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PARK AND RIDE: LESSONS FROM THE UK EXPERIENCE

TRB Paper # 08-0730

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Word Count: 6,743 + 1 figure + 2 tables = 7,493

Submission Date: 6 November 2007 (revised)

ABSTRACT

Park and Ride schemes using dedicated bus services have become particularly popular over the last 40 years with UK policymakers. This popularity can largely be attributed to the UK policy context and the advocating of Park and Ride to tackle increasing car use, congestion and traffic-related emissions. The aim of this paper is to use existing evidence on the degree to which this has been achieved and provide lessons on how bus-based Park and Ride can be used effectively. From this, lessons are provided that will benefit stakeholders internationally on the use of dedicated link-mode Park and Ride schemes operating at the edge of urban areas. It is found that although Park and Ride has been popular amongst motorists, it has also attracted users of existing public transport services and has generated additional trips, resulting in a counter-productive effect. It is concluded that for Park and Ride to be successful, it should be implemented in tandem with other supply-side measures and alongside sufficiently rigorous restraint instruments. Also, despite the use of frequent and dedicated bus-link services providing a key feature that attracts motorists who would not otherwise use public transport, their use needs to be carefully monitored to avoid low load-factors decreasing levels of efficiency.

1 INTRODUCTION

Addressing the issues of traffic growth, congestion, and traffic-related pollution presents a significant challenge to policymakers internationally. Although demand management measures are widely acknowledged as the most effective for dealing with these problems, supply-side instruments have generally been favoured by policymakers as they are usually more politically saleable (1). Park and Ride (P&R) is such an instrument and is broadly characterised by offering a parking facility for private modes while providing direct access to a public transport service.

The concept has been used internationally over the past 70 years or so and there are a number of variations on both the feeder and public transport mode used. In the US, a wide range of systems includes large car parks at light and heavy rail stations, the provision of interchange facilities for ridesharing (often at informal or shared-used sites) and parking for public transport connections between city pairs. In Europe, P&R has been used on both light and heavy rail systems in Germany, France and the Czech Republic for example (2). Bus-based schemes have been used in the Netherlands but to varying degrees of success. Here, their lack of popularity has been due to their introduction in the absence of significant excess demand for accessibility or city centre parking as well as insufficient long-term political support for P&R (3)(4).

In the UK, P&R supplements the heavy rail network usually informally through station car parks. It is also used on light rail schemes due to their upsurge over the past 25 years. It is bus-based P&R however, that has become particularly popular with over 100 permanent schemes currently operating (5). These schemes typically operate from purpose-built car parks 2-6km away from the urban core (6) with capacities up to around 1000 spaces, which are usually served by dedicated buses operating independently from existing bus services.

The aim of this paper is to provide lessons on the use of dedicated link-mode P&R operating from the edge of urban areas for the benefit of stakeholders internationally. Specifically, these lessons will be concerned with the impact of P&R on both levels of car use and the environment. As such, the following section describes the policy context and highlights how P&R has grown in popularity. The traffic- and environmental-related effects of P&R are then examined. This is followed by a discussion of the policy implications and the role of P&R within transport demand management in light of the lessons from the UK experience. The final section offers conclusions and recommendations for future research.

2 UK POLICY CONTEXT

Underlying the sustained popularity of UK P&R has been the policy context in which it has been encouraged. This has provided an attractive transport option for local policymakers who are responsible for implementing schemes. This section describes how the policy has evolved over the last four decades.

Early attempts to implement P&R schemes in the UK occurred in the late-1960s and early-1970s in a number of UK cities such as Leeds, Nottingham and Leicester but their success was not sustained (7). The impetus for these schemes came from the local authorities' concern with the future physical impact of increasing car use. P&R was favoured over road and car park construction within the urban core as a means to preserve local historic identity and valuable urban space (8)(9). They were generally viewed as standalone measures to provide overspill parking in peak

shopping periods and the lack of accompanying restraint instruments resulted in insufficient 'push' towards P&R (10). All of these initial schemes tapered off by the end of the 1970s.

