Urban Transit: Myths of the Present, Realities of the Future and the Role of Technology

*by Greg Mason**

I. INTRODUCTION AND OUTLINE

THE CURRENT MALAISE in urban transportation, in particular the chronic and growing deficits in urban transit operations, reduced service and dwindling patronage stem from three basic causes. First, and most importantly, there is the extension of transit service to sparsely populated suburbs. Second, transit planners are tending to adopt "hard" transit technologies that are both capital and land intensive. With low levels of use the high overhead charges cannot be spread over many patrons. Finally, in many cities the planning of landuse and the planning of transportation are independent functions.

Many myths serve to persuade governments to invest increasing sums in infrastructure improvements and prevent the taxpayer from questioning the need for these expenditures.

This paper begins by outlining some of the more important of the current crop of obfuscations, half-truths and fallacies which dominate both popular and professional thinking. The second section briefly examines the nature of transit technologies, the notion of supply in urban transportation and the relation between urban form and transportation. Finally an alternative is sketched which illustrates the use of "appropriate technology" to alleviate some of the transportation dysfunction that characterizes contemporary Canadian cities.

II. MYTHS, FALLACIES AND BIAS IN URBAN TRANSPORTATION

Myths abound in contemporary urban transportation planning. Prior to 1971, they were innocuous, however, now accelerating and chronic deficit levels impel questioning of the conventional wisdom.

Myths generally derive from three sources. First, there are simply wrong facts. For example, while the nominal price of energy has risen by almost 1000 per cent since 1973, the gasoline cost of driving a private car in real terms (i.e. adjusted for inflation) has risen only modestly.

Another, more important source of myth is the entirely accepted practice of employing **maintained hypotheses** to facilitate empirical investigation. It is now widely accepted, in the physical sciences as well as the social sciences, that empirical work requires a set of value judgements about the best way of discovering workable empirical truths. These practices, which one could call the scientific method, are a set of statements, usually derived by concensus, which guide research. An important example is the use of linear regression type demand functions and to derive price and income elasticities.

Finally, in many applied planning activities, of which transportation is a significant example, practitioners from diverse disciplines offer advice which reflects biases towards their own profession. In large measure, the present planning practice in North American cities reflects the unease that exists between planners based in social science methodologies and planners that approach the problems from engineering backgrounds.

The various broad tendencies that characterize present urban transportation practice and serve to perpetuate myth, can best be illustrated by several notable examples.

Myth: **The energy crisis will force the private car user to abandon the streets in favour of urban mass transit.**

The origins of this idea lie primarily in wrong facts and erroneous technological forecasting. First, while energy prices have increased substantially in the past eight years, it is important to evaluate this proposition using real prices. After the first round of rapid increase (from 1972 to 1974) the real price of energy actually declined until September, 1980. In recent months, gasoline prices have increased, in nominal terms, because of excise taxes imposed by the federal government. At this time it also appears as though world prices of oil will decline in the next few months. Of course the National Energy Policy is the prime reason why the gasoline cost of car ownership in Canada

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has not risen faster than general inflation rates, but even with world prices for gas, transit patronage would only be marginally higher at best.

Price increases are only part of the story. Consumers have responded to nominal price increases by conserving. This conservation has not taken the form of increased transit patronage, but in the consumption of fuel efficient automobiles. A simple study (simple in principle) would be to use Department of Transport ratings on fuel efficiencies and motor vehicle registrations to compute an average fuel efficiency over the past decade. A testable conjecture is that the fuel efficiency of the average car on the road has more than offset the increase (in real terms) of gasoline prices. At any rate the woes of the North American car manufacturers is eloquent testimony to this phenomena.

The sharp increase in oil prices (which most term the energy crisis) produces both substitution and income effects. The mistake is to assume that transit is a close substitute for the private car. An even graver error is to create institutions and regulations that effectively make transit the only substitute. In practice, fuel inefficient cars will and are being replaced by fuel efficient vehicles, ones which will in all likelihood not use gasoline. As for income effects, it is also erroneous to believe that the increase in gasoline prices would impoverish a typical household to the extent that they would be forced to use transit, before seeking alternate technologies based upon the private car.

