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**MODELLING AND APPRAISAL OF PARK AND RIDE SCHEMES  
WHAT APPROACH IS SUITABLE AND MOST EFFECTIVE?**

**David Gregory  
Halcrow Group Limited  
John Seymour  
Halcrow Group Limited**

**1. INTRODUCTION**

Evidence shows that park and ride demand is generated from a wide range of travel choices and results in many impacts. This makes the modelling and appraisal of new sites and their services complicated. This paper assesses the suitability of methods for a range of different proposed schemes, through reference to research and a number of studies completed by Halcrow.

Schemes included in the paper highlight the need to consider issues ascertaining to new sites, expanded locations, the variation in size of sites, the onward mode, and the wider travel behavioural impacts P+R sites can generate. The paper also covers what is important for schemes, and how estimating the demand, benefits and revenues can be achieved to produce effective results and robust outputs.

**2. NEED AND PROVISION**

One of the key transport issues facing cities and towns is that of increasing congestion in core urban areas. A common goal for authorities is to ensure centres are highly accessible to all, so increasing activity and economic performance. To achieve this without exacerbating congestion requires the increased use of sustainable travel modes and less reliance on the car. Park and ride has been identified by transport planners and policymakers as a way to help alleviate this problem. A park and ride scheme allows people to use their cars for part of a journey, while completing the rest by public transport to the final destination. Thus, highway traffic is shifted from the critically congested central area to the park and ride sites that are distributed normally on the edge of the city or town. This approach also delivers other benefits in terms of the environment, accessibility and reliability, helping to retain and attract more workers, visitors and shoppers to the central area, so adding value to the local economy.

Park and ride takes a number of different forms in the UK, in total there are over 140 dedicated sites implemented. In addition rail based park and ride is very common at many stations, where users access existing services where dedicated spaces are provided. The number of spaces provided ranges a

great deal depending on space available, and indeed dedicated Parkway stations have been built specifically to cater for park and ride markets that include a range of longer and shorter distance trips. A recent success has been Warwick Parkway, on the Chiltern line that has over 400 spaces provided at a high quality facility and is able to serve key markets to West Midlands and London, with good access from the M40.

Bus based park and ride is growing all the time, with key successes in York, Nottingham and Oxford, where short distance trips are completed in bus from a range of sites located in the outer areas or edge of the cities. A key part of the success of these services has been implementation of the park and ride service as a package of measures that include good site access and facilities, bus priority and central parking restraint measures, so maximising the attractiveness of the park and ride services to the users. In York, five sites are currently provided with over 3,700 spaces (two more are planned and one site is to be expanded increasing supply to over 5,300 spaces) on the outer ring road to intercept traffic entering the city on the key radials. All sites are designed to a very high standard with onsite facilities and staffing. Services are high-frequency, fast, cheap and benefit from the bus priority measures provided to the core central area of a City.

### 3. WHAT MAKES PEOPLE CHOOSE PARK AND RIDE?

Research of users and non-users of park and ride services show the key factors to deciding to use a park and ride service are varied and depend on local issues and individual circumstances. In summary, the key factors are listed below:

- **Save Money / Cheaper than Alternative** - a key comparison made appears to be between the cost of parking against the park and ride service fare. Whilst the former may vary significant depending on duration of the trip, the latter is fixed and can be very cheap for the regular users through the purchase of season tickets. Vehicle occupancy is also important as costs can be shared, although there are a range of fare strategies applied, with most variation seen for bus based park and ride, with some charging per vehicle and other per person to use the service.
- **Reduced Stress** - access to congested central areas can be stressful especially where the drivers has to find a parking space, assuming spaces are available at a reasonable cost. Park and ride sites more often provide a guaranteed space with a bus waiting to board, so reduce parking space search time and provide seamless interchange. Parking search time can be extensive in central areas, especially for those with limited knowledge of an area, so park and ride provides an attractive alternative.
- **More Convenient than Alternatives** - as well as reducing stress, park and ride provides a more reliable journey to the centre, whilst stops are often

located in the core of the centre in order to minimise walk distances to main attractions. Cheaper parking is often located towards the edge of centres, so walk distances can be significant.