The exception to the early failures was P&R in Oxford, introduced in 1973, which has since become the most established scheme in the UK and remains a blueprint for others (11)(12). Although the scheme suffered financial difficulty in its infancy (13), unlike its predecessors it continued to operate. This can be attributed to some degree to the "*strength of political will*" (12) in terms of financial support and a determination to succeed, which allowed the scheme to survive through an infancy of low patronage. A significant difference from other attempts however, was that policymakers saw P&R in Oxford as a component within a portfolio of measures that also included bus priority, pedestrianisation and central parking controls (14).

Another important consideration is the historic setting in which the scheme was used. Historic towns pose particular problems for transport planners because of the physical constraints limiting road and car park expansion. Coupling this with their tourist attraction role, the resultant congestion means that not only do policymakers often have the weight of public support to implement a scheme, but demand already exists for P&R (15). Indeed, the next wave of schemes in the first half of the 1980s were initiated in the historic centres of Aberdeen, Cambridge and Chester (5). These were stimulated by the sustained success of P&R in Oxford and the contextual similarities spurring policymakers to seek suitable solutions. Thus, a process of 'policy learning' had begun (16) albeit confined at this stage to the most similar settings because of the earlier failures of P&R.

In the late 1980s P&R was pushed from being only a local authority concern into the national policy arena which was induced by the shift in the philosophy of transport policy at the time. The Government's 'predict and provide' attitude - matching road capacity with demand - had reached its zenith with the publication of the White Paper *Roads to Prosperity* (17) promoted as "*the biggest road-building programme since the Romans*". This was the initial response to the revised road traffic forecasts from the UK Department of Transport (DoT) (18) that suggested between 82-134% growth in car traffic between 1988-2025. After the realisation that it was ultimately impossible to build out of the problem however, and coupled with severe financial constraints at the time, 'predict and provide' started to become an increasingly discredited solution. This was exacerbated further by a rising awareness of environmental issues, with the 1987 Bruntland Report (19) and its subsequent recognition by the EU and the 1992 'Earth Summit' (20) (see Goodwin (21) for a full description of the philosophy transition).

At the same time there was mounting opposition to road building, particularly town centre bypasses such as those at Twyford Down and Newbury (22)(23), as a result of increasing awareness of its environmental impacts. Hence, new solutions to capacity constraints had to be sought. The environmental White Paper *This Common Inheritance* (24) advocated P&R as a traffic management instrument to relieve congestion in urban centres whilst maintaining accessibility to sustain economic activity, sentiments which were echoed in the subsequent Planning Policy Guidance (PPG) Note 6 for *Town Centres and Retail Development* (25).

Local authorities were given further incentive to implement P&R schemes through the increase of funding options. As well as attracting funding from the Transport Supplementary Grant (TSG) and the Government's programme for bus priority schemes (which were becoming popular complements to P&R), from 1993 it could be included in Transport Policies and Programmes (TPP) bids for packages of

measures (26)(6). Additionally, it was suggested that funding “*from commuted parking payments, off-street parking revenue, and in the future, funds generated from on-street parking enforcement*” (27) could be used to finance schemes. For local authorities then, P&R was becoming an increasingly attractive option. This is highlighted not least by the growth in the number of UK P&R sites (

FIGURE 1).

