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Current Issues in State and Federal Tollway Assistance Programs

CRAIG MILLER

ABSTRACT

Many revenue-producing highway development projects, although physically necessary, are not considered feasible within the framework of current U.S. regulatory and legislative machinery. These projects, which may represent hundreds of millions of dollars of new construction, are considered infeasible because their projected revenues are insufficient to cover their overall costs. In fact, projected revenues may be required to exceed the projected payment schedule by 30 to 40 percent before the full faith and credit of the state can be pledged to the project. Many state and federal agencies are providing front-end financial assistance to get such projects started. Once this "seed money" is planted to cover a portion of the overall costs, the revenue-gathering capability of a tollway can be harnessed to produce the funding for the remainder of the project. The end result can be a large project for a relatively small federal and state investment. The hypothesis in this paper is that this financing strategy, when compared with other federal and state funding strategies, can produce more public benefits per federal and state dollar than current program strategies. This hypothesis should hold even after toll collections imposed on the user are subtracted from the user-benefit stream. The impact of federal and state policies on toll facilities is traced and analyzed and new legislative and regulatory initiatives and research that can be undertaken to improve contemporary financing strategies are suggested.

Although states have supported tollway projects to some degree, the federal government has traditionally discouraged tollway construction through both policy and legislation. This policy was established by the Federal-Aid Road Act of 1916 and continued by the 1956 legislation creating the Interstate and Defense Highway System. The only toll projects eligible for federal aid under the 1956 legislation are bridges and tunnels, and then only if the tolls are eliminated after the construction costs have been repaid. Federal aid may also be used to finance the construction, up to the point of the last toll-free exit, of public facilities that connect with a tollway. Here again, the agency with jurisdiction over the tollway must agree to eliminate tolls when all debts have been paid. The Surface Transportation Assistance Acts of 1978 and 1982 made toll roads that are part of the Interstate system eligible for resurfacing, restoration, rehabilitation, and reconstruction (4-R) funds. This act also stipulates that tolls must be eliminated when all outstanding debts have been paid.

Other legislation has dealt specifically with bridges and tunnels. The first bridge legislation to mention tolls was the Bridge Act of 1906, which included a uniform standard for setting tolls. A 1926 law permitted private bridge owners to make a profit while allowing public operators to collect tolls only to the point of amortization. The General Bridge Act of 1946 applied more stringent regulations to Interstate toll bridges; however, intrastate toll bridges were left unregulated by that legislation. The last major legislation to deal specifically with bridge tolls was the International Bridge Act of 1972. As its name indicates, this law addressed only international bridges and required that toll rates be "reasonable and just."

The result of these federal legislative acts is that toll bridges are currently operated under various requirements affecting toll collection, ranging from the one that tolls be "reasonable and just" to the one that tolls be eliminated once construction debts have been paid. In addition, FHWA has the power to review bridge tolls and must approve toll increases. As stated in NCHRP Synthesis of Highway Practice 117 (1,pp.11-12), this review procedure "tends to inhibit plans for capital and safety improvements because there is always the possibility that the required toll increase . . . will be delayed or possibly denied." Long-range and contingency planning are thus restricted, and potential investors are discouraged.

STATE AND FEDERAL FUNDING RELATIONSHIPS

In past years, the number of critical, high-priority projects easily consumed the total dollars available annually for highway construction. Recent revenue increases at the federal level have given the United States an opportunity, for the first time in many years, to begin work on the backlog of critical projects. However, highway needs continue to outpace the available resources.

The FHWA uses a matching system to get more mileage from its limited dollars. With this matching system, 70 or 90 percent of the funding is provided by FHWA for various categories of projects, and the state or local government provides the remaining portion. This strategy produces more projects per federal dollar than would otherwise be created; it also entices states to generate and allocate funds toward federal objectives and programs.

With federal revenues growing as a result of re-

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cent tax increases, more pressure is being placed on the states to produce additional funds to match the increased federal funding categories. Many states have responded by increasing their taxes through various mechanisms. These have included increased pennies-per-gallon motor fuel taxes, percentage-of-cost formula taxes on motor fuel, and sales taxes related to motor fuel consumption. The net result has been a significant increase in nationwide revenues for transportation and, consequently, opportunities for making even greater financial contributions to the transportation infrastructure.

TOLLWAY OPPORTUNITIES AND NEEDS

In many fast-growing urban areas, opportunities still exist for the construction of needed limited-access highways in currently undeveloped, noncontroversial corridors on the fringe of existing urbanized areas. These opportunities must be used while they are still available. Many urban areas, particularly in the Sun Belt, are growing so rapidly that there will be no undeveloped corridors left in 5 years or less. Rapid urban sprawl is thus eliminating some of the best locations for essential limited-access facilities. Once residential development has moved into the immediate vicinity of a corridor, controversy will usually erupt if any attempt is made to plan or implement a limited-access facility within that corridor. Residents will oppose such a project, even when the right-of-way is protected in advance and the homeowners have been warned before buying their homes.

A joint role for state, federal, and revenue-bond financing of tollway facilities is suggested here. A possible federal role is important for several reasons:

- Federal leadership is needed;
- Some states must use almost all their funds to match federal dollars; failure to match federal dollars would result in loss of federal revenue, and many states cannot afford to finance a project; and
- Some legislators might not take the initiative or support such initiatives because of a lack of immediate, direct benefit to their constituencies.

The policy suggested is not new: state, federal, and local governments have been combining forces and funds to pursue mutual goals for many years. However, for many reasons, the privately backed revenue-bond-funded agency has not been treated as a valid partner in the financial partnership between the federal government and state and local government.

The fact of the matter is that, for many years, state gasoline tax dollars have been used to support toll-financed systems throughout the United States, both directly and indirectly. This policy should be analyzed and, if appropriate, extended to acquire the maximum public benefits possible. This analysis should include the potential for federal, as well as state, participation in tollway programs.

COST-EFFECTIVENESS OF STATE AND FEDERAL ASSISTANCE

To examine the cost-effectiveness of a possible joint financing policy for tollway projects, a hypothetical example may be used. Assume that a state has $30 million available to spend on a major highway system improvement program in Your Town, United States. Seventy percent of these funds is provided by federal sources and 30 percent is state funds. Your Town has two projects in dire need of improvement (Table 1).

TABLE 1 Hypothetical Expressway Financing Case Study

Item	Cost ($000,000s)
Case 1: Cornerstone Expressway	
Financing and construction cost	600
Supportable bond issue	-570
Front-end shortfall	30
Construction and right-of-way cost	300
Benefit-cost (B/C) ratio	x2.5
User benefits	750
Less tolls (present worth)	-570
Net benefits	180
Net B/C ratio	6
New financing created (with attendant indirect benefits)	570
Case 2: Morningstar Highway	
Right-of-way and construction cost	30
B/C ratio	x2.0
User benefits	60

One is a major signalized arterial highway, Morningstar Highway, that needs four lanes added to its existing four-lane undivided section. The total cost of Morningstar Highway will be $30 million, and it will return $60 million (present worth) in benefits over a 20-year period (benefit-cost ratio = 2.0).

Assume also that the local expressway authority has been trying to construct a second project, the Cornerstone Expressway, for several years. The Cornerstone Expressway will cost $600 million to finance and construct. However, the revenue projection will only support a $570 million bond issue under current legislative conditions. In other words, this project is not feasible because of a $30 million front-end shortfall. Assume that 50 percent of the bond issue will be used for actual construction and that the remainder will be used for financing. (Both projects will be operated and maintained by the state.) Therefore, $300 million (50 percent of $600 million) represents the actual present-worth construction value of the project. Assume also a benefit-cost ratio of 2.5 for the expressway project, yielding $750 million in benefits over a 20-year period (2.5 x $300 million = $750 million).

If the state were to provide the $30 million to the expressway authority to provide front-end financing for the Cornerstone Expressway, a $300 million construction program and $750 million in public benefits would result as compared with the $60 million in benefits that would be derived from the Morningstar Highway project. Even if the user tolls are subtracted from the Cornerstone Expressway benefit stream (present worth = $570 million), $180 million in benefits will still be shown for the Cornerstone Expressway as compared with $60 million for Morningstar Highway. Naturally, this hypothetical analysis is sensitive to the assumptions used and is presented only to illustrate the possible existence of competitive tollway programs that could be eligible for federal and state assistance.

This hypothetical analysis also does not account for the indirect benefits that would be derived from the creation of $570 million in new revenue-bond highway funds that would otherwise never have been created for highway construction. It must also be recognized that operations and maintenance costs for the expressway might be significantly higher than those for an arterial street that already exists.

The investment strategy to assist with the construction of the Cornerstone Expressway would be potentially cost-effective if this hypothetical example is relatively accurate. It is reasonable to assume that the same would hold true for many similar real-life situations. Policies that would permit assistance to worthwhile, high-value revenue-bond programs thus appear to be superior to many current policies. A methodology for evaluating the cost-effectiveness of tollway projects should be used on a case-by-case basis to determine the public value of potential federal and state assistance on the basis of a project's relative benefit to other investment options.

OTHER ASSISTANCE MECHANISMS

Front-end construction cash assistance is not the only available mechanism for assisting high-value tollway programs. Other strategies include

- Participation in or assumption of operating and maintenance costs,
- Construction of off-system connecting facilities,
- Full-faith-and-credit backing of bonds, and
- Financing assistance for preliminary engineering.

Another proven technique involves cost-cutting strategies such as

- Relaxation of design standards from "desirable" to "minimum," with a "minimum" project considered better than no project;
- Reduction of total number of lanes to provide for opening-year traffic or 5-year traffic projections instead of 20-year traffic forecasts; and
- Staged construction.

Other innovative assistance mechanisms that could be explored include

- Creative financing, such as balloon-payment series, graduated increasing-payment series, and so on;
- An increase in the number of years available to repay the bond;
- Assumption of more risk by the state by reducing debt-service-coverage requirements and operating-reserve requirements;
- Establishment of revolving-fund accounts for tollway program assistance;
- Advanced right-of-way (R/W) acquisition; and
- Advanced construction of frontage-road systems to protect the corridor's right-of-way.

These and other financing techniques should be explored in depth. Particularly worthy of examination are alternatives to the standard equal-payment-series mechanism. A variable payment series would take advantage of the fact that tollway projects always produce more revenue through time. There is often difficulty in getting past the first 5 years of payments, when revenues are at their lowest; however, payments during the early years of operation are often identical to those required in the 30th year of the project. Not surprisingly, some tollways experience revenue surpluses in their later years. Graduated or balloon-payment financing could be used to design a payment plan that provides a better fit for the revenue profile.

Another way to increase a tollway project's feasibility would be to lower reserve requirements and debt-service-coverage ratios, which can be critical to a project's success. Legislation to lower reserve requirements or debt-service-coverage ratios, or both, would significantly reduce front-end cash-flow requirements and could thus enable an otherwise infeasible project to get started.

ADDITIONAL RESEARCH NEEDED

Much information must still be compiled and analyzed in order to develop more workable strategies for state and federal tollway assistance. For example, how many tollway projects nationwide are now considered infeasible and by what margin? How many projects would be activated by increased state and federal assistance and what level of assistance is needed? How many dollars are involved? What package of assistance mechanisms would produce the best results? What is the magnitude of the nationwide benefits that could be realized if all or part of the major policy changes suggested in this paper were implemented? The state and federal governments should address these and related questions and then undertake appropriate legislative and administrative actions to create broader opportunities and more flexible policies for assisting in tollway program implementation.

SUGGESTED POLICY FRAMEWORK

If a potential expressway project has wide support and is a legitimate high-priority public need, the state and federal governments should undertake measures to assist in that project. This assistance should be contingent on need and relative public benefits. A policy framework is suggested here as the basis of debate, discussion, and future analysis. It is not the author's intent to imply that these suggestions constitute an optimum plan at this time. Further research is needed to support the concept of optimality. However, it is believed that the following policies would be superior in many respects to the inflexible policies in place today:

- The state should have the flexibility to participate in up to 100 percent of the project's operating and maintenance costs, if needed.
- FHWA and the state highway agencies should continue to support tollway programs by constructing toll-free connecting facilities, as appropriate.
- The state should continue to pledge full faith and credit to support bonds.
- The states should relax their debt-service-coverage ratio to the 1.0 level and stiffen the qualifying requirements for revenue projection consultants.
- The states should extend the debt retirement period to 50 years and permit flexible bond repayment plans that more closely reflect the multiyear revenue profile.
- The state and federal governments should provide up to 50 percent of the front-end construction costs for a tollway program, if needed. Existing state and federal matching relationships should be used in providing this 50 percent share.
- The state and federal governments should provide up to 100 percent of the funds necessary for the definition and protection of clearly defined rights-of-way of future tollways and expressways. This should be accomplished through revolving fund accounts or other devices.
- The states and FHWA should permit design policies to be relaxed in order to reduce project costs, where appropriate. Strict adherence to federal-aid Interstate design standards, although desirable, should not be mandatory for tollway facili-

ties, even though federal funding may be involved. The minimum design criteria of the American Association of State Highway and Transportation Officials should be allowable under difficult circumstances. Once again, a "minimum" project is better than no project.

SUMMARY

The objective of this paper has been to initiate discussion around a tangible, visible target and to crystallize the issues concerning federal and state assistance for revenue-bond tollway programs. A number of potential policy issues have been raised; they require much more discussion, research, and analysis. However, certain policy changes that will improve the existing methods of providing federal and state assistance for tollway programs can be implemented now, without further analysis. In short, higher levels of federal and state assistance to tollway projects appear to be justified without endless research being conducted as a prerequisite. The issue is to determine how much more federal and state assistance is appropriate or optimal. For the time being, case-by-case studies can be used to determine the rate of return and justification of federal and state investments in tollway programs. However, a consistent nationwide policy should be formulated.

At the same time, additional research should be conducted as the basis of optimal policies on tollway assistance. Federal and state policymakers should begin now to develop interim policy plans that increase levels of state and federal participation and to collect more data for fine-tuning the ultimate policy package.

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An Operational Typology for Toll Financing of Highway Facilities

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ABSTRACT

There has been renewed interest among local and state agencies in tolling as a workable revenue-generating option for financing highway construction and maintenance activities. A multitude of complex decisions face the toll facility operators and researchers. An operational typology of tolling concepts for highway financing is presented and a framework for the analysis of such concepts and for the examination of related policy issues in a systematic manner is provided. Documentation is provided that characterizes existing toll operators in the United States. This is accomplished through a survey of operators, the results of which are analyzed according to the dimensions and levels of the foregoing typology. Finally, cell inconsistencies are examined, and cells that correspond to existing tolling concepts are highlighted. The typology also helps to identify tolling approaches that many not currently be in use but may nevertheless be worthy of further consideration.

Since the Federal-Aid Road Act of the 1920s, the federal government and most states have steered away from toll highway financing. Although a number of toll facilities have been constructed since World War II, that position is still quite prevalent. In fact, the Comptroller General of the United States in 1958 barred any state from using federal funds for toll facilities without congressional approval, and only about 20 toll roads have been built in the last 15 years or so. However, current funding considerations may bring about a change in this attitude.

Seven states are currently utilizing toll financing for a number of major roads, 9 states toll either one major highway or a few short segments, 4 use tolls to a very limited extent, and the remaining 30 operate no toll roads whatsoever. The scarcity of resources because of revenue shortfalls and the ensuing decline in road quality have prompted calls for more users to pay their share. This lack of revenue for highways will be the main thrust behind tolling because many states are experiencing dwindling shares of budgets for roads. For example, in 1965 Texas allocated one-third of its budget to highways; by 1982, that figure had been reduced to about 6 percent (1).

CURRENT ISSUES IN TOLL FINANCING

Conversion of Existing or Previously Planned Highways to Toll Facilities

With few exceptions, which can only be granted with congressional approval, roads financed (even partly) by federal funds are not eligible for toll operation. This also affects the feasibility of the advocated use of tolling as the principal (and according to some, the only practical) means of completing the remaining 4 percent of the Interstate system, which involves costly construction of urban links.

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Financial Objectives

The user-pay structure of tolling allows an increase in the user share of support for transportation because, as stated in 1977, "it is estimated that nonusers contributed 24 percent of the expenditures for highway purposes, yet were responsible for only 7 percent of the costs" (2, pp. 306-311).

Tolling is more equitable than general taxation; it is argued that although tolling is not as progressive as the income tax, it appears less regressive than a motor fuel tax (3).

Flexible toll pricing could allow a more equitable allocation of costs to various user groups; in this regard, pricing on the basis of cost appears to be easier to implement (technologically and politically) than some other schemes.

Public Acceptance

Travel for free is taken for granted in most states. The public is generally not well informed about toll financing for highways. Attitudes of a public accustomed to driving on exclusively tax-financed roads are therefore likely to present an obstacle, at least initially, to the expansion of road financing by tolls.

The potential impact on tourist trade and the accessibility to business may lead the affected business community to object to toll roads. This impact has to be compared with that of the potential low service levels offered by improperly maintained or severely congested roads.

On the subject of safety, the International Bridge, Tunnel, and Turnpike Association (IBTTA) and other organizations have compiled statistics that

appear to indicate that toll parkways are safer than other major freeways.

Other Objectives

Besides revenue generation, tolls might achieve other objectives such as congestion relief and efficient pricing, especially when coupled with operating concepts such as exclusive truck facilities or high-occupancy-vehicle lanes.

Recommendations have been made recently regarding a few of these issues. The following were recommended during the session on toll financing held at the 1983 Annual Meeting of TRB:

- New federally constructed roads should be allowed to be tolled,
- Revenues should be used on a facility-specific basis,
- Tolls should be removed after bond retirement, and
- No tolls should be allowed on existing federal projects.

In September 1985 the Institute of Transportation Engineers made the following recommendations (4):

> Transportation agencies should be permitted to develop toll highways in conjunction with use of federal funds on federally aided projects. Tolls should be allowed on federal aid highways and bridges where high maintenance, construction, or reconstruction costs exist. There should be no obligation to replay federal aid highway funds that have been expended on the facility.

And in 1982 FHWA recommended to the Subcommittee on Transportation of the Senate Committee on Environment and Public Works that tolls be used to fund federal construction; that the facility be made toll free after bond retirement; and that no funds for resurfacing, restoration, rehabilitation, and reconstruction (4R funds) be appropriated during the bond life. In 1983 FHWA supported Senate Bill 524, which made similar recommendations, but no such legislation has been enacted.

SCOPE AND OBJECTIVES

The preceding discussion reveals a multitude of complex considerations faced by agencies and researchers alike in assessing the desirability of tolling as a financing mechanism. This is further complicated by the existence of a confusing array of tolling concepts or approaches to implementing and operating a toll facility. The principal objective of this paper is to present an operational typology of tolling concepts for highway financing in order to provide a framework for the analysis of such concepts and examination of related policy issues in a systematic manner.

A second objective is to document and characterize existing toll operations in the United States. This is accomplished through a survey of operators, the results of which are analyzed according to the foregoing typology. Note that the scope of this work is limited to toll collection for the principal purpose of road financing. As such, tolls on urban bridges and tunnels, which serve an important congestion relief function, are not included.

The dimensions of the typology and their corresponding levels are presented next; the resulting cells of the typology are examined and inconsistencies are identified. The survey of operating agencies and its results are discussed in the following section, highlighting cells of the typology that correspond to existing and proposed tolling concepts. The typology also helps identify tolling approaches that may not currently be in use but may nevertheless be worthy of further consideration, as discussed in the concluding section.

THE TYPOLOGY

The typology consists of three dimensions of operating characteristics, each dimension made up of a number of mutually exclusive levels. Each combination of possible facility operating characteristics defines a cell, which represents a particular method of toll road operation. Of the total number of possibilities, many are found to be internally inconsistent, whereas others are not found in current practice. However, the typology allows the highlighting of some tolling concepts that, although not found in current practice, appear to exhibit good potential for applicability in a variety of contexts.

Those characteristics shared by all facilities have been omitted from the typology. For example, because all toll facilities, with the exception of those contributing all revenues to a state's general budget, fund administration and toll collection with gate receipts, this common attribute is not listed as a level within the third dimension of the typology.

The dimensions and levels of the typology have been identified as the following:

Dimension 1 is road status when tolls were introduced and contains three levels:

1.1 New facility,
1.2 Existing facility with payback of original financing, or
1.3 Existing facility with no payback of original financing.

Dimension 2 captures the administrative arrangement for the flow and use of toll revenues from a given facility, coupled with the contribution of these revenues to the facility's overall financing. This dimension also has three levels:

2.1 All revenues are contributed to a general budget,
2.2 The facility is completely self-supporting, or
2.3 The facility requires or is provided with some subsidy.

Dimension 3 describes the functional uses of revenues at the facility level:

3.0 No operations funded directly,
3.1 Right-of-way (ROW) and construction funded,
3.2 Maintenance only funded, or
3.3 ROW, construction, and maintenance funded.

A fourth dimension can be used in conjunction with the typology's feasible cells to examine the compatibility of these cells with tolling objectives under consideration. This dimension consists of five levels, which, however, are not mutually exclusive:

4.1 Road funding,
4.2 Revenue generation,
4.3 Perpetual funds,
4.4 Congestion relief, or

4.5 Truck-lane or authorized-vehicle-lane (AVL) tolling.

The foregoing characteristics are summarized in Figure 1 and are explained in the following paragraphs along with a brief discussion of related issues and trends.

Dimension 1: Type of Facility

Level 1.1 New Facility

Most toll roads in the United States were conceived, designed, and built as toll facilities. Federal law and many state regulations prohibit the implementation of tolls on any publicly constructed facility that was funded by taxes. Exceptions to these laws are occasionally granted, but by far the most common use of tolls for road financing has been on new facilities.

Level 1.2 Existing Facility with Payback

In 1954 Connecticut repaid to the federal government the funds provided for construction of some of the present Connecticut Turnpike. After repayment had been agreed on, Connecticut was allowed to charge a toll. Similar cases include federal repayment for Interstates by Maryland and Delaware in 1960, by Indiana and New Jersey in 1979, and by Maine in 1981 (3). At the present time, difficult-to-acquire congressional approval must be obtained before any repayment and conversion may be undertaken; however, trends show increasing acceptability of this procedure, and contemplated legislation could facilitate conversion in the future.

Level 1.3 Existing Facility with No Payback

Finally, and most controversially, tolls could be placed on an existing road. This might be perceived by the public as double taxation. This perception is reinforced by the knowledge that the road has already been paid for, even if tolls are charged only for maintenance and reconstruction.

