

# Modelling of Trips using Strategic Park-and-Ride Site at Longbridge Railway Station

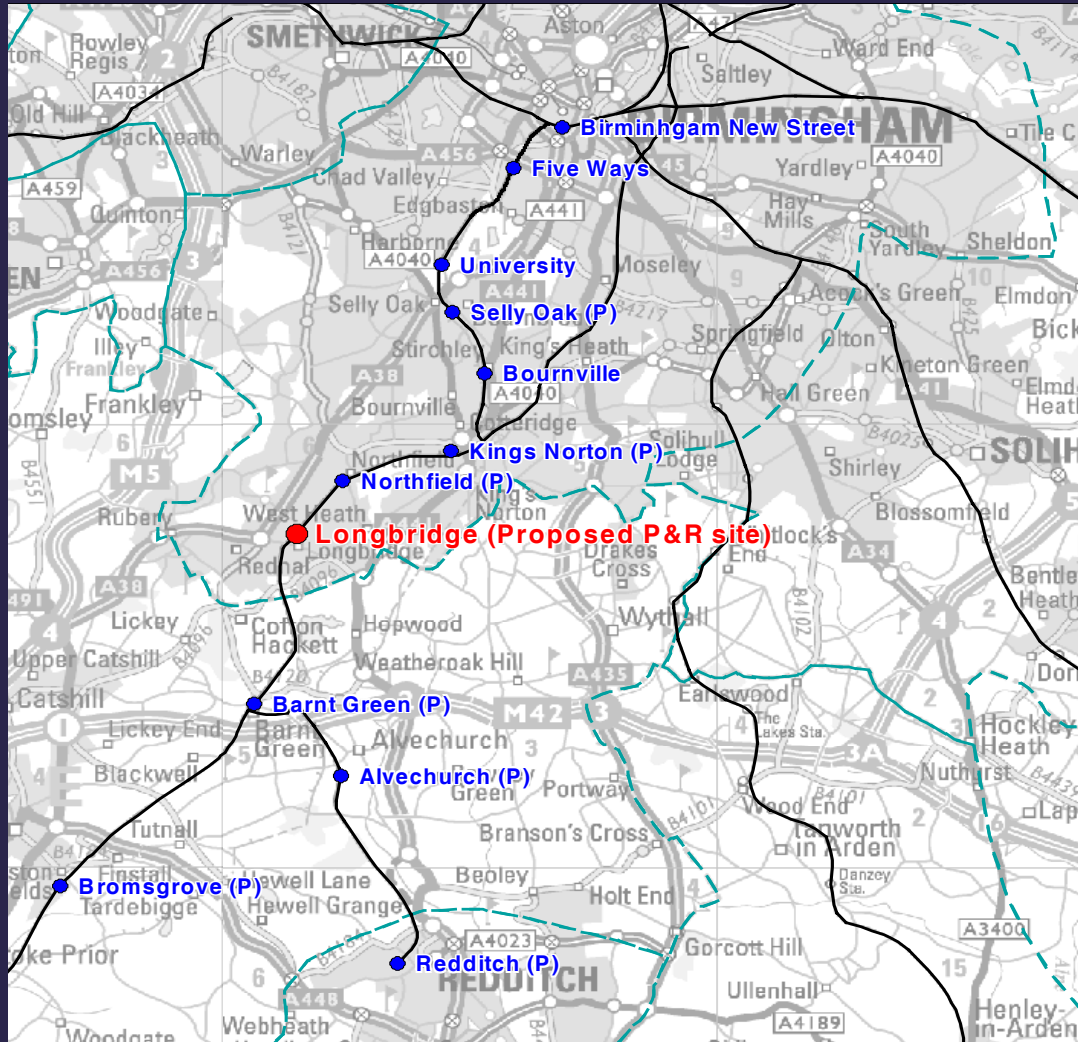
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19<sup>th</sup> International EMME/2 Users Conference  
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# Proposed Longbridge P&R site



- A strategic P&R facility at Longbridge with 980 parking spaces
- on the Cross City railway line
- Just inside West Midlands conurbation boundary
- Free of charge (local government policy)
- Ideal to intercept highway traffic
  - From A38 Bristol Road South
  - Long distance car trips using the M5 and M42 motorways

## Scheme Background

### 7 Existing Rail Park and Ride Sites in the area:

#### Inside West Midlands Conurbation (free parking)

- Selly Oak
- Kings Norton
- Northfield

#### Outside West Midlands Conurbation

- Barnt Green
- Alvechurch
- Redditch
- Bromsgrove

## Scheme Background

### Park-and-Ride

- an integral part of local government strategy
- a key measure to:
  - improve journey times
  - reduce travel costs
  - improve the environment
  - attract passengers onto public transport
  - provide an attractive alternative to a congested car journey.