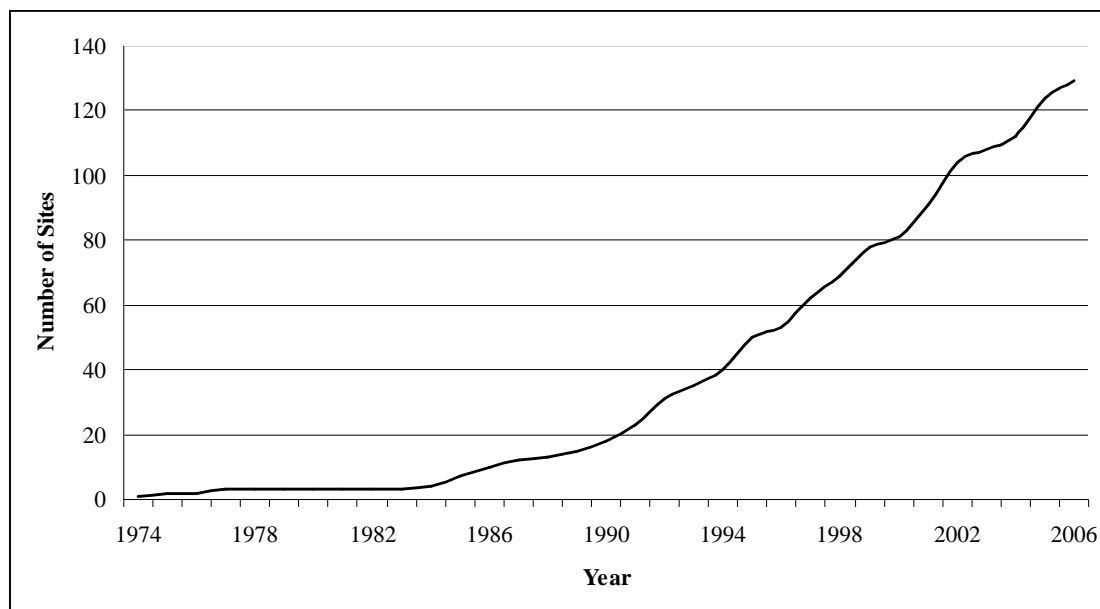


FIGURE 1 Number of P&R schemes 1974-2006 (Adapted from 28).

The role of P&R was also becoming more explicitly recognised as a tool “*usually designed to avoid excessive congestion*” (29). In addition, the economic benefits to “*improve the accessibility of urban centres*” and “*increase the total public parking stock*” were recognised which aligned closely with the goals of the earlier schemes pioneered by local authorities (29). The Government (27)(29) also cautioned that P&R may attract users of existing public transport services, generate trips, and release suppressed demand for the road space freed by intercepted vehicles.

The Royal Commission on Environmental Pollution 18th Report Transport and the Environment (30) also recognised these concerns. In the Report and in somewhat of a contrast to the UK Government’s view, P&R is confined to the role of a ‘carrot’ within a package of measures including ‘sticks’ to discourage car use. Interestingly, the economic benefits that had previously been a primary factor in the popularity of P&R were recognised to “*reduce amenity in the neighbouring area*” (30).

While the 1996 publication of revised PPG6 *Town Centres and Retail Development* (31) further encouraged P&R, it was the election of the Labour Government in 1997 that brought it new impetus. The initial indication of a new direction for policy was a press release from the new Government stating that “*predict and provide is dead*” (32), but the first White Paper of the Government suggested a retreat from such a hard-line approach;

“*Our new approach is about widening choice, not forcing people out of their cars when using a car is their preferred option... We want to see more opportunities for cars to be used as part of an integrated transport system. We are therefore encouraging park and ride facilities to town centres to help beat congestion...*” (11)

Hence, there had been a philosophical regression to “*Pragmatic Multimodalism*” (33) in attempting to satisfy sustainability objectives *to some extent*, whilst not displeasing the generally pro-car electorate. P&R thus offered an ideal solution within the ‘new’ policy setting, not only as a discernible example of the widely quoted mantra of the time – ‘integration’, but as a more politically acceptable option than the ‘sticks’ of road user charging and increased parking restraint. Accordingly, P&R was backed explicitly to reduce both congestion and pollution in the guide ‘*Planning for Sustainable Development*’ (34), and in the longer-term by *The Ten Year Plan* (35):

“[P&R schemes] *can offer an effective way of reducing congestion and pollution in busy urban centres, especially when combined with bus priority measures on the routes to the centre and parking controls... Park and ride therefore provides a flexible tool for local authorities, and we see considerable scope for new schemes in a wide range of towns and cities...*”.

So not only was P&R gaining prominence within transport policy, but it was encouraged in various settings beyond the historic centres with which it had been traditionally associated. The support for P&R was sufficient for *The Ten Year Plan* (35) to outline that a “*heightened level of investment would be able to deliver...up to 100 new park and ride schemes...*”. Further, P&R was being perceived as a viable instrument in achieving air pollution reductions set out in the Air Quality Strategy (6).

