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A LONGER-RANGE STRATEGY FOR CAR-BUS INTERCHANGE: THE 'LINK-AND-RIDE' CONCEPT

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Abstract

It is widely acknowledged that there can be disadvantages due to bus-based park and ride schemes constructed at the edge of the urban area as well as benefits. The present paper considers how these disbenefits might be reduced. In the main it is argued that they derive from the typical level of user charges applied, the proximity of the sites to users' destinations, and the provision of dedicated shuttle bus services. An approach based on more remote location of the sites and integration of the bus services with existing public transport is appraised. It is concluded that such an approach will often provide a wider range of benefits whilst creating fewer disbenefits than an edge of urban area location. It is further suggested that, given patronage levels equivalent to the 'high use' scenario considered, there is potential for a valuable revenue stream to be established.

Keywords

park and ride, integrated transport strategy, transport interchange, traffic restraint

1 INTRODUCTION

The case for encouraging car-bus interchange is supported by UK Government policy as a practical and achievable means of reducing car use, avoiding critical pollution levels in urban areas, and enabling traditional commercial centres to compete with car-oriented retail developments (DETR 1998a). In May 2000 the English Historic Towns Forum (EHTF) published a second edition of its good practice guide to bus-based park and ride (EHTF 2000). The UK Government Department for the Environment, Transport and the Regions supported the report as a source of practical advice for both historic and other towns considering the introduction of park and ride facilities or expanding existing capacity.

However, the report acknowledged a national debate since 1994 into the advantages and disadvantages of providing edge of urban area park and ride (EUAPR) facilities by including appended evidence from a range of authors (including EHTF 1993; CPRE 1998; Parkhurst 1996, 1999; Pickett and Gray 1995; WS Atkins 1998). Hence, concerns were reflected that such schemes can generate traffic, abstract passengers from conventional public transport, cause unacceptable environmental damage to sensitive land including 'greenbelt' areas and result in greater competitive pressure on smaller traditional centres.

The following debate summaries reflect the evidence reported in EHTF (2000) and also the discussions that took place at the launching event[1] for the guide. They seek to identify the current extent of consensus on the key issues relating to the promotion of park and ride.

[1] Publication Launch and debate convened by the EHTF at the DETR Offices, Marsham Street, London on 10th May 2000.

1.1 Economic effects

The economic effects of park and ride have not been subject to the same level of analysis as the traffic implications. The available evidence is mainly of an anecdotal and intuitive nature and restricted to the effects on the host urban area. The collation of indices of economic performance such as comparative visitor numbers and sales figures for urban areas with park and ride and competitors without would be technically feasible and ought to improve the understanding of the economic effects.

Despite the lack of comparative statistical evidence, it is nonetheless generally accepted that EUAPR sites provide an economic benefit to a host urban area by enhancing its accessibility and providing a competitive response to other commercial centres. Where that competitive advantage is gained with respect to an 'out of town', car-dependent commercial centre that is usually seen as advantageous, and within the spirit of UK Government planning guidance (*e.g.* DETR 1999). In contrast, the other commercial centre may in other cases be another traditional one. It may be a settlement lower down the central place hierarchy, such as a rural market town, perhaps already suffering from the effects of competition. In such a case a question about the overall influence of park and ride on the distribution of activity locations is raised.

Hence, the main unresolved debating point is whether EUAPR schemes are beneficial to the overall economy in absolute terms, or mainly offer a relative benefit to the host settlement.

1.2 Influence on local air pollution

As in the case of economic effects, there is a lack of empirical evidence about the direct effects of park and ride on air pollution. Furthermore, collating such evidence would be a challenge, given the impossibility of controlled experimental conditions and the background context of traffic growth (which may or may not have emerged in the absence of park and ride). Furthermore, there are considerable technical and practical difficulties with monitoring air pollution from transport in general. For example, allowances must be made for non-transport sources, meteorological effects and the reliability of equipment. These problems may be overcome to give overall measures for particular urban centres, and even particular streets. However, it is questionable whether monitoring could ever be sufficiently precise so as to allow the reliable apportionment of the responsibility of changes in air pollution in an urban centre to the implementation of one particular policy amongst a range of measures.

