ESSAY COMPETITION IN TRANSPORT

In the first essay competition in transport, the prize offered by the Trustees of the Rees Jeffreys Road Fund through the Journal of Transport Economics and Policy has been divided between:

Professor M. C. Poulton
and Mr. R. L. Mackett.

Their prize-winning essays follow as the first two papers in this issue of the Journal.

THE RELATIONSHIP BETWEEN TRANSPORT AND THE VIABILITY OF CENTRAL AND INNER URBAN AREAS

By M. C. Poulton*

It is but a few years since concern with centres of cities focused not on their viability, but on their vitality. They were too attractive. They starved lesser places of jobs and investment, and overstretched the transport systems on which they depended. But, although the perception of an alarming deterioration in the health of the inner cities is recent, the sources of prosperity for the inner cities have been weakening for decades.

The inner cities are to a large extent creatures of a bygone age. In the nineteenth century new means of transport created a climate for a previously unparalleled period of urban growth and prosperity. In its early years that climate fostered the pre-eminence of the city centre as the place of commerce, service and industry. The climate has changed, and no longer nourishes large central concentrations of activity.

1. URBAN TRANSPORT AND THE INNER CITY

The first part of this essay explains the context for the policy prescriptions on transport and land use which are elaborated in the second part. That context is the relative decline of central areas as foci of economic activity within cities. In some

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cities the deterioration has been such that doubts have been raised of the long-run viability of the inner areas. The main purpose of this part of the essay is to forecast how inner cities are likely to evolve, and in particular to assess the role of transport in stimulating the changes that have taken place in the past, and are likely to take place in the future. The potency of transport policies and innovations as means for arresting the decline of the inner areas is examined. It is concluded that inner cities will continue to lose importance in many ways, and that land use and transport policies should be reconciled to this future. This does not mean that the inner cities will cease to be viable; rather it sets the context for possibilities that should seek to enhance their quality as places to live and work in.

The evolution of urban transport and city growth

In 1851 London was a city of some 2 million people. It was a dense city with a built-up area about six miles in diameter. In the decades that followed, London, like other cities, acquired cheap suburban passenger service on railways, and a fleet of horse-drawn buses and trams. From the 1890s onward electrification further enhanced the public transport system. The first electrified subway line opened in 1890, and the first phase of suburban railway electrification took place between 1905 and 1909. The tram system was electrified at about the same time, and just before the First World War motor buses made their appearance.

The first revolution in personal transport in the modern era was brought about by the steam train. In London as elsewhere, it provided rapid access to the centre for middle-class commuters.

The steam train had poor acceleration and deceleration, so to maintain good overall speeds stations were widely spaced. Travel off the railways remained at walking pace. As a result, the built-up area of London and other cities with radial railway lines took on a "tentacular" form.

The railway termini vastly enhanced the predominance of the centre as the most accessible place in the city. Industry clustered round the rail yards, and commerce thrived where people could congregate in numbers with an ease previously unapproachable.

Adjustment to the potential of the new mode naturally took time. The railways had to be built; the commercial advantages of the central core, with its much enhanced absolute and relative accessibility, had to be recognised and acted upon; and the new suburban homes had to be financed, built, and let or sold. For some thirty years the building of the railways governed the demands for space and location in the city. Then another transport revolution occurred.

Electrification completely changed the characteristics of trams and railways. The typical tram ceased to be a horse-drawn vehicle. The new electric tram was larger, could travel at 20 or 30 miles an hour, and was capable of rapid acceleration and deceleration. Journey speeds were governed by stops and starts and the frequency of street intersections rather than by the inherent limitations of vehicle technology.

Low-density suburban living on a wide scale was made feasible, and streetcar suburbs developed around many cities, most spectacularly in Los Angeles, which for a time boasted the largest streetcar system in the world.

The tram was the first mechanised mode able to serve effectively a dispersed
pattern of trip desires. It was not primarily a linehaul system, as were the railways, and so it provided a new transport climate: one that allowed smaller, more dispersed subcentres to prosper. The new streetcar city of Los Angeles never developed an overwhelmingly predominant central business district of the type typical of the railway cities.

Electrification also affected the design and operation of the railways, and in so doing gave the centres of the large cities a new lease of life. Electric trains could maintain good speeds with stations 200 or 300 yards apart, rather than the half-mile or more needed with steam locomotives, and could be operated on long routes built entirely in tunnels. Thus, as well as providing better access to the city centre, the electric railway could provide an efficient grade-separated downtown circulation system. All it needed was a large enough volume of passengers to justify the expense of construction.