Myth: **Urban transit has important redistributive impacts.**

Many appear to believe that transit is a service that transfers economic welfare from higher to lower income groups. Studies by Frankena (1973) suggest otherwise. In fact, a moment's reflection indicates that among the prime beneficiaries of urban transit are businesses located in the central business district and in industrial parks serviced by transit. For the journey to work, there probably is a net redistribution of benefits toward lower income workers; however, when all trips are considered (social, educational and shopping as well as journey to work) the overall effect of transit on income and wealth inequality is modest at best. Studies which indicate that the income and wealth profiles of transit users do not diverge significantly from that of the general population are probably correct despite the fact that this perspective on benefit incidence is crude. Never-theless, research which examines the redistribution impacts of both energy price increases and transit services still have urgency, since the popular impression is very strong that we do good works by allowing transit services to incur deficits.

Myth: **Transit services are homogenous**

This myth is more in the form of a maintained hypothesis. Very few transit planners would argue that suburban feeder routes have similar demand characteristics as CBD destined radial routes. Yet, transportation policies which raise rates uniformly without regard to time of day or institute service cutbacks across the board implicitly assume that there is homogeity in the service. Much of the rationalization and deregulation discussion currently in vogue mistakenly assumes that broad swaths of policy can be used to alter the social fabric.

Many operators are starting to develop policies which reflect the differences among routes such as distance pricing, adjustments to supply based upon measures of value of service by the user, etc. This experimentation is still embryonic as most operators are severely limited from regarding the transportation system in total. A plethora of regulations delimit their responsibility, and competing interests actively upset systemic planning.

Another aspect of this myth is the inability of urban transportation planners to move beyond the private vehicle/public transit dichotomy. Between these two extremes lie a host of other alternatives (termed private mass transit) in the form of informal car pools, taxicabs, jitney services and van pools. The regulatory environment that imposes this dichotomy (and this will be examined below in somewhat greater detail), encourages planners to move far too quickly from options using decentralized private vehicle (cars) to capital intensive, high technology solutions such as light rail rapid transit and other fixed route strategies.

Myth: **Transit transportation services confer significant public benefits.**

This myth or more correctly half truth, originates primarily from the difficulty of the jargon employed by economists. The distinction between a public and private good (from the point of view of an economist) turns on the appropriability of property rights. A producer that can enforce the payment for property rights contained in a commodity is essentially providing a private good. A television broadcaster cannot generally recover costs from the consumer and must recover revenues from secondary consumers (although there are technological and regulatory envi-

ronments where the consumer can be charged for television shows). In this latter instance, the commodity is a relatively pure public good, regardless of the fact that it is provided by private enterprise. Whether the service is provided privately or by the state has little bearing on its "publicness."

An important feature of the welfare state is the very rapid growth of collective provision of private goods. Recent work in public finance seeks to measure the "publicness" of collectively provided goods. In general, very few commodities provided by government have turned out to have significant public components; that is, surprisingly few governmental services could not also be provided by private enterprise. The upshot of this is that despite the fact that we talk about public mass transit, these services do not necessarily have to be provided by the state. In fact, private mass transit is beginning in many areas on an informal basis—we call them car pools.

An important qualification should be mentioned with regard to the externalities caused by congestion. The public components of private auto are the environmental degradation produced by widespread use of internal combustion engines, and the time costs car users impose on each other. Public mass transit is widely advertised as an effective solution for these effects: The key element is not the public or collective provision of transit but rather the use of technologies that move masses of people.

Myth: **Urban transit has and always will lose money**

This is an example of a myth based upon short memory. Until 1970 transit earned rates of return on invested capital which were comparable (slightly lower) to those earned in manufacturing.

The deficits recorded after 1971 were the result of policy decision to hold fare increases below cost of operators and most importantly by the provision of services to the lightly populated, newly created suburbs. Suburbanites have treated transit with complete indifference as it does not offer a generally feasible alternative to the car.

It is not true that wages and energy costs have caused these deficits. By any measure the wage increases paid to transit workers have rarely exceeded inflation, and when real wages are adjusted by changes in real gross national product it is clear that transit workers as a whole are losing relative to others in the economy. The intransigence of transit unions to changes in working arrangement (e.g. part-time worker to assist with peak hour operations) reflect this deteriorating economic situation.