However, a reduction in car travel within the host urban area amongst the users of EUAPR sites is shown to occur in most studied cases (WS Atkins 1998; Parkhurst 2000). Where traffic is reduced it is probable that there will be local pollution reduction benefits. These benefits will derive from certain vehicle movements being intercepted and perhaps also the remaining vehicle movements (including public transport vehicle movements) enjoying less congested conditions, which provide a

more efficient operating environment. Such benefits would be particularly important where critical air pollution thresholds are likely to be breached.

However, traffic growth outside the urban area is a likely effect of a popular EUAPR scheme (Parkhurst 2000). Hence, localised pollution is likely to be higher in those places, especially at congested nodes. However, the extra traffic is additional to background traffic growth and could potentially result in a critical situation in future years. Traffic growth will often occur at a higher rate outside urban areas as the urban road networks are relatively constrained whilst those outside have more capacity to accommodate greater road vehicle use. In evaluating critical exposure, however, it will be noted that residents and pedestrians are less likely to encounter pollution concentrations if they are outside urban areas. The exposure of car and bus occupants, though, is an important consideration in both cases.

Hence, the key unresolved issue is whether strategies aimed at pollution control through traffic dispersal from the more congested urban areas are appropriate. Those observers who agree that they are appropriate presumably do so because they believe traffic and pollution growth outside urban areas will not be so severe as to recreate the concentrations monitored within them. Those that disagree will tend to concur with the view that EUAPR merely 'moves' the pollution exposure problem elsewhere.

1.3 Landscape and planning considerations

The effectiveness of the careful selection of EUAPR site locations and the use of high-quality landscaping measures are widely understood to be important measures in minimising the environmental disbenefits of park and ride sites. However, there is ongoing concern about the particular suitability of greenbelt locations. One view is that they can be employed in such a way as to withstand pressure for associated development. The counter-view is that protecting what may be in effect a highly-accessible public transport node from development will, in time, prove impossible. One important reason for this is that, in other policy debate contexts, such nodes are portrayed as ideal locations for large traffic generators. A further, opinion is that, in some particular contexts, development around park and ride sites might actually be an appropriate means of managing planned growth.

The crux of the debate is essentially a manifestation of a wider dilemma in planning. With due allowance for the deployment of different approaches according to the features of particular locations, would growth in residential and commercial development in general be best catered for by expanding existing larger settlements, by selecting smaller settlements for considerable expansion, or by building entirely new settlements.

1.4 Emissions of greenhouse gases

At the time of writing the issue of global warming was refocused as a concern[2]. The UK Government is committed to a 12.5% reduction in the emissions of six greenhouse gases by 12.5% on 1990 levels by 2012 in line with the Kyoto Protocol and EU agreements. Government policy is that better integration in the transport sector can make a contribution to these reductions (DETR 1998b). However, the present author (Parkhurst 2000) has demonstrated that users' behavioural responses to the EUAPR schemes studied by WS Atkins (1998) result in a net increase in vehicle-kms travelled. One implication that can be assumed in consequence is that CO_2 emissions will also have increased as a result of the schemes.

Hence, the key question is whether traffic relief strategies for urban areas are acceptable even if they are associated with a likelihood of higher emissions of greenhouse gases.

1.5 Abstraction from public transport

Although the extent of the incidence of public transport passengers switching mode to use park and ride (and so using cars more) varies between places with EUAPR, the finding that abstraction occurs to some degree is a general one. Also to varying extents, the overall level of abstraction derives both from people switching from services within the urban area (local public transport) and from regional and rural services (longer-distance public transport).

Travellers' behavioural responses to interchange opportunities are clearly flexible and complex. In some cases travellers may use park and ride for some trips and public transport for others, or park and ride on a particular day and public transport for the same kind of trip on another day. The sites may facilitate so-called 'kiss and ride' trips, which might otherwise be made by car for the majority of the journey or public transport for the majority of the journey.

