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Policy Strategies for Iowa in Making Major Road Investments

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Policy Strategies for Iowa in Making Major Road Investments

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David J. Forkenbrock
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Public Policy Center
The University of Iowa
2002

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PREFACE

In March 2002, the author met in a retreat with members of the Iowa Department of Transportation Commission and its Director. We discussed ways in which transportation policy can best help strengthen Iowa's economy and make it a safe, comfortable place in which to live and work. Following this retreat, the Commission and Director asked the author to develop a practical guide to assist them when pursuing policy objectives through transportation investments. This monograph is the result of that request.

The Department has considerable resources at its disposal, but the needs it faces exceed them. The question thus emerges: How can the state best deploy available resources to achieve priority policy objectives? Focusing on road investments, by far the largest category of transportation projects, we examine this question in the context of three primary issues: economic development, sustainable urban growth and development, and social equity.

Major transportation investments are a powerful tool for pursuing a variety of public policy objectives. Under the right circumstances, they can help make areas of the state more competitive for attracting economic activity. They also can be a formative element in the way cities develop, thus influencing the quality of life in them. Wise investments can increase the safety of and promote efficient travel for Iowa's residents and its visitors. Finally, enlightened transportation policy can help ease the deprivation of the less fortunate members of the state's population.

The analysis presented in this monograph is not intended to be prescriptive—we are not advocating a particular perspective. Rather, we raise a series of policy-relevant issues and suggest how various sorts of transportation investments can affect them. Our objective is to facilitate informed debate, not to propose firm solutions to the issues discussed.

Our research was carried out at the University of Iowa Public Policy Center. Funding for this research was provided by the Iowa Department of Transportation.

ACKNOWLEDGMENTS

In the preface we mentioned that this research was funded by the Iowa Department of Transportation. We are grateful for its support. Mark Wandro, Director of the Iowa DOT, and Stuart Anderson, Director of the Office of Systems Planning, took a strong interest in this project. Their advice and counsel was invaluable.

Completion of this study would have been much more difficult without the assistance of David Harkins and Judd Vande Voort, graduate students at the Public Policy Center. They were highly enterprising and thorough in helping us find necessary data, as well as in presenting these data effectively. Paul Hanley, a faculty member in Urban and Regional Planning, provided valuable advice and support throughout the study.

Teresa Lopes, editor at the Public Policy Center, ensured that the text is accessible to a wide audience, while maintaining the monograph's technical accuracy. Kathy Holeton, administrative assistant at the Center, developed the graphics and helped us in too many other ways to mention.

With real appreciation, we acknowledge the many and diverse contributions of these people.

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CHAPTER 1
INTRODUCTION

Transportation investments are one of the primary tools for achieving social and economic policy objectives. They can help foster economic development, influence the patterns of growth within and around cities, and improve social equity. To achieve their potential as policy levers, transportation investments must be carefully thought through. This means that policy makers must have a good sense of the likely effects—positive and negative—of each alternative investment under consideration. The object of this monograph is to provide a basic framework for estimating these effects.

SPIRIT OF THIS MONOGRAPH

This monograph is intended to be strategic in nature—it raises a number of issues that should be considered when assessing the merits and impacts of potential transportation investments. It is not an impact assessment manual in that it does not suggest methods or techniques for assessing the social and economic effects of public investments in transportation facilities. In short, the monograph is intended to provide an integrated approach to evaluating potential projects such that policy makers can ask the right questions in a timely manner and analysts can structure their assessments in an informative, useful way. In this monograph, we emphasize the three key areas of economic development, land use and urban form, and social objectives because these are typically the most central considerations in Iowa when major transportation investments are contemplated.

EFFECTS OF TRANSPORTATION INVESTMENTS

Transportation investments that were appropriate for yesterday's social and economic circumstances in Iowa may not work well today and may be badly out of step with tomorrow's needs. Thus, investment decisions must be anticipatory. In particular, the policy objectives that society wishes to pursue via transportation investments must be understood. It is not the purpose of this monograph to suggest what these objectives should be; rather, we explore how to translate possible policy choices into workable transportation investments.

To help provide a context for evaluating potential highway investments in Iowa— a state that has undergone and continues to undergo significant social and economic change—we begin with an analysis of a series of trends. The trends we examine in Chapter 2 reveal that rural areas and metropolitan areas are changing in very different ways. This suggests that the types of highway investments that are called for also are quite dissimilar; clearly, a one-size-fits-all approach will not be appropriate for the state.

It probably is fair to say that the most common reason for investing in highways is to strengthen economic development prospects. It is therefore important to have a good sense of when such investments actually are likely to foster economic growth by helping to attract mobile resources like capital and skilled labor that can locate wherever the opportunity is most promising. In Chapter 3, we examine arguments for building new or upgraded roads or highways in the interest of economic development.[1] We conclude that while some of these arguments have little merit, others are well founded in economic principles. We thus offer an assessment of when such investments are likely to make sense for Iowa.

In and around metropolitan areas, economic development is important, but so is a sustainable form of urban growth. Unplanned, sprawling growth can lead to a host of long-term problems such as traffic congestion, reduced air quality, long commuting distances, and high infrastructure costs. The key role for highway investments is to help foster a sensible pattern of growth, one that is consistent with the preferences of a community's residents. In Chapter 4, we examine the relationship between highway investments and urban form (land use patterns across the community). We develop a predictive approach to land use that is based on differential accessibility. Highway improvements make some areas relatively more accessible than others. Accessible sites tend to attract land uses that are able to out-bid other uses for these prized locations. We suggest that carefully planned highways can be a useful tool in managing accessibility and thus can work with the urban land market, not against it, to produce a desirable urban form.

Even if a highway investment fosters economic development and promotes the type of urban form a community prefers, critical social issues may arise. To what extent would the benefits of a potential project be accompanied by negative impacts? Would the benefits accrue to one group within the state and the costs to another? Other issues of a social nature include whether upgraded highways can actually help declining areas of the state rebound, as well as whether there are more cost-effective ways to assist such areas than building increased road capacity.

In Chapter 5, we examine these issues and suggest a comprehensive framework for examining the social and economic effects of a possible highway investment. We consider the effects both on the users of the facility and on those who would in some way be affected without actually using it. Non-user effects include changes in community cohesion, economic opportunity, traffic noise, visual quality, and property values.

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[1] In this monograph, we use the terms "highway" and "road" more or less interchangeably. Of course, highways are comparatively high standard roads. We also use "community" in a similar way as "city." In general, cities are larger communities.

CHAPTER 2
IOWA: A CHANGING STATE

Iowa has been undergoing substantial demographic, social, and economic change in recent decades. This change has major implications for the types of transportation investments that will be advisable and affordable. Before examining policy issues related to investments in the state's highway system, it is instructive to consider the nature and magnitude of changes occurring within Iowa. This chapter does not seek to provide a comprehensive analysis of the types and levels of highways the state will need in future years. Rather, it is intended to provide a useful context for an assessment of potential investment strategies for Iowa's highway system.

As a reference for subsequent maps provided in this chapter, Figure 2-1 shows the boundaries of Iowa's 99 counties. Metropolitan counties, of which there are 12, are shaded and have darker borders. For ease of reference, subsequent maps also have the borders of metropolitan counties darkened. Names of the state's nine cities with populations over 50,000 also are shown in Figure 2-1.

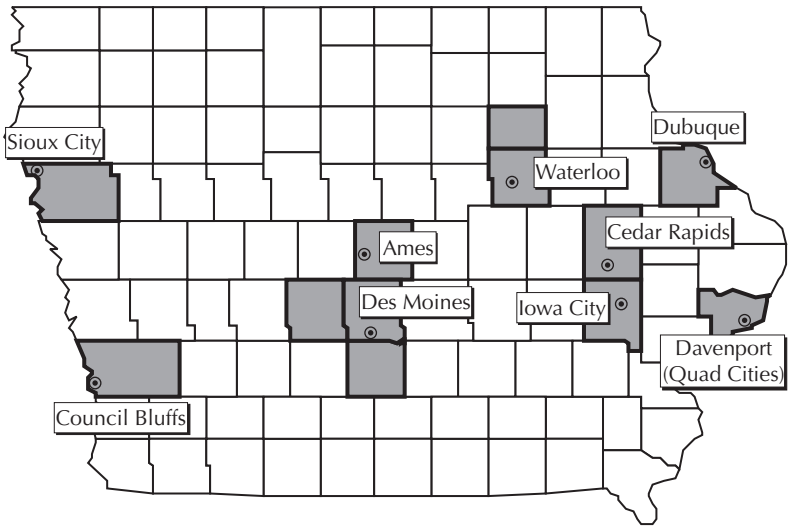

Figure 2-1. Iowa's 99 counties and nine metropolitan areas

POPULATION AND DEMOGRAPHIC CHANGES

The population of the state of Iowa grew slightly in the 1990s, following a decline during the economically troubled 1980s. This growth was by no means uniform; rather, it reflected a continuing trend that existed during much of the 20th century—growth in the larger cities and decline in many rural counties. Figure 2-2 illustrates

this long-term trend quite clearly, from the vantage point of the year 2000. The figure shows that most counties in Iowa reached their maximum populations before 2000, in many cases several decades earlier. Moreover, in 2000 many counties had less than three-quarters of the maximum population they had reached at an earlier time. Indeed, 11 counties had less than half of their maximum population. Most of the 15 counties still growing in 2000 were clustered around larger urban centers: Des Moines, Cedar Rapids, Iowa City, Council Bluffs, and Sioux City.

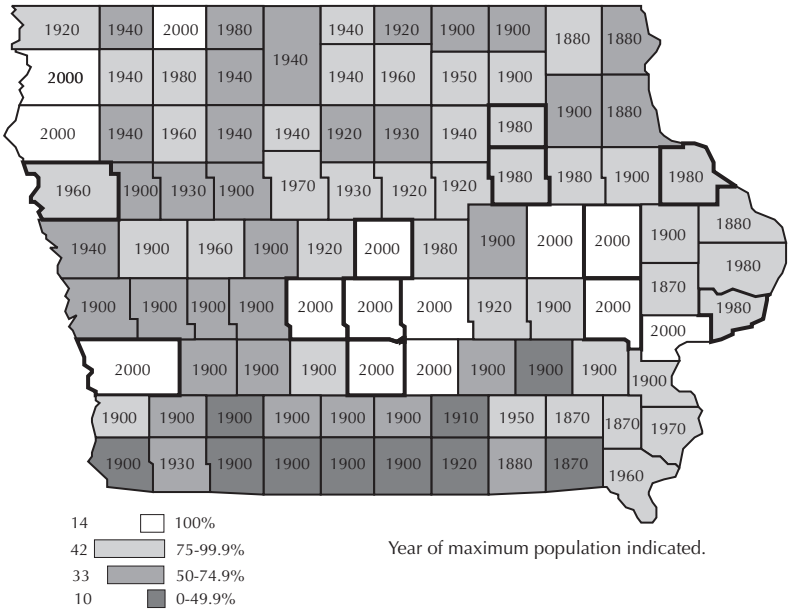

Figure 2-2. Year 2000 county populations as a percent of maximum

SOURCE: (1)

Figure 2-3 provides a closer look at recent population changes among Iowa's counties. Reversing the statewide losses of the 1980s, in the 1990s the overall state grew by 5.4 percent to slightly over 2.9 million (an all-time high, eclipsing the 1980 figure). Between 1990 and 2000, three changes are particularly noticeable. First, eight counties, clustered around Des Moines and Cedar Rapids/Iowa City, increased their populations by more than 10 percent during the decade (Dallas County, in the Des Moines metropolitan area, grew by 37 percent). Second, a moderate growth rate of between 6 and 10 percent was experienced in several counties near metropolitan areas and along the western edge of the state. Third, even though the state grew, 44 counties lost population during the 1990s, some as much as 9 percent.

In the case of many rural counties, the trend of declining population is long-standing, continuing, and cumulatively of significant magnitude. Because numerous road-building decisions were made around the time that many of these counties stopped growing, the size of their current road networks may not be well suited to either their current or future needs.

