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Sydney's Passenger Transport: Accounting for Different Modes

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Abstract

Funding of transport in Australia comes from a wide range of sources with different objectives, assessment criteria and information. The achievement of an optimal mix of modes within an integrated transport system, however, is dependent on a commonality of information to enable objective assessment and comparison between the different transport modes and options. To perform this comparison, there is a need to develop more accurate and standardised transport costings across transport modes.

This paper helps to bridge this information gap by presenting the initial results of a study into transport costs within the Sydney region for three different passenger transport modes: car, bus and train. The study collates a wide range of information from a variety of sources, including modal transport authorities, the Australian Bureau of Statistics, and the NSW Transport Data Centre. Sensitivity analysis has been performed for some of the major assumptions.

For the land, infrastructure and fleet values included in this study, annualised asset values, expressed in cents per passenger-km travelled, were found to be highest (by a factor of two) for cars. Car asset values were dominated by land costs, whereas bus and train asset values were dominated by infrastructure costs. Operating costs, also expressed in cents per passenger-km travelled, were similar in magnitude for all three modes. User charges were also similar in magnitude for all three modes and were roughly half the operating costs.

This study underestimates the costs of cars, because it has not yet considered the costs of traffic policing, of medical/hospital care and of those environmental impacts which can be unambiguously costed in dollars. The data indicate that all three modes of Sydney's transport provision and operation are subsidised

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Introduction

Australian cities are centres of economic, social, cultural and information exchange. These functions are facilitated through a variety of means including urban planning, telecommunications and transport. Urban transport managers therefore need to allocate scarce resources to best assist people in accessing the people, goods, services and facilities that they require.

In addition to society's desire for exchange, there is increasing pressure being imposed by community expectations, economic competition and ecological constraints for urban transport planning to address the issues of traffic congestion, provision of better and more accessible public transport services, and air quality (NSW Govt, 1999b). Negative social and environmental effects of poorly managed transport hamper Sydney's progress as a leading regional post-industrial city. In short, there is a need for Australian cities to ensure that they provide the most appropriate transport services with least cost and greatest benefit to the economy, society and bio-physical environment. Transport assessment in turn must integrate a wide range of factors to give an indication of this optimal course of action.

Presently, decisions relating to the allocation of this funding for transport activities are largely based on budget processes which rely on historical patterns of funding to different modal agencies (see Figure 1). Within the modal jurisdiction of each agency, funds are then allocated to alternative projects on the basis of their performance against assessment criteria, with limited scope for comparison of different modal alternatives.

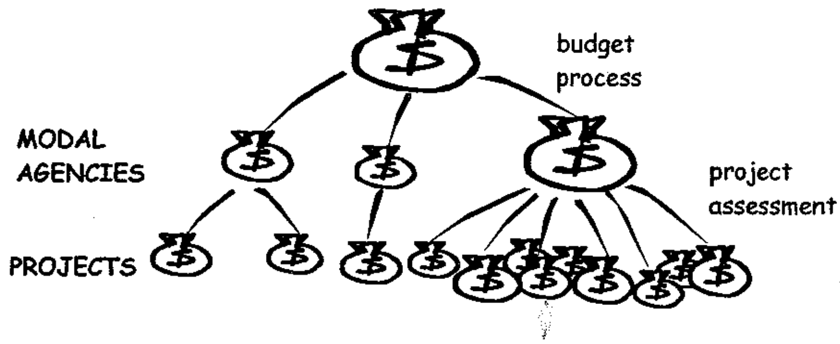

Figure 1: Funding allocation for transport projects

As suggested in Figure 1, the budget process at a Federal and State level presently preempts the modal separation and distribution and therefore limits the efficacy of transport project assessment. There is a lack of integration of modes in the assessment process so, while optimal solutions may be found through objective assessments *within* each mode, there is little mechanism for bringing about an optimal mix of transport modes and accessing solutions more generally. There is also a lack of commonality of information of even a basic nature to assist with comparing between the different modes of transport, specifically the true benefits and costs of each mode.

To assist in providing this comparison, there is therefore a need to develop more accurate and standardised transport costings across transport modes. This paper aims to help bridge this information gap by presenting initial costs estimates across the three passenger transport modes of car, bus and train for Sydney.

The paper will outline the methods used to collate and compare different modal costs for Sydney and will present some of the initial results that have been obtained from this work.