Nevertheless, the effectiveness of P&R was questioned increasingly in the late-1990s (by the pressure group the Campaign to Protect Rural England (36) for example). The study commissioned by the Government, *The Travel Effects of Park and Ride* (37) suggested that it did indeed reduce the car mileage of its users. This study however (discussed below), was shown to have methodological weaknesses (38) which cast doubt over the effectiveness of P&R and resulted, at least in part, to retreat in political support. The revised PPG13 *Transport* (39) for instance, referred to P&R as being suitable only “*in appropriate circumstances*” and while it had been considered previously in isolation, should “*be developed as an integral part of the planning and transport strategy for the area*”.

Emphasis was put on the role of P&R as a component within a range of public transport instruments, thus persuading motorists to consider alternative modes (40). Also, in contrast to the aforementioned Government aspiration for P&R to be developed in “*a wide range of towns and cities*” (35), a subsequent Government publication outlined that “*its use will depend on local circumstances...[it] is not appropriate everywhere*” (41).

TABLE 1 Sources of Funding for UK P&R Schemes (42)(36)(43)

Funding Source	Description
Developer Contributions	Made within a general planning agreement from anticipated extra business or lower costs.
Commuted Payments	Payments made by commercial sector developers using Section 106 planning agreements in lieu of communal parking/transport infrastructure improvements.
Central Area Parking	A levy can be charged on central parking facilities under Section 55 of the Road Traffic Regulations 1984 for P&R funding.
Central Government	Applications made through Local Transport Plans (LTPs), with Transport Supplementary Grant (TSG) or Supplementary Credit Approval (SCA).
Local Authority Funds	Non LTP funding, from the sale of assets or Council Tax/Business Rate payments. Used to cover initial capital costs of operating deficits.

Although there has been a retreat in the Government's support for P&R, the reality does not appear to have matched the rhetoric. The funding mechanisms now in place mean that for local authorities, P&R remains a practical policy option (see TABLE 1). While not fully on course with the ambitious aspirations of the *Ten Year Plan*, between 2001 and early 2007, 51 new sites had opened (5).

3 TRAFFIC IMPACTS

At the most basic level, the intention underpinning the P&R concept is to intercept motorists that would have otherwise driven into the urban core. From the P&R site to the centre, trips are completed on public transport. This transfer to public transport removes cars from the urban core which, in the typically centralised structure of UK cities, is the most severely congested part of the network. There are a number of problems however, recognised in both the policy (above) and the academic literature ((12)(6)(43) for example), which can offset the effectiveness of P&R in reducing traffic. First, the abstraction of users from traditional public transport services. Second, the generation of new trips and diversion of trips from elsewhere. Third, the making of longer access trip to P&R sites than would have otherwise been made to the urban core. Fourth, low load factors on the high-frequency dedicated P&R buses.

This section draws on empirical evidence gleaned from a range of P&R user survey data, presented in TABLE 2. Column *a* shows the host centre of P&R schemes as well as individual sites where a number of sites have been surveyed. The publication date is also given to allow historical trends to be identified. Column *b* shows the individual or range of survey days, whereas *c* shows the sample size (number of P&R users surveyed). Both the previous and alternative travel behaviour of users is given in column *d*, in terms of the percentage of users indicating their previous or alternative mode as traditional public transport, driving into the centre or using another P&R site. Previous behaviour is the mode used prior to the introduction of P&R, whilst alternative behaviour is the mode that would be used if P&R became unavailable. Column *e* indicates the percentage of users that did not travel to the host centre before using the P&R service whereas column *f* shows those visiting more often since the introduction of P&R. Of the users that would not have travelled to the centre if P&R was unavailable, shown in *g*, the percentage split of these users between those that would travel elsewhere and those that would not travel at all are given in columns *h* and *i* respectively.

3.1 Abstraction from public transport

To attract passengers P&R offers incentives to motorists, such as low fares, high frequency bus links and the use of comfortable modern buses. Yet these incentives also lend themselves to users of existing public transport services. Taking the price incentive for example, P&R services must compete with parking charges in the urban core to attract their target motorists. Of course, this can be done by increasing these parking charges (strengthening the 'stick' within the package of measures), but is also done by lowering the cost of the P&R service which is indeed possible because they are often subsidised (43). However in doing so conventional public transport fares can also be undercut (26) which, in the privatised public transport industries, do not generally have subsidy support.

