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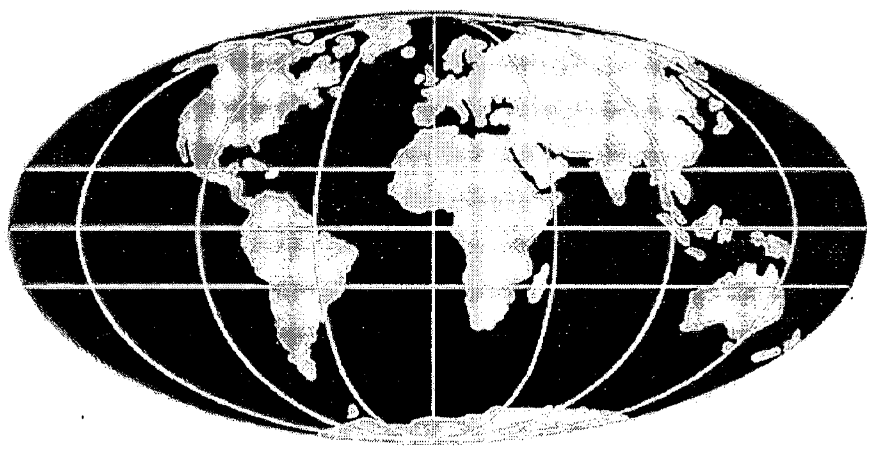

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Transport and Road Research Laboratory

A REVIEW OF INTERMEDIATE PUBLIC TRANSPORT IN THIRD WORLD CITIES

by

P R Fouracre and D A C Maunder

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INTERMEDIATE PUBLIC TRANSPORT IN THIRD WORLD CITIES

(A background paper to the Seminar on transport planning in Developing Countries, PTRC Annual Meeting, Warwick University, 1979)

1. INTRODUCTION

Intermediate public transport, paratransit, unconventional forms of public transport, the unincorporated sector of public transport - these and other synonomous terms have been widely used to describe part of the road public transport sector which does not conform to the more familiar taxis and buses of the western world. In this paper these types of public transport are distinguished very simply on the basis of whether they are providing a 'taxi-like' service or a 'bus-like' service. We compare vehicle types within each classification and also make general comments about the different roles that each category plays in urban transport. The paper does not consider the sociological and political aspects of paratransit, nor is it concerned with the ownership structure, employment prospects, the merits of private and public enterprise, or the merits of large and small scale operations. The purpose is to present an analysis of the transport capability of these vehicle types.

2. BACKGROUND

In the past, Intermediate Public Transport (IPT) systems in developing countries have been described as being modes which provide a service between that of a taxi and a conventional bus, both in terms of fare level and quality of service. This is a rather vague definition which does not mention anything about vehicle size, organisation structure, ownership, operational methods, etc. In particular such a definition fails to distinguish between the two basic types of service on offer: bus-like services which can be identified by a pre-defined, continuous, point-to-point service with intermediate stops for boarding and alighting passengers; taxi-like services which can be identified by the intermittent nature of the service and complete flexibility in destination which is determined by the passenger. Using this simple identification, saloon cars and jeeps used to provide the dolmus and jeepney services of Ankara and Manila are nothing more than small buses, while the converted utility vans or silors of Chieng Mai are true taxis, albeit shared. Similarly the Harley Davison motor bike (phut-phut) of Delhi is used as a bus while in the same city the Lambretta scooter rickshaws provide a taxi service.

The distinction is important. The nature of the two different roles will be reflected in output, load factors and operating costs which may differ substantially. Comparison between vehicles operating different services can be misleading unless the distinction is recognised. For example, the silor of Chieng Mai has a load factor (pass kms per seat km) of less than 0.1 when used in its taxi-like role. A similar vehicle used in the role of a bus might easily have a load factor ten times as large. (Role switching is quite common with these types of vehicles and an analysis of a particular vehicle type should take account of the role currently being played. For example, in Instanbul the true taxi is very often switched to a bus service in slack periods.)

Others have implicitly assumed this role distinction in their analysis or description. Meier[1], for example, remarks on the use of a motorised three wheeler as a taxi or (in his view) its real vocation as a minibus. The consultants, Halcrow Fox and Associates also analysed the role of jeepneys in Manila and bemos in Surabaya as if they were small buses.