- **Quality Service** - the park and ride service is of high quality, high-frequency, safe, provides a seat and is well marketed, branded and the sites are well signed. Further sites are well presented and maintained with onsite staffing and other facilities, i.e. toilets, café and shops. Real time information, facilities and signing are key benefits of many schemes, together with safe and secure parking. All provide confidence to the users of the service.
- **Saves Travel Time** - often park and ride services can be quicker than other modes, notably the car at peak times of the day. However time saving is not always seen as the critical factor in the choice to use the service, apart from in cases where public transport services are currently poor and existing public transport users switch to using the new park and ride services.
- **Access to Sites** - easy access to site, with direct routing into the sites often with dedicated junctions. A range of access modes need to be catered for including walkers from local land uses and cyclists.
- **Multi-Purpose Services** - Park and ride sites and services often have dual purposes and can serve local attractors to the sites with the high level of service available. A typical example is Askham Bar in York where a college is located next to the site and students use the park and ride services to travel from the central area to the college each day.
- **Good Thing To Do** - in the case of York and Nottingham for example, it has become part of the culture to use park and ride. Many people see it as the first choice and a transport success within the city - it has the image (often through strong marketing) that attracts users, unlike many standard bus services.

The factors listed highlight the need in modelling and appraisal of new or expanded sites to reflect a complex range of behavioural effects, some not modelled in the conventional models or included in standard appraisal packages. Key factors on parking choice and cost are critical to forecasting park and ride demand. Within choice is the availability and search time for finding a space.

#### 4. IMPACTS OF PARK AND RIDE

Evidence shows the impacts of park and ride services and site provision to be wide ranging, and more so than perhaps is expected from the initial concept stage. Some impacts are beneficial, though not all, however overall the evidence appears to show net positive benefits of sites.

- **Mode shift - main mode** - the highest level of trip abstraction is from car trips to the central area, so achieving that is often the main aim of the scheme to reduce flow and congestion in the central area. However, evidence shows new sites and services attract existing public transport users especially where current provision is poor. Typically 60% of demand is from car trips to the central area.
- **Mode shift - access mode** - at existing park and ride sites where expansion in the number of spaces is provided or facilities improved, such as security, a change in access mode may occur with a higher proportion of passengers driving to the station including some that previously walked or used public transport. This effect is due to greater availability of parking spaces. Changes can account for 20% of demand for new parking.
- **Parking choice** - increased parking supply at a site can be highly beneficial as it can reduce parking problems on local streets, providing benefits to residents and local businesses. Safe and secure parking can also increase demand.
- **Site choice** - a new site or change in site provision may result in some existing park and ride users switching between sites, as one site is now more convenient to use than the current site. Hence the transfer may have a negative impact to the current site, and there is negligible change in overall revenue to operators, either public transport or parking.
- **New travel demand** - the increase in transport supply, and savings in time and costs, will encourage more trips to be made, including redistribution to different destinations. Typically such demand can be between 5% to 15% of users at the site or service.
- **Reduced congestion** - whilst the evidence of overall change in vehicle kilometres is mixed, with some cases reporting increases and some decreases in totals, the net impact to central congested areas is positive. This is offset by increases in vehicles kilometres, though not necessarily congestion, in non-central areas adjacent to the park and ride sites. Rail park and ride schemes tend to create large vehicle kilometre savings as they attract longer distance trips. Bus schemes are provided for shorter distance travel and savings are less.

- **Revenue impacts** - The impacts of revenue apply to public transport and car park operators. The change in main and access modes generate gains and losses to public transport operators, with gains not as great as often expected due to the transfer behaviour of existing passengers. Abstraction from existing public transport services may result in such service becoming non-commercial and require a level of subsidy to remain in operation. Such a cost is often understated. Car park operators (often the local authority) lose revenue in the central area but can gain at the sites where parking is charged. However the reduction in demand needs to be assessed against the likely reduction in parking space provision, hence operators will save costs and may generate new income from the sale of land and other opportunities.
- **Environmental impacts** - Park and ride sites and service do help reduce noise and improve air quality due to reduced traffic in central congested areas. Evidence in York shows the road space freed up by car drivers now using park and ride has not been simply filled by other road users and generated traffic.
- **Economic impacts** - The reduction of traffic congestion and hence increased accessibility to central areas, attracts more trips including workers, shoppers and visitors, all helping to boost the local economy. Park and ride is supported by local businesses because of the ability to attract people to a central area.

