PUBLIC TRANSPORT IN THIRD WORLD CITIES

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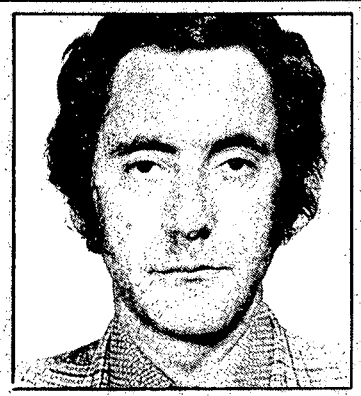
INTRODUCTION

THE forecasting of urban population growth rates is fraught with difficulties, particularly in the Third World where high birth rates, accelerating urban migration and rising life expectations compound the problem. Nevertheless, experts[1,2] are fairly consistent in their forecasts that by the year 2000 the number of people living in urban areas with populations of more than 100,000 (now generally signified internationally by the word "city") will double from some 1200 million to 2400 million. Over two thirds of this expected increase is likely to take place in those cities of the Third World that even today have great difficulty in feeding, housing and transporting the millions who already live there. By the end of the century, if even the most conservative of the predictions comes true, half the world's city dwellers, around 1,200 million or, one in five of the world's entire population, will be living in cities of over 2.5 million population. Furthermore, of the 52 cities of the world with populations over five million, at least 40 are likely to be in the Third World. As Davis' states, "this is not so much 'urbanisation' as 'metropolitanisation on a gigantic scale".

THE AUTHORS



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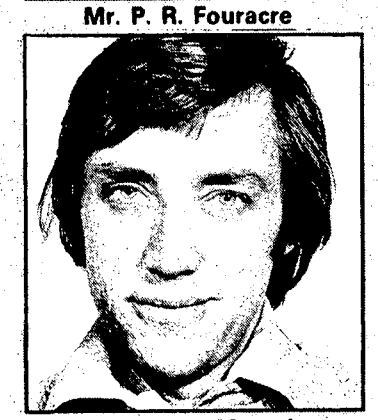

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After taking a science degree at Brunel University Dr. Jacobs joined the TRRL in 1961 and spent seven years working on a range of traffic and safety problems including the design of pedestrian facilities and work on drink-drive legislation. He joined the Overseas Unit, TRRL in 1968 and as a Principal Scientific Officer is now head of the Unit's Traffic and Safety Group. In 1976 he was awarded a PhD from Surrey University for work on road accidents in developing countries. He has worked in over 20 developing countries and published some 40 reports and Papers, most dealing with Third World transport.

Mr Fouracre graduated from Southampton University in 1968 with a degree in economics. Before joining the TRRL in 1973 he worked for the systems engineers and consultants EASAMS on a number of projects, including a national transport study for Algeria. As a Senior Scientific Officer with the Overseas Unit, TRRL, he has been mainly engaged on the development of a research programme on urban transport in the Third World. Between 1978-80 he led an Anglo-Indian co-operative research team in New Delhi, studying the problems of public transport in Indian cities.

Mr Maunder studied economics at Leicester University and joined the Overseas Unit, TRRL in 1974. He spent five years working on rural transport planning problems before transferring his interests to the transport problems of Third World cities. As a member of the urban transport research team in India he developed a specific interest in the access and mobility problems of the urban poor. He is currently developing this research topic, which is also the theme of his postgraduate studies being undertaken at Leicester University. Mr Maunder is a member of the Chartered Institute of Transport.

THE PAPER

This Paper presents a review of public transport operations in cities of the Third World. It is shown that although this is a growth industry in most of these cities, the supply of conventional public transport is inadequate and para-transit systems have developed to fill the void. Operating costs and revenues are examined and although most undertakings are shown not to be profitable, it is explained that little support is provided by either central or local government. The development of para-transit systems is reviewed and the roles that these systems play and the problems they create are examined. The transport problems of low income communities are also considered, including the provision of transport to the urban poor and expenditure on transport.

