ute to an increase in transit use. Further, the nomenclature in strategic planning refers to performance in terms of growth and relative market share. Also, routes in this category are indicative of relatively stable and small routes that are described from the standpoint of providing mobility to a community and ensuring system connectivity.

Second, the real question in terms of success or disaster is whether the problem child routes are converted to either stars or dogs. It is these possible outcomes that account for these routes being so named. Aggressive planning and service expansion for the problem child routes can result in these bus lines becoming stars. Failure to make this correct management decision will result in the problem child routes becoming dogs. Thus, the question is the comparison of the performance measures presented in Table 2 for routes classified as stars and dogs. For all measures except passengers per mile, the preferred sequence is to convert problem children to stars rather than dogs. The seeming anomaly for passengers per mile is attributable to differing operating speeds.

From the previous discussion, it would appear that the strategic planning approach can be applied successfully to urban transit systems.

CONCLUSIONS

The results of the analysis in applying the strategic planning approach to the BJCTA represent only a single case study. Nonetheless, the success of the application and the fact that the Birmingham system is typical of transit systems throughout the nation would suggest the following conclusions:

1. The analytic framework provided by the strategic planning technique in the private sector for multiproduct or multidivision corporations is directly analogous to the urban transport system. In the latter case, the portfolio consists of the individual routes.
2. Because of the limited resources for transit planning and services, as well as internal cross-subsidization, the transit system routes are in competition with one another.
3. By providing a revenue-based analysis technique, the approach provides a novel way of analyzing transit performance.
4. Another advantage of this approach is that it is truly strategic in nature. All routes are analyzed within a consistent framework and this approach affords an opportunity for overall system optimization. Other approaches, such as ordinal ranking and cost centers, can only provide suboptimal investment decisions.
5. By recognizing the dynamics of the urban environment in general and the bus system in particular, the approach provides greater insight into system performance than might be possible with the traditional procedures that examine the transit system at only a single point in time (i.e., a snapshot).
6. By assessing individual routes within a dynamic and global framework, the allocation of system planning and service resources can be made to achieve specific future results.
7. Similar to all such management tools, the strategic planning approach is diagnostic. Plans and programs must be formulated and implemented to remedy route and service deficiencies and exploit opportunities.

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Future Directions for Public Transportation: A Basis for Decision

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The future direction of public transport must be viewed in the context of the major forces that will influence our society. We identify four major forces to consider: population demographics and dispersion, energy cost and availability, overall economics, and technological change. Factors that could far transcend the single personal transport issue (e.g., world war) are purposely not addressed. Within the context of personal and economic forces at work in our society, we recommend that less emphasis be placed on competition between transit and automobile and much more be placed on articulation, system efficiency, and balanced transportation. We recognize that personal, individual transportation will continue to play a major role. The technology and fuel of such transportation may change, but not its basic role. The counterforces do not exist, and nontransportation factors so overshadow the issue at hand that it is not logical to attempt to manufacture them. Much can be done, however, with innovative use of urban personal transportation.

This long-range study is based on a report that was prepared to assist the Urban Mass Transportation Administration (1). It deals with the mobility needs of the American population in the year 2000 and the implications for public transportation. In order to gain a perspective on the time period involved, note that the year 2000 is not any further away from 1981 than was the year 1962. From the point of view of planning transportation facilities (including such long-lasting investments as highways and railways) 19 years is a very short period indeed.

The basic problem, of course, is that there is simply no objective way of knowing what conditions will be like in the year 2000. Many methods exist for attempting to form improved and better-founded opinions on this subject. Some of these methods go by names such as modeling, trend extrapolation, and Delphi. Yet, every one of these methods turns out, on examination, to rest entirely on subjective judgments made in the present by people who, in the nature of things, cannot possibly have any hard information about the future.

It is relevant to consider both the most-reasonable scenarios and some worst-case possibilities. However, contingency planning for a range of disasters and impacts with implications far beyond the scale of the transportation system alone was neither appropriate nor desirable in the transportation-oriented study undertaken. In accordance with the analyses and judgments of the team undertaking this effort, the following factors were selected as being of prime importance in the development of scenarios for public transportation planning purposes:

1. Population growth and dispersion,
2. Energy cost and availability,
3. General economic factors, and
4. Technological advances.