The removal (abstraction) of passengers from existing public transport may negate the mileage savings from intercepted motorists. This clearly depends on users' access to a car, but if public transport was the preferred mode out of choice rather than need, the use of P&R represents generated car journeys for the

TABLE 2 P&R User Survey Evidence

a Centre/Site (Source) - Publication Date	b Survey Day/s	c Survey Sample	d Previous/Alternative Mode Used						e Didn't Travel to Centre Before P&R (%)	f Visited More Since P&R (%)	g Not Travel to Centre Without P&R (%)	h Travel Elsewhere (% of column g)	i Not Travel (% of column g)
			Public Transport		Car (driver)		Other P&R						
			Previous (%)	Alternative (%)	Previous (%)	Alternative (%)	Previous (%)	Alternative (%)					
Brighton (37) - 1998	Mon-Fri	220	18	41	50	26	-	-	-	28	31	68	
Bristol/Bath Road (60*) - 1996	Thurs Sat	674 902	-	40	-	54	-	-	-	3	23	77	
Bristol/Long Ashton (42) - 2000	Mon-Fri Sat	651 1211	-	22	-	71	-	-	-	4	50	50	
Cambridge (37) - 1998	Mon-Fri	204	10	24	58	39	-	-	-	5	40	60	
Chester ¹ (59*) - 1994	Mon/Sat	124	13	14	74	60	7	15	6	12	38	63	
Coventry (37) - 1998	Mon-Fri	208	17	21	52	50	-	-	-	21	-	-	
Maidstone (43) - 1996	Mon-Sat	1000	-	15	-	66	-	-	-	10	16	84	
Norwich (43) - 1996	Mon-Sat	1000	-	12	-	78	-	-	-	5	38	62	
Norwich (37) - 1998	Mon-Fri	204	24	29	56	53	-	-	-	12	40	56	
Nottingham (43) - 1996	Mon-Sat	1000	-	25	-	59	-	-	-	10	38	63	
Oxford (61*) - 1987	Fri/Sat	553	39	-	42	-	7	-	-	-	-	-	
Oxford (62*) - 1978	Wed Sat	262 391	24 13	-	66 81	-	-	-	4 4	-	-	-	
Oxford (63*) - 1976	Tues Sat	155 99	8 5	-	57 68	-	14 12	-	6 2	-	-	-	
Oxford ² (64) - 1994	Fri Sat	741 1000	36 35	31 20	55 58	33 43	-	8 4	-	7 21	-	-	
Oxford (65*) - 1977	Tues/Thurs Sat	208 207	-	30 22	-	57 68	-	14 16	-	2 6	-	-	
Plymouth (37) - 1998	Mon-Fri	208	14	32	70	47	-	-	-	11	23	77	
Reading (37) - 1998	Mon-Fri	220	28	31	66	43	-	-	-	18	31	69	
Sheffield (67*) - 1995	Thurs/Sat	176	13	-	64	-	15	8	-	-	-	-	
Shrewsbury (43) - 1996	Mon-Sat	1000	-	11	-	67	-	-	-	17	46	54	
Shrewsbury (37) - 1998	Mon-Fri	205	15	18	71	53	-	-	-	14	21	72	
York (66) - 1993	N/A ³	154	19	35	63	59	-	-	12	1	-	-	
York (64) - 1994	Fri Sat	288 310	24 13	26 9	66 85	54 65	-	-	-	11 15	-	-	
York (37) - 1998	Mon-Fri	221	15	26	55	57	-	-	-	7	13	87	

Notes

*Reported by Parkhurst (44)

¹Survey of shoppers only. Results weighted for those not previously coming or would not come in the absence of P&R²Only those users previously travelling to centre prior to the introduction of P&R are included in previous modes used³Post survey of users holding payment card⁴The generated trips reported by Pickett and Gray (43), English Historic Towns Forum (42) and Parkhurst (44) are reweighted assuming all users no longer travelling would either travel elsewhere or not make the trip.