In many cities in developing countries the rapid rise in population, increased costs of fuel and limited financial resources have produced the most severe transport problems. For example, average bus speeds in Bangkok are almost half those in London; the average load factor on buses in Indian cities is over three times greater than cities in the UK. In the near future, an improved public transport system is likely to be the only solution for reducing traffic congestion and also the cost of travel in most Third World Cities *"since it is unlikely that the communities concerned can (or even should) afford to build the road network needed to accommodate unrestrained travel by private car"*[3]. Estimates made by the authors suggest that there are, in cities of the Third World with over 100,000 population, some half million buses travelling 100 million bus kilometres per day and carrying 440 million passengers. The cost of operating these vehicles is of the order of £11,000 million per annum or £30, million per day. According to World Bank and IRF statistics this sum of £11,000 million was approximately twice the amount spent in the entire Third World on road construction, maintenance and rehabilitation in 1978.

Public transport in cities of the developing world comprises more than just the traditional bus and train of developed cities. Thus shared taxis, motorcycle, scooter, cycle and, in some cities hand rickshaws all play an important role in urban personal mobility. Such forms of transport are now generally known as "para-transit" systems or intermediate public transport (IPT). This article makes a broad review of the demand for and supply of both conventional and para-transit forms of public transport in cities of the Third World and compares and contrasts the situation in these cities with conditions in Western Europe and North America. It also outlines some of the special problems faced by public transport operators in developing countries and the economic climate under which they operate.

CONVENTIONAL PUBLIC TRANSPORT

Unlike the situation in the UK, public transport is a growth industry in most developing countries and although car ownership has increased in developing countries over the last 30 years, it is still at a relatively low level and there is a great reliance on public transport. Percentage changes in the number of buses and passengers over this period 1964-75 for some 12 cities, most of which would be regarded as being in the "developing world", are given in Table 1.

In almost all the Third World cities there were considerable increases in the number of buses in use and passengers carried. The number of passenger trips made on public transport increased at a faster rate than the population growth rates in all cities except Calcutta. In comparison in the UK there was an approximate three per cent reduction in the number of passenger trips per annum.

Apart from Blantyre, Malawi, buses were being used more intensively in 1975 than in 1964. In Surabaya, Indonesia, for example, there was an increase of almost eight per cent per annum in the average number of passengers per bus. In other cities, increases of four per cent were common. In the UK there were again consistent decreases for all three transport organisations for which data were available.

The number of trips made per head of population (i.e. the trip rate) increased in all Third World cities except Calcutta. It might well be that in a number of developing countries a modest increase in real incomes coupled (in some cities) with improved services has led to increased public transport usage, whereas it has been shown[4] that in the cities of Europe a more substantial increase in real incomes has led to increased car ownership which, together with a decrease in service levels, has led to a decrease in public transport usage.

Data were obtained on trip rates i.e. the average number of passenger trips per person per annum from 42 cities in developing countries and 97 cities in Europe and North America. Simple regression analysis was used to relate the trip rates to the gross

TABLE 1

Average annual percentage changes over the period 1964-75 in the number of buses and passengers in some cities in developing countries and the UK

City	Population	Average number of buses	Passenger trips per annum on road	Average daily passengers per bus	Trips per person per annum per bus
Ahmedabad (India)	+5.5	+2.1	+7.3	+0.4	+1.1
Barbados (Island)	+2.0	+1.6	+5.0	+2.7	+2.4
Blantyre	+9.7	+12.3	+10.6	−0.7	+0.5
Bombay	+5.5	+4.1	+7.0	+2.0	+0.9
Calcutta	+18.4	+1.5	+5.0	+3.0	−4.4
Delhi	+4.8	+13.1	+22.7	+4.0	+11.6
Istanbul	+6.1	NA	+8.0	NA	+1.3
Mauritius* (Island)	−3.4	+9.8	+14.8	+3.4	+21.0
Mombasa	+7.3	+9.6	+15.4	+2.8	+4.5
Nairobi	+8.1	+9.0	+16.6	+3.8	+4.5
Nicosia	+6.4	−0.4	+9.3	+10.4	+1.7
Surabaya**	+3.0	+6.7	+16.7	+7.7	+11.2
UK					
London Transport Executive		−1.8	−2.9	−1.3	
Passenger transport Executive		−0.7	−2.7	−2.2	
Municipal Operators		+0.4	−2.5	−2.7	