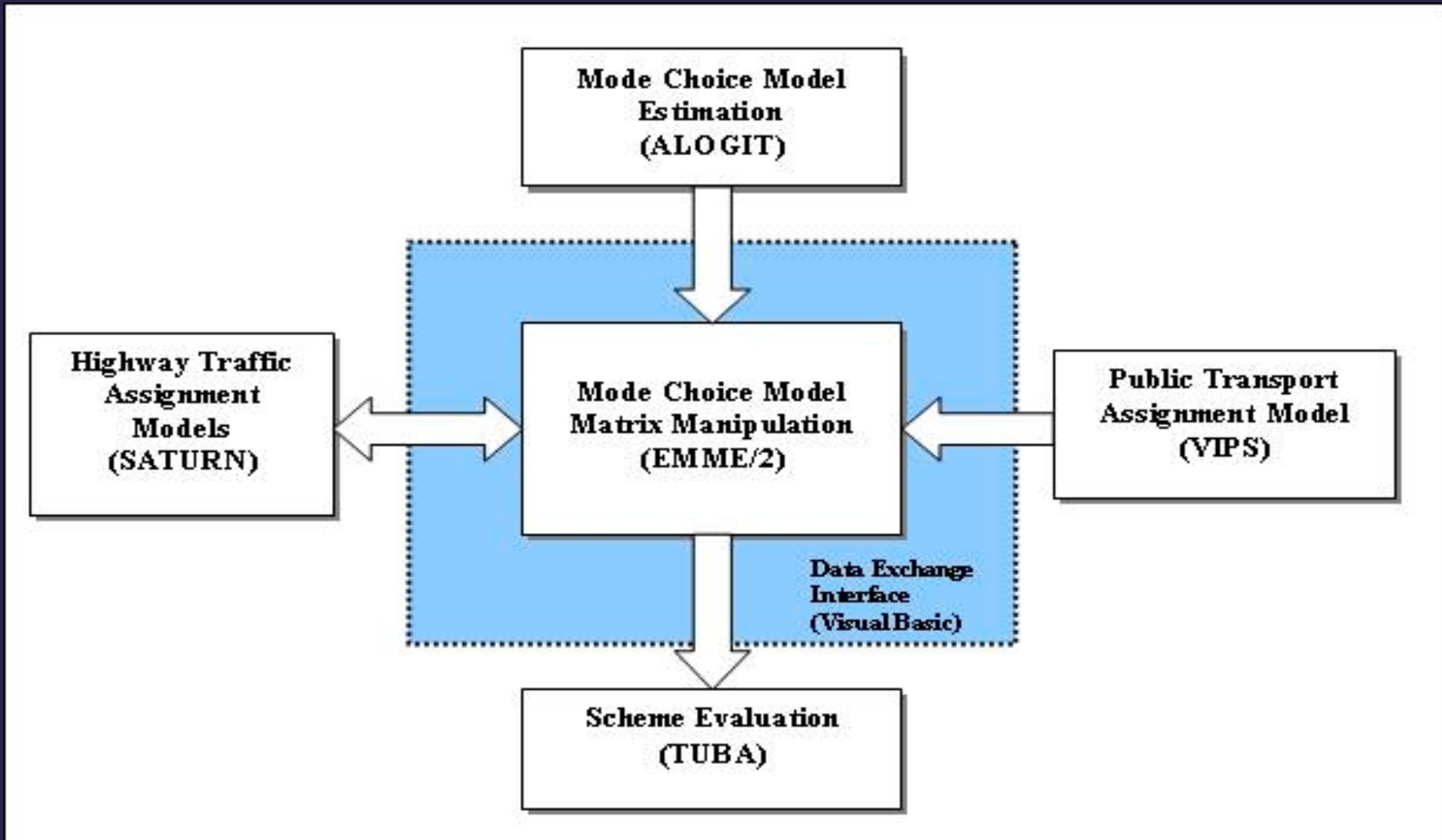
## Scheme Background

- Significant increase in P&R demand in the corridor
- P&R is both a popular and successful tool in
  - attracting passengers onto the local rail network, and
  - removing car trips in the urban area.
- Congestion level has also increased on the key highway routes to Birmingham city centre

## The Development of Park-and-Ride Model

- Scheme considered for a Strategic P&R facility at Longbridge
- Study commissioned by Centro - TfL equivalent in West Midlands area
- Model developed in 2004 to:
  - Estimate the potential use of this proposed strategic Park-and-Ride site
  - Assess its impact on the future year road traffic in the surrounding area
  - Support Centro's funding submission to Department of Transport (DfT)

# Modelling Framework – Modelling Tools



## Modelling Framework

- A highly automated process (from start to finish by calling a main emme/2 macro)
- **EMME/2 is used to link with other modelling tools**
- Achieved by:
  - calling SATURN, TUBA modules from within EMME/2.
  - using Visual Basic data exchange interfaces