Such variety of behaviour presumably reflects choices made by travellers in order to derive personal benefits. However, some of the behaviour may result from logical economic optimising responses made by individuals within a transport market with price signals, which do not take sufficient account of the need to avoid congestion and environmental pollution. For example, price-distortions may result if park and ride is subsidised for commuters but public transport is not. Furthermore, park and ride may encourage decision-responses that are illogical from the economic perspective, due to inaccurate perceptions about the actual time and money costs of car use relative to public transport use.

The key question is hence, given that abstraction occurs, whether it is an acceptable 'side-effect' of the interchange strategy.

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[2]The evidence about global warming is itself not without controversy. Nonetheless, it is noteworthy that two UK Government advisors, the Chairman of the *UK Round Table on Sustainable Development* and the Chairman of the *Royal Commission on Environmental Pollution*, were reported in *The Guardian* of 12th May 2000 as urging the case for much more stringent cuts in greenhouse emissions merely to achieve "tolerable" (*i.e.* less desirable than present) environmental conditions.

1.6 Interchange policy development in an uncertain context

The intention of outlining above these key points was not to prelude an attempt here to resolve all the identified issues. Instead, the summary fulfils two functions. First, it confirms that the implications of the debate are important, sufficiently so that the precautionary principle may apply (*i.e.* that if the effects of a policy are uncertain, but the penalty for the effects being negative is high, that may be sufficient cause for a moratorium on its application). Second, it identifies which are the disadvantageous aspects of EUAPR schemes that an alternative interchange strategy should avoid. Hence, the following sections seek to offer an indirect solution to the problems of short-range bus-based park and ride schemes by circumventing them.

2 ALTERNATIVE APPROACH TO CAR-BUS INTERCHANGE

Although a long-range integrated park and ride scheme is under development for the Witney-Oxford A40 corridor in western Oxfordshire, established facilities in the UK are based on a short-range (typically 4-km radius) shuttle-bus service, which in most cases is also a dedicated service. The alternative considered here is for a longer-range scheme with parking capacity integrated with established public transport services. In the absence of actual operating examples, it is necessary to appraise the alternatives through a model-based approach.

2.1 Key attributes of EUAPR

2.1.1 Limited interception

Empirical evidence suggests EUAPR sites intercept motorists only for the final stages of their journeys because the sites are very close to the urban area (Parkhurst and Stokes 1994; WS Atkins 1998). Hence their potential contributions to overall car use reduction are limited.

2.1.2 Subsidy

Subsidy leads to a lowering of the generalised cost of travel and is responsible in part for the generation of trips by park and ride and the abstraction of trips from public transport. However, subsidy is hard to avoid in the case of EUAPR schemes.

Until all motorists can be regarded as having a reasonable alternative to parking in the centre of an urban area, central car parking charges cannot be increased to a level at which they encourage mode-switching from car use to park and ride. However, until central parking charges discourage car use, park and ride must be subsidised rather than offered at a commercial rate in order to attract motorists. Hence, because the facilities are introduced gradually, site by site, most of the sites must be subsidised for many years.

Furthermore, in practice, EUAPR is operated as part of the urban area parking stock rather than part of the public transport system. Hence, even when all motorists do have an alternative to central area parking, competition with other commercial centres may result in local authorities deciding not to recover the full costs of providing the interchange facility through user charges.

2.1.3 Scale

The operation of a dedicated service, usually with medium or standard-capacity buses at a relatively high frequency, means that operating efficiency can only be achieved by the provision of a large-capacity site: a minimum of 500 spaces and often more than 1,000. Because the EUAPR is in effect a new transport mode, there is also a requirement for the sites to have a high-profile location in order to attract large numbers of users, some of whom may not familiar with the opportunity and to facilitate easy access from the road network. These two attributes, scale and

sensitivity of location, tend to lead the EUAPR approach into conflict with environmental conservation interests. Such conflicts may then result in the interchange policy implementation being delayed or thwarted, and the implementation costs increased.