We have used this simple categorisation in our subsequent analysis. Tighter categorisation leads to anomalies in the definition or else is not practicable for our analysis. For example, Rimmer[2] talks in terms of two different parts of the public transport sector which are based on market and organisation structure; these are termed the corporate and unincorporated sectors. Each is defined in terms of various attributes reflecting supply, demand, operating conditions, etc. Anomalies are easy to discover in such a system. (Do the auto rickshaws of Delhi fall into the corporate transport sector because prices are fixed or the unincorporated sector because they operate on demand?)

Rimmer's definition is useful for a sociological analysis of the important role that the unincorporated sector of public transport undoubtedly plays in urban employment, the drift from rural to urban employment, the creation of private enterprise activities and so on. We feel that it is not a useful framework for analysis of the transport capabilities of the various vehicle types in public use.

3. TAXI SERVICES

3.1 <u>Vehicle types</u>: All types of rickshaw (hand, cycle, auto), horse-drawn carts, saloon cars and utility vans are used to provide a taxi service in cities of the Third World. In particular, the rickshaw seems to be peculiar to S E Asian cities.

The number of cycle rickshaws in a city is often difficult to determine due to non-registration and illegal operations. In Indian cities, there is, typically, of the order of 1 machine per 1,000 population in the largest cities and perhaps 10 times that number in smaller and less wealthy cities. The number of passengers carried per day is low; there is similarity in the figures for a number of Third World cities (see Table 1). This is perhaps not surprising in view of the limitations of human motive power. There is no evidence of a decline in the use of cycle rickshaws in Indian cities (there has been a registered increase in vehicles in many cities). However, the use of 'hand' rickshaws in any significant number is now limited to the city of Calcutta.

Auto rickshaws (ie vehicles based on scooters or motorcycles) provide motorised alternative to cycle rickshaws. In larger Indian cities there are of the order of 5 vehicles per 1000 head of population (although some cities like Bombay and Madras have few). Poorer cities of the south of India tend to have a lower proportion of auto to cycle rickshaws. The major cities of Andhra Pradesh (other than Hyderabad), for example, have less than one auto rickshaw per 1000 population. Data on auto rickshaw use in cities of India for which data are available is given in Table 2.

TABLE 2

NUMBER OF AUTO RICKSHAWS IN USE IN SELECTED INDIAN CITIES (1977)

	Auto rickshaws	Auto rickshaws/ 1000 population (approx)
Delhi	17000	3.4
Ahmedabad	6600	4.1
Hyderabad	5900	3.3
Pune	4600	5.4
Madras	1300	0.5
Kolhapur	1200	4.5
Aurangabad	500	3.0
Vishakhapatnam	250	0.7
Vijayawada	200	0.6

Source: ASRTU/TRRL

Detailed figures of auto rickshaw output have as yet been collected only for the Indian cities of Delhi, Baroda and Bangalore (Table 3).

TABLE 1

COMPARATIVE OPERATIONAL DATA FOR CYCLE RICKSHAWS

	Chieng Mai	Faridabad	Meerut	Penang	Surabaya	Calcutta		Delhi
Population (millions)	0.1	0.2	0.5	0.5	2.3	4.8		5.0
						Cycle	Hand	
No, rickshaws/1000 population	20	19	18	6	15	0.6	5	1
Trend (absolute numbers)	Declining	Rising	Rising	Declining	Stable	Stable	Stable	Stable
Vehicle passenger capacity	2	2	2	2	2	2	2	2
Pass. carried per vehicle day	10-15	18	25	N.A.	8	23	17	18
Vehicle trips per day	N.A.	13	16	N.A.	4-5	N.A.	N.A.	12
Pass. per vehicle trip	N.A.	1.4	1.6	N.A.	1.6	N.A.	N.A.	1.5
Average pass. trip length (km)	N.A.	1.8	1.5	N.A.	1.8	3.0	2.0	1.0
Vehicle kms per day	N.A.	22	24	12-20	25	69	43	13
Load factor	N.A.	0.7	0.8	N.A.	0.3	0.5	0.4	0.7

Sources:
(i) TRRL - Chieng Mai[3], Surabaya[4] (1976)
(ii) School of planning & Architecture - Delhi[5], Meerut, Faridabad (1978)
(iii) A Meier - Penang (1975)
(iv) T Thomas - Calcutta (1977)