The modelling and appraisal of a new or expanded park and ride needs to cover abstraction of new users from other modes and the behaviour of existing users. The latter group can have as big an impact in overall demand terms as the former, and some of the changes may be of limited benefit to the overall scheme, notably on revenue and access modes. Hence, the modelling and appraisal needs are wide ranging to cover the range of impacts. It may require separate models for different impacts and demand markets.

## 5. POTENTIAL DEMAND MARKETS

A key part of any forecast is to understand the potential demand markets that are mostly likely to be attracted to park and ride, or are the target to use a scheme. The former may not be the same as the latter. The failure of many schemes is linked to not having a clear understanding of demand and for example, assuming a high flow on a key radial route where land is available, will attract park and ride users. Effective solutions need to be demand not supply lead. The challenge for park and ride is not only to attract demand, but the types of demand that will deliver the key impacts that a scheme is being designed to address.

Evidence shows that park and ride users are characterised by the following:

- Half of users use the park and ride at least once a week, mainly commuters;
- Up to one third of trips are from origins with 2km of a site;
- 60% of trips are by females, especially for bus park and ride based sites;
- Demand more skewed to older drivers, perhaps as they are less concerned about time and more willing to use alternative modes. Younger drivers, with a first car, will use the car for all trips.
- Demand is more focused to middle income sectors, perhaps not surprising given the need to have access to a car to drive to the sites;
- Rail, including LRT, park and ride is more focused on commuters, where as bus based demand is more focused on shoppers and visitors.

Within a modelling and appraisal process, the key markets to include for estimating park and ride demand are as below:

- Trips where a car is available for access to the site, either as driver or passengers;
- Commuters who have to pay to park in a central area, or will find getting a space a problem each day. Often cheap central area parking is poorly located for the core areas and results in a long walk time;
- Shoppers and visitors who pay to park, want the convenience of easy to access parking spaces, particularly if they are not familiar with the parking in the central area;
- Trips to the central area that currently have poor public transport access, and where there is a high absolute and proportion of trips made by car. Park and ride services should not look to attract existing public transport users, especially where they currently leave their cars at home;
- Trips within a realistic catchment, based on evidence at existing sites or benchmarking, including overlapping of catchments where more than one site is provided in the same area.

The need to model a wider range of time periods, not just peak hours, is desirable so that all markets are captured within the forecasts, hence the need for greater flexibility in the modelling structure. To get data for each demand market and time period requires targeted data collection.

Defining a sensible potential catchment of a site is important. Often there is much focus on thinking longer distance strategic trips will provide the core demand for park and ride, when evidence shows high proportions of local trips (i.e. with 2km of the site) exist. The park and ride service stage of the trip (i.e. the bus or rail stage) needs to be the main stage, and the access to the park and ride site needs to have lower costs or time. There is evidence that a higher value is placed on access time so as to reduce interchange effects and

the wait for the bus or train. Access time needs to be reliable to coincide with the park and ride departure time and so reduce wait time, so the longer the access time and distance the greater the unreliability is likely to be for access to the site.

Markets that are less suitable are as follows:

- Commuters with free parking, or parking paid for by the employer;
- Business trips, where costs are not paid by the driver;
- Trips where public transport service provision is already good and there is already a good choice of services, as the impact will be restricted to public transport demand and revenue transfers and little impact on decongestion and environmental change.

Understanding the full trip origin and destination details of a trip is critical to forecast park and ride demand. A high flow on an urban radial route does not necessarily mean a large potential park and ride market. It is quite possible that very few of the car trips on the radial are going to the central area, as many trips to the centre are already using public transport services. Details of trip destinations within the central area help plan the service route (where a new service is being provided), plus show where the service can compete most effectively with car by providing greater penetration, increase convenience and reduce costs and time.

When forecasting demand for sites, and modelling single time periods, the return time of the trip must be considered, as it must be within the hours of operation of the service. This is most relevant to leisure and shopping trips, but increasingly so to commuting trips as working hours change. Typically, 75% of drivers arrive at the site before 12noon, with few trips starting after this due to lack of return services in the evenings. The need to consider two-way trips is as important as one-way trips. Modelling of all day demands is an option.