The technological factors considered were communication in place of transportation, new modes, new modal hardware, and new efficiencies. This paper considers the other factors because the technology has not been such that major issues are raised in the present context.

Prior to considering the results of the scenario building, it is important to note the historical development of transportation and place it in the perspective of evolving city settlements. Public transportation and the automobile are then seen not as natural rivals, but as technological innovations that respond to the varied economic and life-style preferences of individuals.

HISTORICAL PREFERENCES

Both inter- and intra-urban transportation systems have popularly been viewed as perhaps the most-important technological factors in supporting the growth and vitality of American cities. Although this is clearly true, it should not be overlooked that these technological innovations not only served the vast goods and personal mobility needs necessary for great urban settlements to exist; they also expanded the concepts of personal and economic freedom, previously confined to the scale of either the farm, frontier, or compact city.

Preferences for lower-density life-styles have persisted in the nation and dominated the desires, if not always the realm of possible actions, of many Americans. Public transportation modes especially need to be viewed as innovations that expanded the life-style options for increasing numbers of people. The rise and decline of transit ridership need also to be placed into context: Ridership expanded until the automobile developed as a more successful means of fulfilling two largely inseparable needs--mobility and lower-density life-style.

The earliest American cities were settled and developed in response to technological innovation, especially inter-city transportation developments (e.g., steamboat, canal, and railroad). Internally, urban transportation modes satisfied mobility needs of huge, dense populations, but they also released pent-up preferences for lower-density life-styles. A succession of technologies (e.g., horse-drawn streetcars, cable cars, electric streetcars, subways and elevator trains, buses, and automobiles) allowed more and more people to move further away from the city core. These modes allowed greater range for a given travel time budget and were coupled with continual real cost decreases and rising affluence.

Population dispersion to outlying areas was supported by various forms of public transit since at least the 1850s. These urban transportation technologies allowed increasing numbers of people to escape living in crowded centers of cities since, previously, walking to work was the only modal option. This movement, however, is not easily discerned; even though the rate of population dispersion from the centers of cities has been relatively constant since the middle of the nineteenth century, those who emigrated to suburbia were immediately replaced by waves of rural and foreign immigrants. The flow to the outlying areas was supported by mass transit, while the influx of immigrants from rural areas and overseas was supported by railroads and steamboats. Only the cutoff of massive foreign immigration and the decline of the rural farm population in the twentieth century allowed the underlying trend to emerge clearly.

Public transportation has suffered greatly in the last 30 years. The historical decline of ridership (the heart of the problem) is placed not in the late 1940s but in the late 1920s. The forces that caused this decline actually began to appear some 70 years prior, in the midnineteenth century. Only the extreme, anomalous conditions of the Depression and the Second World War, which masked this trend, have left some transportation planners with the spurious goal of returning to the "natural" ridership levels of the 1940s.

POPULATION DEMOGRAPHICS AND DISPERSION

The future shape of urban settlements must rely on (a) historical precedent, (b) proliferation of automobiles and supporting highway system, and (c) population demographics. These factors will be as important in favoring continued dispersion from high-density centers as were the baby-boom post-World War II years. Dispersion (largely reserved in the past to suburban areas adjacent to urban centers) will assume an even bolder appearance, in the shape of growth in

1. The sunbelt,
2. Small cities and rural areas, and
3. Independent suburban communities.

If such dispersion exists, implications for public transit are clear: Although high-density settlements will not disappear and may possibly level off in terms of relative losses, a growing portion of the population will be settled in areas not amenable to cost-effective service by conventional transit modes.

To set the context, it is important to note the continued major role of a large population in the family-formation years. This is a factor that is even more important than the growing number of elderly, to which we are well sensitized. The overall population shift can then be viewed in terms of the continued needs of this group, and economic and social forces that transcend the single issue of personal transport. Business is relocating because of changing industrial technology, space availability and cost, labor availability and skill, climate, energy availability, and transport of goods. Life-style preferences actually reinforce this in many cases.

