanced design features and wider lanes greatly improve their safety, as well. As traffic volumes create the need for highways with greater capacity, super-two highways can be upgraded to four lanes. They are a potentially cost-effective means for improving access to numerous sites within the state of Iowa. Four-lane highways, we conclude, should not be built in the hope that economic development will somehow follow them but rather when and only when current and forecast traffic volumes indicate that they are needed.

Finally, Iowa should carefully monitor the emerging technologies that are part of Intelligent Vehicle Highway Systems (IVHS). Some IVHS applications, particularly AVI and weigh-in-motion, have great potential to improve the productivity of Iowa's road system.

CHAPTER 5

INLAND WATERWAYS

Barges on inland waterways play a key role in Iowa's economy. As is common in transportation, privately owned barges use publicly operated facilities as they serve various sectors of the economy. The most vital of these facilities are the locks and dams that enable navigation on major rivers. Several important issues exist regarding long-term rehabilitation, possible increases in capacity, and financing of these facilities. Many of the broad concepts discussed in Chapter 3 are applied in our analysis of inland waterway facilities.

BARGE TRAFFIC AND IOWA'S ECONOMY

Navigation of inland waterways is a growing element of transportation service to the Upper Midwest. Shipments on the Mississippi River grew substantially between 1980 and 1990, rising by 41 percent in the Rock Island District (see Figure 5–1). This district encompasses a segment of the Mississippi River from Guttenberg, Iowa (Lock and Dam 10), to Saverton, Missouri (Lock and Dam 22), and includes all Iowa ports except Lansing,

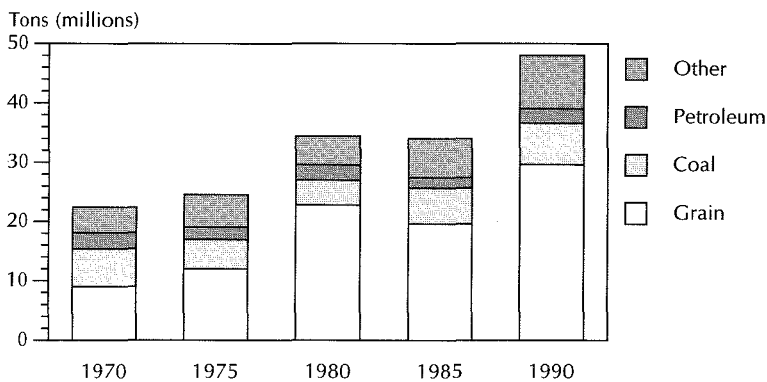

Figure 5–1. Total barge shipments through ports in the Rock Island District on the Mississippi River, 1970–1990

Source: U.S. Army Corps of Engineers, Rock Island District, various years.

McGregor, and Clayton in the northeast corner of the state. Shipments to and from the district grew from 34.4 million tons in 1980 to 48.0 million tons in 1990. Since 1975, commercial barge traffic in this district has doubled.

Iowa's barge traffic

The mix of commodities moved by barge on the Mississippi River has remained fairly stable over the last 20 years, even as the total amount carried has grown. Figure 5–2 shows how the amount of each major commodity carried by barge has grown between 1979 and 1989. Grain continues to dominate barge traffic by tonnage, reaching 8.2 million tons in 1989 (an increase of 17 percent over 1979). Shipments of coal doubled over the decade, from 1.9 million tons in 1979 to 3.8 million tons in 1989. Petroleum became less significant during this period, with shipments falling 19 percent to 537,000 tons. About four million tons of coal were shipped to Iowa by barge in 1989 (17 million tons in total were shipped to the state by barge and rail), almost double that of 1979. Coal arriving by barge generally is consumed at the terminal (mostly by power-generating plants); coal that is consumed at other locations within Iowa is transported largely by rail from western plains states, particularly Wyoming.

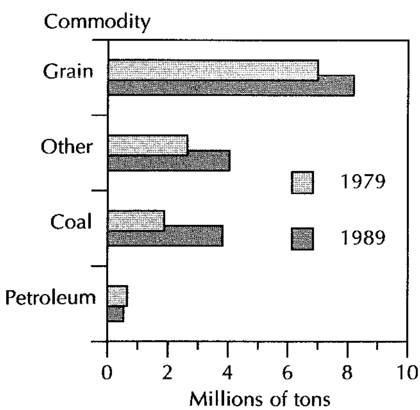

Figure 5–2. Commodities moved through Iowa barge ports on the Mississippi River, 1979 and 1989

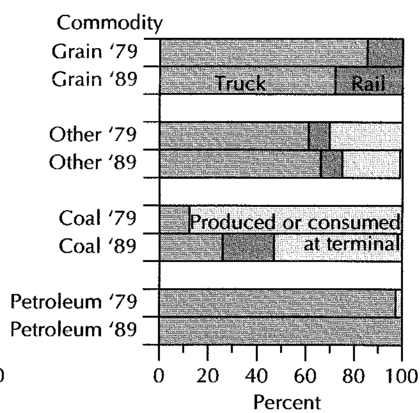

Figure 5–3. Modes used to transport commodities to and from Iowa ports, 1979 and 1989

Sources: Iowa Department of Transportation Planning and Research Division (1981, p. 4) and Iowa Department of Transportation (1990, p. 22).

It is important to think of barge service as one element of a transportation process that involves several modes. Commodities shipped on barges must be transported either directly or via an elevator from their point of production (typically farms) to a barge port. Trucks or railcars are used for these shipments, and often both modes are used for a single shipment. The modal distribution of freight traffic to barge ports has been fairly stable over the 1980s; the modes used to transport each commodity to and from barge ports are shown in Figure 5–3. For grain, trucks carried 72 percent of the total amount in 1989, down from 85 percent in 1979. Rail increased significantly its share of grain traffic to barge ports, from 15 percent in 1979 to 28 percent in 1989. In some cases a significant portion of the journey from grain elevators to New Orleans is made by rail before the transfer to a barge takes place. For example, it may be cost-effective, particularly in western Iowa, to ship by rail to a barge port at St. Louis.

Commercial barge shipments through Iowa ports on the Missouri River have fluctuated between a high of 667,000 tons and a low of 288,000 tons between 1979 and 1989. Largely because of increased water use for recreation in the Dakotas, less water is being routed to the Missouri than once was the case. In dry years the river's depth and width are insufficient to support effective barge navigation.

Importance to Iowa's economy

From areas of the continental United States served by inland waterways, barges are the least costly means for shipping bulk commodities long distances, given the current finance and pricing structure. Iowa's agricultural sector is therefore more competitive because of its proximity to the Mississippi River. Grain shipped from locations in eastern Iowa to New Orleans can be exported by barge at a lower cost. Of all corn and soybeans leaving Iowa elevators bound for out-of-state markets, over half are shipped by barge (Baumel, Ferriss, and O'Riley 1989, Tables 13, 16, 27, and 30). Iowa's agricultural sector benefits in other ways through the lower costs facilitated by river navigation. For example, about 95 percent of the dry ammonium phosphate fertilizer delivered to Iowa moves up the Mississippi River on barges.

Barge service makes its greatest contribution to Iowa's economy in markets where it is the most cost-effective mode. Cost differences between barge service and rail service between Iowa and the Gulf of Mexico vary depending on the point of origin within the state. These cost differences also vary with barge rates, which fluctuate quite substantially. During times of relatively low barge rates, barge service in eastern Iowa may cost as much as ten cents per bushel less than rail service. Generally speaking, a truck-barge combination is the cost-effective transportation alternative from the eastern one third of Iowa to the Port of New Orleans. The remainder of Iowa shifts among modal combinations, depending on the particular location and the prevailing barge rate. "Unit" trains of up to 75 cars also are competitive for shippers in a limited number of Iowa locations.

Barge service is a much less important mode for the nonagricultural part of Iowa's economy. According to those who responded to our survey of major employment locations (see Chapter 7), less than a fifth of the state's manufacturers feel that their access to a waterway is good enough to constitute a workable solution for shipping final or even most intermediate products. The 30 sites (of 234) that use barge service feel that the cost advantage for low value, bulk goods is its best attribute. Longer en route travel time is by far the least positive aspect of barge service. Essentially no manufactured goods travel on barges for any portion of their journey to purchasers.

INVESTMENT AND FINANCING ISSUES

Many of the locks and dams essential to navigation on the upper Mississippi River were constructed in the 1930s, with estimated useful lives of 50 years. With most of the facilities on the river in an advanced stage of their life cycles, major rehabilitation costs loom. Another, separate issue is capacity. Some feel that upper Mississippi River locks and dams need to be lengthened to serve longer barge tows, thereby more adequately serving what they expect to be a steadily increasing demand. Investment policy for these facilities will depend greatly on the level of funds generated by user fees and on the magnitude of subsidies from the federal general fund.

Current financing of the inland waterway system

Inland waterways require ongoing expenditures for operations and maintenance (O&M) and investments to rehabilitate facilities or expand their capacity. Currently, these expenditures are financed through a combination of general federal revenues and user charges. Under the Water Resources Development Act of 1986, half of future investments in the inland waterway system, whether to expand capacity or rehabilitate facilities, must be funded by the Inland Waterway Trust Fund. The other half of the costs are defrayed through general funds. The Trust Fund is financed by a tax on diesel fuel paid by waterway users (implemented at six cents per gallon in 1981). This tax is gradually increasing: at its 1990 level, it generated revenues of $62.8 million. The rate is scheduled to escalate to 20 cents per gallon by 1995, when annual revenues should grow to approximately $100 million. It is significant that the Inland Waterway Trust Fund cannot be used to finance any of the operating costs of the system because it is restricted to financing half of future capital expenditures and major rehabilitations. An important point is that new projects on the upper Mississippi River must compete for funds with projects elsewhere on the inland waterway system.

In terms of operating and maintenance costs in 1990, the U.S. Army Corps of Engineers had an annual budget of $384 million for the entire 11,000-mile system (U.S. Congress Congressional Budget Office 1992); these costs were financed entirely from the general fund. There are 28 locks and dams on the upper Mississippi River (above Melvin Price Lock and Dam in Alton, Illinois—formerly Lock and Dam 26). In 1989, the Corps of Engineers spent $82.4 million to meet routine operating and maintenance needs on this segment of the waterway system (U.S. Congress Congressional Budget Office 1992, Table 14). Routine needs include periodic dredging of channels and repair of locks, dams, and other structures. They also include costs associated with the routine operation of locks and dams.

Rehabilitation of locks and dams

A series of comparatively major rehabilitation projects are being proposed by the Corps. Table 5–1 presents the projects proposed to be started in Fiscal Year 1992 (FY92) on the upper Mississippi River. The table shows that $19.4 million is programmed to be spent in FY92 on these projects, and their total cost is estimated at $71.5 million over a number of years. Given that future investments and major rehabilitation projects must be funded with equal shares from the Trust Fund and general federal revenues, the resources available are effectively limited by the amount of user fees flowing into the Trust Fund. As noted above, annual user fees will approach $100 million by the mid-1990s for the entire inland waterway system. With federal match, about $200 million will be available each year for reinvestment in the system. Absent major capital projects, ample funding exists for beginning a number of major rehabilitation projects each year, provided that project costs range between $10 million and $20 million. However, few funds would be available for undertaking system expansions, which tend to be very costly.

Table 5–1. Proposed major rehabilitation projects for FY92 on upper Mississippi River locks and dams

Lock and Dam	Rehabilitation projects	Cost (millions of dollars) FY92	Total
13	Replace electrical and mechanical components and seals; resurface concrete on lock walls and dam piers; sandblast and paint dam gates; service bridge and emergency bulkheads; provide dam scour protection.	2.10	13.00
15	Same as Lock and Dam 13.	4.60	17.04
11–18, 21, 22	Replace dam gate chains.	4.51	24.00
2–10	Replace or refurbish electrical and mechanical systems; make structural repairs to dams and lock earth embankment.	8.22	17.49
Total		19.43	71.53

Source: Elmore (1991, p. c–5).

Investments for capacity expansion

While the capacity of locks and dams on the upper Mississippi River depends on a number of factors, it is largely determined by the length of each lock chamber. Most of the existing locks are 600 feet in length, thereby limiting the number of barge tows that can be accommodated in a single locking operation. If these locks were rebuilt with chambers 1200 feet long, the capacity of each lock would be greatly increased. Table 5–2 shows the existing capacity of each lock, the capacity that would exist if small-scale capacity improvements were made, and the capacity that would result from complete rebuilding to 1200 feet in length. While small-scale capacity improvements at these locks would cost about $10 million to $20 million per facility (Locks 14 and 15 would cost less), increasing the length to 1200 feet would cost about $380 million per lock.

Table 5–2 also indicates that none of the locks and dams had a traffic volume in 1987 even approaching its capacity. Most carried about 50 to 70 percent of their capacity. As Figure 5–4 shows, however, traffic volumes vary greatly from season to season. The upper Mississippi River can accommodate approximately one million tons per week; however, there are only about seven weeks of the year when even three quarters of

Table 5–2. Traffic on and capacity of upper Mississippi River locks
(millions of annual tons)

Lock and Dam	1987 Traffic	Capacity		
		Existing	With small-scale improvements	With complete rebuilding to 1200-foot chambers
14	24.3	48.2	53.2	168.7
15	25.0	46.3	46.5	162.1
16	26.9	48.8	53.7	170.8
17	29.1	45.3	49.6	158.6
18	29.8	50.1	55.4	175.4
19	31.3	68.9	72.2	137.8
20	32.0	47.2	51.7	165.2
21	33.3	48.7	52.5	170.5
22	34.2	44.6	47.5	156.1
24	35.3	45.9	51.0	160.7
25	35.3	47.6	52.9	166.6

Source: Antle (1991b, Table 4).

its capacity is reached. Quite clearly, it is not necessary to expand the capacity of upper Mississippi River locks and dams at the present time.

Traffic growth projections. The Corps of Engineers is currently engaged in a study of inland waterway investment needs.[1] Their study involves both a needs analysis and a financial analysis of funds available to undertake any recommended investments. Estimates of demand growth are a key element of the study. Table 5–3 shows the assumptions used by the Corps of Engineers in their investment analysis for the most important commodities moved on the upper Mississippi River. These projections imply significant traffic growth on the upper Mississippi River over the next few decades. The Corps has estimated the traffic levels that would result on the upper Mississippi River with and without capacity constraints. These traffic

[1] A number of major studies have examined the inland waterway system in the last decade. See, for example, Schilling et al. (1987) and U.S. Army Corps of Engineers (1983).

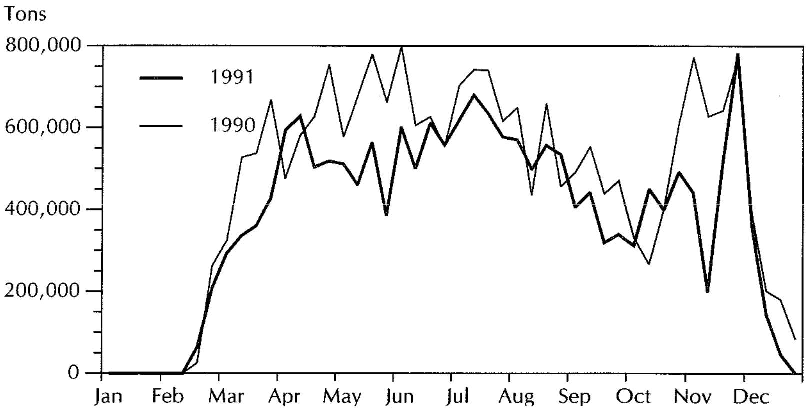

Figure 5–4. Tons of goods and commodities passing through Lock and Dam 15 by week, 1990 and 1991

Source: Data provided by U.S. Department of Agriculture, Agricultural Marketing Service.

estimates are shown in Table 5–4. In general, the unconstrained traffic forecast for 2020 is about twice that of 1990 for locks and dams on the upper Mississippi River.

According to the Corps forecast, these large increases in traffic would lead to significant delays at each lock as barges wait to pass through, unless capacity were increased. The Corps modeled the effect of these delays by diverting traffic to other modes when the cost of delays would otherwise exceed the cost savings afforded by waterways over other modes. These

Table 5–3. Projected growth rates of barge traffic on the inland waterway system, by commodity, and share of traffic on the upper Mississippi River
(percent)

	Annual growth rate assumed by Corps of Engineers		Share of upper Mississippi traffic
Commodity	1991–1995	1996–2030	1989
Grain	2.3	1.9	59
Coal	2.5	2.5	17
Petroleum	–2.0	–0.6	4

Sources: Antle (1991a, Table II) and Iowa Department of Economic Development (1991, p. 89).

estimates of actual traffic after diversions to other modes are shown in the fourth column of Table 5–4. The resulting traffic is about 30 to 60 percent higher than current levels of traffic, in contrast to the doubling that was forecast in the absence of capacity constraints. However, delays for the traffic that remains on the waterways would be significant because traffic levels would be close to the actual capacity of the locks. Table 5–5 shows how current delays would compare with delays in 2020 if capacity remained unchanged and if new high-capacity locks were built. Actual delays in 1987 ranged up to six hours at Lock 22, but generally delays were fairly short. In contrast, the forecast for 2020 shows very long delays at some locks, and up to eight days at Lock 22. If larger capacity locks were in place by 2020, delays would be very small and the amount of traffic that could be handled would be higher.

Cost estimates for capacity improvements. The inland waterway system encompasses much more than the upper Mississippi River, and the entire

Table 5–4. Traffic on the upper Mississippi River, actual and projected, with no capacity constraint and with a capacity constraint
(millions of tons)

	1987	2020	
Lock and Dam	Actual	Unconstrained by capacity	Assuming diversion because of delays
14	24.4	48.5	39.7
15	25.1	49.9	40.6
16	27.0	53.7	40.8
17	29.2	58.4	40.9
18	29.9	59.8	42.3
19	31.4	62.7	40.8
20	32.1	64.2	40.8
21	33.4	66.4	43.2
22	34.4	67.9	44.2
24	35.5	69.7	45.4
25	35.5	69.7	45.4

Sources: Antle (1991b, Tables 10 and 12; 1991a, Table 15).

system has sizable investment needs. If there were no financial constraints, the Corps has estimated that a comprehensive program of improvements to upgrade the entire inland waterways system would cost $4.8 billion in 1991 dollars (Antle 1991a, Table 6). This program would involve large-scale capacity investments at nine upper Mississippi River locks, along with three other large-scale capacity investments and a series of small-scale capacity and rehabilitation investments elsewhere on the system.

The current financing mechanism will be incapable of generating anything close to the $4.8 billion cost of these large-scale capacity improvements because, as noted earlier, a maximum of only about $200 million per year would be available. In fact, an investment program that is predicated on

Table 5–5. Average delay at upper Mississippi River locks in 1987 and forecast for 2020
(hours)

	1987	2020	
Lock and Dam	Actual	Capacity constrained	High-capacity locks built
14	1.3	5.9	13.4 *
15	1.9	11.4	0.4
16	1.6	6.5	0.3
17	2.6	13.6	0.5
18	1.8	6.6	0.4
19	0.6	1.0	3.8
20	2.9	8.7	0.5
21	2.7	9.9	0.5
22	6.0	199.6	0.8
24	4.5	116.4	0.6
25	3.6	25.0	0.5

* The capacity of Lock and Dam 14 is not programmed to be increased: it would become congested if traffic were to increase greatly.

Source: Antle (1991b, Tables 10 and 12).

the current funding mechanism would be much smaller in scope, and would preclude *any* large-scale capacity improvements on the upper Mississippi River. The cost of this less ambitious program would be an estimated $1.36 billion, rather than $4.8 billion for the unconstrained investment program. Instead of large-scale capacity improvements on the upper Mississippi River, this program would involve small-scale capacity enhancements such as improving the guide channels into the locks.

Financing alternatives. If large-scale capacity improvements on the upper Mississippi River are to be considered, major increases in revenues must be secured. Either users must pay significantly higher charges, or the structure of the financing approach must be revised such that a larger portion of the costs would be borne by the federal general fund. One approach that has been examined by the Corps of Engineers is to steadily increase the tax on diesel fuel by one cent per gallon per year starting in 1996. This approach would increase revenue for the Inland Waterway Trust Fund sufficiently to allow many of the large-scale capacity improvements on the system to be made over the next few decades. A one cent per gallon tax increase each year from the 1995 level of 20¢ would lead to a tax rate of 45¢ per gallon by 2020. The effect of this 25¢ increase would be to increase by about three cents the cost of shipping a bushel of corn from Iowa to New Orleans.