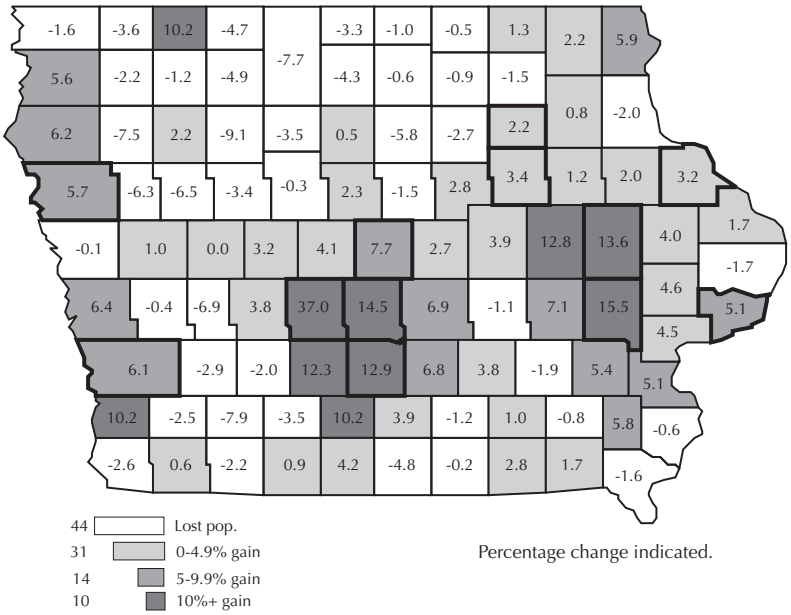

Figure 2-3. Percent change in county populations from 1990 to 2000

SOURCE: (2)

The populations of Iowa's rural counties are somewhat older than those of its metropolitan counties, as Figure 2-4 shows. In 11 of the 12 metropolitan counties, fewer than 15 percent of the residents were 65 years or older in 2000. In contrast, many rural counties, over 20 percent of their populations fall within that group; in some rural counties nearly a quarter of the residents are 65 years or older. A band of counties with comparatively large percentages of elderly residents runs north and south in the western part of the state. It also reaches to the east in northern and southern Iowa.

AGRICULTURAL DEPENDENCY

Another perspective on change in rural Iowa is presented in Figure 2-5. We have developed a simple index of agricultural dependency and examined the scores on this index for Iowa's 99 counties. The index has three components which are averaged to produce a composite value:

- land area devoted to farmland in the county divided by total land area in the county;

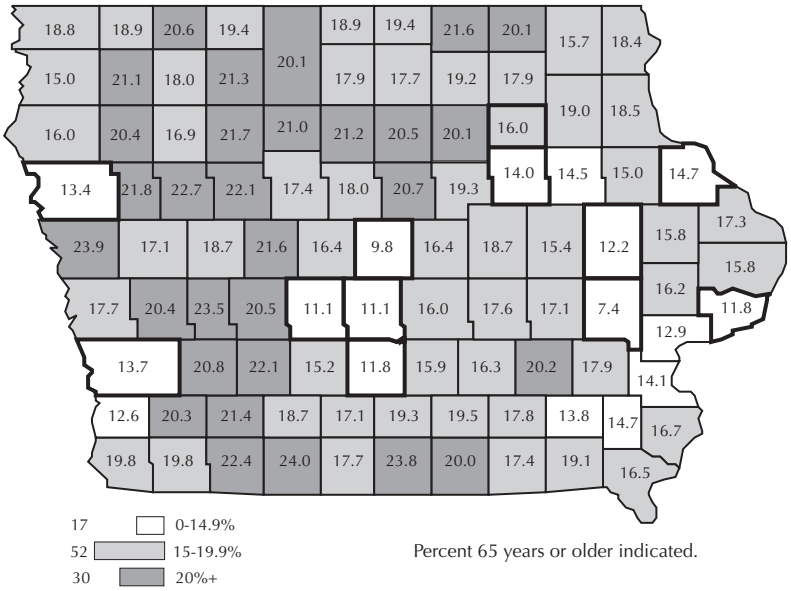

Figure 2-4. Percent of county populations aged 65 years or older, 2000

SOURCE: (3)

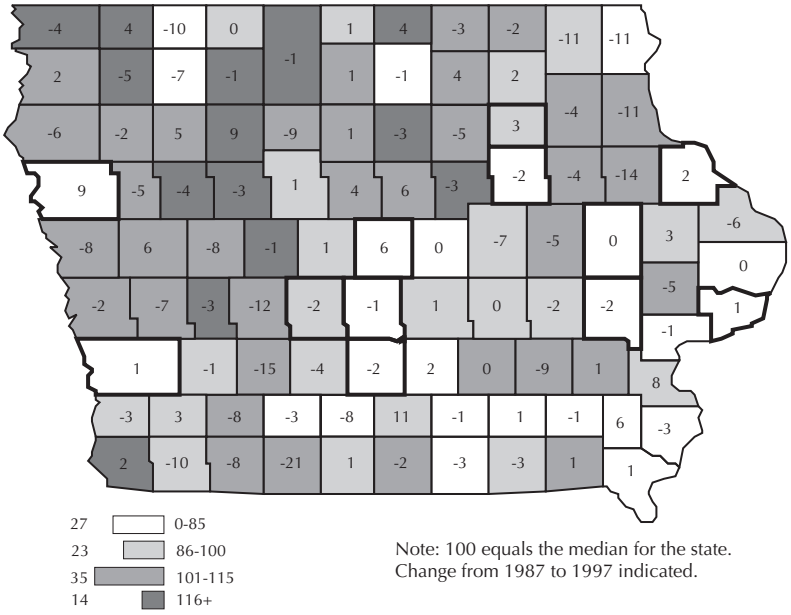

Figure 2-5. Agricultural dependence among Iowa's counties, 1997

SOURCES: (4,5,6)

- total number of workers in the county claiming farming as their principal occupation divided by the total county labor force; and
- total agricultural earnings in the county (value of agricultural products sold minus total farm production expenses) divided by total combined earnings for the following economic sectors: service; wholesale; transportation and public utilities; retail; manufacturing; government; finance, insurance, and real estate; and construction.

The index we developed has an average value for the state of 100. Counties with index values greater than 100 are more dependent on agriculture than average, and counties with index values less than 100 are comparatively less dependent. As one would expect, Figure 2-5 shows that all of Iowa's metropolitan counties have very low agricultural dependence scores. Likewise, counties along the Mississippi River tend to have low scores. Above average index scores appear in western counties and throughout the northeastern part of the state, with the highest scores in north central Iowa. Also shown on the map are changes in index values from 1987 to 1997. A mixed pattern is evident, but generally areas within commuting distance of metropolitan areas decreased in agricultural dependence during that ten-year period.

Counties with high levels of agricultural dependence tend to have more people who work close to where they live. Perhaps the greatest transportation need in these counties is the ability to move crops and livestock to market locations. It is often the case, however, that members of farm households commute to jobs in urban areas to supplement farm income and to secure health insurance *(7).*

EMPLOYMENT AND HOUSEHOLD INCOME

Iowa's economy has been steadily changing. As a share of the state's overall economy, agriculture has diminished, even though its importance is still great. Looking beyond agriculture, Figure 2-6 shows the changing shares of statewide earnings by major economic sector. In the years since 1975, manufacturing has declined in its fraction of total wages paid within the state, while the category of finance, insurance, and real estate (FIRE) has increased somewhat.

The largest relative increase has been in the service sector, which has shown steady growth over the past several decades. Service employment is difficult to summarize succinctly because the sector is so broad. It includes legal services but also janitorial services. Overall, though, it is business-related services that account for the bulk of the growth in this sector. Information processing, advertising, legal counsel, and equipment maintenance are some of the service elements that have witnessed sustained growth in Iowa.

Services, retail and wholesale trade, and FIRE industries are predominantly urban activities, and it is the metropolitan counties that have shown the greatest economic

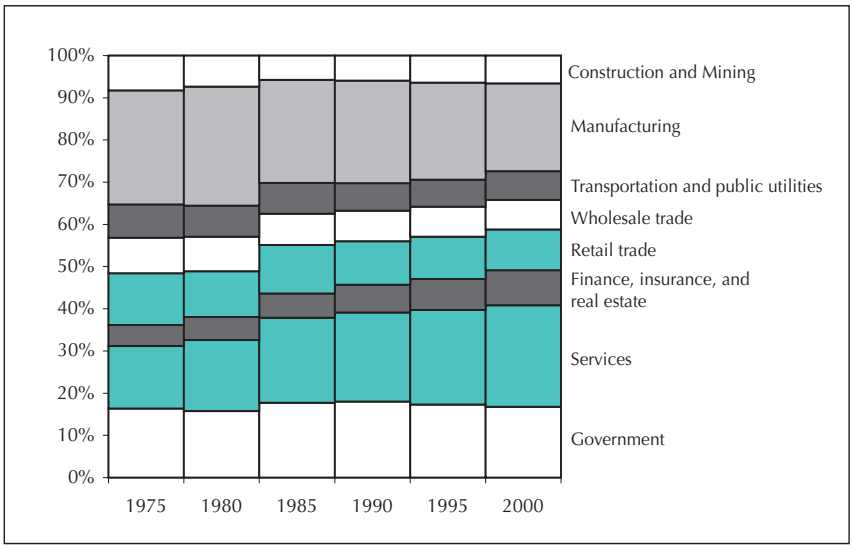

Figure 2-6. Percent of non-agricultural earnings by economic sector, 1975–2000

SOURCE: (8)

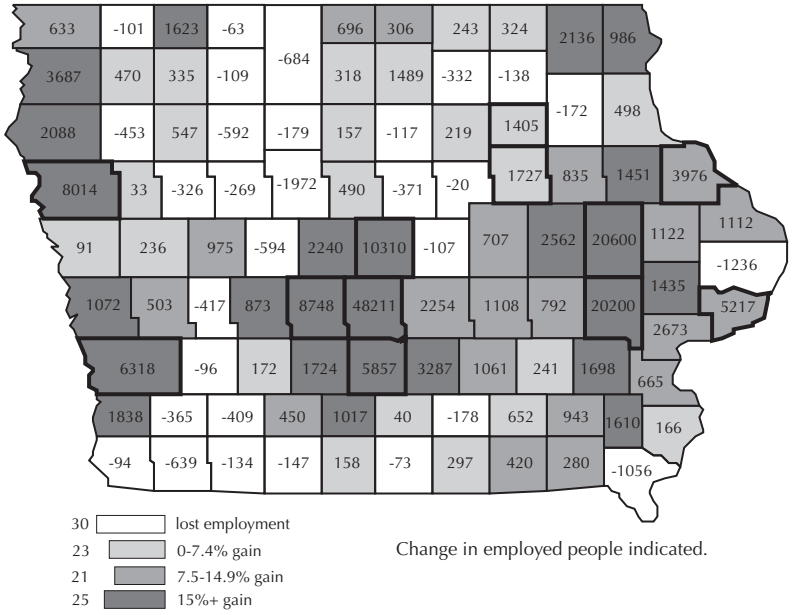

Figure 2-7. Percent change in employed people over age 16 by county of residence from 1980 to 2000

SOURCE: (9)

growth during the past few decades. Figure 2-7 shows the growth in employment in Iowa's counties for the period of 1980 to 2000. We display employment change over two decades because the 1980s were as dismal economically as the 1990s were outstanding. By showing change over these two decades, we gain a good perspective on longer-term structural change within the state's counties.

Figure 2-7 reveals that the Des Moines metropolitan area and the Cedar Rapids-to-Iowa City corridor experienced remarkable employment growth during this 20-year period, gaining 62,456 and 40,770 jobs, respectively. Sioux City and Council Bluffs also posted good increases in employment. Thirty rural counties lost jobs, and some saw very severe job losses. Overall, Figure 2-7 shows a major shift in jobs from rural areas to metropolitan areas; coupled with a degree of change from agricultural employment to service and FIRE industry employment, Iowa's economy has been undergoing a dramatic change.

The change in Iowa's economy is manifested in income levels. As Figure 2-8 indicates, most of the state's metropolitan areas, and the counties around them, have median annual household incomes greater than $40,000. Some southern-tier rural counties' median household income levels are less than $30,000, and many other rural counties in southern, western, and northeastern Iowa have incomes between $30,000 and $35,000. Clearly, the types of jobs found in the state's metropolitan areas typically pay significantly more than those found in rural areas.

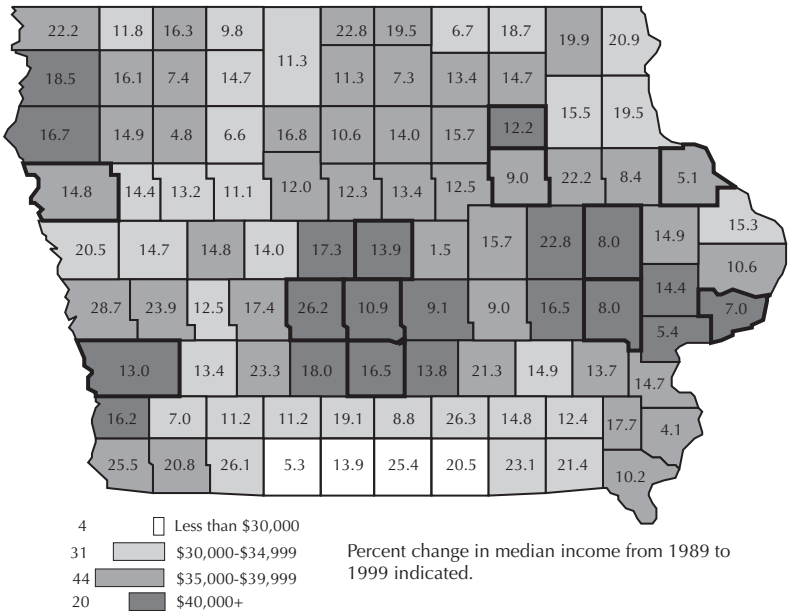

Figure 2-8. Median household income, 1999

SOURCE: (10)

COMMUTING PATTERNS

Based on the foregoing trends, it stands to reason than an increasing number of people living in rural areas will either choose to relocate in metropolitan areas or commute to the better-paying jobs metropolitan areas offer. Many of these commutes involve traveling to another county (including counties in contiguous states). Figure 2-9 shows how the percentage of residents with jobs outside their county varied across Iowa in 2000. It is noteworthy that residents in the northwestern quadrant of the state tend to work in the county of residence. There are comparatively few urban areas within a reasonable commuting distance for many of these counties.