We recognize the rebirth and special advantages of classic urban areas and large cities. Their uniqueness and value are not questioned, nor are the modal advantages within those configurations. However, these are but a few elements in an evolving future and do not signify a major counterforce. We also recognize the modal energy advantages of conventional public transport for personal transportation. Again, however, the total petroleum-based energy advantage may lie with lower-density, automobile-dependent clustered configurations that have alternative energy forms for home and industry and not with the classical high densities (2).

Demographics

For the purpose of understanding mobility patterns and needs, population growth must be viewed not simply in terms of numbers but also in terms of composition. Aside from immigrants, all those who will be 20 years or older in the year 2000 are already born and reside in the United States. Much, therefore, is known about the probable composition of the population. The population will be aging, as numerous reports and census figures have documented (3). However, it is equally important to emphasize the significant growth in absolute numbers of the segment of the population most concerned with family formation.

In 1943, the baby boom began as the number of annual births reached 3.8 million (4,5). Previously, births in the United States had dropped from more than 3 million in 1921 to 2.4 million in 1933, and births never exceeded 2.6 million throughout the 1930s. But, beginning in 1943 and lasting for nearly 30 years, annual births never dropped below 3.2 million. After falling slightly, annual births returned to 3.8 million in 1951 and continued to rise until they peaked at 4.3 million in 1957. The decline was slow, receded to around 3.7 million during the late 1960s and dropped below 3.2 million only after 1972.

The baby-boom period should be best considered in terms of size of cohorts (i.e., annual births) rather than birth rates. The enormous bulge in the age distribution caused by the baby-boom years is moving through the population, over time, as if on a conveyor belt. The rapid rise in cohort size from 1943 to 1957 was a major factor in suburbanization as young postwar families moved for the sake of available homes and space, better schools, grass in the backyard, less traffic in the street, and "a good place for the kids to grow up."

The last of the 3.2 million cohorts will not reach 30 until 2002. If current patterns persist, most of these women will not choose between job and motherhood (6); they can have both. But for most people, this usually means having only one or two children and returning to work. But even the birth of one child usually means commitment to a less-dense life-style, one more easily found in the suburbs, small towns, or rural areas. There is a need for more square feet of housing at a price that can be afforded, more open space for play, better schools, and all the other amenities that families that have only one child still desire (7). High-density living, often very attractive to marrieds without children or singles in their late twenties, is often sacrificed to new priorities, if incomes permit, when a child is born. The new priorities created by the birth of the first child become much more pressing if there is a second child. There need not be a third or fourth child, as was typical during the 1950s, for life-style changes to become imminent.

This enormous force--the former baby boom that is becoming and will continue to become a nesting generation--virtually guarantees continued low-density growth. The mass movement of this segment of the population (over 30, male and female) will also continue to attract more industries to locations closer to their labor force, which will further ensure the maintenance and growth of low-density settlements.

Dispersion

All three movements toward low-density settlements are closely connected. If all three are not considered, apparent indications seem to break down. For instance, the population growth rate in the South during the 1970s was actually below what it was from 1960 to 1970, and certain areas of the so-called snowbelt are gaining population at a greater rate than the national average (8). Yet, neither fact belies that a shift toward the sunbelt is occurring. In the first instance, despite a lower growth rate than in the previous decade, Southern population grew at a rate 28 times greater than that of the Northeast states from 1970 to 1977 (8). In the second case, the population increase has occurred almost entirely within nonmetropolitan areas of snowbelt states, and the metropolitan bulwarks of Northeastern states lost population over the last seven years (8).

The move toward low-density settlements does not mean that the country will become decidedly rural, at least not by the year 2000. Most rural growth has been in the exurbs of urban areas. However, the advantages of urbanization appear erodable to the resident population. Metropolitan areas can and do reach economic maturity, and depreciating manufacturing plants and housing stocks play primary roles in driving much new investment and population outward. Currently, as rural areas are no longer considered isolated and backward, strong latent residential preferences are more likely to be fulfilled.