Implications of investment and financing choices

The investment choices regarding lock and dam facilities on the upper Mississippi River are clear, though the implications of these choices are less so. Briefly, the investment choices are to

- make no further investments in locks and dams other than those necessary to keep them operating properly,
- make minor capacity enhancements as routine rehabilitation efforts are carried out (e.g., extend guide channel walls to facilitate entry by barge tows into locks), or
- make significant investments to increase capacities from the present 600-foot tows to 1200-foot tows.

Similarly, serious choices must be made regarding how locks and dams should be financed. The principles underlying good practices in financing are independent of the scale of investment undertaken; the rates needed are, of course, greatly affected by the scale of investment.

SHOULD CAPACITY BE INCREASED?

Our analysis leads us to conclude that minor capacity enhancements may very well be called for, but doubling the size of upper Mississippi River locks would be unwise. This conclusion is supported by several considerations that are discussed in turn.

Demand and subsidies

In Chapter 3 we stressed that if users of transportation are not asked to pay the full cost of that use, their demand will be artificially high. Only when full-cost pricing is established can an accurate measurement of demand be made. Users of inland waterways pay none of the operation and maintenance (O&M) costs associated with locks and dams. Through the diesel fuel tax, these users are paying half of the capital costs of new investments and only about eight percent of the total costs of the system (U.S. Congress Congressional Budget Office 1992). Thus, a much greater portion of the overall costs of providing navigation on the upper Mississippi River rests with taxpayers generally rather than with actual users of the locks and dams.

It is significant that even with a major subsidy, the cost of shipping grain from Iowa elevators to New Orleans is only marginally cheaper by barge than by rail in the eastern part of the state. Rail often is a less costly mode of transportation in western Iowa. If subsidies to users of inland waterways were removed and user fees were raised to cover all costs, it is unlikely that current demand levels would continue. It is much less likely that demand would approach levels that justify consideration of major capacity improvements. In short, major improvements are very unlikely to be efficient investments of public capital.

Growth in grain shipments. A separate but related consideration is whether the major increases in grain shipments from Iowa forecast by the Corps of Engineers are likely. As Table 5–4 shows, the Corps has forecast a doubling of grain shipments, assuming that the capacity to make these shipments will exist. While it is sensible to look ahead and anticipate future transportation infrastructure needs, it is not prudent to make costly investments when great uncertainty enshrouds the forecasts that govern the economic feasibility of these investments. The main source of this uncertainty is whether demand for Iowa grain by foreign nations will double. Foreign policy considerations, agricultural technology advances in other nations, and other unpredictable factors are bound to affect this demand. Additionally, alternative domestic uses for Iowa grain will influence how much is shipped down the Mississippi River bound for foreign markets. Technology is advancing very quickly in such areas as alternative fuels, food products, and plastics. In short, it is difficult to say with certainty that Iowa farmers will *want* to double their shipments of grain down the Mississippi River.

Peak period pricing. As discussed in Chapter 3, it may not be justifiable to expand capacity when that capacity is needed only during limited periods of time. One alternative is peak-period pricing. By assigning higher prices for the use of locks during periods of historically heavy demand, some of this demand can be shifted to periods when the demand is less. The effect is to improve the overall utilization of facilities and to reduce the need for costly expansions.

Rethinking user charges. The current practice of substantially undercharging users of inland waterways amounts to a subsidy from taxpayers to the farmers whose returns (net of transportation costs to New Orleans) are bolstered. In a sense, then, the underpricing of these waterways is as much related to agricultural policy as it is to transportation policy. To the extent that this is the case, direct support subsidies to farmers are likely to be more cost-effective than massive public expenditures on locks and dams.

Rail response to higher barge costs

If barge operators were asked to pay higher user charges to defray more fully the costs of services they consume, what would happen to the costs of shipping grain to New Orleans? In the long run, barge rates would increase, though not necessarily by the same level as user charges. The effect would be to make rail service relatively more competitive in markets where cost advantages previously favored barges. Whether railroad companies would choose to raise rates and thereby improve their profit margins or hold rates down to increase their market shares is unclear. Most likely, some increases in shipping costs would face farmers in the affected markets. The magnitudes of these cost increases, however, probably would not be great. Even with the subsidies barge operators now enjoy, rail service out of the state is often the lowest cost choice from points in central and western Iowa (depending on fluctuations in barge rates).

It is important to note that below Cairo, Illinois, locks and dams are unnecessary. With sizable rail-to-barge transfer facilities in locations such as St. Louis, the lowest cost alternative to the Gulf of Mexico from Iowa could well prove to be rail for the first part of the journey and barge for the remainder.

An argument for some general fund support

Consistent with the framework presented in Chapter 3, users of locks and dams on the Mississippi River should pay the costs of the services they consume. There is, however, a "public good" argument for some level of general fund support to operate dams on the river. In addition to facilitating navigation, these dams contribute to economic and quality-of-life enhancements, and it would be difficult to establish a functioning market to charge those who benefit from such enhancements. Benefits generated by the dams include preservation of wildlife habitats, flood control, and recreational opportunities. Because the benefits of dams accrue to many people and because a market is not feasible, public funding is a logical source of support. The portion of total costs of the dams to be defrayed through general funds could be determined through an assessment of the relative magnitudes of benefits to waterway users and to the general public.

A STRATEGY FOR IOWA

Iowa's interest in the Mississippi River derives from the fact that an important part of the state's commodities have markets in other nations. The costs of reaching these markets are a critical factor in making Iowa's commodities competitive. As federal taxpayers, Iowans also wish to see the government make investments that are efficient. In the case of large-scale capacity enhancements of locks and dams on the Mississippi River, the large costs and uncertain demand argue against advocating these investments at the present time.

Iowa should endorse a prudent, flexible policy that would match the supply of transportation on inland waterways with reasonable demand expectations. Such a policy should include the following elements:

- A commitment to the maintenance of existing locks and dams on the upper Mississippi River. Investments should be made that are low cost and that ensure the continued operation of the waterway.
- Adoption of measures to increase the efficiency of locks and dams, including administrative or pricing mechanisms to shift demand from peak periods to other times.
- Development of transportation alternatives to New Orleans as demand materializes. Working with railroads, the state should promote better coordination of routes from Iowa to the lower Mississippi River and New Orleans.

These three elements would help ensure cost-effective transportation of Iowa commodities to foreign markets. They also would avoid sizable public expenditures on expanded facilities that are not justified. Keeping the costs of inland waterways in step with the benefits they produce is, in the end, the surest way for these important facilities to strengthen Iowa's long-term economic prospects.

CHAPTER 6

AGRICULTURAL TRANSPORTATION

Agriculture, a highly transportation-intensive activity, remains a major part of the midwestern economy. The quality of transportation services available to this sector is therefore an important determinant of its competitiveness. Stated differently, responsive and cost-effective transportation services contribute to a competitive agricultural sector and thereby boost the state's economic prospects.

We begin this chapter by examining current agricultural shipping practices in Iowa and the roles played by trucking, railroads, and barges. This chapter builds on the previous chapter which examined inland waterways quite extensively. Attention is devoted to rail service and the rural road system, building on the analysis in Chapter 4. Later in this chapter, we explore ways to make current transportation services better tailored to the modern needs of this sector and examine several policy directions to improve the cost-effectiveness of public facilities and benefit Iowa's agricultural sector.

CURRENT AGRICULTURAL SHIPPING PRACTICES

Iowa's two primary types of agricultural products—grain and meat—require different types of transportation. Both their physical characteristics and their shipping destinations vary greatly; each is discussed in turn.

Grain flows

In Iowa, grain production is dominated by corn and soybeans, with about 1.6 billion bushels of corn and 350 million bushels of soybeans produced annually. The total value of corn grown in the state is approximately $3.5 billion; for soybeans the figure is about $1.9 billion (Iowa Farm Bureau Federation 1992, Table 2). Of all corn produced, about 60 percent is shipped to country elevators, with most of the remainder consumed on the farm (though not necessarily on the farm where it was grown). Thus, the shipment of grain from farms to processing facilities generally occurs in two separate stages: from farms to country elevators and from elevators to processors.

From farms to country elevators. Almost all corn shipped from farms to country elevators is delivered by trucks and farm tractor-wagon combinations. No published data exist on the percentages of corn and soybeans shipped to elevators by size of truck or tractor-wagon; however, these types of vehicles have continued to increase in size. Today, the typical size of delivery vehicle used to haul grain to elevators is either a tandem axle truck that hauls 550 bushels with a loaded gross weight of 54,000 pounds, or a farm tractor pulling two wagons and hauling 1,000 bushels with a gross weight of 70,000 pounds (Beenken 1992). In addition, the percentage of grain delivered in semitrailer trucks hauling 900 bushels with gross loaded vehicle weights of 80,000 pounds or more continues to increase. Clearly, as the size of these vehicles increases, there is an increase in the amount of stress placed on local rural roads, particularly on those roads that lead to country elevators.

Shipments from country elevators. The latest data on grain shipments from country elevators are derived from a 1985 grain flow survey. Table 6–1 shows the amount of corn and soybeans shipped in 1985 by transportation mode and destination. Intrastate shipments of corn from country elevators were split about evenly between truck and rail. This was dramatically different from earlier years when trucks clearly dominated intrastate corn shipments (Baumel, Ferriss, and O'Riley 1989, Table 13). Corn shipments within the state typically move to wet corn milling plants in eastern Iowa and to barge loading elevators on the Mississippi River. Since 1985, low cost "mega tonnage" railroad contracts have increased intrastate corn shipments by rail relative to shipments by truck. Baumel,

Table 6–1. Estimated shipments of corn and soybeans from country elevators in Iowa by destination and mode of transport, 1985
(millions of bushels)

	Corn		Soybeans	
Destination	Truck	Rail	Truck	Rail
Back-to-farms	98	0	0	0
Within Iowa	219	212	145	43
Out-of-Iowa	53	139	16	34
Total	370	351	161	77

Source: Baumel, Ferriss, and O'Riley (1989, Tables 13 and 27).

Ferris, and O'Riley (1989, Table 7) have observed that most of the rail shipments originate in central and western Iowa and most of the truck shipments originate in eastern and, to a lesser extent, central Iowa.

As Table 6–1 shows, trucks clearly dominated 1985 intrastate soybean shipments. Most truck movements of soybeans were to nearby soybean processing plants; trucks often returned from these processing plants with loads of soybean meal to deliver to local feed mills. In addition, trucks hauled soybeans from eastern Iowa country elevators to barge loading elevators on the Mississippi River. Most intrastate rail shipments of soybeans were from central and western Iowa to barge loading elevators on the Mississippi River (Baumel, Ferriss, and O'Riley 1989, Table 23).

Railroads dominated out-of-state movements of both corn and soybeans from country elevators. About half of the out-of-state rail shipments of corn were to wet corn processors in Illinois and to broiler feeders in Arkansas and Missouri. Other major destinations of corn shipments by rail were to Texas and California feed lots and export ports on the west coast and Gulf of Mexico. Since 1985, as a result of the rapid growth of wet corn processing in Illinois, larger quantities of Iowa corn have been shipped by rail to that state.

Taking into account all types of grain shipments, three modes play particularly key roles. Each has a different role that is defined by comparative costs for specific locations and distances. In general, trucks dominate in farm-to-elevator shipments, soybean shipments to processors, and corn and soybean shipments from eastern Iowa to processors and barge terminals. Railroads are the mode of choice for shipments of corn from central and western Iowa to corn processors and barge terminals within the state and shipments of corn and soybeans to out-of-state destinations. As we mentioned in Chapter 5, barges operating on the Mississippi River dominate the movement of Iowa corn and soybeans to export markets, except during winter months or periods of drought.

Live animal shipments

In 1991, Iowa meat processing plants slaughtered 27.6 million head of hogs (over 31 percent of the total for the U.S.) and approximately 1.65 million head of cattle (U.S. Department of Agriculture, National Agricultural Statistics Service, Agricultural Statistics Board 1991b, pp. 32 and 46). The cash receipts for these animals approach $5 billion annually (Iowa Farm Bureau Federation 1992, Table 3). Essentially all of these animals are transported to slaughter plants by trucks. Most of the hogs are delivered directly from farms to slaughter plants in farmer-owned vehicles, typically in a pickup truck pulling a gooseneck trailer. An average load is about 37 hogs, so there were an estimated 750,000 loads of slaughter hogs hauled over Iowa highways in 1991. This amounts to about 2,900 loads of hogs per weekday on rural Iowa roads. A large portion of these loads move to slaughter plants over county roads because the distance is shorter and because there are no truck scales on these roads. Most of the cattle are moved to slaughter plants in semitrailer trucks; a typical truckload contains 55 head of cattle. Thus, the number of semitrailer loads of cattle totals about 30,000 loads annually or 115 loads per day.

In addition, the following raw Iowa animal products are moved over rural Iowa roads:

- Milk from 308,000 cows (Iowa Agricultural Statistics 1990, p. 67).
- Eggs from a growing number of laying hens which now total about 11.35 million and are expected to increase to 20 million by the year 2000 (U.S. Department of Agriculture, National Agricultural Statistics Service, Agricultural Statistics Board 1992a, p. 7). Twenty million hens would produce 19,000 semitrailer loads of eggs per year or 73 loads per day.
- A large amount of livestock feed.

Typically, trucks of various sizes carrying animals from Iowa farms to slaughter plants must travel on some unimproved county roads, but drivers generally avoid traveling these roads unnecessarily. They move to paved roads, often part of the primary road system, as quickly as possible. Modes other than trucking play an insignificant role in the transportation of animals and related products to market.

Processed agricultural products

The largest quantities of processed agricultural products produced in Iowa are soybean meal and soybean oil; ethanol, high fructose corn syrup and starches, and by-products produced from wet corn milling; fresh and processed meats and by-products from swine, beef, and turkey slaughter and processing; processed dairy products; and processed vegetables.

The movements of soybean meal are divided about equally between trucks and railroads. Most of the soybean oil is transported by rail. Wet corn milling products are transported by both trucks and railroads, while wet corn milling by-products (corn gluten feed and corn gluten meal) are transported by rail and barge.

Almost all fresh and processed meats and other food products are transported by truck. Given that nearly all parts of the slaughtered animals are used in some fashion, the tonnage of fresh and processed animal products and by-products approximately equals the tonnage of marketed live animals and unprocessed animal products (like milk and eggs). There is a substantial amount of cross-hauling of these products from one plant to another in Iowa, however, so that the total number of loads of fresh and processed animal products probably exceeds the total number of loads of live animals.

In summary, agriculture heavily utilizes the transportation services of trucks, railroads, and barges. Moreover, agriculture is a highly dispersed industry and is a heavy user of local roads in its production and marketing processes.

Basis for modal competition in agriculture

The foregoing discussions show that the various transportation modes play divergent roles in the agricultural sector of Iowa's economy. Railroad, barge, and trucking companies all have different rate structures, and this influences the mode of choice with respect to location and time of year. Yet in certain markets, two or more modes do compete, most notably in shipping grain to New Orleans for export to foreign nations. Grain is an easily stored and relatively low value product. As a result, grain shippers and receivers consider transportation rates to be more important than consistent delivery times.

Under the present methods of charging for the use of inland waterways, transportation by barge is generally the least costly of all three modes for moving large quantities of grain long distances. Because they are restricted to the waterways, however, barges can only serve ports located on navigable rivers. This means that barges are basically limited to hauling Iowa grain to export markets via New Orleans and are limited to hauling fertilizers, chemicals, and coal to Iowa river ports. Barge rates are quoted as a percentage of a 1975 barge tariff: one hundred percent of tariff is equal to the 1975 rate levels. In recent years, barge rates have typically fluctuated between 110 and 250 percent of tariff. Fluctuating demand for export grain is the principal reason for the wide variations in barge rates (Pautsch, McVey, and Baumel 1991, p. 1).

Railroads, which own their rights-of-way, are the second least costly carrier of long distance freight. Typically, railroads haul grain from central and western Iowa to eastern Iowa processors and barge loading elevators located on the Mississippi River; to processor and animal feeder markets in Illinois, Missouri, Arkansas, and Kansas; and occasionally to export ports in Louisiana, Texas, and the west coast (Baumel, Ferriss, and O'Riley 1989, Table 15). The least costly railroad shipments are in multiple-car and unit-train shipments. In the case of unit-trains, an engine picks up 25, 50, or 75 loaded cars at one or two origins and delivers them to one destination. Today, almost all rail grain shipments are in multiple-car and unit-train shipments.

Trucks are generally more costly than either barges or railroads and tend to be limited to short distance intrastate grain shipments. In large measure, the primary role of trucks is to transport grain and animals from the farm to elevators and slaughter plants, respectively. When barge rates are comparatively low (they vary substantially over time), grain is shipped to barge-loading facilities on the Mississippi River from points farther west in Iowa. Where rail service is not a good option, trucks frequently will travel over 100 miles en route to transshipment points to load their grain onto a barge. When barge rates are higher, trucks may be used to ship grain to train-loading elevators at various points across the state.

To summarize, the agricultural shipping practices of farmers and elevators in Iowa vary by commodity and location. They also vary with changes in rates, with barge service being most likely to shift in price over time. The following generalizations are possible:

- Trucks are used to ship most animals from the farm to slaughter plants. This is because the distances traveled do not tend to be great and trucks offer the greatest flexibility.
- Trucks are also the most common mode for shipping grain from the farm to an elevator. Particularly in eastern Iowa, they are the mode most often used to ship grain to barge elevators on the Mississippi River.
- Barges are the most frequently used mode for shipping grain to New Orleans en route to foreign markets. Grain from the central and eastern portions of Iowa is especially likely to be shipped via barge to the Gulf of Mexico.
- Railroads are extensively used to ship grain from western and central Iowa. In the central part of the state, rail shipments of grain either go to Mississippi barge elevators, to elevators farther south (e.g., St. Louis), or directly to New Orleans. From locations in western Iowa, the most frequent choice is rail service to barge elevators, either in Iowa or farther south, or directly to New Orleans.

RAILROADS AND AGRICULTURAL COMPETITIVENESS

Because of the importance of rail to Iowa's agricultural economy, we examine this mode in greater detail. Road and barge services are detailed in Chapters 4 and 5, respectively.

Iowa's railroad system

Figure 6–1 shows the miles of railroad track in Iowa at various times since 1860. Railroad miles grew rapidly from 1860 to a peak of 10,019 miles in 1914. Since then, the system has declined steadily to a total of 4,407 miles, a decline of 56 percent over 77 years. The downsizing was most rapid during the 1980s. Most of this reduction in mileage was a result of the abandonment of rural branch lines that originally had been built to haul small boxcar loads of freight. The development of the jumbo covered hopper car required substantial investment to upgrade branch lines to handle 100-ton loads compared to 50- to 70-ton boxcar loads. These heavier loads, combined with the emergence of unit-trains, required the accumulation of large quantities of grains at fewer elevator locations. This meant that many branch lines no longer served a useful economic purpose. Finally, the rapid growth of barge shipments of grain marked the end of most branch rail lines within 100 miles of the Mississippi River.

There are indications of further reductions in the size of the rail system. Federal Railroad Administration data indicate that in 1989, 41 percent of existing U.S. railroad mileage carried only one percent of the total railroad ton-miles of freight (Gelston 1992). Most of this 41 percent consisted of rural branch lines and short line railroads. Increasing intra- and intermodal competition suggests that many of these underutilized railroad miles will be candidates for future abandonment, particularly when these lines need substantial rebuilding investments.

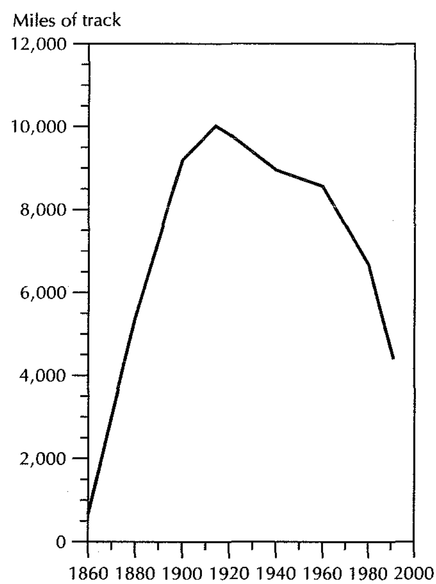

Figure 6–1. Miles of railroad track in Iowa, 1860–1991

Sources: Iowa Department of Transportation (1982, p. 50; 1992, p. 22).