TABLE 1

RATE OF RETURN ON INVESTED CAPITAL

	Transportation Equipment*	Chemicals*	Transit**
1965	12.5	8.8	5.8
1966	5.1	8.3	3.2
1967	9.3	6.5	6.0
1968	10.7	6.5	1.8
1969	12.5	6.8	5.4
1970	5.5	6.6	4.0
1971	11.3	6.6	— 3.1
1972	14.6	9.2	— 9.0
1973	16.0	10.1	—21.8
1974	14.5	15.9	—40.1
1975	11.8	12.0	—22.1
1976	14.1	9.3	—21.6
1977	13.2	6.9	—22.0

*Measured as the ratio of net income to long term debt + equity.
Source: Corporation Financial Statistics #61-207, Statistics Canada.
**Measured as the ratio of net income to value of assets.
Source: Canadian Urban Transit Association, Factbook, 1979.

The myth that these deficit levels are a noble burden for the middle class has its origin in a variety of fallacies about the operation of transit systems and the sources of cost increases. Most analyses of transit cost fail to look at the increasing overhead imposed by attempting to service displaced suburban populations. An elementary maximum for all transit planning is that revenues are proportional to density served. To ignore this rule is to incur deficits.

Myth: **Transit deficits are indicative of the poor planning inherent in government activities.**

Although the tone of the paper thus far suggests that the existing deficit in urban transit is the result of providing unwanted services at uneconomic prices, there are many instances when any producer will use debt to finance an activity. In the case of urban transportation planning it may be desirable to run large deficits, provided that unambiguous benefits are generated.

TABLE 2

REAL WAGES: TRANSIT AND INDUSTRY 1961 - 1978

	Percent Change in Real Wage		Percent Change in Real Wages Less Percent Change in Real G.N.P.	
	Transit Drivers*	Industry**	Transit Drivers	Industry
1961				
1962	1.0	2.7	—6.0	—4.3
1963	2.0	3.5	—3.2	—1.7
1964	1.4	2.9	—6.1	—4.6
1965	4.3	4.3	—3.1	—3.1
1966	.5	4.3	—8.2	—3.4
1967	8.7	4.1	5.0	.4
1968	.8	2.8	—4.2	—2.2
1969	1.3	3.6	—3.9	—1.6
1970	4.1	4.7	.2	.8
1971	5.2	7.3	—2.0	.1
1972	1.9	4.7	—4.4	—1.6
1973	— .4	2.1	—9.5	—7.0
1974	1.5	.6	—6.2	—7.1
1975	4.0	4.3	2.8	3.1
1976	4.6	5.9	—3.0	—1.7
1977	1.7	2.0	.3	.6
1978	2.5***	—8.6		—9.5

*Average top rate. Source: Canadian Urban Transit Association.
**Source: Canadian Statistical Review, #11.003. Statistics Canada. Factbook, 1979.
***Estimated

Rationalization of a service need not imply that cost is always lowered, although this is certainly the widespread belief and practice. The aim of rationalization should be to increase the difference between benefits and costs (or reduce the difference between cost and benefit); it is entirely possible that further expenditures may raise benefits more than costs, thereby improving benefit/cost ratios. Losing sight of this simple notion is the source of constant mismanagement, and mistaken efficiency drives. In urban transportation, rationalization can often be especially complex and often the most productive changes may have little apparent connection to the physical system.

III. RATIONALIZATION AND THE SUPPLY OF URBAN TRANSPORTATION SERVICES

1. Concepts of Supply

Recent work by Morlok (1980) has refined idea of the supply of transportation services. He categorizes three types of supply functions or responses. Type I supply functions are the common user cost—volume relation familiar to all transportation analysts. As volume increases, user costs increase and the service delivered declines. This supply response is inherent in the technology and organization of the transportation operation and is more or less an automatic relationship. That is, volume on

the system determines the level of service.

Type II supply responses take the form of technical and organizational interventions by operators and are adjustments such as traffic light sequencing, changing two way to one way streets and increasing the number of buses on a given route. This type of intervention shifts the user cost function down at demand levels which call forth this intervention. They are primarily confined to the mode in question.

Type III supply responses are system wide adjustments, that call for medium and long range planning. A change in the fare structure of a transit system can have effects not only within the mode, but can also produce impacts for car use and other urban modes. A transit strike often has profound impacts upon the use of cars, and can leave lasting changes in modal choice. Finally, the introduction of a light rail transit system or subway is an example of an especially profound form of type III supply adjustment. Type III adjustments are typically, **although not necessarily**, shifts to a more capital intensive or harder technology.