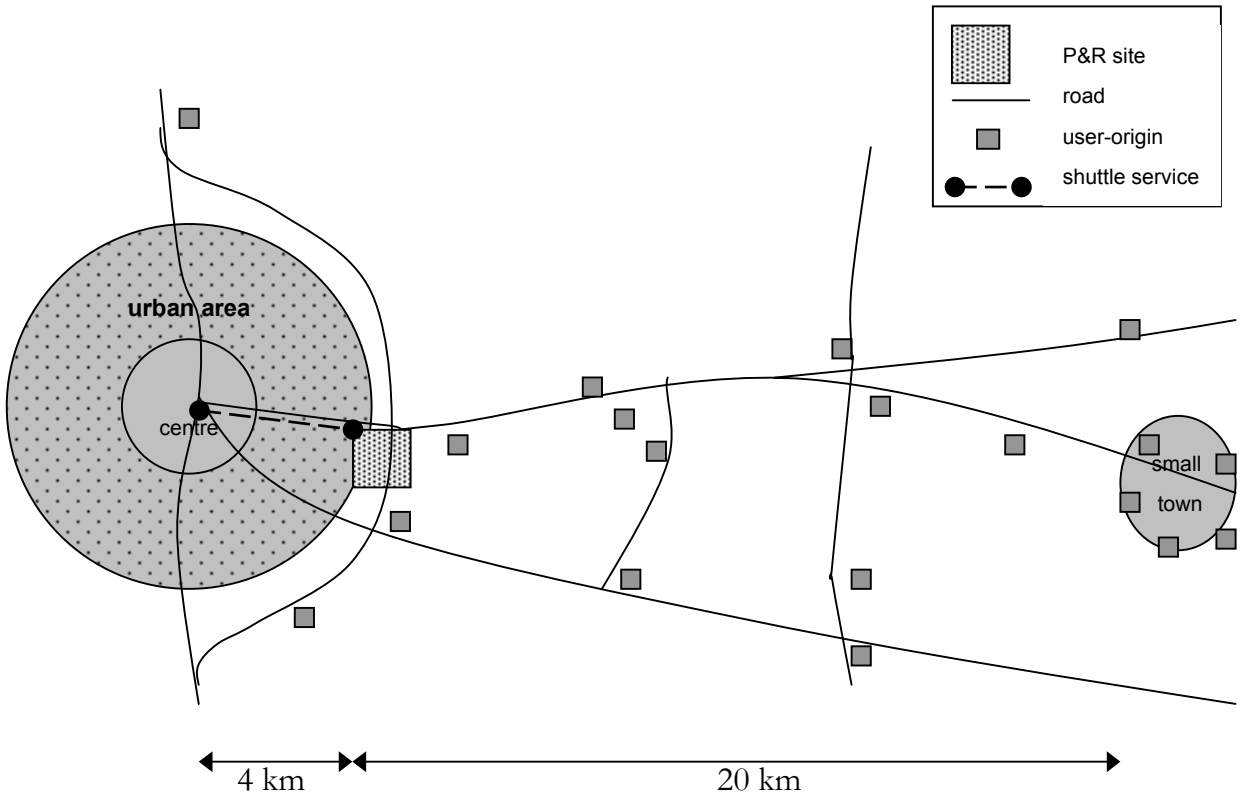
2.1.4 Dedicated bus services

EUAPR schemes are operated independently of public transport, which can result in the duplication of bus services. If a competitive situation develops between the conventional and park and ride bus routes there is the risk that non-park and ride services will be withdrawn or become more subsidy-dependent. Similarly, dedicated park and ride services may mean that potential efficiency and service improvement benefits from combining park and ride passengers with 'conventional' bus passengers on the same service are not exploited.

2.2 Scenario characteristics

Figure 1 presents a typical EUAPR scheme derived from the characteristics of a range of established interchange practice.

Figure 1: Edge of urban area interchange provision



However, the foregoing section suggests that local authorities are most likely to maximise benefits and minimise disbenefits where they are able:

- to locate car-bus interchanges relatively far from the final destinations of travellers,
- to provide relatively small sites,
- to avoid special subsidies for car users, and
- to offer park and ride opportunities in conjunction with conventional bus services.

To that end Figure 2 exemplifies an alternative strategy, labelled 'link and ride' (LR), based on a 'chain' of five smaller-scale interchanges served by an existing, but enhanced, public transport route.