Classes of railroads. The Federal Railroad Administration defines Class I railroads as those with operating revenue greater than $92.6 million, Class II railroads as those with operating revenue of between $18.4 and $92.6 million, and Class III railroads as those with operating revenue of less than $18.4 million. In Iowa today there are six Class I railroads (Chicago and North Western; Burlington Northern; Soo Line; Norfolk Southern; Atchison, Topeka, and Santa Fe; and Union Pacific). These six railroads own about 70 percent of the trackage remaining in the state. Two of Iowa's Class II railroads (Chicago Central and Iowa Interstate) account for approximately 20 percent of the trackage. The other Class II railroad (Dakota, Minnesota, and Eastern) operates in Iowa through agreements with other railroad companies.

Prior to 1980, mergers, buy-outs, and bankruptcies resulted in a continued reduction in the number of railroad companies in Iowa. Shortly after the passage of the Staggers Rail Act of 1980, numerous short line railroad companies were created to operate abandoned and likely to be abandoned track. Larger regional sized railroad companies were formed to operate longer mainline tracks sold by Class I railroads.

Short line railroads. In 1991, a total of 17 short line and regional railroads operated in Iowa (Iowa Department of Transportation 1992, p. 50). Eight of these railroads are switch carriers that provide no line-haul service and are of little interest to agriculture. The other nine short line and regional railroads provide line-haul service and are important to agriculture. Four of these line-haul railroads reported net earnings totaling over $7.0 million in 1991 (Iowa Department of Transportation 1991). The remaining five all reported operating losses totaling $4.5 million. One of these latter five—a short line railroad—declared bankruptcy in 1991 and has been purchased by one of the four profitable railroads. A second unprofitable short line railroad had a $962,000 write-down of a federal loan and still reported an operating loss of nearly one million dollars in 1991. While the long run survival of the remaining four short line and regional railroads remains in doubt, they still continue to provide railroad service to shippers located on their lines. In the event of bankruptcy, parts of these railroads would likely be purchased by other short line or Class I or II railroads, and other parts could be abandoned.

Railroad supply issues

The Staggers Rail Act of 1980 gave railroads substantial freedom in pricing rail services. Two of the most controversial pricing conventions that emerged from this newfound freedom are the Burlington Northern Railroad Certificates of Transportation (COT) program and Burlington Northern's practice of charging higher rates for grain originating on branch lines than on main lines. The COT program allows shippers (generally country elevators) to bid on a predetermined number of grain cars or unit-trains in specific shipment corridors, subject to a minimum bid. The principle behind the COT program is that the auction will establish the market price of grain cars during peak demand periods. It also allows shippers to obtain guaranteed delivery of empty cars during a predetermined time frame. Many shippers object to this program, arguing that it allows the Burlington Northern to exercise market power over rail car supply and allocation of cars among shippers. Moreover, these shippers complain that they cannot use their own cars until all of Burlington Northern's cars have been fully used. The higher charge for branch line service is based on the additional costs incurred by the railroad in providing branch line service. Shippers object to this program because if they pass the higher rates on to farmers in the form of lower bid prices for grain, farmers will bypass the branch line elevators and deliver their grain to elevators located on main railroad lines.

The lack of available rail cars during peak demand periods is not a new phenomenon; historically, agriculture has suffered through periodic rail car shortages followed by periods of car surpluses. During periods of increased export grain shipments, barge rates rise sharply, causing many grain shippers to shift to railroads as an alternative mode of grain transportation. Railroad rate increases respond more to inflation than to changes in demand, and typically lag behind these large increases in rail car orders. Once an export boom subsides, barge rates tend to fall, precipitating a sharp reduction in rail car orders. The problem of grain car shortages followed by surpluses was especially acute during the grain export booms of the 1970s. In the early 1980s, the rail industry experienced huge and continuous rail car surpluses. Rail car owners had difficulty finding available track to park idle rail cars. Many of the companies owning or leasing rail cars went bankrupt and were taken over by companies like General Electric and Chrysler Corporation that had little previous involvement in the rail car industry.

Sluggish railroad prices, coupled with fluctuating demand, will lead to the kind of rail car shortages and surpluses that have plagued the railroad and grain industries for over a century. Furthermore, these conditions strongly discourage investment in rail cars. Since the early 1980s, investments in new covered hopper grain cars have all but dried up. Only three orders for a total of 4,000 new cars have been placed since 1980. The lack of rail car investment and the nation's current aging and shrinking rail car fleet have led the U.S. Department of Agriculture to predict a growing shortage of covered hopper rail cars throughout the 1990s and severe shortages in the twenty-first century (Norton and Klindworth 1989).

Public policy implications

From the preceding discussion, it is clear that rail service is important to Iowa's agricultural sector in several ways. Short line railroads carry grain to barge elevators and to main rail lines, the latter transporting the grain to barge elevators in locations like St. Louis or directly to New Orleans. Rail competes with barges for long-haul shipments to the Gulf of Mexico from locations in eastern Iowa. The ability of rail to compete effectively provides an alternative in the event that locks and dams actually do begin to experience congestion at some point in the future.

It is advisable to view short line railroads as distinct from main rail lines. Quite likely, the consolidation of country elevators will continue. This consolidation of elevators and short line railroads will produce gains and losses among rural communities. However, there is relatively little that state and local governments can do to change the basic economics of short line railroads.

Part of the difficulty short line railroads face is the comparatively (and artificially) low cost transportation possible through trucking grain to elevators a moderate distance from originating farms. It may be that pricing the use of rural roads by grain trucks in accordance with costs occasioned (costs arising from the truck's road use) would lead to grain shipment practices that are superior from a societal perspective.[1]

RURAL ROADS AND AGRICULTURE

As discussed in Chapter 4, the state of Iowa has an extensive rural road network. Many of these rural roads were built in the late 1800s and early 1900s when farms were small and farmers needed access to homes, schools, churches, and markets. During the 1920s and 1930s, these roads were surfaced, mainly with gravel, and bridges were reinforced to carry six-ton loads. The demands placed on these roads have changed. Even though the number of farmers has declined, the total amount of grain produced in the state has increased. Over the years, farm size and the size and weight of vehicles operating on rural road systems have increased

[1] A comparison of societal costs of shifting grain shipments from closed short line railroads to upgraded rural roads was conducted by Baumel et al. (1991). They concluded that the road upgradings were not easily justified because of the low traffic volumes served.

greatly. With fewer but larger elevators, average trip lengths are increasing as well. Farmers are using large tandem-axle and semitrailer trucks, long farm tractor-wagon combinations, and wide combines that travel to and from fields. Farm supply and other businesses are using similarly heavy trucks for pickups and deliveries.

With increasingly heavy trucks and equipment being used in agriculture, and with increased off-farm employment becoming the norm, new requirements for rural roads are emerging. Roads must be capable of enabling grain trucks and farm trailers with comparatively high axle loadings (large weight levels per axle) to journey to elevators at all times of the year. Grain prices fluctuate, and farmers need to sell their stored grain when a favorable opportunity avails itself.

The desire to operate trucks with high axle loadings even when the ground is saturated suggests two investment choices. One is to pave as many rural roads as possible with a surface capable of accommodating these great weights. The other choice is to forego paving and regrade roads as needed. The cost of upgrading a gravel road to a paved two-lane road capable of supporting these loads is approximately $267,000 per mile.[2] As was explained in Chapter 3, this level of expenditure can be justified only if sufficient benefits to users (i.e., transportation cost savings) would result. Practically speaking, these benefits would require traffic volumes higher than currently exist on many county roads in rural Iowa. Comparatively high traffic volumes of larger grain trucks, though, are found on roads leading to major grain elevators. It is likely that the number of grain elevators will diminish; as this occurs, grain truck traffic will become even more concentrated on these routes. In many instances, a strong argument can be made for upgrading the pavement on county roads approaching major elevators. According to Baumel, Hamlett, and Pautsch (1986, Table 12), operating costs of large tandem-axle grain trucks traveling on paved roads are about 26.8 cents less per mile than on gravel roads.

Where traffic volumes are low—less than 200 average daily trips (ADT)—paving is generally not economically feasible (De Leuw 1985, Figures 3-4 and 3-5). Instead, gravel roads are regraded as needed to counteract wear and natural deterioration. Large grain trucks traveling on gravel roads accelerate

[2] This figure is intended to be illustrative. It was arrived at by applying the cost estimation guidelines contained in the Iowa DOT's latest quadrennial needs study (Iowa Department of Transportation 1991). The example considered involves a traffic volume of 300 vehicles per day, no new land requirements, flat terrain, a design speed of 50 miles per hour, no bridges, and a location in east-central Iowa.

the frequency with which regrading is necessary, but the cost implications probably are not particularly severe. Baumel, Hamlett, and Pautsch (1986, Table 8) estimate a cost of $21.00 per mile per pass for regrading.

Much more costly are repairs to low-capacity rural bridges not designed to support the high axle loads of large grain trucks. Many of these bridges are in need of rehabilitation because of age, and reinvestment decisions must be made quite soon. Rebuilding a bridge on a county road so that it will be able to accommodate a semitrailer truck laden with grain would cost approximately $200,000 to $400,000, depending on the span and other site-specific conditions.

The principles discussed in Chapter 3 apply quite well to issues related to rural roads and agriculture. How well should a particular road be maintained? Should the road be upgraded, and if so, to what level of functional rating? Such questions must be tied to the magnitude of cost savings to users that could be expected were the improvement completed. It is economically wise for the state of Iowa to invest in roads that warrant upgrades due to the traffic volumes they carry, including grain trucks, trucks hauling animals to market, or other vehicles.

POLICY CHOICES

Transportation in rural Iowa involves several modes, hauling commodities grown or raised at locations scattered across the state. These commodities are transported to facilities within Iowa for processing or they are shipped to distant places. The cost-effectiveness of each leg of the journey plays a significant role in the ultimate prosperity of the state's agricultural sector. Early in the chapter, we examined the nature of agricultural shipments and the roles played by the several modes in these shipments. Our analysis reveals that in some cases a particular mode dominates and in other cases competition exists between modes. In the latter situation, a slight cost change could shift the modal balance, perhaps significantly.

Analysis of an investment in a particular transportation mode should take into account the projected impacts on other modes. In Chapter 5 we discussed the difficulty of considering impacts of waterway improvements when barge transportation subsidies are much greater than those received by competing railroads. Likewise, implicit and significant subsidies are given to heavy trucks operating on roads with poor load bearing capabilities by not levying user charges that cover the incremental costs of these vehicles' trips. Higher user charges would deter long trips to grain elevators by truck; for short trips these higher user charges would not represent a significant cost burden to farmers.

Heavy truck user charges

A policy issue thus arises: should user charges to operators of heavy grain trucks or farm wagons be increased to reflect more fully the costs imposed on the rural road network?[3] On low-volume, unimproved roads (i.e., gravel roads), a single passage of a heavily laden truck can impose significant damage, particularly following precipitation. While it would not be feasible to vary user charges with the weather or the load bearing capabilities of specific rural roads, raising user charges for larger trucks that operate on county roads should be seriously considered.

The alternatives to raising user charges for larger agricultural vehicles are:

- allowing the county road system to deteriorate because of insufficient funds to adequately maintain it;
- reducing the size of the county road system, trimming lower volume links where alternative routes exist;
- increasing the cross-subsidy to the rural road system from the primary road system by adjusting the Road Use Tax Fund (RUTF) formula; or
- allowing lesser used parts of the county road system to decline to a lower standard (functional classification).

The first alternative would result in gradually increasing operating and time costs for all vehicles, including those transporting grain and animals to market. As we discussed in Chapter 4, the savings possible by closing county roads are not particularly great, so the second alternative does not hold much promise. Equally unpromising is the third alternative, given that several years ago the RUTF distribution formula was changed by the Iowa General Assembly to reduce the cross-subsidy from the higher-volume primary roads to county roads. The fourth alternative would increase efficiency and should be a part of the solution to the county road finance problem, but additional resources must be found.

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3 As discussed earlier, where traffic volumes warrant, county roads should be paved and appropriately maintained. As of 1985, 15,369 of the 89,687 miles of county roads were paved (De Leuw 1985, Table 2–6). Most county engineers use traffic volume as the principal criterion for upgrading county roads to so-called "trunk" roads.

In the short run, the most practical way to raise these user charges would be to increase the registration fees for larger farm trucks licensed to carry heavy loads. Because most of these vehicles travel comparatively similar distances in a year, the higher registration fee would be reasonably equitable.[4] If heavy farm vehicle registration fees were increased, two positive impacts would result. First, there would be a marginal shift to rail for longer trips. Second, cross-subsidies from other vehicles operating on Iowa's streets and roads to heavy trucks operating on unimproved rural roads would be reduced.

Currently, Iowa law allows owners of agricultural trucks to pay registration fees for weights 25 percent lower than those which they are permitted to operate (Iowa Code 321.466). For a truck with a gross weight of 80,000 pounds (the highest weight allowed in Iowa), this amounts to a reduction of $495 per year in the registration fee. With a total of 37,800 agricultural trucks in Iowa (though not all are registered at 80,000 pounds) this reduction represents a sizable amount of revenue—over $10 million annually. If heavier agricultural vehicles were to pay the full registration fee, the additional revenue could be used to upgrade county roads with the greatest traffic volumes and need for improvement. The overall effect would be to enhance the productivity of Iowa's agricultural sector.

A longer-term approach would be to adopt a system of cost-based user charges for heavy vehicles, as discussed in Chapter 4. This approach would provide an incentive for farmers to reduce axle loads and to consider more fully costs to the road system when deciding where and how to ship their products.

Joint investment and pricing decisions

Would total grain transportation costs decline if waterway, railroad, and rural road investment decisions were coordinated? Would more efficient public infrastructure investments result? The answers to these questions are elusive, but some fundamental statements are possible. Keeping the length of locks on the upper Mississippi River at 600 feet in length and establishing a peak period pricing structure for these locks would encourage shifts to rail when capacity constraints of the locks are exceeded. A result of this policy would be an incentive for railroads to purchase new covered hopper

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[4] From an equity standpoint, the greatest concern about registration fees is that the effective user charges paid by operators of vehicles traveling many miles in a year are appreciably less on a per mile basis than those paid by operators of low-mileage vehicles. If the vehicles in a given class travel similar distances, this inequity is much less of a problem.

rail cars.[5] Rail car demand would increase for hauling grain to St. Louis or all the way to New Orleans during periods of high export demand.[6] The increased number of rail cars would help relieve shortages during the winter months when the upper Mississippi River is frozen.

Pricing the use of rural roads to reflect costs more accurately and to use the funds generated to upgrade roads where traffic volumes warrant (e.g., near busy country elevators and livestock slaughter plants) has good potential. These higher quality roads would reduce maintenance costs for both vehicles and roads.[7] Quality roads could encourage farmers to haul grain directly to rail shipping elevators, possibly encouraging more branch rail lines to remain in operation.

In summary, agriculture is a highly transportation-intensive activity that needs the services of three primary modes. Public policies that encourage users to pay their fair costs tend to result in the lowest cost and most efficient mode being used. To facilitate cost-effective agricultural transportation while minimizing undue burdens on taxpayers, Iowa should invest in facilities where the incremental cost savings to users exceed the costs of the investment. The state should encourage the federal government to do the same.

In pricing the use of publicly-owned transportation facilities, we must recognize the potential for demand management. Private industry, utility companies, and (increasingly) public agencies have come to appreciate the salutary effects of shifting the use of facilities from peak periods when capacity is reached to other times when it is not. Well reasoned pricing strategies have the potential to flatten demand and make more effective use of transportation facilities. They also can promote appropriate use of the

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5 Regarding these new covered rail hopper cars, there is an issue of size. Larger hopper cars for use on mainline railroads may not always be compatible with branch lines. This incompatibility would lead to longer trips by trucks transporting grain to elevators that are served by these larger hopper cars.

6 For railroad companies to respond to an increased demand for grain shipments, they would need to share the most direct routes to St. Louis. For example, the most direct route from north-central Iowa is on the Chicago and North Western line to Des Moines and the Norfolk Southern-Burlington Northern line from Des Moines to St. Louis. Joint trackage rights on these lines would reduce aggregate miles and rail costs to St. Louis.

7 As noted earlier, Baumel, Hamlett, and Pautsch (1986, Table 12) have estimated operating cost savings of 26.8 cents per mile for a loaded tandem-axle truck operating on a paved road versus a gravel road. This figure is based on the assumption that the truck is loaded. The road maintenance cost savings would be slight, about $100 per mile per year (Iowa Department of Transportation 1991, p. 41).

several modes, as we have argued in this chapter. Finally, decisions to subsidize a mode must be based on clearly defined policy objectives. We must recognize that these subsidies weaken the ability of one or more other modes to compete; subsidies should be considered only if important societal objectives are promoted or if the most efficient mode cannot operate economically otherwise.

The best long-term strategy for ensuring modal choices for Iowa's agricultural sector is to create as level a playing field as possible with respect to modal competition. The surest way to encourage the lowest cost mode to be used in any given market is to price its use according to the costs of providing the service. Above all, investment and pricing policies that are coordinated across modes deserve much greater consideration.

CHAPTER 7

TRANSPORTATION OF FREIGHT

Iowa's economy is highly dependent on transportation: each year the state is the origin or destination of about 100 million tons of freight. Ideally, the state's freight transportation should have several attributes. One is modal competition: trucking should compete with rail, such that the mode that is best able to meet a shipper's needs would win its business. Another attribute is choice of carriers. Within each mode, several carriers should compete on the basis of price and service quality. Third, public policy should work to support transportation that will help to make the state competitive while ensuring fairness and promoting the public interest.

In this chapter we examine the current status of freight transportation in Iowa. We begin by discussing the results of an extensive survey of Iowa businesses regarding current logistical practices, assessments of available services, and opinions regarding good policy. The survey provides considerable insights into shippers' needs and preferences. We then examine the mode that transports by far the greatest share of freight into and from Iowa: trucking. The effects of deregulation are assessed, and the current structure of the trucking industry is examined. Emerging service trends and their implications are explored, and the question of allowing longer combination vehicles on the state's major highways is contemplated. Finally, we provide an assessment of intermodal transportation in Iowa: how it operates, its potential, and the key issues it faces. We conclude the chapter with several public policy suggestions to enhance freight transportation's ability to support economic development.

SURVEY OF IOWA BUSINESSES

For transportation to make a contribution to economic development within Iowa and other states, the needs of shippers must be met in a cost-effective way. The cost-effectiveness of goods transportation depends in part on the quality of private sector carriers. It also depends on public policy: the types of transportation facilities that are provided, the level and type of user charges and taxes that are assessed, and the regulatory environment that exists at the federal and state levels.

A key element in our assessment of how transportation can best contribute to a positive economic future for Iowa has been to survey shippers within the state. The primary goal of our survey was to gather information regarding current shipping practices, perceived performance and cost-effectiveness levels of the several transportation modes, and beliefs regarding appropriate policy directions in the future.