Having a basic understanding of potential markets is therefore important, and benchmarking the size of these markets to cities and towns where park and ride has successfully been applied will show if the markets are suitable for developing a park and ride service. Separate comparisons should be made for peak and interpeak travel, reflecting different markets, and should consider the absolute size of markets. Benchmarking should also cover supply factors such as parking costs versus fares, central parking utilisation and supporting measures to maximise the advantages of a park and ride service.

## 6. MODELLING OF PARK AND RIDE

Modelling of park and ride sites and services has been well established for many years, and results have been mixed, like many other types of schemes that have been modelled. However, results are getting better over time as both more and a wider range of sites are established, along with the greater evidence base enabling an increased understanding about travel behaviour.

There appear to be two main approaches to the modelling of park and ride, namely:

- **Area Model** - normally an urban area multi-modal transport model that includes travel costs (time, fares etc) and some form of choice algorithm to distribute and assign trips to the site and route. The detail within such models is critical, and for robust forecasts a fine level of cost definition is required, highlighted by the reasons why people park and ride. In many cases such cost factors are not modelled, i.e. parking search time. Obtaining results from the higher level strategic transport / land use models for park and ride is often problematic and results have to be handled with caution, as models are not always designed or validated for park and ride trips.
- **Site Specific Model** - covering local catchment size and characteristics, parking availability, location variable (i.e. facilities, security). Such models are more applicable to existing sites that are perhaps being expanded, and where existing evidence is available to develop the forecasts and case for the expansion. Site specific models may take the form of regression models that include key demand drivers as input variables (such drivers include fares, parking provision and competition costs) or an elasticity model using change in travel costs to estimate change.

Area models have the advantage of providing high level outputs on potential demand, decongestion and catchment, whilst the local models reflect more of the detail within the corridor and adjacent to the sites. Local models are more flexible, require less data and resource input and provide robust and relevant outputs. Interaction between time periods, so reflecting parking spare capacity in the middle of the day as a result of morning peak demand, is easier in a site specific model, for example.

The choice of models depends on the site size, whether it is a new or existing site and the results of any benchmarking. In some cases, a combination of the two approaches may be required.

The following table summarises the strengths and weaknesses of the different approaches in terms of modelling and appraisal of sites, split by choice, impacts and modelling requirements.

Factor	Area Model	Site Specific Model
<b>Choices</b>		
<b>Main Mode Choice</b>	Provide abstraction effects between all modes.	Need to make assumptions of abstraction from evidence base from existing sites.
<b>Access Mode Choice</b>	Often weak at local access change due to poor parking modelling and other modes such as walk and cycle.	Need to make assumptions of abstraction from evidence base from existing sites. Parking search time can be modelled.
<b>Parking Site Choice</b>	Better model to use for site choice, however such models do not always include parking costs and supply so additional model development is required.	Limited as catchments are fixed, but allows for local changes between site and on-street choice.
<b>Parking Supply</b>	Limited modelling, and interaction between time periods.	Able to model range of time periods and interaction between time periods.
<b>Impacts</b>		
<b>Revenues Change</b>	Most models include fare changes but at a general level. Need for validation of results.	Allows for more disaggregation of changes to be defined as wider range of impacts are reflected in the model.
<b>Decongestion</b>	Assessed area wide decongestion with changes in central and site area over full catchment of park and ride trips.	Need to make assumptions of abstraction from evidence base from existing sites.
<b>New Demand</b>	Estimated if full demand model is available	Need to make assumptions of abstraction from evidence base from existing sites.
<b>Model Requirements</b>		
<b>Time Periods</b>	Limited to hours of main models - conventionally weekday peak hours.	Wide range of time periods can be modelled. i.e. Saturday, busy weeks.
<b>Data Requirements</b>	Extensive data collection needed to develop models. Need for park and ride parameters. Models often restricted to standard periods.	Need a range of sites to calibrate regression models. Elasticity values are provided in guidance i.e. WebTAG.
<b>Model Flexibility</b>	Need to use software package and have skilled staff to run the models.	Easier to use, often spreadsheet based.

## 7. APPRAISAL OF SCHEMES

Given the range of impacts and benefits new or expanding park and ride sites or services can generate, the appraisal requires careful consideration. It can be made more complicated where a package of improvements is proposed and park and ride is one element of that package, and there may be a need to demonstrate that this element is value for money in its own right.