2. Appropriate Technology in Urban Transportation Services

E. F. Schumacher (1973) introduced the concept of appropriate technology to common planning parlance, although undoubtedly economists would protest that the idea is completely defined in the corpus of economic efficiency. Derivative from the appropriate technology concept is the distinction between soft and hard technologies, a distinction which has found widespread use in energy planning.

A hard technology path is usually chosen to exploit the economies of scale associated with capital intensity. Provided that demand is sufficient, significant market power can be obtained if the average cost curve of the firm falls over significant volumes of output, and most desirably, if the demand curve intersects the cost curve while unit costs are declining. Such high volumes of demand tend to produce large planning bureaucracies, not only to plan market strategy for the firm and control the associated technical aspects of the capital, but also to create a suitable regulatory environment in which to control profit levels and to maintain services since monopoly is the usual result.

Soft technology paths seek to avoid many of the regulatory problems associated with capital intensity by decentralizing supply, thereby permitting greater consumer control over supply and pricing decisions. The ownership of plant and equipment is spread among many more firms and, in some cases, consumers own and maintain the equipment.

Heating homes with natural gas or electricity is an example of a hard energy path, while using oil is an example of a soft energy path. The use of cars for travel reflects soft technology, while transit services are hard.

Proponents of hard technologies point to the lower costs of production which can be passed on to the consumer, while those that favour soft paths argue that consumers benefit from decentralized supply. A strong point in favour of soft technology is that the consumer is not at the mercy in the case systemic interruptions (weather interrupting service of electricity, and strikes eliminating transit services). On the other hand, soft technologies are often associated with significant externalities such as the congestion cost produced by cars. Centralized technologies are often the only way of avoiding the dysfunction produced by independent decisions and prisoner's paradoxes.

The major problem of urban transportation planners is to examine the set of type III supply responses and to design effective portfolios of both hard and soft technologies to maintain transportation service over the long run. In the words of Morlok (1980:24);

> The network equilibrium problem thus takes on the characteristics of a game in which each player is trying to optimize his own position. This type of behaviour has not been considered on the supply side of network models and its inclusion will require considerable extension of the present models.

Far too frequently the debate degenerates where advocates of a soft technologies extoll the virtues of individual choice and denigrating the possibilities of transit, while the proponents of hard technologies point to alleged social benefits and allude to uncertainties over fossil fuels as arguments which support massive infusions of capital and bureaucracy. In order to draw more finely the nature of the contemporary urban transport problem, a simple example of urban form and transportation function is useful.

3. Urban Form and Light Rail Transit

Consider a city on a flat, featureless plain, which I shall call "VonThunenville." Let this city have a single identifiable central business district and be served by four radial roads, each ema-

nating toward the poles of the compass at time t = 1. The usual situation is the circular city presented in Figure 1.

Sometime after t = 1 the city council sites an airport in the northwest quadrant, and heavy industrial activity to the east (possibly oil refining) to permit air pollution to be carried away by prevailing winds. Consequently urban expansion is impeded to the northwest and to east.

At time t = 20, the region experiences a significant population increase due to a resource based economic boom. In addition, some 200 miles to the south a second major city (Ricardoville) also experiences significant growth. The government decides to locate a second airport some thirty miles south of the existing boundary of VonThunenville to service growing national and international air travel. While residential development occurs in all quadrants, the bulk of the population and economic activity is located to the south, taking advantages of the new airport and the heavily travelled corridor between the two cities. At time t = 30 the Von-Thunenville appears as in Figure 2.

Until time t = 30, the urban transportation function of VonThunenville has been serviced using the private car and conventional diesel buses. This portfolio of soft and hard technologies fails to curtail the escalating congestion costs, as increasing proportions of urban travelers use private cars (exploiting the high incomes from the rapid economic growth). The widespread disenchantment with the transportation function prompts government to install a light rail transit system.