Survey approach

Working with our subcommittee on Industrial Transportation Practices and Needs, we designed a survey questionnaire. The questionnaire, a copy of which appears in Appendix A, has three major sections:

- Information about the responding facility
- Transportation and the facility's competitive position
- Assessment of general transportation issues

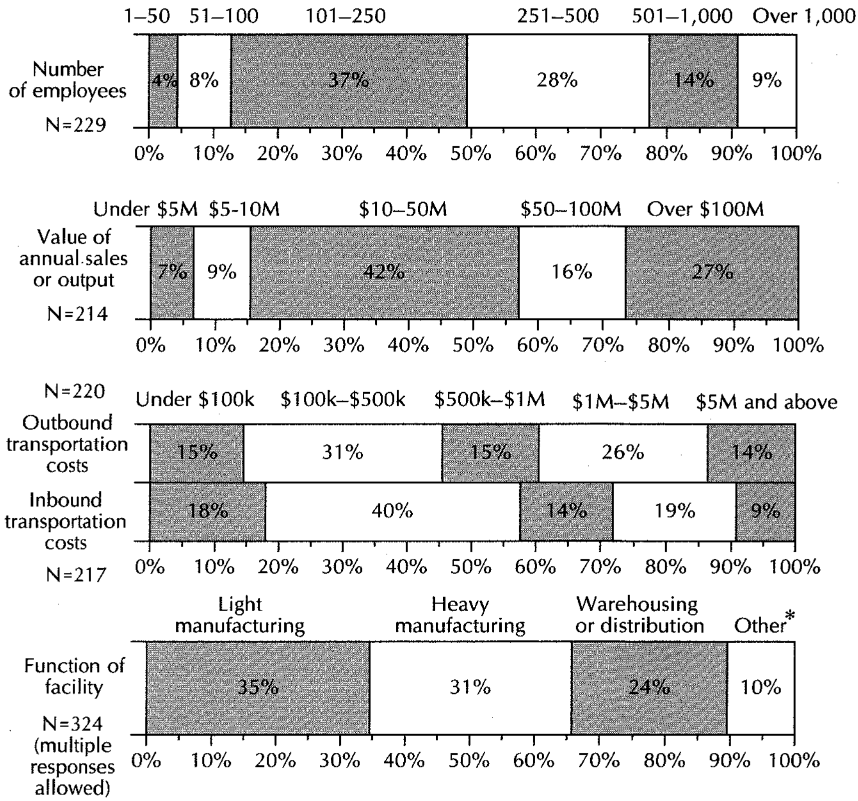
The first section requested information about the responding facility: its functions, size, and use of various modes of transportation. In the second section, respondents were asked a series of questions about how various modes affect the ability of their facility to compete effectively. The third section focused on a series of industrial trends and public policy issues related to freight transportation. In all, the questionnaire contained 27 questions, several of which had multiple parts.

The questionnaire was mailed in October 1991 to managers at all manufacturing and warehousing facilities in Iowa believed to employ 50 or more workers. A total of 474 facilities were contacted using a mailing list provided by state economist Harvey Siegelman, Iowa Department of Economic Development. Of the 474 questionnaires mailed, 234 were completed for a response rate of 49.4 percent.[1]

Profile of responding facilities

Figure 7–1 presents a summary profile of the 234 responding facilities. The figure shows that most of the facilities employ between 100 and 500 workers and are engaged in some form of manufacturing. The annual output or sales for responding facilities tend to be in excess of $10 million, with 57 facilities showing annual figures greater than $100 million. When facilities were asked to approximate their transportation expenditures for

[1] Nonrespondents were sent a follow-up letter three weeks after the survey was sent. Actually, questionnaires were sent to 490 facilities, but 16 were returned due to business closures or relocations.



*Retail/wholesale sales: 16; public utilities: 3; finance, insurance, real estate: 1; other: 14.

Figure 7–1. Characteristics of employment facilities returning completed questionnaires

the previous fiscal year, responses varied greatly. The largest number, however, indicated that they spent $100,000 to $500,000 on transportation of inbound materials; the same was true for outbound products.

Responding facilities geographically are distributed all across the state, with 88 (39 percent) located in metropolitan areas. No clear differences were evident in the sizes or functions of facilities located in metropolitan areas versus those found elsewhere.

Transportation and competitive position

One of the paramount objectives of the survey was to measure the relative importance of transportation in general to the facility's competitive position, as well as determine the roles played by specific modes.[2] Figure 7–2 shows that responding facilities view other factors, particularly labor, as more important than transportation in determining how competitive a facility is. If factors ranked as "most important" are isolated, transportation ranks fifth among the seven attributes. This is also true if the top two ratings are isolated. This result must be interpreted carefully, however. It is possible that transportation service to most locations is good enough to make transportation less of an issue in determining a firm's competitiveness.

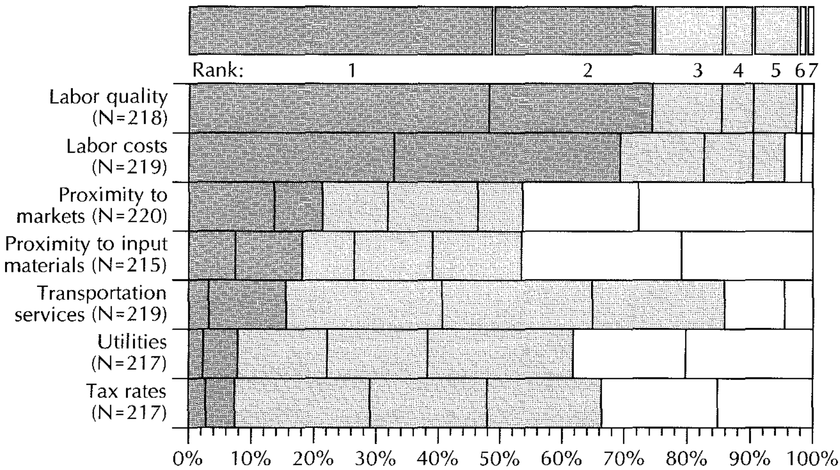


Figure 7–2. Importance of factors in contributing to a firm's competitiveness*

* Respondents were asked to rank factors in terms of their contribution to the firm's competitiveness: 1 is most important, 7 is least important. Distributions are of all mentions of each factor; for example, 74 percent of those mentioning labor quality gave it a ranking of 1 or 2.

Current shipping practices. Table 7–1 shows how the 234 facilities responded to questions regarding their reliance on different shipping modes. For both inbound and outbound shipments, the number of facilities that use each mode is indicated. The accompanying percentage represents the mean proportion of these facilities' total annual transportation expenditures for that particular mode. For example, 13 facilities use barges for inbound supplies; on average 10.9 percent of the transportation

2 It is worth stressing that respondents were asked to consider only their specific facility, not the overall business which may also operate other facilities.

Table 7–1. Transportation expenditures by mode

Mode	Inbound		Outbound	
	Number using the mode	Average spent on mode (percent)	Number using the mode	Average spent on mode (percent)
Barge	13	10.9	5	5.8
Truck	217	83.6	210	88.2
• Private	99	30.1	90	39.7
• Contract	146	44.0	142	46.9
• Common for-hire	170	51.4	165	50.3
Rail	57	40.2	40	26.1
Air freight	99	7.7	84	10.7
Intermodal	17	15.8	38	13.4

expenditures for inbound supplies by these 13 facilities were for barge service. Thus, for each mode, the percentages apply only to those facilities that reported using that mode. If all 234 facilities were included, each of the percentages would, of course, be much smaller because many facilities do not use certain modes at all.

The responses to this question indicate that trucking is the dominant transportation mode. In terms of transportation expenditures for nearly all facilities, fully 83.6 percent of the inputs and 88.2 percent of the products are shipped by truck. Common for-hire trucking is used by the largest number of responding facilities. Private trucking (i.e., vehicles operated by the firm shipping its own goods) is used by the smallest number. Actually, 87 of the 224 facilities are served by private trucking fleets, ten of which are expected to be eliminated, but six other facilities anticipate the establishment of private fleets. As a general rule, private trucking is decreasing in use nationally and in Iowa.

About one quarter of all facilities (57) use rail service for inbound shipments; on average, rail accounts for 40.2 percent of their transportation expenditures for inbound materials. Fewer facilities (40) use rail to ship their products, and their average percentage use of that mode is lower as well, only 26.1 percent. Note, too, the low percentage of intermodal freight shipment.[3] Neither air nor barge transportation are heavily used by most facilities in Iowa that are engaged in manufacturing and warehousing.

Adequacy of access. Respondents were asked to indicate whether their facilities have good access to these various modes of transportation and, if not, how significantly the lack of access impacts transportation costs for their facilities. Access to interstate and four-lane highways is considered good by more than two thirds of all respondents. Rail and intermodal access is judged good by about one half of all respondents, while barge access is viewed as good by about one in six respondents.

Not surprisingly, rural respondents are less likely to characterize their access to both interstate and four-lane highways as good, though more than one half judge highway access as good. Fully 90 percent of the urban firms rate access to these facilities as good. Those respondents located within 20 miles of an interstate or four-lane highway generally consider accessibility to them to be good. There is no significant difference between rural and urban respondents' perceived access to rail, intermodal, and barge transportation.

The fundamental concern or issue with accessibility is its impact on the firm's transportation costs. Respondents who do not view access as good were asked to indicate how significantly this lack of access increases their transportation costs. A sizable majority of these respondents report no impact at all from lack of good access to rail (70 percent), barge (90 percent), or intermodal transportation (60 percent). About one fifth indicate that lack of good access to rail and intermodal has "a little" impact on their transportation costs, while only about five percent report the impact to be considerable. There are no differences between the views of rural and urban firms regarding transportation cost impacts with respect to a lack of good access to rail, barge, or intermodal transportation service.

The impact of highway access on transportation costs is more significant for a greater number of respondents. A lack of good access to interstates is deemed to have some impact on costs for approximately 70 percent of rural facilities and 20 percent of urban facilities, respectively. The results are similar for a lack of good access to four-lane highways (about 60 percent and 15 percent, respectively). Furthermore, there is an inverse relationship between access to interstate and four-lane highways and the

[3] Intermodal freight shipment involves several different modes, such as trucking, rail, and ocean vessels. See the discussion later in this chapter.

perceived competitive position of the firm. That is, a lack of good access is thought to adversely affect a firm's competitive position. The overwhelming majority of respondents, however, indicate that this lack of good access does not create particularly serious problems.

Choice of carriers. Respondents were asked to indicate whether they have an acceptable selection among transportation carriers for the modes they use. Carrier selection for truck and air freight shippers (both rural and urban) is extremely high: well over 90 percent of the users report an acceptable level of choice. In particular, the number of motor carrier alternatives is viewed very positively, with only five of the 228 truck shippers expressing dissatisfaction with the choices available. Additionally, nearly 80 percent of intermodal users report an acceptable selection of carriers.

Commercial air passenger carrier alternatives are viewed quite favorably: more than two thirds of respondent users indicate an acceptable level of choice. A larger percentage of urban users (almost 80 percent) than rural users (about 60 percent) expresses satisfaction.

Rail and barge carrier selection is not viewed nearly as favorably by current users of these two modes. Slightly less than one half of all respondents believe they have an acceptable selection among railroads, with rural users being somewhat less satisfied than urban users. While almost 60 percent of barge users report an acceptable selection among carriers, a much larger percentage of urban users (over 75 percent) than rural users (40 percent) believe this to be the case.

Quality of transportation service. Just as important as access to transportation is the quality of service provided by carriers. While the caliber of management plays a prominent role in a carrier's service performance, public policy (e.g., maintenance of transportation facilities or economic regulation) may also impact the ability of transportation firms to meet the needs of their shippers. Survey respondents were asked to assess the impact of their carriers' service performance on their competitive position. There is an extensive body of literature on service quality that addresses the relative importance of various dimensions or components of service.[4] Five of the more important carrier service components identified in the literature were selected for evaluation: cost, travel time, on-time delivery, loss or damage, and service responsiveness.

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4 See, for example: Bardi, Bagchi, and Raghunathan (1989); Coulter et al. (1989); McGinnis (1990); and Vorhies, Allen, and Crum (1991).

- Cost, of course, is a key factor in mode and carrier selection because it directly affects a shipper's competitiveness. Following federal deregulation of railroads and the trucking industry in the late 1970s and early 1980s, the importance of transportation cost differentials has grown.

- Travel time is important because of its effects on customer service and inventory costs. Particularly in the case of expensive products like large machinery or electrical components, inventory costs can become significant if transit times are long. Inventory costs are much less of a concern in the case of comparatively low value, bulk goods like grain or coal.

- On-time delivery has grown dramatically in importance over the past decade. Just-in-time (JIT) manufacturing has become a major feature of industrial strategy here and in other nations (Raia 1990). By acquiring components a very short time before they are needed in the manufacturing process, inventory costs can be held to a minimum.[5] For JIT manufacturing to be successful, however, there must be great certainty as to the arrival time of components. Even a low-cost transportation mode is not compatible with JIT manufacturing if it cannot assure on-time delivery.

- Two other service components are service responsiveness and loss or damage. Service responsiveness refers to the ability of a carrier to meet the specific and unique needs of its shipper customer. Minimizing loss or damage is important both in ensuring that adequate inputs arrive at a plant and that customers receive products which are in good condition.

Figure 7–3 shows how users of the several modes evaluated their performance with respect to five service components. For each mode, respondents were asked to rate how each service component affects their competitive position. Cost is viewed as helpful in the cases of rail, barge, and trucking, with almost 40 percent of those responding saying that the cost of these modes helps them to be competitive. On the other hand, 45 percent of those using trucking feel that its cost hurts their competitiveness. Only air freight evokes a stronger expression of concern over cost.

Travel time behaves in an almost opposite manner. The speed of air freight is thought to help 59 percent of its users; trucking also is highly regarded in terms of travel time. Rail receives the least favorable assessment in terms

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[5] Several large manufacturers in Iowa have indicated to the study team that they currently use JIT manufacturing windows as short as three hours. If a critical component arrives more than three hours late, an entire assembly line may have to be shut down.

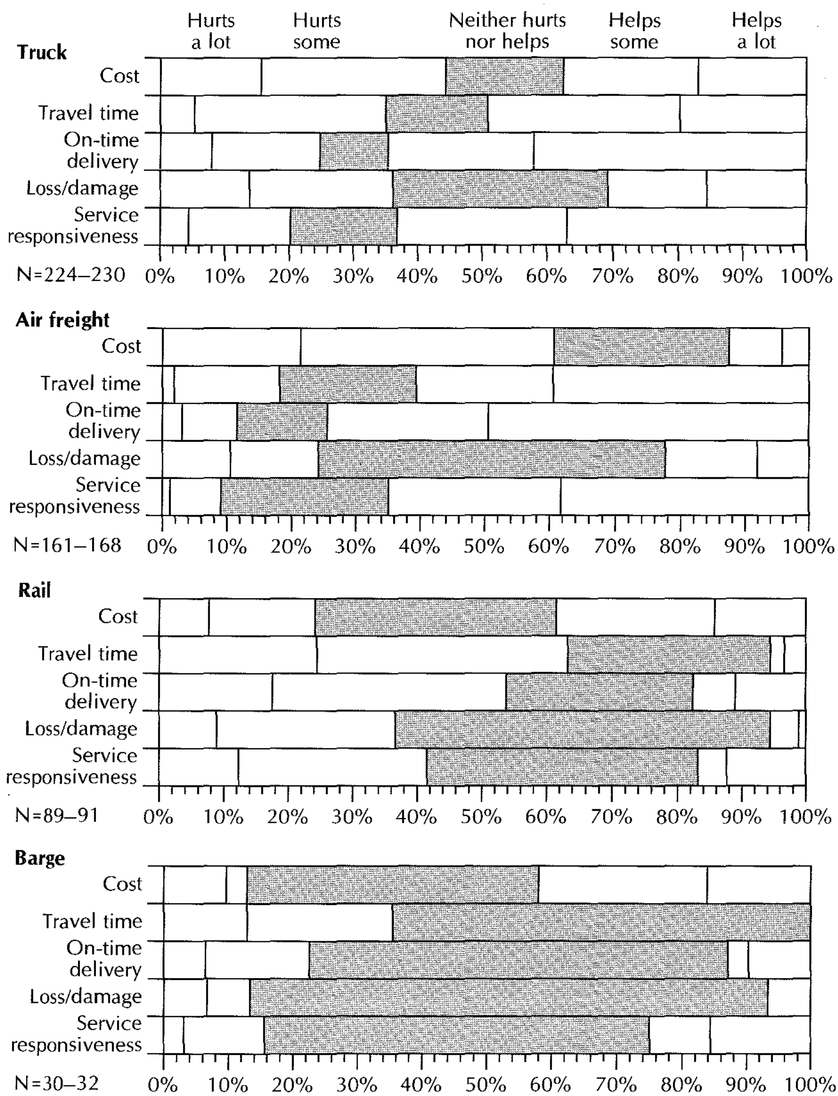

Figure 7–3. Distribution of responses regarding how service components of various modes affect competitive position

of travel time: 63 percent of those responding feel that its comparative slowness hurts their competitiveness. The fact that a relatively small number of industrial barge users generally do not see the long travel times of barge tows in a negative light suggests that they are using this mode to ship low value, bulk goods for which inventory costs are not much of a problem.

The ability of trucking and air freight to deliver goods on time is evaluated as helping the competitive position of responding facilities; however, rail's ability to deliver goods on time is evaluated by a majority of respondents as hurting it. Given the growing importance of on-time delivery in modern logistics, it is significant that 64 percent of those responding feel that trucking helps their competitiveness because of its ability to deliver goods on time. Perhaps this helps to explain the fact that over 80 percent of the goods shipped to and from most of the facilities represented in this survey are carried by truck. Service responsiveness follows a similar pattern as on-time delivery, further strengthening the favorable reviews given to trucking and air freight. Loss or damage rates are seen as equally problematic by firms shipping by truck as by rail.

Respondents were asked whether, on balance, transportation creates a competitive advantage, competitive disadvantage, or neither for their facility. Forty-three percent of the respondents say that the transportation services they consume help to create a competitive advantage, 38 percent see it as creating neither an advantage nor a disadvantage, and only 19 percent maintain that transportation creates a competitive disadvantage.

Respondents were also asked to indicate which specific transportation system characteristics give their facility either a competitive advantage or disadvantage. As Table 7–2 shows, the total response was very favorable toward nearly all transportation system factors, but a larger percentage of urban than rural shippers responded favorably in every case. Among both rural and urban shippers, the availability of different transportation modes, a choice of transportation carriers, and Iowa's primary road system are most often seen as fostering a competitive advantage.

General transportation issues

In the final section of the survey, respondents were asked for their views on a series of trends in transportation practices and on various public policy issues. A subset of the statements regarding transportation and industrial practices with which they could agree or disagree is presented in Figure 7–4. The statements have been ranked based on the percentage of respondents who strongly agree with them. Significantly, the strongest agreement is with the statement that on-time delivery for shipments will be as important as travel time itself; about three fourths of the respondents strongly agreed with it. Next most strongly agreed with was the statement

Table 7–2. Aspects of transportation service seen as competitive advantages (by rural and urban respondents)

Aspect	Rural		Urban	
	Number of respondents	Percent who see aspect as competitive advantage	Number of respondents	Percent who see aspect as competitive advantage
Interstate highways	109	67	76	86
Secondary roads	49	71	46	83
Primary roads	94	79	66	91
Access to waterways	13	31	18	72
Choice of carriers	130	85	82	90
Different modes	85	79	70	91
Rail service	50	62	46	74
Air freight service	79	75	58	88

Note: Respondents were asked to rate each aspect as either a competitive advantage or competitive disadvantage.

that reliability will be emphasized as a measure of transportation service quality. Strong agreement with the statement that industries will "pull" goods from suppliers shows the emerging importance of JIT processes. That is, receiving industries will dictate the rate at which goods are obtained, rather than accepting them when the supplier is able to send them.

Other transportation and industrial practice statements were included in the questionnaire, as were several statements related to public policy choices. Because these statements pertain to topics addressed in other chapters, the responses to them are examined in context. The message contained in Figure 7–4 is unmistakable, though: for manufacturing and warehousing facilities in Iowa to be competitive in future years, reliable, cost-effective freight transportation will be a necessity.

TRUCKING IN IOWA

The survey of 234 shipping facilities within the state of Iowa has attested to the important role played by trucking in Iowa. According to Reebie

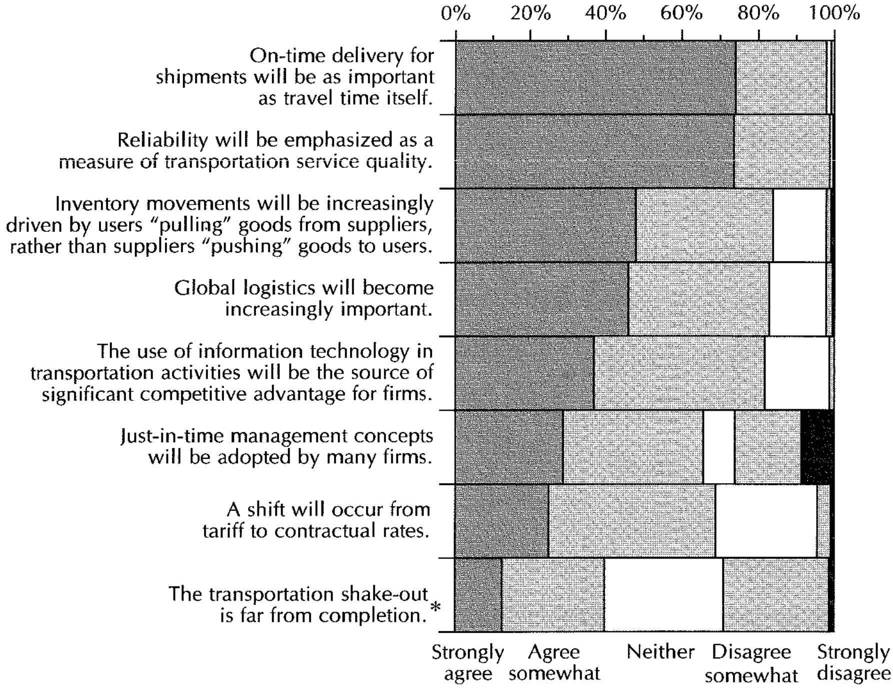

Figure 7–4. Assessment of possible changes in transportation and industrial practices

* Question reversed from original in survey. See appendix for original wording (question 25).