Scope of the study

The project compares the cost effectiveness of three major passenger transport modes in Sydney – car, bus and train -- by compiling data on all internal costs of each of the modes, expressed in $/passenger-km. At this stage there are very few data on the extent and performance of somatic transport (e.g. walking and cycling) and minor motorised passenger transport (e.g. motorcycle, ferry) modes in Sydney. Later work should therefore focus on establishing baseline information on somatic and minor motorised passenger transport modes, as well as incorporating freight transport modes into the model.

The project has also been restricted to internal costs ('accountables') which can be determined with a greater degree of accuracy. While it is essential to include transport externalities in the long term, they are omitted from the present project due to the time consuming and difficult nature of calculating these values, taking into account the virtual absence of existing Sydney based externalities data. Internal costs considered in the project include:

- Asset values:
  - Land under infrastructure;
  - Infrastructure; and
  - Fleet / rolling stock.
- Operating costs:
  - System administration;
  - System maintenance;
  - Fleet operation, labour , fuel; and maintenance.
- User costs:
  - Fuel, excise and maintenance payments; and
  - Fares, tolls and charges.

Each of the costs and values has been defined according to payment by (for asset and operating costs) or towards (for user costs) public and private expenses. Wider costs, such as those associated with traffic policing and transport accidents, have not been included in the present project and should be incorporated in later stages.

Data, method & assumptions

Data

The project collates information from a wide range of sources including various modal transport authorities, the Australian Bureau of Statistics, and the NSW Transport Data Centre. Where possible, figures have been collected for each Local Government Area across the Sydney metropolitan area, as defined by the ABS's Sydney Statistical Division. This definition of Sydney includes all LGAs within the area normally considered to be part of the Sydney region, and also includes the LGAs of Blue Mountains, Gosford, Wyong and Wollondilly. Due to data limitations, cross-modal costs were calculated only at the whole of Sydney level, as presented in the next section. Much of the data on asset and operating costs of transport in Sydney were calculated using information obtained directly from transport agencies or through cost reporting in annual reports

Method

Prior research to determine partial transport costings have been undertaken for Perth (Laube & Lynch, 1993) and Melbourne (Vic EPA, 1994). In Sydney, although costs and fares for public transport have been reviewed by the NSW Independent Pricing and Regulatory Tribunal, a comprehensive comparison has not been made of private transport. Thorough transport costing work undertaken for the *Heidelberg Study* (Germany) provides a model for estimating not only internal costs but also environmental and external costs of one car at each of its different stages from 'cradle to grave'.

Research for this project has drawn on the method of Laube & Lynch and existing public transport cost data, to provide a comparison across all three major transport modes of car, bus and train. In order to be able to present this information in a comparative manner, a number of assumptions were made, as outlined below.

Assumptions

- All values were calculated for 1996 to coincide with census data.
- Annual vehicle kilometres travelled (VKT), passenger kilometres travelled (PKT) and passenger journeys (PJ) were determined using home interview survey data (TDC, 1997) and on the assumption that weekly traffic was equivalent to 6.5 times the average weekday traffic, as verified on a number of routes. Annual increases in VKT, PKT and PJ were based on a consistent rate of increase in VKT between 1976 and 1995 (EPA NSW, 1997).
- Annual increases in length of road were assumed to be proportional to increases in population.
- VKT (by mode), reflecting average traffic flow, was used to assess the contribution of different modes to road capacity usage for the *flow* and *flow&force* cases (defined in the next Section). The design volume for setting the capacity of road traffic

facilities, however, is conventionally based on peak traffic flow rather than average traffic flow (e.g. HHV30 or HHV80) (Hidas, 1995). It would therefore be more appropriate to relate construction and land consumption costs to the distribution of peak rather than average flow, however, this data is not yet collected on a mode by mode basis (RTA, 1999). Peak distribution is likely to have a higher proportion of cars and lower proportion of trucks, therefore the values used in this project will tend to underestimate the contribution and cost of cars, and overestimate the contribution of trucks.