Figure 2: 'Park and link' interchange provision

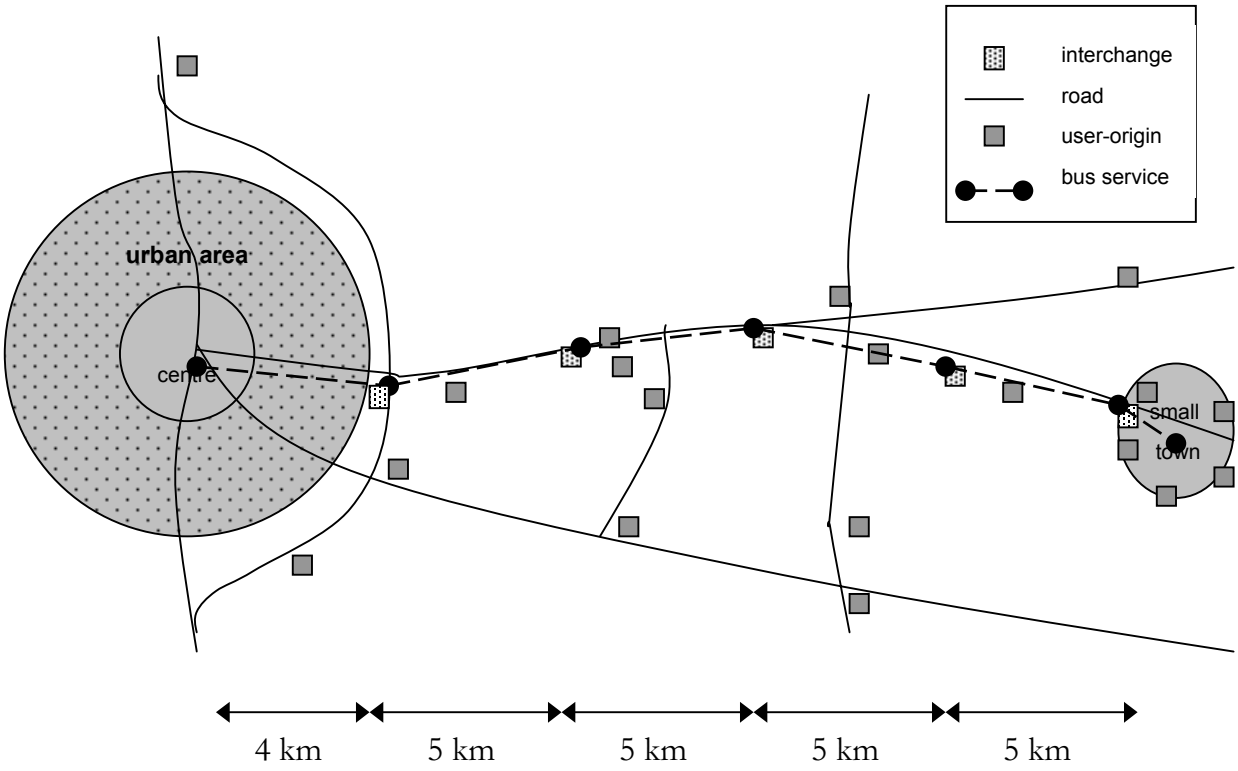


Table 1 considers the site characteristics and the behavioural and cost parameters of the two approaches. The parameters of the EUAPR approach are based on evidence from existing sites studied by WSA (1998) and further analysis by the present author (Parkhurst 2000).

Table 1. Parameters of short and long-range interchange options

Option		**EUAPR**	**LR**
No sites		1	5
Distance from urban centre (km)		4	4, 9, 14, 19, 24
Parking acts per space/day		1	1
Average distance driven to sites including deviation from desire line (km)		12	2
Car occupancy (adult passengers)		1.3	1.1
Proportion of users who:	Arrive at site by car and would otherwise have driven to central area	0.68	0.86
	Arrive at site by car and would otherwise have travelled to central area by urban or longer-range public transport	0.14	0
	Arrive at site on foot and would otherwise have travelled on foot, by bicycle or urban public transport to central area	0.09	0
	Arrive at site by car and would otherwise have accessed longer-range public transport on foot or by bicycle	0	0.05
	Arrive at site by car and would not otherwise have travelled	0.09	0.09
Additional travel by existing long-distance public transport users (return person trips)		0	20
User costs	Average bus fare paid (£)	1.3	2.7
	Petrol costs per km (£)	0.07	0.07
Provider costs	Provision (£/space/annum)	160	160
	Maintenance (£/space/annum)	160	160
	Bus services operated by single-deck bus (£/bus-km)	1.5	1.5
	Bus services operated by double-deck/articulated bus (£/bus-km)	1.6	1.6

