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Park and ride facilities on light rail transit systems

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Abstract. There is now considerable interest in exploring the idea of strategic park and ride as a means of promoting the use of rail transit and encouraging a transfer of commuters from car to public transport. This is especially evident in North America, where extensive park and ride facilities have been installed on a number of light and heavy urban rail systems. There is a general consensus about the most suitable types of location for facilities, but less agreement on the development of a reliable method of forecasting demand and also on the required size of sites. Experience in practice indicates that although park and ride is attractive to commuters, schemes do not generally result in lasting reductions in highway congestion, due to rising car ownership and use and the phenomenon of generated traffic.

Abbreviations: Centro — West Midlands Passenger Transport Executive, K&R — Kiss and ride, LRT — Light Rail Transit, PT — Public Transport, RT — Rapid Transit, TRRL — Transport & Road Research Laboratory, UK

Scope

This paper investigates the use of and potential for park and ride facilities on light rail transit (LRT) systems resulting from a postal survey of 51 European and North American cities.

Because of the general paucity of information about park and ride (P&R) on LRT systems, some data on bus and metro-based P&R has also been included. A considerable amount of research has been carried out in the USA into the design, location and use of P&R facilities. Similar research and information from Europe (apart from the UK) is harder to find, although Stuttgart and Rhine-Ruhr are exceptions.

The concept and potential of park and ride

The introduction (or in many cases re-introduction) of LRT has been a key development in urban public transport during the 1980s. Cities which

abandoned their tramways in the 1940s and 50s have been rediscovering the merits of lightweight urban railways. LRT promoters seek, inter alia, to attract car users on to their systems in order to relieve pressure on the highway network and a key element in this has been the spread of P&R systems. The concept of strategic P&R, sometimes designed into the LRT system from the outset, has gained acceptance, particularly in North America. European LRT systems, which have often been developed from existing street tramways, have been rather slower to appreciate the merits of P&R and have often adopted the more opportunistic approach of installing facilities where land is easily available. The result is that North American systems are generally much more dependent on P&R than their European counterparts. However, even in Europe there is now increasing enthusiasm for P&R as an instrument of transport policy.

Park and ride and its variant kiss and ride (K&R) (or pickup/dropoff) is used whenever a car user decides that changing to public transport part of the way along their journey will be to their advantage. The advantage may be time, cost or both. The US Council on Environmental Quality reported in 1976 that "Significant P&R use will be made of transit only if it is as fast and as cheap as driving to work . . ." (CEQ 1976). The report went on to define the park and ride "impact area" around a transit station as

> . . . the area in which the car/transit travel time to the central business district, in the rush hour, is less than that for an automobile alone.

Various studies (for example, by Keck and Liou in 1976 and by the UK Transport and Road Research Laboratory in 1980) have indicated that time savings are more important to drivers than cost savings. The latter study suggested that there was an "interchange penalty" of 3 to 4 minutes, in addition to the actual waiting time. So, for example, if the waiting time at the P&R lot is 10 minutes, the total time advantage of LRT/P&R over the car would have to be at least 13 to 14 minutes in order to persuade a significant proportion of motorists to transfer.

If car users implicitly or explicitly calculate this kind of advantage for themselves, they will use P&R without any "official" encouragement. In fact, this can lead to problems of (for example) excessive on-street parking around suburban rail stations. However, increasingly city planners have seen the potential of "official" P&R as perhaps the most direct means of encouraging a modal transfer from car to public transport. The basic reasoning behind this is that it will relieve the pressure on roads. Most transport authorities would agree with Cox (1982) that P&R has potential

in cities where there is significant congestion on primary roads coupled with parking problems in the employment centre(s).

Cox has in fact suggested that park and ride policies can help to solve more than one transport problem. They can effect a modal transfer of car users to public transport, which would relieve traffic congestion and the demand for city-centre parking; and they can be used as marketing tools by the public transport operator.