Conventional packages such as TUBA and COBA (DfT's Economic Appraisal Tools) allow for time and cost saving benefits to be computed using the methodologies defined in WebTAG. But such benefits, covering time, decongestion and vehicle operating costs, can be very small and sometimes negative as time savings is not the main factor affecting the decision to use park and ride.

Hence other benefits and outputs are required in a complete appraisal to show the full case, presented in a framework:

- **Financial and commercial analysis** - looking at the revenue generated against operating (including maintenance and replacement) costs of the scheme, and identifying the size of any subsidy;
- **Revenue Impacts** - net changes to and between operators, and the revenue and cost changes to parking operators;
- **Facility and Amenity Benefits**- benefits of the wider measures that are not fully reflected in the area wide models but are critical benefits to scheme users;
- **Reliability Benefits** - reflecting the convenience of the journey and ease of finding a parking space on the site, again not reflected in the area wide modes;
- **Accessibility Benefits** - with reduced travel costs and increased access to jobs and key services, trip redistribution effects will occur and more trips take place;
- **Noise and Air Quality Changes** - estimating changes in emissions, and population affected by noise change;
- **Supply and Demand Analysis** - modelling of park and ride parking demand against numbers of spaces provided, including for events or busy times of the year (i.e. pre Christmas). Plus, the demands against seats on the park and ride service to check the project demand can be carried in comfort.

Research suggests that key areas for appraisal relate to the environment, and economic factors including economic efficiency and safety. The impact on equality and social inclusion are currently uncertain and there is little evidence available from existing sites to be able to judge the actual changes.

The demand profiles for park and ride mean careful consideration needs to be given to the annualisation of modelled outputs. Profiles do not follow the same patterns as general traffic, and as benefits are related to parking costs and

fares they can differ per trip between time periods. Being able to model a range of time periods helps define the differences and hence annual estimates.

The conventional appraisal tools are able to assess some of the impacts of the scheme, but many impacts are outside their scope. There is a need for tools that include the full range of benefits, linked to the different demand markets (notably new and existing users) and include for economic and financial appraisal. Such tools take the form of a spreadsheet.

## **8. SUMMARY AND CONCLUSIONS**

Below is a summary of the key points from the paper:

- Research shows that reasons for choosing to use park and ride services are varied and often relate to the quality of the service and site provided and the costs of alternative modes, notably central area parking cost and space availability. The latter needs to be included in forecasting models.
- The impacts of park and ride are also varied, with benefits and disbenefits generated. Different demand markets generate different impacts, so any modelling and appraisal needs to reflect this range. The change of site and access mode is as important as main modes for trips, resulting in transferring of demands and revenues. Data collection needs to include for transfer of demands, not just new users.
- Understanding potential park and ride demand models is critical in forecasts, as the markets are limited. Benchmarking of key factors (i.e. car travel and public transport accessibility to the core centre) will help identify if the corridor is suitable for a site and service. Solutions need to be demand not supply (i.e. site) lead if they are to work.
- Demands also need to be considered for catchment issues, covering outer area and the central area. Final destinations of the trips need to define the service route, in order to maximise demands and benefits. Focused data collection is needed to ensure robust and accurate trip data is available in the modelling and appraisal processes.
- The approach to modelling of park and ride schemes appears to be split between area wide models and site specific models. Each offers advantages over the other, with the former offering more strategic high level impacts and the latter a wider range of local impacts, more detail and greater flexibility. With the need to make better use of existing infrastructure, the scope to use site specific models appears more attractive, especially given the likely available evidence.
- Given the range of impacts and hence benefits, the appraisal of a park and ride scheme needs careful thought. Using a conventional appraisal based on time savings will not present the full benefits of the scheme, and there is a need for simple addition tools to quantify and capture all impacts. Such tools can be developed in spreadsheets, and allow for greater flexibility and save time.

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## **Contact Details:**

David Gregory / John Seymour  
Halcrow Group Ltd  
Deanway Technology Centre  
Wilmslow Road  
Handforth  
Cheshire  
Tel: 01625 540456  
Email: [gregoryda@halcrow.com](mailto:gregoryda@halcrow.com)  
[seymourje@halcrow.com](mailto:seymourje@halcrow.com)