** 1975 ** 1970-76 NA: not available*

national product (GNP) per capita of the various countries. Since the GNP values relate to the countries as a whole and not to the specific cities this must be regarded as an approximation of the real relationships that may exist. Nevertheless the relationships derived between trip rates in the cities and the GNP/capita for the countries as a whole were statistically significant at the five per cent level. The slope of the regression line in Third World cities was found to be positive, the trip rate increasing rapidly with the increasing GNP, whereas in the European and North American cities the slope was negative, the trip rate decreasing slightly with increasing GNP. This implies (although this may perhaps be an over-simplication) that as people become more affluent in the Third World they may make more bus journeys each year, whereas in the developed world they buy more cars and consequently make fewer bus trips.

Although trip rates have increased considerably over the last 10 years in Third World cities the actual number of journeys made per person per annum is still relatively low. White estimates for example that the annual number of trips per person by buses in Pune and Bombay, India is about 150 rising to about 250 in Kuala Lumpur (on buses and mini buses) and 300 in Singapore. British cities of over one million population have about 150-250 bus trips per person per annum. Thus the Indian bus figures do not exceed those in Britain despite far lower car ownership. It may well be that an inadequate fleet size and route network is constraining the total number of passenger trips and there may be a considerable suppressed demand for public transport in these Third World cities. In order to obtain an estimate of the level of service provided in the two groups of cities, the average values of parameters that describe, in part, the level of public transport service were calculated. These are given in Table 2.

TABLE 2
Number of buses and route kilometres per 100,000 population in developed and developing cities

Country/Region	Buses/100,000 population
Asia	48
Africa	30
India	30
Other (developing)	63
UK	90
	Route Km/100,000 population
Developed (av. of 97 cities)	100
Developing (av. of 42 cities)	54

It can be seen from Table 2 that there are, on average, about 40 per cent fewer buses per head of population in cities of the Third World even though the level of car ownership is very much lower than in the industrialised countries. Similarly, the number of route kilometres per head of population is about half that in Europe and North America. It should, of course, be remembered that, in many Third World cities, para-transit systems provide additional transport services. This is discussed later.

As White[5] states, the overcrowding observed on buses in Third World cities (Figure 1) is a result of there being fewer buses relative to population. This also has the effect of spreading the peak and buses travel with high load factors throughout the day.

As seen earlier, the demand for public transport has declined steadily in the UK over the past decade. This in turn has led to general agreement that public transport services should be regarded, in part, as providing an essential service for those sections of the community unable to afford private transport and, as such, should receive a measure of financial support. Recent studies[4][6] of subsidy levels in cities in the developed countries show that they range from as low as 11 per cent of total operating cost to as high as 70 per cent. Results suggest there is considerable evidence that increases in subsidy permit a reduction in fare levels and improvement in service thereby attracting more patronage. In contrast, it might be expected that with the large and increasing demand for public transport in Third World cities, bus companies should have no difficulty in being economically viable enterprises. The small sample show in Table 3 suggests that this is not the case.

In over half the cities for which data were available, operating costs per bus kilometre exceeded revenues. In many of these countries, India being a particularly good example, there has been a policy of maintaining low fare levels irrespective of the cost of providing the service. Requests for fare increases are subject to lengthy enquiries and small increases (if granted at all) are often out of date by the time they are implemented.

As opposed to the provision of subsidies for large transport undertakings in Third World cities, there is a school of thought *"that challenges the conventional wisdom that large buses in large organisations with subsidies to produce optimum frequencies are the best arrangement*

Figure 1. An overcrowded bus in Dehli, India.