Before the First World War the automobile was in mass production and the motor bus was becoming more common. Buses do not need overhead wires or steel rails. They can use virtually any paved road at any time. The car proved such a threat to the tram operators that by the end of the 1920s jitneys were banned throughout North America. With the jitneys out of the way, and the buses yet to take over, the 1920s were the heyday of streetcars. In Chicago a series of studies made in that decade forecast rapid growth of the streetcar system and its use (Chicago Area Study, 1960).

It was not to be. In the 1930s buses replaced the streetcars, and provided a public transport system quite sufficient to allow urban sprawl to take place at net densities of 12 houses to the acre and less. Throughout the 1930s, in Britain, less than one family in ten had a car, but suburban homes sold for a price that was the lowest it has ever been in relation to wages, and house building boomed (Hall, 1975, ch. 2). London became once again a roughly circular city.

The bus operator did not have to provide any special infrastructure, and the vehicles could be mass produced. As a result bus service spread very rapidly, and within a decade an overall level of service within and between cities was established that has not been much improved since. The most significant response was the spread of residential development, which filled up the open land around cities and ran in ribbons between them. Buses could bring workers to suburban factories and offices, so employment too began to disperse.

In less than a generation after the Second World War the fourth great urban transport revolution was completed in North America and was well under way in Europe. Car ownership in the United States increased from about 0.2 car per head of population in 1950 to over 0.4 per head of a larger population before 1970 (U.S. Department of Transportation, 1968). By then the rate of growth of the car population was slowing appreciably as saturation levels of ownership were approached.

By the mid-1970s at least 80% of all person trip miles travelled in all towns and cities, with the notable exception of New York, were travelled in cars.

In terms of total journey time, including walking and waiting, the car is virtually always very much faster than its public transport competitors. The mere availability of a car doubles the number of trips by vehicle that people undertake (Oi and Shulder, 1962, p. 91) and increases the number of easily accessible destinations enormously (Figure 1).

The car is also a great consumer of space, both road space and parking space.
Figure 1
Road and Transit Travel Times for Suburban Zone in Toronto

Therefore, unlike the streetcar and the bus, in large-scale use it has created a
tremendous demand for roads. But, whether these roads are built or not, the
am automobile will have left its mark in the freeways that already exist and in the
car-oriented suburban shopping centres, offices and factories.

The history of transport developments to date might suggest that the main effort
still to come would be the completion of urban motorway networks. Until little more
than a decade ago this seemed very likely. Public investment in roads would then
catch up with the demand created by the enormous private investment in vehicles.
However, the last few years in Britain and North America have been notable for the
very cautious attitude toward the building of freeways in cities. This has been
motivated largely by fear of the destructive impact of freeways on the neighbour-
hoods through which they pass, and belief that they will encourage sprawl on the city fringes and decay at its centre.

It is widely assumed that the future of the inner areas is heavily dependent on investment in public transport. But re-investment in public transport may have little effect on the health of the inner cities, and resistance to improvement of the primary road network may harm rather than help central areas.

The demand for different transport modes

"Cities should be designed for people, not cars"—a provocative slogan that suggests that cars are, at best, a burdensome necessity, a private obligation that people would happily do without, if only sensible urban planning decisions and a decent transit system made this possible. In fact, the evidence suggests that car ownership is highly valued.

In North America car ownership is extensive even among the poorest groups. They tend to economise on the purchase price and the mileage driven, so that the average cost per mile is remarkably constant across income groups. The proportion of income spent on owning and operating a car in the United States is generally above 10%, and for some groups as high as 25%, of discretionary income (U.S. Department of Transportation, 1972). The fact that so many people accept this burden and choose to own a car is an indication of its value to them.

It has been vehemently argued that deterioration in the standards of service offered by public transport is largely responsible for its declining share of personal travel. In fact service levels, whether measured in terms of route miles or in vehicle miles, did not fall nearly as much as passenger loadings in the 1950s and 1960s. Vigorous efforts to encourage the use of transit in the late 1960s and early 1970s produced more passengers, but generally at marginal cost levels that were excessive, and few of the extra trips were trips diverted from automobile.

Finally it should be remembered that mass transit systems had the great advantage in the immediate post-war years of being there first. The automobile as an alternative mode had to win passengers away from transit.