"Von-Thunenville" at t = 1

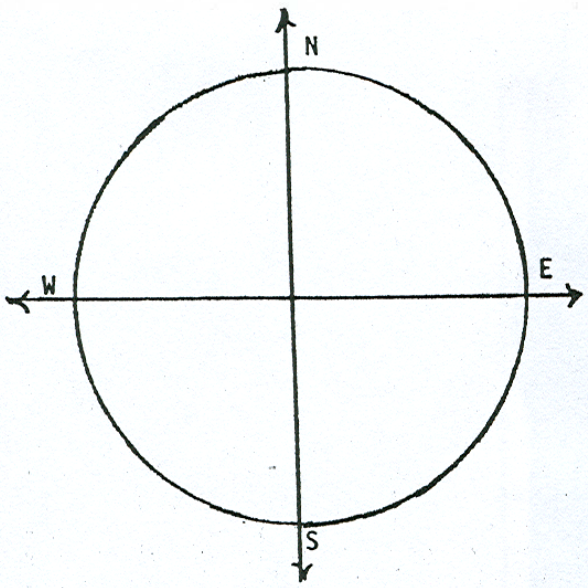

FIGURE 1

"Von-Thunenville" at time t = 30

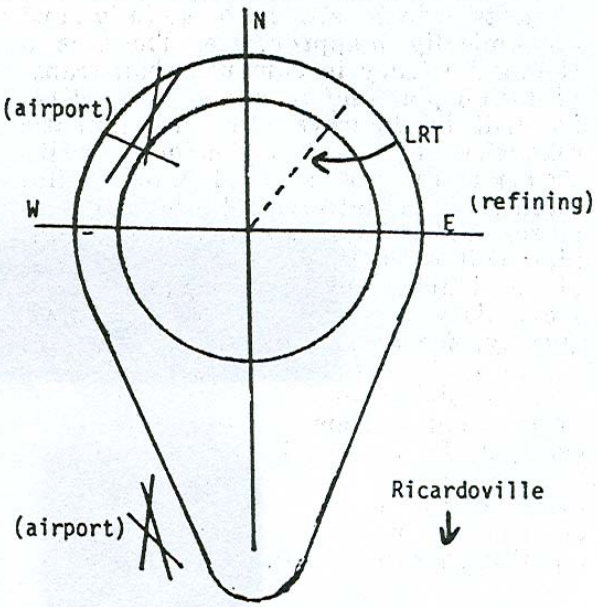

FIGURE 2

The city government, assisted by grants from senior levels of government, recognizes that the emerging development to the south is in greatest need, but the very high land costs and recent development preclude expropriation. As a result, the third mode is routed to the northeast, where relatively modest development and an existing right-of-way facilitate construction. Planners defended the routing on the grounds that the project is a demonstration to portray "state-of-the art" transit service, and they allude to future zoning and development plans which will encourage higher density developments along the corridor. Plans are laid to acquire rights-of-way to the south but expropriation costs loom large, and the rapid southerly extension of the city requires a much longer transit route than originally intended. Inflation in capital costs and land costs threaten the project as senior levels of government become reluctant to follow the expensive logic of the original scheme. Meanwhile to the northeast, along the existing rail route, homeowners whose properties abut the right-of-way, complain about the external effects of above ground rapid transit, while others, a short distance away, using the former as buffers, quietly enjoy a modest capital gain in the land values.

This brief parable, with no particular city in mind, illustrates the problems inherent in modern urban transportation

planning. Often pure engineering elegance serves to encourage transport projects which are both socially and economically inappropriate. There is a strong tendency in current urban transportation planning to assume that service will be improved by an automatic extension of hard technologies. City governments are seduced into capital intensive alternatives, not solely by the biases that exist in transportation planning (although they are important) but by the inability of landuse planners and economists to devise alternatives. Frequently, the alternatives offered require overly complicated tax and legal matters, involving more than one level of government and empirically shaky propositions from social science. Despite these caveats, it is possible to devise intermediate transportation technologies that offer promise for alleviating the malaise in contemporary city planning.

IV. PRIVATE MASS TRANSIT: AN EXAMPLE

Hitherto, the options considered by planners has been either private transit or public mass transit. Very little work has been done on encouraging intermediate private mass transit. To make the problem solvable, consider only the journey to and from work, since this is the one trip that actually produces the major dysfunction in urban transportation.

The proposal is relatively simple and involves both technical, legal and economic components.

First, the vehicle would be the standard twelve passenger van. In fact, physically, this scheme is identical to the van pooling experiments which are becoming popular throughout North America. However, there the similarity stops.