Whether P&R results in a significant reduction in road traffic is very difficult to discover. Although put simply every P&R trip is one less car on the road, the latent demand for car travel is such that absolute reductions in traffic, if they occur at all, are generally of a temporary nature. For example, research in Tyne and Wear (UK) concluded that, although in *theory* reductions in traffic flows of 9.3% should have occurred at Benton Bank following the introduction of P&R on the Metro, in *practice*

> . . . there has been no net reduction in traffic on this link. It is likely that any reduction . . . due to park and ride has been balanced by increased demand for car travel. Car ownership in Tyne and Wear has risen by 14% between 1976 and 1984, making it difficult to identify any decrease in road traffic due to Metro. (Pickett et al. 1986)

However, there have been successes; in Calgary about 20% of LRT travellers are former car commuters, and Calgary Transit have concluded that

> traffic studies have shown an increased transit modal split for the downtown work trip from 36% (pre LRT) to 45—48% during the AM peak. At the same time, vehicle traffic entering the downtown has decreased (—4% in 1988). (Calgary Transit 1988)

In Hanover, studies have shown that 30—35% of LRT passengers did not previously use public transport, while 50% of all persons who had a car available used LRT instead for their city centre trips. The transport authority (USTRA) concluded that the system had taken pressure off the highway network and as a result had saved investment in roads. (Felz 1982)

Barry Simpson, of the University of Aston in Birmingham (UK), has effectively summarised the situation —

> rail based public transport has been more effective as a means of

> bringing into town more people for the maximum tolerable level of congestion than as a means of reducing congestion. (Simpson 1987)

Rapid transit and park and ride are not, however, ineffective, even if they do not result in permanent reductions in road traffic. By increasing the capacity of the overall transport system, they take the pressure off the road network and may reduce the need for additional highway investment. This was certainly the view of Priest (1980). In addition, they result in time and cost savings to individual travellers, which is a worthwhile end in itself. Hence, both user and non-user benefits are achieved. Six out of the seven cities which responded to this question reckoned that P&R had helped to ease congestion.

A further advantage is the saving of city centre parking. The TRRL study of Tyne and Wear, referred to above, calculated that the provision of suburban P&R had saved a net £484,900 a year in central area parking costs. Similarly a study by Walker and Cummings in 1972 predicted that P&R would save the construction of 4,348 spaces in downtown Boston. Although these would have to be provided at suburban P&R lots, the lower price of land would result in a net saving of $8 million at 1974 prices.

Summary of study results

The study which forms the basis of this article was carried out in 1988/89 on behalf of Centro of 51 cities with rapid transit systems (mostly light) in Europe and North America. Information was received from 25, with the following results (See Table 1).

In terms of P&R practice, there were a number of points of similarity between cities, but also some significant differences, particularly between European and American experience.

North Amrican cities were much more likely to employ P&R in a widespread and systematic way, as part of an overall strategy to tackle excessive car use and the resulting congestion. European cities more often took a pragmatic, ad hoc, attitude — providing P&R if and when the opportunity arose.

The other main difference between the continents was the average age of the systems. European LRT systems are in general more 'mature' than those in North America. It was therefore easier and more appropriate for European authorities to take an incremental view of P&R provision. American systems were often planned from the outset to contain large-scale strategic P&R — the two were seen as complementary arms of the

Table 1. Summary of case studies (as at 1989). This table contains the results from the majority of the case studies. Some results were not in a form appropriate to this table and have had to be omitted. In some cases, answers are either approximate, or are qualified in some way.

City	Tyne & Wear	Boston	Buffalo	Portland	Sac'mento	Wash'ton	Los Ang's	S Diego	Calgary	Edm'ton	Cologne	R-Ruhr	Stuttgart	Antwerp	Berne	Toulouse
Existing routes	4	1	1	1	2	4	none	1	3	3	14	8	3	1	5	none
Existing km	56	40	10	24	30	112	nil	33	28	10	140	82	32	159*	63	nil
Planned routes	1	none	—	—	2	—	3	—	1	1	—	—	—	4	1	2
Planned km	4	—	20	50	—	166	74	80	—	2	14	81	68	13	—	12
LRT million trips p.a.	45	11	10	6.6	3	137	40 (est)	10.2	14	6.2	120	51	?	32*	14	44 (est)
% total Modal Split	?	18	1	?	0.75	21	—	1	7.7	10	26	5-LRT 26 — Tram	13	10.5*	?	—
No. of P&R sites	16	6	1	5	11	21	—	14	14	3	24	—	3	2	14	4
Total spaces	1,241	1,923	600	1,600	3,270	20,723	—	2,400	8,627	2,085	1,699	2,700	—	—	255	2,000
Expansion plans?	no	yes	yes	yes	not yet	yes	yes	yes	yes	?	yes	yes	yes	yes	yes	yes
New/expanded sites	0	3	1	?	0	9	20	8	4	?	15	?	?	6	?	4
New spaces planned	0	1,500	1,000	?	0	6,210	8,400	1,660	3,200	?	1,192	3,300	?	?	?	2,000
Kiss & ride at sites?	yes	yes	?	some	?	some	some	some	yes	some	?	?	?	?	yes	?
Bus transfer at sites?	yes	yes	?	some	some	yes	some	some	no	yes	some	yes	yes	?	?	yes
P&R trips/day (av)	3,562	2,100	1,400	5,400	1,800	74,400	25,000 (est)	1,500	8,000	3,000	1,700	2,000	?	?	?	?
% LRT trips by P&R	5	5	5	30	21	16	10—35 (est)	50	15—21	14	1	1	1	?	?	?
Parking charge?	no	$1/day	no	no	no	$2/day	no	no	no	no	no	no	some	no	?	?
% spaces occupied	?	100	?	?	30—50	75—100	—	50	70—100	70—100	100	?	?	?	?	—
Funding % — national	—	—	—	85	—	80	—	57	—	—	60	60	60	100	—	—
for P&R — regional	—	} 100	—	} 15	—	} 20	—	} 43	75	68	30	30	25	—	—	—
sites — City	100		} 100		—		100		25	32	10	10	15	—	—	—
— Private	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0
Prior economic appraisal?	?	yes	yes	yes	yes	no	yes	no	no	no	no	yes	?	no	?	?
Cost per space	?	?	?	?	?	$2,500	?	?	$3,500	?	DM6,000 DM7,000	DM7,000	DM8,000	?	?	?
Has P&R reduced or slowed down rises in road congestion?**	yes	yes	?	?	?	yes	?	no	yes	?	?	yes	yes	?	?	?