Dimension 2: Financial Support Arrangement

Level 2.1 Revenues to General Budget

Revenues may be used on a general government (local, state, or federal) level either for specific projects or for the general budget. However, prevailing attitudes suggest a reluctance of the public to accept any cross-subsidy not closely related to transportation (3). Because revenues from the facility are channeled to a broader administrative level before eventually returning to support the facility, the typology will classify this type of operation as not directly funding any of its own financial requirements (see Dimension 3, Level 0).

Level 2.2 Self-Supporting Facility

In the next two levels, priority for use of toll revenues is given to support and finance the toll-

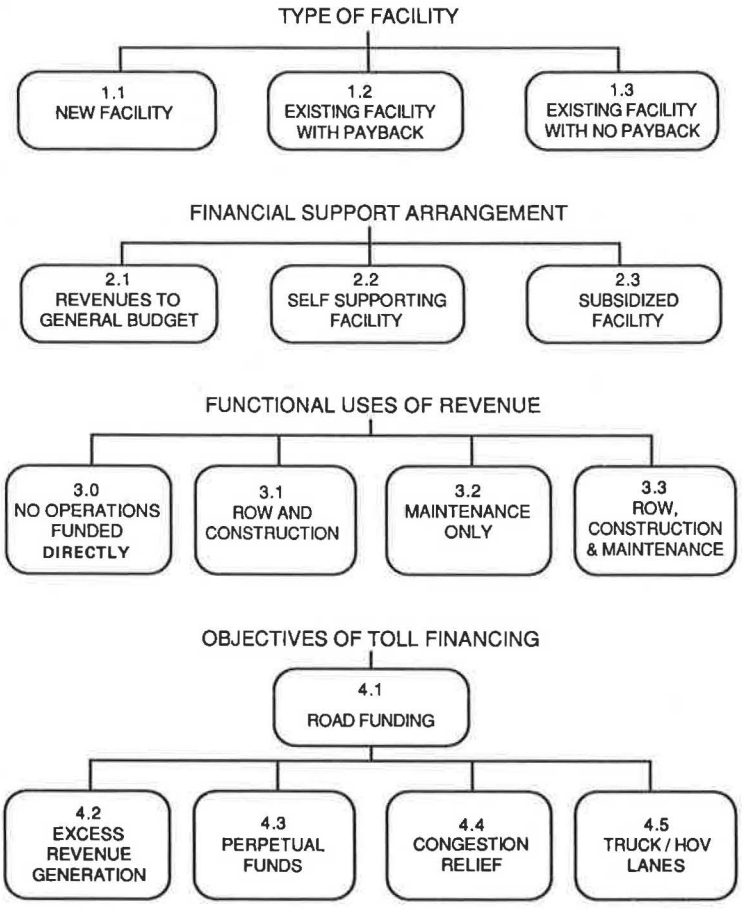

FIGURE 1 Dimensions and levels for toll road typology.

generating facility itself. Levels 2.2 and 2.3 differ in terms of the relative contribution of these revenues to the toll facility's overall financing. Under Level 2.2, the facility is self-supporting and excess revenues may even be generated. Further distinction can be made on the basis of the disposition of these excess funds. These might be limited to future spending on the generating facility only or be used to support the operating toll authority's other projects, thereby remaining within the bounds of that agency's budget. Other restrictions may stipulate that excess revenues be spent on roads in the immediate geographic or administrative area (e.g., Texas Turnpike Authority). Broader uses would allow the extra revenue to go into a general state or local road fund, or even into the highway trust fund.

Level 2.3 Subsidized Facility

When a toll facility cannot fully support itself, some toll authorities have the flexibility to allow alternative partial funding, such as support through tax subsidy, whereby a facility's deficit at the toll booth may be complemented by the use of tax dollars. On the positive side, the support of a toll facility by a tax base assures bond investors of a safe return, thereby enhancing bond rating and keeping interest payments lower. This funding would also allow for more income for maintenance and operations in the event of low gate receipts caused by unforeseen circumstances. However, this extra security may have a negative impact, particularly if the project's economic feasibility originally is dubious or if it is poorly planned.

Dimension 3: Function Uses of Revenue

Level 3.0 No Operations Funded Directly

Level 3.0 applies to those facilities that contribute all revenues to a general budget (Level 2.1). Although the facility is ultimately funded by this budget, the indirectness of this scheme loses the identity of the source of these funds, with no special restrictions applying to their use beyond those that affect funds from any source. This level is therefore denied in the typology to provide a level within Dimension 3 that is compatible with Level 2.1

Level 3.1 ROW and Construction Only

Expenses incurred in ROW acquisition and construction of a toll facility are usually funded by bonds, which in turn are repaid by toll revenue. The dedication of toll revenues to this purpose has been encountered in one situation where maintenance is provided by another agency (Richmond Metropolitan Authority).

Level 3.2 Maintenance Only

At some facilities, revenues are dedicated only to the maintenance and rehabilitation of the highway. In such a case authorities may implement tolls on existing facilities where ROW and construction has already been paid for, such as by the city of Colorado Springs.

Level 3.3 ROW, Construction, and Maintenance

Level 3.3 is provided to characterize the majority of facilities that toll for support of all operating expenses (ROW, construction, and maintenance). This level also represents those agencies operating on existing facilities where repayment of original funding classifies them as providing financing for ROW and construction as well as those operating new facilities that fund their own maintenance.

Dimension 4: Primary Objectives of Toll Financing

Tolling can contribute to multiple objectives, though the relative importance of each may vary from one case to another. The following levels are typical objectives that could be addressed by tolling. Unlike in the previous dimensions, these levels are not mutually exclusive because this dimension is not intended so much for classification as to provide a vehicle for examining the compatibility of these objectives with the various operating characteristics identified in this typology.

Level 4.1 Road Funding

Although various tolling objectives have promoted other types of facilities, such as bridges and tunnels, road funding is currently the primary objective exhibited by agencies collecting tolls for highway financing (see the section on the survey conducted for this study).

Level 4.2 Excess Revenue Generation

An objective of toll collection that has been considered for heavily used facilities is excess revenue production. High-growth corridors and congested areas are both candidates for such revenue tolling. A public-acceptance issue might arise, however, because this objective goes beyond the user-pay concept of tolling and the users are burdened with subsidizing other projects in addition to the cost of the tolled facility. However, in the absence of strong opposition, revenue tolling could provide a workable alternative to increasing taxes, particularly when the revenues are kept within jurisdictional areas.

Level 4.3 Perpetual Funds

Perpetual funds are savings accounts that are deposited from toll revenues during bond life. Once the bonds have been retired or the initial debt has been paid off, the interest from the perpetual funds is spent for maintenance or reconstruction. Although this procedure would increase tolls, the assurance of good maintenance after tolls have been lifted would be appealing to both the users and the highway departments that are finding it increasingly difficult to undertake care of these facilities.

Level 4.4 Congestion Relief

Pricing objectives may also include congestion relief in urban areas. Tolls could be adjusted during the day to reflect the "true" cost imposed by drivers on the system and provide incentives for drivers to change trip-making habits. A system like this has been tried in Singapore (5). There are other nontechnical issues associated with the implementation of congestion tolls, such as income redistribution, in which it is argued that individuals with high incomes receive a greater benefit from congestion pricing than do those with low incomes. The travel

choices available to the user when faced with congestion tolls include changing the time, destination route, or frequency of the trip as well as making the same trip and paying the toll (6). Any of these choices improves the situation of the facility, the last by increasing revenues and the others by increasing the level of service.

Level 4.5 Truck-Lane or AVL Tolling

In some states, trucks are already assigned to specific lanes or are prohibited from using certain facilities. Accommodating increasing traffic of larger and heavier trucks can be facilitated by constructing new turnpikes for truck use or by designating certain new or existing lanes as truck lanes and requiring only trucks to pay a substantial toll for the use of these facilities. Depending on the details of its implementation and perceived equity, this concept could receive opposition from the trucking industry or actually be welcomed by the many truckers who would prefer paying for premium, well-maintained, safe roads.

AVLs, including high-occupancy-vehicle (HOV) lanes, provide another example of restricted-lane use. It has been proposed that the excess capacity of some of these lanes could be utilized by toll-paying automobiles or trucks, thereby generating significant revenue and still allowing for a sufficiently high level of service. The basic concept consists of operating only the AVL as a toll facility on a "free" roadway or treating the AVL separately as another facility if the main lanes are tolled and then implementing a pricing scheme that would charge different rates to various user categories.

Formulation of Typology Cells

Dimension 4 will subsequently be used to examine the compatibility of the typology's feasible cells and various levels with the objectives defining Levels 4.2 through 4.5. The total number of cells that can be formed is equal to the product of the respective numbers of levels within each of the first three dimensions. Therefore, the total number of possible cells is 3 x 3 x 4 = 36 possible cells. This number is further reduced in the following discussion through the elimination of inconsistencies.

Elimination of Inconsistent Cells

Of the 36 cells, many can be shown to be internally inconsistent. The following cell inconsistencies have been identified. (See Figure 2 for identification of all 36 cells and for cells eliminated by inconsistency. Toll road operators are identified by letters that correspond to the list at the end of this paper.)

1. If all revenue is channelled into a general budget (2.1), no funds are directly used for support of facility ROW and construction (3.1), maintenance (3.2), or both (3.3).
2. The combination of self-supporting facility (2.2) and no operations directly supported by tolls (3.0) is inconsistent.
3. New (1.1) self-supporting (2.2) facilities must fund ROW, construction, and maintenance (3.3).
4. Existing repay facilities (1.3) do not provide funds for ROW and construction (3.1) or all operations (3.3).
5. Existing repay facilities (1.2) provide support for ROW and construction (3.1) or in the form of repayment (3.3).
6. New facilities (1.1) will always at least partly fund ROW and construction (3.1), maintenance (3.2), or all operations (3.3), unless all revenues go into the state's general budget.
7. Placing tolls on an existing facility with no payback (1.3) when no revenues go directly to road

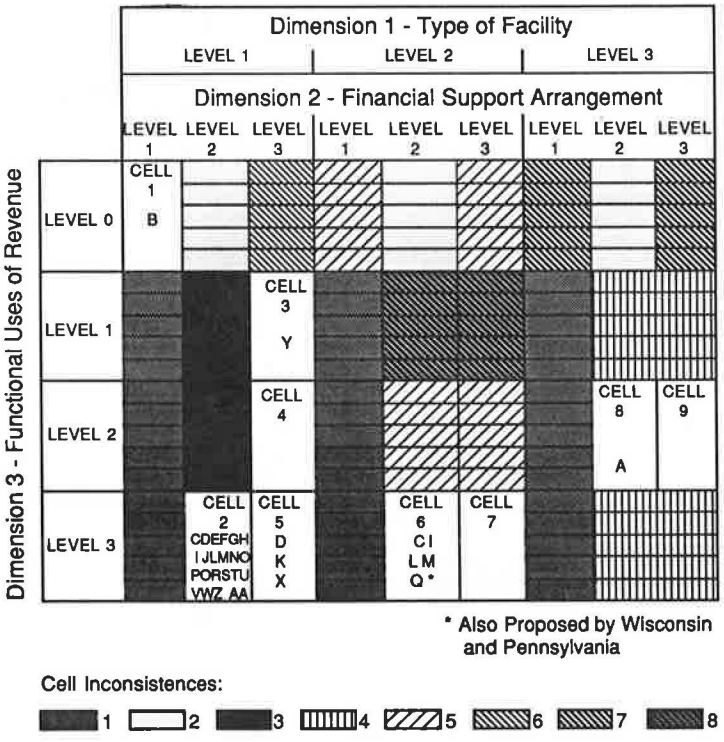

FIGURE 2 Typology for toll road financing: elimination of inconsistencies and identification of cells.

operations (3.0) is politically infeasible. This is just revenue generation.

8. Finally, placement of tolls on existing facilities with payback (1.2) is inconsistent with tolls being spent only to repay ROW and construction costs (3.1). (This would be useless.)

Elimination of inconsistent cells together with the omission of Dimension 4 (because road funding is the only current pricing objective) produces the final typology, which consists of nine cells (Figure 3).

SURVEY

To substantiate the typology's usefulness as a classification tool and document current toll operations, a survey of toll operators was conducted to obtain the data needed to identify (a) the relative prevalence of the various cells among current toll operations, (b) cells not currently represented, and (c) related issues and trends. The survey procedure is described next, followed by a discussion of the results.

Procedure

A questionnaire was sent to all toll road authorities in the United States that were members of the 1985 IBTTA. This survey was followed by phone calls to most operators, including all those not contacted by questionnaire. The data were collected on an agency basis and represented 27 major toll road operators. These authorities operate 62 toll roads, and 2 more are under construction. Although other toll agencies exist, either they operate only bridges, tunnels, short road segments connected to bridges or tunnels, or seasonal roads or they were not identified in the search. Because of the different operating characteristics of bridges and tunnels and the scope of the present study, they were not included in the data base, but future research could produce an effective typology for study of these facilities.

Discussion of Results

The survey results led to the grouping of the 27 agencies into six of the nine cells of the typology identified in the previous section. Cells are numbered in order of appearance in the dimensions and levels of the typology, and descriptions of their characteristics are as follows:

Cell 1 is represented by one agency and is characterized by collecting tolls on a new facility (Level 1.1) with all revenues going to the state's general budget (Level 2.1). The facility then in turn is wholly supported by an allotment from this budget (Level 3.0).

Cell 2 is by far the best-represented cell; 22 of the 27 agencies operate roads by this method. The cell's characteristics are appealing to user-pay advocates because operation is with new facilities (Level 1.1), is self-supporting (Level 2.2), and pays for ROW and construction as well as maintenance (Level 3.3).

Cell 3 is represented by one toll road operator. This method of operation on a new facility (Level 1.1) includes subsidy in two forms. First, maintenance is provided by another agency (Level 3.1), and second, support is available in the event of inadequate gate receipts (Level 2.3).

Cell 4 is currently unrepresented by toll road agencies. It characterizes new facilities (Level 1.1) operating with subsidies (Level 2.3) where only maintenance is funded by revenues (Level 3.2). This cell will probably never be represented because new

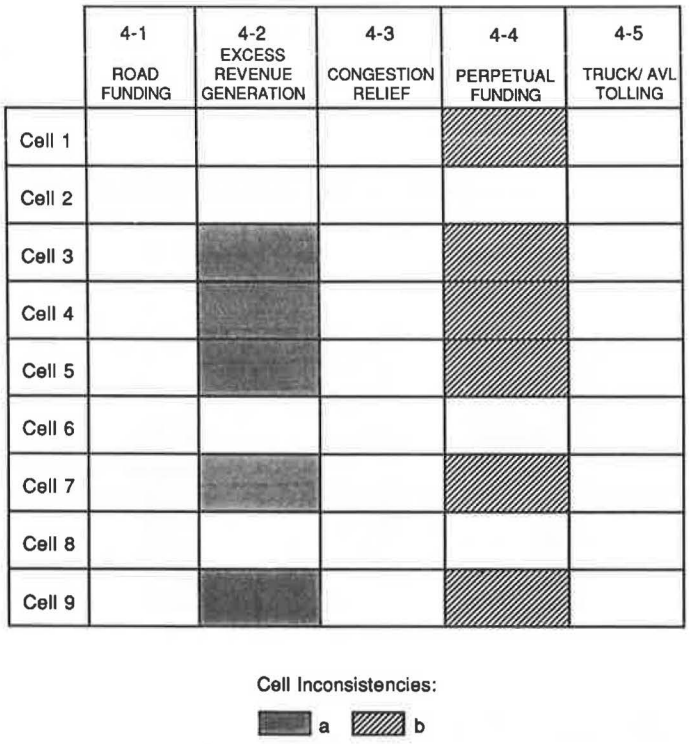

FIGURE 3 Typology for toll road financing: combinations of cells with tolling objectives.

facilities are expected to recover at least some of the ROW and construction costs.

Cell 5 is represented by three toll agencies and is similar to Cell 2 (Level 1.1) in that all operating expenses may receive funds from toll revenues (Level 3.3). However, tax or other subsidies exist to make up possible operating deficits (Level 2.3).

Cell 6 is represented by five agencies. Pennsylvania and Wisconsin are also proposing such facilities. This cell is characterized by facilities that are completely self-supporting (Levels 2.2 and 3.3) and that have been converted from free facilities by repayment of original financing (Level 1.2).

Cell 7 remains unrepresented at this date. It characterizes existing facilities tolled with payback of original funding (Level 1.2), subsidized for operations (Level 2.3), and using revenues to fund the repayment and maintenance (Level 3.3). This cell could become better represented if subsidy requirements for operation are not extensive.

Cell 8 is represented by one agency. This cell is characterized by the use of tolls only for maintenance (Level 3.2). The operation can be labeled self-sufficient (Level 2.2) because the road was constructed before tolls were introduced (Level 1.3). This cell could become better represented in the future as less tax revenues are being made available for road funding.

Cell 9 is not represented by any toll road authority. It characterizes tolls placed on existing facilities (Level 1.3) where subsidy is required (Level 2.3) and maintenance is at least partly funded by tolls (Level 3.2). This cell could become represented in the future by states that have problems with support of maintenance on heavily traveled roads.

CONCLUSION

The results of a survey of agencies operating toll roads in the United States indicated that methods used by the agencies could be grouped into six of the nine cells identified in the typology developed in this study. These methods differed by type of facility on which tolls were introduced, administrative level of financial support, and functional use of revenues. Cell 2 of the typology is represented by 22 of the nation's 27 toll road operators identified in this study. This cell characterizes facilities that were built specifically as toll-financed facilities, that are completely self-supporting, and that utilize gate revenues to support operations, ROW and construction obligations, and maintenance and rehabilitation.

Some of the typology's cells identify promising methods for toll financing of highways and will probably generate some interest in the future. If tolling is undertaken on a large scale, Cell 1 would present a method to consolidate funds (Level 2.1), thereby facilitating the administration of a number of operations. Cells 6 through 9 perhaps represent the methods for operations that exhibit the most promise. However, new legislation would be required, because all these cells represent conversion of existing facilities to tolling (Level 1.2 for Cells 6 and 7, Level 1.3 for Cells 8 and 9). Such legislative changes appear to be favored by current attitudes.

When the nine currently feasible cells are combined with the five primary objectives for tolling contained in Dimension 4, a number of new possibilities emerge. However, some inconsistencies reduce the number of possible schemes. The following inconsistencies involving the Dimension 4 combinations have been identified:

1. The objective of excess revenue generation (Level 4.2) is inconsistent with operating a subsidized facility (Cells 3, 4, 5, 7, and 9).
2. The objective of perpetual funding (Level 4.3) is inconsistent with all revenues going to a general fund (Cell 1), operation of a subsidized facility (Cells 3, 4, 5, 7, and 9), and exclusive use of funds for ROW and construction (Cell 3).

These inconsistencies are shown in Figure 3.

The typology provides an organizing framework for the discussion of legislative issues related to tolling. Subsidy, perpetual funding, truck tolling, revenue generation, congestion tolling, and especially repayment of original financing are some of the currently or potentially controversial issues that are of importance to transportation planners and decision makers.

The typology should be of particular interest to those agencies investigating the possibility of toll financing for their projects in that it serves as a mechanism for identifying the various toll road financing and operating schemes, thereby providing a starting point and an essential input to the evaluation and decision-making process.

ACKNOWLEDGMENTS

Funding for this study was provided by a research contract with the Texas State Department of Highways and Public Transportation. Special thanks go to the International Bridge, Tunnel, and Turnpike Authority; the Texas Turnpike Authority; the Harris County Toll Road Authority; and the following public toll facility operators for their assistance in providing information for the survey (toll road operators are identified by letters that correspond to the classification in Figure 2):

A--City of Colorado Springs, Colorado: Pikes Peak Auto Highway
B--Connecticut Department of Transportation
  Connecticut Turnpike
  Merritt Parkway
  Wilbur Cross Parkway
C--Delaware Turnpike Administration: John F. Kennedy Memorial Parkway
D--Florida Department of Transportation
  East-West (Miami) Tollway
  Alligator Alley (Everglades Parkway)
  36th Street (Miami) Expressway
  Airport Expressway (Miami)
  Buccaneer Trail (Ocean Highway)
  South Dade Expressway
  South Crosstown Expressway (Tampa)
E--Florida Department of Transportation and Florida Turnpike Authority: Florida's Turnpike
F--Florida Department of Transportation and Orlando-Orange County Expressway Authority
  Bee Line Expressway
  East-West Expressway
G--Jacksonville Transportation Authority, Florida: Jacksonville Toll Road
H--Illinois State Toll Highway Authority
  Northwest Tollway
  Tri-State Tollway
  East-West Tollway
I--Indiana Department of Highways: Indiana East-West Toll Road
J--Kansas Turnpike Authority
  Kansas Turnpike
  18th Street Expressway
K--Kentucky Turnpike Authority
  Western Kentucky Parkway
  Western Kentucky Parkway Extension

Mountain Parkway
Bluegrass Parkway
Jackson Purchase Parkway
Pennyrile Parkway
Audubon Parkway
Daniel Boone Parkway
Cumberland Parkway
Green River Parkway
L--Maine Turnpike Authority: Maine Turnpike
M--Maryland Transportation Authority: John F. Kennedy Memorial Highway
N--Massachusetts Turnpike Authority: Massachusetts Turnpike
O--New Hampshire Department of Public Works and Highways
New Hampshire Turnpike
F.E. Everett Turnpike
Spaulding Turnpike
P--New Jersey Expressway Authority: Atlantic City Expressway
Q--New Jersey Highway Authority: Garden State Parkway
R--New Jersey Turnpike Authority: New Jersey Turnpike
S--New York State Thruway Authority
Thomas E. Dewey Thruway (Main Line)
Berkshire Section
Niagara Section
New England Section
Garden State Parkway Connection
T--Ohio Turnpike Commission: Ohio Turnpike
U--Oklahoma Turnpike Authority
Turner Turnpike
Will Rogers Turnpike
H.E. Bailey Turnpike
Indian Nation Turnpike
Muskogee Turnpike
Cimarron Turnpike
V--Pennsylvania Turnpike Commission
Pennsylvania Turnpike
Northeastern Extension
W--Texas Turnpike Authority: Dallas North Tollway
X--Harris County Toll Road Authority, Texas
Hardy Toll Road
West Belt Toll Road
Y--Richmond Metropolitan Authority, Virginia
Powhite Parkway
Downtown Expressway
Z--Virginia Department of Highways and Transportation
Richmond-Petersburg Turnpike
Norfolk-Virginia Beach Toll Road
Dulles Toll Road
AA--West Virginia Turnpike/Toll Road Commission: West Virginia Turnpike/Toll Road

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Alternative Roadway Financing Methods: National Examples and Recent Experiences in Texas

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ABSTRACT

Methods of financing roadway improvements have undergone significant changes since the early 1970s. For a variety of reasons, traditional sources of highway revenues have not kept pace with transportation needs. Alternative financing methods that have been implemented in various areas of the country are reviewed. The Texas legislature recently passed two new approaches for state and local highway finance: transportation corporations and road utility districts (RUDs). Transportation corporations provide private land owners and developers an opportunity to expedite highway projects by conducting preliminary engineering studies and accepting right-of-way donations. RUDs, which are similar to municipal utility districts, are given the authority to issue bonds supported by property tax levies for local roads. These two methods provide an alternative infrastructure for the development of transportation projects and give state and local agencies additional sources for revenues.