- Consumption of road space by different modes was based on standard size equivalence factors (O'Flaherty, 1986, p352).
- The distribution of VKT and PKT by mode was calculated by using information on modal split in NSW as well as the proportion of public transport in major urban areas across Australia (Austroads, 1997)
- High, low and median asset values were calculated for a range of discount rates and repayment/asset lifetime periods. For all assets the discount rates used were 5%, 7% and 10% in real terms (adjusted for inflation). The repayment periods used were 20, 25 and 40 years for land and infrastructure; 5, 8 and 11 years for cars; 8, 10 and 20 years for buses; and 20, 25 and 35 years for urban passenger rail rolling stock
- For the purposes of calculating land values, the ratio of RTA roads in Sydney to the whole of NSW was assumed to be proportional to the ratio of the population and vehicle fleet in Sydney to the whole of NSW. While this assumption is not completely accurate, it was necessary in order to produce comparable results. Also, higher land values in Sydney were thought to be balanced by higher population and fleet density with respect to road space.
- The proportion of classified roads in Sydney was approximately equivalent to the proportion of State roads in Sydney, as verified in a number of tests run by the project.
- Levels of private parking, e.g. garages, driveways, office car parks, shopping centre car parks, were assumed to be 70% of the level of that in the USA (Renner, 1988).
- The relationship between local and classified (regional and State) roads in Sydney was estimated at 2/3 for width and 1/8 for infrastructure cost per square metre. This estimate was based on road geometric design parameters for different roads and some cost comparisons. More precise information on the ratio of local and classified roads would depend on the provision of average urban road infrastructure cost data by the NSW Roads and Traffic Authority.
- Land requirements for rail are based on peak rail network usage. Since no freight operations occur during peak times in Sydney, rail land requirements were entirely attributed to passenger rail.
- Private or semi-private (e.g. BOOT) transport infrastructure projects have been omitted from this project due to difficulties in obtaining information and allocating costs for each project. Inclusion of these projects will increase private and public costs of transport systems, especially road transport systems
- Parking infrastructure costs were equated to the low end of Section 94 contribution rates for different Councils, minus the land cost component

- Fleet values of cars were calculated on the basis of fleet engine size, year of manufacture and number of passenger vehicles in Sydney.
- Costs for buses include both public and private buses. Private buses have been included in the project in order to provide a more complete geographic range which is consistent with information on the other modes. However, precise aggregated data from each of the private bus companies operating in the Sydney region has not been obtained, so private buses costs are based on those for public buses. The proportion of private bus activity has been estimated by the split of private and public bus activity indicated by census data and TDC home interview surveys. Buses were assumed to be of the same value per bus for public and private buses
- PKT and PJ for public transport were calculated using data from public operators in Sydney (STA, 1996; STA, 1997; CityRail, 1997; Austroads, 1997) and on the assumption that the average distance of a bus trip was the same for users of public and private buses.
- Land consumption rates for specific bus facilities (e.g. termini, depots) were assumed to be proportional to level of road use for public and private bus services. Higher level of support services for public buses was assumed to be balanced by the lower economies of scale for a large number of private operators.
- Public and private bus user costs are assumed to be proportional to the respective number of passenger trips. Higher private bus fares and a lack of multi-ride tickets on private buses is balanced by a higher proportion of concession tickets in low density areas.
- Road administration costs were attributed to different road transport modes in proportion to fleet sizes and usage rates.
- State and Local road administration and development costs were assumed to be in proportion to the level of the task, e.g. in terms of length of road. Lower economies of scale and specific responsibilities at the local level were assumed to balance specific responsibilities, e.g. registration at the State level.
- Car operating costs were interpolated (using Lagrange polynomial) for vehicles under 8 years. Therefore car operating costs may be underestimated since they are likely to be higher for older vehicles.
- User contributions to car operating costs assume that the distance travelled is proportional to the number of trips. This would overestimate user contributions to fuel costs if people have longer trips when fuel is subsidised by their employer. User costs also took account of employer contributions to various transport costs such as subsidies for car payment, fuel and public transport passes.

Results

Transport usage

The overall focus and nature of transport activity and development in Sydney is reflected in the use and provision of transport services for different modes across the metropolitan region. As seen from data on passenger kilometres travelled by various modes (Figure 2), cars dominate Sydney's passenger transport task, with 32 billion passenger kilometres (pkm) per year travelled in cars. Other major passenger transport modes are passenger rail with 4 billion pkm per year, and buses with 2.5 billion pkm per year.

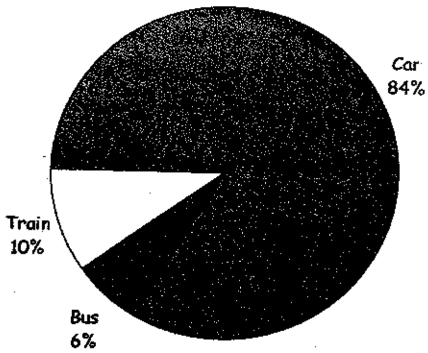

Figure 2: Distribution of transport usage by passenger mode, Sydney, 1996 (PKT)

(Based on data from IDC, 1997; SRA, 1996a; CityRail, 1997; Austroads, 1997; STA, 1996; STA, 1997).