* Pre-Metro plus Tram.

** Not all cities were asked this question.

same anti-congestion strategy. This was usually true in Europe only of new systems (e.g. Toulouse).

There are generally accepted guidelines for the location of P&R sites. All authorities subscribe to what Morrall (1987) has called the "Comuter-Shed" principle (Fig. 1), although with detailed variations. The catchment area has been described variously as a parabola (Morrall 1987), an ellipse (Sacramento 1987), a cone (Keck & Liou 1976) and a pear (Cox 1982).

All agree that facilities should be located in corridors of heavy travel demand at or near motorway junctions or on major radials so as to involve as little diversion from normal commuting paths as possible. Catchments should not overlap and lots should be at least 6.5 km from CBDs and upstream of the heavier congestion.[1]

Lots should be highly accessible and well signed, with easy entry and exit — Sacramento recommends one entrance/exit per 300 stalls.

Recommended lot size varies from 50—100 up to 800—1,000, with Morrall suggesting 1,600 as an absolute maximum. The lower limit is defined by economic viability and the upper limit by maximum walking distance from car to station. However, there are examples of lots larger than 1,600, particularly in the USA — New Carrolton on the Washington Metro has 2,000 stalls. However, these are probably not viable on a *light* rail system.

It is interesting to compare this with the results of a study by Morrall

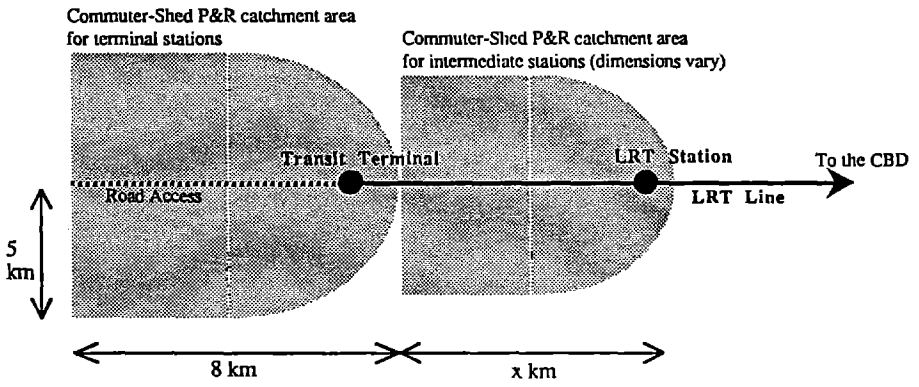

Fig. 1. The commuter-shed concept.

[1] 6.5 km is a compromise — Mather suggests 4.8 to 9.7 km, Cox 6.5 km at most and Morrall 8 to 9.7 km. A survey by Morrall of US and Canadian lots (1990) indicated an average distance from the centre of 19 km. European distances will, however, probably tend to be less than this.

(1990) which compared successful lots in a selection of US and Canadian cities. This found that the average lot size was 670 stalls.