That the automobile has proved to be such a successful mode can be put down largely to two factors. First, car ownership immensely increases the number of trip end opportunities open to a user. The number of workplaces within a given isochrone of home is likely to be four or five times greater for travel by car than for travel by public transport. Second, experimental evidence, from studies of the value placed on travel time savings and from analysis of mode choice decisions, suggests that time savings and comfort in travel are highly valued. Figures of one-quarter to one-third of the average wage rate are widely accepted as a reasonable estimate of the value placed by individuals on savings in discretionary or leisure time (Hensher, 1976); and values much higher than this appear to be placed on savings of travel time spent in uncomfortable conditions, such as walking and waiting for vehicles (Quarmby, 1967).

Automobiles are usually at least twice as fast as buses in urban areas, and the car passenger does very much less waiting and walking than the bus passenger. Add that many people feel a great deal more comfortable and secure in their own car, and the high level of preference for car usage is hardly surprising.

The chances of transit greatly increasing its market penetration at a reasonable cost
are slim. Improved vehicles, innovative services such as "dial-a-ride", and substantial subsidies have all failed to have much of an impact. Even a free service is unlikely to cut greatly into car travel (Moses and William, 1963). Transit is, and is likely to remain, an inferior substitute for the private car. It only captures the larger share of the travel market when automobile use is expensive or inconvenient. Given the high values placed on time-saving, comfort and mode flexibility, it is hard to imagine conventional transit systems having a competitive advantage over the car except in very limited circumstances. Attempts to re-establish the bygone position of city centres by promoting the provision and use of conventional public transport are therefore likely to prove futile; nor is it certain that innovations in transport technology will be of much help either.

The potential impact of innovations in urban passenger transport

A review of the technological advances in urban transport that have been made since the 1930s makes disappointing reading. Despite a great deal of research work, particularly in the last two decades, no striking advances have been made. Existing modes have been refined and used in better ways, but no new modes have been developed beyond the simplified prototype stage. This has led Schaeffer and Sclar (1975) and, earlier, Meyer, Kain and Wohl (1965) to believe that future improvements will follow past trends and be limited to refinement of existing modes. Despite this scepticism, attention continues to be lavished on the development and proving of new technologies. The case for believing that this research is unlikely to be productive is even stronger than the paucity of significant advances in recent years would suggest. This is because there appears to be a technological barrier that must deny the exploitation of the one remaining source of large potential transport benefits—the elimination of the slow, uncomfortable service associated with travel to, from and within the places where trips are most concentrated. To exploit this source of benefits a mode must be fast, flexible and economical in its use of space. However, experience to date suggests a "law" which states that this is impossible. The evidence for this proposition comes from two sources: a comparison of the relative performance of existing and proposed modes, and a review of the yield from recent research and development in urban transport.

An ordering of the main modes according to their performance shows that none do relatively well in more than two out of the three aspects of performance mentioned above: speed, flexibility and economy of space. See Table 1.

At one end of the spectrum is the automobile, which provides high levels of speed and flexibility, but its road bed and storage requirements are such that it cannot provide the flow capacity necessary in large central business districts. At the other is the railway, which combines high speed and track capacity, but only at the expense of flexibility. Buses are between these two. If they share road space with cars their overall speed may not be much more than half that of a car, and they can never match the capacity of a rail system using exclusive rights of way.

The other modes in use are of less significance. They fall between the primary modes in terms of performance, and they have been squeezed out in Western Europe and North America. The bicycle is the most widespread mode of private transport, other than walking, in the poorer countries of the world; jitneys provide extensive and
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TABLE 1

<table>
<thead>
<tr>
<th>Mode Performance</th>
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<tbody>
<tr>
<td>Speed</td>
</tr>
<tr>
<td>--------</td>
</tr>
<tr>
<td>Train</td>
</tr>
<tr>
<td>Automobile</td>
</tr>
<tr>
<td>Bus</td>
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<tr>
<td>Walk</td>
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heavily used transport services in most of Asia and Latin America; and light railway systems are successful in northern and central Europe.

For a new mode of urban transport to be accepted as a major means of personal transport it must be competitive with existing modes in most respects, and clearly superior in at least one. It must be at least in line with the general standards of comfort, safety and cost achieved by the front rank of existing modes. The motorbike, for instance, is not, and in consequence is a very minor mode in Western Europe and North America. A successful new mode must serve existing settlements. It may change them, just as the transport revolutions of the past did, but it must accommodate them meanwhile, if only because the short-run costs of abandoning these existing assets are so great that no transport mode so far conceived could possibly justify them.

The search for new modes to operate within the envelope of these requirements has been vigorous. Table 2 orders the more significant or widely publicised ones along with the existing primary modes according to their performance.