Source: Based on Parkhurst (44) with additional data from W.S. Atkins (37), English Historic Towns Forum (42) and Pickett and Gray (43).

P&R access trip. The offsetting effect is significant given that these trip legs are typically large when compared with the mileage savings made from P&R bus trips (44). Notably, from the spatial perspective the traffic flow change is not directly comparable as intercepted motorists will represent mileage savings between the P&R site and the urban core (*downstream* of sites), whereas those abstracted from public transport will increase traffic flows between the P&R site and user origins (*upstream* of sites). The previous and alternative travel behaviour shown in column *d* of TABLE 2 suggests that the proportion of P&R users abstracted from public transport is significant.

3.2 Trip Generation

In policy terms, at the local authority level at least, economic vitality goals often run counter to those of reducing car use (45) and trips generated by P&R would seem to conform to this view. The rationale is that new trips are good for business yet they result in more traffic. Increased mileage is the primary concern here however, as this will affect the degree to which P&R fulfils its policy goal of reducing congestion.

The traffic implications of generated trips are a little more complex than simply categorising trips as extra distance travelled. It is important to delineate the trips diverted from other centres from those newly generated (columns *h* and *i* in TABLE 2). In the latter instance of course, mileage is *de facto* entirely accumulated. The mileage effects of diverted trips though, depend on whether trips are shorter or longer than would have otherwise been made. Because P&R is often supported by subsidy, it reduces the generalised cost of travel so will theoretically induce longer trips (46). Trip making decisions are more complex than this however and will depend on the relative perceived quality of the range of available destinations.

The notion of generated traffic also extends beyond journeys made to P&R sites. The relatively elastic demand for cross-centre journeys will result in a replacement of the removed vehicles downstream of P&R sites to some extent (47). This argument is reinforced not only by its clear correlations with the notion of induced traffic (see 48), but also because there is a lack of (reported) overall traffic reduction in host centres despite P&R intercepting up to 25% of incoming traffic (49)(26). This cannot be attributed directly to P&R, as any discrete measure to reduce traffic is likely to induce similar results. Rather, it is the lack of restraint measures implemented alongside that maintains the congestion equilibrium (12).

3.3 P&R Access Trips

The length of P&R access trips will affect the overall impact of P&R. P&R shifts the destination of motorists who would otherwise drive into the urban core towards the urban fringe, to the P&R site. Whether these 'new' access trips will be lesser or greater than previous trips will clearly depend on the location of user origins.

Users may detour and make longer journeys to avoid higher parking charges within the urban core. This argument depends however on the value placed on in-car access time by users, which for commuters particularly, may be high. Yet detouring can occur on radial routes to avoid congested cross-centre routes. Nevertheless, the empirical evidence on the matter (37)(46) indicates that although some longer trips are made to access P&R sites, this is insufficient to result in net mileage gains. This however excludes abstracted and generated trips, as discussed above.

3.4 P&R Bus Trips

Trips between P&R sites and centres should not be regarded as completely removed mileage from the network as these trips will be made by P&R bus services. The problem here is that a fundamental benefit of P&R is the convenience of dedicated and frequent buses which minimise both waiting time and travel time.

Due to the high peaking because of typically heavy commuter use, the use of frequent bus services results in low load factors in off-peak periods. In many cases this results in a higher total distance travelled by users, in terms of the car-equivalent distance travelled by bus for each user (46). With conventional public transport this would generally not be the case as the privatised operations are arguably more demand-led. The inefficiency with P&R buses however, is effectively enabled by the subsidy support of services.

In terms of the degree to which these P&R buses increase the distance travelled by users, the key factors are the distance between the P&R site and the destination within the host and the load factors of P&R buses. Load factors are in turn related to the size of sites, number of users and space turnover, and therefore the journey purpose of users (46).

4 ENVIRONMENTAL IMPACTS

The environmental role of P&R grew in importance in the 1990s, as discussed above. Yet there appears to be a dearth of research considering the effect of P&R on air pollution quantitatively, but the premise underpinning this role of P&R is that the aspirations for reductions in car use will result in proportional emission reductions. This assumption therefore rests heavily on the ability of P&R to reduce car use and given the arguments and evidence outlined above, seems unlikely.