TABLE 3

COMPARATIVE AUTO RICKSHAW OPERATIONAL DATA

	Delhi	Bangalore	Baroda
Population (million)	5.0	1.3	0.6
No. auto rickshaws per 1000 population	3.4	1.3	6.6
Trend (absolute numbers) Vehicle pass. capacity	Rising 2	Rising 2	Rising 3
Pass. carried daily per 1000 population	92	99	343
Vehicle trips/day	18	N.A.	25
Pass. carried per vehicle day	27	77	52
Pass. per vehicle trip	1.5	1.5	2.1
Average pass. trip length (km)	6.6	4.2	2.5
Vehicle kms per day	120	214	75
Load factor	0.7	0.8	0.6

Sources: (i) School of Planning & Architecture - Delhi (1978)
(ii) Central Road Research Institute - Bangalore (1969)[6]
(iii) I A Jenkins - Baroda (1978)

Saloon cars are used for the archetypal taxi service in most cities of the world, both developed and developing. In Third World cities for which data are available there are typically between 0.5 and 3 taxis per 1000 population (Table 4).

Shared taxi services are not, in our experience, widely found in developing countries. Large vehicles used for sharing involve the driver in the problem of matching the many destinations of passengers. The shared taxi system for Chieng Mai is the only such system to our knowledge and this employs utility vans of relatively high capacity. In the case of Chieng Mai the high number of taxis per 1000 population is a function of their different usage in this city.

TABLE 4

NUMBER OF TAXIS IN USE IN SELECTED CITIES

Country	City	Taxis	Taxis/1000 population (approx)
India	Delhi	5200	1.0
	Calcutta	7000	1.0
	Madras	2400	0.8
Indonesia	Jakarta	4600	0.8
Malaysia	Kuala Lumpur	1000	1.0
	George Town	145	0.5
Philippines	Manila	8500	1.6
Thailand	Bangkok	13500	3.0
	Chieng Mai	2000	20.0
Jamaica	Kingston	1600	2.3

Some output figures for cars and utility vans used as taxis are shown in Table 5.

TABLE 5

COMPARATIVE TAXI (SALOON CAR/UTILITY VAN) OPERATIONAL DATA

	Delhi	Calcutta	Kingston	Chieng Mai
Population (million)	5.0	4.8	0.7	0.1
No. taxis per 1000 population	1.0	1.0	2.3	20
Trend (absolute numbers)	Stable	Declining	N.A.	Stable
Vehicle pass. capacity	4-5	4-5	4-5	14
Pass. carried per vehicle day	18	N.A.	N.A.	120
Vehicle trips/day	7	N.A.	8	N.A.
Pass. per vehicle trip	2.5	1.8	N.A.	N.A.
Average passenger trip length (km)	10.4	N.A.	N.A.	1.2
Vehicle kms per day	90	150	N.A.	160
Load factor	0.5	0.3	N.A.	0.1

Sources: (i) School of Planning & Architecture - Delhi (1978)
(ii) TRRL - Chieng Mai (1976)
(iii) T Thomas - Calcutta (1977)
(iv) M J Heraty - Kingston (1978)

3.2 Vehicle comparisons: There is clearly a difference in the taxi service provided between the cycle rickshaw at one end of the market and saloon cars at the other end. Differences, measured in terms of speed, comfort and journey range, are reflected in the different operating costs and tariffs. Some comparative output/cost indicators for Delhi are shown in Table 6.

TABLE 6

OUTPUT/COST INDICATORS FOR TAXI SERVICES (AS RATIOS)

	Capital cost/seat	Vehicle operating cost/km	Vehicle operating cost/seat km	Output (seat km)	Speed
Cycle rickshaw (two seats)	1	1	1	1	1
Auto rickshaw (two seats)	20	0.5	0.5	8	2
Saloon car (four seats)	25	1	0.5	16	4

(Figures based on operational data from Delhi 1978)

The high capital cost of auto rickshaws and saloon cars in Delhi, by comparison with cycle rickshaws, is off-set by their higher output. Taxis and auto rickshaws have similar costs per seat km, but load factors tend to be higher for the smaller vehicles (which is not unexpected in view of the nature of the service). Average load factors for taxi services tend to lie in the range 0.1-0.8 with auto rickshaws being at the top end of the range and saloon cars/utility vans at the bottom end. Thus the cost per passenger km is likely to be less for auto rickshaws than for saloon cars. Even cycle rickshaw passenger km costs will be lower than cars, despite the high operating costs indicated in Table 6. The per km cost of a cycle rickshaw is double that of an auto rickshaw and the per seat km costs are double both those of cars and auto rickshaws. (This reflects the relatively low output of cycle rickshaws in Delhi; in other cities output may be more than double.)