In terms of the number of passenger journeys, cars account for approximately ten times the passenger journeys of either buses or trains. In terms of the size of infrastructure, cars account for approximately 20,000 km of road, or about twenty times the infrastructure length of trains and buses combined (Figure 3).

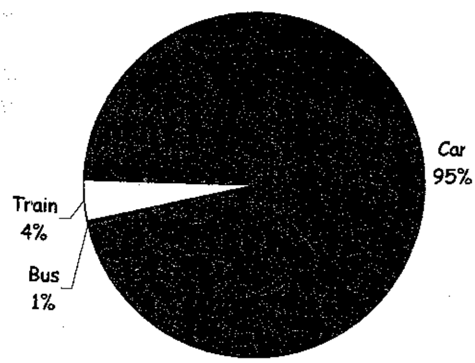

Figure 3: Distribution by infrastructure provision, Sydney, 1996 (km track or road)

(Based on data from Austroads, 1994; Austroads, 1997; RTA, 1994; RTA, 1997; SRA, 1996)

Despite recent statements regarding the central role of somatic and public transport in Sydney, it is clear that the existing transport system and usage across the metropolitan region is (and has been) heavily dominated by cars and car-based road infrastructure. Trains and buses comprise a much smaller component (about 15%) of the integrated transport system, and the contribution of other modes such as cycling, walking and ferry, is either not measured or is negligible with respect to cars.

Annualised asset costs and sensitivity analysis

Given the different size of the transport task for different modes, asset and operating costs also vary. Comprehensive data collection on the level and cost of different modes of transport has not yet been undertaken so, comparison of the costs of different modes necessitated a variety of assumptions. To test the significance of these assumptions, the project undertook calculations using different cases and sensitivity parameters. Sensitivity analysis of annualised asset costs was undertaken using different discount rates and asset life spans. These values and the effect of assumptions are outlined below.

Total asset costs were calculated for cars, buses and passenger trains in Sydney (see Figures 4-6). These costs include land, infrastructure and fleet/rolling stock capital costs, and use a range of discount rates as discussed in previously.

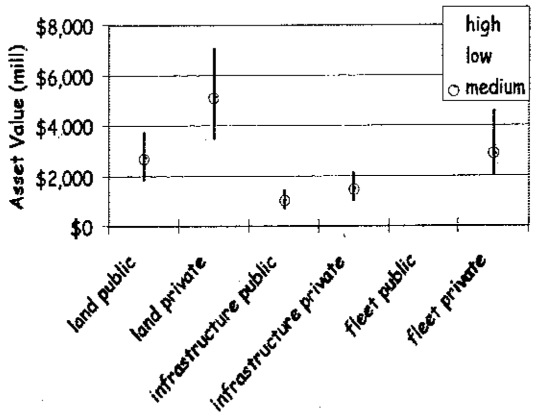

Figure 4: Sensitivity range for annualised car asset costs

(Based on data from ABS, 1996a; Renner, 1988; RTA, 1996; IDC, 1997)

In the case of cars, about 60% of asset costs were attributable to private and public land under car-related space, which varied by up to 35% when different discount rates were used.

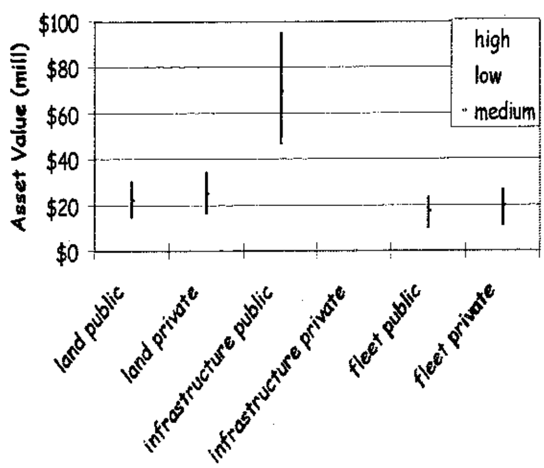

Figure 5: Sensitivity range for annualised bus asset costs

(Based on data from RTA, 1996; STA, 1996)

For buses, the main component (45%) of annualised asset costs was found to be public infrastructure costs – reflecting the greater contribution of heavy vehicles to the cost of road pavement construction. Bus asset costs had a similar level of sensitivity as cars, to the range of relevant discount rates.