Much has been said in recent years about the growth in the sunbelt. The factors that drive this overall pattern (i.e., economics, space, labor, climate, intercity transportation, and collection-distribution) far exceed those directly affected by intraurban person-transport facilities and service.

In addition to the aggregate shifts, consider the nonmetropolitan pattern. Prior to the 1970s and, except for a brief number of years during the Depression, metropolitan growth has exceeded nonmetropolitan growth rates since 1820 (9). In the 1970s, however, a dramatic shift occurred. The nonmetropolitan growth rate as of 1976 was nearly twice that of metropolitan counties--8 percent versus 4.7 percent (10). Although a considerable amount of this growth occurred in nonmetropolitan counties adjacent to standard metropolitan statistical areas (SMSAs) (possibly better characterized as suburbanization rather than rural migration), freestanding rural counties indicated significant growth and net migration gains. Thus, both suburban and developing small urban growth is a fact to contend with.

ENERGY COST AND AVAILABILITY

The fuel crises of 1973-1974 and 1979 demonstrated dramatically how sensitive our society is to perturbations in its gasoline supply. Alternative means of moving individuals were sought. Public transportation offers a much more efficient alternative in terms of British thermal units per seat mile and also, at typical peak loadings, per passenger mile.

To the extent that the lower-density pattern cited above is inconsistent with the feasible deployment of public transportation, it would follow that the energy problem is a substantial counterforce to that lower-density pattern. Simply put, if public transportation is necessary to move people, and if low density cannot support public transportation effectively, then a substantial force would be working against the low-density pattern. The evidence of 1973-1974 and 1979 and the subsequent rises in gasoline prices are commonly cited as support for this reasoning. However, a closer inspection of these postulates is required.

The study on which this paper is based considered two distinct supply scenarios: (a) a steady but significant increase in price and (b) an abrupt reduction in supply, regardless of price. Other scenarios were considered, but were deemed to be variations of these or less probable. Indeed, the first of these is judged to be the most probable of all such scenarios. The second is improbable but has effects that justify special attention and consideration.

The dramatic increases in gasoline prices are well documented. The discomfort that they have caused is without question. Nonetheless, it is also true that automobiles are becoming more efficient, driven by federal mandates and market forces, and that the real dollar costs (corrected for inflation) are not as dramatic. Thus, real, constant-dollar cost of fuel per passenger mile can actually decrease in some scenarios. Figure 1 illustrates some computations under the assumption of orderly, adaptive change.

We readily acknowledge the circular reasoning implicit in this situation. Petroleum supply is a major political concern in our society. Sharp petroleum price increases are primary causes for the inflation we are experiencing. Thus, they are responsible for driving up the overall cost of living, which mitigates the relative cost of the gasoline price increases.

Despite the overall problem, the individual will perceive a much less dramatic relative choice to avoid the automobile than we might generally expect. We conclude that there may be major user-generated forces for more-efficient vehicles or for alternate fuels but not comparable forces to forsake the individual, personal vehicle.

The problem that is of special interest is not the steady adaptation and change just depicted, with some influence on transit (perceived as significant only relative to transit's minor present role) but rather the less likely scenario of a dramatic and rapid decrease in supply.