The 1970s may be characterized as a period of transition for the transportation industry, particularly with regard to highway finance and development. The muscle flexing of the Organization of Petroleum Exporting Countries (OPEC) and a refined U.S. energy posture had serious implications for federal, state, and local transportation agencies. The cost of highway development, mainly maintenance and construction, is inextricably linked to fuel costs. The rising fuel costs during this period significantly reduced the purchasing power of highway dollars. This problem was magnified by a decline in highway revenues. The principal source of revenue for most state agencies is the fuel tax, which is dependent on the level of fuel consumption. As fuel prices rose, the rate of fuel consumption declined. Coupled with this was the trend toward more fuel-efficient vehicles and an altering of travel behavior. The result of the rising highway development costs and reduced revenues was a funding dilemma. Transportation agencies were forced to reevaluate and downscope many projects, and legislators were forced to consider new sources of funding.

Some of the alternatives that are being used to fund transportation projects are examined. First activities in different parts of the United States are reviewed. Then two alternatives recently enacted by the Texas legislature are discussed.

ALTERNATIVE FINANCING ARRANGEMENTS

Most state transportation agencies responded to the funding dilemma with increases in fees and taxes from traditional highway user charges. Since 1975, approximately 90 percent of the states have increased their fuel taxes, and most states have also increased their vehicle registration fees. Although highway development has traditionally followed a user-pay strategy, during the 1980s many states enacted legislation allowing for the transfer of general funds to state highway funds. During 1980-1981 alone, six states passed legislation for general revenue fund transfers to supplement state highway user charges (1,p.170). Several states also enacted indexing procedures to ensure adequate revenue levels during periods of rising inflation. The results of the indexing procedures, however, have been mixed, and one state--Texas--eliminated the procedure in 1984.

To supplement the more traditional sources of funding, many agencies, state and local, have attempted to involve private interests. This participation generally takes one of three forms: voluntary, incentive, or mandatory. Under the voluntary arrangement private-sector groups may agree to participate in transportation projects, but without a legally enforceable commitment to perform. Incentive programs, although voluntary, provide development bonuses, reduction in parking requirements, and so on, in return for specified transportation assistance. Mandatory participation requires private-sector participation in transportation programs or payment for provision of transportation services, or both.

The voluntary arrangement allows transportation projects or programs to be tailored to specific needs and opportunities and can be easily adjusted to new situations. However, because of its voluntary nature, governments are hesitant to depend on this approach to alleviate transportation problems. The incentive arrangement is the most difficult of the three approaches. Identification of real incentives is not an easy task and may result in some administrative difficulties. A common incentive used by localities is a reduction in parking space requirements in exchange for support or participation in commuting and ridesharing programs. In one instance, after receiving the desired permit, an employer discontinued participation in the program on the basis that it was not cost-effective. Experiences like this have caused city officials to shy away from incentive

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programs (2). Mandatory programs developed primarily because incentive and voluntary programs were deemed too risky and, in the case of incentive arrangements, unwieldy.

Although voluntary arrangements are not legally binding, many areas have been successful in using this approach to supplement traditional financial sources. A good example is the solicitation of private donations. In Grand Rapids, Michigan, the local transit authority approached an individual interested in the improvement of the local zoo. This person agreed to donate $100,000, to be matched by the city, for the purchase of five buses. The transit authority then agreed to extend bus stops to the zoo. A developer in Newport Beach, California, donated land and $300,000 toward operation of a shuttle service. An $800,000 transit center is to be built on the grounds of the developer's shopping center (3). Few jurisdictions, if any, would reject private donations for transportation programs. The key to success, however, is in identifying and soliciting potential sources.

In addition to donations, participation of local merchants has also been solicited in some localities. Participating merchants in Cedar Rapids, Iowa, gave bus coupons to customers who made purchases at their places of business. The coupons, ranging from half to full fare, accounted for $21,350, or 3.1 percent of the locality's revenues. In Champaign, Illinois, a local grocery chain subsidizes the operations and maintenance of a vintage 1960 bus. The bus is painted to resemble a generic grocery product and runs different routes around the city each day, charging half-price fares. During holidays, merchants in Springfield, Massachusetts, provided $1,500 to the city bus service in exchange for which the city operated the buses at no charge to riders during the four Sundays before Christmas. The $1,500 covered the revenues lost to the city through not charging these fares to the riders (3).

Governments are not always the major force behind transportation projects. In areas where local development is on the rise, private developers often provide the initiative for fulfilling transportation needs. The Friendswood Development Company of Houston, Texas, for example, was willing to contribute nearly $1 million for the completion of a section of highway if the Texas State Department of Highways and Public Transportation (SDHPT) agreed to speed completion. The Texas SDHPT eagerly accepted. The Woodlands Development Corporation of Woodlands, Texas, continually expedites transportation improvements in its community by providing contributions ranging from 15 to 20 percent of the project's cost. A private, nonprofit development organization provided the impetus for improving streets in downtown Pittsburgh, Pennsylvania. Total renovations costing $13 million to $14 million are to be funded 75 percent federally and 25 percent locally, with additional improvements beyond city standards provided by the development organization. The development organization is soliciting funds totaling $750,000 from major corporations in the area (3).

Municipalities have enacted a variety of methods for requiring private-sector participation in transportation programs. Most of these methods are tied to the development approval process. Fees or performance of certain activities, for example, may be required before a building permit is issued. One such method is the traffic signal fee, which is an assessment made on a developer or business to offset the costs of new traffic signals or intersection modifications to control increased traffic. Anaheim, California, enacted such an ordinance in 1978. Fees are assessed on all new developments--residential, retail, industrial, and so on--and deposited in a special traffic signal fund. The assessment rates are based on trip-generation rates, land use, economic data, and projected traffic signalization costs as determined by the city traffic engineer. Riverside County, California, emphasized operational improvements in the traffic signal network through the creation of traffic signal mitigation districts. Currently, nine signal districts are in operation with a combined $1.5 million to $2 million surplus. Thornton, Colorado, enacted a traffic signal fee assessed to new development on the basis of trip generation and the cost of traffic signals. The city ordinance specifies the construction cost of a new signal annually adjusted by the Colorado highway construction cost index and requires the assessed fee to include 18 percent of the interconnection construction costs, 7 percent of the specification and plan costs, and 5 percent of the construction engineering costs. All fees are paid before issuance of a building permit and are reserved exclusively for building and modifying traffic signal systems.

A second variety of the mandatory arrangement is the impact fee. Impact fees require businesses or developers to contribute resources to offset all or a portion of the increased transportation costs that result from their developments. Kansas City, Missouri, recently required a developer at one of its major intersections to submit plans indicating additional traffic flow as a result of the development. The developer was then required to undertake specific street improvements and provide funds for interchange modification (4). The Palm Beach County, Florida, Commission enacted an ordinance requiring new developments generating road traffic to pay their fair share of any necessary road improvements. The ordinance contains a formula requiring fees of $300 per single-family home, $200 per unit for multifamily homes, and $175 per unit for mobile homes. The fees can only be spent for road improvements in the area of collection. San Francisco, California, is in the process of approving a series of ordinances requiring developers to pay $5/ft^2 to support the additional load on transportation facilities (5).

A third type of mandatory participation involves benefit assessment districts. Under this scheme municipalities establish benefit districts to recover the cost of capital improvements benefiting a certain area. Property within the district is assessed a charge sufficient to retire bonds used for the capital improvements. In San Diego, California, developers may request the city manager to create an assessment district. In creating the district, the city manager considers the areas benefiting from the proposed project, prepares a schedule for the costs and timing of the capital improvement project, determines assessments, and schedules a public hearing. If more than 50 percent of the residents and property owners do not refuse, the facilities benefit assessment district is created and all property is assessed a fee with a lien on the property until the assessment is paid. Since its inception in 1980, assessment districts in San Diego have raised $3.5 million. A similar program, but only for rural dirt roads, has been established in Missoula County, Montana. Rural special improvement districts are created with 60 percent approval of the area residents and are responsible for paving a stretch of the roadway. Fees are charged to each landowner on the basis of their frontage or acreage or both. The county contributes 33 percent toward the total cost of the pavement project.

NEW TEXAS LEGISLATION

For the most part, Texas highway development has followed a pattern similar to that in the rest of

the country. In the early 1970s, the Texas SDHPT and other state officials became keenly aware of the highway planning and funding dilemma. After a major study and several planning documents, the 65th legislature passed House Bill 3, which created a new mechanism for funding the activities of the SDHPT. This mechanism provided increased funding without increasing highway user charges by utilizing some of the state budget surplus, which was rather significant at that time. The mechanism was designed to maintain a 1979 level of highway services by measuring and compensating for the impact of inflation on the costs of construction, maintenance, and operations--the three functional areas of highway activity.

This new mechanism, however, did not accomplish its intended results. As indicated in Figure 1 (6,p.66), total SDHPT revenues have been declining steadily, both in current and constant dollars. In 1980 total state highway funds approximated $2.4 billion, whereas in 1983 total available funds declined to slightly less than $1.9 billion, or $1.5

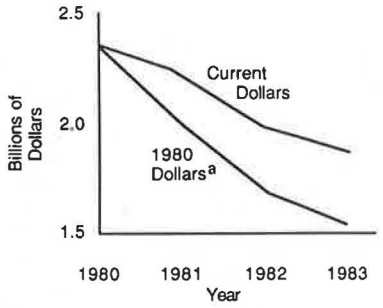
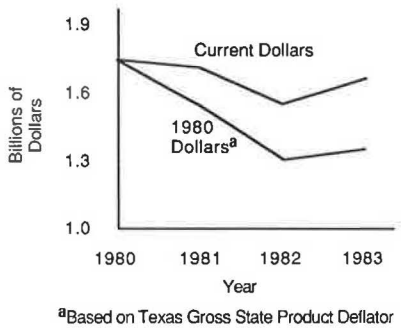


FIGURE 1 Texas state highway funds *(6).*

billion in 1980 constant dollars. Similarly, this decline forced a reduction in highway development outlays, as indicated in Figure 2. State highway disbursements equalled $1.75 billion in 1980 and declined to $1.65 billion in 1983, or $1.36 billion in 1980 constant dollars. In 1980 disbursements accounted for 73 percent of state funds; however, in 1983 disbursements used up 88 percent of available funds. As a result of the higher expenditures for existing highway projects, there have been significantly fewer authorizations for new highway projects. In 1980 the SDHPT authorized $1.4 billion in new projects, but in 1983 this figure declined 28.6 per-



[a]Based on Texas Gross State Product Deflator

FIGURE 2 Texas state highway disbursements *(6).*

cent to $987 million (7). These trends create a serious quandary in light of the SDHPT's 20-year Operational Planning Document Study, completed in 1982 (8). The planning study set the cost of transportation needs for the state during the next 20 years at $61 billion.

These trends are even more pronounced in the major urban areas. Population changes in the seven major standard metropolitan statistical areas (SMSAs) have been significant. The information in Table 1 documents the growth in these urban areas and reveals that of the 3 million increase in population, 75 percent occurred in the major metropolitan areas. However, despite these increases, construction expenditures for highway development have not kept pace (Table 2).

These trends, along with other procedural problems of the highway funding mechanism passed in House Bill 3, forced the legislature to once again reevaluate Texas highway finance. During a special session in the summer of 1984, the legislature voted to rescind the earlier-mentioned funding mechanism in favor of increasing traditional highway user charges. However, the legislature still recognized a need for new approaches and sources for highway funding. Thus, to supplement the increase in fuel taxes and registration fees, the legislature enacted House Bill 125 and Senate Bill 33 authorizing the creation of transportation corporations and road utility districts, respectively. These pieces of legislation were attempts to bring innovative financing approaches to Texas transportation development.

The authorization of transportation corporations is aimed at encouraging strong private-sector support of highway development and innovative financing of roadway improvements. The transportation corporations are nonprofit entities acting as instrumentalities

TABLE 1 Population Changes in the Seven Major Texas SMSAs

SMSA[a]	Population in 1970		Population in 1980		Change, 1970-1980	Percent Change
	No.	Percent	No.	Percent		
Austin	295,516	2.64	536,688	3.77	+241,172	81.61
Beaumont	315,943	2.82	375,497	2.64	+59,554	18.85
Corpus Christi	284,832	2.54	326,228	2.29	+41,396	14.53
Dallas-Ft. Worth	2,318,036	20.70	2,974,878	20.91	+656,842	28.34
El Paso	359,291	3.21	479,899	3.37	+120,608	33.57
Houston	1,985,031	17.73	2,905,350	20.42	+920,319	46.36
San Antonio	864,014	7.72	1,071,954	7.53	+207,940	24.07
Total	6,422,663[b]	57.35	8,670,494[c]	60.93	+2,247,831[d]	35.00

Source: U.S. Census Bureau, various reports.

[a]Some of the growth in the SMSAs is due to the addition of new counties. Any differences in percentage are due to rounding.
[b]Total state population in 1970 was 11,198,655.
[c]Total state population in 1980 was 14,229,191.
[d]Total change from 1970 to 1980 was 3,030,536.

TABLE 2 Construction Expenditures for Seven Major Texas SMSAs *(7)*

SMSA	1980 ($000,000s)	1983 ($000,000s)
Austin	33.609	23.114
Beaumont	25.796	24.435
Corpus Christi	14.692	19.454
Dallas-Ft. Worth	209.718	152.893
El Paso	20.894	13.286
Houston	225.194	247.751
San Antonio	88.503	69.676
Total	618.406[a]	550.609[b]

[a]Total for state was $1,293,557,000.
[b]Total for state was $1,030,350,000.

of the state for the purpose of assembling right-of-way and financial support toward completion of state highways. The corporations provide private property owners the opportunity to form a tax-exempt entity that can accept property and funding to support the assembly of right-of-way and engineering plans to support major highway developments. This gives private property owners a greater opportunity to obtain tax deductions for their land and dollar contributions as well as to expedite the completion of transportation construction projects near the property.

The transportation corporations, the creation of which must be approved by the SDHPT Commission, are governed by a Board of Directors serving without compensation (although expenses are reimbursable). Advisory directors can be appointed to assist the corporations but may receive no compensation, not even for expenses. The corporations are subject to the same open records provisions as other state agencies. They may work directly with property owners, governmental agencies, and elected officials to develop and promote their projects as follows:

- Prepare preliminary and final alignment studies;
- Receive land and cash contributions;
- Retain staff, consultants, engineering services, and so on;
- Establish appropriate formulas for proportionate sharing of costs among property owners; and
- Borrow funds to meet expenses.

The SDHPT Commission approved the first transportation corporation soon after the legislation was enacted. The Grand Parkway Association was created to assist in the planning and development of additional hurricane and emergency evacuation routes from low-lying areas in Galveston and Brazoria counties. The association was authorized to perform the following activities (SDHPT Minute Order 82325, October 25, 1984):

- Prepare preliminary and final alignment studies;
- Receive contributions of land for right-of-way and cash donations to be applied to the purchase of right-of-way not donated or to be applied to the design or construction of the Grand Parkway or both;
- Review and select candidates for advisory directorships;
- Retain necessary administrative staff and legal, public affairs and information, and engineering services;
- Prepare, via staff and retained consultants, right-of-way documents, environmental reports, and preliminary and final engineering plans;
- Solicit cash contributions to cover the costs of the services performed by the corporation and consultants;
- Borrow money to meet any expenses or needs associated with regular operations of the corporation or any capital improvements undertaken by the corporation, provided the borrowing does not encumber any right-of-way facilities;
- Issue press releases and other material to promote the activities of the corporation; and
- Make official presentations to the state and other affected agencies or groups concerning development of the Grand Parkway.

Northeast Austin property owners and developers are in the process of developing a second transportation corporation--the MOKAN Corridor Association. This association is planning the development of a 30-mi travel corridor (the MOKAN Corridor) to provide highway and express transit access from downtown Austin to north of Georgetown. When fully developed, MOKAN will cost an estimated $80 million to $100 million. The association expects to raise $19 million for right-of-way and engineering costs. The entire project is expected to be completed by 1998.

These two examples illustrate how private interests can assist in the planning and development of transportation systems. This new legislation changes the infrastructure of the highway development process in order, through private efforts, to expedite the completion of many urban transportation projects.

The second bill adopted by the state legislature, Senate Bill 33, encourages private participation in road development at the local level. The legislation authorizes the creation of road utility districts (RUDs) for the purpose of financing, constructing, acquiring, and improving arterial or main feeder roads and related projects. Similar to municipal utility districts (MUDs), RUDs may issue bonds supported by levying property taxes or assessing fees. The use of property taxes requires approval by a two-thirds majority of voters residing in the district; however, bonds may be issued without voter approval if secured by assessing fees.

In order to create a RUD, 100 percent of the property owners within a proposed district must petition the SDHPT Commission for approval to create a RUD, subject to voter approval. The local governing agency or agencies must also acquiesce in the creation of the district and assume responsibility to maintain the completed roadway, if necessary. In addition, the petition for creation of a RUD must also contain a full description of facilities to be acquired, built, or improved and an estimate of financial need and valuation of property contained within the district.

Once the RUD has been approved by the SDHPT Commission and accepted by a majority of voters in the district, it may issue bonds not to exceed 25 percent of the assessed value of real property within the district. The district may also assess a maintenance tax not to exceed $0.25 per $100 of assessed value, subject to a majority vote of the electors within the district. This maintenance tax can be used to support the operations of the district.

The requirements for creation of a RUD are a bit more difficult than those for transportation corporations. However, given the bond and taxing authority of the district, it certainly can have a significant effect on local road development. During the first 10 months after adoption of Senate Bill 33, no RUDs were created. However, the SDHPT right-of-way division has reported a number of inquiries about creation of such districts. The RUD concept has been used in Arapahoe County, Colorado. A coalition of metropolitan districts financed the building of the Yosemite Street Overpass through bonds supported by property tax levies.

CONCLUSION

The past decade has demonstrated that transportation agencies must look at a variety of ways to finance growing transportation needs. A number of areas have involved private business owners in the planning and development of transportation systems. The transportation corporation in Texas created an unlimited number of ways in which organizations could raise funds to assist in highway development. The potential for these various financing arrangements is significant and should help alleviate the funding dilemma faced by many transportation agencies. Transportation and highway financing for the future will require mutual consideration and cooperation between the private and public sectors. National examples demonstrate that when the two have merged, their interests benefited.

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Highway Cost Allocation and User Tax Revision in Indiana

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ABSTRACT

A discussion is presented of the use of the findings of a highway cost-allocation study in revising the highway financing scheme in Indiana. The cost-allocation study indicated that passenger cars and single-unit trucks as a group would continue to overpay their cost responsibilities whereas heavy combination trucks would continue to underpay if the 1983 highway user taxation structure were to remain unchanged. Several proposed taxation revision schemes were evaluated in terms of equity of revenue contribution and cost responsibilities of various user groups. These schemes involved the revision of fuel taxes and registration fees as well as the imposition of a new weight-distance tax. The adopted tax package included an increase in gasoline tax, a diesel fuel surcharge, an increase in registration fees, and a new user fee of $50 per year for commercial vehicles. Revenue/cost analyses conducted for each of the options considered indicated that no significant improvement in equity could be achieved without the imposition of a weight-distance tax. The adopted taxation scheme, although able to guarantee a funding goal, would not establish a desirable balance in equity among highway user groups. The possible reasons that the legislature did not include a third-tier tax are examined.

As in many other states, most of the expenditures in Indiana to construct, maintain, and rehabilitate highways are supported by highway user charges. In an effort to improve and reform the highway user tax structure in Indiana, a highway cost-allocation study (1), the first of its kind in Indiana, was mandated by a House Enrolled Act (Indiana General Assembly, No. 1006) in April 1983. The recommendations of this study served as important input for the highway user tax revisions enacted by the Indiana General Assembly in April 1985.

The major findings of the Indiana highway cost-allocation study are discussed and a description is given of how these findings were considered for revision of highway user charges in Indiana. The outcome of the user tax revision provides an excellent illustration of the fact that the determination of highway user charges involves not merely an engineering analysis of the cost responsibilities of individual user groups but also consideration of many economic and political issues.

INDIANA COST-ALLOCATION STUDY

Features

The main objective of the Indiana study was to fulfill the requirement of the legislative directive by determining the responsibilities of individual vehicle classes in occasioning highway costs. In addition, the revenue contribution of each vehicle class for the same analysis period was also computed. A comparison was then made between the cost responsibilities and revenue contributions of vehicle classes to determine whether the tax payment of each user class matched its cost responsibility for total highway costs. The complete analysis was performed for the study year 1983 and then repeated for the biennial budgetary period of 1985-1986. A flowchart is presented in Figure 1 to show the steps involved in the cost-allocation and revenue-attribution analyses.

The Indiana cost-allocation study team carried out an elaborate data collection effort on traffic volume and traffic stream composition. A vehicle classification survey was conducted at 60 randomly selected sites throughout Indiana in 1983. The traffic data for 1985 and 1986 were estimated on the basis of projected growth rates by vehicle class derived from the 1982 FHWA cost-allocation study (2).

The vehicle classification system adopted is shown in Tables 1 and 2. In Table 1, 14 vehicle classes based primarily on vehicle axle configuration are defined. In Table 2 the further subdivision of truck classes into subgroups on the basis of gross operating weights is shown.

The various cost-allocation procedures developed for individual items may be classified into two major groups, namely, roadway related and structure related. In the first group, the main concern was to develop a rational unified approach for allocating highway construction, routine maintenance, and rehabilitation costs in a consistent manner. An important feature of the unified approach developed (3,pp.3.59-3.70) is that the cost responsibilities of load and nonload factors are determined analytically on the basis of measured pavement performance data and there is no reliance on subjective judgment. In the structure-related group, an incremental approach similar to that used in the FHWA study (2) was followed.