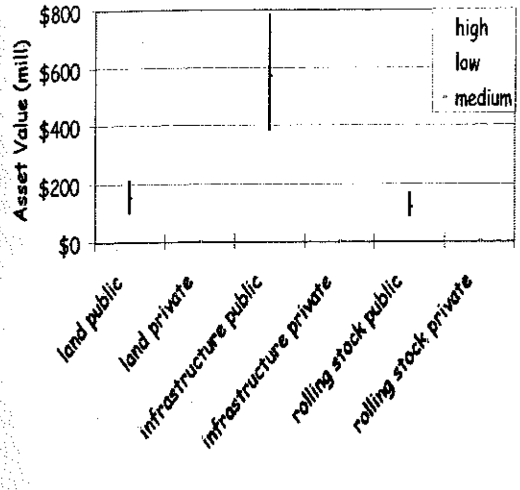

Figure 6: Sensitivity range for annualised train asset costs

(Based on data from CityRail 1997; SRA, 1996a)

Finally, passenger rail asset costs were found to be dominated by infrastructure costs (at 68% of asset costs) with figures again varying by up to 35% according to the range of different discount rates used.

Allocation cases

Having established a range of asset and operating costs, road transport costs were allocated to cars and buses for three different cases: *force*; *flow*; and *flow&force*.

The *force* case (see Figure 7) attributed road construction and maintenance costs to their proportional force on road pavement, primarily determined by heavy vehicles. While heavy vehicles determine the strength of many roads, the demand for roads is due to total traffic task, of which heavy vehicles are less than 20%. Hence the *force* case overestimates the contribution of heavy vehicles to the need for additional road capacity.

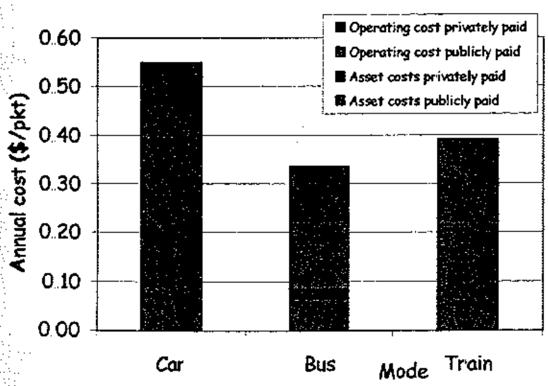

Figure 7: Annual asset and operating costs - *force* case

(Based on data from ABS, 1996a; CityRail 1997; FreightCorp, 1998; NRMA, 1991; Renner, 1988; RTA, 1996 & 1997; SRA, 1996a & 1997; STA, 1996; TDC, 1997)

The *flow* case (Figure 8) took the opposite view of attributing road investment according to traffic flow and hence the demand for road building and operation (of whatever strength). This assumption allocates road based costs primarily to light vehicles in proportion to their consumption of capacity, but it fails to recognise the disproportionate contribution of heavy vehicles to construction and maintenance costs.

It therefore underestimates the contribution of heavy vehicles to transport construction and maintenance costs.

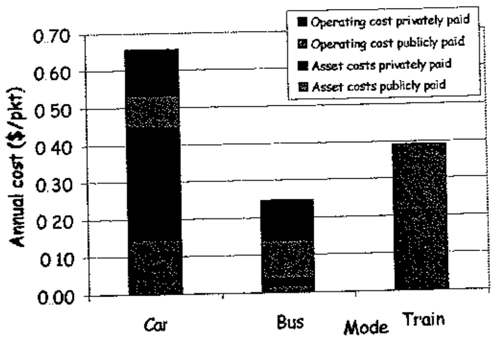

Figure 8: Annual asset and operating costs - *flow* case

(Based on data from ABS, 1996a; CityRail 1997; FreightCorp, 1998; NRMA, 1991; Renner, 1988; RTA, 1996 & 1997; SRA, 1996a & 1997; STA, 1996; IDC, 1997)

Finally, the *flow&force* case (Figure 9) balanced these two extremes by assuming that different roads are inevitably built to different strengths. Classified roads were therefore attributed primarily to force contributions (mainly heavy vehicles) and local roads primarily to traffic flow contributions (mainly light vehicles).