Journey range is not reflected in the above figures. A cycle rickshaw is constrained by the limits of the driver's abilities. Journey time may also limit the range within which an auto rickshaw is used. In Delhi average journey lengths are 1 km, 7 km and 10 km for cycle rickshaws, auto rickshaws and saloon cars, respectively.

The high availability of cycle rickshaws in many cities at relatively cheap rates may be artifically created by the ownership structure (usually an oligopoly with considerable political power) and exploitation of the drivers. Other taxi types are far more likely to be owner driven and regulated by statutory bodies.

4. BUS SERVICES

4.1 Vehicle types: Bus services are operated by horse-drawn carts, adapted motor-cycle outfits, saloon cars, utility vans (using 2 stroke and 4 stroke engines), minibuses, conventional single-deck buses and double-deck articulated buses. It is immediately obvious that human powered machines are not used for this type of service, presumably because the effort required to sustain a continous service is too much.

Horse-drawn tongas (ie carts) are used in Delhi on point-to-point services (though in other Indian cities they are also used in the role of a taxi). The number of tongas in use seems to be on the decline. In Delhi there are now fewer than 0.4 tongas per 1,000 population, though they are concentrated in a small area of the city. Output figures for these vehicles are shown in Table 7.

Our experience of motor-cycle combinations is limited to Delhi, and the system may well be unique. Far more widespread are the various saloon cars, utility vans, jeeps and minibuses used for bus-like services. Some comparative figures are given in Table 7.

Lastly, we turn to conventional buses. In Indian cities, the numbers of buses in use are typically of the order of 30 per 100,000 population. An analysis of 41 major cities in the Third World gave an average of 63. Some bus output figures are given for a number of cities in Table 8.

4.2 Vehicle comparisons: We can distinguish between the service of the larger conventional buses and the smaller vehicles. The former, because of their large capacity, are more naturally suited to a rigid route network with scheduled services. Small vehicles can be used more flexibly; they can be operated perhaps more responsively to demand through use of route switching, route deviation, unscheduled services and the like. Because of this demand responsiveness, load factors tend to be higher on the smaller vehicles. (Average load factors for bus services in cities for which data were available range from 0.4-1.0 and, exceptionally, greater than 1.) This is particularly the case where small and

TABLE 7

COMPARATIVE OPERATIONAL DATA OF MINIBUSES AND HORSE-DRAWN SYSTEMS IN SELECTED CITIES

	Delhi		Calcutta	Surabaya	K.L.	Kingston	Meerut
Population (millions)	5.0		4.8	2.3	1.0	0.7	0.5
Vehicle type	Horse	M/cycle	Minibus	Minibus	Minibus	Minibus	Horse
No. vehicles per 1000 pop.	0.4	N.A.	0.1	0.9	0.4	1.7	1.1
Trend (absolute numbers)	Down	Down	Stable	Stable	Rising	Stable	Stable
Vehicle carrying capacity	6	5-6	23	7-11	14-16	10-20	6
Pass. carried per vehicle day	60	50	295	180	500	80	72
Av. pass. trip length (km)	4.5	5.8	5.0	4.5	8.2	N.A.	2.8
Vehicle kms per day	45	60	103	135	192	220	30
Load factor	1.0	1.0	0.6	0.7	1.4	N.A.	0.7

Sources:
(i) School of Planning & Architecture - Delhi, Meerut (1978)
(ii) T Thomas - Calcutta (1977)
(iii) TRRL - Surabaya (1976)
(iv) A A Walters, Kuala Lumpur (1978)
(v) M J Heraty - Kingston (1978)

TABLE 8

COMPARATIVE OPERATIONAL DATA OF CONVENTIONAL BUSES

	Bombay	Delhi	Surabaya	K.L.	Kingston	Chieng Mai
Population (millions)	7.0	5.0	2.3	1.0	0.7	0.1
No. vehicles	24	46	3	55	46	38
Trend (absolute numbers)	Rising	Rising	Rising	Stable	Down	Stable
Vehicle carrying capacity	76	66	48-56	58	N.A.	30
Pass. carried/vehicle day	2330	1150	750	1200	930	700
Av. pass. trip length	5.5	9.9	N.A.	3.9	N.A.	1.8
Vehicle kms per day	219	220	240	220	180	200
Load factor	0.8	0.8	N.A.	0.4	N.A.	0.2