The effect of P&R on both atmospheric and local pollution however, does not depend solely on the change in car-miles travelled by its users. The emissions generated are also influenced by other factors such as the speed and overall distribution of traffic on the network and the type of vehicles that are redistributed (50)(51).

Regarding vehicle speed, the most obvious changes will occur locally around P&R sites because of access trips on the existing road network and the creation of what are in isolation, individual traffic generators. The wider effects on the host centre will be more complex however. Although it has been outlined above the distance travelled by P&R users may well increase, there may still be traffic speed gains downstream of sites from vehicles that are removed from this part of the network. In reality though this will be negated by latent demand and it has also been argued (52) that the introduction of bus lanes which is a popular complement to P&R, will decrease traffic speeds from the loss of road space for private vehicles. Similarly, the spatial distribution of traffic will affect the concentration of localised pollutants (53).

The amount of emissions generated is also influenced by the type of vehicles on the network through factors such as their age, engine size, fuel, and weight (51). P&R will have some effect on this from the vehicles that it attracts and their resultant change in trip length and route. In addition, the characteristics of induced traffic using freed road space will also determine the overall environmental effect of P&R.

The most prominent environmental issue with regards public and media attention, in the UK at least, is the construction of P&R sites (54). Notwithstanding the localised pollutant increases that may occur from P&R access trips, other

important concerns include traffic noise and road safety, particularly if surrounding areas are residential.

Environmental concerns are exaggerated if sites are located on greenbelt land, which is permitted by PPG13 *Transport* (39), but only where “*non-Green Belt alternatives [are] investigated first*”. Nevertheless, for those implementing schemes at the local level the greenbelt typically covers the urban fringe which is the preferred location of P&R sites to intercept motorists travelling into the centre. A trade-off is thus made in favour of the perceived congestion and air pollution benefits of P&R (55)(56). Quite clearly, the opposing argument is one of a ‘lose-lose’ situation where countryside amenity is diminished with visual intrusion and noise pollution created, while not reducing car use or dependency (36).

A way in which site construction is avoided is through shared-use sites where P&R operates from sites that are used for other purposes, but are in low demand at times when P&R capacity is required. There are examples of shared-use sites in the UK, in supermarket and racecourse car parks for instance, but it does not appear to have experienced as much popularity as in the US (57). A possible explanation is the availability of existing sites on which P&R could operate.

5 IMPLICATIONS FOR POLICY

Although P&R has become a popular instrument, it has had a somewhat confused position within transport policy that has led to misunderstanding of both what it is capable of achieving and its unintended impacts. This is arguably because of its promotion within policy as a panacea, able to achieve reductions in congestion, car use and air pollution while benefiting the economic vitality of host centres. Although there has been a retreat this view recently within policy, there remains some inertia. This has been encouraged by both the growth in P&R funding options and the pressures on the economic vitality of centres from out-of-town development and neighbouring centres.

P&R is a strong ‘carrot’ within transport policy that offers greater flexibility benefits to motorists than conventional public transport. These benefits however, in the absence of sufficiently rigorous restraint measures on car use, have had a counter-productive effect and encouraged car use for P&R access trips by users otherwise making trips on conventional public transport, to other destinations, or not making trips at all.

From the economic perspective, road user charging – charging motorists based on car use and traffic conditions – has long since been perceived effective in dealing with traffic congestion. The problems that have arisen from P&R would seem to conform to this view. Road user charging would minimise the detouring effect of cars making longer trips to access P&R than would have been made to the centre and would dissuade public transport abstraction and trip generation. Whether this would hold true for trip diversion would clearly depend on users’ origins in relation to P&R sites and the relative strength of available destinations. Alternative accompanying transport policies may have very different effects however. P&R prices are often set against parking charges within the urban core to provide ‘push’ to P&R. Although this has been effective in attracting motorists, it has had little effect on public transport abstraction, trip generation or detouring access. Similarly, a cordon congestion charge such as that operated in London would not effectively manage these problems as P&R generally induces traffic for access trip, upstream of sites.