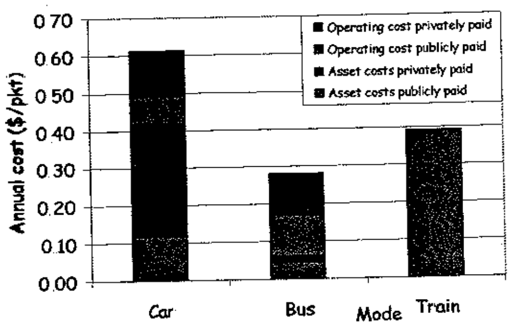

Figure 9: Annual asset and operating costs – *flow&force* case

(Based on data from ABS, 1996a; CityRail 1997; FreightCorp, 1998; NRMA, 1991; Renner, 1988; RTA, 1996 & 1997; SRA, 1996a & 1997; STA, 1996; IDC, 1997)

The actual breakdown of asset and operating costs will be discussed in the following sections.

Total asset values

The total (non-annualised) asset value for roads and parking in Sydney are estimated to be roughly $92 billion. These Sydney estimates are derived from RTA estimates given for the whole of New South Wales. The corresponding asset value for trains is $1.77 billion (see Table 1).

Table 1 Total (non-annualised) asset values (in $M) of passenger modes in Sydney.

Component	Car	Bus	Train
Land	91,600	545	1,765
Infrastructure	29,500	380	6,646
Fleet / rolling stock	17,200	263	1,422
Total	138,200	1,188	9,833

Notes: (a) Infrastructure component is calculated according to the *force&flow* model.
(b) Values in the Car column have been rounded off.

The contribution of public funds to asset costs varies considerably between the different modes. For trains, all asset costs included in the project were publicly funded, however the inclusion of recent rail BOOT projects in Sydney would increase asset costs slightly by adding a private or semi-private component. Bus asset costs included in the project were 85% publicly funded for the *flow&force* case (and 88% and 79% for the *force* and *flow* cases respectively). If BOOT road costs were included, this public contribution value would be slightly lower. Finally, car asset costs were 31% publicly funded for the *flow&force* case (and 26% and 36% for the *force* and *flow* cases respectively), with land forming the most expensive component of both public and private costs.

Operating costs

Operating costs calculated from this project displayed less variation between the two modes than asset values. Transport operating costs were consistently higher for buses than the other two passenger modes, as shown in Figure 10. Car operating costs were found to be 89% that of buses per PKT for the *force&flow* case (and 62% and 98% for the *force* and *flow* cases respectively). And trains were found to have operating costs which were 81% that of buses per PKT for the *force&flow* case (and 70% and 83% for the *force* and *flow* cases respectively).

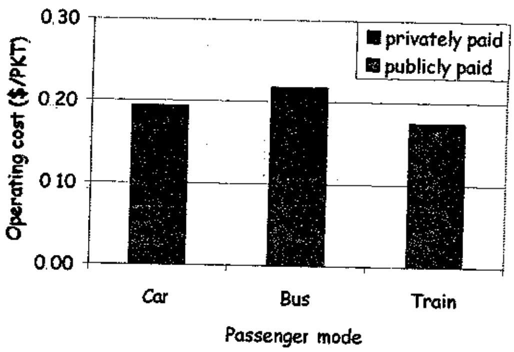

Figure 10: Operating costs of passenger modes in Sydney, 1996

(RTA, 1996; NRMA, 1991; TDC, 1991; STA, 1996; SRA, 1996; FreightCorp, 1998; SRA, 1997)

The contribution of public funds to operating costs was again highest for passenger rail, at 100%. Public funding of buses (public bus operations plus the bus component of road maintenance) constituted 50% of operating costs for the *flow&force* case (and 57% and 48% for the *force* and *flow* cases respectively), and public funding of car operation (for road maintenance) accounted for 37% of operating costs for the *flow&force* case (and 22% and 41% for the *force* and *flow* cases respectively). The *force* case produced the highest proportion of publicly funded operating costs for buses.

Total annualised costs

Bringing together all of the above annualised asset and operating costs (see Figures 7-9), cars were consistently found to have the highest costs per PKT, estimated at 61c/PKT for the *flow&force* case (and 55c/PKT and 66c/PKT for the *force* and *flow* cases respectively). Trains were found to have the next highest total annualised costs, estimated at 39c/PKT for all cases. And buses had the lowest total annualised costs, estimated at 28c/PKT for the *flow&force* case (and 34c/PKT and 25c/PKT for the *force* and *flow* cases respectively).

User costs

User costs calculated in this project include private vehicle fuel, public transport fares, and transport charges. User costs were not affected by variations in assumptions regarding force and flow. On the basis of cost per passenger-kilometres travelled, buses were found to have the highest cost to users at about 12c/PKT. This was followed by cars (84% that of buses), and trains (78% that of buses), as shown in Figure 11. User costs for all modes, and particularly for cars, were far lower than costs associated with providing the transport services.