## Park-and-Ride Modelling Process

- Base Year Model Development
- Future Year Forecasting and Evaluation

## Park-and-Ride Modelling Process

- Two time periods:
  - AM peak hour
  - an average inter peak hour
- Two forecasting years:
  - opening year of 2008
  - design year of 2023
- RP/SP data Estimation
- Base Year Model calibrated/validation

## Park-and-Ride Modelling Process

- TEMPRO forecasts taking account of local developments and schemes
- In accordance with the current UK government Guidance, including;
  - Major Scheme Appraisal in Local Transport Plans
  - New Approach to Transport Appraisal (NATA)
  - Guidance on the Methodology for Multimodal Studies (GOMMMS)
- Allows for robust sensitivity tests:
  - parking charges
  - connection times between the car park and station platform

## Mode Choice Model – Key Modelling Requirement

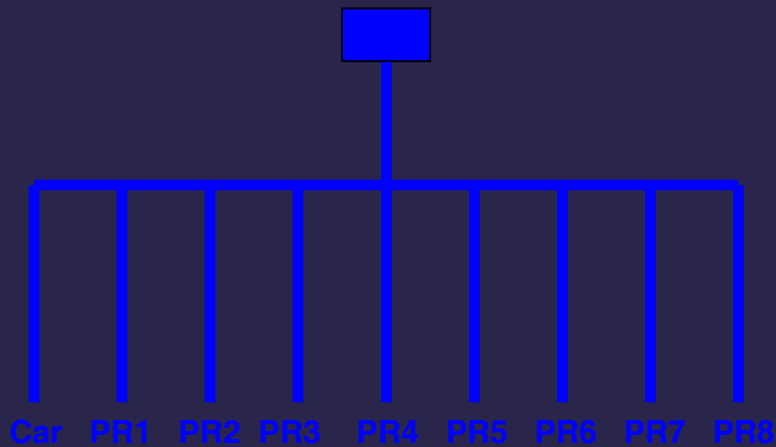
Ability to model competitions between:

- Car-all-the-way and Park-and Ride
- Londbridge and other existing Park-and-Ride sites

# Mode Choice Model- Possible Model Structures

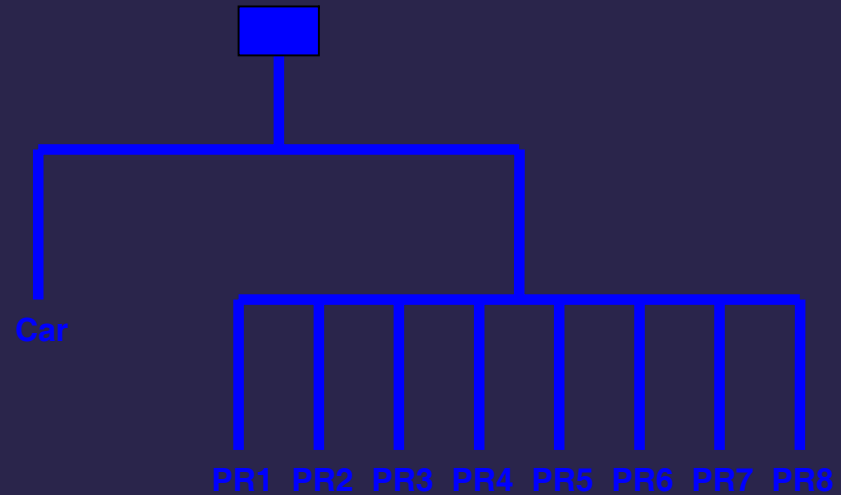
## Multi Nomial Logit Model

(MNL)



## Hierarchical Logit Model

(HL)



# Mode Choice Model

## Utility functions based on concept of generalised time

### 1) For car-all-the-way:

- Car access time;
- Car in-vehicle time;
- Car park searching time;
- Walk time to destination;
- Car operating cost; and
- Parking charge.

### 2) For Park-and-Ride:

- Car access time;
- Car in-vehicle time to P&R site;
- Parking charges at the P&R site;
- Walk time from car park to station platform;
- Train wait time;
- Train in-vehicle time;
- Train fare; and
- Walk time to destination.