Tough and O'Flaherty (1971) describe conveyor and "neverstop" systems, and assess their potential. Black et al. (1975) do the same for personal rapid transit and the now largely abandoned dual-mode concept, and an encouraging account of experience with Dial-a-Bus operations is given by the Transportation Research Board (1976).

Most of the "new" technologies fall into a group, best described as "enhanced versions of existing modes". They will provide a better sidewalk, a better car, a better bus or a better train. The conveyor/neverstop, mini-car, dial-a-bus, monorail, high speed rail and sky-lounge all fall within this group. The remaining two technologies, Dual-Mode and Personal Rapid Transit, are truly revolutionary. They offer high corridor capacities, flexible routeing, and vehicles available on demand.

A review of the technologies listed in Table 2 shows that high speed is associated with a track or road free from obstruction, flexibility is associated with user control over vehicle and route, and efficient use of space is associated with vehicles that can move people in large groups. No new modes other than P.R.T. and Dual-Mode have been able to break these connections. Thus efforts to develop small city cars can at best yield nothing more than modest increases in the capacity of arterial roads and parking structures. The monorail is superfluous, and so are the high speed rail technologies, because existing dual rail systems are easier to operate and not significantly inferior in the key respects of overall speed and operating cost.
TABLE 2

Mode Performance for New and Existing Technologies

<table>
<thead>
<tr>
<th>Speed</th>
<th>Flexibility</th>
<th>Efficient Use of Space</th>
</tr>
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<tbody>
<tr>
<td>High speed rail</td>
<td>Walk</td>
<td>Conveyors</td>
</tr>
<tr>
<td>Railway, subway</td>
<td>Bicycle</td>
<td>Conveyors</td>
</tr>
<tr>
<td>Monorail</td>
<td>Automobile</td>
<td>Conveyors</td>
</tr>
<tr>
<td>*Personal rapid transit</td>
<td>Mini-car</td>
<td>Conveyors</td>
</tr>
<tr>
<td>*Dual-mode</td>
<td>*Dual mode</td>
<td>Conveyors</td>
</tr>
<tr>
<td>Automobile</td>
<td>Personal rapid transit</td>
<td>Conveyors</td>
</tr>
<tr>
<td>Mini-car</td>
<td>Jitney</td>
<td>Conveyors</td>
</tr>
<tr>
<td>Jitneys</td>
<td>Dial-a-bus</td>
<td>Conveyors</td>
</tr>
<tr>
<td>Light rail</td>
<td>Conventional bus</td>
<td>Conveyors</td>
</tr>
<tr>
<td>Dial-a-bus</td>
<td>Streetcar</td>
<td>Conveyors</td>
</tr>
<tr>
<td>Conventional bus</td>
<td>Light rail</td>
<td>Conveyors</td>
</tr>
<tr>
<td>Streetcar</td>
<td>Railway, subway</td>
<td>Conveyors</td>
</tr>
<tr>
<td>Bicycle</td>
<td>High speed rail</td>
<td>Conveyors</td>
</tr>
<tr>
<td>Conveyor</td>
<td>Monorail</td>
<td>Conveyors</td>
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<tr>
<td>Walk</td>
<td>Conveyors</td>
<td>Conveyors</td>
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The most fundamental problem hampering improvement in transport is that the technological imperatives associated with different facets of performance conflict. The key to the conflict is the positive relationship between the margin of space needed for safe separation of individual moving vehicles and the speed at which they move. To combine high speed and high lane or track capacity (for efficient use of space), people must be moved in large groups; as a result flexibility is lost. To combine high speed and flexibility a dense road network must be provided, with the capacity for a large number of vehicles to move safely at the same time; as a result efficient use of space is lost. To combine high capacity and flexibility people must be able to move singly or in small groups, and require little individual space; as a result speed is lost.

Only the unproven Dual-Mode and P.R.T. systems purport to resolve the space/speed conflict. But as they exist to date the P.R.T. systems built or in the planning and construction stage are no more than automatic transit systems with very simple route layouts, using small vehicles and exclusive roadbeds. This type of practical experience does nothing to prove the feasibility of the large-scale P.R.T. systems envisaged for the future. The controlling factor is still the safety requirement that stopping distances must be less than headway distances. This translates into minimum headways of between two and ten seconds. Exclusive bus lanes with standard buses can operate at four seconds headway, and cars commonly travel at less than one second headway (about 30 yards apart at 60 mph) on freeways. Chan and Ellis (1978) indicate half-second headways and line capacity of between 3,000 and 4,000 vehicles per hour in stating the performance specification of P.R.T., but there is no hard evidence that this level of performance can be achieved.
There are only two plausible ways in which headways can be much reduced. The first is to design to such a high level of reliability that stopping distances can be much greater than headways, and vehicles can be scheduled to cross each other's paths at intersections, without risk of collision. The second is to couple and uncouple vehicles at speed so that they operate as trains. Both seem infeasible: the former because the levels of design and maintenance for the guideway, vehicles and control mechanisms in a system constantly exposed to wear and interference seem unobtainable, the latter because the addition of a vehicle to a train is hazardous, and speed synchronisation to allow coupling will itself cause delay.