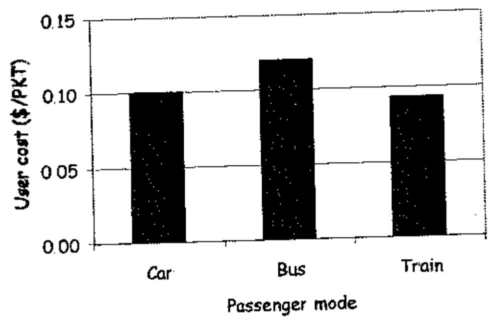

Figure 11: User costs of passenger modes in Sydney, 1996

(Data from RTA, 1996; SRA, 1996a; STA, 1996; TDC, 1997)

Discussion

Costs of passenger transport modes

From the above results a number of observations can be made about transport costs in Sydney: First, costs paid by users were found to be relatively similar for each of the three passenger transport modes included in the project, with slightly higher costs paid by bus users per PKT. Operating costs were also similar for the three modes, with slightly higher operating costs calculated for buses per PKT. Asset costs however, were far higher for cars than for the other passenger modes.

These observations suggest that all three modes of passenger transport in Sydney receive subsidies. The exact value of this subsidy for each mode is still being evaluated, however it is already clear that the subsidy to cars is at least as great as to trains and buses. This subsidy is particularly clear in the area of public and private provision of land and other transport assets. Consumers of transport are therefore receiving a distorted indication of transport costs from the market and, as a result, tend to overuse cars.

Economies of scale

The effect of the subsidisation of car transport is more significant when taken in the context of economies of scale for public and private transport. For private transport activities such as car based transport, a standard supply-demand curve (Figure 12) is often used to describe the appropriate matching of the cost to supply transport services (operating and asset costs), and the cost to use the system (user costs). As demonstrated in the previous section, the present cost to use car-based transport is well below that of supplying such services. This means that consumers will tend to participate in a higher level of car transport than is economically optimal.

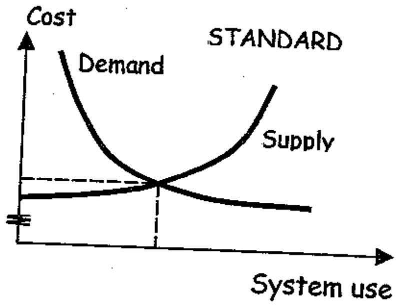

Figure 12: Supply-demand curves for car transport system

The low level of car user costs in relation to car asset and operating costs therefore encourage inefficient overuse of car based transport in Sydney. In relation to public transport optimal costs, the standard supply-demand curve is less appropriate since there may be several 'optimum costs' (indicated by the intersection of the two curves). At low patronage levels, public transport services are fairly costly to supply and hence the optimal user cost is high. With increased patronage, the system functions more efficiently and hence a different, lower optimal cost per user should be found, as indicated in Figure 13.

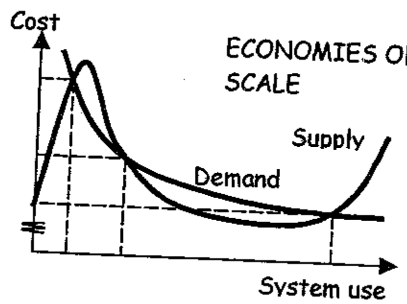

Figure 13: Supply-demand curve for public transport systems

Dominance of car based transport and low investment in public transport service, as indicated by the Project, are therefore likely to cause an increase in the apparent cost to provide public transport services throughout the city. With greater train and bus patronage, the calculated asset and operating costs per PKT for public transport would tend to be lower. Studies from Australia and overseas suggest that such a change in public transport can be effected through individualised marketing, increased public transport service frequency, restricted car parking and access, and improved public transport infrastructure provision.

Land values

The land values given in this paper are *average* market values for the Sydney metropolitan area. However, the market value of land depends upon levels and types of transport access. For instance, residential, commercial or industrial land, without transport access of some kind to the majority of its buildings, would have a very low value. Nevertheless, it need not be assumed that every building has to be on a road, in order to maintain its property value. For instance, some urban villages in Europe have roads and parking limited to the periphery of the site (Newman & Kenworthy, 1999). A national park may only require a single public access road or railway station. If it is criss-crossed with roads, its value as a national park may be greatly reduced.