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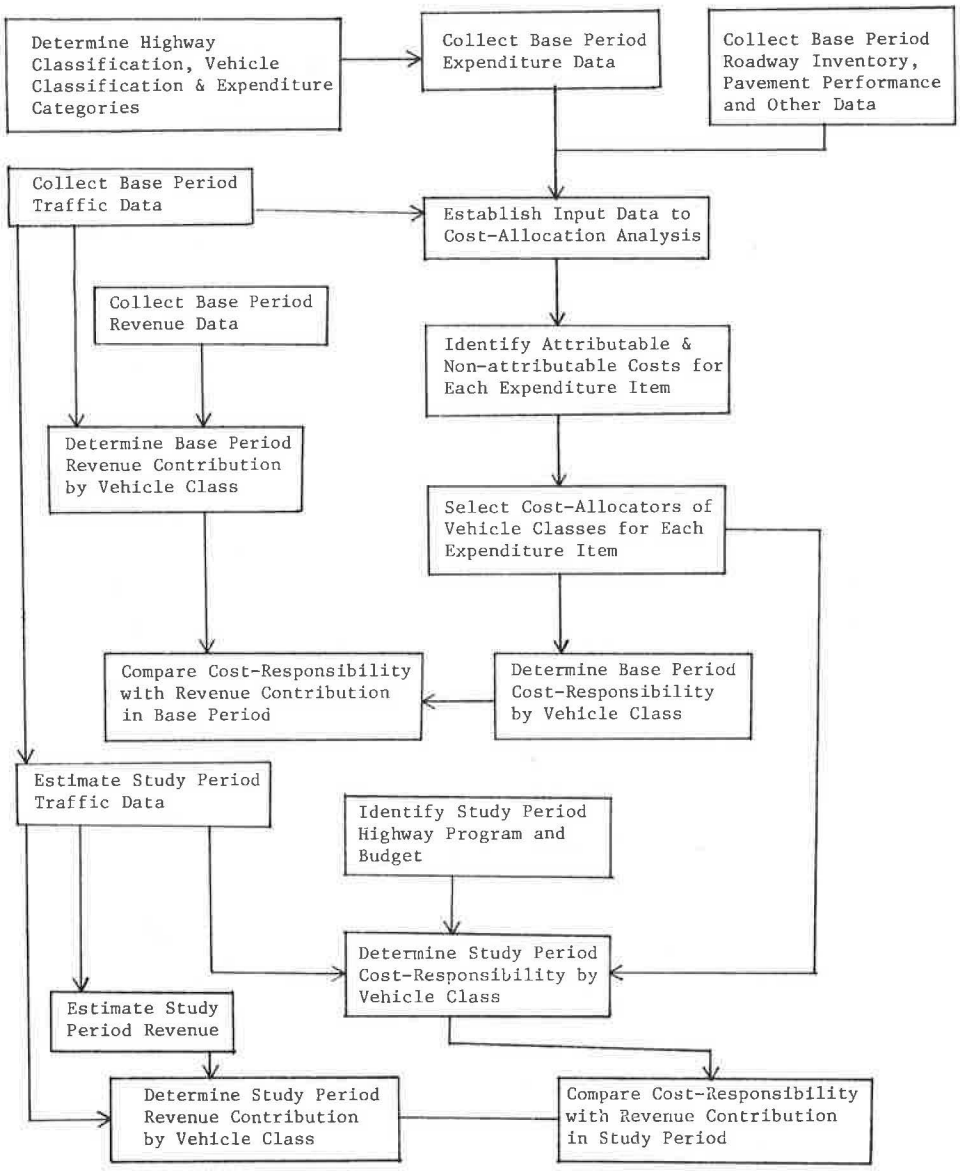

FIGURE 1 Flow chart for Indiana highway cost-allocation study.

Findings

The results of the cost-allocation analysis were expressed as percentage of cost responsibility for each vehicle class. Likewise, the results of the revenue attribution analysis provided percentage of revenues contributed by individual vehicle classes. Tables 3 and 4 present the overall statewide vehicle class cost responsibilities for FY 1983 and the biennial period 1985-1986, respectively. Tables 5 and 6 give the revenue contribution by vehicle class for the same two periods, respectively.

TABLE 1 Vehicle Classification

Class	Description
1	Small passenger car
2	Standard and compact passenger car, panel, and pickup
3	Two-axle truck (2S and 2D)
4	Bus
5	Car with one-axle trailer
6	Three-axle single-unit truck
7	2S1 tractor-trailer
8	Car with two-axle trailer
9	Four-axle single-unit truck
10	3S1 tractor-trailer
11	2S2 tractor-trailer
12	3S2 tractor-trailer
13	Other five-axle tractor-trailer
14	Six-or-more-axle tractor-trailer

The cost responsibilities and revenue contribution of vehicle classes were combined to provide a revenue/cost ratio for each vehicle class. Such a comparison provides an indication of equity in revenue contribution. The revenue/cost ratios for FY 1983 and the biennial period 1985-1986 are summarized for each vehicle class in Table 7. A revenue/cost ratio of unity indicates perfect equity. A revenue/cost ratio with a value less than 1 indicates that the vehicle class underpays its fair share of cost responsibility, whereas a value greater than 1 implies overpayment.

The conclusions that can be derived from the findings in Table 7 are as follows:

1. Passenger cars as a group overpaid their cost responsibility in 1983. There was, however, a significant imbalance between costs and revenues within the group. In particular, small cars underpaid their

TABLE 2 Vehicle Class Weight Group Classification

Vehicle Class	Vehicle Subgroup	Gross Operating Weight (lb)
1	1	All weights
2	1	All weights
3	1	<7,500
3	2	7,500-10,000
3	3	10,000-12,500
3	4	12,500-15,000
3	5	15,000-17,500
3	6	17,500-20,000
3	7	20,000-22,500
3	8	22,500-25,000
3	9	>25,000
4	1	All weights
5	1	All weights
6	1	<17,500
6	2	17,500-20,000
6	3	20,000-22,500
6	4	22,500-25,000
6	5	25,000-27,500
6	6	27,500-30,000
6	7	30,000-32,500
6	8	32,500-35,000
6	9	>35,000
7	1	<20,000
7	2	20,000-22,500
7	3	22,500-25,000
7	4	25,000-27,500
7	5	27,500-30,000
7	6	30,000-32,500
7	7	32,500-35,000
7	8	35,000-37,500
7	9	37,500-40,000
8	1	All weights
9	1	<22,500
9	2	>22,500
10	1	<27,500
10	2	27,500-30,000
10	3	30,000-32,500
10	4	>32,500
11	1	<22,500
11	2	22,500-25,000
11	3	25,000-27,500
11	4	27,500-30,000
11	5	30,000-32,500
11	6	32,500-35,000
11	7	35,000-37,500
11	8	37,500-40,000
11	9	40,000-42,500
11	10	42,500-45,000
11	11	45,000-47,500
11	12	47,500-50,000
11	13	>50,000
12	1	<22,500
12	2	22,500-25,000
12	3	25,000-27,500
12	4	27,500-30,000
12	5	30,000-32,500
12	6	32,500-35,000
12	7	35,000-37,500
12	8	37,500-40,000
12	9	40,000-42,500
12	10	42,500-45,000
12	11	45,000-47,500
12	12	47,500-50,000
12	13	50,000-52,500
12	14	52,500-55,000
12	15	55,000-57,500
12	16	57,500-60,000
12	17	60,000-62,500
12	18	62,500-65,000
12	19	65,000-67,500
12	20	67,500-70,000
12	21	70,000-72,500
12	22	72,500-75,000
12	23	75,000-77,500
12	24	77,500-80,000
12	25	80,000-82,500
12	26	82,500-85,000
13	1	<42,500
13	2	42,500-45,000
13	3	45,000-47,500
13	4	47,500-50,000
13	5	50,000-52,500
13	6	52,500-55,000
13	7	55,000-57,500
13	8	57,500-60,000
13	9	60,000-62,500
13	10	62,500-65,000
13	11	65,000-67,500
13	12	67,500-70,000
13	13	70,000-72,500
14	1	<40,000
14	2	40,000-60,000
14	3	>60,000

cost responsibility, whereas large cars considerably overpaid.

2. Single-unit trucks as a group also overpaid their cost responsibility in 1983. Although two-axle and four-axle single-unit trucks overpaid, three-axle single-unit trucks underpaid.

3. Combination trucks significantly underpaid their cost responsibility in 1983. The underpayment was consistent among all combination trucks. However, the extent of this underpayment varied within the group.

4. The same general pattern of overpayments as that in 1983 is present for the biennial period 1985-1986. In fact, the underpayment by heavy combination trucks is more pronounced in 1985-1986 than in 1983. This implies that the subsidization of heavy vehicles by passenger cars and single-unit trucks would continue to exist if the tax structure were to remain unchanged.

Implications

The 1983 Indiana highway user taxation scheme was primarily a two-tier system that consisted of first-structure vehicle registration fees and second-structure fuel taxes. Because the net result of the cost-allocation analysis was that passenger cars and single-unit trucks subsidized heavy combination trucks, the following revision options were considered in Indiana:

1. Increase heavy vehicle registration fees,
2. Increase special fuel (diesel) tax, and
3. Impose a third-tier weight-distance tax on heavy trucks.

The first two options involved revisions of tax rates while retaining the existing two-tier system. The third option required additional administrative organization and personnel. A switch from the existing two-tier system to a weight-distance taxation scheme was considered too drastic a change and was not included in the revision schemes seriously considered by the legislature.

Raising registration fees of heavy combination trucks is a simple method of increasing revenue contribution of these trucks. It, however, has the drawback of creating inequity between vehicles with

high annual mileage and those with low annual mileage. Increasing the special fuel tax, on the other hand, tends to reduce the inequity between these vehicles. Unfortunately, as both single-unit and combination trucks are affected by a special fuel tax increase, it is not effective in eliminating the inequity between these two categories of trucks. A third-tier weight-distance tax with a properly designed rate schedule can help bring equity among passenger cars, single-unit trucks, and combination trucks. A major disadvantage of this option is the comparatively high administration and enforcement costs. In theory, it is possible to achieve equity for the major vehicle classes in Table 7 by means of an appropriate combination of Options 1, 2, and 3, identified earlier.

Both Indiana highway officials and legislators recognized that there was an unmet need for additional highway funding at both the state and local levels in order to ensure adequate highway maintenance and rehabilitation. Initially, there were proposals that some general revenue funds be allocated to highways. However, the findings of the cost-allocation study clearly established that some users were not paying their fair share and that additional funds could be raised from these users. Consequently, it was generally agreed by the legislators that highway funding should continue to be derived from highway user fees and taxes. At the same time some legislators expressed interest in improving the equity of the state highway user taxation system.

The trucking industry in Indiana was strongly in favor of retaining the existing two-tier taxation system without imposition of any additional forms or types of taxes applicable to highway users (statement by G.G. Cline, Indiana Motor Truck Association, Inc., December 6, 1984). It also suggested that the benefits of a good highway system enjoyed by nonusers of the highways should be recognized by assigning some highway cost responsibility to the general public. Noting the recent increase of federal tax on diesel fuel from 4 cents a gallon to 15 cents a gallon, the trucking industry expressed its concern over the possible adverse effect on the economy of the state

TABLE 3 Overall Vehicle Cost Responsibilities, 1983

		Percentage of Responsibility				Percentage of Responsibility	
Vehicle Class	Vehicle Subgroup	Vehicle Class	Vehicle Subgroup	Vehicle Class	Vehicle Subgroup	Vehicle Class	Vehicle Subgroup
1	1	10.869	10.869	11	6		0.410
				11	7		0.142
2	1	41.510	41.510	11	8		0.183
				11	9		0.133
3	1	6.766	0.440	11	10		0.161
3	2		0.403	11	11		0.197
3	3		0.866	11	12		0.213
3	4		0.873	11	13		0.463
3	5		0.450				
3	6		1.587	12	1	30.253	0.020
3	7		1.179	12	2		0.072
3	8		0.388	12	3		0.263
3	9		0.580	12	4		0.994
				12	5		0.455
4	1	0.448	0.448	12	6		0.526
				12	7		0.187
5	1	0.387	0.387	12	8		0.308
				12	9		0.581
6	1	2.605	0.362	12	10		0.612
6	2		0.266	12	11		0.286
6	3		0.174	12	12		0.388
6	4		0.234	12	13		0.551
6	5		0.092	12	14		0.544
6	6		0.117	12	15		0.629
6	7		0.144	12	16		0.675
6	8		0.220	12	17		0.955
6	9		0.995	12	18		3.051
				12	19		1.817
7	1	0.974	0.029	12	20		3.499
7	2		0.035	12	21		5.320
7	3		0.049	12	22		3.808
7	4		0.072	12	23		3.737
7	5		0.077	12	24		0.672
7	6		0.137	12	25		0.136
7	7		0.156	12	26		0.171
7	8		0.191				
7	9		0.228	13	1	1.285	0.259
				13	2		0.317
8	1	0.081	0.081	13	3		0.249
				13	4		0.158
9	1	1.087	0.018	13	5		0.182
9	2		1.069	13	6		0.008
				13	7		0.017
10	1	0.107	0.021	13	8		0.009
10	2		0.025	13	9		0.009
10	3		0.027	13	10		0.016
10	4		0.033	13	11		0.009
				13	12		0.025
11	1	2.525	0.060	13	13		0.028
11	2		0.106				
11	3		0.224	14	1	1.110	0.095
11	4		0.128	14	2		0.249
11	5		0.105	14	3		0.765

TABLE 4 Overall Vehicle Cost Responsibilities, 1985-1986

Vehicle Class	Vehicle Subgroup	Percentage of Responsibility: Vehicle Class	Percentage of Responsibility: Vehicle Subgroup
1	1	11.707	11.707
2	1	43.610	43.610
3	1	5.746	0.409
3	2		0.240
3	3		0.783
3	4		0.793
3	5		0.435
3	6		1.302
3	7		0.960
3	8		0.342
3	9		0.484
4	1	0.344	0.344
5	1	0.427	0.427
6	1	2.224	0.325
6	2		0.238
6	3		0.164
6	4		0.206
6	5		0.083
6	6		0.101
6	7		0.124
6	8		0.186
6	9		0.799
7	1	0.804	0.031
7	2		0.032
7	3		0.044
7	4		0.062
7	5		0.066
7	6		0.109
7	7		0.132
7	8		0.152
7	9		0.176
8	1	0.090	0.090
9	1	1.146	0.020
9	2		1.126
10	1	0.093	0.018
10	2		0.021
10	3		0.025
10	4	0.029	13
11	1	2.287	0.059
11	2		0.104
11	3		0.218
11	4		0.124
11	5		0.111
11	6		0.340
11	7		0.122
11	8		0.153
11	9		0.123
11	10		0.147
11	11		0.174
11	12		0.201
11	13		0.413
12	1	29.281	0.021
12	2		0.084
12	3		0.323
12	4		1.042
12	5		0.544
12	6		0.536
12	7		0.241
12	8		0.337
12	9		0.539
12	10		0.571
12	11		0.324
12	12		0.401
12	13		0.519
12	14		0.569
12	15		0.620
12	16		0.799
12	17		0.999
12	18		2.670
12	19		1.718
12	20		3.155
12	21		4.910
12	22		3.851
12	23		3.453
12	24		0.736
12	25		0.130
12	26		0.190
13	1	1.218	0.222
13	2		0.274
13	3		0.226
13	4		0.148
13	5		0.161
13	6		0.016
13	7		0.027
13	8		0.012
13	9		0.013
13	10		0.024
11		0.015	
13	12		0.037
12	13		0.044
14	1	1.030	0.089
14	2		0.217
14	3		0.724

if an additional drastic hike in diesel fuel tax or truck registration fee were imposed in Indiana.

The railroad industry believes that as highway costs increase, the burden of fuel taxes should not be shifted further to the midweight trucks and away from the heavy long-haul vehicles, which had been found to underpay by the greatest amount. Because the railroad industry competes with heavy long-haul trucks for as much as 70 percent of its revenue nationally (4), it strongly advocates the adoption of a weight-distance tax, which, it claims, could create a more equitable user charge structure, add to highway revenue, and help simplify procedures for taxing interstate motor carriers.

There was no known organized position of passenger-car owners and single-unit truck operators in Indiana. One suspects, however, that such owners and operators would not oppose the imposition of a third-tier weight-distance tax on heavy combination trucks. Passenger-car owners and single-unit truck operators likely would not be favorable to increases in gasoline fuel tax, claiming that it would further widen the inequity gap already existing between light and heavy vehicles.

TAX STRUCTURE REVISION SCHEMES

Several tax structure revision schemes were proposed for discussion in the Indiana legislature during early 1985. The results of the cost-allocation study were used to provide direction to these revisions. The direction was, in general, to raise additional revenues from heavy combination trucks. The revision schemes included fuel tax, registration fees, axle tax, and axle-mile tax as well as a weight-distance tax. Revenue/cost ratios were computed to evaluate the equity aspect of each of the proposed schemes. Discussed in this section, in chronological order, are some of the major revision schemes proposed.

Transportation Coordinating Board Recommendation (5)

The first draft of the Indiana cost-allocation study final report was issued on October 31, 1984. In December 1984 the official transportation policy group in Indiana, the Transportation Coordinating Board (TCB), recommended the following changes in highway user tax structure:

Scheme A

1. Increase of state gasoline tax by 4 cents, from 11.1 cents/gal to 15.1 cents/gal;
2. Increase of state diesel fuel tax by 6 cents, from 11.1 cents/gal to 17.1 cents/gal;
3. Increase in passenger-car registration fees from $12/year to $15/year; and
4. Increase in truck registration fees by 35 percent.

Scheme B

1. All changes in Scheme A, and
2. Imposition of an appropriate weight-distance tax for combination trucks. The study team that performed the cost-allocation study designed the following weight-distance tax scheme:

Registered Weight (lb)	Cents/Mile
48,000-54,000	1.00
54,000-60,000	1.50
60,000-66,000	2.00
66,000-72,000	2.75
72,000-74,000	3.75
74,000-76,000	5.00
76,000-78,000	6.50
78,000 and above	8.50

TABLE 5 Revenue Contribution by Vehicle Class, 1983

Vehicle Class	Vehicle Subgroup	Percentage of Contribution: Vehicle Class	Percentage of Contribution: Vehicle Subgroup
1	1	8.080	8.080
2	1	56.670	56.670
3	1	8.020	3.240
3	2		0.450
3	3		0.900
3	4		0.940
3	5		0.710
3	6		0.580
3	7		0.330
3	8		0.400
3	9		0.460
4	1	0.372	0.372
5	1	0.453	0.453
6	1	2.210	0.390
6	2		0.240
6	3		0.160
6	4		0.250
6	5		0.160
6	6		0.210
6	7		0.210
6	8		0.160
6	9		0.450
7	1	0.540	0.037
7	2		0.046
7	3		0.036
7	4		0.090
7	5		0.038
7	6		0.031
7	7		0.180
7	8		0.040
7	9		0.039
8	1	0.078	0.078
9	1	1.620	0.630
9	2		0.990
10	1	0.069	0.017
10	2		0.016
10	3		0.020
10	4		0.016
11	1	1.211	0.074
11	2		0.110
11	3		0.200
11	4		0.106
11	5		0.110
11	6		0.150
11	7		0.070
11	8		0.073
11	9		0.073
11	10		0.063
11	11		0.062
11	12		0.058
11	13		0.066
12	1	18.900	0.043
12	2		0.166
12	3		0.563
12	4		1.370
12	5		0.847
12	6		0.631
12	7		0.400
12	8		0.419
12	9		0.457
12	10		0.416
12	11		1.120
12	12		0.329
12	13		0.397
12	14		0.468
12	15		0.487
12	16		0.718
12	17		0.606
12	18		0.730
12	19		0.614
12	20		0.782
12	21		1.442
12	22		1.799
12	23		0.952
12	24		0.454
12	25		1.337
12	26		1.355
13	1	1.260	0.461
13	2		0.128
13	3		0.080
13	4		0.073
13	5		0.056
13	6		0.032
13	7		0.046
13	8		0.037
13	9		0.037
13	10		0.049
13	11		0.038
13	12		0.057
13	13		0.163
14	1	0.520	0.189
14	2		0.068
14	3		0.264

TABLE 6 Revenue Contribution by Vehicle Class, 1985-1986

Vehicle Class	Vehicle Subgroup	Percentage of Contribution: Vehicle Class	Percentage of Contribution: Vehicle Subgroup
1	1	8.946	8.946
2	1	60.250	60.250
3	1	8.306	3.563
3	2		0.450
3	3		0.833
3	4		0.897
3	5		0.977
3	6		0.556
3	7		0.306
3	8		0.350
3	9		0.375
4	1	0.336	0.336
5	1	0.459	0.459
6	1	1.824	0.369
6	2		0.204
6	3		0.138
6	4		0.212
6	5		0.130
6	6		0.173
6	7		0.170
6	8		0.129
6	9		0.300
7	1	0.420	0.034
7	2		0.064
7	3		0.032
7	4		0.058
7	5		0.035
7	6		0.028
7	7		0.097
7	8		0.036
7	9		0.035
8	1	0.079	0.079
9	1	1.179	0.515
9	2		0.664
10	1	0.062	0.016
10	2		0.015
10	3		0.018
10	4		0.014
11	1	1.087	0.066
11	2		0.113
11	3		0.175
11	4		0.094
11	5		0.098
11	6		0.131
11	7		0.062
11	8		0.065
11	9		0.064
11	10		0.055
11	11		0.055
11	12		0.051
11	13		0.058
12	1	15.029	0.038
12	2		0.148
12	3		0.490
12	4		1.195
12	5		0.733
12	6		0.547
12	7		0.344
12	8		0.362
12	9		0.391
12	10		0.358
12	11		0.490
12	12		0.279
12	13		0.307
12	14		0.353
12	15		0.357
12	16		0.546
12	17		0.476
12	18		0.573
12	19		0.467
12	20		0.612
12	21		1.159
12	22		1.427
12	23		0.814
12	24		0.383
12	25		1.083
12	26		1.099
13	1	1.457	0.813
13	2		0.108
13	3		0.067
13	4		0.061
13	5		0.041
13	6		0.027
13	7		0.036
13	8		0.029
13	9		0.029
13	10		0.038
13	11		0.030
13	12		0.045
13	13		0.134
14	1	0.566	0.304
14	2		0.051
14	3		0.212

Scheme C

1. All changes in Scheme A, and
2. As an appropriate weight-distance tax for combination trucks, the study team also designed the following alternative scheme:

Registered Weight (lb)	Cents/Mile
48,000-54,000	0.25
54,000-60,000	0.38
60,000-66,000	0.50
66,000-72,000	0.70
72,000-74,000	0.95
74,000-76,000	1.25
76,000-78,000	1.63
78,000 and above	2.13

Scheme A involved only rate changes of the existing tax structure, whereas both Schemes B and C introduced a weight-distance tax in addition to the changes in the existing tax rates. The rate schedule of the weight-distance tax in Scheme B was designed to bring to unity the revenue/cost ratio of combination trucks as a whole. The rate schedule in Scheme C was set such that the weight-distance tax would raise $50 million in 1986. The estimated additional highway user revenues that could be collected in 1986 with the foregoing revisions was $147 million, $349 million, and $197 million for Schemes A, B, and C, respectively.