The very limited extent to which P.R.T. and Dual-Mode systems have been developed is indicative of the problems associated with making a further great technological advance in urban transport. Not only has progress been slow, but ambitions have been scaled down so that P.R.T. is now seen as a limited internal circulation system for central business districts rather than as a system eventually capable of serving a whole city. The crucial technical breakthrough required, if a complex high capacity system using small personal vehicles is to be created, has not been made. The one respect in which present modes could be greatly improved upon has proved to be unyielding to technological ingenuity. This means that there will be continuing pressure for cities to accommodate existing modes, and in particular to adjust to the private car. This process of adjustment is likely to emphasise urban forms that are well adapted to conditions where the majority of families own cars. Hence it should favour cities that are moderate in size, and concentrations of activity within cities that are also of moderate size. In North America the very large cities have not grown as vigorously as smaller cities, with the possible exception of Los Angeles, which really functions more as a cluster of medium-size towns than as one big city. The finding that the position of the private car is very strongly entrenched does not mean that urban areas where it is costly and awkward to use will be suddenly plunged into crisis. But it probably does mean that the process of dispersal from the inner city will continue. In some respects this process has been going on for a long time.

Colin Clark (1951) drew attention to a characteristic of development that appeared common to all cities in modern times, irrespective of where they were or how they were governed. This feature was the prolonged decline in residential densities in the central areas, and the increasing uniformity of residential density across cities, that had been occurring since mechanical passenger transport started to make an impact on cities in the mid-nineteenth century.

Clark fitted a negative exponential curve to average gross residential densities measured at different radial distances from city centres, and traced the changes in the parameter values for the curves over time. He did this for cities in Europe, America, Africa and Asia, and found that in each case the curve became flatter over time. Subsequent work has tried to better the description and expand the results. Data for Toronto indicates that there, at least, the rate of flattening of the fitted negative exponential curve has not decreased in recent years. In Hälsingborg it has: the curve tracing the rate at which densities are becoming more uniform is kinked. It thus appears that the adoption of planning policies designed to prevent urban sprawl have slightly slowed the pace of increasing uniformity.

These findings were entirely consistent with the type of changes to be expected as
TABLE 3

*Mean Time–Distance to Selected Activities for City and Suburban Nonmovers in Large SMSA's*

<table>
<thead>
<tr>
<th></th>
<th>Central city (minutes)</th>
<th>Suburbs (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grocery</td>
<td>8.3</td>
<td>6.2</td>
</tr>
<tr>
<td>Home of best friend</td>
<td>16.9</td>
<td>11.6</td>
</tr>
<tr>
<td>Elementary school</td>
<td>7.5</td>
<td>7.1</td>
</tr>
<tr>
<td>Downtown</td>
<td>24.7</td>
<td>17.7</td>
</tr>
<tr>
<td>Shopping centre</td>
<td>13.5</td>
<td>10.8</td>
</tr>
<tr>
<td>Park or playground</td>
<td>8.1</td>
<td>9.5</td>
</tr>
<tr>
<td>Doctor's office</td>
<td>18.0</td>
<td>13.8</td>
</tr>
<tr>
<td>Hospital</td>
<td>17.4</td>
<td>16.3</td>
</tr>
<tr>
<td>Work</td>
<td>25.3</td>
<td>26.0</td>
</tr>
<tr>
<td>Church</td>
<td>10.3</td>
<td>8.7</td>
</tr>
</tbody>
</table>


the opportunities created by new modes of transport were reflected in decisions on location and development. These encouraged residential development to spread out, first along the railway lines, then into the spaces between the lines, and then further into the surrounding country. Public transport created an alternative to living in the cramped inner cities, and car ownership was a positive inducement to migrate from the congested city centre to the suburbs.

What is remarkable is not that the densities have declined in central areas and become more uniform over all, but that the process has been so persistent and so impervious to demographic, social and policy variations.

Accessibility, too, has become more uniform. Stegman (1969) showed that, contrary to expectation, people who lived in the suburbs of American cities were as close, or closer, to most of their chosen trip destinations than were people who lived in the inner cities. See Table 3.