TABLE 3
Costs and revenues in various cities

City	Cost per bus Km (pence)	Revenue per bus Km (pence)	"Profit" per bus. Km (pence)
Ahmedabad 1979	16	15	−1
Bandung 1979	15	12	−3
Bangkok 1980 (est)	20	14	−6
Bombay 1979	23	21	−2
Delhi 1979	19	11	−8
Jakarta 1979	17	13	−4
Kolhapur 1979	15	16	+1
Madras 1979	15	16	+1
Nicosia 1980	15	16	+1
Pune 1979	16	14	−2
Average values of 5 municipal operators in UK 1980	64	62	−2

for urban road passenger transport. It is shown that in theory small buses are often appropriate, giving the best frequencies and speeds and waiting times. Furthermore, the best institutional organisation is not the large firm or municipal authority but the small firm, often the owner/driver. There is no case for any substantial subsidy for appropriately organised urban bus transport."[7]

In the authors' opinions, levels of service as well as economic efficiency need to be examined with care, before it can be stated conclusively that the private sector with small companies and small buses is to be preferred. This is an area where further research is needed.

An examination of the structure of operating costs in cities in developed and developing countries reveals some interesting differences. It can be seen from Table 4 that in the UK the major cost component, about two-thirds the total, is that of staff, with maintenance and spares making up most of the remainder. Operating costs in the Third World cities are clearly different, with staff costs being about one-third the total, but with fuel and depreciation/interest costs being much greater than in the UK. In Bangkok where the transport authority have to pay the full commercial rate for fuel, the cost of fuel actually exceeds staff costs and represents a remarkable 38 per cent of total operating costs. The number of staff employed per bus in the 42 cities of developing countries was, on average, over twice as high as in cities in developed countries. Thus, even with one-man operation on many buses in the UK, staff costs are high: in comparison, in many Third World cities there are often three persons operating each bus, but nevertheless staff costs would seem to be relatively low.

TABLE 4
Operating costs for public transport operators (percentages)

	London Transport 1978	Average of seven Indian cities 1979	Nairobi 1977	Nicosia 1977	Kingston Jamaica 1977	Kuala Lumpur 1978	Blantyre 1977	Bangkok 1979
Staff	60	40	39	44	60	35	38	35
Fuel	4	16	16	6	4	13	12	38
Tyres/Spares	1	14	5	3	24	28	6	3
Maintenance	23	x	19	27	x	21	20	18
Depreciation/ Interest	6	19	6	12	5	9	9	5
Taxes/Licences	neg	5	—	4—	—	—	—	
Other	6	6	15xx	4	7	4	15xx	1
Total	100	100	100	100	100	100	100	100

x Bus companies allocate maintenance costs mainly as cost of tyres and spare parts
xx Depot and traffic operating costs and administration

Perhaps the most interesting difference in operating costs between cities in the UK and in the selected cities in the developing countries is the proportion of total costs allocated to depreciation and interest. In many Third World countries the operational life of a bus is often extremely short, sometimes as low as six years; consequently vehicles have (in theory) to be replaced at very short intervals of time and depreciation costs are correspondingly high. In addition, many public transport operators in developing countries receive virtually no government support at all. In order to continue supplying public transport services, loans have to be acquired (sometimes from central government itself, as in Delhi, or from state governments, as in Calcutta). The interest paid on these loans is often a considerable proportion of total operating costs for these bus companies. Financial costs of operation are further complicated in India by the imposition of direct and indirect taxes. Such taxes consist of passenger taxes (levied on the number of passengers carried), vehicle taxes and income taxes. This means that the more successful and efficient the transport organisation, the greater the taxes imposed by government.

To a visitor from Western Europe or North America, bus fares might appear to be low in many cities in developing countries. Thus, in Delhi passengers are able to travel up to 16km for the equivalent of a 2p fare. In the UK a similar journey could cost over 40 pence with a graduated fare system and of the order of 25 pence with a flat-fare system.