Associates (cited in Iowa Motor Truck Association 1991, p. 11), 38,664,567 tons of manufactured goods left Iowa and 34,287,422 tons were shipped to the state via truck in 1987. Together, these tonnages constitute 72.9 percent of all manufactured freight moved by all modes.

Trucking, Iowa's dominant mode of freight movement, is undergoing significant change due to several forces. Federal deregulation of the motor carrier industry in 1980 has spurred a major restructuring. Technology is advancing rapidly in terms of vehicles themselves as well as electronic devices that improve efficiency and allow different types of user charges to be levied. Policy debates continue regarding the appropriate level of user charges for trucks, as well as how these charges should be collected. Some of the more pressing of these issues are discussed in turn, along with policy choices.

Deregulation and the emerging trucking industry

The Motor Carrier Act of 1980 was meant to create a more competitive environment for the U.S. trucking industry. Barriers to entry and exit were almost completely eliminated, rate-making policies became less restrictive, and motor carriers were allowed to transport a wider range of products. The Act also allowed private fleets to operate more like for-hire carriers and eased the requirement that common carriers operate on regular routes.

Types of trucking firms. In terms of size, the Interstate Commerce Commission (ICC) defines three classes of trucking firms. Class I carriers are those with annual revenue greater than $5 million, Class II carriers have revenue from $1 million to $5 million annually, and Class III carriers' revenues are less than $1 million per year. Since deregulation, the number of larger carriers (Class I and Class II) has declined, but considerable growth has occurred in the number of smaller, Class III carriers.

Another way to categorize trucking carriers is by the nature of their operations. In simple terms, there are three types of operations: private carriers, truckload (TL) carriers, and less-than-truckload (LTL) carriers. The amounts of revenue generated nationally by these three types of motor carriers and by package carriers (e.g., United Parcel Service) appear in Table 7–3 .

As mentioned earlier, private carriers are operated by businesses for which trucking, per se, is not their primary interest. Rather, these businesses operate their own fleets in support of other activities. Quite often, though, these firms act as for-hire fleets in that they transport goods for other businesses. This allows considerable revenue enhancement, particularly if a truck would otherwise have returned to its origin empty following a delivery.

Truckload carriers are for-hire operations that normally do not handle freight at their own terminals. Generally TL carriers are contracted to haul freight from one place to another for a specific firm. As the name implies, TL carriers typically fill their trucks at one location and transport the load to another location. Nationally, about 46.4 percent of TL business by the larger Class I and II carriers is in the form of ongoing contracts with specific shippers (Crum and Allen 1991, Table 4).

Less-than-truckload carriers operate very differently. They generally maintain terminals to which vehicles bring freight that has been picked up from numerous businesses (or households). This freight is consolidated and transferred to long-haul trucks that operate between terminals. On a given trip, then, an LTL carrier probably carries cartons of freight for numerous

Table 7–3. Revenue generated nationally in 1991 by the trucking industry
(billions of dollars)

Industry segment	Revenue generated	Percent of total
Private fleets	85.2	53.5
Truckload (TL)	44.0	27.6
Less-than-truckload (LTL)		
• National LTL	9.7	6.1
• Regional LTL	4.0	2.5
• Interregional LTL	2.3	1.4
Package	14.0	8.8
Total	159.2	100.0

Source: Foster (1992, p. 20).

shippers. Only about 18.4 percent of the freight moved by LTL carriers is the result of ongoing contracts with a shipper (Crum and Allen 1991, Table 4). LTL carriers generally represent the lowest cost alternative for shipments under 15,000 pounds (Bowersox, Closs, and Helferich 1986, p. 161). Unlike the more fragmented TL sector, the LTL sector consists of fewer than 500 companies nationally, of which only about 100 are national or interregional operations (Transportation Research Board 1989, p. 72). The great emphasis on high quality service and the large investment in terminals traditionally have made entry into regional or national LTL markets difficult.

Emerging service trends. Overall, entry into the trucking industry since deregulation has been easier, greatly increasing the number of smaller trucking firms serving localized markets. The advent of trucking brokerage firms has enabled small carriers to enjoy coordination and networking benefits previously provided only by and for larger LTL carriers that conduct this function internally. Now, smaller truckers can more effectively locate and target potential markets for their services. Small communities and rural areas, many of which have suffered from rail abandonment, have benefited from an increased number of available carriers providing service at a lower price than before deregulation. After deregulation, most carriers initially competed on price, but the competitive basis has now switched more to service quality and performance.

For Iowa, federal deregulation of the motor carrier industry has been highly beneficial. The improvements have been especially great in rural areas that no longer are locked into permanent, long-term relationships with a few select carriers (Putsay 1986). Currently, the available carriers compete sufficiently to yield a better value for shippers. If one firm does not supply a needed type or level of service at a reasonable price, the shipper can look elsewhere. Thus, transportation costs as a percentage of overall costs of doing business typically are lower now than before deregulation.

Intrastate trucking still is regulated to varying degrees by 42 states, including Iowa. An important public policy issue has emerged: what should be the future role of state regulation of trucking? Congress has been debating a "safe and competitive trucking act" that would prohibit states from enacting more stringent economic regulation over intrastate trucking than ICC regulations dictate for interstate truckers. The basic premise underlying the move to relax state economic regulation is that such regulation stifles trucking competition in intrastate markets and results in higher transportation rates, lower quality of service, and inflated carrier profits. Indeed, the potential cost savings of eliminating state economic regulation of trucking has been estimated to be as high as $25 billion per year (Schulz 1991, p. 19).

A recent study of 37 states that regulate trucking has concluded that intrastate truck rates are higher than comparable interstate truck rates in 20 of these states, including Iowa (Allen et al. 1990, pp. ii–iii and 294). The authors have estimated that intrastate economic regulation in Iowa increases costs by approximately $35.1 million annually. The truck rates used in that study, however, have been questioned in light of contracting and discounting practices widely used since federal deregulation. Another analysis of economic regulation in Iowa has concluded that the trucking industry within the state faces very little such regulation, well less than existed a decade ago (Maze, Allen, and Walter 1992).

While further review of intrastate economic regulation in Iowa would be worthwhile, there is no compelling evidence to suggest that it is a major cost contributor. Iowa has a very liberal entry policy, such that very few carriers do not have statewide authority. Furthermore, the majority of carrier rates are filed individually and not through rate bureaus, rate discounting is permitted, and private fleets are allowed to serve affiliated businesses without any form of for-hire operating certificates.[6]

[6] Service to other businesses by private carriers without obtaining for-hire operating certificates was a major feature of federal deregulation. Iowa is one of comparatively few states that do not require certificates for intrastate private trucking operations.

Longer combination vehicles (LCVs)

An issue closely related to cost-based user charges is the role of longer combination vehicles (LCVs). LCVs are typically multiunit combination trucks with gross weights in excess of 80,000 pounds. Because pavement damage is most directly related to a vehicle's axle weight rather than its overall weight, distributing a load over more axles has the potential to reduce such damage. From the perspective of trucking companies, longer vehicles can increase productivity because labor is the greatest single variable cost component. To reduce pavement damage and increase productivity, considerable interest has been shown in longer combination vehicles.

Current status. Congress took a step toward new large truck configurations when it passed the Surface Transportation Assistance Act of 1982.[7] This act requires states to allow trucks pulling twin 28-foot trailers to travel on interstate highways and other principal roads. Mandatory allowable trailer widths were increased from 96 to 102 inches, as well. The result has been to increase cargo-carrying capacity by up to 33 percent (Transportation Research Board 1989, p. 25).

Since passage of the 1982 act, several states have enacted legislation to allow even larger combination vehicles on specific roadways. The common 45- or 48-foot semitrailer is giving way to 53-foot semitrailers, which are allowed in 34 states and are under consideration in others. This change has lowered the cost of shipping certain packaged consumer goods by up to 25 percent (Transportation Research Board 1989, p. 27). Twenty states, mostly in the West and Northeast, now allow so-called "Rocky Mountain double" vehicles with one tandem-axle 40- to 48-foot trailer and a second single-axle 27- to 28-foot trailer (see Figure 7–5). Even longer "turnpike double" configurations (two tandem-axle 48-foot trailers) now are allowed in 17 of these states. Fifteen of the 20 states also allow triple 28-foot units on designated routes.[8]

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7 The concept of larger, heavier trucks with lower axle weights has since been advanced by Francis C. Turner, former Federal Highway Administrator. It is now common to hear certain types of longer combination trucks referred to as "Turner trucks."

8 Overall lengths and gross weights within each type of LCV vary depending on trailer lengths, truck wheelbase, and number of axles. The length of Rocky Mountain doubles can range from 75 to 98 feet, and gross weights can reach 110,000 pounds (with seven axles). Turnpike doubles may range from 104 to 118 feet in length, with gross weights up to 129,000 pounds. Triple combination units can have lengths of 98 to 110 feet and gross weights of up to 115,000 pounds (rarely do they exceed 110,000 pounds).

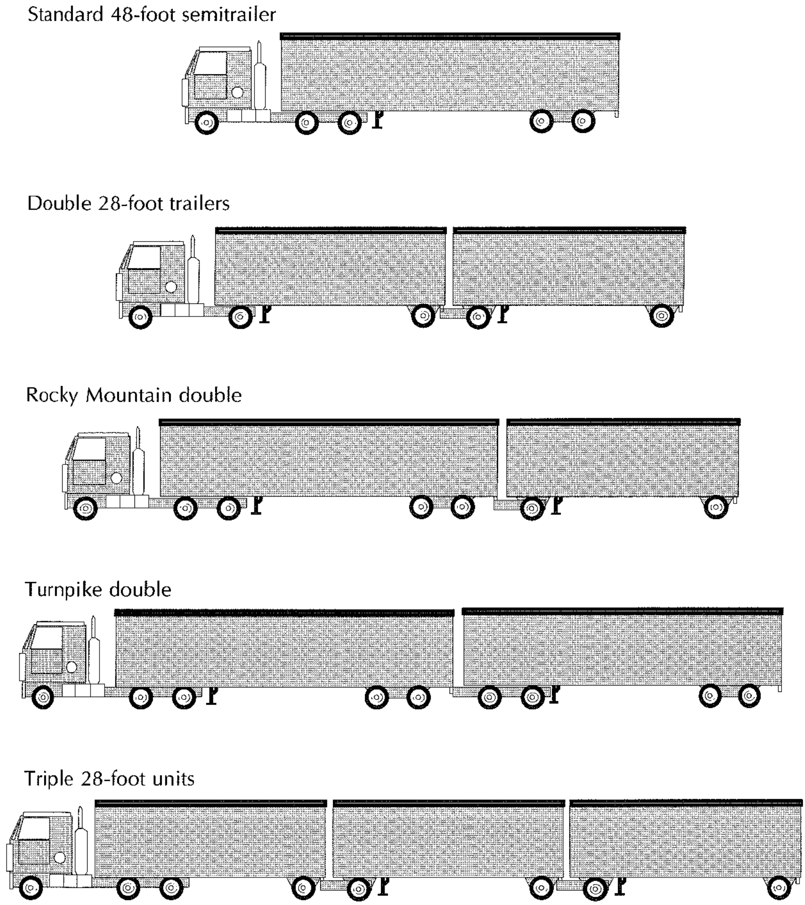

Figure 7–5. Sizes and configurations of combination vehicles

Generally speaking, these LCVs are used to transport high-value, small-shipment general freight by LTL carriers. Nationally, 70 percent of all trailers sold in 1988 were 102 inches wide. By 1988, sales of 53-foot trailers had grown to five percent of the total, with twin 28-foot units accounting for 17 percent of all sales (Transportation Research Board 1989, p. 75). Sales of twin 28-foot units have been held down by a lack of interest on the part of TL carriers, who have found that these units do not integrate well with their operations.

Acceptance of LCVs. Few doubt the productivity improvements possible through various types of LCVs; however, there is little consensus as to whether they should be allowed to operate on public highways. Opponents of expanded use of LCVs include various groups concerned with the safety of longer trucks and freight railroads concerned with the potential loss of traffic to more productive trucks. Safety concerns focus on passing, braking, and vehicle handling and control (Federal Highway Administration 1985, Chapters III and IV). Approximately 85 percent of our survey respondents agreed with the statement that LCVs raise a number of issues related to safety. According to proponents of LCVs, highway accident data show that LCVs have a better safety record than conventional trucks. The U.S. General Accounting Office (GAO), however, considers the safety record of LCVs as "largely unknown" because of inadequate reporting standards for accidents. It has noted that nine previous studies of the relative safety of LCVs resulted in widely different conclusions. These studies have found safety rates varying anywhere from 21 percent less likely to be involved in accidents to 66 percent more likely, when compared with single-trailer trucks (U.S. General Accounting Office 1992, p. 6). Uncertainty regarding the safety of LCVs led Congress in the recently passed Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) to freeze the expansion of operating rights for LCVs. The Act generally restricts them to routes in states where they were allowed as of July 1, 1991.

The LCV debate also includes two economic issues: the implications of improved productivity and the impact on highway infrastructure. A study for the American Trucking Associations has claimed that nationwide operation of LCVs would reduce shipping costs by $4.4 billion per year (Sydec, Inc. 1990, Exhibit 5–1), primarily as a result of increased fuel and labor productivity. While a decrease in trucking costs would benefit shippers using this mode, rail shippers could be adversely affected; as truck costs decline, there would be some diversion of rail traffic to truck. The remaining rail traffic would then face higher freight rates as fixed costs would be allocated over less tonnage. The likely extent of diversion is not clear; one estimate by the Association of American Railroads is that 4.3 percent of annual ton-miles of rail shipments would be diverted to LCVs if their use became widespread nationally (Transportation Research Board 1990, Table 3–12). For farm products, the estimated diversion would be 3.4 percent. An advocate of LCVs, however, has contended that such estimates are unrealistically high: the amount of capital required to finance the additional truck capacity needed to handle such a diversion would be prohibitive (Larkin 1991, p. 12).

The key economic consideration is whether fewer restrictions on LCV use would lead to net cost savings for the nation or for a group of states. Better data on safety are needed, to be sure. Also important are the changes in roads, bridges, and other infrastructure needed to support travel by LCVs. Because axle weights may actually be lower with LCVs than conventional semitrailer trucks, pavement strength is not the central issue—bridges are. The required design capacity of bridges would need to be raised for the total weight of the vehicle to be supported safely. Seven thousand interstate and primary highway bridges (about four percent of the total) would require replacement, at a cost of $2.8 billion (Transportation Research Board 1990, pp. 5–6). A rough estimate for Iowa is $62.4 million, based on 3,900 such bridges within the state. Furthermore, to gain access to primary highways, nonprimary roads must be traveled. To accommodate LCVs on nonprimary roads in Iowa, about 300 new bridges would be required at a total cost of approximately $3.2 million.

On the positive side, the Transportation Research Board has estimated that properly designed LCVs would damage road pavement as much as 40 percent less than the trucks they would replace (Transportation Research Board 1990, p. 6). Taking into account the greater capacity of these trucks and the projected diversion from rail, a 19 percent reduction in pavement wear due to traffic is possible. This would result in a $729 million net saving annually to highway agencies at the local, state, and federal levels. Netting out the added costs and cost savings, a $326 million annual saving nationwide is possible (Transportation Research Board 1990, p. 6). This figure does not include safety, energy, or environmental considerations.

An LCV policy for Iowa

Most research suggests that the widespread use of LCVs, on balance, would improve productivity. To realize this productivity gain, however, substantial improvements in the road system, particularly bridges, would be necessary. A complete benefit-cost analysis should be undertaken, perhaps in consort with other states, to balance the productivity gains against the relevant costs. As noted above, these costs must include safety, energy, and environmental impacts, about which relatively little currently is known. One reason that the energy and environmental impacts of LCVs are not clear is that while LCVs clearly consume less energy and pollute less than standard semitrailer trucks per unit of weight or volume shipped, diversion of freight from railroads is likely. Rail transportation is less energy intensive than LCVs, and it is likely to pollute less per unit shipped. A study by the U.S. DOT has suggested that rail diversion would be greatest in central and eastern states (Federal Highway Administration 1985, p. VI–15). Regarding safety, Iowa would need to work with other states to determine the most appropriate type of driver training, as well as what sorts of safety-enhancing technologies should be required (see U.S. Congress Office of Technology Assessment 1991, pp. 43–55).

A key element of Iowa's policies toward LCVs would be the level of user charges assigned to them. As argued in Chapter 3, it is impossible to evaluate the merits of revisions in user charges based on changes in vehicle size and weight standards if the current pricing of road use is not realistic. If, on the other hand, all vehicles were charged for their use of roads on the basis of the costs they actually occasion, several important public policy opportunities avail themselves. For example, it is technologically feasible to build LCVs with axle weights that are well less than those of standard semitrailer trucks. It would be good policy to create an incentive to operate low axle weight vehicles by reducing their user charges relative to other vehicles of the same overall weight. Current motor fuel and registration fees are not effective means for accomplishing this.[9]

In short, as we suggested in Chapter 4, Iowa should work with other states to establish a road user charge system that enables vehicles to be charged in accordance with their cost responsibilities; that is, based on the costs they impose on the highway system (U.S. Congress Office of Technology Assessment 1991, p. 58).[10] The best possible outcome of this policy would be increased use of vehicles that are productive for carriers and shippers and vehicles that are less damaging to pavement. It is true, though, that the cost of bridge redesign to accommodate vehicles with greater overall weights must be factored into the user charges assigned to LCVs. Costs of accommodating LCVs on noninterstate portions of the road system also need to be considered. The previously mentioned study for the American Trucking Associations has estimated that in Midwestern states like Iowa, only five percent of the primary road system other than interstate highways could accommodate triple 28-foot units and one percent would be suitable for turnpike doubles (Sydec, Inc. 1990, Exhibit 3–4).[11]

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9 This point is well argued in Transportation Research Board (1990). See especially pages 210–212.

10 It is vital that states work with the U.S. DOT to establish a standard methodology for carrying out cost responsibility studies. While the results are bound to vary by state due to soils, climate, and other factors, a consistent approach is necessary to ensure fairness and practicality.

11 Seventy-five percent of the respondents to our survey doubt that these roads can adequately accommodate LCVs.

INTERMODAL TRANSPORTATION

Moving freight by two or more modes in an integrated manner is a practical definition of intermodal transportation. A good example is the agreement between J. B. Hunt Transport Services, Inc., the nation's second largest TL trucking company, and Sante Fe Railway, the seventh largest railroad in the country. Freight being shipped from the Midwest to the West Coast is transported via semitrailer truck from its origin to a special terminal facility in Chicago. There the semitrailer is lifted onto a rail flatcar for the line-haul portion of the trip. Upon reaching a West Coast terminal, the semitrailer is off-loaded and pulled by a truck to its destination (see Salpukas 1992, sec. F, p. 5).

Intermodal transportation is becoming an important element of freight movement in the United States and worldwide. In this country alone, the yearly value of goods transported by container is over $195 billion (Transportation Research Board 1992, p. 15). It requires new and innovative relationships involving several modes, carriers, and often the public and private sectors. Because intermodal transportation has the potential to lower shipping costs, it also has the potential to improve the service area's economic competitiveness. Our interest is in how this growing approach to freight movement can best become an asset for locations in Iowa.

Emergence of intermodalism

Since its introduction in the 1950s, intermodal transportation has been seen as a way of capitalizing on the inherent strengths of the railroads, while compensating for some of their weaker points. Specifically, railroads have a significant line-haul cost advantage over trucking (as noted earlier in this chapter), an advantage that has not been fully realized. As we noted earlier, trucking has provided better quality service than railroads in terms of travel time, on-time delivery, and service responsiveness. The key to intermodal transportation is to build on the strengths of both modes.

