The Suite of Surface Access Models Supporting the Expansion Plans for Stansted Airport

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1 Introduction

Five airports service the London area, these being (in order of current size) Heathrow, Gatwick, Stansted, Luton and London City Airports (Figure 1), the three largest being owned and operated by BAA. Next year, a new fifth passenger terminal will open at Heathrow.

In the 2003 Aviation White Paper (Department for Transport, 2003), the UK Government described the continuing demand for airport capacity at the London airports. It recommended expansion at Stansted Airport, to be followed by further expansion at Heathrow if the air quality issues could be resolved. The Government made it clear that the onus on forwarding the required planning applications for the expansion plans lies with the owners of the airports.

Subsequently, BAA engaged a team of consultants to assist in the preparation of the planning applications for Stansted Airport, for which the surface access impacts of the proposed development are of importance. This paper describes the complex and comprehensive suite of transport models that has been developed for the purpose of the planning application.

As well as informing transport modelling professionals in Australia and New Zealand of UK practice, the paper is intended to provoke consideration of whether such methods are needed here and whether they would in fact be feasible.

2 Stansted Airport

Stansted airport is located outside London, 50 kms from the centre of London, and is the third biggest London airport and is also the third largest in the UK. It is the main UK base for the leading low cost scheduled airlines, accounting for its high growth: throughput at Stansted has risen sharply over the last 5 years, from 14 million passengers per annum (mppa) in 2001 to 24 mppa in 2006. Currently, Stansted has planning approval to cater for no more than 25 million annual passengers, so is virtually at the limit.

It is also a centre of employment with over 11,000 people employed on the airport in 2005.

Like the other London airports, Stansted is served by rail, with a railway station in the passenger terminal. The main rail service is Stansted Express, which operates from Liverpool St station in the City of London, running 4 trains per hour through most of the day, taking approximately 50 minutes.

Traditionally coach services have provided public transport connections to other UK cities, but in recent years there has also been a proliferation of direct coach services to London taking 1-1½ hours depending on the destination and time of day (they can be much slower in the peak periods). In total, there are up to 15 coach services per hour in each direction operating from London.

There are also local bus services to the airport, for employees.

For road access, the airport is directly linked to the M11 London-Cambridge motorway.

Overall, almost 40% of air passengers accessed the airport by public transport in 2005 (Table 1). More air passengers (about 60%) used public transport to/from London and most (ca. 90%) used public transport to/from central London (CAA, 2006).