A revenue/cost analysis for the three revision schemes yielded the results presented in Table 8. Scheme A would produce only slight improvements in equity among the different vehicle classes, and combination trucks would continue to underpay under this scheme. By including a weight-distance tax, Scheme C would produce further improvements for all vehicle classes in terms of equity, but the situation would, however, still be far from perfect. With Scheme B, the overall revenue/cost ratio for the combination trucks as a group could become 1.00, and the corresponding group revenue/cost ratios for passenger cars and single-unit trucks would be close to unity.

TABLE 7 Cost-Allocation and Revenue Contribution Summary

Vehicle Class	Vehicle Subgroup	FY 1983 VMT (%)	FY 1983 Cost Responsibility (%)	FY 1983 Revenue (%)	FY 1983 Revenue/Cost Ratio	1985-1986 VMT (%)	1985-1986 Cost Responsibility (%)	1985-1986 Revenue (%)	1985-1986 Revenue/Cost Ratio
Passenger car	1	19.124	10.869	8.080	0.743	19.176	11.707	8.946	0.764
	2	68.921	41.510	56.670	1.365	68.001	43.610	60.250	1.382
	5	0.623	0.387	0.453	1.171	0.641	0.427	0.459	1.075
	8	0.107	0.081	0.078	0.963	0.127	0.090	0.079	0.878
		88.775	52.847	65.281	(1.235)	87.945	55.834	69.734	(1.249)
Bus	4	0.164	0.448	0.372	0.830	0.162	0.344	0.336	0.977
Single-unit truck	3	2.666	6.766	8.020	1.185	2.604	5.746	8.306	1.446
	6	0.692	2.605	2.210	0.848	0.646	2.224	1.824	0.820
	9	0.091	1.087	1.620	1.490	0.092	1.146	1.179	1.029
		3.449	10.458	11.850	(1.133)	3.342	9.116	11.309	(1.241)
Combination truck	7	0.196	0.974	0.540	0.554	0.219	0.804	0.420	0.522
	10	0.040	0.107	0.069	0.645	0.043	0.093	0.062	0.667
	11	0.688	2.525	1.211	0.480	0.752	2.287	1.087	0.475
	12	6.385	30.253	18.900	0.625	7.211	29.281	15.029	0.513
	13	0.224	1.285	1.260	0.981	0.245	1.218	1.457	1.196
	14	0.078	1.110	0.520	0.468	0.081	1.030	0.566	0.550
		7.611	36.254	22.500	(0.621)	8.551	34.713	18.621	(0.536)

Note: Values in parentheses refer to revenue/cost ratio of vehicle class.

House Bill 1462 Proposal

Indiana House Bill (H.B.) 1462, distributed in March 1985, contained the following proposal, which is designated Scheme D. In addition, another scheme was devised combining the fuel tax and registration fee increases with a weight-distance tax for the purpose of legislative deliberation. This scheme is designated Scheme E.

Scheme D

1. Increase of gasoline tax by 3.9 cents, from the existing 11.1 cents/gal to 15.0 cents/gal;
2. Increase of diesel fuel tax by 7.9 cents, from the existing 11.1 cents/gal to 18.0 cents/gal; and
3. Increase of truck registration fees by 35 percent according to the H.B. 1462 schedule to yield $17.5 million in 1986 for trucks with more than 7,000 lb registered weight.

Scheme E

1. Increase of gasoline tax by 1.9 cents, from the existing 11.1 cents/gal to 13.0 cents/gal;
2. Increase of diesel fuel tax by 3.9 cents, from the existing 11.1 cents/gal to 15.0 cents/gal;
3. Increase in truck registration fees by 35 percent according to the H.B. 1462 schedule to yield $17.5 million in 1986 for trucks with more than 7,000 lb registered weight; and
4. Imposition of a third-tier weight-distance tax on combination trucks to yield $50 million in 1986 (see Scheme C).

The pattern of revision of Schemes D and E was similar to that of Schemes A and C, respectively. In 1986 Scheme D was expected to yield a total revenue of $153 million, and Scheme E, $134 million. The impacts of these two schemes in terms of revenue/cost ratios are presented in Table 9. The results showed that the improvement in the equity of the tax struc-

TABLE 8 1986 Revenue/Cost Ratios for Schemes A, B, and C

Vehicle Class	Vehicle Subgroup	Existing Tax Structure	Scheme A	Scheme B	Scheme C
Passenger car	1	0.764	0.742	0.601	0.701
	2	1.382	1.355	1.097	1.281
	5	1.075	1.068	0.865	1.009
	8	0.878	0.433	0.351	0.409
		(1.249)	(1.223)	(0.990)	(1.156)
Bus	4	0.977	1.064	1.006	1.047
Single-unit truck	3	1.446	1.468	1.189	1.387
	6	0.820	0.866	0.701	0.818
	9	1.029	1.086	0.879	1.026
		(1.241)	(1.273)	(1.031)	(1.203)
Combination	7	0.522	0.524	0.911	0.671
	10	0.667	0.710	1.259	1.984
	11	0.475	0.511	0.862	0.675
	12	0.513	0.550	0.892	0.677
	13	1.196	1.148	1.388	1.217
	14	0.550	0.540	0.660	0.565
		(0.536)	(0.565)	(1.001)	(0.695)

Note: Values in parentheses refer to revenue/cost ratio of vehicle class.

TABLE 9 1986 Revenue/Cost Ratios for Schemes D and E

Vehicle Class	Vehicle Subgroup	Existing Tax Structure	Scheme D	Scheme E
Passenger car	1	0.764	0.737	0.697
	2	1.382	1.337	1.262
	5	1.075	1.070	0.998
	8	0.878	0.878	0.822
		(1.249)	(1.209)	(1.141)
Bus	4	0.977	1.102	0.980
Single-unit truck	3	1.446	1.384	1.358
	6	0.820	0.880	0.823
	9	1.029	0.915	0.908
		(1.241)	(1.202)	(1.171)
Combination truck	7	0.522	0.598	0.738
	10	0.667	0.882	1.108
	11	0.475	0.615	0.775
	12	0.513	0.594	0.709
	13	1.196	0.134	1.242
	14	0.550	0.475	0.541
		(0.536)	(0.611)	(0.611)

Note: Values in parentheses refer to revenue/cost ratio of vehicle class.

ture would be marginal with the Scheme D revision. Better results could be obtained with Scheme E, which incorporated a third-tier weight-distance tax into the existing structure.

The Adopted Tax Revision

A review of Tables 8 and 9 suggests that schemes with a third-tier weight-distance tax are more effective in improving the equity of combination trucks. The final tax revision adopted by the Indiana legislature did not, however, include a third-tier tax. One of the reasons cited for excluding a weight-distance tax was that it would be costly to put into operation.

The new highway user tax structure as described by the Indian House Enrolled Act 1462 includes the following major revisions:

1. Increase of gasoline tax by 2.9 cents to 14.0 cents/gal,
2. Increase of diesel fuel tax by 3.9 cents to 15.0 cents/gal,
3. Imposition of a diesel fuel surcharge tax of 8.0 cents/gal on commercial vehicles,
4. Imposition of a $50 annual supplemental highway user fee per commercial vehicle, and
5. Increase in truck registration fees of 35 percent according to the H.B. 1462 schedule for trucks with more than 7,000 lb registered weight.

The revenue/cost ratios of vehicle classes for the new Indiana highway user tax structure were computed and are shown in Table 10. The results indicate that although the funding goal would be met under this structure, there is little improvement in the overall equity among user groups. The combination trucks as a group would still underpay by a significant margin, and the position of single-unit trucks would become even more inequitable.

TABLE 10 1986 Revenue/Cost Ratios for New Tax Structure

Vehicle Class	Vehicle Subgroup	Existing Tax Structure	Existing Tax Structure
Passenger car	1	0.764	0.700
	2	1.382	1.270
	5	1.075	1.007
	8	0.878	0.949
		(1.249)	(1.148)
Bus	4	0.977	0.930
Single-unit truck	3	1.446	1.528
	6	0.820	1.079
	9	1.029	1.082
		(1.241)	(1.362)
Combination truck	7	0.522	0.622
	10	0.667	0.968
	11	0.475	0.660
	12	0.513	0.651
	13	1.196	1.207
	14	0.550	0.524
		(0.536)	(0.667)

Note: Values in parentheses refer to revenue/cost ratio of vehicle class.

CONCLUSIONS

A discussion has been presented of how the findings of a highway cost-allocation study have been used in revising the highway financing scheme in Indiana. The cost-allocation study indicated that passenger cars and single-unit trucks as a group would continue to overpay, and heavy combination trucks would continue to underpay their cost responsibilities if the 1983 highway user taxation structure were to remain unchanged. In fact, the underpayment by heavy combination trucks would be more pronounced in 1985-1986 than in 1983. It was apparent that funds for unmet highway needs did not have to come from general revenue funds, as proposed by some, but that additional funds could be reasonably generated by taxing heavy combination trucks. The study also indicated the need to balance the tax burden among user groups if equity in terms of revenue/cost ratios was to be achieved.

Several taxation-increase schemes included increases in fuel taxes and registration fees as well as the imposition of new taxes such as the axle tax, the axle-mile tax, and the weight-distance tax. Ultimately, the legislature adopted a tax package that included an increase in the gasoline tax, a diesel fuel surcharge, an increase in registration fees, and a new user fee of $50/unit per year for commercial vehicles. Revenue/cost analyses conducted for each of the options indicated that no significant improvement in equity could be achieved without the imposition of a weight-distance tax. The taxation scheme adopted, although able to provide the funding goals, did not provide the desirable balance in equity among highway user groups. There were several possible reasons for the legislature not to include a third-tier tax, even though many legislators recognized the desirability to achieve equity. These reasons are as follows:

1. The legislature did not have sufficient time to evaluate thoroughly the alternative taxation schemes in regard to equity and other factors before adjourning in April 1985.
2. The implementation and enforcement costs of a third-tier tax could not be clearly or reliably identified and there was concern that much of the revenue raised would be offset by the added costs.
3. The advantage of piggybacking on the existing taxes by simply increasing the rates would eliminate the uncertainty of a new taxation scheme.
4. There was considerable uncertainty about truck volume and weight data, and the reliability of estimates of expected revenues from a weight-distance tax was questioned.
5. Although many members of the legislature were interested in creating a better balance in equity among highway user groups, the greater concern was the raising of a funding goal for the highway program with minimal political resistance.
6. Indiana is the ninth major trucking state in the nation (6). Any revision in the highway user tax structure that might create an adverse effect on the trucking industry might not be in the overall economic interest of the state. It was widely perceived that a weight-distance tax would impose a great burden on the Indiana trucking industry, both in higher taxes in Indiana and in possible new regulations imposed on Indiana trucks in other states.

In summary, there are a great many factors that are associated with decisions regarding any tax revision scheme, including economic and political consequences. Thus, although it was clear that the current imbalance in equity could be greatly reduced by imposing a weight-distance tax, the Indiana legislature decided not to impose such a tax at present.

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Transportation Impact Fees: The Florida Experience

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ABSTRACT

Transportation impact fees are now being considered in communities throughout Florida and have recently been enacted in four Florida counties. In view of its obvious appeal, this new tax is expected to be the subject of experiment by communities throughout the country. The purpose of this paper was to explore this new source of transportation revenue by using the Florida experience as a point of departure. Judicial standards on which impact fees are based are discussed, and a fee system that has become a model in Florida, having survived judicial challenge, is examined in some detail. A means to estimate the economic incidence of an impact fee is demonstrated and the use of the impact fee as a growth management tool is examined.

Government at all levels faces financial uncertainties. During the 1970s, the rising cost of government was attributed to a combination of general inflation and rapid increases in the cost of energy. Although the pressure of these factors has abated in recent years, it remains, particularly in urban areas experiencing rapid growth. The Reagan administration shift to federalism has reduced revenue pass through for state and local governments. At the same time, pressure to further relieve the property tax has intensified as controls like Proposition 13 abound throughout the country. This has resulted in a search by local government for alternative revenue sources.

In response to this search, local governments have begun experimenting with a variety of revenue-raising devices that are capable of both achieving political support and withstanding legal challenges. Several of these devices, including dedications, fees in lieu of dedications, and impact fees, have met with moderate success over the last decade. An increasing number of local communities in Florida now believe that new residents or developers, or both, should bear a fair share of the infrastructure cost required to provide additional services demanded. This interest is not exclusive to Florida. The states of California, Washington, and Arizona have had a history of legislative enablement and judicial support for impact fees and mandatory dedications (1).

The fiscal impact fee, in particular, has generated a great deal of excitement recently in Florida and throughout the country. Impact fees are a one-time charge collected by local government from new development in order to generate revenue for capital

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funding necessitated by that development. There are several advantages associated with the use of impact fees (2). Those who directly benefit from the capital funding project are the ones who pay for those facilities. Impact fees are relatively easy to administer because they are collected from one individual at one time. To the extent that they are a form of user charge, it has been suggested that they have the potential for imposing a degree of market discipline on resource-allocation decisions (2).

Impact fees have been used to recover all (or in most cases part) of the cost of recreational facilities, sewers, fire and police stations, water supply systems, and medical facilities. Although transportation impact fees have only recently generated interest, they are now being considered in communities throughout Florida and have recently been enacted in four Florida counties (Palm Beach, Sarasota, Lake Hillsborough, and Broward). In view of its obvious appeal, this new tax is expected to be the subject of experiment by communities throughout the country. The purpose of this paper will be to explore this new source of transportation revenue by using the Florida experience as a point of departure. Several specific issues will be discussed.

First, transportation impact fees should be evaluated in view of a number of legal considerations. The judicial standards on which impact fees are based in many states depend on the reasonableness of such fees in serving the police power objectives of health, safety, and welfare. These standards foster a judicial concern for the satisfaction of a number of strict legal requirements that will be discussed.

Second, the ordinance establishing transportation impact fees in Palm Beach County has survived judicial challenges and has become a model in Florida. Important features of this ordinance will be described, including its system of fees.

Third, the economic incidence, or who ultimately bears the burden, of the transportation impact fee is an important public policy issue that will be explored.

Fourth, tax systems are often established in order to exert a constructive influence on behalf of public policy objectives. Many public officials in Florida are concerned with the development stress associated with rapidly increasing population, sprawling settlement patterns, and a fragile natural environment. It has been suggested that transportation impact fees, when used in conjunction with a legally binding comprehensive plan, can be an effective growth management tool.

LEGAL ISSUES

Impact fees are generally subjected to a two-tiered constitutional attack (3). First, they are challenged as unauthorized by state statute or constitution. Second, if statutory authority is found, the local ordinance establishing the impact fee is either challenged as an unreasonable regulation exceeding policy power authority or as a disguised tax.

Whether impact fees are taxes or not is critical in shaping their legal environment. The choice a court makes will often determine their validity. If labeled a tax, the impact fee will be invalidated unless specific statutory authorization exists. Alternatively, if the impact fee is viewed as a police power regulation, broad legislative delegation will suffice. The principles of law applicable to impact fees operating under the police power umbrella are in sharp contrast to those relating to impact taxes, which depend on powers of taxation (4).

Impact taxes are viewed solely as a revenue device. Their purpose is to raise revenue to help defray the general cost of government. In the process, they must be nonconfiscatory and nondiscriminating, but otherwise they can be set at relatively arbitrary levels and used for any general fund purpose (4).

For fees, the chief concern of the courts, beyond the question of statutory enablement, is the reasonableness of the impact fee in serving the police power objectives of health, safety, and welfare. This fosters a concern for the relationship between how the fee is levied and expended on the one hand and whether the developer who pays the fee benefits from the facility on the other. The judicial criteria by which the courts judge whether impact fees are reasonably related to the broad objectives of police power vary across state jurisdictions. Three distinct tests of reasonableness are evident in case law but have already been fully discussed elsewhere (2-4) and therefore will not be addressed in this paper.

In many jurisdictions, Florida included, the legal parameters have been established by the courts and the focus of attention of public officials has shifted from the legal validity issues toward how to draft impact fee ordinances that are acceptable to the courts. Offering guidelines for the design of impact fees is difficult because legal standards differ according to the jurisdiction in question. Nevertheless, some generally applicable standards can be formulated. The following basic list has been suggested for Florida but should have considerable applicability to other states as well (3,5):

1. An impact fee ordinance should expressly cite statutory authority for local government regulation of the substantive area selected.
2. A need for the service or improvement resulting from new development should be demonstrated.
3. The fee charged must not exceed the cost of improvements required by the new development.
4. The improvements funded must benefit adequately the development that is the source of the fee (even if nonresidents of the development also benefit).
5. In place of a rigid and inflexible formula for calculating the amount of the fee to be imposed on a particular development, a variance procedure should be included, so that the local government may consider studies and data submitted by the developer to decrease his assessment.
6. Last, the expenditure of funds should be localized to the areas from which they were collected.

PALM BEACH COUNTY IMPACT FEE SYSTEM

In 1979 Palm Beach County, Florida, enacted an ordinance that established a system of transportation impact fees (Fair Share Contribution for Road Improvement, Ordinance 79-7, as amended by Ordinances 81-4 and 85-10). From September 1979 through June 1985, this system of fees generated approximately $13.5 million in transportation revenue (according to the Finance Department, Palm Beach County). The ordinance, as amended, sets forth a schedule of impact fees that are based on trip generation by type of land use activity, the cost of constructing additional highway lanes, and lane capacity. The collected funds are deposited in the trust fund of a designated impact zone, 40 of which were created by the ordinance. The zones were drawn from a base of circles within a 6-mi radius and then modified to fit major geographic, traffic, and planning boundaries within the county. The use of the zone ensures that the developer paying the fee will receive a benefit from the road improvement. The funds collected can only be used for the purpose of constructing or improving roads and bridges on the major

road network system. Fees collected must be expended within the zone and during a reasonable period of time (6 years) or returned to developers.

Impact fees are assessed at the time the building permit is issued for any new land development activity within the county and municipalities that have adopted the ordinance. In addition, the county encourages developers to make road improvements themselves, which are fully credited against the impact fee.

The fee schedules are based on the following formulas:

$$\text{Residential fees} = (1/2 \text{ external trips}/1 \text{ lane capacity}) \times (\text{cost to construct 1 lane for 3 mi}) \quad (1)$$

$$\text{Nonresidential fees} = (1/2 \text{ external trips}/1 \text{ lane capacity}) \times (\text{cost to construct 1 lane for 1 mi}) \quad (2)$$

The ordinance includes different formulas for residential and nonresidential development. Many of the nonresidential trips are captured from traffic already on the road. Therefore, the formula for nonresidential development requires a fee sufficient to replace the capacity of only 1 mi of road versus 3 mi of road for residential development.

An external trip is one that originates from or is destined for the development site and that affects the major road network system. One-half of the external trips is taken to account for a 50 percent split in the direction of traffic.

As an illustration, the following data from the Palm Beach ordinance are used to calculate the fee on a single-family home (under 2,000 ft^2) using Formula 1:

External trips:	10
Road capacity:	7,000 vehicles a day
Construction cost (1 lane for 3 mi):	$1,125,000
Trip distribution:	50 percent
Transportation impact fee:	$804

Table 1 provides a selected list of impact fees that were taken from Palm Beach County Ordinance 85-10 and calculated from the foregoing formulas.

ECONOMIC INCIDENCE

When local officials decide to institute a new tax mechanism, an important issue to be considered is the economic incidence of the tax, or who ultimately bears the tax burden. There are important legal distinctions between a tax and a fee; however, the economic effects of a tax and a fee are the same and thus the terms are used synonymously in the field of economics and in the remainder of this paper. The economic incidence of a tax can differ significantly from those who have the legal responsibility for payment. As with any tax, the economic incidence of a transportation impact fee depends on supply and demand, structural aspects of a particular housing market, and the time period during which supply adjustments may occur (6,pp.353-435). In this particular section the question of who may ultimately pay for the fee as it affects the residential housing sector will be addressed.

The housing industry is assumed to be competitive and for purposes of this analysis is defined in terms of units of housing services. In Figure 1, the horizontal axis represents the quantity and the vertical axis, the price per unit of housing services in a given market. In addition, SS is the supply schedule before the fee and DD the demand schedule. Following the analytical framework of Musgrave (6) in Figure 1, OC is the output before the fee and OB the price before the fee. With the imposition of the impact fee, which is a unit fee (u), the supply schedule shifts from SS to S'S' and output declines to OE. The buyer-occupant pays the gross price, which rises to OF, and the builder-landowner receives the net price, which has fallen to OK. The community establishing the impact fee collects revenues equal to the rectangle KLGF, which can be divided into BHGF, the buyer's share, and KLHB, the share of the fee burden to be paid by the builder. The division of the burden will depend on the absolute value of the elasticities of demand and supply (6,p.428). Thus,

$$S_b/S_d = |E_s/E_d| \quad (3)$$

where

S_b = buyer's share of fee,
S_d = developer's share of fee,
D_s = elasticity of supply, and
E_d = elasticity of demand.

TABLE 1 Transportation Impact Fees for Various Types of Land Development in Palm Beach County, Florida

Land Development Activity	Official Daily Trip Generation Rate	Fee ($)
Residential		
Single family (<2,000 ft^2)	10 per dwelling unit	804
Single family (>2,000 ft^2)	13 per dwelling unit	1,045
Multifamily	7 per dwelling unit	562
Mobile home	5 per dwelling unit	402
Nonresidential		
Hospital	15 per bed	402 per bed
General recreation	3 per parking space	80 per parking space
Nursing home	3 per bed	80 per bed
Motel	14 per room	375 per room
General office		
100,000 ft^2 or less	18 per 1,000 ft^2	482 per 1,000 ft^2
Greater than 200,000 ft^2	11 per 1,000 ft^2	295 per 1,000 ft^2
General retail		
80,000 ft^2 or less	100 per 1,000 ft^2	2,679 per 1,000 ft^2
Greater than 1,500,000 ft^2	29.8 per 1,000 ft^2	799 per 1,000 ft^2

Source: Palm Beach County Ordinance 79-7, Fair Share Contribution for Road Improvement, as amended by 85-10.