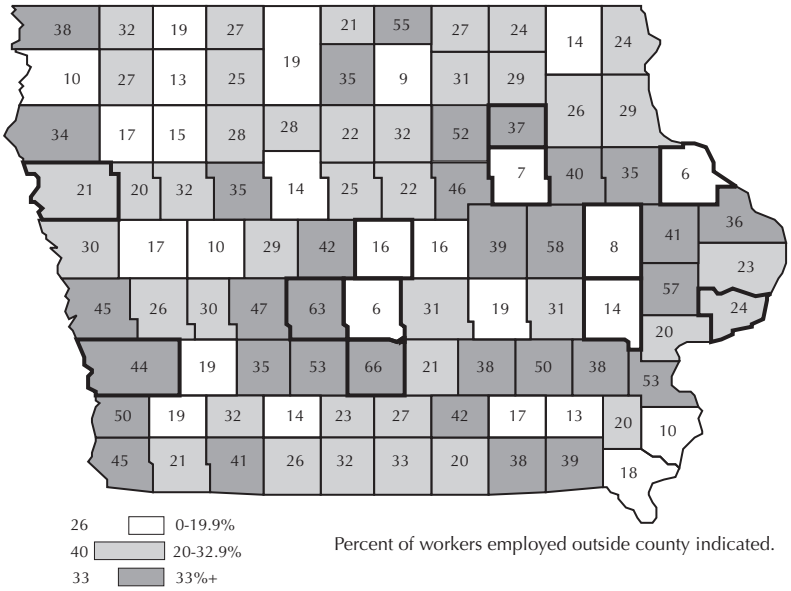

Figure 2-9. Percent of Iowa workers employed outside the county of residence, 2000

SOURCE: (11)

A discernable pattern of commutation is present in Figure 2-9. Perceptible rings of counties appear around metropolitan counties, the rings containing counties from which over 30 percent of the workers travel to jobs outside their counties of residence. The figure indicates that fairly long-distance commuting is quite common in parts of Iowa. This is especially true in rings of counties contiguous to metropolitan counties where at least one-third of the workers work outside the county of residence. In some counties, substantial percentages commute to jobs outside the county in which they live. This suggests that long-distance commuting to metropolitan counties has become a common practice of Iowa's workforce. It follows that providing good commutation routes into metropolitan areas is of growing importance.

CONCLUSIONS

The several county maps and statistics presented in this chapter point to great change within Iowa over the past decades. The recession and the farm crisis in the 1980s led to significant job losses across the state; the more prosperous 1990s saw a good recovery in the metropolitan areas, but not so much in many rural counties. As a result, population shifts have been evident, as people have moved from rural areas to cities in search of economic opportunity. Others have increasingly tolerated relatively long commutes to jobs in metropolitan areas. All told, there have been impressive employment gains in several of the state's metropolitan areas over the past two decades, while many rural areas have lost disturbing fractions of their jobs.

Clear differences have emerged between rural and metropolitan counties within the state. Rural counties tend to have considerably larger percentages of the elderly, and they generally have lower median household incomes. The decline in economic opportunity in rural areas has contributed to more extensive commuting from rural areas to Iowa's larger cities. Over one-third of the employed workers in most counties that are contiguous to metropolitan counties commute to them. In particular, the commuting shed for the Des Moines, Waterloo, Cedar Rapids, and Iowa City areas has become larger and more active than was the case two decades ago.

All of these trends are quite consistent with each other as they point to a state undergoing considerable change. The implications for transportation investments are clear. Iowa needs to:

- Accommodate and facilitate growth in the metropolitan areas that are able to compete for labor and capital with out-of-state locations (see Chapter 3).
- Be sure that the road and highway investments in these metropolitan areas encourage sensible land use patterns that are sustainable (see Chapter 4).
- Facilitate commuting from rural areas to jobs in the state's metropolitan areas, thereby giving hope to rural areas and increasing the labor pool in the metropolitan areas.
- Address the transportation needs of the sizable numbers of elderly Iowans, including those who live in more remote rural areas (see Chapter 5).
- Ensure that its highway investments produce an equitable distribution of benefits and costs among people of varying income circumstances and ethnicity.

CHAPTER 3
ECONOMIC DEVELOPMENT

This chapter develops a context for evaluating the economic development effects of transportation investments. During the past two decades, economic development has been the motivation for a large share of highway upgrades in Iowa, as well as for investments in facilities serving other transportation modes (*1*). The question arises, how effective will a contemplated investment be in spurring the desired economic growth and development?

To help predict the likelihood that a particular project will lead to a stronger, more competitive local or state economy, it is useful to explore the relationship between transportation and economic development. In this chapter, we first examine the nature of this relationship and consider some commonly cited arguments for inadvisable road investments. We then offer ten circumstances in which a road investment has a good chance of fostering economic development.

ECONOMIC DEVELOPMENT DEFINED

Let us begin by considering a basic definition of economic development. Simply stated, economic development occurs when the income and product generated within an area increases. Increased production requires that either more resources (land, labor, materials, and capital) be employed or that existing resources be employed more productively.

It is the case that state and local governments are limited in their ability to increase income and employment. National and international market forces and policies largely determine the economic environment in which businesses operate. The need is to identify instances in which improvements in public facilities would alter the way in which individuals and businesses deploy their resources, directing more toward the state or community of concern.

How can transportation investment influence business decisions? Transportation is best thought of as a "tool" used in transporting goods and people from one place to another. Investments in highways and other facilities generate benefits only to the extent that they lower transportation costs. In the final analysis, all of the benefits of any transportation facility, and therefore the justification for building it, flow from its ability to expedite transportation. There really is no separate economic development justification for transportation investments; they have to lower transportation costs.

By lowering transportation costs, an investment in a highway or other facility promotes productivity growth because it enables more to be produced per dollar spent on inputs. But the investment also requires that resources be devoted to it.

These resources come from user fees or general taxes, both of which operate to discourage productivity. Depending on which of the two effects is greater, the investment may or may not contribute to better productivity. When a project produces transportation cost savings that exceed the project's total costs, we say that the investment is economically efficient. Efficient projects make us more productive, more competitive.

DOES IOWA GAIN?

When considering economic development effects, actual net gains to the State of Iowa as a result of transportation cost savings should be distinguished from mere shifts in economic activity within the state that result from changes in relative competitiveness among different locations *(2).* When a highway or other transportation system investment lowers transportation costs at one location, economic activity may shift to that location. From a societal perspective, however, shifts in the location of existing economic activity usually do not bring about a net increase in economic activity; it just happens at a different place. Generally speaking, transfer effects within the same state should not be a basis for investing in upgraded highways or other facilities. Doing so makes the state as a whole poorer absent sufficient transportation cost savings, which should be the principal basis for public investment decisions.

The foregoing point usually has strong geographical implications. If the shift were to occur within Iowa, the state would not experience a net gain in economic activity. On the other hand, if economic activity would be drawn from another state, it is may be to the gaining state's advantage to encourage the shift in location, even though the national economy may not experience a net gain. Not much of an argument could be made for using federal funding to bring about this relocation.

We should add one important qualification. In some cases it may be possible for a business to substantially improve its productivity by relocating. Perhaps it will be better able to capitalize on productive labor, be closer to raw materials or markets, or enjoy a superior business climate. An increase in productivity generally implies greater net income and hence an improvement in society's well being. It is important, however, to balance these gains against the costs, such as new or expanded infrastructure, required to influence the relocation.

MISGUIDED ARGUMENTS FOR INVESTMENTS

The importance of making efficient investments can hardly be overstated. Occasionally one hears the argument that even if the transportation cost savings of an investment would not be greater than the construction and maintenance costs, perhaps the investment should be made anyway. Several rationales may be offered by proponents of an inefficient investment. While understandable, these rationales are flawed from a societal point of view. Five such rationales are discussed in turn.

1) Poor Area

Chronically impoverished areas often find it challenging to attract job-producing economic activity, and their leaders frequently turn to transportation investments as a means for encouraging businesses to locate there. Unfortunately, attempts to stimulate growth in a declining area by over-building transportation facilities usually are ineffective. If assisting the declining area is a policy objective, the search should be for the cost-effective way to achieve this end. It might be that the cost-effective approach is better schools, job training programs, or other infrastructure. But over-building transportation facilities (for example, building a four-lane highway when the existing two-lane highway has less than 6,000 to 7,000 average daily traffic [ADT]) is not likely to be the cost-effective solution. If traffic flows steadily at or slightly above posted speed limits on an existing highway, no significant performance improvement is likely to be gained by adding lanes. Also, adding lanes is very expensive.

2) Businesses Expect Four-Lane Highways

Occasionally, local development officials contend that four-lane access is absolutely vital to attracting businesses to small- and medium-sized communities. But consider the facts: nationally, in the early 1990s, the average flow speed on rural primary highways with speed limits of 55 mph was 56.4 mph, and in only 14 states was the average flow speed less than 55 mph *(3).* In 1999, only 2.9 percent of all rural interstate and primary arterial highways nationwide had volume-to-capacity ratios greater than 0.8, the traffic level at which flow speeds begin to slow.

In a survey of approximately 500 major employers across Missouri and Iowa, two-thirds of the responding companies said that direct access to a four-lane highway is not critical, as long as reasonable access exists *(2).* An optimistic conclusion might be that business leaders often understand that transportation system performance is what matters, not the number of lanes, per se.

3) Competition Among Iowa Communities

Imagine a case in which a community works to attract an out-of-state business that would bring desirable income-producing economic activity. The business would need an upgraded connecting highway that would cost several million dollars. Several other communities that could serve the business equally well may already have necessary access to suitable sites. The dilemma is that the cost-effective solution would be to encourage the business to locate in one of these other communities, but the community that worked to attract the business would be highly displeased. When individual communities act alone to attract businesses, the state DOT is likely to be asked to finance a series of redundant facilities.

4) We Paid For It

One can readily understand why community leaders want high-capacity highways funded through the state's road use tax fund or the state's apportionment of federal funds. The amount of motor fuel taxes paid by the area's residents, for example, will

not change whether or not the community gets its upgraded highway. Thus, a moral imperative exists: "If we don't get the highway, someone else will, and who knows whether they—whoever they are—deserve it more than we?" Although it sometimes is difficult for local leaders to accept, any form of transportation network is bound to involve some degree of cross-subsidization. The key to a well-functioning network is to make efficient investments, and that nearly always means there will be winners and losers in a spatial sense.

5) Construction Creates Jobs

Traditionally, a strong argument has been made for road construction on the grounds that it creates a large number of jobs (see, for example, [*4*], in which construction expenditures of $100 million were credited with generating 3,800 jobs). It is becoming more widely recognized that construction expenditures are good only if what is being built is efficient—the benefits (mostly transportation cost savings) exceed the costs. The act of construction, per se, is actually a transfer from those paying for the project through user fees or taxes to those paid to carry out the construction. No net gain to society occurs through the physical act of construction. The same resources could have been deployed to build another project—perhaps by a different group of people—or used in some meritorious way. The only issue is whether this is the right project, not to whom the construction dollars will flow.

ADVANCING ECONOMIC DEVELOPMENT

When does it make sense to invest in highways or other transportation facilities if economic development is an objective? To contemplate this question, one should think of transportation as one factor of production. Stated differently, transportation is a necessary but not sufficient component for most economic activity. As one factor of production, if transportation costs can be lowered, it follows that a given good or service can be produced in a less costly manner. If comparable cost savings are not experienced in competing locations, a competitive advantage will be gained. When this occurs, mobile resources such as capital and labor will be attracted to the area in search of increased returns. Income and product generated in the area will then increase.

Ten generic circumstances in which transportation investments are highly likely to have a positive effect on an area's economic competitiveness are discussed in turn. The first group of circumstances pertains directly to making business operations profitable, and the second group relates to making an area attractive as a place to live and work by holding down the social and economic costs of transportation.