Intermodal freight movements involving rail were completely deregulated by an ICC ruling in 1981. Additionally, barriers to intermodal ownership were greatly reduced after passage of the Staggers Rail Act of 1980 (discussed in Chapter 6), and the wave of mergers among railroads that followed has greatly improved the quality and reduced the cost of rail line-haul service. With rapidly escalating labor costs, problems of driver turnover arising from long distance travel and extended absences from home, larger TL truck carriers are seeing intermodal transportation as a serious opportunity for cost containment.[12]

Types of intermodal service

Two types of rail-truck intermodal transportation are becoming common: trailers on flat cars (TOFC) and containers on flat cars (COFC). In the case of TOFC, trailers are driven up ramps or lifted onto flat cars for the line-haul portion of the trip. COFC involves using a large lift to raise containers onto special rail cars; in some cases the containers are double stacked. About 90 percent of all containers are dry metal boxes eight feet wide, 8.5 feet high, and 20 or 40 feet long (Transportation Research Board 1992, p. 24).[13] These same containers are used for domestic or worldwide freight movements. For transoceanic shipment, containers are brought to port facilities aboard a special truck trailer.[14] There they are hoisted aboard the oceangoing vessel.

The growth in COFC usage has exceeded that in TOFC, and many rail, truck, and ocean vessel carriers see a bright future for container shipping. Over the past two decades, dramatic growth has occurred in the use of containers on cellular vessels. Whereas in 1969 there were 250,000 marine containers in the U.S., today the number has grown to 4,600,000 (Transportation Research Board 1992, p. 23).

Intermodalism in Iowa

The potential for intermodal transportation in Iowa is great, even though it is still only a small part of all manufactured goods movements. During the 1980s, the volume of intermodal traffic originating in Iowa grew by about 118 percent (Maze, Walter, and Allen 1990, Table 4–1). Still, about 97 percent of the intermodal traffic in Iowa only passes through the state. Currently, the goods most frequently shipped from Iowa include food products and electrical machinery. The latter reflects the Iowa Interstate Railroad's operation of an intermodal loading facility in Newton, Iowa.

[12] Labor is a serious issue in the trucking industry. J. B. Hunt is not unlike other companies with its 150 percent per year driver turnover rate (Salpukas 1992, sec. F, p. 5). The new U.S. DOT Commercial Drivers License Program is likely to reduce the supply of drivers slightly.

[13] Several U.S. container manufacturers have begun building 48- or 53-foot long containers that provide better bulk capacity and are consistent with standard semitrailer lengths. The lack of standardization in container sizes worldwide has created operational problems, particularly for the railroads.

[14] It still is not convenient to transfer containers from rail cars to ocean vessels. In nearly all cases, the containers first must be transferred from rail cars to trucks for at least a short haul.

Among our survey respondents, only 17 (seven percent of the total) indicate that they use intermodal transportation for inbound shipments and 38 (16 percent of the total) use it to ship their products. For these shippers, intermodal movements constitute about 15 percent of their annual transportation expenditures. In spite of this low usage level, two thirds of our survey respondents in urban areas feel that their access to intermodal service is good; in rural areas 40 percent rate their access as good.

Currently, there are two primary intermodal facilities in Iowa: the previously mentioned facility in Newton and a new one in Davenport. The Newton terminal has over 6,000 originating containers each year, with the largest percentage terminating in Illinois (50 percent) and California (29 percent) (Maze, Walter, and Allen 1990, p. 75). Many of its containers are transporting electrical appliances from the Maytag plant in Newton. The Davenport facility opened in 1989 with a $750,000 loan from the Iowa DOT as a pilot double-stack container terminal operated by Soo Line Railroad. During the first quarter of 1992, the facility lifted 2,131 trailers and containers, somewhat below the projected rate of 9,000 trailers and 4,260 containers per year.

Issues facing intermodal transportation in Iowa

Intermodal transportation has great potential because it allows the superior attributes of trucks, rail, and ocean vessels to be utilized. Its strength in this regard, however, is accompanied by the inevitable difficulties that result from different modes and carriers working together. These difficulties include:

- Changing dimensions of truck trailers. For TOFC operators, rail flat cars initially were designed to accommodate the standard 40-foot truck trailer. As trailers have increased to 48 or 53 feet, the fleet of flat cars has become less compatible and efficient. This has weakened rail's competitive position for provision of TOFC service. It now is imperative that railroads invest in flat cars more suited to longer truck trailers.
- Packaging and loading practices. Rail transportation of trailers inherently entails more jostling, and thus damage to freight, than does over-the-road truck transportation. This jostling is a problem both in the coupling of flat cars in rail yards and in line-haul movement. Major improvements in yard operations and the development of articulated cars have reduced the problem. Additionally, the use of containers substantially diminishes freight damage.

- Rarity of container shipping. Container shipping has yet to become as commonplace in the U.S. as in most other nations. In many other parts of the world, containers are standardized and usually packed tightly; this enables their productive use. In this country railroads and vessel lines have the problem of empty backhauls of containers to West Coast ports. Backhaul problems may subside, however, if COFC movements grow as a means for shipping freight domestically, perhaps on double-stack cars.

- Ability and interest on the part of railroads to embrace advancing technology. An example of a promising technology is so-called "Roadrailer" service, whereby truck trailers have permanently affixed or detachable rail wheel assemblies. This so-called "carless technology" reduces handling costs at rail terminals and transit times. Based on a trial application by Union Pacific between Chicago and Dallas, this technology shows potential. A recent joint venture by two of the nation's largest railroads, Consolidated Rail (Conrail) and Norfolk Southern, will expand Roadrailer service in the New York-Chicago, Chicago-Atlanta, and Atlanta-New York corridors (Machalaba 1992, p. A2). Wider use of this technology will require significant investments, and many rail companies are concerned about the great cost involved.

- Construction of intermodal terminals where demand is limited. Because intermodal facilities are expensive to construct, they tend to be located in major metropolitan markets. As a result, direct access to these facilities is not available to most Iowa shippers. It is not likely that Iowa will attract major intermodal hubs, given the proclivity of railroads to operate long-range, dedicated intermodal trains as a means of improving their service competitiveness vis-a-vis truck carriers. It is possible, however, that smaller feeder hubs will be viable in Iowa.

While many issues remain as the future of intermodal transportation is contemplated, the potential exists for benefits to Iowa shippers. As major hubs are established in large midwestern cities, it will be increasingly feasible for containers to be trucked between Iowa plants and these hubs. Because plants within large cities with hubs also must have containers trucked to and from them, the only difference is a longer truck leg to and from the Iowa plants. The overall cost differential probably would not prove great in most circumstances.

CONCLUSIONS

Iowa is part of a highly integrated U.S. economy that itself is becoming more closely tied to those of other nations around the world. It follows that the state must do all it can in the short and long run to be accessible. Our survey of 234 sites of major economic activity suggests that currently transportation is not an especially serious problem for Iowa businesses. The survey shows that trucking is by far the dominant transportation mode for freight to and from respondents' sites.

The survey produced several key findings. First, on-time delivery has grown dramatically in importance. Just-in-time manufacturing requires great reliability: knowing when a shipment will arrive is as important as speed of delivery. The reason trucking is so dominant is less related to cost advantages than to service quality. Part of the advantage enjoyed by trucking is related to the generally high marks respondents give to Iowa's road system.

Economic deregulation has changed the trucking industry, generally for the better. Competition is much greater, and service quality is receiving increased emphasis. The state of Iowa has narrowed the scope of its intrastate regulation of trucking, and we conclude that is good policy. Regulation should not be economic, but rather it should ensure a safe operating condition of vehicles and sizes and weights that are compatible with the state's road system.

Longer combination vehicles (LCVs) represent something of a public policy dilemma for Iowa and other states. They offer the potential for significant improvements in productivity for the trucking industry, and that could lead to lower shipping costs. LCVs also can be configured to damage the pavement less than conventional semitrailer trucks. Because LCVs are heavy, damage to bridges is a serious concern. Another concern, largely due to great uncertainty, is safety. Before Iowa can formulate a policy position with respect to LCVs, more needs to be learned about their ability to operate safely in different environments.

Intermodal transportation offers the opportunity for cost savings in long-haul freight shipment to and from Iowa. It blends some of the best attributes of rail, trucking, and ocean vessels. The state now has two lift facilities for loading truck trailers and double-stacked containers aboard rail flat cars. The trend, however, is likely to be for larger facilities to emerge in major metropolitan areas, with a hub-and-spoke service configuration. This sort of configuration could serve Iowa well because of good trucking routes to Kansas City, Chicago, and other major metropolitan areas.

The role eventually played by intermodal transportation in Iowa will be determined largely by investment decisions made by railroad companies.

Major investments in intermodal terminals and flat cars will be required. Also important will be a willingness on the parts of trucking and railroad companies to form partnerships of the type entered into by J. B. Hunt and Sante Fe Railway.

The overarching conclusion of this analysis is that following deregulation, trucking service in Iowa has improved, and most businesses surveyed are quite satisfied. The real hope for competition between the modes is fair pricing of road use by different types of large trucks and intermodal transportation. Limiting public sector regulations to those related to safety and pavement longevity, pricing facility use fairly, and investing in roads when travel volumes warrant will create a setting in which efficient, productive freight transportation can take place.

CHAPTER 8

TRANSPORTATION POLICY RECOMMENDATIONS

Economic development is the process through which real income within an area is increased. An important strategy for any government in fostering long-term economic development is to provide the "right" infrastructure services in a cost-effective way. Transportation is by far the largest component of infrastructure. The right transportation services are those which generate benefits that exceed their costs (foregone private goods). This means that the state's residents would be willing to pay the full cost of these services if they were sold by government. The limited dollars available to a government should be allocated to projects that collectively yield the greatest net benefits to state residents. This promotes income growth within the state, making government a "good buy" and thereby fostering economic development.

TRANSPORTATION INVESTMENTS

Transportation facilities are essentially "tools" for moving goods and people from one place to another. These facilities generate benefits only to the extent that they lower transportation costs. Cost savings from transportation improvements may either accrue directly to those using the transportation facility or indirectly to consumers. Among the key types of cost savings are

- safety improvements that reduce accident costs,
- reduced travel time,
- lower production costs due to certainty of arrival time,
- decreases in vehicle operating costs,
- improved logistical efficiencies, and
- reduced noise or air pollution.

Transportation cost savings are true benefits to society. When travelers experience time savings, greater safety, or reduced vehicle operating costs, their gain is not offset by losses to other people. Cost reductions act exactly the same as income increases by making more resources available for other purposes. If the effective increase in income brought about by an investment exceeds its cost, the project is said to be "efficient." It makes society better off.

It is worth stressing that the only way transportation investments can contribute to economic development is by reducing the cost of moving people or goods. There is no separate economic development justification for investing in transportation, such as enhancing an area's image. Furthermore, actual net gains to society as a result of transportation cost savings should be distinguished from mere shifts in economic activity that result from changes in relative competitiveness among different locations. Transfers of economic activity from one location to another within an impact area (state, region, or nation) do not constitute economic growth.

Very different types of changes in transportation systems can be evaluated in logically consistent ways. Disinvestment decisions, for example, are really akin to investment decisions: the question must be contemplated as to whether society overall will be better off. The presence or scale of existing facilities should not dictate choices for the future since past investments in these facilities are properly regarded as sunk costs. They should be maintained if they continue to generate benefits that outweigh their continuing costs, otherwise they should not. The equitability of any transfers of wealth that result from the project or its financing should be considered as well.

PRICING AND USER CHARGES

For transportation services within a state to be cost-effective and responsive, both appropriate pricing of public facilities and a competitive environment are essential for providers within and between modes. If one mode is subsidized relative to others, its use generally will be "artificially" high. There are two important policy implications of this subsidy. First, other competing modes will tend to be less viable, and their ability to compete probably will erode over time. Second, the higher use levels of the subsidized mode will lead to an overstatement of the benefits that would result if further investments were made in public facilities related to this mode. If full-cost pricing were the basis for user charges, fewer people or businesses would choose the previously subsidized transportation service. Fewer travelers may well mean that a different level of future investment would be appropriate.

Ideally, the use of any transportation mode should be priced such that each user is asked to pay his or her marginal or incremental cost. Stated differently, each traveler creates costs that would not have arisen if the trip had not been taken. The traveler should be made aware of these costs as a basis for deciding to make the trip. To do this, user charges should be structured to as nearly as possible approximate the marginal cost of the particular trip.

The demand for some transportation facilities varies significantly by time of day or by season. As an alternative to investing in greater capacity to serve peak users, pricing can be used to allocate scarce capacity during peak periods and to partially shift demand to other periods. Thus, pricing and investment policies and applications of these policies for specific transportation facilities should be evaluated in tandem. In summary, investing in facilities that make society better off and pricing the use of these facilities on the basis of marginal cost should constitute the foundation of transportation policies intended to strengthen Iowa's economic future.

POLICY RECOMMENDATIONS

The preceding chapters contain a series of transportation policy recommendations that center around the investment and pricing principles just summarized. Collectively, they would improve the efficiency of Iowa's transportation services and, in the process, strengthen the state's long-term competitiveness. Our recommendations are consolidated into ten points, which are discussed in turn.

- **Promote efficiency in resource allocation.** Resources should be devoted to transportation facilities only if the transportation cost savings would exceed the costs of construction, operation, and maintenance.

  The costs of constructing, operating, and maintaining transportation facilities act as a drag on economic activity by taking away productive resources. It is vitally important that cost savings resulting from a transportation facility exceed these construction, operating, and maintenance costs. If they do, the facility is efficient and will contribute to the long-term economic future of the state.

  It is not necessary to wait until a new investment is contemplated to assess whether a facility is efficient. Certain very low-volume roads may have lost their economic reason for existing; maintaining these roads is likely to entail costs exceeding the cost savings that accrue to their users (their costs with the low-volume road compared to their costs without it). Investment and disinvestment (e.g., allowing a road to decline to a lower functional classification or level of service) are really opposite sides of the same problem.

For Iowa to be a good buy, its publicly-owned transportation facilities must be efficient. Proposed facility upgrades or other investments should be analyzed carefully, and existing facilities should be reviewed periodically to ensure that the state's transportation resources are allocated efficiently.

Finally, Iowa should not encourage its political leaders to bring to the state "its share" of nonformula federal transportation funds for projects that are inefficient. The argument that these funds will otherwise go to another state is not a sufficient basis for justifying a specific project.

- **Assess user charges that cover costs.** User charges for all vehicles operating on the state's roads should be based on the costs these vehicles impose.

The costs vehicles create as they travel on roads within Iowa fall into two categories: fixed and variable. Fixed costs should be averaged among road users on a per-mile basis: those who make greater use of roads benefit more from signs and other fixed cost services and should pay for a greater portion of their cost. Variable costs are the real issue: these are costs that arise because a particular vehicle makes a specific trip. Both in terms of fairness and efficiency, user charges should be structured so that, as nearly as possible, road users pay the full marginal cost of their trips. If they do not pay them, others must, through user charges, taxes, or deferred maintenance costs faced by future generations.

More research is needed before Iowa can establish precise cost responsibilities for various vehicle configurations and weights. With recent progress in computer analysis techniques, however, the potential for fair cost responsibilities to be defined has become much greater. It is well known that axle weight bears a closer relationship to pavement wear than does overall vehicle weight. Knowing this, Iowa should create incentives for operators of heavy vehicles to configure their vehicles with more axles.

For Iowa to establish marginal cost-based user charges, it must work with other states. Experience has shown that any form of road pricing works best when states cooperate fully, particularly those in the same region. A multistate and preferably national approach to cost-based user charges could enhance productivity of the trucking sector, while facilitating efficient pricing. It also would prevent any short-term losses in competition due to user charges that are out of balance with other states.

- **Establish effective vehicle monitoring.** Iowa should make a serious commitment to establishing automatic vehicle identification and weigh-in-motion capability on the state's major highways.

  Currently, interstate trucking companies must obtain a series of permits and registrations to move freight within the United States. Occasionally, this process is sufficiently cumbersome that it substantially increases transaction costs and hence transportation costs. Further losses in efficiency result from trucks waiting in line at roadside weigh stations. Automatic vehicle identification and weigh-in-motion technologies, though not yet widespread, have demonstrated the ability to dramatically reduce transaction costs associated with interstate motor carriage.

  These technological advances offer great potential for the formulation of sound public policy. Progressive forms of heavy vehicle taxation are possible because a vehicle's identification and its axle weights can be deduced instantaneously, without ever stopping the vehicle. A few other states already have shown that user charges can be posted electronically, and they can take into account actual rather than registered weight. This makes it possible to charge vehicles fairly for the costs they generate.

  In the interests of both cost-effective freight transportation and good public policy, Iowa's business and government leaders should work to gradually expand automatic vehicle identification and weigh-in-motion capabilities.

- **Reduce cross-subsidies.** Cross-subsidies among users of the state's road systems should be reduced; under no conditions should these cross-subsidies be allowed to increase.

  Iowa has three categories of roads—primary, county, and municipal; users pay various taxes and fees for their use of these roads. Each of these categories serves a different set of purposes, ranging from higher-capacity long-haul interstate highways (part of the primary road category) to comparatively low-volume rural roads that collect and distribute traffic in sparsely settled areas. Because of their divergent natures, direct comparisons are difficult to make accurately and fairly.

At present, the state legislature determines the formula used to allocate the RUTF among these three road categories. The formula assigns 47.5 percent to primary roads, 32.5 percent to county roads (including farm-to-market roads and secondary roads), and 20 percent to municipal streets and roads. This formula currently results in users of primary roads paying about $125 million per year more in user charges than is allocated to them. Interstate highways and other primary roads are a key avenue from Iowa to markets in other states, as well as the principal way in which supplies and materials are brought to plants in Iowa. With many primary roads reaching advanced stages of their life cycles, cross-subsidies from these vital highways should not be allowed to increase. Rather, careful thought should be devoted to identifying ways for these cross-subsidies to be reduced.

- Make wider use of super-two highways. Super-two highways should be built in lieu of four-lane highways when two-lane roads are identified for upgrading, except when projected traffic volumes justify the additional capacity.

  If cost were not a constraint, high capacity highways could lace the state, connecting most cities and towns. Traffic levels, both current and forecast, often are far too low to justify the expense of a four-lane highway, however. Rather than upgrading comparatively few miles of two-lane roads to four-lane highways, particularly when average daily traffic is not sufficient to warrant four lanes, a high standard of two-lane highway is likely to be the best choice. "Super-two" highways cost only about 40 percent as much as four-lane, 55 mile per hour expressways, and they cost only about one fifth as much as 65 mile per hour freeways. Properly designed, however, super-two highways can support steady-flow speeds at moderate traffic volumes (up to six or seven thousand vehicles per day) almost as well as expressways.

  Super-two highways perform so well because they substantially reduce vehicle conflicts which slow traffic on conventional two-lane roads. With passing lanes, turn and acceleration lanes, wide driving lanes and shoulders, and bypasses around smaller communities whenever possible, good traffic flow can be achieved at moderate demand levels. Simply stated, super-two highways are a highly cost-effective solution for linking many Iowa communities.

  The biggest problem facing super-two highways is expectations. Many people believe that good access to a four-lane highway is essential to a strong local economy. In fact, reliable arrival times and generally competitive transportation costs are what is essential. If a super-two highway can provide safe, dependable highway transportation, spending 250 percent more for a four-lane highway is not efficient. It is also worth remembering that a super-two highway can eventually become half of a four-lane expressway when traffic levels warrant the additional investment. The "image problem" two-lane highways suffer from often could be corrected through a better understanding of what they can offer. Iowa's public and private sector leaders should work together to advance cost-effective transportation solutions; super-two highways often constitute a viable solution.

- **Encourage a prudent waterway facility program.** The federal government should be encouraged to properly maintain existing locks and dams on the upper Mississippi River, but heavy investment in major capacity enhancements should not be supported.

  Barges are an important transportation mode for moving agricultural commodities from Iowa to the Gulf of Mexico. Because most lock and dam facilities on the upper Mississippi River are about 50 years old, they are in serious need of reinvestment. At a cost of $10 to $20 million per facility, rehabilitating them and making other needed improvements are sensible investments. It would be less sensible to invest about $380 million per lock to extend capacity to 1,200 feet in length from the existing 600 feet. To be economically sound, this $4.8 billion program would need to bring about great increases in barge traffic levels. In the unlikely event that at some point in the future these high traffic levels are attained, they would occur only during brief peak periods.