Nicholas Clark (1971), using data from Melbourne, showed that in recent years access to jobs, as measured by an index of travel times to job locations, was rising throughout the city. But it was rising faster in the suburbs than in the centre, reflecting transport improvements, the growth of employment in the suburbs, and the relative lack of growth in the city centre.

Many inner cities had the appearance of employment growth but not the reality. Hutchinson (1974, p. 180) traced the number of jobs in, and number of trips into, the centres of Canadian cities. Both were stable, even though redevelopment and office building booms gave the impression of growth. In fact, the new office space partly replaced older, more crowded space, and the new office jobs that were created did not compensate for jobs lost in retailing and industry.

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 Jobs and people are becoming more dispersed, and this makes sense in terms of reducing travel costs. A conscious policy of living close to work is not required, although Vancouver, among other cities, has adopted this rationale for a policy of dispersing office development away from the central business district.

Vaughan (1972) has shown that for all route networks, except the pure radial, the pattern of trip ends that diminishes total travel time is dispersed, not concentrated. For the best distribution the origin ends (residential) will be more spread out than the destination ends (work). How much more depends on the proportion that delay due to congestion bears to total travel time. The larger this proportion the smaller will be the degree of dispersal of origins and destinations that minimises total system travel time. The pure radial network approximates the position when the railways were predominant. No other mode operates on a pure radial route structure. One implication of Vaughan's results is that failure to improve the road system will encourage activities to leave the inner city when the automobile is the most popular mode.

Conclusions

Confidence in a conclusion or forecast comes not from the results of a single investigation, however carefully carried out, but from corroboration—arrival at roughly the same conclusion from different starting points or ways of looking at a problem. The evidence pointing to a continuing relative decline of the inner cities as foci of economic activities is extensive and diverse.

It is unsound to expect central areas to retain the degree of pre-eminence that was a legacy of the railway age. The railways provided a fast service, superior to both the streetcar and the bus, but the automobile is potentially inferior to the railway only in efficient use of space, and this is an attribute that must decline in value as activities become more dispersed through the city.

The decline in the population of central areas has continued for a long time, and through a wide variety of circumstances. It is not likely to be reversed, except by policies designed to appeal to specific groups of people who have a strong desire to use the extensive range of services and facilities available in city centres.

The pre-eminence of central areas was built upon the superiority of their transport facilities. But inner cities now have serious transport drawbacks, particularly in road capacity. The pressure to leave the central areas is enhanced, not restrained, by the refusal to improve the primary road network, and compounded by the failure of accessibility levels from the inner city to rise as fast as they have in the suburbs.

There is an unfortunate tendency to treat central area problems as a matter of "stopping the rot." In the long run, policies associated with this attitude are likely to prove little more than delaying tactics, because "the rot" is a fundamental shift in the importance and role of the central area within the city. As activities become more dispersed it will revert to being a less overpowering centre of activity. It will still be the primary centre of commerce and probably of employment, but customers for its services are less likely to be drawn from outside the central area. Inner areas will not be bolstered by depending on inferior transport technologies; nor are they likely to be helped, for long, by the use of planning policies that inhibit the development of rival commercial entities.
Once a central business district reaches a critical size it offers a selection of services and goods that is highly attractive, even if there are countervailing disincentives of high prices and congestion to overcome. Because of this, a central area can continue to thrive; but it is vulnerable, and activities with few linkages within it are likely to leave. They should not be prevented from doing so; rather, policies should aim to enhance those aspects of the inner area that can potentially contribute to its comparative advantages over other areas of the city. Transport policies that can help in this way are the subject of the second part of this essay.

2. TRANSPORT POLICIES FOR THE INNER AREAS

In the first part of this essay it was argued that there are powerful reasons to expect a continued relative decline in the appeal of inner cities. This part discusses the contribution of transport policies to the viability of the central areas. The emphasis is on access, environment and cost.

Access to and within central areas

Cities try to cope with road congestion by increasing road capacity, discouraging cars and encouraging the use of public transport. Congestion can drive down speeds and capacity to levels far below the potential throughput of the system. Effort has therefore been concentrated on ways to prevent excessive overloading of the roads, and on ways to keep speeds up. Practical policies have tended to be ameliorative rather than radical.

The element in short supply is road space, and it is difficult to increase it because road building is expensive and politically unpopular. However, a great deal can be done at modest cost by concentrating on expanding the capacity of intersections, and by managing existing road space better.