Facilitating Profitable Business Operations

The first five points quite directly relate to the performance of transportation systems and their capacity to help businesses operate competitively.

1) Improvement in Reliability

Traditional economic analyses of potential highway investments focus on the change in mean travel time between points served. Much more emphasis is now being placed on reliability of arrival time, a key element of just-in-time manufacturing (*5*). If a highway upgrade would reduce the average time en route to or from a factory to the rural interstate, but the variation in travel time would not change, little would be gained.

Time en route, the mainstay of most benefit-cost analyses, may be overrated as an economic measure. Cargo valued at $100,000 aboard a truck has an hourly inventory cost of only 80 cents (based on a 7 percent interest rate), but having to close down an assembly line and send workers home because a shipment did not arrive on time is very serious *(6).* If a highway improvement were to result in an average time en route that remains about the same as before, but variation in travel time were substantially diminished, a real gain in competitiveness may result for the factory. Just-in-time (JIT) operations need reliable arrival times, not necessarily greater traffic speed. Aside from episodic delays, such as those due to weather, traffic congestion is the most important cause of travel time variation; it precipitates incidents and accidents that lead to unforeseen delays *(7).*

2) Transportation-Intensive Industries

If transportation costs are a sizable part of the cost of producing an area's particular products, improvements that reduce these costs will do the most to help make the area more competitive. Data are readily available (in input-output tables) as to how transportation-intensive a given industrial classification is. More subtle is the extent to which transportation can be substituted for other production inputs. An example of transportation being substituted for another factor of production is JIT operations. In many instances, transportation services are at least in part substituted for warehousing inventory (*8*).

3) Intermodal Effectiveness

Consider a potential investment in an intermodal freight facility, perhaps a river port. Traditional benefit-cost analysis methodologies would take into account the travel time savings for users of a particular mode traveling to or from the facility. It well may be, however, that other productivity gains occur, quite beyond these mode-specific time savings (*9,10*). Improving the certainty of arrival time of goods shipped by rail, for example, might make the terminal facility less congested and improve the productivity of river vessels or of trucks. The net result could be lower total transportation costs and greater competitiveness for the area served by the transportation facility.

4) Safety Enhancements

In 2000, over 4,600 persons were killed and more than 56,000 injured in accidents and crashes involving freight trucking or rail (*11,12*). A rough estimate of the societal cost of these deaths and injuries is $20 billion. We estimate that accident

costs are equivalent to an average of 5.3 percent of trucking costs and 16.7 percent of freight rail costs. Lowering accident costs is a logical way to reduce the transportation costs borne by society, thereby reducing the cost of conducting business.

Most directly related to economic development are unexpected delays on both urban expressways and rural highways caused by crashes. As we noted earlier, these delays are highly inimical to reliable arrival times at a JIT facility. Relatively high volume-to-capacity ratios on fast moving highways are most likely to beget crashes. Upgrading highways to reduce safety problems makes these highways perform better in terms of enabling freight and commuters to arrive on time.

The same is true of other modes. One area where special attention is warranted is highway-rail at-grade crossings. They have been the largest single safety problem for freight rail, accounting for over half of all fatalities (*13*). Additionally, time delays at these crossings can be considerable; such delays operate counter to reliable arrival times and thereby weaken economic development prospects.

5) System-Wide Efficiencies

Evaluating the productivity gains of possible transportation investments one at a time may understate certain synergies or positive network effects. These effects may be intermodal, as we have already noted, or they may make a single mode perform better. It is difficult to quantify with great accuracy the overall system effects of a single project, but at least a general sense can be gained. For example, if an upgraded highway would improve travel time or safety on a parallel route, the benefits to the other facility should be taken into account.

Improving the Quality of Life and an Area's Attractiveness

A major aspect of using transportation investments as a lever to attract economic activity is to make the area function well economically and socially. The remaining five points focus on this aspect.

6) Construction Incentives

If an area were to invest in transportation to foster economic development, there are few approaches more likely to get the job done in a cost-effective manner than incentives to contractors to complete rehabilitation or reconstruction projects early (*14*). The value of time in terms of long delays to motorists at construction sites is massive; at times these delays may involve social costs that approach the direct cost of the project. Additionally, reducing the duration of construction projects will pay dividends in fostering reliable arrival times and, hence, JIT operations. Even large incentives may produce cost savings to travelers that far exceed the cost of the incentives. There really is no risk involved—if the contractor is unable to complete the project early, the agency would not bear any costs beyond those it would incur otherwise.

The greatest limitation of these incentives is that while the time savings to travelers makes them better off, no additional revenue accrues to the state Road Use Tax Fund. Travelers thus gain what economists call "consumer surplus" (benefits that they do not have to pay for). In fact, because traffic would flow better, less fuel would be consumed, and the revenue from motor fuel taxes would actually be reduced.

7) Social equity

This policy initiative is intended to prevent the adverse impacts of transportation system changes from falling disproportionately on low-income populations and minority populations. Relevant impacts go well beyond pollution and include access to economic opportunities and other economic considerations (*15*). If applied creatively, the federal executive order on environmental justice can help reduce income and racial inequality through transportation investments and policies (*16*).

Two practical issues are important here. One is that given the labor shortages that exist periodically in Iowa and many other parts of the United States, ignoring a sizable pool of potential workers makes no sense. Second, the disharmony that economic deprivation brings is anything but conducive to a positive business climate. Transportation can be a highly effective social policy lever, and it can help raise incomes in the area, which of course is the objective of economic development. Social equity is discussed in Chapter 5.

8) Land Use Planning

It is not wise policy to regard transportation investments as an economic development lever in isolation. Progressive land use planning has at least as great a potential to reduce transportation costs as any form of transportation investment, per se (*17*). If an area can encourage mixed uses that enable fewer and shorter vehicle trips and can find a way to curb sprawl, it will promote economic development by coming reasonably close to minimizing transportation costs. Not only would travel times for trips within the metropolitan area shrink, reliability of arrival time would increase. Among the best ways to combat the huge societal costs that traffic congestion brings is through progressive land use planning (*18,19,20*). In general, it is unlikely that metropolitan areas can invest their way out of congestion by building more and larger urban freeways. Land use issues are discussed more fully in Chapter 4.

9) The Final Ingredient

Perhaps the most compelling argument for transportation investments to influence business location decisions or to improve economic development prospects generally exists when all of the other critical factors already exist in an area (e.g., cost-effective labor, natural resources, other infrastructure), but access to and from the location is a problem. In such cases, a transportation investment amounts to adding the last critical ingredient needed to make the area viable; as such it can act as a catalyst. An argument can be made for the upgrade if the magnitude of the

potential economic gain, coupled with traditional traveler cost savings, compares favorably with the cost of the investment.

Note the contrast between this important consideration and the second misguided argument cited earlier. In the former case, an investment would be argued for on the basis of perceived image (a larger highway would imply that a community has good access). The present point is grounded in reality: A clear need exists for improved transportation services, and if an appropriate investment were made, sufficient access would exist for the available resources to be put to productive use.

10) Level Playing Field

Comparing the economic merits of very different alternative transportation investments can be difficult to do well. One alternative may involve greater external costs, such as air pollution, noise, greenhouse gas emissions, or crashes. While many users may not face these costs directly, they are real costs to society and should be accounted for in investment analyses (*21*). Likewise, one transportation mode may receive government subsidies in the form of user charges that do not fully cover infrastructure costs. Failing to consider such costs can greatly distort the comparison and result in something other than the most beneficial solution to society being chosen. Such a choice would operate counter to economic development.

CONCLUSIONS

In this chapter, we have argued that investing in inefficient transportation projects will make an area poorer, but efficient investments that capitalize on conducive circumstances can be powerful stimuli. The key is to invest in appropriate improvements. The question of which transportation services are appropriate is dynamic: the answer changes over time. The principles discussed in this chapter are offered to help guide planners in suggesting investments that can advance an area's development potential. Government, working with business leaders, has a major responsibility to ensure that transportation promotes economic development: it must make efficient investments in transportation infrastructure with an eye toward maximizing the ability of the different modes collectively to foster a vitally competitive local and state economy.

Specific recommendations drawn from this chapter include:

- Do not overbuild transportation facilities (i.e., constructing a four-lane highway when a super-two highway would be sufficient) serving declining areas as a means of turning around their economies. Such investments are expensive and are highly unlikely to have a significant effect in stimulating economic development.
- Whenever possible, discourage using state-funded transportation projects to help communities within the state attract economic activity away from other in-state locations. Also, only if a certain community has a clear

advantage in attracting a particular type of economic activity should redundant transportation facilities be built or upgraded.

- Do not let the "construction creates jobs" argument influence how public funds are deployed. Construction expenditures are not a gain to society but rather a transfer from road users (via user charges they pay) to those carrying out the construction. The same resources could have been used for other purposes. The only consideration should be the inherent value of the project, not who gains by it being built.
- Invest in projects that implement integrated transportation and land use plans. Especially in larger urban areas, the ability to move people and goods in a reliable fashion is critical to a competitive economy. Bottlenecks and general congestion are inimical to reliable arrival times. Further, congestion leads to incidents (stalled vehicles, minor collisions, and more serious crashes) that cause long delays. Land use planning and transportation investments must both be part of efforts to improve reliability.
- Whenever possible, take into account the likely effect of investments in one transportation mode on the effectiveness of other modes. Search for intermodal synergies.
- Choose projects in part on the basis of reduction in risk of crashes. Aside from the tragic human and economic consequences, safety problems are highly antagonistic to a positive business climate. Placing people and goods at risk is likely to have negative consequences of multiple forms, including a tendency for labor and capital to move where such risks are much less.
- Always take into account the social equity effects of potential transportation projects. If the benefits of a project would accrue to people who already are better off and the costs (including negative impacts) would tend to fall upon those who are comparatively disadvantaged, do not proceed. It is possible that the negative effects can be mitigated or perhaps an alternative project would avoid the injustice.
- Do not treat transportation investments and land use policy as separate, disjoint considerations. Rather, view them as interrelated policy instruments.

CHAPTER 4
LAND USE PATTERNS AND SUSTAINABLE DEVELOPMENT

The current trend in Iowa and the United States generally is for cities of all sizes, as they increase in population and economic activity, to spread outward in a low-density, land-intensive pattern. As urban densities have been falling, the distances people have to travel have been increasing. Lower-density development has led to a very different configuration of land uses and has changed the general shape or form of urban areas in a way that many doubt is sustainable or workable in the long run.

Policy makers now have two options. One is to continue with past practices regarding urban development, which generally means accommodating incremental growth in line with observed demand and providing infrastructure as necessary to enable such development to occur. Alternatively, transportation policy makers can search for ways to help guide development toward more desirable patterns of land use and associated activity. Of course, what constitutes desirable urban form is inherently subjective, and the residents of any given community must ultimately decide how they would like to see their city grow and develop.

The objective of this chapter is to help make the second option a viable choice[2]. More specifically, we explore how alternative transportation investments can be used to influence urban growth patterns in ways that people living in the area would prefer. Thus, the first requirement for this approach is for a certain level of consensus to be achieved as to how residents *want* their community to evolve. Only then can appropriate policies, including those pertaining to transportation investments, be adopted.

This chapter is rooted in the premise that a key determinant of the value of a parcel of land is its accessibility. Reasonably accessible parcels tend to be developed more intensively and used for purposes that can generate income sufficient to enable their owners to outbid others whose intended uses might also benefit by the accessibility these parcels afford. Alternative transportation investments differ in terms of the accessibility provided to different land parcels. In this way, such investments can substantially influence land use patterns, and hence, the way a community evolves.

In short, the chapter is intended to be helpful when contemplating two interrelated questions:

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[2] Much of this chapter is a summarization of an earlier monograph *(1)* we prepared for the Iowa DOT on transportation and urban form.

- What land use patterns would be encouraged if a particular transportation investment were to be made within the community?
- What types of transportation investments would be advisable to help achieve a desired land use pattern?

It is important to stress that the approach we suggest cannot offer a completely deterministic way to address either question. Two inevitable problems interfere with our ability to forecast the land use impacts of transportation investments *(2).* First, the investment may be only one of a series of changes occurring simultaneously. Even looking back at the effects of transportation investments in various cities, it often is difficult to ascertain how much of the observed change in land use was due to these investments and how much resulted from other dynamics. Second, the interactions between transportation investments and land use patterns occur over an extended period of time. One must wait up to 20 to 30 years to fully assess how land use patterns evolve following such investments.

The two problems also interact. During the several decades following a transportation investment, significant changes in the regional economy, the demographic structure, and consumer preferences very well may take place. It is not yet known how to separate the effects of these changes from those of the transportation project.