## Mode Choice Model

- Dummy zones representing P&R sites
- Model parameters derived from SP/RP sample data
- P&R utility functions including an alternative specific constants (ASC)
- Catchment zone groups (EMME/2 ensemble)

## Mode Choice Model – Mathematical Representation

$$P_{car} = \frac{\exp(\lambda U_{car})}{\exp(\lambda U_{car}) + \beta \sum_i \exp(\lambda U_{PR})} \quad (1)$$

$$P_{PR} = 1 - P_{car} \quad (2)$$

Where:

$U_{car}$  – Generalised time for car all the way;

$U_{PR}$  – Generalised time for rail journeys using Park-and-Ride site  $i$ ;

$\lambda$  – Scaling factor;

$\beta$  – Parameter for composite Park-and-Ride disutility (=1 in the current application);

$P_{car}$  – Proportion of car users; and

$P_{PR}$  – Proportion of Park-and-Ride users

## Mode Choice Model – Mathematical Representation

And therefore:

$$T_{car} = T \times P_{car} \quad (3)$$

$$T_{PR} = T \times P_{PR} \quad (4)$$

$$T_{LB} = T_{PR} \times \frac{\exp(\lambda U_{LB})}{\sum_i \exp(\lambda U_{PR})} \quad (5)$$

Where:

$T$  – Total trips;

$T_{car}$  – Car trips after mode choice model;

$T_{PR}$  – Park-and-Ride trips after mode choice model; and

$T_{LB}$  – Park-and-Ride trips using the Longbridge station car park.

## Mode Choice Model - Implementation in EMME/2

- Compute highway and public transport time and cost matrices
- Compute disutility for car-all-the-way from origin  $p$  to destination  $q$ ,  $\exp(U_{car}^{pq})$
- Compute disutility for the car leg of Park-and-Ride journey from origin  $p$  to Park-and-Ride site  $k$ ,  $\exp(U_{PR\_car}^{pk})$
- Compute disutility for the Rail leg of Park-and-Ride journey from each Park-and-Ride site  $k$  to destination  $q$ ,  $\exp(U_{PR\_rail}^{kq})$

## Mode Choice Model - Implementation in EMME/2

- Compute P&R disutility for each origin(p)–parking lot(k)–destination (q) combination (Module 3.23)

$$\exp(U_{PR}^{pkq}) = \max_k (\exp(U_{PR\_car}^{pk}) \times \exp(U_{PR\_Rail}^{kq}))$$

- Run the mode choice model according to Equations (1) to (5) set out above;
- Separate Park-and-Ride trips into respective highway and PT components;
- Assign highway trips on the highway network to produce time and cost skim matrices; and
- Process and output highway and public transport matrices for scheme evaluation.

# Mode Choice Model – EMME/2 Implementation

## EMME/2 Macro Snippet – Calculating P&R Disutility (M3.23)

3.23

```

~/--- 4. Now calculate P&R disutility for each site -----
~+#1#mf23#*#mf22#n# #.max.#mf51#y#utis1#disuti P&R Stn1 Selly Oak (OB) pk#~?q=1#y#0
~+# #y#go4 go6# #100857# #go1# # #y#2
~+#1#mf23#*#mf22#n# #.max.#mf52#y#utis2#disuti P&R Stn2 Kings Norton (OB) pk#~?q=1#y#0
~+# #y#go5 go9#go12# #100823# #go1 go2# # #y#2
~+#1#mf23#*#mf22#n# #.max.#mf53#y#utis3#disuti P&R Stn3 Northfield (OB) pk#~?q=1#y#0
~+# #y#go6 go12# #100815# #go1 go2# # #y#2
~+#1#mf23#*#mf22#n# #.max.#mf54#y#utis4#disuti P&R Stn4 Barnt Green (OB) pk#~?q=1#y#0
~+# #y#go8 go9# #101718# #go1 go2# # #y#2
~+#1#mf23#*#mf22#n# #.max.#mf55#y#utis5#disuti P&R Stn5 Alverchurch (OB) pk#~?q=1#y#0
~+# #y#go8 go9# #101716# #go1 go2# # #y#2
~+#1#mf23#*#mf22#n# #.max.#mf56#y#utis6#disuti P&R Stn6 Redditch (OB) pk#~?q=1#y#0
~+# #y#go10 go12# #101804# #go1 go2# # #y#2
~+#1#mf23#*#mf22#n# #.max.#mf57#y#utis7#disuti P&R Stn7 Bromsgrove (OB) pk#~?q=1#y#0
~+# #y#go10 go11# #111804# #go1 go2# # #y#2
~+#1#mf23#*#mf22#n# #.max.#mf58#y#utis8#disuti P&R Stn8 Longbridge (OB) pk#~?q=1#y#0
~+# #y#go5 go12# #111808# #go1 go2# # #y#2

```

q

## Conclusions

- A multi-modal modelling approach necessary for a robust assessment, and consistent with government guidelines
- A modelling framework involving a number of existing models and modelling tools
- EMME/2 playing a central role in a highly automated modelling process
- Model parameters derived from SP/RP data estimation
- Base year model calibrated/validated to local survey data
- A newly developed mode choice model able to assess
  - the potential use of the strategic P&R facility at Longbridge
  - its impact on existing car users and road traffic
- Matrix manipulation facilities in EMME/2 providing an efficient way to implement P&R modelling
- Sensitivity tests on key variables

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