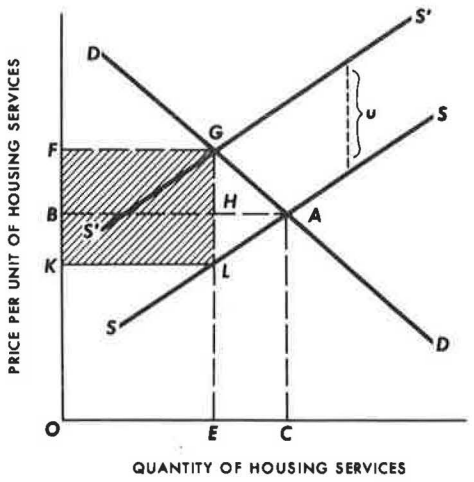

FIGURE 1 Economic incidence of a transportation impact fee.

Price elasticity is the percentage change in quantity demanded or supplied divided by the percentage change in price. A high elasticity of demand means that consumers will react to a small price increase by cutting back sharply on quantity demanded, presumably in favor of substitute goods or services. Low elasticity of demand, or inelasticity, means that consumers will pay higher prices with little reduction in quantity demanded, presumably because they have very few close substitutes. When the percentage change in quantity over the percentage change in price equals 1, the condition is referred to as unity. With an elastic supply schedule, production will increase substantially in response to a modest price increase, whereas under inelastic supply conditions production will increase relatively little.

Given Equation 3, the buyer's share of the fee will clearly be larger the less elastic the demand is and the more elastic the supply. With inelastic demand the buyer of housing services is less able to avoid the fee by substituting other housing, whereas with elastic supply the builder, especially over time, is able to adjust production by shifting his resources into other areas.

According to Weitz (7), this is exactly the type of housing market found most often in urban areas. For example, empirical estimates of the price elasticity of demand for all housing in urban areas (8,9) have been around unity or below, whereas studies of the supply side of the housing industry have found very high price elasticities. In one study, Muth (10) concludes that the price elasticity of supply is 5.5. Under these conditions, the buyer-occupant would probably bear most of the tax burden. As an illustration, the buyer's share of the $804 tax burden on a single-family house (<2,000 ft^2) in Palm Beach County would be $680. This crude approximation was derived by using Equation 3 and the absolute value of the demand and supply elasticity given previously (E_s = 5.5 and E_d = 1).

GROWTH MANAGEMENT

Growth management is a term that is difficult to define clearly. It is often discussed as if it were a singular concept, yet the wide variety of recommendations made on its behalf can usually be assigned to two distinct categories: (a) the management of the nature, location, and timing of growth or (b) the management of the impacts of growth.

The first category includes land use planning controls, transportation investment decisions, and water resource controls. Land use planning controls such as staging plans, public facility ordinances, and point-permit developer incentive plans are used to both encourage and discourage development. Transportation investment decisions are used to deny access to environmentally sensitive areas or provide enhanced access to declining urban areas. Water resource controls are equally effective in discouraging or preventing development in undeveloped or environmentally sensitive areas. Although public discussion of growth management often focuses on the first category (affecting the location and timing of growth), public officials are often more interested in the second category--managing the impacts of growth.

Impact fees are an example of the second category and can be considered a fiscal approach, the impact of which is to shift a greater share of the cost of providing new public services to new residents or developers or both. In one sense, impact fees, along with benefit assessment districts, exactions, joint development, and other value capture approaches, are current examples of the pressure in public finance to find new revenue sources and to rely, wherever possible, on user fees. They are in effect a form of narrow-based taxation. Impact fees function more to accommodate growth than to manage it, by providing another source of revenue that can be used to invest in new infrastructure. It has even been suggested that local impact fees have reduced pressure on the property tax and helped to blunt resistance to new development (4).

Several features of the typical impact fee in Florida prevent its effective use in controlling the location of growth. For most of the ordinances in Florida, the fee structure does not permit discrimination among like categories. For example, all residential structures of a certain size, regardless of their location, are assessed the same fee. Fees currently collected in Florida are generally less than 1 percent of the development cost and thus are too low to affect location decisions, even if the structure of fees were allowed to vary across a community. Nor do the impact fee ordinances enacted in Florida currently have a mechanism that would allow government to control either the timing or nature of growth. Thus impact fees as currently established in Florida are basically neutral toward the nature, timing, and location of growth but are sensitive to the fiscal cost of growth.

SUMMARY

Local governments have begun experimenting with a variety of revenue-raising devices that are capable of both achieving political support and withstanding legal challenge. One such revenue device, the transportation impact fee, has generated a great deal of interest in Florida and, because of its obvious appeal, holds great promise as a new revenue source.

Evolving case law provides local officials with sufficient legal guidance to enact ordinances establishing transportation impact fees. In this regard, the ordinance establishing impact fees in Palm Beach County, Florida, has survived judicial challenges and become a model in Florida.

The economic incidence of a transportation impact fee is an important public policy issue. With price elasticity of demand at unity or below and the price elasticity of supply very high, it can probably be

anticipated that the buyer-occupant of a home will bear most of the tax burden.

Finally, impact fees are essentially fiscal devices and function poorly as a growth management tool for control of the nature, timing, and location of growth.

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Design and Implementation of an Automated Management Information System for the Iowa Department of Transportation

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ABSTRACT

Recently transit systems of all sizes have begun to explore the variety of small-scale computer uses for assisting management. The process of design and implementation of a computerized management information system (MIS) for the Iowa Department of Transportation and five Iowa transit properties is traced. The automated system chosen consists of an NCR supermicrocomputer and Tower hardware coupled with the UNIFY data-base management system and other software. The project consisted of two phases. Focusing on research and design, Phase 1 included needs analysis conducted on site, review of institutional relationships and capabilities, assessment of available hardware and software, evaluation of telecommunications needs, and development of a Request for Proposal (RFP) to procure hardware and software. Phase 2, centered around the implementation and evaluation portion of the project, included distribution of the RFP, evaluation of bids and the procurement process, development of the chosen software, preparation of training materials, and development of a computerization impact analysis. The variety and scope of issues relevant to the development and choice of a particular computerized MIS are presented. Among the major factors affecting choice were the functions to be performed on the computer, the relationship to both local and state computer resources, the amount of employee experience with computers, the desired level of telecommunications between local and state users, and the actual software and hardware needed to satisfy the MIS needs. The entire process of design through implementation was complex and involved, and the results should prove insightful to state transportation officials and transit managers.

The management information requirements of transit properties involve large volumes of data. Once the data have been collected, they are combined with other data, summarized, and manipulated in a variety of ways. Utilization of computers for managing these data has been recognized as both efficient and productive. The change from manual to computerized data processing is a complex process that must be thoroughly planned. The transition to a computerized management information system (MIS) centers around several interrelated elements: the actual users, creators, and flows of information; the information needs as viewed by the transit professionals who will be using the system; and the desired modes of computer operation.

The design and implementation of a microcomputer-based MIS for the Iowa Department of Transportation (DOT) and five Iowa transit properties are examined here. The project was executed in two phases, the first phase concentrating on background research and design. Information was gathered using on-site visits and interviews with key transit personnel. From this information, institutional relationships were examined, and individual experience using computers was reviewed. Next an assessment was made of the readily available hardware and software suitable to meet the transit management informational needs as defined and ranked by priority by the Project Team. The Project Team consisted of state and local officials and a private consultant. Telecommunications requirements were also evaluated, and hardware and software specifications were developed in order to prepare a Request for Proposal (RFP) for prospective hardware and software vendors.

The second phase of the project centered around implementation and evaluation issues. The RFP was finalized for bid and purchase of hardware, software, and related materials. Then the RFPs were evaluated by using an assigned point system, followed by procurement of NCR Tower hardware, the UNIFY data-base management system (DBMS), and other software. The software was then adapted to serve the functional requirements identified in Phase 1. Following system installation, a variety of training aids were developed for the Iowa DOT and transit property personnel. The final step was to establish a method for evaluating the operational differences resulting from computerized data processing.

PHASE 1

Needs Analysis

An on-site needs analysis was conducted at transit systems in five of Iowa's major cities and the Public Transit Division of the Iowa DOT concerning priority

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tasks to be computerized. Other issues such as communications and procedures related to the municipal mainframe, financial, payroll, and personnel systems were examined. Basic implementation capabilities for an information system, including such items as organization, skills, resources, policies, and procedures, were determined. The Project Team assessed the information flow at each location (i.e., the data users and data creators).

In addition to individual interviews at each site, two group interviews were conducted to help determine and document user requirements. Participants at each site were encouraged to consider appointing a key staff person who would have the primary responsibility for each respective automated information system. Potential users at each transit site were contacted to provide existing and desired data elements and to gain an understanding of the short-term and long-term labor requirements involved in the implementation and maintenance of the information systems. The interest among the transit administrators in automating the various activities was determined. Based on these considerations, a ranking of functional priorities for computerization for each site was determined. These site priorities and a projectwide summary are shown in Table 1.

Existing Relationships and Capabilities

The individual and group interviews and discussions just described served to identify the relationships that existed between each city's transit, finance, and data processing departments and their respective information management activities. All of the source data forms completed by data creators and the reports produced for the data users for each of the transit systems were collected and analyzed with respect to who completes the forms, who uses them, how often they are completed, what information is included, what additional reports are produced from the data, and what purpose is served by the form or report. This information was tabulated in summary form (1) for each of the five transit sites and the information was confirmed with site staff.

Certain conclusions were drawn for all of the transit sites as a result of the determination of information flows. Some level of data--either detailed or summary--is transferred between each functional department and nearly every other department. Reports prepared by departmental supervisors often require information from several of the other departments. Once prepared, these reports are then often used by other functional departments in the preparation of their own reports. In four of the five cities, the municipally operated mainframe computer was used to assist the transit property in processing and analyzing primarily financial data. This interrelationship qualified the low prioritization for administrative and financial functions noted earlier.

Information was also obtained that provided a basis for assessing the transit system's capability to use a microcomputer or minicomputer from an operational and personnel standpoint. These assessments were based on three factors--the computer experience levels of the site staff, the overall organizational effectiveness of the staff, and the attitude of the staff toward the prospects for computerization of the present manual processes. The latter two factors were subjective observations. Computer experience was determined by interviewing staff on site and included previous experience with any of the following: word processing software, DBMS software, spreadsheet software, accounting software, graphics software, programming in a computer language, computer courses or seminars, end-user turnkey applications, or other special-purpose software packages. Such experience was classified by the hardware used--either microcomputer system or terminal to a larger minicomputer or mainframe.

Three of the five sites had little or no staff computer experience and only one site had any programming or development experience among the staff. The DOT staff capabilities, outside of the Data Processing Department, included some development with off-the-shelf microcomputer software.

The lack of computer experience among site staff indicated that both the hardware and the software procured had to be designed for ease of use and ease of development by the end user, in spite of the scope and complexity of data-processing tasks among the management functions of each site. All the sites exhibited high levels of staff cooperation, overall management organization, and interest in the automation effort. The consultant concluded that the staffs at all sites, with appropriate training, would be able to use the menu-driven applications.

Assessment of Computerized Systems

An assessment of the state of the art of computerized systems for small to medium-sized transit systems was conducted on the basis of available information. This assessment included consideration of software, hardware, and software-hardware combinations as described in the following paragraphs.

Software

An evaluation was made of software alternatives and recommendations were developed for implementation based on this evaluation. The software alternatives explored included existing transit-specific applications and general business accounting applications. The usefulness, necessity, and potential integration of these programs with a commercial microprocessor-based DBMS were determined. The aim was to select software that would allow for future modifications by the users and for expandability. Site requirements

TABLE 1 Computerization Priorities by Site

	Dubuque	Waterloo	Davenport	Sioux City	Cedar Rapids	Total Score[a]	Project Priorities in Rank Order of Importance
Maintenance	3	2	1	1	1	8	1
Materials and equipment management	4	3	2	2	2	13	2
Performance monitoring and evaluation	2	4	3	3	3	15	3
Operations	1	5	4	4	4	18	4
Administration and finance	5	1	5	5	5	21	5

[a]Lowest total score indicates highest priority, projectwide. The grouping of needs follows the categorization scheme employed in Figure 1 of the report by McOwen and Collura *(1,p.13)*.

called for multiuser expandability at each site while also permitting use in a single-user environment. Evaluation criteria included more than 60 features and considerations, as follows:

1. Transit applications;
2. General business applications for transit systems;
3. Degree of user friendliness;
4. Cost for purchase;
5. Documentation;
6. Integration and interaction between programs;
7. Need for user training and availability of trainers, cost;
8. Warranties and service (maintenance availability);
9. Communications programs;
10. Security data;
11. Back-up data system;
12. User policies and responsibility;
13. Flexibility;
14. Availability;
15. Capacity limits;
16. Upgrades;
17. Other limitations;
18. Interfacing needs;
19. Speed of program operations;
20. Reliability;
21. Ownership of software (control and licensing);
22. List of current transit or small business users or both; and
23. Program language or languages.

Additional software considerations in the preliminary evaluation of candidate DBMS software were as follows:

1. Data retrieval requirements,
2. Data update requirements,
3. Security requirements,
4. Recovery capabilities,
5. Ease of use by nonprogrammers,
6. Format convertability,
7. Program and data independence,
8. Cost,
9. Operating effectiveness (response time),
10. Operating efficiency [central processing unit (CPU) and disk access speeds],
11. Documentation,
12. Vendor support (user questions and maintenance),
13. Expandability,
14. Size of data base and type of indexing,
15. Training requirements, and
16. Communications support.

More specific features of the candidate DBMS were as follows:

1. Data manipulation language employed,
2. Data types allowed,
3. Screen format design,
4. Number of indexing keys per file,
5. Help screens,
6. Conditional processing of commands,
7. User-defined messages,
8. Entry of parameter values from terminal,
9. Maximum file size,
10. Maximum record size,
11. Maximum field size,
12. Maximum records per file,
13. Maximum fields per data base,
14. Minimum random access memory (RAM) requirements,
15. Data entry options (automatic range checking, automatic repeat, display only, calculated fields, verification, default entries, password protection for any field, logical operation, skip field),
16. Maximum files per output mask,
17. Maximum files per input mask,
18. Maximum pages per screen mask,
19. Custom menu program creation with predefined commands for interactive use,
20. Global file operations,
21. Data-base file merging with word processing,
22. Multiuser and networking capabilities, and
23. Interfacing and telecommunications.

All five transit systems needed to provide computer work stations to several functional departments. Standardization of the software packages, operating systems, applications programs, data elements, and attribute-record-file structures among the five transit sites was an important evaluation objective. Options that allowed the selection of the data elements and report formats most useful to each work site were provided.

Hardware

An assessment was made of appropriate hardware so as to provide for the optimal design specification, selection, and performance of the hardware systems and peripherals. The software specifications and needs analysis determined the hardware requirements.

The reliability and usability of the alternative hardware packages were determined by contacting other users with similar hardware configurations. Hardware was considered only if it did not require new, specially qualified staff for its operation. All hardware considered supported industry-standard operating systems, which in turn supported industry-standard programming languages.

Evaluation criteria for hardware are as follows:

1. System standards that will meet the three operating modes (stand-alone, terminal, and network);
2. Degree of user friendliness;
3. Cost for lease or purchase or both of
   a. Memory and
   b. Peripheral options;
4. Need for user training and availability of trainers, cost;
5. Warranties and service;
6. Communication systems;
7. User policies and responsibilities;
8. Availability;
9. Capacity limits;
10. Need for remote terminals or separate work stations;
11. Speed of system;
12. Reliability;
13. Usability by staff;
14. Expandability;
15. Operating system or systems;
16. Upgradeability;
17. List of similar system users;
18. Language capabilities; and
19. Work-station characteristics (e.g., physical dimensions, electrical requirements, temperature, humidity control).

Criteria for selection and evaluation of candidate hardware components and packages are as follows:

1. Detailed specifications for CPU main memory requirements,
2. CPU speed,
3. Size of data path,
4. Secondary hard disk storage requirements and tape backup,

5. Terminal requirements,
6. Keyboard requirements,
7. Communication ports,
8. Communication modems,
9. Printers and related peripherals and adjuncts,
10. Expandability from single-user to multiuser capability without changing software, and
11. Upgradeability of system's main and secondary memories.

Hardware and Software Combinations

The best combinations of hardware and software for this application were formulated and presented by the consultant. The trade-offs involving cost, capabilities, and ease of use of the software-hardware combinations were discussed and a consensus was established.

A primary consideration in evaluating the combinations was that they be easy to use. The recommended combinations provide for nontechnical, logical-level views and access and powerful high-level system commands that are well documented and capable of being learned by individuals without any knowledge of computer programming languages. Although the initial design and structure of such a DBMS is critical and does require professional assistance, once the users have become familiar with the systems they should be able to modify the data-base structure and generate new reports by following the manuals and procedures provided.

Communications Needs and Requirements

The choice of the software and hardware should be viewed in terms of their compatibility in a coordinated system. Not only must the computer work well at an individual site, it also must be able to "communicate" easily with the other sites.

The requirements of the Public Transit Division of the Iowa DOT for communications capabilities between its computers and the sites' computers and among the site computers was determined by the consultant.

Four of the transit sites exchange information with their respective municipally controlled mainframes or minicomputers. All five of the transit sites, including Waterloo, exchange much data with the Iowa DOT. In order to streamline the exchange of information and reduce the time and expense involved with manual information exchange, which usually involves multiple copying of information (data entry), there are advantages to establishing means of electronic exchange of data among the respective information systems (computers) of the transit sites, the city's mainframe, and the Public Transit Division of the Iowa DOT.

In addition, the division's responsibility for distributing state and federal transit funds to local sites and monitoring publicly funded projects gives the division added interest in accessing data produced at the transit sites.

The Public Transit Division will utilize the same equipment and software as the local transit sites. With a telecommunications link, the division can receive data automatically from the various transit systems. These data have had to be manually entered at the division in the past and are used for performance monitoring by the state and for UMTA Section 15 reporting. Although most of the data to be transmitted to the division will be aggregated or summary data, it will also be possible to transmit detailed data if needed. The ability of the division to receive data promptly from the sites will provide for improved project management and financial planning.

The other important function of the communications link among the transit sites and with the division is to share data and programs. Software modules that are developed by the state or one of the local sites can be shared by transmitting the source code (programs) to any interested site for its own use. The ability of one transit site to obtain a computer program from another site that has developed a particular program to solve a similar problem is an important telecommunications feature. Examples could include the development of a data base for storing and retrieving information about ticket, pass, coupon, or token sales and use or a program to analyze accident data. By sending these programs from one computer to another electronically, any site can take advantage of the efforts of the other sites to solve common management information needs without having to start from scratch or type in the program by hand.

Communications between computers for file transfer or for terminal emulation are achieved with the appropriate hardware and software. Telecommunications also provides the advantage of allowing access by the local sites to the DOT's statewide information network. An integrated system between the state DOT and the transit properties facilitates all types of information exchange.

System Design and Specifications

Given the trade-offs among capabilities and functions of available hardware and software, it was decided that the greatest consideration should be given to those proposals that came closest to providing all of the components specified and were best suited to meeting the needs of the project. The elements identified as a necessary part of the Request for Proposal (RFP) were the following:

1. Special consideration should be given to software that is proposed in combination with the accompanying hardware, and vice versa.
2. All software and hardware must be available for demonstration and testing, and vendors should make available software and hardware for benchmark tests if requested. Vendors may also offer their own benchmark programs and data for testing, if desired.
3. Software must be designed for multiple-user environments with comprehensive concurrency control features that allow multiple users to read and update data concurrently without overwriting updates or other loss of integrity. Lock tables (at least at the record level) or timestamping are acceptable methods. If locking methods are used, deadlock detection and response should be provided.
4. Comprehensive documentation will be required with accepted software and hardware, and telephone support for end users must be available for software and hardware.
5. Proposers should submit technical information with proposals, including users' manuals for all proposed hardware and software in sufficient detail so as to allow for close examination of the products. If requested, users' manuals may be returned for proposals that are not accepted.
6. Proposals may be considered for only a portion of the nonprimary hardware and software requested in the RFP, including individual hardware or software components. However, special consideration should be given to those proposals that come closest to meeting all of the hardware and software requirements specified. Any hardware or software components proposed must be demonstrably compatible with the major hardware and software components selected.

7. All software should be menu-driven and include help screen features.
8. Combinations should be required for the following primary components:
   a. Central processing system [including all main and secondary memory and input-output (I/O) ports],
   b. Operating system, and
   c. Relational DBMS.

There should be no exceptions to this requirement.
9. Proposed prices should be itemized for all hardware and software components.
10. All proposals should include a list of end users who currently use the proposed components and combinations and who may be contacted for references.

With these elements in mind, the RFP was finalized.

PHASE 2

RFPs

In August 1984 the Iowa DOT sent out the RFP (2). After much review, it was decided that a multiuser computer system capable of supporting multiple work stations would be required. The on-site analysis process and experience with other transit systems with similar characteristics precluded the use of a single-user personal computer at any of the sites. Multiple-user requirements narrowed the scope of available hardware and software considerably. The range of potential uses that the Iowa DOT computer should be capable of handling was as follows:

- Electronic spreadsheet
- General ledger
- Financial and statistical reporting
- Accounts receivable
- Accounts payable
- Cash management
- Passenger and revenue accounting
- Payroll, personnel, and labor distribution
- Timeroll
- Maintenance scheduling and management
- Materials management (inventory/consumables) and valuation
- Purchasing and receiving
- Claims and safety
- Responsibility and project accounting
- Construction project management
- Scheduling, estimating, and accounting
  - Financial forecasting
  - Budget development
  - Performance measurement systems
  - Section 15 reporting
  - Grant reporting
  - State and local agency funding report
- Cost-allocation plans
- Fund accounting
- Grant accounting
- Cash receipts and disbursements system
- Budget preparation and budgetary accounting
- Purchasing and encumbrance accounting systems
- Fixed-assets accounting
- Revenue and tax administration
- Cost-accounting systems
- General audits
- Attachment P "Single Auditing"
- Section 15 reports
- Section 5 level of effort and maintenance of effort
- State and local reports
- Bond indenture reports
- Pension plan audits
- Transfer of data files and program files among and between proposed work stations and IBM 4331 (operating under DOS/VSE) and or IBM 3081 (operating under OS/MVS) over existing DOT communications network
- Electronic mail
- Human resources management
  - Personnel planning
  - Training
  - Performance evaluation
  - Wage and salary administration
  - Fringe-benefit planning
  - Pension plans
  - Affirmative Action, Equal Employment Opportunity, Minority Business Enterprise
- Route analysis systems
- Internal control evaluations
- Internal audit functions
  - Organization
  - Computer methods
  - Staff training
  - Audit programs
- Revenue estimation and forecast
- Tax sales or depreciation
- Financial feasibility studies
- Funding alternative studies
- Nonfinancial feasibility studies
- Vehicle scheduling
- Customer information
- Ridership sampling
- Run cutting
- Schedule writing
- Extraboard and run picks
- Accident and safety reports
- Word processing
- Work rules impact
- Impact of service and fare changes
- Life-cycle cost data
- Warranty data (vehicles)
- Demand-responsive dispatching data
  - Client file
  - Origin-destination file
  - Vehicle use
  - Consuming-client data
  - Billing and rates
- Invoice preparation
- Market research data (surveys)
- Graphics
- Special-purpose examinations
- Contract auditing
  - Construction costs
  - Professional services
  - Transit vehicles
- Performance audits
  - Efficiency and economy review
  - Program results evaluation
  - Performance measurement systems

The hardware and software specifications set out the mandatory and supplementary requirements for the information systems. The complete list of requirements was quite extensive, and it included many of the features just described. Some selected paragraphs from the RFP that other properties should consider when undergoing a microcomputer purchase are as follows:

> The hardware components should be a multitasking, multiuser general purpose central processing microcomputer system including a floppy-disk system (one drive) or equivalent for program loading, cartridge streamer tape or equivalent (for disk backup), a printer buffer (not required if spooling-despooling software is proposed).
>
> The software DBMS should be based on the

> relational model as opposed to network or hierarchical models in order to provide for the most flexibility to the user with the least requirements for predetermined, more rigid design of file relationships. Nested comparison joins, selects, and projects should be available. Ad hoc queries should be available and capable of use by end users without programming experience. Nonprocedural queries are preferred and queries should be powerful and comprehensive.