There has also been a lack of considering P&R alongside other supply-side ‘carrots’. The problem of public transport abstraction occurs from gearing P&R

towards motorists rather than also considering public transport in order for them to work in synergy. To prevent public transport abstraction, mechanisms could be used that create a hierarchy, through pricing for instance, with the price of P&R being set higher than conventional public transport (12). Yet public transport services operate in a privatised industry, in the UK context at least, so this could involve increasing the price of P&R at the risk of losing patronage. Ideally, the cost of car use would be higher than both P&R and public transport in this price hierarchy approach, which returns to the argument for appropriate restraint measures.

The problems associated with P&R are not only extrinsic and its efficiency is further reduced by low load factors on P&R buses at off-peak times, yet part of the attraction to P&R for motorists is the convenience and reliability of high frequency bus links. Clearly more effectively monitoring of the demand for P&R link trips and adjusting the frequency or size of the buses accordingly could address this issue.

Furthermore, although the focus of this paper is to evaluate UK P&R schemes as they currently operate, a notable solution to address increased user mileage from access trips is a change in the fundamental design of schemes - link-and-ride (58). Here, P&R sites are decentralised along access corridors to the host centre with a number of a small sites rather than one large site, thus decreasing the length of access trips (see 58 for a detailed analysis). Essentially this brings P&R closer in design to traditional public transport services. Nevertheless, there is a lack of UK examples of such schemes, possibly because of perceptions that it is too closely associated with traditional public transport to attract car users.

6 CONCLUSIONS AND RECOMMENDATIONS

The UK has over 40 years' experience of P&R and it has certainly become a popular instrument. Its initial success was confined to medium-sized historic centres experiencing traffic congestion and limited scope for expanding infrastructure in the urban core. The UK policy context however, has provided the impetus for the development of schemes in a much wider range of settings. Its use has been promoted by the UK Government for reducing congestion and the associated environmental by-products and to further encourage its development, the number of funding sources for schemes has also been increased. Although the economic benefits to host centres have been an important motivator for policymakers introducing P&R, this paper has highlighted serious concerns over its effects on car use.

P&R is able to attract motorists otherwise not using public transport. Nevertheless, given the effects of P&R to abstract passengers from conventional public transport, generate and divert trips, and induce detouring of access trips, the clear lesson from the UK experience is that P&R should not be viewed as a standalone measure. It should be implemented as a component alongside an effective package of restraint measures on car use. Road user charging would be the most appropriate if motorists were charged directly according to their car use. But care also needs to be taken by policymakers for P&R to work in synergy with other supply-side measures such as public transport.

A key difference between the UK experience of P&R and other international examples where P&R is used with existing public transport networks is the use of dedicated buses. This has perhaps strengthened the ability of P&R to attract motorists because of the reliability and time savings of the link journey compared to conventional public transport services, yet P&R buses often operate with low load factors. Operators thus need to focus on compromising the attractiveness of dedicated, frequent link-modes with demand.

Although previous research on UK P&R has challenged the orthodoxy that it will universally reduce car use and benefit the environment, the evidence base remains relatively weak. There are three main areas which future research should seek to address:

First, the impact of P&R on the distance travelled by users has been confined to trips that would have previously been made by motorists driving and parking in the host centre. The trips abstracted from public transport, generated or diverted need to be included in further research as they will have a significant effect on the overall impact of P&R on distance travelled by users. This should also help to understand how these trips increase car dependency and their equity implications from the loss of patronage on public transport services.

Second, the location of P&R user origins is of particular importance and need further investigation. Further understanding of the geographical distribution of user origins could help identify the sphere of influence of P&R schemes and their impact on the relative importance of centres within users' trips making decisions.

Third, it has generally been assumed by policymakers that P&R will benefit the economic vitality of host centres and this has been one of the main reasons for their popularity. Yet P&R is often supported by large amounts of subsidy. Future research should consider the overall economic contribution of P&R to host centres. Associated with this, there is a need to assess the economic effect of P&R on the vitality of neighbouring centres, which will determine whether P&R encourages economic growth in real terms, or simply redistributes activity and spending. If P&R does result in economic growth in real terms, an interesting analysis could focus on the views of both policymakers and those living close to P&R sites to establish whether the trade-off between local traffic increases and economic growth is perceived as acceptable.

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