Most cities adopt strategies to restrain the number of vehicles entering central areas. The deliberate control of parking to discourage commuting by car is probably the policy in widest use, but many others have been tried or proposed. In Singapore vehicles must obtain licences for entry into controlled areas. Nottingham has used restrictions at points through which all traffic going into the centre must pass. Road pricing schemes, obliging travellers to pay an amount equal to part or all of the social cost of their decisions to occupy scarce road space, have been advocated but never implemented.

Efforts to divert travellers from cars to buses and trains have concentrated on more extensive and flexible services and on subsidies to keep fares down. "Bus only" lanes have been widely adopted, both to speed buses through bottlenecks and to provide them with congestion-free routes to and from city centres.

Most of the policies implemented have been helpful in some degree, but their impact has been dissipated by failure to be selective. What is required to enhance the viability of central areas is a set of measures that will provide them with environmental and transport conditions comparable with those that people can find in the less crowded suburbs.

Thus improvements in road conditions should not aim for a general, gradual
increase in capacity and speeds, but rather for selective but dramatic improvements. Restrictions on use of cars should be kept to the minimum. They should be applied to a small number of routes and places so as to release these for other modes, rather than to damp down the total volume of traffic. Public transport should be accepted as inferior to private cars and should be used to provide two distinct types of services: on the one hand to substitute vehicle capacity for deficient road capacity, and on the other to provide a level of mobility that is warranted either by demand or by social considerations.

Improvement in roads and public transport

Lane capacity is generally low on mixed-use urban roads: 700 vehicles per hour is typical on streets with frequent intersections. Motorways, however, frequently operate at lane capacities of 2,000 p.h. or more. One would expect that, since one motorway lane can replace three primary road lanes, motorways would be popular with their neighbours. They are not. The benefits they offer by draining traffic from parallel roads, and by cutting down noise, danger and filtering traffic in the process, is offset by the oppressiveness of their presence. As a result they are not being built, and journeys to or from the inner city take three times as long as they need do. This poor access to the outer suburbs and beyond is a considerable drawback to living or working in the inner areas.

What is needed is motorways that connect the central areas to the primary network beyond the inner suburbs, and also offer demonstrable environmental benefits. These roads would not have frequent access and egress points, as they would be designed to move traffic only between the central areas and the outer suburbs. As far as possible they would use existing rights of way and would be built in cuts. This would limit demolition to the absolute minimum, and shield adjoining properties from noise and visual intrusion. All existing primary roads crossing the routes should be retained, so that neighbourhood severance would be quite limited. Entry to the new roads could easily be controlled, so they could be financed by tolls. They need not be wide; two lanes in each direction should be standard, so they could be designed to take over roughly parallel pairs of existing roads.

Marshall (1976) has demonstrated the feasibility of a "minimum impact" freeway for Vancouver. He showed that such a road could be built to motorway standards, within the rights of way of two existing roads, and at a relatively low cost. Only six homes needed to be demolished; and, when it was analysed as operating at capacity with a normal mix of traffic, the noise level experienced by adjacent properties was not significantly different from existing noise levels. By diverting traffic now using existing primary roads to get from the central area to a suburban freeway this road would, if built, greatly reduce peak flows on three parallel routes that are heavily congested.

A cost–benefit analysis, heavily influenced by the value placed on time savings of a few minutes on short trips, may indicate that a conventional urban motorway with many entry and exit points would yield a higher net benefit. But this does not take into account the virtues of the minimum impact motorway: that it is simple in concept and non-disruptive. The conventional motorway alternative is far more expensive, takes longer to build and requires extensive demolition.
Even with some extra road capacity, central areas are going to remain heavily dependent on public transport.

In providing access to the central areas the vehicle capacity of buses should be regarded as a substitute for road space, and the operating costs of the vehicle as replacing the capital costs of the roads otherwise needed. Fast, frequent shuttle services on congestion-free bus routes linking the city centre with relatively uncongested suburban arterials are most to be desired. The shuttle services should run on routes that are short, so that the buses can be turned round to make several trips during each peak period.

The attraction of such services to the user is that they enable him or her to avoid the slow, congested inner city roads and the expensive parking facilities of the city centre. Policies to improve access to and from central areas will improve the viability of city centres if they make a significant cut in full travel costs for a substantial number of people, and if access within the centres is adequate.

**Circulation in central areas**

Despite being very dependent on pedestrian traffic, most central areas offer a very poor environment for pedestrians. They grew by accretion, and the location of shops, offices, factories and houses is not the best. As a result the central retail and business districts are vulnerable to competition from new purpose-designed centres able to cater very well for the pedestrian and the motor-car.