For the purposes of this paper, it is useful to consider *average* market values of land in a city. They give a rough idea of costs incurred by society and subsidies to various transport modes. They also provide basic data for determining the static optimal economic mix of different transport modes for a city, subject to various levels and types of access and constraints on the use of various transport technologies. Indeed, the present paper is part of a larger project, which is ultimately directed towards an optimal mix calculation. The results of such a calculation are unlikely to provide areas of residential or industry land without transport access of any kind.

For other purposes, such as the choice of building an inner city freeway versus a heavy rail line to serve a region (such as Sydney's northern beaches), it is essential to consider *marginal* costs of various options at the site rather than average values across the city. In this case, the real estate values of the land required are highly relevant to the choice of mode and indeed to the cost of the whole development, especially if land has to be acquired compulsorily.

Other parameters and costs

While the Project has outlined narrow economic costs of different transport modes, the next stage is anticipated to incorporate wider economic, environmental and social costs (sometimes referred to as externalities). These include costs associated with policing, hospital and damage costs of crashes, health and productivity costs of transport emissions, alternative access costs for transport severence effects, damage costs associated with transport greenhouse emissions, and so on. Improved accuracy in the measurement of these costs will further improve the understanding of relative costs of transport modes in Sydney.

Subsequent work should also include other modes of transport including freight transport, ferries and somatic transport in order to give a more complete view of passenger transport costs in Sydney.

To enable comparison of modal costs for the Transport System Costing Project, a number of assumptions were made which should be addressed and reduced in later work. Particular issues were encountered relating to a lack of homogeneity of information and a lack of data collection on the contribution of different modes to peak traffic flow levels. To improve the understanding of multi-modal transport performance in Sydney, there is a need for improved data collection on a variety of different parameters including peak flow distributions by mode.

As suggested by Maddison *et al* (1996), discrepancies between the asset and operating costs, and user costs in Sydney's transport system indicate that some of the success of private road use over other forms of transport has been attributable to road users' non-payment of both internal and external costs associated with their travel. This situation has developed and remained through conventional transport planning and funding mechanisms, and the conceptual and practical difficulties involved with providing an alternative system of costing externalities and charging or collecting the full costs of transport.

Through integrated planning and implementation of more accurate total costing regimes between the different modes of transport, society will derive greater benefit from its transport networks as well as improved economic, environmental and social outcomes.

From analysis of the costs of different modes of transport in Sydney, the efficiency and performance of Sydney's transport system is hindered by the modally biased nature of transport provision and operation across the city. In an environment of dwindling economic resources and increasing environmental strains and awareness, these inefficiencies are reflected in a simultaneous escalation of road congestion, environmental deterioration and public disquiet on transport and sustainable development issues. It is therefore a matter of urgency to address these issues through implementation of mode neutral transport planning and funding systems, backed by improved and comprehensive data on transport parameters and costs across all modes.

Conclusion

As a result of this analysis, annualised figures for the basic transport asset and operating internal costs considered were estimated at 61 cents per PKT for cars, 28 cents per PKT for buses and 39 cents per PKT for trains (all for the *flow&force* case). Of these costs, car asset values were dominated (60 per cent) by land costs, whereas bus and train asset costs were dominated by infrastructure values. For user costs, the Project estimated these at 10 cents per PKT, 12 cents per PKT and 9 cents per PKT for cars, buses and trains respectively, which is consistently lower than costs associated with providing transport services, especially for cars.

The data indicate that all three modes of Sydney's transport system are subsidised. The value of the subsidy to car-based transport is at least comparable with the subsidy to other passenger transport modes. Once the costs of traffic policing, hospital and medical care are taken into accounting, the subsidy to car-based transport may turn out to be substantially greater than to buses and trains. Low relative transport user costs tend to encourage an overuse of transport services and a particularly inefficient overuse of cars. Taking into consideration public transport economies of scale, it is possible that higher public transport usage will increase its efficiency and reduce the apparent asset and operating unit costs associated with public transport.

Costs of transport modes in Sydney highlight inefficiencies in the mix of transport modes across the city, with a strong car bias in past transport planning and funding mechanisms. In response to these issues there is a need for more mode neutral research planning and funding of transport for Sydney, and implementation of more modally balanced (less car dominated) patterns of transport throughout the metropolitan region. This might be done through provision of safe and comprehensive metropolitan-wide networks for somatic transport, promotion of increased public transport patronage, and funding of intermodal transport facilities. There is also a need for further investigation of the costs associated with different modes of transport including external costs (such as those associated with air pollution) and costs of freight transport, somatic transport (eg. walking and cycling), and other passenger transport modes.

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