  Based on our analysis of the capital cost differences between proper maintenance of upper Mississippi River locks with their current capacity and a major expansion to 1,200-foot lengths, we conclude that the state of Iowa should encourage the federal government to maintain the current capacity. Doing so would meet the likely demand for barge traffic for years to come, and it would do so in a cost-effective manner.

- **Coordinate investment and pricing among modes.** Investment decisions for waterway facilities, railroads, and rural roads should be coordinated to the fullest extent possible; pricing strategies should promote competition among the modes serving agriculture and industry.

A transportation facility should be invested in only if the investment will produce benefits that exceed associated costs *and* if no other project would produce a higher level of net benefits. Cost-effective transportation cannot result if investments are redundant or one mode is overbuilt while another is underbuilt.

Current and forecast traffic volumes are the primary means for assessing transportation investment needs. If, however, implicit subsidies are given to users of a type of facility, more use will be made of it than would be the case if users were asked to pay their full costs. If this subsidized, exaggerated use level is the basis for an investment, a larger facility may be built than would be the case if full-cost pricing were in place.

Optimal investment decisions are important because they facilitate the lowest overall transportation costs. Stated differently, subsidies to groups of transportation users make society worse off overall. Subsidies to users of inland waterways or rural roads and operators of heavy vehicles thwart the ability of railroads to compete because their public subsidies are much smaller or, in some cases, nonexistent. Such subsidies also raise the cost of certain types of vehicles (such as lighter trucks) operating on primary roads.

Pricing structures and subsidies to users should be reevaluated so that transportation can make the greatest possible contribution to Iowa's economic future. A concentrated effort should be made to move toward full marginal cost pricing of all modes. The use levels that result should then be the basis for future transportation investment and maintenance decisions.

- **Use thicker pavement on major highways.** As they are reconstructed, thicker pavement should be used on highways that serve heavy truck traffic; the incremental cost of the thicker pavement should be paid through user charges levied on heavier trucks.

Recent research has shown that the ability of pavement to support loads increases considerably with thickness. This research also projects large operating cost savings for trucking companies that depend on long-haul road use. As rehabilitation cycles for roads occur, paving a designated heavy truck system at a thickness that minimizes the sum of initial capital and long-term maintenance costs could pay good dividends. To defray this incremental pavement cost, the beneficiaries of thicker pavement (heavier trucks) should pay for it. However, the resulting decrease in cost responsibilities for these vehicles probably would lower their overall user charges.

The implications for Iowa of an optimal pavement investment policy are significant. Major highways within the state would be damaged less by heavy vehicles, and as a result they would last longer. Operating costs for heavy trucks, and thus shipping costs, would be reduced slightly. Issues of where thicker pavement should be poured, how thick it should be, and how its costs should be assigned to classes of heavier vehicles all warrant careful analysis.

- **Conduct further analysis of longer combination vehicles.** Research on the feasibility of longer combination vehicles should continue, with emphasis on safety, productivity gains, pavement and bridge wear, and energy and environmental impacts.

  There is little doubt that longer combination vehicles offer the potential to improve productivity significantly. In particular, major cost savings are possible in the transportation of high-value, small-shipment freight. For a transportation-dependent state such as Iowa, these lower transportation costs would undoubtedly be advantageous. Additionally, these vehicles may actually wear the pavement less than other heavy trucks because they have more axles placed more evenly, resulting in lower axle weights.

  Yet several important questions remain. The greatest of these is safety: passing, breaking, and vehicle handling and control are key safety issues. Are these vehicles safe? Will the safety of other vehicles on roadways be affected in any way? So far the evidence is inconclusive. Questions remain regarding the impacts of longer combination vehicles on bridges because the entire weight of the vehicle (not just one axle at a time) must be supported. Preliminary estimates indicate that it would be very costly to increase the weight-bearing capacity of all bridges where longer combination trucks may have occasion to operate. Whether access roads could accommodate the turning radii of these longer vehicles also is unclear.

  Other questions relate to net energy use and environmental impacts. It is quite likely that longer combination vehicles would use less energy and pollute less per unit of freight shipped than standard semitrailer trucks. At issue is whether freight would be diverted from railroads, which are superior to trucks in terms of energy use and environmental impacts. Iowa policymakers should work with other states, the federal government, and the trucking and rail industries to search for answers to these questions.

- **Cooperate with private suppliers of transportation.** Government and industry within Iowa and other states should explore cooperative arrangements to respond effectively to emerging opportunities in such areas as intermodalism and intelligent vehicle highway systems.

Enlightened public policy can help strengthen Iowa's economic future, but parallel leadership in the private sector is vital. Private sector providers of transportation equipment and services must innovate and make investments in new technology for transportation in Iowa to advance. Because the state stands to gain a competitive advantage if these innovations and investments are successful, cooperation and even risk-sharing have merit.

Two cases where joint efforts are warranted are intermodal transportation and intelligent vehicle highway systems. Intermodal transportation has the potential to lower long-haul shipping costs because it combines some of the best attributes of several modes including trucking, railroads, and ocean vessels. To date, however, intermodal transportation has not become commonplace in Iowa, and only two facilities for double-stacking freight containers on railcars exist within the state. Use of containers by Iowa businesses is very limited. As container shipping and intermodalism become more competitive nationally, Iowa's leaders should work together to enhance shippers' opportunities to benefit from this emerging technology.

A second area where cooperation is called for is intelligent vehicle highway systems. With advancing computer technology, new capabilities are emerging to monitor vehicles, provide information to drivers, and manage traffic movements. Together, these new capabilities will be able to contribute rather dramatically to productivity enhancements in Iowa. The state's business and government leaders should closely monitor technological advancements in this area and work together to acquire technology that can reduce transportation costs. Quite clearly, both sectors will need to make serious commitments if the great potential of intelligent vehicle highway systems is to be reached.

A CALL TO ACTION

Appropriate transportation services will play a key role in fostering Iowa's long-term economic development. What transportation services are appropriate is dynamic: they change over time. Government, working with business leaders, has two major responsibilities in ensuring that transportation promotes economic development. First, it must make appropriate investments in transportation infrastructure and must price facilities so that costs are borne by users. Second, government must encourage competition both within and between modes. The quality of Iowa's transportation system in the future will depend greatly on strong competition and on the innovation Iowa's policies stimulate among transportation providers. While we can never know the future, we *can* establish policies that strengthen the abilities of government and business to meet emerging needs and adapt to changing circumstances. Our purpose has been to suggest these policies.

APPENDIX A

SURVEY QUESTIONNAIRE AND RESULTS

This appendix presents the survey questionnaire sent to 474 Iowa business facilities. They include all manufacturing and warehousing facilities in Iowa believed to employ 50 or more workers. Questionnaires were returned by 234 facilities, for a response rate of 49.4 percent.

Responses are tabulated on the questionnaire. To determine how many respondents did not answer a specific question, the total of the response categories should be subtracted from 234.

The University of Iowa
PPC
Public Policy Center

IOWA BUSINESS AND INDUSTRY SURVEY ON IOWA'S TRANSPORTATION SYSTEM

N=234 responses

This survey is being conducted by the Public Policy Center at the University of Iowa as part of a major study of transportation and Iowa's economic future being carried out in cooperation with the Iowa Business Council. Results of this survey will be important as policy recommendations are developed for public and private sector leaders.

Please complete this survey for your particular location. If a question is not applicable to your business, please mark NA (not applicable) as a response and go to the next question. Please print your responses as legibly as possible. Thank you.

If you have any questions about the survey or the information requested, you may direct them to Dr. David J. Forkenbrock, Director, Public Policy Center, University of Iowa, on 319-335-6800.

Company	
Address	City / State / Zip
Survey completed by:	Title
Telephone #	Date completed

If you are a division of a larger company, please name the parent company and its location:

Parent company	City/State

You can be assured your specific responses to this survey will be held in strict confidence and will be reported only as part of summarizing the larger survey.

A. Information about the facility

This information will help establish a context for our questions on transportation needs and practices.

1. What is the approximate number of employees at this facility ?

1 – 50	51 – 100	101 – 250	251 – 500	501–1,000	Over 1,000
10	19	84	64	31	21

2. Describe the major products/commodities transported to and from this location by mode, using appropriate letters from the following lists.

Inbound	Outbound
a. Metals b. Unprocessed commodities c. Coal d. Production components e. Chemicals f. Petroleum g. Processed food h. Lumber/wood components i. Finished goods j. Other (specify)	l. Processed foods m. Chemicals n. Finished goods o. Intermediate products for other industries p. Unprocessed commodities q. Other (specify)

Mode	Inbound	Outbound
Air	97 mentions	104 mentions
Barge	16	7
Parcel carriers	120	123
Truck	223	224
Rail	61	41

3. Which of the following best describes the functions of your facility? (Check more than one, if necessary).

Light mfg.	Heavy mfg	Ware housing/ distribution	Finance, insurance & real estate	Retail / wholesale sales	Public utility	Other (specify)
112	101	77	1	16	3	14

4. During the last fiscal year, what was the approximate value of your facility's sales or output, *in millions of dollars*? (Check one only.)

Under $5m	$5m–$10m	$10m–$50m	$50m–$100m	$100m+
14	19	89	35	57

5. During the last fiscal year, what was the approximate amount of transportation costs incurred for shipping goods and products to and from your facility. (Check one range for inbound and one range for outbound shipments.)

	Under $100,000	$100,000–$500,000	$500,000–$1 million	$1 million–$5 million	$5 million and above
Inbound	39	86	31	41	20
Outbound	32	68	33	57	30

6. Of your facility's total annual transportation expenditures, approximately what percentage is spent on each of the following modes? (Please round to the nearest percentage.)

	Inbound	Outbound
Barge	13 replies, avg: 10.85%	5 replies, avg: 5.80%
Private truck	99 replies, avg: 30.08%	90 replies, avg: 39.70%
Contract truck	146 replies, avg: 44.03%	142 replies, avg: 46.89%
Common for-hire truck	170 replies, avg: 51.43%	165 replies, avg: 50.28%
Rail	57 replies, avg: 40.23%	40 replies, avg: 26.10%
Air transport	99 replies, avg: 7.68%	84 replies, avg: 10.70%
Intermodal	17 replies, avg: 15.82%	38 replies, avg: 13.39%
TOTAL	100%	100%

7. Approximately what percentage of each of the following transportation services is under contract?

	Responses	Percent under contract
Rail	41	84.24%
Truck (LTL only)	64	67.16%
Truck (TL only)	98	68.99%
Truck (both TL and LTL)	78	74.63%
Barge	12	80.42%
Air transport / express	53	77.55%

Note: TL refers to truck-load carriers; LTL refers to less-than-truck-load carriers.

8. Does your company employ a "core carrier" strategy (i.e., doing business with a limited number of carriers) for the following?

	Yes	No
Truck (TL)	169	52
Truck (LTL)	160	59

Note: TL refers to truck-load carriers; LTL refers to less-than-truck-load carriers.

B. Transportation and competitive position

9. Does your facility have good access to each of these various modes of transportation? If not, please indicate how significantly this lack of access impacts transportation costs for your facility.

Does your facility have good access to			If no, how significantly does this lack of access increase transportation costs?			
	Yes	No	Not at all	A little	A lot	Comments
Rail?	107	112	66	22	5	17 comments
Barge?	33	179	130	13	2	18 comments
Interstate highway?	163	69	8	42	11	10 comments
4-lane highway?	150	75	17	37	9	10 comments
Intermodal?	89	80	41	21	5	13 comments

10. Please indicate whether your facility has an acceptable choice (selection) among transportation carriers for each of the following modes.

Does your business have an acceptable selection among transportation carriers for	Yes	No	Not applicable	Comments
Barge?	27	20	174	1 comments
Rail?	62	66	96	9 comments
Truck?	223	5	2	6 comments
Commercial air (passenger)?	129	58	39	10 comments
Air freight / express?	189	14	22	4 comments
Intermodal?	88	23	75	5 comments

11. Please rank the following factors in terms of their contribution to your firm's competitive position. (Please use 1 for most important, 2 for next important, and so on.)

Rank	1	2	3	4	5	6	7	Total
Labor costs	72	80	29	17	11	6	4	219
Labor quality	105	57	24	11	15	2	4	218
Transportation services	7	27	55	53	46	21	10	219
Tax rates	6	10	47	41	40	40	33	217
Utilities	5	12	31	35	51	39	44	217
Proximity to input materials	16	23	18	27	31	55	45	215
Proximity to markets	30	17	23	32	16	41	61	220

The next five questions (12 through 16) ask how certain characteristics of each mode of transportation affect your facility's competitive position. Answer *only* the questions pertaining to modes that your facility *currently uses* to ship goods and products to and from your facility.

12. Does your facility use rail service? If no, go to question 13.

To what extent does each of these **RAIL** service components affect your competitive position?

	Hurts a lot	Hurts some	Neither hurts nor helps	Helps some	Helps a lot
Cost	7	15	34	22	13
Travel time	22	35	28	2	3
On-time delivery	16	33	26	6	10
Loss/damage	8	25	52	4	1
Service responsiveness	11	26	37	4	11

13. Does your facility use barge service? If no, go to question 14.

To what extent does each of these **BARGE** service components affect your competitive position?

	Hurts a lot	Hurts some	Neither hurts nor helps	Helps some	Helps a lot
Cost	3	1	14	8	5
Travel time	4	7	20	0	0
On-time delivery	2	5	20	1	3
Loss/damage	2	2	24	2	0
Service responsiveness	1	4	19	3	5

14. Does your facility use air freight service? If no, go to question 15.

To what extent does each of these **AIR FREIGHT** service components affect your competitive position?

	Hurts a lot	Hurts some	Neither hurts nor helps	Helps some	Helps a lot
Cost	36	66	45	14	7
Travel time	3	27	35	35	65
On-time delivery	5	14	23	41	81
Loss/damage	17	22	86	23	13
Service responsiveness	2	13	43	44	63

15. To what extent does each of these **TRUCKING** service components affect your competitive position?

	Hurts a lot	Hurts some	Neither hurts nor helps	Helps some	Helps a lot
Cost	36	66	42	47	39
Travel time	12	68	36	67	45
On-time delivery	18	38	24	51	95
Loss/damage	31	50	74	34	35
Service responsiveness	10	36	38	60	84

16. About how many miles is it to the nearest airport with commercial airline passenger service? *Average*—30.99 miles

Does it have jet service? *Yes*—181 *No*—44

To what extent does each of these **COMMERCIAL AIRLINE** service components affect your competitive position?

	Hurts a lot	Hurts some	Neither hurts nor helps	Helps some	Helps a lot
Cost	39	79	88	7	6
Travel time	21	74	75	26	22
Punctuality	16	60	96	24	23
Frequency of flights	29	77	71	22	20

17. About how far is your facility from each of these types of highways?

	Less than 1 mile	1 to 3 miles	3 to 10 miles	10 to 20 miles	Over 20 miles
Interstate highway	45	33	32	25	97
4-lane non-interstate	57	34	33	10	94

18. To what extent does the distance to each type of highway affect your competitive position?

	Hurts a lot	Hurts some	Neither hurts nor helps	Helps some	Helps a lot
Interstate highway	14	57	68	47	47
4-lane non-interstate	15	46	84	56	29

19. Regarding trucking service, which of the following statements most accurately reflects your forecast of your company's intentions over the next five years? (Check only one response.)

Don't have a private fleet and don't intend to start one	138
Don't have a private fleet but plan to start one	6
Have a private fleet—forecast elimination	10
Have a private fleet—forecast a smaller number of units	4
Have a private fleet—forecast constant number of units	52
Have a private fleet—forecast a larger number of units	21

20. If your business employs a private truck fleet, which of the following best describes its primary use? (Check only one response.)

Principally inbound freight	12
Generally balanced flows	42
Principally outbound freight (TL)	23
Principally outbound freight (LTL)	16

21. Does your company currently use any of the following electronic data interchange (EDI) services offered by your commercial transportation carriers? (Check all services being used.)

	Yes	No
Tracking freight in transit	100	115
Freight rate pricing	83	130
Freight billing	75	135
Bar coding to identify products being shipped	47	157
Other (specify: *1 comment made*)	4	43

22. Transportation may offer a competitive **advantage**. Indicate if the following modes give your facility a competitive advantage. (Check as many as apply.)

	Yes	No
Interstate highway system	138	72
Access to inland waterways	17	166
Choice of transportation carriers	185	35
Availability of different transportation modes	131	74
Rail service	65	129
Air freight services	110	91
Primary road system	134	64
Secondary road system	73	111
Commercial air (passenger services)	72	115
Other	1	7

23. Transportation also can create a competitive **disadvantage**. Indicate if the following modes give your facility a competitive disadvantage. (Check as many as apply.)

	Yes	No
Interstate highway system	47	137
Access to inland waterways	14	153
Choice of transportation carriers	27	152
Availability of different transportation modes	24	150
Rail service	31	139
Air freight services	27	145
Primary road system	26	143
Secondary road system	22	146
Commercial air (passenger services)	49	124
Other	0	24

24. On balance, for our facility, transportation creates (check one only)

A competitive advantage	100
A competitive disadvantage	43
Neither	88

C. Assessment of general transportation issues

25. We are interested in your assessment of possible changes in transportation and industrial practices. Please indicate the extent to which you agree or disagree with each of the following statements. All these statements concern possible trends in transportation in the 1990s.

	Strongly agree	Agree somewhat	Neither agree nor disagree	Disagree somewhat	Strongly disagree
A shift will occur from tariff to contractural rates.	56	99	60	8	2
There will be no increased use of EDI (Electronic Data Interchange).	10	12	35	79	94
Global logistics will become increasingly important.	105	84	34	4	1
Just-in-time management concepts will be adopted by few firms.	20	40	19	85	66
Reliability will be emphasized as a measure of transportation service quality.	170	58	2	0	1
The use of information technology in transportation activities will be the source of significant competitive advantage for firms.	85	103	39	3	0
Inventory movements will be increasingly driven by users "pulling" goods from suppliers, rather than suppliers "pushing" goods to users.	110	82	32	3	2
The transportation shake-out is nearing completion.	3	64	72	63	29
Turbulent times are still ahead for the transportation industry.	39	111	55	20	5
The continuing industry concentration of all modes of transportation is a concern to my firm.	24	96	87	18	2
My firm expects a negative effect from the impact of the projected national truck driver shortage.	29	87	74	37	3
My firm is comfortable with the features of the U.S. DOT's new mandatory drug screening regulations.	87	93	44	5	1
My firm is comfortable with the features of the U.S. DOT's new Commercial Drivers License Program.	71	99	49	7	3
On-time delivery for shipments will be as important as travel time itself.	171	55	3	2	0
My firm favors allowing triple 28-foot trailers on Iowa's interstate system	26	39	86	36	42
My firm favors allowing double 48-foot trailers on Iowa's interstate highway system.	31	38	85	37	38

26. We are interested in your assessment of possible policy choices in Iowa regarding transportation. Please indicate the extent to which you agree or disagree with each of the following statements. All these statements concern possible policy choices for the 1990s.

	Strongly agree	Agree somewhat	Neither agree nor disagree	Disagree somewhat	Strongly disagree
Iowa should expand its network of 4-lane highways even if it must raise user taxes to pay for them.	28	93	40	48	22
Iowa should expand its network of 4-lane highways even if it must reduce funding of county roads.	11	52	42	96	30
I would be willing to pay increased taxes to improve the speed with which snow is removed from roads and highways.	7	47	70	69	38
Iowa spends too much on its road and highway network. Less should be spent and user taxes reduced.	2	10	59	117	43
It is not critical that my facility has **direct** access to a 4-lane highway as long as it has reasonable access to a 4-lane highway.	32	123	23	36	15
Rail abandonments constitute a serious enough problem for Iowa that I would favor higher state expenditures to selectively maintain rail lines.	10	38	63	70	50
I favor an increase in the state fuel tax if the funds were devoted to repairing primary roads, including interstates.	25	92	43	40	28
Maintenance of existing highways and roads should be given priority over upgrading 2-lane roads to 4 lanes.	24	91	53	54	7
The roads and highways used by my firm (including suppliers and customers) are in better condition than they were a few years ago.	14	70	70	55	22
Generally speaking, it is my impression that the roads and highways in Iowa are in worse condition than in other Midwestern states.	6	35	73	89	28

27. One important transportation issue is whether longer combination trucks should be allowed on highways. Regardless of whether your business favors allowing longer combination trucks, to what extent do you agree with the following?