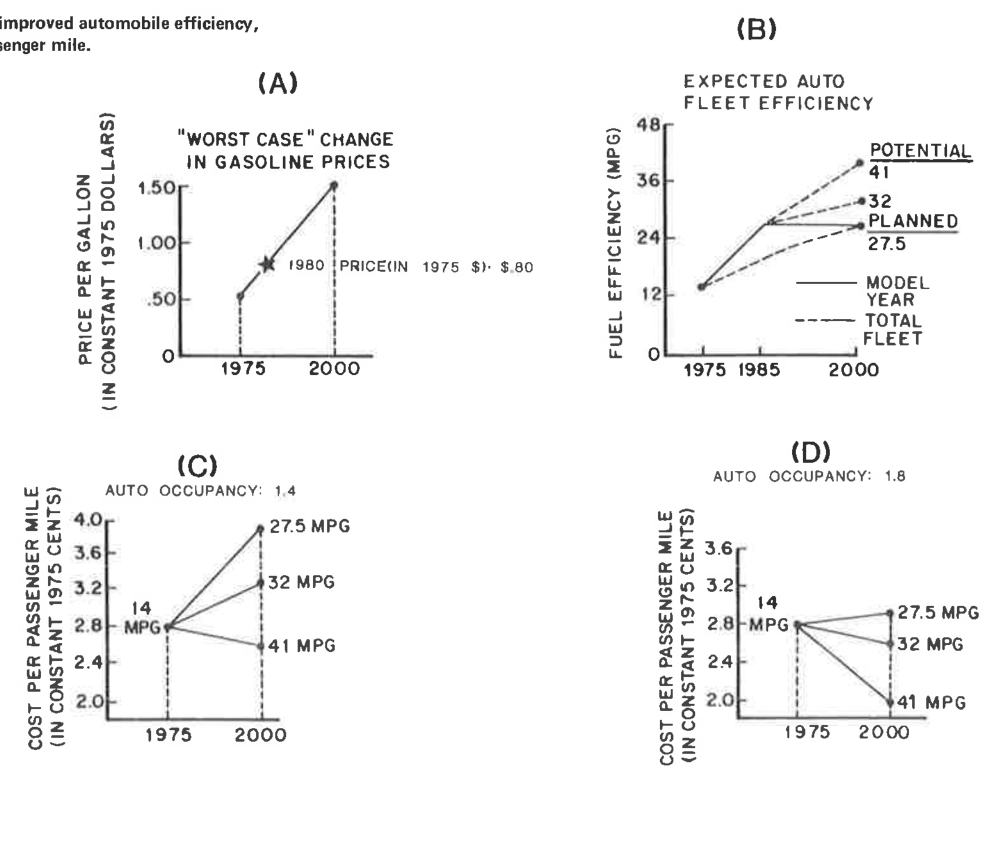
The political and economic forces that can bring about such a decrease are clear. Moreover, the political and economic dangers are so real that some agree that we should impose the restriction on ourselves. Further, we must recognize that an attempt to protect internal supplies to industry and to home heating may lead to a disproportionate impact on the personal transport sector. A decrease of 10 percent and even 20-30 percent in the motor vehicle component must be seriously considered.

The essential problem is that trip needs must be met with a decreased energy supply, so as not to disrupt the economy. Response options can include greater efficiency in automobile trips, more public transportation, and a return to higher densities.

Greater efficiency within the automobile mode can be achieved with carpooling, vanpooling, elimination of unnecessary trips, packaging of other trips, and other measures. At the level of 10 percent reduction in supply, the existing trip patterns and occupancies are such that the disruption can be overcome relatively easily. As the reduction in oil supply approaches 25 percent, the core of necessary trips will be affected seriously and measures that rely on packaging and efficiency within automobiles become less feasible as the total solution.

Public transportation can respond, but, for the most part, it cannot be with rail transit. Some service options can be improved on existing systems, but most areas neither have rail transit nor could they implement it in the required time frame. In most areas the principal response must come from buses, vans, and paratransit, including more innovative uses of private automobiles.

Figure 1. Impact of energy cost increases, improved automobile efficiency, and automobile occupancy on cost per passenger mile.



The need for buses can be met, despite current delivery lags, for one important reason: The automotive industry will clearly be hurt significantly by a decreased demand for automobiles (because serious fuel supply problems are part of this scenario) and it must move rapidly to new markets. Buses, vans, and related vehicles represent this opportunity, and the production knowledge and experience exist to make such production alterations.

Rights-of-way also exist. Existing roads can be converted to busways and high-occupancy-vehicles-only systems. Institutional problems such as insurance for pooled riding and for vans and paratransit vehicles as well as possible franchise infringements can be overcome.