TRANSPORTATION'S INFLUENCE ON LAND USE

We begin with the premise that urban growth is fundamentally a good thing. As communities increase in economic activity, they create more opportunities for people, both as members of the labor force and as consumers of goods and services. Yet, urban growth can contribute to certain problems, such as traffic congestion, air quality degradation, high costs for public services, and social and economic segregation. It is not inevitable that such negative consequences accompany urban growth and development; good planning can ameliorate these consequences. The key to good planning is to find ways to maximize the positive effects of growth, while working to minimize the less desirable effects.

The fundamental way in which transportation policy can be used to influence urban development patterns is by changing the relative accessibility of different areas of the community. Areas with comparatively good accessibility will tend to attract more capital-intensive activities because the potential for obtaining a good rate of return on one's investment is particularly good in these locations. In simple terms, transportation projects affect urban form through a four-step process:

- Initially, transportation projects can reduce the cost of travel between various pairs of locations within the community. Generally, transportation costs are of three main varieties: travel time costs, crash costs, and vehicle operating costs.
- By reducing one or more of these cost components, such projects change the relative levels of accessibility of certain locations from

other points within and outside of the community. That is, people can travel to these locations more cheaply than to otherwise comparable places. Similarly, goods can be shipped to and from these locations less expensively.

- The land made more accessible has a greater capacity to support profitable business activity because it costs less to do business there, given that transportation is an important cost component of most businesses. Businesses wishing to maximize their profits will compete for these accessible locations. Reduced transportation costs are thus capitalized into higher land values because the benefiting area is more capable of engendering profitable economic activity. The types of businesses that will tend to outbid others for relatively high-accessibility sites include retail and office functions that need good access to customers and that can pack a large amount of activity onto limited amounts of land by building tall buildings. Activities less able to compete for high-accessibility sites include large-lot single-family housing, large manufacturing plants, and agriculture.
- Over time, locations within the urban area that are made more accessible through transportation projects will become intensely developed, and land uses that are less able to compete for more valuable sites will be relegated to the periphery of the urban area. Relatively intense development will take place along major transportation routes, due to the accessibility these routes afford.

The important point here is that by carefully selecting transportation projects, a community can influence land markets in such a way as to encourage a desirable urban form. This chapter makes no attempt to define what this desirable form may be; that must be decided by each community's residents. Our objective is to illustrate several different types of urban form and show how they can be pursued in part through transportation investments.

A PREDICTIVE FRAMEWORK

Building on the concepts just discussed, we present a basic framework for evaluating transportation investments in terms of their potential for encouraging desirable land use patterns in urban areas. The framework can be applied in two different ways. Planners may use the framework to identify the kinds of transportation investments that will help achieve a desired land use pattern within a city; they also can evaluate the likely long-term impact of a proposed transportation investment on the city's land use pattern. On another plain, this basic framework can help clarify in a practical way the interrelationships between highway investments and emerging urban form.

Elements of the framework

We begin with the issue of accessibility for which a variety of measures have been proposed over the last 30 years. Several studies contain detailed reviews of existing accessibility measures and their applications *(3,4,5,6).* Accessibility is variously defined as "nearness to places," "nearness of activities," and, most recently, "ease of participating in activities." The notion of "nearness" is usually summarized as the degree of travel impedance as measured by travel distance, time, or costs *(3,7,8).* A good way to think of accessibility is that it pertains to how easy it is to get *from* a given place, as well as how easy it is to get *to* that place from other locations *(2).*

Some accessibility measures also incorporate features of a location's "attractiveness," which is determined by its proximity to physical amenities such as employment; shopping; and educational, cultural, and social activity centers *(9,10).* Typically, such approaches formulate accessibility indices based on the opportunities available within a specified area defined by travel time or cost *(9).* The appropriate measures of accessibility differ, however, depending on the type of opportunities being considered. For example, if total employment is the applicable criterion, then the CBD might receive higher accessibility ratings than other parts of an urban area. Conversely, when available housing is used as a measure of attractiveness, certain suburbs are likely to achieve a higher score *(11).* Variations in a population's makeup (e.g., gender, race, and income level) can lead to different assessments of what constitutes an opportunity; these assessments will in turn influence an area's accessibility rating *(12,13).*

In order to use transportation investments as a tool for land use planning, it is necessary to apply the concept of accessibility to *predict* rather than *describe* the relationship between such investments and emerging land use patterns. Planners need to predict how the changes in relative accessibility resulting from transportation investments are likely to alter urban land values, land uses, and developmental densities. Transportation may then be used to stimulate, support, or dampen the attractiveness of a location for particular land uses, ultimately serving to influence the emerging form of an urban area.

Land markets are constantly matching the demand for land on the part of various urban activities with an ever-changing supply of accessible land. This process is dynamic; changes in relative accessibility work with other factors to prompt changes in land use patterns. The influence of transportation investments on land use is based primarily on their ability to alter relative access. In isolating the role of transportation in shaping land use, the following points can serve as the basis for identifying criteria for evaluating investments in terms of their likely developmental effects:

- The development potential, and hence value, of individual parcels of land are differentiated by relative levels of accessibility.
- The attractiveness of a parcel of land for a particular activity is the result of a tradeoff between land value (reflecting accessibility to

other activities and the potential for agglomeration economies) and the costs of interaction (i.e., transportation costs and convenience).

- Location decisions are based on the comparative ability of a given type of activity to pay the cost of land at the most accessible locations.

Agglomeration economies are cost advantages for businesses located near each other due to the ability to share suppliers of essential goods and services or to share customers. In the CBD, diverse businesses agglomerate to ensure access to myriad activities (e.g., a city block might host a restaurant, a bank, a dry cleaner, and a brokerage service). For agglomeration economies to occur, however, the location must have sufficiently good overall regional accessibility to attract the multiple activities that are vital to other businesses.

Table 4-1 illustrates how travel impedance (constraints on the ability to move freely, such as circuitous routing, low-speed roadways, or congestion) and potential for agglomeration economies interact to influence overall accessibility of a land parcel to customers and other businesses, and hence, the likely value of this parcel. Higher travel impedance implies lower accessibility, restricting land use in such areas to activities that are locally confined or that do not require a high degree of accessibility from multiple origins throughout the metro area *(14).*

Table 4-1. Variations in accessibility and land values

Travel impedance		Agglomeration potential		Overall accessibility		Potential land value
Low		High		High		High
Low	+	Moderate	=	Moderate to high	→	Moderate to high
Low		Low		Low to moderate		Low to moderate
Moderate		High		Moderate to high		Moderate to high
Moderate		Moderate		Moderate		Moderate
Moderate		Low		Moderate to low		Moderate to low
High		High		High to moderate		High to moderate
High		Moderate		Moderate to low		Moderate to low
High		Low		Low		Low

For example, a neighborhood grocery store can tolerate (and even benefit by) high levels of travel impedance because it relies on customers in its immediate vicinity (i.e., it has a small trade area). Likewise, the streets in a CBD may experience

localized travel impedance due to congestion, but overall accessibility from multiple origins across the metro area generally is comparatively good.

In already developed areas, changes in land values affect the intensity of land use (i.e., where land values are relatively high, a housing developer would be likely to build a multi-story condominium complex rather than single-family housing). In CBDs, more intensive land use is manifested in taller buildings, smaller office spaces, and more compact stocking of products. In effect, tall, densely arranged buildings represent a substitution of capital (cost of tall buildings) for higher-priced land. As little as possible of this expensive land is used.

Transportation costs and opportunities to interact with activities of interest can vary greatly within a city. The larger the share of transportation-related cost associated with a particular activity, the stronger will be its tendency to agglomerate with its preferred set of activities. For example, a financial firm would benefit from locating near a ready supply of trained labor, an available source of common services (such as restaurants and office supplies), as well as a sufficient customer base. Based on this agglomeration tendency, the following conclusions may be drawn.

- Activities that have high rent-paying abilities and that prize access will locate close to the regional center (often the CBD).
- Activities that value accessibility but have a lower ability to pay high rents will locate at the next affordable subcenter or node.
- Activities that value local access will locate in subcenters (smaller clusters of economic activity) because such subcenters manifest a certain potential for agglomeration economies on a smaller geographic scale.

Reconciling Supply and Demand

We offer a framework for evaluating the land use impacts of transportation investments based on the concept of a land market in which parcels are differentiated according to a combination of travel impedance and the potential for agglomeration economies. This framework follows a simple representation of supply and demand, with business and residential land uses constituting the demand side of the equation (the need for accessible land) and transportation services largely differentiating the supply (accessible land) side. The demand for land is a derived demand because its value is predicated on its ability to enable income-producing activities to occur. Transportation represents a means to an end—it helps differentiate the land parcels that are supplied in terms of their potential contribution to the productivity of an activity such as manufacturing.

The following criteria identify the elements of the demand side of the equation for different land uses:

- extent of need for local access to other activities,

- extent of need for regional access to other activities, and
- ability and willingness to pay for land at preferred locations.

On the other hand, transportation systems, as facilitators of the supply side of the land use equation, can be distinguished according to the extent to which they:

- provide local access to other activities and
- provide regional access to other activities.

Each type of land use requires or at least benefits from a particular combination of transportation facilities and services. If planners and policy makers balance the access needs of desired land uses in a particular area of the city with the transportation facility likely to supply the required level of access, it is possible to influence development patterns.

Performance of Transportation Facilities

Transportation facilities such as highways and streets perform a dual role. They allow traffic to travel through an area of the city, and they also furnish access to specific locations within that area. From the perspective of transportation system design, a facility's ability to provide uninterrupted traffic movement depends in part on the level of access it allows to and from adjoining land areas *(15).* For example, a freeway, which has very limited access, offers the highest level of mobility, with traffic often flowing at relatively high speeds. In contrast, streets in a residential area must be designed to provide direct access to numerous private driveways, and as a result, they move traffic much more slowly. The functional category of a transportation facility specifies the extent to which it will allow uninterrupted traffic flow. Based on its capacity and access, a very simple hierarchy of urban roadways includes:

- Freeway corridors and interchanges
- Expressways and arterial corridors (including principal and minor arterials)
- CBD streets and connectors
- Residential collector and local streets

Each of these general categories affords a different blend of mobility and access to and from land parcels. Thus, each category will have a different type of influence on land use patterns.

Freeway corridors and interchanges. Freeways cut across diverse land use settings, but because they have comparatively few access points, they do not provide a high degree of access to most individual land parcels. On the other hand, parcels that are located near exits, entrances, and interchanges generally have exceptionally good regional access.

Expressways and arterials. This category includes high-capacity urban roadways that fall between freeways and most urban streets. They have the important quality of being able to offer a greater degree of access to adjacent locations than do freeways. An urban arterial system typically provides strategic links between activity centers.

Central business district streets and connectors. Streets within the CBD usually are comparatively wide and thus are able to move large traffic volumes, albeit at comparatively low speeds. These streets often connect with arterials, expressways, or even freeways that can handle high volumes of traffic, usually giving the CBD moderate regional access.

Residential collector and local streets. Local streets provide access within and to residential areas. They are typically designed to handle low volumes of traffic and may feature traffic-calming devices such as stop signs and cul-de-sacs to keep speeds low. Collector streets gather traffic from local streets and feed it into arterial corridors, providing the link between neighborhoods and high-capacity urban roadways. Multiple access points to residential areas are important to reduce congestion.

Land Use Categories

The land use category of a given area within the city will determine its accessibility requirements. Conversely, changes in accessibility will affect the sorts of land uses found within this area of the city. Following are six land use categories, based on their function. While generalized, these categories are sufficient for our analysis of transportation and urban form:

- Central business districts
- Other major activity centers (e.g., large employers and shopping centers)
- Smaller commercial areas (e.g., commercial strips or smaller neighborhood shopping centers)
- Multi-family housing (ranging from low-income housing to upscale condominiums)
- Single-family housing (traditional grid street layout or modern subdivision patterns)
- Parks, recreation areas, and serene or natural areas

Each of these land use environments has specific accessibility needs. An examination of these land use categories can help illuminate the transportation-land use connection.

Central business districts (CBDs). As the traditional center of the city, a CBD functions best when it is highly accessible to all parts of the metro area *(16).* Because travel and location decisions traditionally have been based on time rather than distance, CBDs in larger cities have required high-capacity freeways and

expressways, and in smaller cities CBDs have needed arterials to enable passenger and freight vehicles to enter and leave with relative ease. Large volumes of traffic must be served, due to the comparative density of economic activity in the CBD.

Other major activity centers. Such centers include large employers and shopping centers, as well as institutional land use categories such as hospitals, universities, and sports arenas. They also include industrial complexes, such as factories, warehouses, and other freight-handling facilities (e.g., rail yards and trucking depots). Major activity centers require good access for freight and people, ideally from multiple directions. At a minimum, these centers should be in close proximity to an arterial that connects with residential areas and with highways leading to distant locations.