Sources:
(i) DTC - Delhi (1977)
(ii) TRRL - Chieng Mai, Surabaya (1976)
(iii) M J Heraty - Kingston (1978)
(iv) BEST - Bombay (1977)
(v) A A Walters - Kuala Lumpur (1978)

large vehicles are competing directly with one another. (Average load factors can be misleading since they do not reflect the variability experienced throughout the operating day. For example, on some conventional bus routes in Delhi load factors vary between 0.5 and 2.5, the latter figure indicating extreme overloading in the peak period.)

Some comparative indicators of costs and output are shown in Table 9 for a small and large vehicle. The figures are based on Surabaya data. Output/cost figures for these vehicle types are likely to be particularly contentious. There is a dearth of suitable comparative data from cities where small and large buses are run together. In Kingston, Jamaica, operating costs per seat km for large buses are reported to be nearly twice as high as for minibuses; in Kuala Lumpur the situation is effectively reversed, with the conventional bus costs being less than half those of the new minibuses.

TABLE 9

OUTPUT/COST INDICATORS FOR BUS SERVICES IN SURABAYA AND CHIENG MAI

City	Vehicle type	Capital cost/seat	Operating cost/km	Operating cost/seat km	Output (seat/km)
SURABAYA	Bus (60 seats)	0.7	2.3	0.4	8.5
	Minibus (11 seats)	1	1	1	1
CHIENG MAI	Bus (30 seats)	2.3	4.0	-	4.0
	Minibus (10 - 12 seats)	1	1	-	1

The figures from Table 9 indicate the higher per km operating cost of larger vehicles, but, not surprisingly, low per seat km costs.

Output measured in terms of seat kms is very much higher from the larger vehicles. The difference in per seat km costs between large and small buses, must be balanced by load factors where the two types of vehicles are competing. Thus the passenger km costs of small buses in such conditions may be lower than those of large buses. This will be the case in Kuala Lumpur for example, where the load factors for the bus and minibus are 0.4 and 1.4 respectively. Hence the corresponding costs per passenger km will be 0.4 pence and 0.3 pence for bus and minibus respectively. It is not to be unexpected that conventional bus operators will complain when they see their average load factors decimated by the competative operations of small, demand responsive vehicles.

Large vehicles tend to be associated with large organisations either in the public or private sector. Small vehicles are more closely associated with owner-operation or vehicle renting by the driver from the owner.

5. ROLE COMPARISONS

In general taxi services and bus services compete for different markets. Bus service markets are characterised by regular passenger trips, a low price elasticity of demand, a low middle income clientele and competition from walking and cycling modes as well as to a limited extent, those taxi services giving lowest service quality and costs (ie rickshaws). Taxi service markets are characterised by non-regular and emergency trips (unstructured needs), a high price elasticity of demand, a middle/high income clientele and competition from private (personalised) transport and those bus services giving very high service quality (express and luxury buses).

Some comparative output and cost data for a typical large bus (60 seats) and a typical saloon car taxi (4 seats) are shown in Table 10, based for example on data for Delhi.

TABLE 10

COMPARATIVE COST-OUTPUT INDICATORS OF BUS AND TAXI SERVICE IN DELHI (AS RATIO)

	Capital cost/seat	Operating cost/km	Operating cost/seat km	Output (seat km)
Bus (60 seats)	0.25	3.0	0.2	30.0
Taxi (4 seats)	1	1	1	1

(Figures based on operational data for Delhi (1978)

The figures contained in Table 10 are not unexpected, being representative of two different types of service. Taxi fares tend to be higher, as a result, reflecting the nature of the door-to-door service being provided.

While the two types of service are not usually direct substitutes many exceptions exist. Sometimes sharing the taxi may be cheaper than the use of a bus service. For example, two persons travelling by rickshaw may, for short journeys, be better off than they would be using a bus. Also, if the consumer places a high value on his walking and waiting time, the taxi service may become a close substitute for the bus service. (This is not however, likely to happen often.) Further, in cities where choice does not exist, one service will take over the role of the other.