More basic than these responses can be the return to high-density areas or the development of new high-density areas or local clusters. Certainly some of this will occur. However, the fact that there is such a massive infrastructure of lower-density development (privately held by individuals and, for most, the major capital investment of their lives) is a major force. (Moreover, the capital requirement for rehabilitation or construction of new, dense housing for all these persons would be immense.) For every seller, there must be a buyer or abandonment. In addition to this reality, the American preference for an individual holding is historic and characterizes our national development.

The realignment of people may lead to shorter trip lengths, and higher-density clusters may be inserted in areas, but it is reasonable to expect that the future will contain the basic housing structure and preferences that now exist. Depending on the level of the petroleum constraint, some balance of efficient use of automobiles and bus or van transit and paratransit will be the preponderant response.

Given a significant transit role in meeting the immediate problem, one must then ask whether the fact that the infrastructure is in place will then lead to a permanently enhanced role for transit. One can even think in terms of providing more efficient transit (e.g., rail construction initiated now), in anticipation of this new structure and need.

At the same time, many energy alternatives that are now infeasible due to cost or implausible because of societal priorties will become attractive and can be pursued, particularly on a crash basis. Alternative fuels from coal, oil shale, and some renewable sources can be manufactured. Electric vehicles can be manufactured in a major effort. Nuclear reactors can be built to supply the necessary energy, as the current 8-10 year building period conceivably could be greatly reduced.

One must also recognize that the basic density infrastructure and historic preferences will exist. Further, usable fuel alternatives will also exist. They can be cost effective due to new relative costs and technological advances. Synthetic fuels and electric vehicles represent the two major opportunities. Industry can reorient and provide one or the other or both as the primary market response. The costs of transit can represent a major difficulty by the second decade, particularly the labor intensiveness of the bus-oriented response. A probable response, therefore, is a dissipation of the enhanced transit-paratransit ridership and a return to private vehicles, albeit in a new form. The dissipation will be not unlike that that followed World War II. Indeed, both the postwar period and the years following such a disruption have common characteristics: a period of special problems that limit the availability of the automobile, but which technology or the passage of time can overcome.

ECONOMIC FACTORS

Our best estimate is that U.S. economic growth will continue on its long-term path. Aberrations in economic growth in two key industries--automotive and petrochemicals--are possible due to energy considerations, but the likelihood that major disruptions would occur is small. However, government support may be necessary. When added to other such support (necessary to increase investment in energy sources, pollution abatement, and improved social welfare), a substantial amount of private capital investment could be diverted, causing a possible fall off in productivity growth. Yet, as the nation becomes increasingly linked to a service economy, productivity and even real gross national product (GNP) are less-accurate indices of long-term trends in the well-being of society (11). Therefore, we do not expect there to be unmanageable business cycles or severe trade deficits that will alter long-term trends. Such a scenario implies no changes in the public transportation-automobile picture thus presented. There is, however, one alternative economic scenario that is a highly probable alternative: stagflation. This merits special discussion, for a number of transportation observers have judged that this phenomenon might lead to a resurgence of mass transit.

Stagflation is the simultaneous existence of high unemployment and high inflation. Some people believe that stagflation induces transit use, because the reduced level of economic activity coupled with (and partially caused by) higher petroleum costs will make transit more attractive in two separate ways: (a) an income effect and (b) a substitution effect. The lowered disposable real personal income and relatively tight money policies (high interest rates instituted to control inflation) would lower automobile sales, because fewer persons could afford the relatively large capital outlay and associated fixed expenses (e.g., insurance). In addition, the increases in the price of gasoline relative to transit fares would cause a substitution of conventional transit modes for private cars.

Although there is some justification for this type of connection between oil-fed stagflation and mode choice, other urban transportation scenarios can also be hypothesized around stagflation that are at least equally plausible and that would reduce transit use. The prime factors are that, as work trips decrease, costs increase and nonfare income decreases.

Unemployment under stagflation most directly reduces work trips--the dominant transit trip purpose and crucial travel market for transit systems, especially outside the transit-dependent cities (e.g., Chicago, New York, and Boston).