Forecasting demand for P&R has proved to be a complex issue, and there is no consensus about whether forecasting is even feasible, let alone on a standard methodology. A number of cities and individuals, primarily Sacramento, Calgary and Morrall have developed models for predicting demand and site size, which depend on defining catchment areas and then either making some comparison between car and LRT service quality or applying a P&R "generation rate" derived from past experience.

However, VVS in Stuttgart, after attempting to devise a technique, concluded that

> experience shows that the factors influencing demand for P&R spaces are so varied that . . . no generally reliable and valid method of forecasting demand can be developed [Stuttgart, 1986].

Nevertheless, Stuttgart have gone ahead with their P&R planning using past trends and present knowledge. Similarly, Rhine-Ruhr are developing their P&R facilities on the basis of a simple projection of existing trends.

In Morrall's survey of North American lots (1990), only 55% of cities responding have attempted to estimate the use of a proposed lot. Of those that did attempt a forecast, 88% used an empirical and 12% a behavioural method. These techniques worked satisfactorily in 65% of cases.

Other key findings can be summed up as follows.

- LRT's share of journeys to work varies widely between 1 and 26%, but tends to be lower in North America than in Europe, although there are exceptions.
- P&R is provided on all systems to some degree, but the extent of the facilities and their importance as part of an overall policy of attracting car users varies considerably from city to city. The percentage of LRT trips that are P&R ranges from 1 to 50%, although a range from 5 to 20% is more typical. North American cities generally show higher percentage use than European cities and are more likely to be actively pursuing P&R as a method of increasing LRT use and trying to reduce road congestion. However, some European cities are increasingly realising the potential of P&R in this direction.
- Nearly all cities are intending to extend their P&R facilities. In the USA, the cities investing most heavily in P&R are either large traditional metropolitan areas such as Washington and Boston, which require a significant level of public transport use in order to function effectively, or West Coast cities with very low levels of public transport

use such as San Diego, Sacramento and Los Angeles, which are attempting to reduce their overwhelming dependence on private motoring.

- Very few cities charge for P&R parking, because they wish to maximise its use and attract drivers on to public transport. Those that do charge are generally larger metropolitan areas, such as Washington or Altanta, where public transport commuting is necessarily higher and therefore more of a captive market. Charges in these cases are typically $1 to $2 per day.
- Occupancy of P&R sites is generally high — between 70 and 100%. Anything over about 90% should, however, be regarded as over-use, because of the need to ensure that about 10% of capacity is free at any time in order to guarantee commuters a space.
- Kiss and ride and bus transfer facilities are often provided at LRT/P&R stations.
- Funding sources for P&R vary from country to country, but generally involve some central government contribution as well as local sources. Private funds are rarely used.
- Of those cities which were asked, six out of seven reckoned that LRT/P&R had either helped reduce traffic congestion or at least slowed down its increase. The one that did not (San Diego) responded that its urban growth rate and, hence, the rate of traffic increase was higher than LRT/P&R could absorb.

As can be seen, there are significant differences between countries, and especially between the two continents. Morrall's study, referred to above, found that the maximum weekday occupancy of lots was 576 (86%) out of an average site capacity of 670 (Morrall 1990). He also found that lots were typically situated in commercial/retail areas some 19 km from the city centre and served a catchment area of medium density and income residential development. A number of reasons were given for the success of the lots, including location relative to the catchment area and easy access, congested highway conditions into the central area coupled with free parking at the lot, and a good quality public transport service from the lot into the centre.

Case studies in detail

The United Kingdom

Experience of P&R in the UK has been mainly confined to heavy rail,

with a few well-publicised bus-based schemes such as those in Nottingham and Oxford. Most 1970s schemes did not survive, but the Oxford services have endured and are very well patronised. There is now evidence of a revival of bus-based P&R in UK cities. Rail based P&R has generally been on a relatively small scale (at least when compared to the USA) and has not contributed significantly to the relief of peak hour traffic congestion. The strategic use of P&R to reduce congestion has never really been whole-heartedly employed, but various studies have shown that there is potential for greatly increased use (e.g. Merseyside 1974; Tyne & Wear 1986, Oxford 1986). The problem has generally been lack of finance and (particularly) of land at the right price.

Despite this relative lack of positive experience, all the currently proposed LRT schemes intend to provide P&R facilities. For example, Leeds suggest installing sites at route terminals, while the West Midlands is investigating the concept of strategic sites.