From the results of detailed home-interview surveys of low and middle income communities in a number of Third World cities it has been possible to estimate the proportion of household income spent on transport [8] Results are given in Figure 2. It can be seen from the three cities studied that over the range £10-£50 income per month there is a marked decrease in the proportion spent on transport with increasing monthly income. Low income families are obliged therefore to spend propor-

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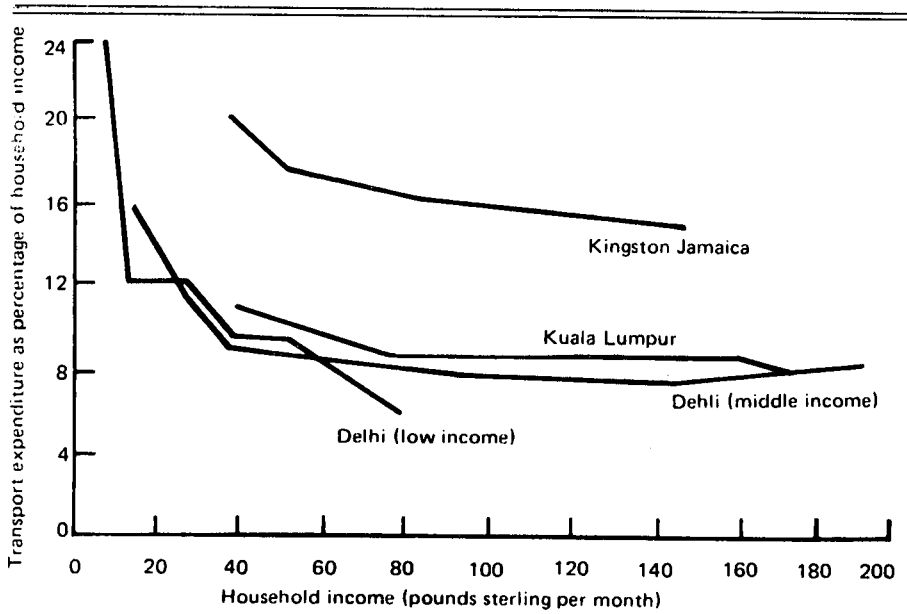

Figure 2. Expenditure on transport as a proportion of household income.

tionately more on transport in order to make essential journeys. The proportions spent on transport in Delhi and Kuala Lumpur were similar over the range £50-£160 per month and ranged from 8 to 11 per cent depending on income level. The proportions in Kingston were significantly greater and ranged between 15 and 20 per cent. In Delhi the lowest income groups spend up to 25 per cent of their income on transport, even though the large majority of trips are to and from work or possible school with very few social and leisure trips being made.

In contrast, a study by Tulpule[8] of household expenditure in Great Britain in 1970 indicated that non-car-owning households in this country spent between three and four per cent of income on transport. Also the Department of Employment Family Expenditure Survey 1976[10] stated that households with (low) incomes of £15-£20 per week spent 3.4 per cent of total expenditure on transort. It would appear therefore that people in Third World cities have to spend significantly more, proportionately, on transport than those from low-income groups in Britain.

If, for the sake of argument, the cost of housing, food and fuel are regarded as "essential" items of expenditure, the sum remaining can be regarded as the "disposable" income of the household. The proportion of disposable income spent on transport in the above three cities was estimated to be between 18 and 36 per cent in Delhi and Kuala Lumpur, depending on income and in Kingston, the range was a remarkable 54 to 74 per cent. Interviews in this city indicated in fact that some households (low income earners with several children living in rented accommodation, for example) were obliged to spend almost all of their disposable income on transport. Again, in contrast, Tulpule's study suggests that non-car-owning households in Great Britain in 1970 spent of the order of 8 per cent of their disposable income on transport. With such large proportions of the household budget being spent on bus travel it is hardly surprising that in many Third World cities, bus fares are kept at an artificially low level. Whilst this benefits the low income groups, it does mean that middle-income groups are travelling at an artificially low rate. This policy of maintaining cheap fares for all users of public transport has a detrimental effect on the service provided by bus operators. A bus company which is improverished by virtue of a low fare structure and at the same time is not in receipt of positive government support will always be short of investment capital, as a consequence of which the service will inevitably deteriorate. The decaying or stagnant service is further eroded as more expensive intermediate (para-transit) forms proliferate, their owners taking the opportunity to fill the gaps in transport supply.