Smaller commercial areas. These areas include a variety of businesses ranging from suburban strip malls and larger grocery stores to clusters of service businesses and branch offices. Such commercial areas serve only part of an urban area so their accessibility requirements are more confined. In general, to be economically viable they need arterials connecting them with their service areas.

Multi-family housing. This category covers the range from low-income subsidized housing to upscale condominium complexes. In general, multi-family housing locates where accessibility to employment centers, shopping, and various services is good; having high-capacity roadways nearby is usually more important for this type of land use than is tranquility *(17,18).*

Single-family housing. There are many permutations of single-family residential development, ranging from comparatively dense grids with very small yards to large-lot subdivisions with cul-de-sacs. Because of the diversity in development patterns, it is difficult to make sweeping generalizations about access requirements, other than that the preferred access usually is low-volume city streets leading to higher capacity arterials, expressways, or freeways. Good access to other activities that support the residential life style (e.g., schools, parks, grocery stores, doctors' offices, and other commercial activities) is important *(19).*

Parks, recreation areas, and serene or natural areas. Because high traffic volumes on nearby highways can elevate noise levels and lower air quality *(20)*, parks and other areas where serenity and fresh air are prized are not particularly compatible with especially high-capacity transportation facilities. Yet, recreation areas need the access provided by moderate-capacity streets.

PREDICTING THE IMPACT OF TRANSPORTATION INVESTMENTS

The functional classification of urban roadways and the categorization of typical land uses presented above is a starting point in assessing the potential of changes in transportation systems to shape land use patterns. Table 4-2 summarizes the accessibility demands of the land use categories just discussed, as well as their concurrent abilities to pay for such access; Table 4-3 rates transportation facilities

in terms of the level of accessibility they offer and the potential impact this accessibility has on land values.

By matching the types of accessibility afforded by different transportation facilities with the access needs of various land use categories, it is possible to predict the likely developmental impacts of investments. For example, Table 4-3 indicates that an arterial corridor is characterized by "high" local access and "moderate to high" regional access. Moving to Table 4-2, the kinds of land uses that "match" this profile in terms of accessibility needs are business districts, single and multi-family residences and perhaps smaller commercial areas.

It is because arterials provide necessary access to numerous types of urban land uses that they have been instrumental in changing the shape of the traditional, single-center urban area *(21).* While many businesses value high-profile central locations, and therefore cluster in the CBD, smaller subcenters containing some of the activities found in the CBD form at other locations within the urban area. Particularly attractive are sites in the suburban periphery made relatively accessible by the intersection of major arterials and expressways *(22,23,24).* As a result, many metropolitan areas have become more polycentric in form, with circumferential and radial corridors connecting activity clusters throughout the urban area. A study of Los Angeles, a prime example of a widespread, multi-centered metropolis, revealed as many as 58 distinct subcenters *(25*); other studies have counted numerous such subcenters in many U.S. metropolitan areas (summarized in *26*).

Table 4-2. Accessibility demands of land use categories and ability to pay for land

Land use category	Local access required	Regional access required	Ability to pay land costs
Business districts	High	Moderate to high	High
Major activity centers	Moderate to low	Moderate to high	Moderate
Smaller commercial areas	High	Low to moderate	Low to moderate
Residential (multi-family)	High	Moderate	Low to high
Residential (single-family)	High	Moderate	Low to moderate

Table 4-3. Level of accessibility associated with transportation facilities and impact on land values

Facility	Local access provided	Regional access provided	Potential land value impact

Freeways and interchanges	Low to moderate	High	Moderate to high
Expressways and arterial corridors	High	Moderate to high	Moderate to high
CBD streets and connectors	High	Low to moderate	Moderate to high
Residential collector and local streets	High	Low	Low to moderate

The matching approach outlined above can also be reversed; starting with a developmental goal, it is possible to identify the transportation facilities that would support and encourage a particular land use category. For example, a community might have a developmental goal of revitalizing commercial activity in the CBD. Table 4-2 indicates that business districts need "high" local access, and "moderate to high" regional access. Table 4-3 observes that while CBD streets and connectors provide "high" local access, they offer "low to moderate" regional access, and are therefore not sufficient to fully satisfy the needs of business districts. To strengthen the prospects of the CBD, then, other types of facilities are needed, such as freeways and interchanges, or at least expressways, in order to assure access to the broader region.

Interactions Among Transportation Facilities

As we blend transportation facilities with the accessibility needs of various land uses, it becomes clear that changes in the performance characteristics of these facilities can significantly influence land uses. Table 4-4 provides a brief look at possible combinations of the transportation facilities in Table 4-3 in terms of the likelihood that they will influence certain land use patterns. For example, if an interchange were to be constructed near a network of residential streets, it would increase the regional accessibility of the neighborhood, and large activity centers might begin to compete with low-order local outlets for space in the area.

Table 4-4. Land use impacts of investments

Transportation investments	Land uses encouraged
Adding freeways and interchanges connecting to residential streets	Business districts Large activity centers (employment, shopping, manufacturing)
Adding freeways and interchanges connecting to CBD and connector streets	Business districts Multi-family residential
Adding freeway interchanges connecting to collector streets	Large activity centers (employment, shopping, manufacturing)

Adding collector streets connecting to arterial roadways	Single-family residential Multi-family residential Small retail and commercial

Likewise, multi-family housing tends to follow freeways and expressways, but the immediate area around intersections of two or more of these major highways (which are highly accessible to much of the region) may well attract almost entirely commercial land uses. Multi-family housing is more likely to develop nearby, in locations that have good access to the major intersection but where land is less expensive. Thus, residential or commercial activity is far more likely to be a consequence rather than a cause of greater accessibility *(12).*

It is worth stressing that the effects just discussed presuppose that the area is growing so that there is a substantial demand for land. When this is the case, it is possible to manage that demand by creative transportation investments and land use policy as just discussed. If, however, the area is experiencing very limited growth or is stagnant, adding transportation facilities generally will have a modest or even an inconsequential effect.

Implications for Sustainable Development

If a community is growing so that a demand for commercial and residential development exists, transportation investments have the potential to play a substantial role in how future land use patterns unfold. Building high-performance arterials that connect developed areas with sites on the urban periphery that have good vistas will contribute to low-density, leap-frog development patterns as developers pass by less attractive sites for those with greater amenities. A more sustainable urban form is likely if the focus of urban road investments is to make developable sites within the currently built-up urban area more accessible.

In growing metropolitan areas, a multi-centered urban form has several advantages. The most prominent center generally will be the CBD, and other specialized centers gradually are developed farther out. These centers have an intensity of land use that is appreciably greater than in surrounding areas. Some such centers are a blend of office space, commercial firms, and retail activities; others serve light industrial production, warehousing, and utilities; still others combine multi-family residential, retail outlets, and services. On the edge of the metropolitan area, modern, single-story manufacturing plants locate near such major transportation facilities as interstate highways and rail lines. Other supporting facilities will locate nearby, including suppliers and worker-serving businesses such as restaurants, branch banks, and discount retail stores. The point is that as activity centers emerge, they attract more development, and the value of land near them becomes significantly higher than it was before the activity center existed. It is noteworthy that Seattle's metropolitan development plan to the year 2020 is heavily based on a hierarchy of 14 urban centers *(27).*

The most sustainable form of multi-centered development is that which combines housing and employment for those who live in or near the center. High-capacity transportation facilities (freeways or passenger rail transit) connect the centers, and shorter trips are made from points within the center to the nearest center. Wise highway investments can be a major catalyst for this form of urban development, provided the area's comprehensive plan is fully consistent with it.

THE PROBLEM OF FRAGMENTED LOCAL GOVERNMENTS

Iowa, like many states, has a strong tradition of home rule such that local governments are generally free to create their own procedures, institutions, and plans. Except for programs that require state or federal funds, municipalities and counties in Iowa are, for example, able to establish land use policies that reflect local preferences. Such independence provides opportunities for cities to pursue distinctly different varieties of urban form. Local citizens often feel that local government is more responsive to their needs than are regional or state governments *(28).*

Differences among nearby communities, however, may confound both local and regional land use plans and goals. Because home rule allows cities to evolve independently of state control, cities vary substantially in planning goals and capacity. For regional and state-level planners, accommodating the divergent goals and policies of each municipality within a metropolitan area can be a challenge. Given the diversity of planning goals among jurisdictions, it is inevitable that the transportation projects pursued by state and regional agencies will act to promote some local developmental goals much more than others.

Consider, for example, a situation in which the Iowa DOT were considering the pros and cons of implementing an improvement in a metropolitan area where one municipality has as its goal higher residential density and shorter commuting distances while another municipality is committed to increasing its tax base by rapid outward expansion. Almost any decision that the Iowa DOT were to make would support one municipality's goals but be inconsistent with those of the other. Plans that may be advanced by the area's regional council of governments also would not be likely to win universal support by member governments.

Differences in developmental goals among municipalities within a metropolitan area make it difficult to gain consensus as to the desired urban form for the area as a whole. Lacking this consensus, the ability of regional governments to work with the Iowa DOT to use transportation investments as a policy lever to encourage a sustainable, workable urban form is much less than would be desirable. As a result, a formal state policy regarding regional growth is difficult to enact. Several states including Florida and New Jersey, however, have made progress in formulating state policies of this sort.

A corollary of the lack of consensus among municipalities within a metropolitan area is the concern that these governments occasionally may actually compete with one another rather than cooperate. Cities and counties frequently seek to strengthen

their tax bases, and the temptation to modify existing plans or to grant rezoning requests (or other exceptions) to create opportunities can be strong. Even if a municipality strives to manage or constrain certain land use patterns, it runs the risk that development capital will flow to a neighboring municipality. Thus, tempering inter-jurisdictional competition for the good of the overall metropolitan area can be a daunting task. It is a necessary one, however, if such policy actions as transportation investments are to be an effective tool in fostering a long-term growth strategy that is sustainable.

CONCLUSIONS

Transportation policies aimed at increasing mobility as an end in itself will not necessarily satisfy a community's accessibility needs. In the same vein, the descriptive indicators currently available to measure accessibility often fail to take into account the developmental objectives of an urban area, focusing instead on a kind of general "accessibility for accessibility's sake." As we stressed earlier, in order to select appropriate investments, there is a need for guidance—an area-wide comprehensive plan to inform decision-makers about the types of access and urban form valued by the community.

Thus, an agreed upon area-wide comprehensive plan is the necessary starting point for any attempt to use transportation investments to help an urban area move toward a desired form. Such a plan should serve almost as a blueprint—a 20-year forecast of what land uses will be encouraged and what development pattern the community would like to pursue. This approach elevates the comprehensive plan from a simple collection of land use forecasts to a proactive tool to guide a community in achieving its long-term developmental goals.

When separated from local development goals, transportation investments tend to distribute a region's economic growth unevenly along its facilities. For example, it is becoming increasingly common in major metropolitan areas for urban centers to decline as growth occurs along suburban corridors *(29,23,21).* If a local development goal is to foster the vitality of the CBD, transportation investments must be consistent with this objective. A study of the central area of Atlanta revealed that the city had sufficient capacity in terms of street, water, sewer, and communications infrastructure to provide adequate levels of service to at least 50 percent more businesses than were currently located there *(30).* The problem appeared to be that regional access to the CBD was limited due to traffic congestion on freeways serving the district. Atlanta's planners decided to widen certain freeways from four lanes to ten, and others from six lanes to 12, while constructing a passenger rail system. The result was a drastic reduction in recurring congestion, with travel delays occurring during two hours per day, down from six. As the transportation improvements were moving forward, several billion dollars worth of new office buildings were constructed in the downtown area *(30).*

Traditional system performance measures focus primarily on lowering traffic impedance, ignoring a crucial element in a location's overall accessibility—its development potential. In order for transportation changes to serve as a tool for

shaping land use patterns, this key aspect of the transportation-land use connection must be made part of the evaluation process. The framework presented here combines conventional operational measures (travel impedance) with land use characteristics to achieve a more comprehensive assessment process.

The conceptual underpinnings of the framework create a common ground for planners and decision makers without requiring changes on the part of existing planning institutions. The framework binds together existing institutional mechanisms—land markets, comprehensive planning, and transportation system management—to work toward a desired urban form. The key point is that it is possible to use transportation investments as policy levers to influence urban development. Taken together with appropriate land use controls and incentives, infrastructure investments, and other conducive initiatives, transportation projects can help a community move toward the living environment it prefers.