To compensate for poor physical layout central areas need good mobility. This can be provided by a free and frequent bus or jitney service. It should be free because this speeds up the service, and because payment would inhibit use by a person who would want to make several stops. The system would be a great asset to inner area residents, and would be a substitute for the building of suburban-type shopping centres in the city centre. It would also keep a large area intact for comparative shopping. This is important in preventing concentrations of retailing activity that would leave parts of the central area with inferior drawing power, with the consequent threat of being trapped in a cycle of decline.

One great advantage of central areas is the existence of physical assets. A thriving central area is in the interest of property owners, so they should support ancillary transport services that will encourage the use of their property. They gain the benefits and should therefore pay the costs.

The intimate relationship between transport and environment in inner areas has long been recognised. But this recognition has not been translated into analysis to show how to get the most out of the road system in terms of travel and environmental improvement.

Many schemes have been adopted to reduce the deleterious effects of traffic. They include pedestrianisation of shopping streets, replanning road layouts to keep through traffic out of residential areas, and reducing road widths so as to give more space to pedestrians.

What appears to be lacking is an analytical framework for the replanning of the access road system as a whole. On the face of it this is surprising, because the road system in most inner cities was laid out before modern traffic conditions were contemplated. The primary network has commanded virtually all the attention
because that is where the traffic problems are. The access network has created few problems, mainly because it is so extensive. Any system of roads using 15% or more of the ground space in inner cities could hardly fail to be effective. However, the fact that it is effective does not mean that it is being used wisely. In general there are too many intersections between access streets and between access and arterial streets. These are hazardous and hamper the flow of traffic without producing any compensating benefits. There is very little traffic on most access streets, but it is sufficient to deny that space to other users.

It has been shown that a highly efficient network of access and arterial streets that also has excellent environmental characteristics can be created from a grid of existing streets, while releasing most of the road space for other users (Poulton, forthcoming). Existing arterials should be retained if their capacity is needed, and if they do not obstruct each other. The grid of access streets should be pared down to a pattern of interlocking fingers connected to adjacent arterials (Figure 2).

These findings are not directly translatable to the mesh of roads found in European cities, but the principles probably are. In particular, most access roads simply get in the way. With some concentration of parking they could be converted to other uses, including shared open space. With more stringent restrictions on traffic, a network of walkways or bikeways could be created.

Replanning the access street system in this manner taps what is often the only available source of land for the creation of open space in the inner city. It can contribute vitally to the attractiveness and viability of the inner areas as places to live.
CONCLUSIONS

Not all central areas are threatened, and not all parts of those that are threatened are lacking in prosperity. More than forty years ago Hoyt (1939) pointed to the phenomenon of decay in city centres and the drift of the centre of activity toward the prosperous adjacent sectors. Change and decline in inner areas has been going on for a long time.

The modern decline of inner cities cannot be turned round by transport policies. It is a response to a changed transport climate that allows people to avoid the congestion and crowding most apparent in these areas. What transport policy can do is to ameliorate conditions so that the advantages of living or location in the central area are available to be utilised to the full.

Unfortunately, much of British and North American transport policy has done nothing of the sort. It has wavered and temporised. Motorway and freeway building has neither destroyed inner cities nor proved their immediate salvation, but it has been carried out with a great lack of sensitivity to environmental impacts. Comprehensive redevelopment around the new roads has compounded the destructive effects rather than alleviated them. Much activity in public transport has simply drained resources and delayed action for very little benefit to travellers. The politics of equality has led to expanded suburban and long-distance commuter services, the cost of which has pushed many cities to the limit of acceptable transit subsidies.

A fraction of the buses tied up in these services could provide shuttle services through the inner suburbs, and do far more to assist the city centres in the process.

The future viability of central areas depends on how well they function as neighbourhoods with large resident populations. The working population supports an abundance of services that the resident population can take advantage of. The people who want to live in these surroundings are generally young, mobile and gregarious. They want a transport system that allows them to circulate in the city and to get out of it with ease. They seek an attractive environment and homes at a reasonable rent. The transport desires fortunately accord with those of commuters, so meeting them supports two groups essential to the viability of the inner areas.

The recipe to speed the decline of the inner areas is to adopt restrictive transport policies that make it difficult to use cars in the central area; not to facilitate environmental improvements; and to encourage people who can make little use of the city centres' facilities to live there. Sometimes it appears that this is the trilogy of policies that is being pursued.

REFERENCES

TRANSPORT AND VIABILITY OF CENTRAL AND INNER AREAS

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