INTERMEDIATE PUBLIC TRANSPORT (IPT)

Any road-based form of public transport which is not obviously a conventional stage-carriage bus service (operated with single or double-deck vehicles) or conventional taxi service (operated with saloon cars) may be classified as IPT. It is useful to sub-divide vehicles into two categories which are broadly identified by role[11],[12]. These are:
(a) the bus-like service in which vehicles are used on relatively fixed routes on which there are recognised stopping points and each user pays an individual fare which is predetermined for any given journey.
(b) the taxi-like service in which the user(s) hire the vehicle (the hire charge being either metered or bargained) and have control over its destination, and for which individuals do not pay separate fares (since the vehicle is hired).

The distinction between role types is important because vehicle utilisation, unit operating costs and user costs are likely to be significantly different. In some instances role switching may occur amongst vehicles. For example, in Calcutta, saloon cars are used to provide a classic taxi service for much of the day, but may be used as shared taxis (i.e. a type of bus service, as defined above) during peak periods. In some Indian cities tongas (horse-drawn carts) are used in the taxi-like role, while in other cities they are used in the bus-like role and yet in others there may be continual role switching. Even the two seat rickshaw has been observed to be used in a bus-like role in some cities of India (e.g. Jaipur).

The IPT vehicles undertaking an essentially taxi-like role, which include all forms of rickshaw and horse-drawn cart, seem to be generally confined to south-east Asian cities. (Rickshaws are not, to the authors' knowledge, found west of Pakistan). The IPT vehicles undertaking an essential bus-like role are found in cities throughout Africa, South and Central America, South-east Asia and Oceania. some indications of their numbers for a selection of cities are given in Table 5.

Little is known about trends in the numbers of vehicles in use, though some analysis has been made of the relationship between supply levels and city development characteristics in south-east Asian cities. In India there are some cities which are still very dependent on the more traditional forms of public transport like the cycle rickshaw. Other cities have a broad mix of IPT and conventional public transport, while some cities are more dependent on conventional public transport with some IPT in a supporting role. These patterns of public transport supply seem to be related to city prosperity, size and accessibility within the city. The more prosperous, more populated and more dispersed cities tend to

TABLE 5
Availability of IPT vehicles in selected cities

	Number per 1000 population
IPT bus-services:	
tempos — Jaipur, India	0.3
matatus — Nairobi, Kenya	2.3
jeepneys — Manila, Phillipines	3.2
bemos — Surabaya, Indonesia	0.9
minibuses — Kingston, Jamaica	1.7
IPT taxi-services	
cycle-rickshaws — Kanpur, India	33
hand-ricksaws — Calcutta, India	3
auto-rickshaws — Jakarta, Indonesia	0.3
samlor — Chieng Mai, Thailand	20

have a high component of conventional public transport. Dispersion generates long passenger leads (journey length) and mass movements; hence there is a need for cheap transport which can move large numbers of travellers efficiently. Compact, less populous cities will generate small leads and there may be less dependence on public transport because walking and cycling are practicable alternatives. Furthermore, accessibility, or, more accurately, the ease of penetration within the city may well determine the type of vehicle best suited for operations there; the congested and tortuous streets, which are more characteristic of less prosperous and more compact cities, are more likely to be the preserves of cycle rickshaws and horse tongas, which can easily be manoeuvered. Thus, evidence from India suggests a relationship between city development and structure and the development of public transport. Broadly similar patterns were noted in other south-east Asian cities[12]. It seems probable that the traditional modes of IPT which were developed in South-east Asian cities, and which still flourish in some of the less prosperous cities, were never developed in cities of Africa, South and Central America, and Oceania, because of the relative modernity (in the sense of having been established in very recent history) of most of these cities. These cities are likely to be more dispersed and easily penetrable, both conditions which are more suited to the operations of buses, whether conventional or not.