In defining the two strategies, the following assumptions are made:-

- Residential distribution within rural areas is assumed to be reasonably even.
- Car occupancy for the EUAPR option is higher (1.3 adults per car) than the LR option (1 adult per car) as petrol costs apply per vehicle and public transport costs usually apply per passenger, making accompanied travel more attractive in the case of longer-distance car use.
- In both cases it is assumed that each parking space is used once per day.
- Users under the EUAPR scenario are assumed to drive an average 10 km further (one-way) to the site than LR scenario users do to local interchanges.
- Deviation by motorists from the desire-line of their trips to reach sites is assumed to contribute a similar absolute amount of generated traffic in both cases (an average of 2 km one-way per intercepted car).
- Under the EUAPR scenario, 23% of users of the facility are assumed to switch mode from using public transport for the whole (or most) of the trip. However, a minority (9% of users) is assumed to switch from urban area services, with the other 14% switching from longer-distance services. It is further assumed that each longer-distance mode switch adds 20 km per round-

trip to the road network and abstracts an average fare of £3.00 from bus or rail operators.

- Trip generation as a result of the provision of an interchange opportunity is assumed to be equivalent to 9% of users under each scenario. Car trips to sites are assumed to be 10 km longer in the case of the EUAPR strategy than the LR strategy.
- A higher proportion of LR users are motorists who park a car at the park and ride site who would otherwise have driven to the urban centre because abstraction from public transport is avoided. However, 5% of LR users are assumed to be established public transport users who previously walked or cycled to a stop, but who drive once the park and ride opportunity is made available.
- In the LR case, the provision of a higher service frequency means that existing public transport passengers are likely to travel more. This travel is assumed to add 10% to an existing notional market for 200 return trips using the established low frequency service per day. The total number of trips which can be lost from public transport in the EUAPR case is, however, greater than 200. Abstracted trips may previously have been made by rail as well as bus and, due to the destination-focussed location of the interchange facility, they are likely to include trips made from other corridors which access the site via an orbital road.)
- Petrol costs for accessing the site are £0.07/km, assuming average consumption to be 12 km/l and petrol priced at £0.84/l.
- The average LR bus fare is set to match the user costs of the EUAPR option once the bus fare and higher petrol consumption in reaching the site are taken into account. The average bus fare paid under the LR option results from a fare structure based on a lower £/km rate for the car-bus interchanges which are relatively distant from the central area than for those relatively close. This is to encourage interchange relatively early in the car journey and avoid competition with urban area public transport.
- The site construction costs of the two approaches are assumed to be similar. In practice land costs may be lower away from the urban area, but some elements of design and construction may be higher for a multiple-site approach.
- Operating costs are also assumed to be similar. However, there would inevitably be differences in the way security would be provided. A permanent security staff presence could be afforded at a single, large site, but not for each of a set of five smaller sites. Hence, considerations of passive surveillance would be important in locating the smaller sites, whilst a mobile security force would operate linked to camera observation.
- Bus service costs per km are assumed to be similar for the two approaches.

Table 2 indicates the variables considered in the comparison. The total capacity of the longer-range sites is defined by the number of spaces required to achieve a similar amount of car traffic interception from the urban area as occurs under the EUAPR approach. (In other terms this is the capacity required to accommodate those users who park cars at the sites and would otherwise drive to the urban centre). This calculation takes into account the differences in users' behaviour characterised in Table 1.

The EUAPR option is assumed to operate entirely independently of existing public transport services, whilst the LR option is integrated with an inter-urban service with a one-hour headway. The frequency of service provided is adjusted to reflect the total adult patronage expected according to the parameters in Table 1.