The P&R facilities on the Tyne and Wear Metro have been extensively studied. The TRRL carried out a specific study of P&R on the Metro, published in 1986 as Research Report 40 (Pickett et al. 1986). Overall results were mixed, and perhaps a little disappointing. There has been an economic gain, but P&R seems to have made no real impact on either traffic flows into Newcastle or parking demand in the city centre. However, given the general rise in car ownership and use, it may safely be concluded that P&R has eased the situation and slowed down rises in traffic and parking demand. It has also increased the overall capacity of the transport system and attracted some journeys to Newcastle that would not otherwise have been made.

A similar conclusion was drawn from a study of the bus-based system in Oxford.

> . . . the development of P&R has enabled increasing numbers of people to get into the city centre without any substantial increase in flows on the radial routes. If those motorists who use the P&R service were to drive into the city centre there would be a very substantial increase in flows on Oxford's radial roads. (Butler, in Bixby 1986)

United States

Replies were received from nine cities — Boston, Buffalo, Portland, Sacramento, Washington, Los Angeles, San Diego, Newark and Atlanta. Of these, Washington and Atlanta have full Metro systems, while Boston has a mixture of LRT and Metro lines.

Some systems made very extensive use of P&R — there are 20,000

spaces on the Washington Metro. Most cities are aiming to increase their facilities. On the whole, cities saw P&R as a means of making better use of their rapid transit networks and of encouraging a modal transfer from car to public transport for work journeys. Both Boston and Washington said that it had slowed down rises in road traffic. Some West Coast cities with very high levels of car use have adopted strategic LRT/P&R as a primary weapon in tackling congestion. A typical example is Sacramento, whose LRT system consists of two lines totalling 30 km and carrying 3,000,000 passengers a year.

In Sacramento, P&R provision was evaluated as an integral part of LRT route planning. Likewise, the funding of P&R was not separately identified but subsumed within LRT costs. Eight stations have P&R facilities, making a total of 3270 spaces. The largest site is at Roseville Road with 1,100 stalls. All parking is free, to encourage use, and two of the sites have connecting bus services. Some 650,000 P&R trips are made annually, comprising 21% of all LRT journeys, a similar proportion to Calgary's 15—20%.

Although new and extended LRT lines are proposed (March 1989) Sacramento had not yet then begun specific studies on new P&R sites.

Sacramento Transit have produced a study on "Co-ordination of Land Use and Transit". This concludes that such co-ordination, including provision of P&R can have benefits such as

> less traffic congestion, a cleaner and healthier environment, better accessibility between jobs and housing, increased job opportunities and more pleasant life style.

The P&R spaces are not, however, fully used. Sacramento Transit surveys show that in September 1988 typically only between 30 and 50% of stalls were occupied. There thus seems to be a degree of over provision at present, or conversely under-promotion, in contrast to some other cities where P&R lots are regularly at or near capacity.

Canada

Replies were received from Calgary, Edmonton and Toronto. Calgary in particular has conducted quite extensive research into LRT and P&R use. In all three cities, the proportion of LRT trips which employ P&R is about 15%. This generally lower than in the USA, but considerably higher than most European cities.

Calgary has made a greater study of P&R than almost any other city.

The three existing lines carry 14,000,000 passengers a year, accounting for just under 8% of commuting trips.

The city has a comprehensive programme of P&R provision and an agreed target for P&R use of 15—20% of all LRT trips. There is a similar target for kiss and ride. The total number of stalls at present is 8,627 at 14 stations, with a further 3,200 planned (March 1989). The majority of lots have between 300 and 800 stalls. P&R facilities are deliberately restricted to suburban stations in order to maximise the reduction in road traffic nearer the city centre. Parking is free. Stations are also served by bus feeders, although transfer facilities are not specifically provided, and a kiss and ride area is available. Short-term parking is provided adjacent to LRT stations at some locations.

Usage of P&R varies from 15% of LRT users on the NE line to 21% on the South line. Calgary believe that any use in excess of about 20—25% would detract from the use of feeder buses, and therefore do not wish to see use exceed those levels. One reason for this is that greater use would entail the provision of over-large lots, which would create local traffic and access problems.

Lot use is very high, particularly on the South line where all but one station had occupancy rates of 90—100%. But even on other lines, occupancy was over 80%. Despite the very high occupancy rates Calgary report no significant dissatisfaction with the availability of spaces from South line users.

Surprisingly, given the extensive facilities, no prior economic appraisal of the proposals was carried out. Stalls cost between $3,500 and $5,200 (Canadian) each and the annual operating costs for all lots is $200,000. The cost is met 75% by the Province of Alberta and 25% by the City of Calgary.