The importance of IPT is indicated by the modal split in public transport use in some selected cities, shown in Table 6.

Output from individual vehicles in the IPT sector may not be high, but the importance of IPT is derived from the large numbers of vehicles in use.

IPT vehicles are primarily in the private sector; sometimes the driver hires the vehicle on a daily basis from the owner. Less common is for the driver to be an employee of the owner. Drivers tend to work long hours and there is less likelihood of fixed hours and shifted-working as is usually the case with the more institutionalised operations of conventional buses.

Unit costs of operating IPT vehicles vary with the vehicle type and its role. Typically a minibus is more expensive per seat km to run than a large conventional bus; however, fare levels (per passenger km) and load factors (passenger kms to seat kms) are often higher on the minibus, making it a profitable enterprise to the private entrepreneur. Load factors can be higher because for a given demand level throughout the day it will always be easier to fill a small vehicle than a large one. Fare levels may be higher because the service provided is geared to the more discerning travellers (i.e. those prepared to pay extra for speed and/or comfort) or because the conventional fleet operators are more likely to be under pressure to maintain artificially low fares (for which they may be receiving some form of subsidy).

Taxi-like vehicles tend to have high unit operating costs in comparison with both conventional buses and mini buses. Utilisation and carrying capacity of these vehicles are low. Tariffs, per passenger km, can be as much as five or ten times higher than those charged on a bus service for an equivalent journey length. In these circumstances demand for taxi-like services tends to be of a "non-regular" nature with middle and high-income travellers making the most use of these vehicles. However, there is evidence from Indian cities that in those cities where conventional public transport is deficient, the traditional public transport types, though undertaking an essentially taxi-like service, are used on a regular basis by middle-income groups. Even low-income groups make more use of these forms of public transport than their counterparts in cities where conventional public transport is more readily available.

Apart from the pure transport characteristics of IPT, the development potential of these vehicles is often discussed in terms of such external factors as employment, congestion, safety and health. Energy efficiency is also an important factor nowadays.

IPT creates employment on a large scale. In some cities it has been estimated that as many as 10 to 20 per cent of the population may be either directly employed or dependent on those employed in the industry. Earnings are not always good in the IPT sector, which is not well protected by labour legislation or unions. In particular, cycle rickshaw drivers are usually towards the bottom end of the social scale. Evidence from India on the operations of IPT suggests that the minibus forms of IPT may not always be the most labour intensive means of public transport. Table 7 shows some estimates of input and output for the main IPT and conventional types.

TABLE 6
Percentage modal split in use of main public transport types in selected cities

Trips made by:— City	rickshaw*	minibus	conventional bus	rail/tram metro	Total
Calcutta, India	8	4	48	40	100
Delhi, India	17	neg	83	neg	100
Jakarta, Indonesia	20	—	80	—	100
Chieng Mai, Thailand	7	86	7	—	100
Manila, Phillipines	—	64	36	—	100
Surabaya, Indonesia	54	39	7	—	100
Kanpur, India	88	5	7	—	100
Jaipur, India	72	10	18	—	100
Bangkok, Thailand	8	11	81	—	100

** Includes hand, cycle and auto rickshaws*

TABLE 7
Estimates of public transport input and output levels for Indian cities

	Capital to labour ratio (Rs per man)	Annual output to capital ratio (pass kms per Rs)	Daily output to labour ratio (pass kms per man)
Cycle rickshaw	500	12	20
Auto rickshaw	7,000	4	100
Taxi (saloon car)	25,000	2	150
Minibus (15-seat)	40,000	15	2,000
Minibus (25-seat	50,000	10	1,700
Single-deck bus (60 seat)	17,500	16	940
Double-deck bus (100 seat)	17,000	16	910

Table 7 suggests that minibuses require a higher level of capital to labour input, though the productivity of the labour is significantly higher (in terms of passenger kms per man employed). As might be expected, the most labour intensive vehicles are the rickshaws.