Existing van pooling arrangements have several critical limitations. First, service is offered in the context of work, and the journey to work becomes an extension of employment responsibilities, at least for the driver and alternate. Second, there is a limit to the cost that an employer will be willing to bear to facilitate such activities despite the significant benefits obtained in the form of reduced absenteeism. Third, the fact that employers might be willing to support such a plan, could be interpreted by workers as a management ploy to encourage productivity, and there is a risk of participant disaffection. Fourth, if the transportation capital (the vans) are owned by the employer, users actually have little discretion over the conditions of service. As the number of vans increase (and a large employer could support twenty vans), the bureaucracy would impose common conditions for all users and the benefits that a soft technology offers in the form of consumer control are muted. Fifth, most schemes fail to return a significant reward to the operator, and difficulties in finding drivers on a continual basis are being experienced with some of the experiments.

One way for addressing some of these concerns is to have unions coordinate van pooling. This alleviates the suggestion that it is a tool of management to increase employee performance, but the general problem of user control remain. In large workplaces, uniform standards would undoubtedly emerge, that would make it difficult to amend services such as having the van also make regular shopping runs.

An alternative proposal is to remove the responsibility for initiating vans from either the government, employers or labour organizations and provide incentives or individuals to organize their own operations. At the moment a variety of impediments exist to frustrate such private van pools. For example, most municipal acts give monopoly powers to their transit companies for "busing" operations. In addition, taxicab lobbies would undoubtedly oppose such schemes. Also, the licencing off drivers and insurance matters would have to be clarified. None of these obstacles is particularly difficult.

One major issue is how to confer significant benefits upon the driver to assume such responsibilities. A typical fee charged for twelve mile roundtrips is in order of $25.00-$40.00 which is attractive to the user considering the door-to-door service, reduced overall travel time and the costs of private car use over the same distance. Even so, a total revenue of $250.00 to $400.00 per month (assuming ten passengers) would fail to cover costs. In this case, a sound argument can be constructed to create a tax shelter for owner/drivers who initiate such a scheme. If losses incurred in the provision of such a service (including capital cost allowance) were deductible from employment income, the initial economic disadvantage could be transformed into a substantial gain. Furthermore, regular riders of such private van pools could also be given a tax credit to encourage participation.

The important aspects of this proposal are not the details of the tax statement, but the illustration of how an intermediate technology that moves between the polar extremes of private car use and public mass transit can be designed. Integral to such plans is the combination of both technical innova-

tion (the passenger van) and legal innovations. Whether such a plan could prove beneficial in fact, as opposed to a simple theoretical exercise remains unproved, however, the use of tax expenditures to promote social efficiency is well established in Canadian Tax law.

Such a scheme would not divert masses of car drivers away from the private automobile. Private van pooling can only work for larger employers where enough employees live in close proximity to each other to make collection and distribution feasible. Patronage estimates higher than 4 - 5 per cent of the travelling public are probably wildly optimistic. Even so the tax expenditure involved is modest. The prime virtue in such a scheme is to illustrate that there are intermediate transportation technologies which ought to be explored as potentially fruitful before we reach for the state-of-the-art techniques.

V. CONCLUSIONS

Urban transportation labours under many myths. Some of the most common were detailed above, but none is as potentially harmful as the assumption that capital intensive technologies offer the only constructive solution for solving transportation problems. The real power of hard technologies in urban transportation lie in their ability to guide development and land use. Light rail transit and other fixed route modes should be planned and the rights-of-way acquired significantly in advance of need. In this way landuse and development initiatives can be allowed to condition landuse in such a way that the eventual transportation corridor is supported by high density. Even if the transit system is installed prior to full development densities have been attained, the deficits incurred are justifiable under the argument that they are encouraging eventual patronage and permitting the system to achieve the economies of scale to allow cost recovery. This is a vastly different argument and justification than the largely specious arguments advanced in favour of present day transit deficits.

Given the extreme difficulty most urban environments have in digesting capital intensive transportation technologies after residential and industrial patterns have been allowed to gel, transportation planners should forsake their fascination with high technology and concentrate upon devising more plans which are technically more modest, but which address the needs of the travelling public. The challenge lies, not in technical sophistication, but in devising legal and social innovations required to support these intermediate technologies.

FOOTNOTES

1 This paper is part of a series of papers and research into urban transit supported by grant #337-1625-10 from the Centre for Transport Studies at the University of Manitoba.

2 One logical loose end in the characterization of private autos as soft transportation technology is that cars are very land intensive. The opportunity cost of land used to service the car has been pointed out by many researchers. Land also has many of the attributes of capital, and faithfully reflects planning mistakes. It is important to stress that capital (land) intensity is only one aspect of characterizing a technology as hard or soft. Another important feature is the decentralization of decision-making.

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