6. DISCUSSION

Public transport in Third World cities is an expanding industry. The relative importance of the taxi and bus service (and the magnitude and quality of service provided) is probably determined largely by city size, land use/operating environment and per capita income. (Of course, political and pressure group activities often distort the situation to be found at any one place and at any one time. For example, some major Indian cities with over one million population still rely almost exclusively on cycle rickshaws for their public transport; political factors dominate the supply patterns.) Many of those factors are working simultaneously and it makes comparative assessment between cities difficult. However, the following general observations can be made to indicate some of the relationships between provision of public transport and demand/operating environment factors:

- small cities involve shorter passenger journeys which can be handled at reasonable rates by cycle rickshaws and horse-drawn taxis.

- the mass movement of passengers in large cities, often involving long journeys, are more suited to bus service networks (or for that matter suburban trains). The physical problems of providing a service for peak demand are likely to make the use of large vehicles a necessity.

- sharing of taxi services is more likely to be a feasible proposition the smaller the city size.

- the operating environment of parts of many cities in the Third World makes the use of large vehicles difficult. Heavy concentrations of cycle rickshaws, cycles, pedestrians, street traders, etc can reduce the speeds of conventional buses to 5 km/h even on wide roads. Under such conditions it is a struggle to achieve economically viable utilisation from the vehicle.

- studies in Delhi show that rising incomes affect modal choice with people changing from walking to private personal transport modes. There is probably also a distinction to be made between richer and poorer cities in that the lower quality vehicles are gradually discarded with increasing city prosperity.

There can be no doubt that there is a place for both types of public transport (taxi and bus) in urban centres. Usually argument arises over what vehicle type should be used in which role, the amount of supply capacity to be allocated to each role and the extent to which competition should be allowed within roles. The argument often gets caught up with the questions of private versus public ownership and large scale or small scale operations.

The very real problem of employment is also raised, though perhaps given too much emphasis. The question of employment opportunities is probably only of major significance in the case of cycle rickshaws. Output per man is low and consequently more productive motorised vehicles could put many cycle rickshaw drivers out of business. (In Delhi each auto rickshaw driver handles ten times as many passenger kms per day as the rickshaw driver handles.) In the bus service sector the differences in output per man for different vehicle types are not nearly as significant.

There may also be other external costs associated with selection of vehicle type - in particular congestion and accident costs. There is not sufficient evidence available to suggest how significant these costs are for individual vehicle types. In principle many small vehicles ought to cause more congestion than a small number of large vehicles. Similarly, in principle, it ought to be easier to maintain safety standards in large organisations (associated with large vehicles) more easily than in small organisations (associated with small vehicles). Furthermore, resource utilisation (particularly of costly fuel) outght to be more efficient with larger vehicles.

One further issue to which much lip-service is given, but of which there is not enough evidence, is the plight of the drivers of rickshaws. If their health is seriously impaired by this occupation then clearly it should be a major factor in determining the future of the cycle rickshaw as a means of transport in Third World cities.

Without becoming entangled in the question of organisation/ownership structures and sector regulatory policy, we make the following observations about the operations of different services using different vehicles types:

- it seems right to provide the two basic services, taxi and bus. A taxi service has a specific role in meeting the unstructured travel demands of users while a bus service is needed to cater to the mass travelling public making regular and scheduled trips.

- it also seems right to license the right vehicle for the right job. On bus routes small or large vehicles should be employed where they can be most effective. There will be an optimum size bus for a given passenger loading and this will depend on generalised costs of operation. The value of time in Third World cities is unlikely to be high for the majority of passengers.

- competition by different vehicles for the same markets may make the sector economically efficient but it may not be equitable for the community as a whole. Thus, if load factors are low then the economics of operating a bus suffer correspondingly. The benefit of operating large vehicles on bus services is that they can efficiently move large numbers of travellers at low rates. Competition from smaller vehicles inevitably affect the load factor and hence economic viability of large vehicles, which, by their nature of size and operations, are less demand responsive.

- there may be a case for putting different vehicles on the same routes/service where they are competing for substantially different markets at substantially different rates. The co-existence of auto rickshaws and saloon car taxis may be seen in this light. Equally, luxury minibuses plying the same route as standard buses may be an acceptable proposition.

- small vehicles may be most suited to some feeder and low-density routes or in areas where large vehicles cannot penetrate or where bus route service is being experimentally extended.

Of course, by ignoring the issues of organisation structure of the sector and regulatory policy we have sidestepped many important issues. In conclusion, however, the authors believe that policies in the public transport sector should be geared towards community needs and not necessarily towards the limited objectives of economic efficiency within the sector.

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