Specific recommendations that grow out of this chapter include:

- Transportation investments can have a significant impact on the way a community grows. Each time a major transportation project is contemplated, its likely effect on emerging urban form should be questioned. The basic relationship of relative accessibility, land use regulations, and likely land use should be kept in mind.
- A series of individual transportation investments within a community that is not part of a coordinated, planned effort is highly unlikely to lead to an urban form that functions well and is sustainable. Each investment will exert a strong influence, but the collective effect will be confused and even internally in conflict. Projects must be evaluated in the context of the "big picture."
- The logical place to start when using transportation as a tool in achieving a desirable, livable urban form is to reach at least a basic consensus as to how its residents want their community to evolve. There is no "correct" urban form; but some general types are more likely than others to lead to a city that is accessible and a pleasant place to live. Before acting on a particular project, decision makers should require that the project's influence will be consistent with and help lead to the consensus view of what is desirable urban form.
- Transportation investments primarily influence urban form by making some locations more accessible than others. They thus affect the land market. If zoning and transportation investments are consistent, they can enable the urban land market to function very well. A city's comprehensive development plan, its zoning ordinance, and its transportation improvement plan must be fully consistent to be effective. This consistency should be demonstrated before any major transportation project is approved.
- Land use policies that encourage shorter urban trips (e.g., jobs–housing balance) are more likely to reduce traffic congestion than are investments

in additional capacity of major transportation facilities. Over the medium- to long-run, it is rarely possible to invest one's way out of congestion. Bigger facilities often promote short-term accessibility and land uses that generate and attract numerous trips. In time, congestion is almost inevitable. Enlightened land use planning is a much superior tool.

- It would not be unreasonable for the Iowa DOT to require that all projects to be undertaken using state or federal pass-through funding within the limits of a metropolitan area or any other incorporated urban area within the state must conform to an adopted area-wide comprehensive plan for long-term development.

CHAPTER 5
SOCIAL OBJECTIVES

Anticipated social and economic impacts are a critical aspect to consider when assessing almost any potential transportation investment. Who would benefit and who would bear the costs of the investment may well be just as critical a concern as the overall net gain or loss to society. In this chapter, we suggest a series of practical considerations for evaluating the benefits and costs of transportation projects on particular population groups.

BENEFITS OF TRANSPORTATION INVESTMENTS

The primary benefit of almost any transportation investment is the improved accessibility it offers people to the destinations they wish to reach. It does this in three principal ways:

- reducing transportation costs, most notably travel time, safety, and vehicle operating costs;
- improving people's ability to reach destinations they currently travel to and making it possible for them to reach destinations that were previously not available; and
- increasing the set of travel options available to the traveler.

As discussed in Chapter 3, reduced transportation costs can be a stimulus to economic development because these cost savings make it possible to conduct business more competitively. They also save households time and expense, making more resources available for other uses.

Accessibility is related to mobility, which is the ability a person has to move about. If a person does not have access to an auto, that person's mobility normally is severely impaired with few destinations being accessible to him or her. It is worth stressing that road investments generally will not improve people's mobility, but they will make certain destinations more accessible to those with reasonably good mobility.

The greatest need of low-income (and elderly) persons is more likely to be mobility than improved accessibility, per se *(1).* This is especially true of the rural poor for whom public transit and non-motorized modes (e.g., walking or bicycling) are not usually viable alternatives to the auto. For low-income people living in Iowa's metropolitan areas, public transit may be an alternative, even though the array of destinations likely to be accessible is bound to be considerably smaller than for those with an auto available.

Constructing Improved Roads in Lagging Regions

We observed in Chapter 3 that constructing higher-capacity highways in lagging regions is unlikely to promote growth and development in these regions. An exception, we noted, would be if all of the other necessary ingredients—labor, natural resources, infrastructure, and capital—already were available and the only thing lacking was transportation access. In this case, upgraded roads may provide sufficient improvements in accessibility to stimulate development. Usually, however, one or more of these other resources are absent, in which case the upgraded road is unlikely be a sufficient stimulus to influence development.

In Iowa, the primary and secondary road systems are sufficiently extensive that a reasonable degree of accessibility from rural origins to a wide array of destinations generally exists. Very rarely is the rural road system unable to connect any given origin-destination pair without substantial circuity. The main issue is the quality of these connections. Most origin-destination pairs rely on two-lane roads and highways, and while most of these facilities offer a reasonably good ride quality, they do vary in terms of their overall condition. Capacity rarely is a serious constraint, as few rural highways have volume-to-capacity ratios higher than 0.4, meaning that they definitely do not suffer from congestion.

Given these conditions, investing in upgraded two-lane highways (e.g., "super-two" highways) or four-lane highways generally cannot be defended on the basis of system performance[3]. Exceptions are two-lane highways that carry greater than about 4,000 vehicles per day; quite often super-two highways are cost-effective upgrades at these traffic volumes.

People Prosperity Versus Place Prosperity

In general public policy terms, the efficient approach—that which benefits society in an overall sense—is people prosperity. This approach implies that society's resources will be deployed to produce benefits that exceed the associated costs. Thus, by making this investment, society becomes better off. No consideration is given to which members of society gain, only to the fact that the gains exceed the costs. Efficient transportation investments typically are those in which (1) travel-time savings, (2) accident-cost savings, and (3) vehicle-operating-cost savings collectively are greater than the capital and operating cost of the investment over its useful life. For these magnitudes of benefits to arise, it follows that the road being upgraded must serve at least a moderate travel volume. People prosperity will not arise when low-volume roads are substantially upgraded because not enough people use them to produce benefits that exceed the associated costs.

Place prosperity implies that a particular place or region is to receive a public investment to help it become more competitive or to upgrade the quality of life for

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[3] Super-two highways have two lanes 12 to 15 feet wide, ten-foot shoulders that are at least partially paved, passing lanes approximately every five miles, bypasses around smaller communities whenever possible, and turn lanes and acceleration lanes where needed.

people living there. The investment is made even if this is not the most efficient use of public funds (i.e., greater benefits minus costs could accrue from other investments). At issue is how inefficient a place-specific project would be. If the benefits would be substantially less than the associated costs, making the investment would make society overall poorer. In effect, a transfer to the beneficiaries of the project from other members of society would occur. One should ask whether another sort of transfer to the same people would produce more impressive results. For example, would upgrading educational facilities, other infrastructure, or job-training capabilities be more cost-effective mechanisms for bolstering the area's economic prospects?

It probably is true that most transportation investments occupy a place somewhere along a continuum between people and place prosperity. Travelers within metropolitan areas typically pay more road user charges than are returned to the area as investments or maintenance expenditures. Conversely, the low traffic volumes found on many secondary roads are far from sufficient to generate enough user revenue to defray the costs of maintaining these roads. In a manner of speaking, the massive subsidies given to the secondary road system in Iowa amount to a pursuit of place prosperity. Yet, it would be unrealistic to expect connector roads that join smaller communities to the state's primary road system to be self-financing. Some magnitude of cross-subsidization is a necessary feature of highway finance policy in a state like Iowa. How great this transfer should be is an inherently subjective issue, one that is best addressed by elected politicians.

ALTERNATIVES TO ROAD INVESTMENTS IN RURAL AREAS

We have concluded that smaller rural communities in Iowa are unlikely to benefit significantly by capacity increases in the roads that most directly serve them. A question thus arises as to what can be done in terms of transportation policy to help make these communities as viable as possible. Transportation can play a contributing role in aiding these communities only to the extent that their problems are related to a lack of accessibility to opportunity or to inadequate mobility of residents. Accessibility problems are largely a function of distance, and higher capacity highways are often not an option because of the aforementioned low levels of travel demand. Proper maintenance of existing roads, including prompt removal of snow on commuter routes, however, is important to maintaining accessibility.

Perhaps the best approach to assisting residents of comparatively remote rural communities is to improve their mobility when possible. To the extent that auto availability is a problem, especially for households with multiple off-site workers (a growing phenomenon in many rural areas), several policy interventions may be advisable including:

- Support and facilitate organized ridesharing.
- Encourage the Iowa General Assembly to institute tax concessions or even direct subsidies to low-income households to purchase and operate vehicles used for the journey to work.

- Work with major employers and groups of smaller employers to organize subscription commuting services from small communities to employment centers and clusters of businesses. These services pick up employees at prior-arranged locations each work day.

It is worth noting that there are examples of commuting services that have been successful in Iowa. One such service, the University of Iowa Employee Vanpool Program, enables staff to travel from numerous small communities each day. These employees benefit by low-cost transportation, and the University benefits by having access to a much larger population of qualified employees.

ASSESSING IMPACTS OF PROPOSED TRANSPORTATION PROJECTS

Just as assisting distressed communities and low-income Iowans is an important consideration in transportation policy, so is ensuring that the negative effects of transportation projects do not fall disproportionately on low-income populations or minority populations. Even highly meritorious projects often produce certain negative consequences; these effects need to be understood and fully taken into account in the project planning and evaluation process. Often such negative effects can be mitigated, or alternatives can be fashioned that would reduce them. It is critical to discuss proposed transportation projects with appropriate members of the public so that possible effects can be understood and the value placed on them by affected citizens can be ascertained.

The Issue of Protected Populations

Distributive effects—who benefits and who is in some sense made worse off—related to transportation projects always should be considered because equity issues may arise at any time. Under the applicable federal legislation *(2,3)*, the focus on populations to be protected tends to be on low-income populations and minority populations. If a significant finding occurs regarding adverse impacts, a civil rights challenge may occur, especially if the disadvantaged community has historically borne negative effects of regional transportation projects but enjoyed few, if any, benefits.

Special care should be taken to identify all possible significant adverse effects. A project-related effect may seem insignificant in and of itself, but in the context of other effects—including those existing already and not related in any way to the proposed project—it may have clearly adverse and significant effects on the disadvantaged population. Under the National Environmental Policy Act of 1969 (NEPA), an assessment of likely distributive effects is not necessary if an intensive preliminary examination of the project impact area shows that:

- no protected population is present;
- a protected population is present, but it would suffer no adverse effects from the project; or

- a protected population is present and would suffer adverse effects, but not significant ones nor disproportionate ones, compared with non-protected populations in the project area.

It should be noted that the requirements related to incidence of adverse effects in NEPA pertain solely to income and race and ethnicity, not to gender, religion, or other differentiating characteristics. Project effects on other population groups (e.g., those with disabilities) are governed by other laws and regulations such as the Americans with Disabilities Act (ADA).

The provisions of NEPA were further clarified by the Federal-Aid Highway Act of 1970; this act requires that

> "possible adverse economic, social, and environmental effects relating to any proposed project on any Federal-aid system have been fully considered in developing such project, and that the final decisions on the project are made in the best overall public interest, taking into consideration the need for fast, safe and efficient transportation, public services, and the costs of eliminating or minimizing such adverse effects as the following:
>
> 1. air, noise, and water pollution;
> 2. destruction or disruption of man-made and natural resources, aesthetic values, community cohesion and the availability of public facilities and services;
> 3. adverse employment effects, and tax and property value losses;
> 4. injurious displacement of people, businesses and farms; and
> 5. disruption of desirable community and regional growth" *(4).*

As a practical matter, impacts on protected populations arising from transportation projects in states like Iowa with relatively sparse rural settlement patterns almost always occur within urban areas. Care needs to be exercised that the interests of low-income populations and minority populations are fully considered when evaluating proposed transportation projects, especially major ones.

Social and Economic Effects

An analysis of the likely social and economic effects of a proposed transportation project is a vital component of a comprehensive assessment. Figure 5-1 presents the general types of social and economic effects that can arise from a transportation investment *(5).* In providing a brief overview of the types of social and economic effects that can materialize, we proceed from the premise that the ultimate purpose of changes in transportation systems is to enhance quality of life (center of Figure 5-1).

Of course, quality of life is a very general term that can mean different things to different people. Although any given person might place greater emphasis on some

of the effects noted in Figure 5-1 than on others, in the aggregate these effects are bound to be important to quality of life. Being able to move about easily and safely, having a choice of how to travel, being able to reach important destinations, and living in a pleasant, cohesive community with a robust economy all are part of how people commonly define "quality of life."

At the most fundamental level, one can divide the effects of transportation projects into two clusters: transportation system effects and social and economic effects. In brief, transportation system effects pertain to changes in how well the transportation system serves its users. Social and economic effects generally relate to how a transportation project affects people in the community other than those actually using the transportation system.