The public transit sector is not spared the effects of inflation, for the costs of labor, equipment, construction, and energy all increase operating expenses. All of this occurs while the economic slowdown produces a leveling off or even reduction of tax revenues needed to offset rising deficits.

Fare increases and service cuts, both of which lead to reduced ridership, could very likely happen if the necessary nonfare support were no longer forthcoming. In addition, it cannot be assumed that the population is dispersed in a way that makes the switch from private to public modes of transportation possible. The postwar residential land use patterns, geared around the flexibility of the private automobile, are not well served by the relatively fixed characteristics of conventional transit, even if economic conditions were to make it relatively more attractive than the private automobile.

Based on these considerations, it is very difficult and probably erroneous to label stagflation as an economic scenario that would bring riders back to transit and gradually turn private automobiles into vestigial machinery. The counterargument seems more justified, especially when the impacts on both ridership demand and tax revenues are considered. There is also the potential for alternative energy actions (e.g., renewable fuels, increased domestic oil, and coal production) and the substantial and very probable increase in automotive energy efficiency that will help that mode ride out the cost impacts of stagflation.

CONCLUSIONS

The major scenarios of the future of urban America considered in this paper, based on the most influential and plausible trends, all point toward a continued and even strengthened trend to lower-density living. This is due to a number of societal forces that could not be realistically reversed or impeded by any feasible public transportation policy. However, there are opportunities for conventional transit to be efficiently implemented or expanded, but such modes cannot (and should not) be expected to reverse the overall decentralization trend.

For the purposes of providing efficient mobility to the population, planners should pay particular attention to novel uses of the automobile and to novel implementations of paratransit in low-density environments. Every effort should be made to (a) improve the energy efficiency of the automobile and (b) create situations where the tremendous excess capacity in automobiles can be used through expanded ridesharing. The use of transit policies as a counterforce to the growth of these low-density areas is not deemed possible, due to the major societal forces at work. More importantly, agencies that try to emphasize conventional transit modes in such areas will essentially be providing incentives for inefficient transportation, because the world of low-density urban and suburban regions is simply not amenable to such high-density modes.

The various capabilities of automobiles, paratransit modes, and conventional transit services must be applied only in those markets that they can serve efficiently. Single-passenger automobiles should be dissuaded, for example, from rush-hour trips into central cities, and conventional bus services should not be supported in low-density areas that are served more suitably by private automobiles or various paratransit services.

The atmosphere of modal competition, especially between the private automobile and conventional transit modes, must be replaced by one that

1. Accepts the capabilities of each mode,
2. Accepts the nature of the demand for each, and
3. Stresses the coordination and effective articulation of existing and planned transportation networks.

To some, any conclusion that does not advocate high-density transportation and the infrastructure that supports it is an abdication of our responsibility as planners. To those, we must simply observe that sound planning must be consistent with underlying social choice. In the present context of transportation, we have identified population composition and preferences and private sector economic decisions that are massive forces moving the nation in certain directions. We have also reasoned that the likelihood that substantial increases in automobile operating costs will act as a notable counterforce is virtually nonexistent.

We note that this is an overall prognosis that addresses the substantial lower-density areas--cities, towns, and suburbs, which represent the areas of significant growth. The older urban areas, with their high-density infrastructure, represent an alternative that some will continue to elect. Future transportation assessments must not overlook these existing areas, even if they are not the primary direction of development.

The fact that conventional transit modes are incapable of meeting the mobility needs of the newer urban areas, and currently handle roughly five percent of the nation's total trips, does not mean that they do not play a crucial transportation role in dense urban areas, including service between lower-density areas (by use of paratransit modes for passenger collection and distribution). The decline of such regional urban centers as New York, Boston, and Chicago may have leveled off, and most experts feel that they will be able to maintain these somewhat lower levels of population. Conventional transit already exists in these areas, and upgrading (and possible expansion) of these networks is both necessary and justified. In addition, every effort should be made to provide the necessary paratransit support services to expand the effectiveness of fixed-guideway systems, especially those only recently developed or still under construction. However, we feel that a mere replication of such conventional systems cannot significantly stem the longstanding social and economic trends toward decentralization, and must be augmented by new paratransit concepts, including the private automobile itself, in lower-density areas. Indeed, these systems may, themselves, be links for clusters with a general lower-density area development.