The vendor selection criteria included the following:

> The evaluation of the submitted proposals will be made by an evaluation committee. The evaluation of qualified proposals will include, but not be limited to, the following items: features and capabilities of DBMS and other software; benchmark performance of such activities as disk I/O, terminal I/O, and CPU intensive processing; optional features provided and the extent to which they are provided; the amount and type of disk storage provided; overall performance of such items as ease of operation to communicate with the host computer, suitability of software, integration of components, additional software included; availability of service site, service turnaround time, and service rates; net cost to the Iowa DOT; a review of the proposed software and a comparison of applications features and compatibility with other proposed software; features and capabilities of hardware components.

Evaluation of the RFPs

A section of the RFP was devoted to an explanation of the proposed evaluation process. Evaluations, performed by an evaluation committee composed of Iowa DOT representatives and the consultant, were based on a scoring system. Fifteen components were assessed a maximum point value and were awarded on a continuum from zero to the indicated maximum in each of the categories. It should be noted that a weighting factor, up to the maximum number of points possible, was awarded to each criterion on the basis of the judgment of the evaluation committee about that particular aspect of the proposal. The point system was also used to determine the cost-effectiveness of acquiring optional items.

Table 2 shows the evaluation categories and their assigned points. Five different vendors responded to the RFP; one vendor offered three options. The total cost per unit ranged from a low of $17,000 to a high of $73,000. The evaluation committee, after thoroughly reviewing all the proposals, found two that were acceptable according to the defined criteria. These two were then subjected to a comprehensive evaluation. The NCR Tower computer coupled with UNIFY DBMS software was chosen as most suitable for Iowa's needs. The Iowa DOT procured the computers according to state procurement policies.

Training Aids

A variety of training aids was employed in order to assist transit managers and staff in using the information system. These training aids included on-line help screens and comments integrated into the software, written documentation in the form of an 11-page end-user guide and a 14-page guide for technical resource persons, both of which appear in the project final report (3). In addition to these training aids, telephone consulting and support were also provided to users during the initial implementation of the systems.

TABLE 2 Evaluation Categories

Category	Points
Proposal organization and completeness	Max. 30
Benchmark performance	Max. 200
Command completeness	10
Compile time	10
Disk write throughput	20
Floating point	20
Multiuser disk performance	60
Multiuser CPU performance (sorting)	40
System RAM test	10
CPU scheduling (context switching)	20
DBMS software features	Max. 40
Microprocessor features	Max. 110
Coprocessors used	20
Caching features	10
Floating point support	15
Time for single-track positioning	5
Time for average-track positioning	5
Rotational latency	5
Transfer rate	5
Maximum number of users	15
Maximum RAM	15
Maximum hard disk capacity	15
Terminal features	Max. 15
Printer features	Max. 15
Financial software features	Max. 15
Source code availability	5
Source of support	5
Spreadsheet software features	Max. 20
Main system resident in RAM	10
Number of cells	10
Word processing software features	Max. 25
Operating system features	Max. 20
Programming languages supported	10
Utilities provided	10
Maintenance and service terms	Max. 200
One phone number for hardware and software problems	20
Toll-free line for support	30
Telephone response time	20
Service response time	60
Same day	60
Within 24 hr	40
Within 48 hr	20
Over 48 hr	0
Original Equipment Manufacturer service (versus third party)	20
Telephone diagnostics availability	25
Length and terms of guarantees and warranties	25
Options available (at additional cost)	Max. 40
Extras (at no additional cost)	Max. 40
Communications	Max. 20
Installation	Max. 10
Total maximum points	800

Computerization Impact Analysis

A before-and-after case study was developed by the consultant and carried out with the assistance of local and state officials. The evaluation goal was to illustrate the potential for benefits, costs, savings, successes, and failures accruing from computerization.

Before the impacts of computerization were assessed, the procedural elements of the manual reporting process were examined. These elements included the time needed to complete the reports and the use of data in more than one report. The scope of the "before" evaluation was narrowed to the Cedar Rapids system, which has completely manual data processing and analysis. This focused on the property that would show the most pronounced impact from computerization.

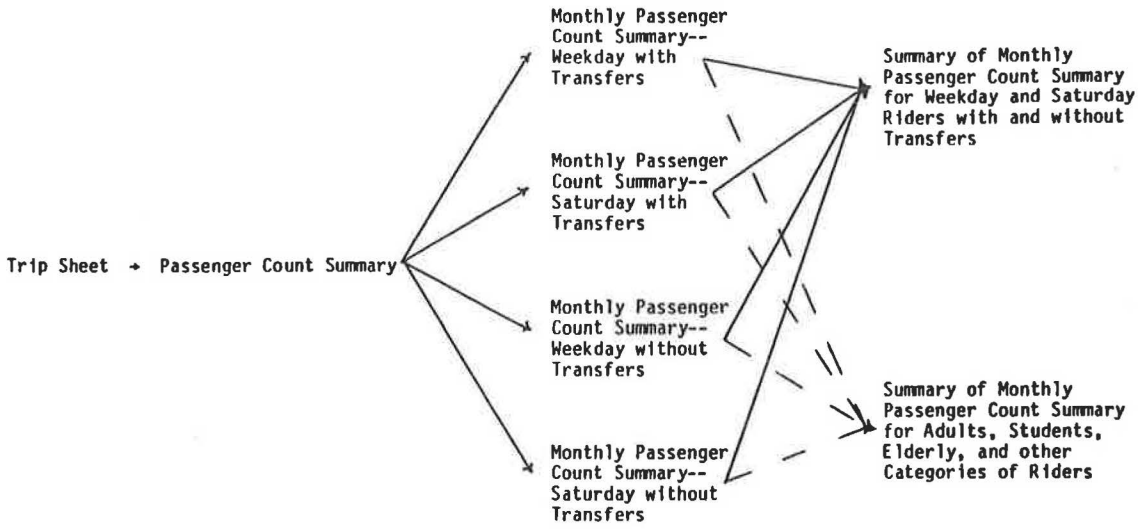

FIGURE 1 Cedar Rapids performance and operations reports.

The forms and reports prepared by Cedar Rapids personnel were collected by the consultant in order to trace the transition process from the base forms to the final reports. Figure 1 shows the data path for some selected performance and operations reports. A number of people utilize the data from these forms for completing these different reports. Extensive arithmetic manipulation is needed to produce the data shown.

To track the time spent on report preparation, a series of time logs was developed. The completed time logs showed that report preparation times varied from a low of 29 min to a high of 13 hr and 40 min. The variations, resulting from the complexity of the individual reports, were representative of the types of data collected and manipulated on the other properties.

The "after" study was designed to assess MIS implementation effects. The topics addressed are ease of microcomputer use, difference in adaptability by site, the success of the training program, and the time needed to prepare reports. To perform this study, a small data base was established and incorporated within the overall information system. Users enter a variety of data via the usual menus and screens, such as the amount of time required to use the system and any difficulty experienced. Management can then query these evaluation files in order to summarize and evaluate these data.

SUMMARY AND CONCLUSIONS

The process of designing and implementing an MIS for small and medium-sized transit properties in Iowa has been described. This process yielded a number of findings that should prove interesting to other transportation officials.

The findings are as follows:

- Transit MIS needs fall into five functional areas: maintenance, materials and equipment management, performance monitoring and evaluation, operations management, and administration and finance. A multitasking, multiuser computer system was required to meet these needs.
- In many cities a municipally operated mainframe computer is used to assist the city bus operator in processing and analyzing primarily financial data; in these instances, administration and finance may be of less importance as compared with the other four functional areas.
- At most local transit sites, employees have little or no experience with microcomputers.
- Telecommunications between a state DOT and local transit sites is technically feasible.
- The software components needed to satisfy local and state MIS needs include a relational database manager (DBMS), a multitasking operating system, a financial package, an electronic spreadsheet, and word processing, graphics, and telecommunications software. The approximate costs of off-the-shelf software per site range between $5,000 and $10,000, depending on the number of components required, discount rates, and other factors.
- The cost of developing and customizing this software for a particular site will vary with the site characteristics and requirements.
- Appropriate MIS hardware components include a multitasking, multiuser CPU, printers, modems, display screens and keyboards, tapes for disk backup, hard disk systems, and other minor peripherals. The approximate costs per site for hardware range between $20,000 and $40,000, depending on the quality of the CPU and peripherals, memory requirements, number of work stations (terminals), discount rates, and other factors.
- The RFP process was suitable for the acquisition of the appropriate hardware and software combinations.

ACKNOWLEDGMENTS

The cooperation of the Public Transit Division of the Iowa DOT and of the transit systems and other agencies in the cities of Davenport, Dubuque, Cedar Rapids, Sioux City, and Waterloo in providing the information on which this paper is based is gratefully acknowledged. The authors cannot thank by name all those who participated in this project; nevertheless, they would like to acknowledge the help of those state and local officials who served on the Project Team and aided the staff of BC Enterprises (formerly Bucher and Cope) throughout the study--most notably, Candace Bakke, Donald Alexander, and Frank Sherkow. Individuals interested in the Project Final Report, the hardware and software RFP, or other materials related to the project may contact the Public Transit Division of the Iowa DOT.

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All errors of fact and interpretation rest solely with BC Enterprises.

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Management Recruitment in the Transit Industry

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ABSTRACT

Recruitment of talented transit managers has been identified as a critical problem for the industry. A description is offered of the scope of the problem as reported by transit agencies. It is sought to determine whether the problem is more acute for particular types of transit agencies or is more accurately viewed as an industrywide problem not linked to factors such as agency size or organizational structure. An overview of the recruitment problem as reported by a sample of 207 transit agencies is presented first. The analysis includes identification of those management areas for which recruitment is a particular problem, a listing of the possible reasons for recruitment difficulties, and a summary of steps taken to resolve recruiting problems. Next addressed is whether the problem of attracting new managerial talent to the industry is related to particular characteristics of some agencies or is more generally an industrywide problem. The agency characteristics included in this analysis are size, degree of change, organizational complexity, and institutional setting. The findings of the study establish that no particular type of agency is more likely to experience recruitment problems. This contradicts the expectation that larger, organizationally complex agencies would be more attractive. Thus, recruitment difficulties either are products of local, particularistic factors irrespective of size and complexity or reflect a problem for transit as an industry.

In a 1973 study of managers in the transit industry, transit was accurately described as an "up-from-the-ranks" industry (1). Management personnel were drawn largely from within the industry, and individuals frequently moved up from nonmanagement positions. However, current trends suggest that this is less true in the mid-1980s. The increasing specialization of management functions, changes in services offered, and the institutional changes resulting from the process of governmentalization have required many agencies to recruit management personnel from outside traditional manpower pools. The resulting problem for the industry was described in the proceedings of the Transportation Research Board's 1982 Conference on the Future Directions of Urban Public Transportation (2,p.7):

> A long-term fundamental problem has been that new blood cannot be attracted into a declining industry. Only in the last decade has it been possible to attract some new managers as a result of modest growth that has occurred, and now these benefits are threatened by loss of revenues from all levels and by changing federal policy.

Thus, the recruitment problem may be seen as partly a product of the perception that transit is an industry in decline. It would be expected, therefore, that agencies reporting decreases in the numbers of vehicles operated, work force, or numbers of management personnel (or all three) would report greater

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difficulties in attracting qualified management personnel.

Shifts in the number of transit modes are expected to show some relationship to the measure of recruiting difficulties, but the direction of that relationship is not anticipated. On the one hand, decreases in the number of modes would support an image of decline that may make the agency less attractive to new managerial talent. On the other hand, adding new transit modes may increase the number of management personnel required, resulting in short-term recruitment difficulties.

The importance of agency size and organizational complexity for managerial recruitment is suggested by the results of an in-depth study of management personnel in 16 California transit agencies (3). Both size and organizational complexity were found to be positively associated with job satisfaction and personnel retention. From this it would be inferred that these two factors would also be associated with fewer difficulties in recruiting new managers. In particular, more organizationally complex agencies are expected to have fewer recruiting problems, because the opportunities for career development and advancement will be greater than those in less complex agencies.

Finally, the institutional setting of transit agencies is expected to have some bearing on their ability to recruit new managerial talent. The shift from private to public ownership resulted in not one, but several different institutional forms. Indeed, a 1981 analysis of the forms of public enterprise in transit concluded that there was no generally accepted model or form of government enterprise for public transit (4). Not only did this outcome add to the general image of turbulence, it produced an almost bewildering array of institutional contexts within which transit managers must function. It cannot be stated at this point that it is expected that one institutional form will experience more recruiting difficulties than any other; that determination is a major goal of the analysis presented here. In a more general sense, it is suspected that this complex range of institutional forms may reduce the clarity with which career tracks and opportunities for advancement can be identified by potential managerial talent, thus adding to industrywide recruitment problems.

For the purposes of this analysis, agency size is measured by four variables: the total number of vehicles operated, the number of full-time employees, the number of management personnel, and the number of modes operated. The degree of change is measured by comparing agency responses for these variables for 1979 with those reported for 1983. Both actual and percentage change data are used. As an additional measure of the change experienced by these agencies, increases or decreases in the the number of transit modes operated are included. Organizational complexity is a composite measure that sums the number of vertical levels, major departments, and administrative specialties exhibited by the organization charts submitted by the responding agencies. Finally, institutional setting is based on the self-characterization selected by the respondents of one of the following institutional types: city or county subdivision, multipurpose agency, special district, nonprofit organization, private company, or other.

DATA COLLECTION

The first step in determining the sample was to compile a list of every transit agency operating 10 or more vehicles. The sources used were

- Bus Ride: Bus Industry Directory 1982-1983
- UMTA Urban Directory
- UMTA Rural Directory
- Section 15 Report, 1981
- 1982 and 1983 Membership Directories of American Public Transit Association (APTA)

It should be noted that there were some differences among these sources even as to the names and addresses of transit agencies. After duplicate names, agencies no longer in existence, those that did not actually operate vehicles, and listings for subunits of larger agencies had been removed, the final population consisted of 493 agencies. Each agency was sent a questionnaire, a request for an organization chart, and a request for a listing of management personnel. Extended follow-up procedures produced responses from 207 agencies, a response rate of 42 percent.

Strictly speaking, this sample is not a scientifically drawn, random sample of the population of transit agencies. Rather, it is a self-selected sample that, as is explained in the following, includes a broad cross section of the industry. For this reason, the findings must be interpreted cautiously. In addition, for the same reason, tests of statistical significance are not used to establish the probability that a particular result is characteristic of the industry. Instead, these tests are used to indicate those differences or relationships that appear particularly important.

The sample includes agencies from 44 states, the District of Columbia, and Puerto Rico. Figure 1 shows that the responses from each region are approximately equal to the region's percentage share of the total number of agencies contacted.

Figure 2 presents a comparison of respondents and nonrespondents on the basis of agency size as measured by the number of vehicles operated. The distribution shows somewhat lower response rates for the smallest and largest agencies. However, all size categories are represented, indicating that the sample includes a broad range of transit agencies as measured by this characteristic.

OVERVIEW OF RECRUITMENT PROBLEM

To determine the extent to which the sample has experienced problems in recruiting qualified managerial personnel, each agency was asked to respond to the following request:

> It has been suggested that one of the difficulties currently facing the transit industry is the recruitment of qualified "managerial" personnel. With a "1" indicating that this has been a major problem for your agency and a "5" indicating that your agency has no problem at all recruiting qualified personnel, please indicate how serious this difficulty has been for your agency.

In Figure 3 it may be seen that a majority (55.7 percent) of the 196 agencies responding indicated that managerial recruitment has been either a minor problem or no problem at all. Conversely, nearly 20 percent reported that recruitment has been a serious or major problem for their agency. The remainder (24.5 percent) have experienced a moderate degree of difficulty in their recruitment efforts. Whether these figures are descriptive of an industry generally experiencing trouble in its attempts to replace and expand the managerial core is unclear, because no general measurement standard exists. The results indicate that recruitment of qualified managerial

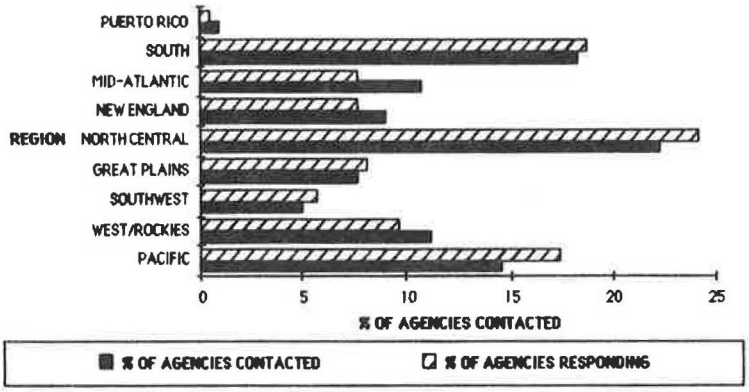

FIGURE 1 Percent distribution of agencies contacted and responding by region.

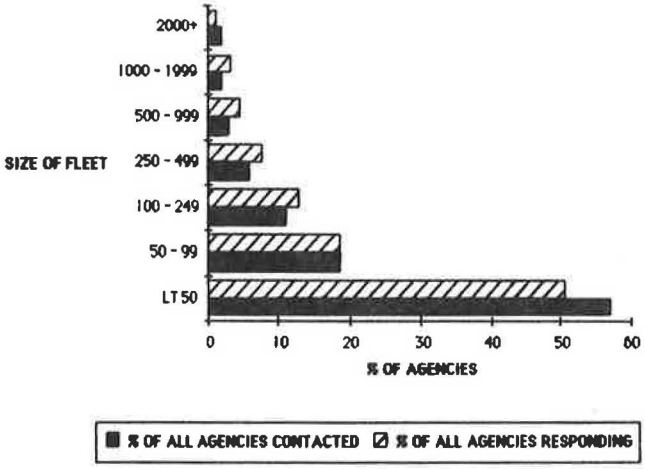

FIGURE 2 Percent distribution of all agencies contacted and responding by agency size.

personnel is not perceived to be a problem by a substantial proportion of those agencies responding to this question.

Those agencies indicating that managerial recruitment was a moderate to major problem were asked whether there were any particular positions for which they had experienced recruiting problems. Sixty-nine percent responded that there were specific managerial areas that posed a recruitment problem rather than management positions in general.

Agencies indicating specific problem areas were asked to identify them; the results are summarized in Table 1. Some agencies identified more than one problem area, which accounts for a greater number of areas identified than agencies responding.

Nearly half of the 58 responding agencies identified maintenance supervisors as the most widely experienced recruitment difficulty. Operations management and administrators with special skills also appear to be problem positions for the sample. These results suggest that the recruitment problem for many agencies is the need for a mix of specific knowledge of transit functions or particular administrative skills coupled with training or experience, or both, in management.

TABLE 1 Specific Problem Areas for Management Recruitment

Management Area	Responses No.	Responses Percent of Total	Percent of Agencies Mentioning (N = 58)
Maintenance supervisor	27	32.9	46.6
Administration management	6	7.3	10.3
Operations management	16	19.5	27.6
Directors and executives	9	11.0	15.5
Special skills			
Administration	12	14.6	20.7
Operations	6	7.3	10.3
Dispatcher	3	3.7	5.2
Other	3	3.7	5.2
Total	82	100.0	141.4

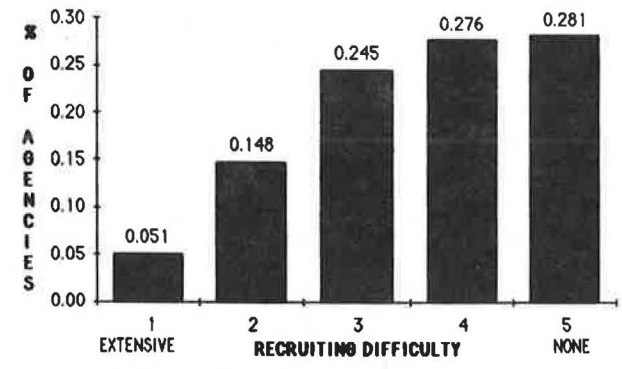

FIGURE 3 Extent of recruiting difficulty.

Those agencies indicating that they had had recruiting problems were asked to identify the reasons for those difficulties. Seventy-nine agencies responded to the question, some identifying more than one reason (Table 2).

The frequency with which financial issues are mentioned is not especially surprising. More intriguing is that nearly 60.8 percent of the responding agencies indicated a lack of qualified applicants as a reason for their recruitment difficulties. Although the survey instrument does not allow the pursuit of this finding in more detail, the frequency with which it is mentioned suggests that applicant qualifications may be a broad-based problem within the industry. It may be that the requirements for and demands on some particular management positions in transit require a combination of unique skills and training, thus limiting the available pool for recruitment. It may also be true that the industry

TABLE 2 Reasons for Recruitment Problems

Reason	Responses		Percent of Agencies Mentioning (N=79)
	No.	Percent of Total	
Financial	45	38.8	57.0
Lack of qualified applicants	48	41.4	60.8
Lack of qualified in-house personnel	6	5.2	7.6
Lack of career opportunities	1	0.9	1.3
Regulatory issues	2	1.7	2.5
Organizational issues	9	7.8	11.4
Other	5	4.3	6.3
Total	116	110.0	146.8

is not able to attract personnel with the appropriate skills.