In the authors' opinion it should perhaps be stated that the main objective of public transport ought to be to move people efficiently (however defined) from origin to destination. The generation of employment and entrepreneurial skill ought to be considered as a secondary objective.

At present there is little evidence on the congestion effects that IPT may create. It seems intuitively sensible to hypothesise that large numbers of small vehicles (i.e. IPT) will create more congestion than small numbers of large vehicles (i.e. conventional public transport). There are many situations in Third World cities, however, where the operating environment is in a chaotic state because of the narrowness of roads and their use by hawkers, pedestrians, etc; as noted earlier, in these conditions IPT types can be operated more efficiently than conventional public transport.

Again, on the question of safety there is little evidence to suggest that IPT is more or less safe than conventional public transport. Statistical data are often deficient and difficult to interpret for comparative purposes. What is probable, however, is that the fatality rate associated with the occupants of vehicles involved in an accident is likely to be higher for many of the IPT types as compared to conventional public transport. The flimsy construction of IPT vehicles, particularly rickshaws, gives passengers little protection in the event of an accident. Further, the speed differentials between IPT types (again, rickshaws in particular) and conventional public transport are likely to create potential conflict situations.

The impairment of health as a result of riding or pulling a rickshaw has also been put forward as a reason for abandoning this form of public transport. While there is no hard evidence to suggest how health is impaired, funds have been made available by various organisations to try to improve cycle rickshaw design in order to reduce the drivers' efforts. In Britain Oxfam have sponsored the development of Oxtrike[13] while in India various attempts have been made to fit a small motor to the rickshaw. The latest attempt is being undertaken by the Automotive Research Association of India and involves building a purpose-built powered cycle rickshaw (Figure 3).

CONCLUSIONS

Public transport in Third World cities consists of a variety of vehicle types engaged in the two basic roles of stage-carriage bus service and taxi service. (A few, but not many, cities also have an important suburban rail component.) These vehicle types have been classified as either conventional or IPT. The IPT taxi services are not common outside south-east Asia. In general, however, IPT is an important component of public transport.

Public transport is a growth industry and this is undoubtedly connected with general urban development in the Third World. The creation of minibus systems in addition to conventional public transport is a feature of this growth. The more traditional IPT types like cycle rickshaws and horse-drawn carts are now only significant in some of the less prosperous or less well-developed cities.

The development of IPT systems has generated some controversy over the use of small or large vehicles, the encouragement of small or large enterprises and whether the public transport sector should be privately operated or nationalised. Resolving the arguments is not an easy task because technical merits of a particular system may be masked by institutionalised constraints. In general, small vehicles are likely to be more expensive to operate (per seat km) than

Figure 3. A prototype powered cycle rickshaw in Pune, India.

large vehicles (assuming the same operator were to be running the two types). But returns on the smaller vehicle may be higher because of higher load factors and fares (per passenger km). A small enterprise is likely to be able to operate a given vehicle type more cheaply than a large enterprise. This is less likely to be because there are any economies of scale, but because labour productivity is higher in the small enterprise, for institutional rather than technical reasons. The small enterprise is less subject to labour laws and union pressures, which affect manning levels, working hours and wage rates. (In many cases the small enterprise is the self-employed man, who dictates his own conditions of employment.) Lastly, the nationalised industry is likely to incur higher costs in operating a given number of vehicles, than a private concern. But the nationalised concern is likely to be under much greater pressure to provide high service levels, at artificially low fares. The losses inevitably incurred are made good either by some form of subsidy (which is inclined to encourage waste and lower productivity) or through the deterioration in the fleet through lack of investment and the consequent effects on vehicle output.

More research is needed to elaborate further on some of these topics and also on some of the other external issues influencing public transport development potential, like employment generation, congestion, fuel economy, safety, health, and the relationship with city development. IPT must have a continuing task to perform in urban transport alongside conventional public transport. The markets for the two types must be clearly identified and the systems encouraged to develop to meet the demands of these markets.

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