	Strongly agree	Agree somewhat	Neither agree nor disagree	Disagree somewhat	Strongly disagree
Longer combination trucks cause greater damage to the highway.	30	74	57	53	17
Longer combination trucks will divert a considerable volume of freight away from railroads.	17	88	61	55	11
Longer combination trucks raise a number of safety-related issues (i.e., passing, controlling vehicle, etc.).	83	116	16	15	2
The current off-interstate road system could adequately serve longer combination vehicles.	2	22	35	103	70
Significant cost savings are possible with longer combination vehicles.	46	109	49	24	4
Allowing longer combination trucks will set a precedent for even longer trucks in the future.	27	68	72	48	15

You can be assured your specific responses to this survey will be held in strict confidence and will be reported only as part of summarizing the larger survey. Would you like to receive a copy of the final report?

Yes ❑ 217

No ❑ 17

Thank you for participating in this important survey. Your voice will help in determining Iowa's future transportation policy. Please return the survey in the enclosed envelope to

Professor David Forkenbrock, Public Policy Center, 227 South Quad, University of Iowa, Iowa City IA 52242

APPENDIX B

SUMMARY OF PRESENTATIONS AT CONSULTATION MEETINGS

As part of our efforts to obtain the views of businesses and organizations with major interests in transportation, a series of consultation meetings were held on June 17, 1992, in the Iowa State Capitol. Robert Peterson, chair of the project advisory committee, presided, and eight other committee members participated: Deo Koenigs, Myrt Levin, Westley McDaniel, Melvin McMains, Lloyd Mullins, Merlin Plagge, Rose Rennekamp, and Austin Turner. The research team also participated.

Presenters were encouraged to address five policy areas:

- highway investment strategies,
- the appropriate level of upper Mississippi River reinvestment,
- investment in advanced technologies,
- rural road standards, and
- the role of scenic byways.

PRESENTATIONS

Following are synopses of the 11 presentations.

Gene Willis, Iowa State Association of Counties; Marvin Johnson, Iowa County Supervisors Association

Presentation. The rural and secondary road network is a vital asset to Iowa's economy. The Iowa Association of Counties has three primary concerns: (1) a property tax freeze would affect the ability of counties to maintain their roads, (2) road use taxes should not be used to balance the state budget, and (3) allocation of state funds based on need may inadvertently reward counties for past neglect or penalize counties with low tax bases. It is possible that the glory of a four-lane system has been oversold; we should upgrade existing roads rather than abandoning them in favor of building new roads.

Question and answer. Mr. Willis agreed that maintenance among counties could be coordinated more effectively, but he emphasized the need for local control of specific maintenance decisions. Regional agreements may be necessary, but they should evolve from common sense and economic necessity rather than by state mandate. When allocating state funds, local effort should be part of the consideration of need.

Mr. Johnson urged completion of existing networks before building more roads. He expressed concern over the practice of turning over road jurisdiction to counties without the concomitant resources to provide adequate maintenance.

Scott Weiser, Iowa Motor Truck Association (IMTA); Deb Johnson, American Trucking Associations (ATA) Foundation

Presentation. Good roads are necessary for efficient freight transportation services and economic vitality. To ensure good roads, taxes paid by their users should not be diverted to other purposes. The state must also consider seriously the long-term implications of diverting dedicated highway funds to balance short-term budget problems. The trucking industry is leading the effort to improve highway safety in this country, but the safety improvements that we continue to fight for are not without cost. The share of total Iowa manufacturing freight moved by trucks increased from 28.4 million tons in 1982 to over 54.5 million tons in 1990, a 92 percent increase. The 54.5 million tons of freight moved to and from Iowa by truck in 1990 represented 84 percent of the total manufactured freight moved by all modes of transportation. Iowa's geographic position as a bridge state in the center of the nation provides the state's businesses and agricultural interests with a key advantage. Our extensive state highway system allows for business expansion opportunities in every corner of the state.

Question and answer. The IMTA's biggest concern is the diversion of funds from road use taxes. Before we can make progress, we must protect the Road Use Tax Fund (RUTF). We cannot neglect infrastructure; the costs of one year of neglect are astronomical. Neglect represents short-term thinking; instead, we must spend what we have more effectively. The biggest challenges to the industry are government regulation and associated costs (e.g., environmental standards, taxes, labor, and safety). We cannot rely on increases in user fees to raise revenue. We need to see ourselves as a bridge location within the Midwest. Missouri, which has a lower tax, sells 10 to 13 percent more diesel fuel. The ethanol industry is currently subsidized by the RUTF; unfortunately, a subsidy will probably always be needed. We are very supportive of advanced technology and consider it beneficial to the government as well. When a particular technology is deemed good for carriers and there are incentives for companies to adopt it, they will do so. RUTF allocations should go to the systems that generate the revenue, with some subsidy of rural roads.

John Landon, Iowa Grain and Feed Association/Iowa Fertilizer Association

Presentation. The continued development of new agricultural processing activities is likely to be fueled by our continued research building on the intrinsic properties of grain and soybeans. If the market attaches economic significance to specific quality characteristics for grain and soybeans, we could see greater demands placed on existing processing centers, or even the development of new processing facilities throughout the state. Economics will determine whether such development is in the direction of fewer, larger processing facilities or more numerous, smaller facilities. In either case, there may be increased demands on our transportation network. With this in mind, it may be appropriate to direct highway investment strategies toward the development of improved two-lane highways with the potential for expansion to four-lane highways as required.

Technologies that improve the movement of agricultural products are viewed as positive. Lowering the amount of time spent in weigh stations increases efficiency; however, the adoption of advanced technologies should not place undue economic burdens on shippers and carriers. Adoption of new technologies on a "pilot project basis" could provide valuable data on how these technologies can improve the efficiency of transportation.

It is likely that traffic across county lines will increase in the future, so the coordination of development between counties could be of great benefit. Using embargoes on bridges as a traffic management practice is not the answer to our long-term problems. If we need to improve roads and bridges to handle traffic, that need should be stated openly; we should plan for it and work to see it through. While the associations Mr. Landon represents recognize the importance of attracting tourism dollars, they believe that the primary thrust of Iowa's transportation policy should first address the movement of the goods and people associated with our agricultural and industrial base.

Question and answer. As railroads decline, it becomes necessary to transport our products more by truck. Although the number of producers has decreased, the size of individual producers has grown, resulting in an overall increase in rural traffic. Iowans want rural traffic to be safe and efficient. Mr. Landon spoke of one embargoed bridge that is not even long enough to have all the axles of a truck on the bridge at the same time. Thus, he feels that the weight problem may be overstated and that embargo standards should be reviewed. He is not opposed to embargoes in the frost-and-freeze period, but feels that the state and county governments must get serious about repairing embargoed roads and bridges. Railroads and barges are key components on a national policy level; at the state level, he feels that the tax mix should be kept in line with other states and with the benefits received.

Steve Spade, Iowa Public Transit Association

Presentation. Economic development means the creation of jobs; the other side of this issue is to make sure that we can provide an adequate number of workers. Public transit provides access to jobs for a special population. This special population includes the disabled, the elderly, the young, or those who simply cannot drive or cannot afford to drive. Potential employers also benefit from the increased access of this population to the workplace.

Question and answer. In response to an inquiry about the role of public transit for rural workers, Mr. Spade responded that one role of public transit is to work with local businesses and government to meet the transportation needs of rural workers. These needs can be met in part by developing carpooling and vanpooling services. Pooling services provide the connection needed as people move from one mode of transportation to another. The automated scheduling system used for paratransit operation could also be used for pooling efforts. If more employers are involved, more travel options can be provided.

Andy Baumert, Iowa Pork Producers

Presentation. The primary competitive advantage of the Iowa pork industry is the proximity of feed grain production to hog production units. It is therefore vital that an adequate network of rural roads be maintained to continue to capitalize on this advantage. Counties should be encouraged to share information that will promote continuity in rural transportation. Because of the need to ship nearly all Iowa pork outside the state's borders, interstate highways and major expressways are also key to our competitiveness. Investments in waterway improvements or scenic byways should not be a priority for the use of our state's limited transportation funding. The Iowa Pork Producers are more inclined to favor allocating resources to technology developments such as identifying the most efficient way to ship chilled pork to the Far East, or developing an improved system for distributing manure nutrients to Iowa cropland.

Question and answer. More blacktopped roads are needed. Animals are being moved more frequently than before as more producers create additional sites on their farms for hogs. This increases the importance of the rural road system at the farm level.

Paul Soyke, U.S. Army Corps of Engineers

Presentation. Commodity shippers in the upper Midwest use a truly intermodal transportation system. Their commodities to be shipped by barge are delivered to the river by both rail and truck. Many transportation companies have developed intermodal rates; Iowa has been a leader in this trend. A national needs assessment completed this past year showed that the lower locks on the Mississippi River are ranked, both in terms of benefits and delays, as two through ten in the nation, out of a total 167 locks. It is vitally important for the people in the state of Iowa to take an active interest in navigation as well as in the needs of all transportation modes. The people and industries in this state require access to all modes of transportation if they are to remain competitive in world markets. For many of these commodities, a margin of mere pennies can make the difference in making a sale; transportation can represent a significant portion of the total cost (especially with commodities for export).

Question and answer. Mr. Soyke described a recent accident that forced the closure of Lock 25. It was not reopened for use until two days later. Fifty barges were backed up when the lock reopened; three days later there were still 42 barges waiting. The delays cost barge companies an estimated $400 per hour in operating costs.

A question was posed regarding the costs of making the necessary system improvements by the year 2020. It would cost upwards of $400 million to expand a 600-foot lock to 1200 feet; however, it is not known how many locks need to be expanded. The time required for an average tow to go through a 1200-foot lock is 30 minutes, thus about 50 tows per day can be accommodated. It would cost $2 billion dollars to increase the size of the lower five locks. This compares with the $95 billion needed to repair the nation's bridges. Repairs of the locks are ongoing; Locks 20 through 22 have already been completed. The repairs cost from $12 million to $20 million per lock and should last 20 to 25 years at the current rate of use. Replacement of these locks is a high priority for the Corps of Engineers, but that priority may not be shared by national policymakers.

Evan Stadlman, Iowa Corn Growers

Presentation. A recent Iowa grain marketing study has indicated that approximately 95 percent of all corn sold in the state for livestock feeding was transported an average distance of 18 miles; the remaining five percent was moved by rail an average distance of 230 miles. Iowa's transportation system must continually address the ability of western Iowa producers to move their products more competitively to the larger and growing processing and export markets generally located in eastern Iowa or along the Mississippi River. Our conservative estimates indicate that over 940,000 bushels of corn or the equivalent of over 7,800 acres of production need to be delivered to these processing plants every day. To do that by truck would require nearly 1,100 semitrailer loads of corn moving on Iowa roads each day. Moving that same tonnage by rail would require 268 hopper cars daily. The establishment of priorities for rural road maintenance cannot be stressed enough. Counties must be required to develop a coordinated program to promote more continuity within the state.

Question and answer. Bridge repair is essential to the improvement of the current system. Increasing fuel taxes will not cover the costs of these repairs, so we need to look at other sources. Producers want access to a usable road within one or two miles. Access can be via a gravel road that leads to a higher grade road, which in turn leads to a still higher grade road, and so on. The main issue is maintenance. There is no way to move goods from the western part of the state to the eastern part without additional cost to the producer; also, producers are generally less familiar with the railroad network. If we want rail service in Iowa, we must address certain issues such as determining the cost-effective number of hopper cars or pooling to specific producer locations. We need to review and analyze our transportation options; although unlimited access is ideal, farmers are coming to terms with the need to discuss realistic transportation choices.

Darrell Weems, Iowa Farm Bureau Federation

Presentation. It is important that funds originated, collected, and intended for road use purposes be used to build and maintain the state's roads and bridges. The Farm Bureau is opposed to diversions from the RUTF and encourages the study committee to address that issue. The Farm Bureau recognizes the sentiment behind and the need for recreational trails in Iowa, but it believes that specific user fees should pay for acquisition, development, and maintenance of recreational trails. The unmet needs of the secondary road system and the important role this system performs dictate that the system retain its current percentage of funds from the RUTF. It will be especially important to consider the likelihood that Iowa will move away from being a supplier of raw products to become a value-added agricultural state. Transportation policy must allow for changes in grain and livestock marketing structures as well as agriculture industry changes that result form the move to value-added technologies. The Farm Bureau encourages the study, development, and use of alternative construction standards for roads and bridges that would reduce costs while maintaining a reasonable level of safety for the traveling public.

Question and answer. Mr. Weems commented on the premise that dollars should be spent where the revenues are generated and observed that agriculture is a main part of Iowa's economy. The state has a comparatively high mileage of roads relative to other states, resulting in fiscal problems. To allocate limited maintenance dollars, we could identify the value-added routes, and make adjustments as needed. Farmers are now aware that not all perceived needs can be met, given the funds available. Local roads are still important, but the bigger picture is also understood.

Regarding the RUTF subsidy of ethanol production, the Farm Bureau is in favor of promoting ethanol production, but not from the RUTF. Major unmet needs in the secondary road system include the maintenance and repair of bridges and roads. Currently, the system is adequate for non-farm work trips. The Dallas county rural population is probably higher than ever, but the growth is not in the number of farmers. Preferring to shift maintenance dollars to the 20 percent of roads that carry 80 percent of the traffic, Mr. Weems expressed doubt that closing roads really saves money.

Paul Warner, Iowa Waterways Operators

Presentation. Iowa is blessed with one of the best natural transportation systems in the country: it is bordered by navigable waterways on both the east and the west. Iowa's primary exports and imports are bulk products, including grain, coal, fertilizer, and petroleum. Waterways are typically the least expensive way to ship bulk products. There is no reason, however, to assume that major waterway infrastructure rebuilding projects are necessary to strengthen Iowa's economic prospects. More likely, selected infrastructure enhancements tied closely to port and terminal growth would best support the state's goals.

Question and answer. Large-scale waterway projects probably will not continue because taxpayers simply cannot pay for them. Although user fees pay 50 percent of new construction projects, there has been no correlation between the fees collected and the improvements made, except in the case of Lock and Dam 26. We must develop alternative projects. One such project might utilize engineering expertise to devise a way to extend the guidewalls of the locks without rebuilding them. We need funding alternatives; neither the Inland Waterway Trust Fund nor the U.S. Treasury can do it. We also need to look at the beneficiaries. Locks and dams have several purposes and users: flood control, environmental control, conservation, municipal water supply, and hydroelectric power systems. The revenues from the last item go into the General Treasury, not into the rebuilding of infrastructure. The 50 percent drop in tonnage on the Missouri River is due to a combination of the drop in water level and producers shipping to the east. The depth of the Missouri River has gone from nine feet to seven feet, but the river is also narrowed so that while operators previously could tow six barges (three side-by-side), now they can tow only three barges in a single row. With the uncertainty of Missouri River navigation, shippers have sought other methods for getting their products to market. Also, the difference between shipping on the Missouri River and on the Mississippi River is greatly affected by the availability of transportation to and from each river. Finally, in eastern Iowa there are more value-added facilities (plants in Cedar Rapids, Ottumwa, Davenport, and Muscatine) so price differentials between western and eastern Iowa are not entirely due to the cost of shipping to distant locations.

We need to bear in mind the following factors: (1) the potential impact of making the Missouri River fully navigable, (2) the political pressures that influence the Corps of Engineers, (3) the goal of improving waterborne transportation (which is not necessarily the same as improving infrastructure), and (4) the importance of considering not only the needs of the operators but of all beneficiaries of the waterways.

Ron Heck and Dave Larson, Iowa Soybean Association

Presentation. We are concerned with ensuring economical and efficient means of transportation with an emphasis on coordination within the system. All the decisions regarding investment and maintenance should be based on a benefit-cost analysis, using all alternative transportation modes available when conducting the evaluation. Adequate funding must be maintained for the rural road transportation system. Needs and priorities must be assessed and implemented in an interactive way, on an ongoing basis. Coordination of priorities is critical. World competition is a major concern. We are more likely to use railroads because of the enormous bulk we ship and because the rates are better. Rural roads and bridges need to be adequate both for farm equipment and for semitrailer trucks.

Question and answer. The use of intermodal container shipments would facilitate the shipment of some varieties of soybeans. A study of ways to improve the secondary road system could be done by choosing several small, key areas; talking to county engineers; and establishing a gridwork with car and truck traffic on paved roads. The problem of bridges on gravel roads also must be addressed; there are thousands of concrete bridges that are crumbling. Is there a way to design something to "drop in" on the site, rather than designing a bridge for each location? Regarding the spending of RUTF dollars where the economic value is greatest, Mr. Heck voiced concern about defining the economic benefits: do they refer to the gains by individuals or to Iowa generally? The Iowa Soybean Association is completing a study of the future of soybean production that includes transportation issues. Regarding the use of so-called "Missouri Bridges" (gravel fill across a small stream) to provide access on low-lying roads, Mr. Heck would prefer this style of bridge only if the alternative were no bridge: even a bad 20-foot bridge would be preferable.

Dennis Schwitters, Iowa-Nebraska Farm Equipment Association

Presentation. Mr. Schwitters surveyed 10 to 15 members across the state for input on transportation. Transportation issues to be addressed should include *intrastate* commerce as well as *interstate* commerce. The local road system is important and should be under local rather than state management. The RUTF should be reserved for road use purposes, especially for capital needs.

Question and answer. The Iowa-Nebraska Farm Equipment Association has no complaints regarding the current system for local management of roads, but there is concern about future political decisions resulting in a greater percentage of funds for non-road purposes. Changes in transportation strategies should react to economic changes, not vice versa. We do not believe that "If you build it, they will come." Farm equipment manufacturers build to accommodate most bridges over eight feet by designing for fold-up. We believe the state should be "next in line" for capital investment in advanced technology rather than on the "cutting edge." Regarding regional control of road planning and continuity of maintenance across county lines, Mr. Schwitters feels that study groups should be formed to review the idea, particularly for overall efficiency. It should not be managed by the state, however, because counties are different and have varying management systems and needs. It is important to do traffic counts, but we need to do more to judge the use of a particular transportation link than just assess the quantity of the goods moved.

WRITTEN SUBMISSIONS

Three organizations whose representatives were unable to attend the consultation meeting provided written discussions which are summarized below.

Jack C. Soener, Iowa Association of Business and Industry

The Iowa Association of Business and Industry recommends that heavily used roads be developed as four-lane highways for both safety and rapid transportation, linking major regions and cities both within the state and with adjoining states. Smaller communities could be part of such a system of improved two-lane highways. Improvement of the upper Mississippi River should be in proportion to usage; also, users should pay charges proportionate to those paid by highway users. Investment in advanced technologies should occur only when there is an attractive cash payback. As a result of farms being consolidated into fewer, larger units, the need for rural roads every square mile is diminishing. Investment should reflect this changing need. The economic benefits of investment in scenic byways are not easy to forecast, making it somewhat risky.

Mark Rodvold, Siouxland Interstate Metropolitan Planning Council

The specifics of a highway investment strategy must incorporate a thorough evaluation of benefits and costs, including economic development, costs and maintenance of types of roads, and even the appropriate location of passing and turning lanes. For waterway investment, the use of General Fund revenues is not appropriate because of the relatively small statewide benefit of waterway use. Investment in advanced technologies should be targeted to the areas of highest return: the regional, interstate travel corridors that are also the most responsive to economic growth. Rural road standards commensurate with needs and system use should be reviewed. Caution is urged regarding scenic byway investment because these investments can easily exceed actual tourism potential.

Bob Bateman, American Automobile Association (AAA) Iowa

Highway user fees should not be diverted from the highway program to reduce the deficit or to fund other projects. More emphasis must be placed on rehabilitating Iowa's highways and bridges. The Road Use Tax Fund should be studied in the near future and modified to reflect more adequately the needs of the state, counties, and cities. The federal government should not impose excise taxes on motor vehicles or increase motor fuel or crude oil taxes as means of promoting conservation, reducing the deficit, or establishing a floor price for oil. A national alternative energy strategy should be implemented to ensure that non-petroleum fuels are used on 25 percent all of vehicle miles traveled in the year 2005. AAA Iowa believes that government at all levels should develop scenic roads, recognize them as important resources, and protect them by developing a system of scenic highways to be enjoyed by the motoring public.

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