Table 2. Scenarios examined

Policy options	**Low capacity**		**Medium capacity**		**High capacity**	
	EUAPR	**LR**	**EUAPR**	**LR**	**EUAPR**	**LR**
Total capacity (spaces)	500	395	1,000	791	1,500	1,186
Adult passengers attracted to facility (per day)	710	455	1,419	890	2,129	1,325
Bus service headway (min)	15	20	15	20	15	20
Additional return bus services (per 12-hr operating day)	48	24	48	24	48	24
Bus ridership	13	18	27	30	40	42

The LR scenarios employ a larger headway (20 minutes rather than 15 minutes). The EUAPR service is more frequent in order to provide sufficient bus capacity for the expected patronage. However, it is suggested that an average wait-time 2.5 minutes longer will be accepted by passengers without major differences in behavioural responses. One reason is that the ratio of wait time to travel time on the public transport mode will be lower in the LR operation. The walk time from car to bus will also be shorter, as the sites will be one-fifth as large, which may compensate for some of the additional wait time.

Both the high-capacity options would require the use of either double-decked or articulated vehicles to manage peak demand at the given headways.

2.3 Scenario outcomes

Tables 3 and 4 indicate the traffic impacts and financial obligations that would be expected to derive from each scenario. The distances travelled by buses in Table 3 are factored to reflect the assumptions that:

- one bus-km operated by a single-deck bus is assumed to have an overall environmental impact 2.5 times greater than one car-km and
- one bus-km operated by a double-deck or elongated bus is assumed to have an environmental impact three times one car-km.

The bracketed figures in Table 3 indicate additional traffic, *i.e.* scenario elements that counter the policy intention. Figures in bold indicate under which circumstances overall traffic reduction occurs.

Table 3. Modelled traffic impacts (km)

Policy options	Low capacity		Medium capacity		High capacity	
	EUAPR	**LR**	**EUAPR**	**LR**	**EUAPR**	**LR**
Intercepted from urban area	845,920	845,920	1,691,840	1,691,840	2,537,760	2,537,760
Additional bus-km operated in urban area	(298,560)	(149,280)	(298,560)	(149,280)	(358,272)	(179,136)
net change within urban area	547,360	696,640	1,393,280	1,542,560	2,179,488	2,358,624
Intercepted from extra-urban area	0	2,114,800	0	4,229,600	0	6,344,400
Additional bus-km operated in extra-urban area	0	(746,400)	0	(746,400)	0	(895,680)
access traffic to sites	(422,960)	(422,960)	(845,920)	(845,920)	(1,268,880)	(1,268,880)
Extra traffic due to abstraction from public transport	(429,180)	0	(858,360)	0	(1,287,540)	0
Extra traffic from generated trips	(279,900)	0	(559,800)	0	(839,700)	0
Net change within extra-urban area	(1,132,040)	945,440	(2,264,080)	2,637,280	(3,396,120)	4,179,840
Overall net change in traffic	(584,680)	**1,642,080**	(870,800)	**4,179,840**	(1,216,632)	**6,538,464**

Hence, under all capacity scenarios, the provision of a 'chain' of five interchange sites results in a net traffic reduction, whilst EUAPR implementation leads to a net traffic increase. As less bus movements are provided in the LR scenarios, these also offer a larger net traffic interception benefit in the urban areas.

In Table 4 bracketed figures indicate financial expenditures, which it is assumed policy implementation seeks to minimise. Bold figures indicate the circumstances in which an overall financial surplus is achieved.

Table 4. Modelled costs (£)

Policy options	Low capacity		Medium capacity		High capacity	
	EUAPR	**LR**	**EUAPR**	**LR**	**EUAPR**	**LR**
Annual site provision costs	(80,000)	(63,256)	(160,000)	(126,512)	(240,000)	(126,512)
Annual site operating costs	(80,000)	(63,256)	(160,000)	(126,512)	(240,000)	(126,512)
Annual bus operating costs	(179,136)	(537,408)	(179,136)	(537,408)	(191,078)	(573,235)
Total provision costs	(339,136)	(663,920)	(499,136)	(790,431)	(671,078)	(952,770)
Revenue from P&R fares	286,935	381,999	573,869	747,171	860,804	1,112,343
Change in public transport revenue	(35,830)	16,828	(71,659)	16,828	(107,489)	16,828
Net costs	(88,031)	(265,093)	**3,074**	(26,432)	**82,237**	**176,401**

Hence, it is apparent that both the EUAPR and LR low-capacity scenarios require subsidy. This is considerable in the LR case. It could possibly be reduced (or even eliminated) by operating a 30-minute frequency, although some patronage would probably be deterred by an average 15-minute wait time.