Perhaps more than any other city, Calgary has focussed attention on the possibilities of P&R. It has carried out considerable research; produced guidelines for the location and design of sites; developed methods of forecasting demand and provided a comprehensive network of facilities. Sacramento and Calgary together serve as useful models for other cities considering the development of P&R.

West Germany

Information was obtained from five West German cities — Cologne, Rhine-Ruhr, Hanover, Stuttgart and Munich. On the whole, less attention is paid to P&R on European LRT systems, which is reflected in the fact that typically only 1% of LRT trips use P&R, compared with about 15%

across the Altantic. But this is beginning to change. Stuttgart and Rhine-Ruhr, for example, are both researching the subject and have extensive expansion plans.

At present sites are generally small, which may reflect difficulties in finding land at the right price. In West Germany, P&R has to be grafted on to existing systems, a difficult and expensive process. North American networks, being new, have built-in P&R from the outset, and are thus at an advantage.

A typical German system can be found in Rhine-Ruhr. Like that in most other German cities, its LRT system has evolved from long-established street tramways and thus consists of a mix of the two modes. It currently comprises 82 km of route, covering Dusseldorf and surrounding towns. Expansion plans mean that by 1994 there should be 130 km and by the year 2,000, 163 km. In 1985, the LRT routes handled 5% of all public transport trips and the tramways a further 26%.

VRR (the operating authority) believe that ". . . inner city areas will be relieved of congestion from vehicles, both on the road and in parking facilities" through the use of P&R (Rhine-Ruhr 1988). P&R sites are provided at or near both LRT and S-Bahn stations, a total of 2,700 spaces altogether (1988). Each space costs DM 7,000 but maintenance costs are low.

As usual in West Germany, funding is shared between Federal (50—60%), State (30—40%) and City (10%) governments, and appraisals are carried out before facilities are authorised. As in many other cities, stations also have facilities for bus transfer. The bus network has a "collection and distribution function" and acts as feeder to the tracked networks. Parking is free. VRR estimate that further spaces are needed as about

> . . . half the present number of P&R users are forced to park at the road side. The uncertainty of finding an available space . . . means that many other motorists don't use the network. (Rhine-Ruhr 1988)

Rhine-Ruhr have plans to restrict the number of parking spaces in the CBD and other centres and hence induce greater use of the public transport system, including P&R. However, P&R is not judged to be a major component in this strategy. Only 2,000 P&R journeys are made daily and it accounts for only 1% of all LRT trips. VRR hope to increase this in the future by

> observing the occupancy of public parking lots near stations which don't have park and ride facilities at the present time and then draw up plans to construct the necessary sites.

The eventual aim is to provide nearly 7,000 spaces at almost 200 sites (VRR 1988).

Other examples

Adoption of P&R in other European cities tends to depend on the age of the LRT system. In the case of new systems, such as that in Toulouse, P&R is being planned in from the outset. Toulouse intends to provide 2,000 spaces at four sites on its first line, varying in size from 200 to 1,000 stalls. These are designed to serve as railheads for commuters from outside the city. Feeder bus services will also be provided.

In contrast, the long-established rapid transit system in Antwerp provides very few P&R spaces at present, although sites are planned. The tramway is being converted gradually to pre-Metro status and P&R facilities are being systematically installed. Problems arise from the shortage of suitable land in the inner city. However, after studying other cities, Antwerp considers that P&R is an "*obvious necessity*" on the improved pre-Metro system.

In conclusion

There is no doubt that P&R is becoming an increasingly important element of urban transport policy on both sides of the Atlantic. It is viewed as providing part of the answer to the old problem of attracting car users back on to public transport — particularly in circumstances where traffic congestion is high and central area parking difficult or expensive. An integrated strategy comprising LRT and P&R is becoming a favoured technique in some north American cities, particularly those with high rates of car use. So far, Europe has lagged somewhat behind, partly because its LRT systems were well established and patronised and P&R was therefore not viewed as such an imperative. However, it is now being designed into new European systems from the outset and is also gradually being expanded in the older networks.

Although there is general agreement on the circumstances in which P&R is viable and on the ideal types of site location, there is no accepted method of forecasting the future use of prospective lots. Decisions therefore often have to be taken in a partial information vacuum. Morrall (1990) found that only 34% of cities surveyed had developed a satisfactory forecasting method. A reliable method of appraising potential usage is therefore urgently required.

If this problem can be overcome, then the design of P&R systems will

become more viable and their use as instruments of urban transport policy will undoubtedly become more widespread and effective.

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