In closing, we note that the abrupt-reduction-in-supply scenario would provide an incidental by-product: The scale on which transit and paratransit would have to be implemented gives opportunity for efficiencies, economies of scale, and innovations that did not previously exist or that now exist in most real-world environments. In our judgment, the innovations must be in implementing comparable levels of service to the automobile at comparable cost. The comparable level of service requires much attention to articulation of services, with good frequency of service. Certainly some such innovations can be thought out and planned, even without such an unpleasant scenario, and should be developed. It follows that some of these will be by-products of contingency planning, which is itself justified considering the severity of the abrupt-reduction-in-supply scenario.

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Effect of Environmental Factors on the Efficiency of Public Transit Service

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As part of efforts to improve the productivity of public transit systems, performance-evaluation techniques have received a great deal of attention among transit analysts. Development of performance-evaluation methodologies applicable to groups of systems has been limited by the issue of comparability. Transit performance is thought to be sensitive to the environment in which the system operates. Because operating conditions vary from one system to another, performance comparisons may not be appropriate. However, the extent to which operating conditions affect performance has not yet been established. By using a sample of 30 California fixed-route transit systems, this paper examines the effect of environmental and institutional factors on efficiency. Operating conditions are found to have a significant impact on transit efficiency and, therefore, these factors must be identified and controlled for when performance comparisons are made. Significant improvements in the efficiency of transit systems will require the cooperation and efforts of both transit operators and policymakers.

During the past decade, public transportation policy underwent a major shift from support of massive capital improvements to an emphasis on maintenance and improvement of existing services. In an effort to put a lid on rapidly escalating costs and subsidy requirements, better management of the transportation system, aimed at more effective use of the system, became a major focus of public transit policy. Under the rubric of transportation system management (TSM), a number of transportation and traffic engineering improvement techniques were implemented, and interest was renewed in developing ways to evaluate the performance of public transit services.

Research in public transit evaluation began with the development of indicators that measure different aspects of performance, such as labor use or cost efficiency. These indicators were found to be useful for identifying areas of potential improvement within the transit organization and for monitoring progress toward specified goals (1-3). It became apparent, however, that performance indicators had limited utility for performance evaluations between transit operators, primarily because the extent of comparability between transit firms had not yet been established. Performance comparisons between different transit modes, such as between fixed rail and conventional buses, are limited because of differences in technology and type of service provided. Within the same transit mode, the issue of comparability centers on the locational differences that exist among public transit systems. In general, transit systems are organized as spatial monopolies, and therefore, each operates in an environment that is to some extent unique. Locational differences between public transit systems are an important consideration for two reasons. First, the institutional framework through which transit service is provided varies from place to place. Second, public transit service interfaces with the operating environment on two levels. On the supply side, it must operate within the structure of the existing transportation network; on the demand side, its ability to compete with other modes is a function of both population characteristics and existing travel patterns. Because of these place-specific variations, analysts have maintained that the comparability of transit system performamce is severely constrained. If performance comparisons are to be made, environmental factors that affect performance must be identified and taken into account. This paper analyzes the extent to which the operating environment affects the performance efficiency of fixed-route transit service.

ANALYTICAL FRAMEWORK

In an ideal world of full information, the appropriate model for such an analysis would be one in which transit performance is conceptualized as a function of two sets of factors: those within the control of the operator or manager and those outside operator control. Performance evaluation should be aimed at the first set of factors; it should evaluate the outcomes of decisions the transit firm has made. Unfortunately, the extent of operator control is difficult to determine. Although the internal operations of the transit organization are clearly under the control of transit management, labor union work rules may create constraints on efficient labor use, and federally mandated lift-equipped buses may gen-