The EUAPR and LR medium-capacity scenarios are close to break-even, although the LR option requires a modest annual subsidy.

The high-capacity options show the possibility of an operating surplus resulting from providing the facilities at an appropriate economy of scale. The EUAPR scenario suggests a modest surplus, limited by the inclusion in the model of lost fares from longer-range public transport. However, the LR option has the potential for a surplus of around 15% of turnover. Depending on political choices, the potential for surplus could be used variously to:

- encourage private sector involvement in the operation,
- achieve a more frequent bus service than every 20 minutes on the LR route,
- offset public investments elsewhere in the public transport network (cross-subsidy), or
- finance enhancements in the fixed infrastructure of the LR route such as real-time information displays, waiting facilities and bus priority routes.

3 CONCLUSIONS

EUAPR schemes, as implemented hitherto, have been shown by the available evidence to vary somewhat in their balance of effects, but overall can be regarded as having maintained the accessibility of traditional urban centres and relieved congestion, but at a public subsidy cost. Further, although in a context of contributions from developers and local taxation this subsidy requirement may be regarded as 'sustainable' in financial terms, in environmental terms EUAPR has been associated with more, not less, car travel.

Local circumstances and conditions will remain important during the search for strategies to enhance car-bus interchange that are effective in addressing policy issues such as climate change and rural traffic growth. In general terms though the present paper demonstrates that a longer-range 'link and ride' strategy offers an alternative approach to maintaining the accessibility of traditional centres whilst at the same time reducing overall car use. Further, the estimations also suggest that the interception of car trips at a longer-range can be financially viable.

Viability will, however, be dependent on effective marketing of the facilities to the public. In turn, marketing will only be effective if critical service quality aspects are respected.

- The services must be made attractive to motorists by avoiding excessive delays to buses at the interchanges.
- Buses must be protected from significant traffic congestion delays on their routes both inside and outside the urban area by the provision of adequate bus priority.

The implementation of an appropriate ticketing system that permits a high rate of boarding is perhaps the most important practical measure for avoiding delays at the car parks. However, this may offer an opportunity to rural retail and service facilities as vendors of pre-purchase tickets. Security staff could also provide a conductor and on-board ticket sales facility at busy times.

Sections of bus lane, reserved carriageway, and guided busway, along with traffic light priorities, are all established traffic engineering measures with a role to play in ensuring a virtual (or even actual) busway track can provide standards of priority to buses which approach those achieved by railways.

The analysis of different levels of capacity provision suggests that an appropriate scale remains important for both interchange strategies. Although the LR approaches do achieve overall traffic reduction, the financial outcomes of achieving that reduction are likely to be more extreme than EUAPR implementations. A higher level of subsidy in the LR case compared with the EUAPR case is needed at the given level of bus service supply if interchange patronage amounts to around 400 return trips per day, but a greater financial surplus results if such patronage

reaches 1,200 return trips. Under the high-patronage conditions, the case for private sector involvement on a commercial basis is strong.

The provision of LR facilities will create an opportunity in some corridors for smaller towns to benefit from users travelling in the reverse direction to the dominant movement to the main town of the area. The 'counter-flow' opportunity may lead to a higher overall level of car-bus interchange as well as the generation of walk-to-bus patronage within the corridor. The model presented above does not incorporate this additional patronage.

Initial searches for potential routes for applying the 'link and ride' approach should perhaps seek established bus services with a 30-minute or higher frequency. Those are likely to be the routes linking the regional centre with a settlement such as a market town, but passing through a more rural catchment. Such routes will require the lowest level of marginal investment in service enhancements. Once the principle is established and the local travel culture has begun to assimilate the opportunity then routes requiring a higher level of investment might subsequently considered for treatment. A final stage could be to consider the launch of entirely novel routes.

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