The importance of applicant qualifications is further supported by the steps agencies are taking to resolve recruitment problems they have encountered. Table 3 shows that the most frequent action has been to provide in-house training. Thus, at least for these agencies, training is a more common response to recruitment difficulties than is enhancing financial incentives.

TABLE 3 Steps Taken to Resolve Recruitment Problems

Solution	Responses		Percent of Agencies Mentioning (N=71)
	No.	Percent of Total	
Internal training	36	35.6	50.7
Financial incentives	17	16.8	23.9
Increased incentives	6	5.9	8.5
Stronger recruitment	12	11.9	16.9
Have not overcome	14	13.9	19.7
Other	16	15.9	22.5
Total	101	100.0	142.3

EXTENT AND BASIS OF RECRUITMENT PROBLEM

Is the problem of managerial recruitment shared generally by agencies throughout the industry or is it centered on particular types of agencies defined by size, change, organizational complexity, and institutional setting? If all or some of these factors are related to managerial recruitment, the recruitment problem would appear to be an issue for certain classes of transit agencies and not others. Conversely, if no relationships are found, the perception that recruitment of qualified managers is an industrywide problem would tend to be supported.

Following a brief review of the measures used for agency characteristics, contingency table analysis is used to determine the relationships between agency characteristics and recruitment difficulties. This is followed by an application of regression analysis to determine whether agency characteristics acting in combination explain the different recruiting experiences reported by the sample.

Agency Characteristics

Agency size is measured by four variables: total number of vehicles operated, number of full-time employees, number of management personnel, and number of modes operated. The distribution of the sample along these dimensions is summarized in Table 4.

TABLE 4 Measures of Agency Size

Measure	Distribution	
	No.	Percent
Total No. of Vehicles[a]		
Less than 50	95	48.5
50-99	33	16.8
100-249	29	14.8
250-499	19	9.7
500-999	10	5.1
1,000-1,999	6	3.1
2,000 or more	4	2.0
Total	196	100.0
No. of Full-Time Employees[b]		
Less than 25	30	15.4
25-99	75	38.5
100-499	55	28.2
500-999	12	6.2
1,000-1,999	8	4.1
2,000 or more	15	7.7
Total	195	100.1
No. of Management Personnel[c]		
Less than 5	64	34.2
5-9	47	25.1
10-24	33	17.6
25-49	18	9.6
50-99	10	5.3
100 or more	15	8.0
Total	182	99.8
No. of Modes Operated		
1	95	51.6
2	56	30.4
3	29	15.8
4	4	2.2
Total	184	100.0

[a] Mean = 195.64; median = 52.17; SD = 387.75.
[b] Mean = 529.2; median = 81.3; SD = 1,395.07.
[c] Mean = 36.1; median = 6.9; SD = 100.62.

The data are presented in categorical form, with the mean, standard deviation, and median calculated from the noncategorized results. It is anticipated that larger agencies will report managerial recruitment to be less of a problem than smaller agencies.

As measures of the degree and direction of change experienced by the sample, the figures reported for 1979 were compared with those for 1983 for each of the foregoing variables. The percentage change for each measure was also computed. In addition, it was determined whether the number of modes operated by agencies increased, decreased, or stayed the same between 1979 and 1983. In general, it was expected that those agencies that had experienced declines in size or number of modes operated would be more likely to report problems in recruiting qualified managers (Table 5).

Organizational complexity is a composite measure that is a sum of the following three structural attributes: number of vertical levels, number of major departments, and number of administrative specialties. Each of these was determined from an analysis of the organization charts or listing of management positions submitted by 175 agencies. It was expected that more organizationally complex agencies would have experienced fewer recruiting problems than those that are less differentiated (Table 6).

Figure 4 shows the distribution of the sample with respect to institutional setting. Even though most of these agencies fall within either the city-

TABLE 5 Measures of Agency Change, 1979-1983

Measure	Distribution No.	Distribution Percent
Change in No. of Vehicles[a]		
Decrease of more than 10	21	13.0
Decrease of 1-10	21	13.0
No change	20	12.3
Increase of 1-9	45	27.8
Increase of 10-49	33	20.4
Increase of 50 or more	22	13.6
Total	162	100.1
Percentage Change in No. of Vehicles[b]		
Decrease of more than 10 percent	25	15.4
Decrease of 1-10 percent	17	10.5
No change	20	12.3
Increase of 1-9 percent	23	14.2
Increase of 10-24 percent	28	17.3
Increase of 25-49 percent	21	13.0
Increase of 50 percent or more	28	17.3
Total	162	100.0
Change in No. of Full-Time Employees[c]		
Decrease more than 10	21	13.7
Decrease of 1-10	38	24.8
No change	15	9.8
Increase of 1-9	31	20.3
Increase of 10-49	25	16.3
Increase of 50 or more	23	15.0
Total	153	99.9
Percentage Change in No. of Full-Time Employees[d]		
Decrease more than 10 percent	26	17.0
Decrease of 1-10 percent	33	21.6
No change	15	9.8
Increase of 1-9 percent	29	19.0
Increase of 10-24 percent	21	13.7
Increase of 25 percent or more	29	19.0
Total	153	100.1
Change in No. of Managers[e]		
Decrease	25	17.2
No change	57	39.3
Increase of 1-9	47	32.4
Increase of 10 or more	16	11.0
Total	145	99.9
Percentage Change in No. of Managers[f]		
Decrease	25	17.2
No change	57	39.3
Increase of 1-49 percent	33	22.8
Increase of 50 percent or more	30	20.7
Total	145	100.0
Change in No. of Modes Operated		
Decrease	7	4.7
No change	115	77.7
Increase	26	17.6
Total	148	100.0

[a] Mean = -2.57; median = 3.75; SD = 217.59.
[b] Mean = 63.8 percent; median = 8.6 percent; SD = 358.8 percent.
[c] Mean = 53.88; median = 1.0; SD = 264.32.
[d] Mean = 22.5 percent; median = 1.8 percent; SD = 96.7 percent.
[e] Mean = 4.28; median = 0.33; SD = 21.45
[f] Mean = 30.2 percent; median = 0.1 percent; SD = 108.9 percent.

county or special-district categories, these results illustrate the diverse array of institutional settings that characterizes the industry. However different these categories may be with respect to decision making, autonomy, or organizational structure, it was not possible to anticipate which were likely to have experienced greater or fewer recruitment difficulties.

TABLE 6 Measure of Organizational Complexity

Score	Distribution No.	Distribution Percent
1-10	26	15.0
11-20	81	46.8
21-30	40	23.1
31 or more	26	15.0
Total	173	99.9

Note: Mean = 19.69; median = 17.64; SD = 9.43.

Contingency Table Analysis

As presented in Table 7, the results of the contingency table analysis show that only two measures, number of modes currently operated and the percentage change in the number of managers, are significantly related ($p < .05$) to the level of recruitment problems reported by the sample. The results indicate that agencies operating three modes and those that increased their management personnel by 50 percent or more were more likely to view managerial recruitment as a serious problem.

To the extent that the addition of service modes increases the need for management personnel, these findings suggest that recruitment difficulties emerge when agencies attempt to rapidly increase their managerial core. Though the relationships are not statistically significant, a similar trend is found for each of the change variables. That is, those agencies experiencing increases appear more likely to consider recruitment of qualified managers as a moderate to major problem for their agency. Obviously, these results are counter to the expected association between agency decline and recruitment difficulties.

The absence of statistically significant associations between agency characteristics and the measure of recruitment problems indicates that no particular type or class of transit agency is more likely to experience difficulties recruiting replacement of or additions to its managerial core. Rather, these results imply that recruitment may become a problem for agencies irrespective of their size, organizational structure, institutional setting, and the degree and direction of change.

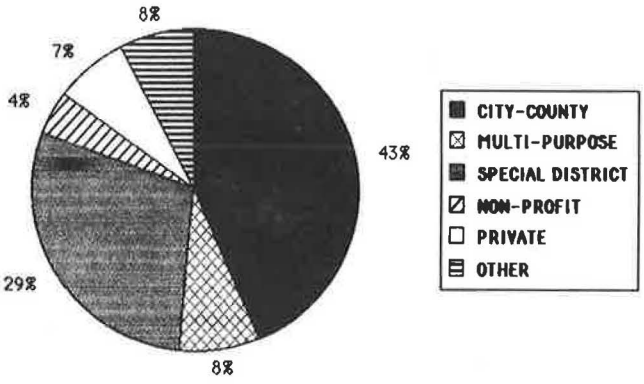

FIGURE 4 Distribution of institutional types.

TABLE 7 Cross-Tabulations of Measure of Recruitment Problems with Agency Characteristics

Variable	Percentage of Total by Ranking of Problem[a]					
	1	2	3	4	5	No.
Institutional Setting ($p > .05$)						
City-county	4.7	16.5	25.6	22.1	31.4	86
Multipurpose	–	–	35.3	23.5	41.2	17
Special district	7.3	20.0	21.8	30.9	20.0	55
Nonprofit	11.1	11.1	33.3	22.2	22.2	9
Private	–	6.7	–	53.3	40.0	15
Other	7.7	15.4	30.8	30.8	15.4	13
Overall	5.1	14.9	24.1	27.7	28.2	195
No. of Vehicles ($p > .05$)						
Less than 50	4.4	14.3	26.4	22.0	33.0	91
50-99	6.1	12.1	33.3	27.3	21.2	33
100-249	11.5	19.2	15.4	30.8	23.1	26
250-499	–	11.1	11.1	44.4	33.3	18
500-999	14.3	28.6	28.6	28.6	–	7
1,000-1,999	–	16.7	33.3	33.3	16.7	6
2,000 or more	–	–	50.0	50.0	–	4
Overall	5.4	14.6	25.4	27.6	27.0	185
No. of Full-Time Employees ($p > .09$)						
Less than 25	6.9	10.3	24.1	17.2	41.4	29
25-99	4.1	13.7	23.3	23.3	35.6	73
100-499	7.5	18.9	24.5	28.3	20.8	53
500-999	–	16.7	–	58.3	25.0	12
1,000-1,999	–	–	33.3	33.3	33.3	6
2,000 or more	7.7	15.4	38.5	38.5	–	13
Overall	5.4	14.5	23.7	27.4	29.0	186
No. of Managers ($p > .05$)						
Less than 5	3.2	14.5	32.3	17.7	32.3	62
5-9	6.7	4.4	22.2	28.9	37.8	45
10-24	12.5	21.9	21.9	25.0	18.8	32
25-49	–	17.6	11.8	29.4	41.2	17
50-99	–	12.5	12.5	50.0	25.0	8
100 or more	–	23.1	23.1	53.8	–	13
Overall	5.1	14.1	24.3	27.1	29.4	177
No. of Modes ($p < .05$)						
1	3.3	13.3	28.9	20.0	34.4	90
2	5.7	22.6	13.2	41.5	17.0	53
3	11.1	3.7	37.0	22.2	25.9	27
4	–	25.0	–	50.0	25.0	4
Overall	5.2	14.9	24.7	27.6	27.6	174
Score of Organizational Complexity ($p > .05$)						
1-10	4.3	13.0	17.4	21.7	43.5	23
11-20	5.1	13.9	25.3	29.1	26.6	79
21-30	5.3	15.8	31.6	26.3	21.1	38
31 or more	8.7	13.0	17.4	34.8	26.1	23
Overall	5.5	14.1	24.5	28.2	27.6	163
Change in No. of Vehicles ($p > .05$)						
Decrease of more than 10	–	15.8	26.3	36.8	21.1	19
Decrease of 1-10	5.0	20.0	25.0	20.0	30.0	20
No change	–	5.0	35.0	20.0	40.0	20
Increase of 1-9	4.4	13.3	24.4	31.1	26.7	45
Increase of 10-49	3.3	13.3	33.3	26.7	23.3	30
Increase of 50 or more	10.5	15.8	15.8	26.3	31.1	19
Overall	3.9	13.7	26.8	27.5	28.1	153
Percentage Change in No. of Vehicles ($p > .05$)						
Decrease of more than 10 percent	–	17.4	26.1	21.7	34.8	23
Decrease of 1-10 percent	6.3	18.8	25.0	37.5	12.5	16
No change	–	5.0	35.0	20.0	40.0	20
Increase of 1-9 percent	–	19.0	14.3	38.1	28.6	21
Increase of 10-24.9 percent	3.7	11.1	29.6	22.2	33.3	27
Increase of 25 to 49.9 percent	4.8	4.8	33.3	33.3	23.8	21
Increase of 50 percent or more	12.0	20.0	24.0	24.0	20.0	25
Overall	3.9	13.7	26.8	27.5	28.1	153

TABLE 7 Continued.

Variable	Percentage of Total by Ranking of Problem[a] 1	2	3	4	5	No.
Change in No. of Full-Time Employees ($p > .05$)						
Decrease of more than 10	–	16.7	11.1	44.4	27.8	18
Decrease of 1-10	2.8	11.1	22.2	22.2	41.7	36
No change	–	–	26.7	26.7	46.7	15
Increase of 1-9	–	9.7	22.6	32.3	35.5	31
Increase of 10-49	8.0	20.0	36.0	24.0	12.0	25
Increase of 50 or more	10.0	10.0	25.0	30.0	25.0	20
Overall	3.4	11.7	24.1	29.0	31.7	145
Percentage Change in No. of Full-Time Employees ($p > .05$)						
Decrease of more than 10 percent	4.2	12.5	8.3	37.5	37.5	24
Decrease of 0.1-10 percent	–	13.3	26.7	23.3	36.7	30
No change	–	–	26.7	26.7	46.7	15
Increase of 0.1-9.9 percent	–	10.7	25.0	39.3	25.0	28
Increase of 10-24.9 percent	5.0	20.0	30.0	25.0	20.0	20
Increase of 25 percent or more	10.7	10.7	28.6	21.4	28.6	28
Overall	3.4	11.7	24.1	29.0	31.7	145
Change in No. of Managers ($p > .05$)						
Decrease	4.2	16.7	8.3	33.3	37.5	24
No change	–	7.1	26.8	30.4	35.7	56
Increase of 1-9	7.0	9.3	30.2	23.3	30.2	43
Increase of 10 or more	7.1	21.4	21.4	28.6	21.4	14
Overall	3.6	10.9	24.1	28.5	32.8	137
Percentage Change in No. of Managers ($p < .05$)						
Decrease	4.2	16.7	8.3	33.3	37.5	24
No change	–	7.1	26.8	30.4	35.7	56
Increase of 0.1-49.9 percent	–	10.0	20.0	36.7	33.3	30
Increase of 50 percent or more	14.8	14.8	37.0	11.1	22.2	27
Overall	3.6	10.9	24.1	28.5	32.8	137
Change in No. of Modes Operated ($p > 0.5$)						
Decrease	16.7	50.0	16.7	16.7	–	6
No change	2.7	11.8	27.3	25.5	32.7	110
Increase	8.0	16.0	24.0	36.0	16.0	25
Overall	4.3	14.2	26.2	27.0	28.4	141

[a]Rank of 1 indicates major problem; rank of 5 indicates no problem.

Regression Analysis

Regression analysis was employed to explore the foregoing results in more detail and to examine the joint effects of agency characteristics on recruitment problems. Institutional setting, number of modes operated, and change in the number of modes operated were treated as categorical data and represented by dummy variables, which were created by a "1" or "0" to the response categories.

As the first step in the analysis, each of the independent variables was separately correlated with the reported degree of recruitment problems. The results (Table 8) establish that size, change, and organizational complexity are not significantly related to the recruitment problems reported by the sample. Indeed, most of the correlations are extremely weak, with several approaching zero. These findings generally confirm the contingency table results.

The second step in the analysis was to construct regression models for the categorical variables (institutional setting, number of modes operated, and change in the number of modes operated) using a dummy-variable approach. For these models the regression coefficients represent the difference between that category and the base category. The regression model for institutional setting is as follows (base category = city-county; significance of $F = 0.056$; $R^2 = 0.055$; adjusted $R^2 = 0.030$; b = regression coefficient; S_b = standard error of b):

Category	b	S_b
Multipurpose	0.473	0.310
Special district	-0.223	0.202
Nonprofit	-0.253	0.410
Private	0.680	0.327
Other	-0.279	0.348
Constant	3.586	0.126

The regression model for number of modes operated is as follows (base category = one mode; significance of $F = 0.337$; $R^2 = 0.106$; adjusted $R^2 = 0.011$):

Category	b	S_b
Two modes	-0.208	0.254
Three or more modes	-0.275	0.197
Constant	3.690	0.110

The regression model for change in number of modes operated is as follows (base category = no change; significance of $F = 0.015$; $R^2 = 0.043$; adjusted $R^2 = 0.033$):

Category	b	S_b
Decrease modes	-1.333	0.486
Increase modes	-0.307	0.251
Constant	3.667	0.091

TABLE 8 Correlations of Measures for Size, Change, and Complexity with Measure of Degree to Which Recruitment Is a Problem

Variable	r	N	Significance of F (p)
No. of vehicles	-0.31	185	0.676
No. of full-time employees	-0.048	186	0.519
No. of managers	-0.020	178	0.790
Change in no. of vehicles	-0.007	153	0.933
Percentage change in no. of vehicles	-0.066	153	0.416
Change in no. of employees	-0.010	145	0.908
Percentage change in no. of employees	0.004	145	0.962
Change in no. of managers	-0.104	137	0.229
Percentage change in no. of managers	0.001	137	0.994
Organizational complexity	-0.051	163	0.521

The models for the relationships of recruitment problems with institutional setting and number of modes operated are not statistically significant. Also the proportion of variance explained by these characteristics (R^2) and the explained variance adjusted for the degrees of freedom (adjusted R^2) approach zero in both cases. These coefficients do not establish meaningful distinctions among the categories.

The model for the change in the number of modes operated is statistically significant, though the proportion of variance explained is marginal. The regression coefficients indicate that agencies that have increased the number of modes operated report managerial recruitment to be somewhat less of a problem than do those that experienced no change. The coefficient for those agencies that decreased their number of vehicle modes is significantly less than that for the base category.

As the final step in this analysis, three regression models were constructed to determine whether agency characteristics acting in combination could explain the variation in recruiting problems reported by the sample. The first model introduced the measures of agency size; the second, those for change; and the final model included all the measures of size, change, organizational complexity, and institutional setting. None of these models was statistically significant, and the measures for the proportion of variance explained were extremely low. The results indicate that placing any importance on the separate regression coefficients is unwarranted, and for this reason only the summary measures for these models are reported in Table 9.

TABLE 9 Summary Statistics for Multiple Regression Models of Measures of Size, Change, and All Agency Characteristics with Degree to Which Recruitment Is a Problem

Model	R	R^2	Adjusted R^2	Significance of F (p)
Measures of agency size (no. of vehicles, no. of employees, no. of managers	0.028	0.001	-0.017	0.988
Measures of change (actual and percentage change of size measures)	0.143	0.020	-0.029	0.870
All measures of agency characteristics	0.41	0.17	0.03	0.256

CONCLUSIONS

This analysis revealed that a substantial proportion (28.1 percent) of the sample did not consider management recruitment to be a problem at all, and only 5.1 percent considered recruitment to be a serious problem. Overall, 55.7 percent of the responding agencies considered management recruitment to be only a slight problem. Those agencies that considered recruitment to be a moderate to severe problem tended to identify particular management areas (operations and maintenance) as especially troublesome. They considered limited financial compensation and a lack of qualified applicants as important reasons for the difficulties encountered.

Analysis of the association between agency attributes and the level of recruitment difficulties established that no particular class of agencies was more likely to experience problems than any other. No statistically significant association was found between agency size, organizational complexity, change, or institutional type. It was found, however, that the number of modes operated was related to the degree of difficulty in recruiting managers. Perhaps those agencies with a range of services require more specially qualified, experienced managers. This finding also would be consistent with the perception of some agencies that their recruitment difficulties center on specially qualified managers.

The percentage change in the number of managers is also statistically significant in relation to recruitment problems. Agencies experiencing declines or large percentage increases in management personnel were likely to report recruitment difficulties. The addition or subtraction of a particular service would significantly affect the management pool of a given agency. Total size of management staff or gross change (raw numbers) were not statistically associated with recruitment difficulty, indicating the kind of spotty recruitment problems associated with recruiting for one or two specialists.

More troubling perhaps is the failure to find any association between recruitment problems and the organizational characteristics expected to be associated with job satisfaction. None of the measures produced a statistically significant relationship except change in the number of modes and percentage change in the number of managers. Thus, although it would have been expected that larger and more complex organizations would have reported less difficulty in recruitment, they provided responses comparable with the remainder of the sample. More important, the variation explained by the regression models is minor and not statistically significant. Although this may reflect a recruitment problem of individual agencies intermittently looking for unique talent, it may also suggest a broader, more complex difficulty. That is, the particularized products of local histories with respect to funding patterns and organizational base may create important disincentives for the attraction of new managers.

A further observation is that the problem may not be one of isolated hiring difficulties. Rather, the issue may reflect a broader industry dilemma--increasing the human resource pool of transit managers. If the most attractive organizations (in terms of size and complexity) are having the same success as less attractive organizations, then an absolute scarcity of talent in the pool may be the problem. As the 1983 TRB report acknowledges, it has been hard to attract talent to a declining industry.

In sum, the problem of recruiting qualified, talented managers into the transit industry may be related to one of the following factors or to all

three: characteristics of the industry, characteristics of particular classes of transit agencies, or particularistic factors related to the localized development of transit agencies. The results of this study establish that no particular type of agency is more likely to experience more difficulties than any other. Therefore, recruitment problems are products of either the general attractiveness of the industry or the particular situations of individual transit agencies. The authors suspect that these factors are interrelated and affect the available pool of qualified personnel.

FUTURE RESEARCH

The second phase of this research will examine the perceptions of individual managers, about which at this time the authors can only speculate. Certainly the turbulence of federal policy and recent fiscal stresses would decrease confidence in industry employment opportunities.

It is hoped to examine in future analyses the extent to which the lack of clear and consistent career paths discourages entry to the industry. Because organizational size and complexity were not found to relate significantly to recruitment problems, there may be a lack of commitment to transit as a lifelong career base for managers. This may reflect uncertainties or ambiguities on the part of individual managers concerning advancement opportunities. If true, this would be a major disincentive to the recruitment of necessary management talent.

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