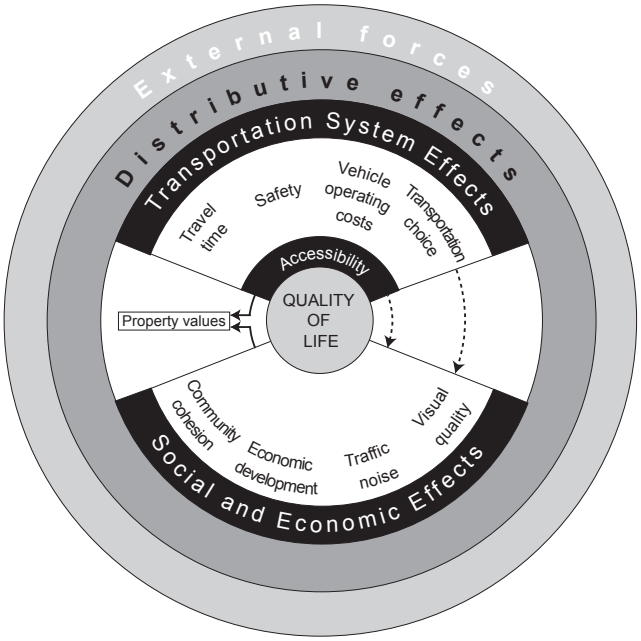

Figure 5-1. Interrelationships among social and economic effects

As mentioned earlier in this chapter, there are three traditional system performance effects: (1) changes in travel time, (2) changes in safety, and (3) changes in vehicle operating costs. The other two system effects are transportation choice and accessibility. Transportation projects may change the modal choices available to travelers. Especially in the case of disadvantaged persons, additional travel options are often highly valued. Making alternative transportation modes more readily available and convenient can be an important aspect of transportation system performance in its own right by helping to reduce automobile dependency. Particularly in congested cities or in those with environmental problems, expanded travel options can be among the most important effects of a transportation project.

Alternative transportation choices can also help a community avoid becoming congested or environmentally challenged in the future.

Changes in accessibility can be considered the cumulative user-related effect of changes in transportation systems. Accessibility is affected by changes in travel time, safety, vehicle operating costs, and transportation choice. The foregoing user effects combine and interact to change the accessibility of multiple destinations within a community. The accessibility of work locations, schools, public services, friends and family, houses of worship, and entertainment is a fundamental dimension of quality of life.

Figure 5-1 shows that there are four separate but interacting social and economic effects that a transportation project may have on a community: (1) community cohesion, (2) economic development, (3) traffic noise, and (4) visual quality. Although each of these effects needs to be examined individually—because the best methods for estimating them vary—they are certainly interrelated. For example, improving the visual quality of a community may well strengthen its prospects for economic development. Likewise, elevated noise levels can interfere with community cohesion, as people spend less time conversing near the street. A factor that may influence some of these social and economic effects, particularly economic development, is changes in accessibility. In Figure 5-1, a dashed arrow indicates the potential nature of this influence. Another dashed arrow denotes that transportation system effects may influence certain social and economic effects. For example, expanding a roadway to reduce travel time may well increase noise levels.

Changes in property values are a product of changes in accessibility and various social and economic effects, including community cohesion, economic development, traffic noise, and visual quality. If a transportation project would not bring about any of these other effects, it would not be likely to influence property values. Closely related to property values is land use. As we discussed in Chapter 4, when the value of a land parcel is altered through, for example, a change in accessibility, the land market will adjust. More expensive land will tend to be used intensively; that is, in time taller buildings and a generally higher ratio of floor space to land area will appear. Projects that increase accessibility of undeveloped areas will tend to promote lower-density land use patterns due to the availability of relatively inexpensive land.

As Figure 5-1 indicates, surrounding both transportation system effects and social and economic effects are distributive effects—the way in which the benefits and costs arising from the investment are experienced by different groups within society. On the very outside of the graphic, external forces condition all effects of virtually any transportation project. The strength of the economy, commonly held attitudes and values, political circumstances, and geography all interact to define and limit the effects a transportation project will have on a community or region.

CONCLUSIONS

Under certain circumstances, major transportation investments may produce various social and economic effects. Sometimes these effects are anxiously hoped for, such as strengthening the economic prospects of stagnant rural communities. Occasionally concerns arise that the negative effects of a project will be disproportionately experienced by already disadvantaged populations. It would be especially helpful to those analyzing the likely effects of proposed projects if we could provide definitive projections of what the array of social and economic effects will always be when transportation investments are carried out. As a practical matter, however, the nature and magnitude of any of the various effects discussed in this chapter will vary with the particular project being examined.

What we can do is suggest a series of questions that should be contemplated when considering the advisability of making a particular transportation investment. Building on the discussions in this chapter, general questions worth considering include:

- How great will be the value of travel-time savings (average time savings multiplied by the average daily traffic)?
- To what extent will crashes (fatal, personal-injury, and property-damage-only) per 100 million miles of travel be reduced?
- How much will the per-mile operating costs of various types of vehicles be reduced?
- To what extent will accessibility from applicable origins to multiple destinations, especially popular ones, be enhanced?
- If the objective is to assist a stagnant or declining area, is the transportation project the cost-effective way to do so (e.g., would other policy interventions produce more desirable impacts per dollar spent)? Is the project likely to have a significant effect?
- To what extent will protected populations (in particular, minority populations and low-income populations) be affected by the project? Will any adverse effects be disproportionately large, compared to non-protected populations?
- How will the cohesiveness of the area be affected? Will people's ability to informally interact and feel a sense of community be impacted?
- To what extent will economic development be facilitated? Will the reliability of arrival times for freight and personal trips be improved? Will the total cost of moving goods and people be reduced?
- To what extent will traffic noise increase as experienced by residences, schools, houses of worship, and other places where quietude is important?
- How much and in what ways will the visual quality of the affected area be altered?

- Taking into account the foregoing impacts, to what extent will private property values change? (They may increase due to better accessibility, and certain other impacts may reduce them.)

These questions are suggestive. Which questions are important with regard to a particular transportation investment will depend on the nature of the project and the particular preferences and values of the populations affected by it.

CHAPTER 6
SUMMARY AND POLICY IMPLICATIONS

As a state with a relatively dispersed population, Iowa's economy and quality of life in general are highly dependent on its highway system. There always are advocates for various improvements to this system, and state officials must often make difficult decisions as to which investments to move forward. Traditionally, highway investments were almost based almost exclusively on current and projected traffic volumes; now, however, the array of considerations is broader. Economic development has become one of the primary considerations, and other initiatives such as sustainable urban development and social equity have taken on increased importance.

In this final chapter, we first explore several fundamental policy trade-offs that often must be made when selecting the investments, trade-offs that can be complex and difficult. Then, we stress the need to maintain a flexible perspective as potential investments are contemplated.

INVESTMENT POLICY TRADE-OFFS

Throughout this monograph, we have discussed a series of public policy objectives that can be pursued by making investments in highways. Taking a series of such objectives into account simultaneously can be a daunting task, in part because these objectives may sometimes operate counter to one another. Several of the more profound policy trade-offs that may arise when evaluating possible investments are discussed in turn.

Commuting Routes and Sustainable Development

In Chapter 2, we noted that the transportation issues within the state vary considerably among the 99 counties. The needs of rapidly growing urban counties are quite different from those of rural counties that are transitioning to smaller and older populations and generally weaker economic circumstances. It follows that the appropriate highway investment strategies usually will vary between urban and rural counties. Such strategies also vary among counties within each of the two groups. Predominantly rural counties that surround larger metropolitan areas grew in population during the 1990s. They have higher median family incomes than other rural counties. This is largely because a substantial fraction of the workers living in these counties commute to jobs within metropolitan areas. Obviously, the major need for counties surrounding metropolitan areas is good commuting routes.

A complex policy trade-off may exist in providing these routes. In Chapter 4, we discussed how high-capacity routes leading out of metropolitan areas can contribute to sprawling, low-density development patterns on the urban fringe. In some instances, then, commuting routes may become catalysts for the type of urban form

that can lead to functional problems in future years, such as traffic congestion, long commutes, or diminished air quality. It will be important to coordinate plans to upgrade commuting routes with comprehensive plans for the affected metropolitan areas to minimize the distortions precipitated by upgrading these routes.

Redundant Investments and Assisting Communities

In Chapter 3, we discussed the circumstance when a community requests state assistance in financing road upgrades in an effort to lure businesses and thus strengthen the local economy. From a state-level perspective, it would be cost-effective to encourage the businesses in question to locate in other communities where suitable roads connecting to major routes already exist. The state does not maximize the net gain of its available resources by constructing redundant facilities. On the other hand, communities that work to develop their economies understandably believe that the state DOT should assist them. Only when the proposed projects are of moderately large scale and at variance with state-level improvement plans is the investment likely to be a significant issue. This presumes, of course, that the investment is not merely a speculative effort to make the community more attractive to not-as-yet-identified businesses or that the businesses being attracted are not already located somewhere else in the state.

Reliability and Excess Capacity

We stressed in Chapter 3 that reliability in travel time (i.e., certainty of arrival time) has become more vital to businesses than the actual time en route. A late-arriving shipment to a factory can lead a business to shut down an assembly line and send workers home. Just-in-time (JIT) windows have become increasingly smaller in recent years with precise arrival windows becoming essential for firms in many industries to be competitive *(1)*. Various studies have documented the close relationship between traffic capacity and reliability in arrival times *(2,3,4).* As highways become congested, the probability of an incident (i.e., a collision or vehicle breakdown) increases. Further, the delays caused by the incident become much greater as the congestion level increases because the highway already was at or over capacity.

The conclusion is that congested highways are likely to experience occasional incidents that may add considerably to the time en route for affected vehicles. Drivers of vehicles delivering materials on a strict JIT basis must either add a time pad to their travel or take the chance that an incident will not affect their arrival time. The policy choice is whether to add excess capacity to the highways serving manufacturing and retailing operations to reduce the likelihood of congestion-related incidents and the resulting delays. Doing so may make the area more attractive to such businesses. Excess capacity is expensive, however, and rarely does it last long, as drivers increasingly select such routes. Coupled with traffic volume increases resulting from urban growth, long-term congestion relief through capacity increases often is elusive.

Local Choice and Sustainable Urban Form

In Chapter 4, we discussed the problem of fragmented local governments in the formulation of metropolitan area-wide comprehensive plans. It has proven difficult for regional governments to secure sufficient consensus among municipalities within metropolitan areas to produce comprehensive plans that can serve as a blueprint for longer-term land use patterns. Failing this consensus, it is impractical for the state DOT to ensure that its investments will work in concert with local preferences regarding the evolving form of their urban area. This is a true dilemma because urban form has a significant bearing on the quality of life within a city and yet transportation needs must be addressed. Federal planning regulations currently require that federally funded transportation projects adhere to formally adopted comprehensive plans. The problem is that such plans for individual municipalities often do not aggregate into a workable, consistent plan for the entire metropolitan area, which is comprised of numerous municipalities.

Efficiency and Social Equity

Throughout this monograph, we have stressed the importance of making efficient highway investments—those in which the benefits to society exceed the associated costs. We observe that to do otherwise would in effect make the state poorer. Also, the funds committed to inefficient projects could be used for efficient projects, so the benefits foregone (i.e., the opportunity costs) may far exceed the benefits derived from the inefficient project. In Chapter 5, we also discussed the importance of fully taking into account social objectives, such as ensuring that the benefits of an investment do not accrue to those with greater means, while the costs fall upon those who traditionally have been less fortunate.

Therein may lie a trade-off. Suppose that the most efficient potential investment (i.e., the one where the benefits would exceed the costs by the greatest amount) would produce an adverse distribution of effects. Possibly minority populations or low-income populations would experience disproportionate adverse effects and fewer benefits. In such a case, there would be a conflict between two laudable objectives: efficiency and social equity.

In cases where such a conflict would possibly occur, it is important to involve the affected groups in devising a solution. Perhaps the most egregious impacts could be mitigated, or perhaps the project could be modified. Turning the problem around, it never makes sense to invest in an inefficient project in the interest of advancing social objectives. No matter what the purpose, an inefficient project will make society poorer, and it should not be an outcome of any public investment.

NEED FOR A FLEXIBLE PERSPECTIVE

The main objective of this monograph has been to set forth a number of practical considerations when evaluating potential transportation investments. It would be wonderful if a rote, sure-fire approach could be spelled out for estimating the nature and magnitude of various impacts. Unfortunately, the circumstances surrounding major highway investments vary tremendously, so that each one must be evaluated

based on the positive and negative effects that would be likely to arise. For this reason, our approach in this monograph has been to identify the types of impacts that can result from a project; we have not attempted to specify a generic magnitude likely to occur or the nature of such impacts.

It also would be highly desirable to be able to conveniently sum up all of the impacts to facilitate an easy "go" or "no go" determination. There are at least three reasons why this is not feasible.

- The people affected by the project may place a higher or lesser value on any given impact than others would.
- The magnitude of a given effect often is influenced by existing conditions. For example, 100 new jobs would mean more to an economically depressed area than one that is having trouble accommodating the rapid growth it is experiencing.
- Various impacts may interact with each other in subtle ways; their effects may not always simply be additive. Earlier, we noted that commuting routes to a metropolitan area may contribute to outward growth in a low-density manner. The employment opportunities would be positive, but the resulting urban form may not be.

All of this suggests that the basic concepts and principles discussed in this monograph need to be applied creatively—each potential investment must be evaluated by taking into account a series of effects. These effects can only be fully understood through a careful analysis, coupled with meaningful interaction with those affected by the project.

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