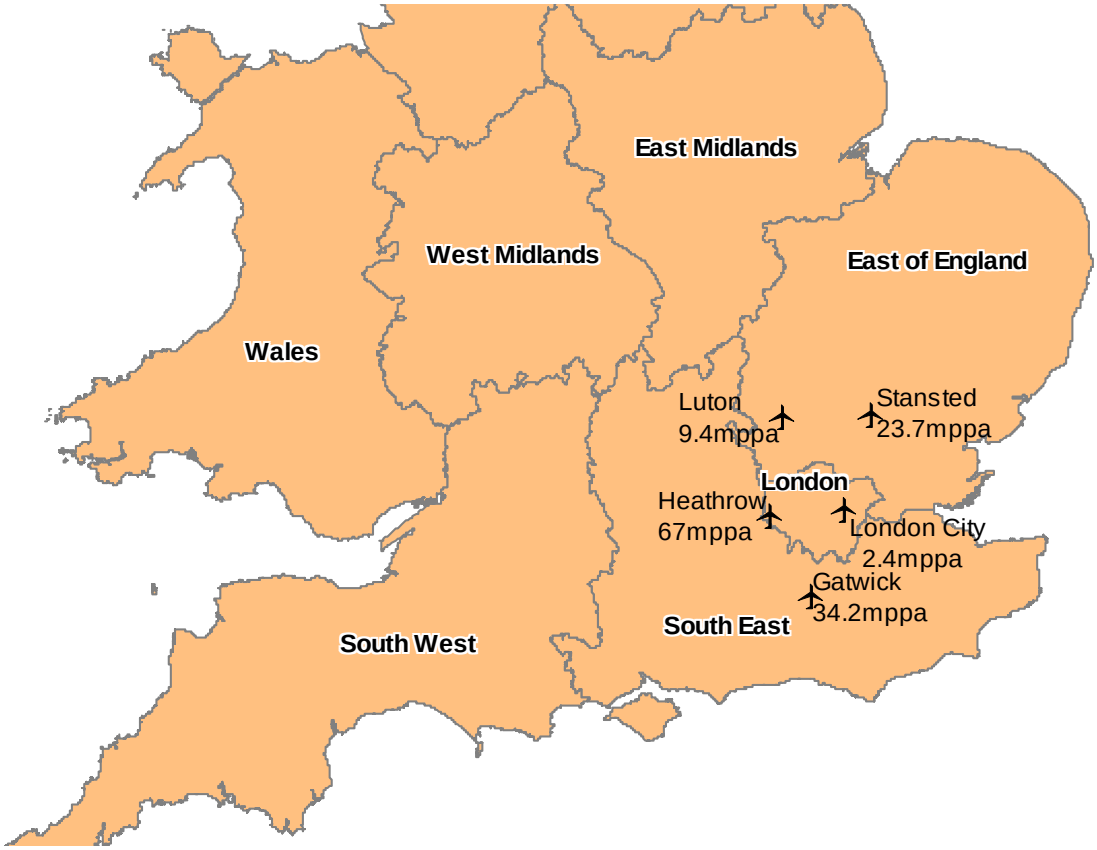

Figure 1 London Airports (with 2006 passenger throughput) and the UK regions

Table 1 Air passenger surface access mode shares at Stansted Airport in 2005

Main Mode	Mode Share
Bus and Coach	14%
Rail	25%
Private Car/Hire Car	52%
Taxi	9%

(CAA, 2006)

Currently 14% of employees use public transport, particularly those whose workplace is close to the passenger terminal area, which is adjacent to the rail and bus stations (BAA 2007).

3 The planning applications

The Aviation White Paper (Department for Transport 2003) discussed two aspects of the expansion at Stansted.

The first was to remove the planning and statutory constraints on Stansted's throughput enabling the airport to make full use of the existing single runway. Called 'Generation 1' (G1), this would enable the airport to increase throughput to around 35 mppa. Following a public consultation, the G1 Planning Application was submitted in March 2006 to Uttlesford District Council (UDC), the planning authority (BAA, 2006). UDC rejected the planning application in November 2006 to which BAA immediately appealed, forcing the decision to

the public inquiry process, which began in late May 2007 and is scheduled to run through to October 2007.

Forming a significant part of the G1 Environmental Statement which accompanies the application is the Surface Access Transport Assessment, based on the models described in this paper.

The second aspect was the provision of a second runway and associated infrastructure. Called 'Generation 2' (G2) this second development application would, if successful, raise the capacity of the airport to over 65 mppa. The separate G2 planning application is due to be submitted later this year.

4 The system of transport models

4.1 Overview

Among the important contextual issues affecting surface access considerations are three matters raised in the White Paper: the adequacy of existing and planned rail capacity for accommodating the growth of Stansted airport, the road connections and the plans for regional growth in the east of England.

This implied that the model system needed to address multimodal issues, with an emphasis on road and rail, and to encompass not only the travel demands of the airport development but also the growth in travel demands on the transport networks associated with the growth of the rest of the region. The modelling requirements thus ranged from strategic regional demand down to detailed analysis of the networks local to the airport and, of course, the specific treatment of the additional demands generated by the developed airport.

These requirements led to the design of the model suite whose 6 primary components are (Figure 2):

- a multi-modal model capable of forecasting travel demand in the East of England region (Figure 1) and parts of London (RDM, the Regional Demand Model);
- airport-specific surface access mode share models, comprising
    - a model of the choice of mode of air passengers using the airport (LASAM, the London Airports Surface Access Model);
    - a model of the choice of mode of airport employees (SESAM, the Stansted Employee Surface Access Model);
- a model of the highway network in the East of England region and parts of London (RHRM, the Regional Highway Routeing Model);
- a rail network model (PLANET) covering the region and London, the industry standard rail forecasting tool, developed for the Department for Transport (by the Strategic Rail Authority);
- a detailed traffic model for the roads in the vicinity of the airport (SRTM, the Stansted Road Traffic Model).

Such a sophisticated suite of models is largely feasible because of the extensive survey data bases which are collected as a matter of course in the UK and the long term investment in open access transport modelling systems. The major existing data bases used included:

- the regular Civil Aviation Authority (CAA) surveys of air passengers at each UK airport; at smaller airports the surveys are periodic and the sample size may be typically 5,000 interviews while larger airports are surveyed continuously with the number of passenger interviews varying between roughly 10,000 and 70,000 per year depending on the size of the airport;

- a regular survey of airport employees, conducted by BAA (at Stansted these have been undertaken in 2002/03, 2005 and most recently in 2007) and intercept 20-40% of employees on the airport site;

- the large-scale surveys of London and its surrounds every 10 years (LATS – London Area Transport Survey), most recently in 2001 involving very large scale household travel, public transport intercept and roadside surveys; and

- the regular programmes of road traffic counts.

These models were either developed and refined from existing model systems (RDM, LASAM, SRTM), were based on common access models centrally provided (RHRM, PLANET) or were developed specifically for Stansted airport based on technologies already tested in other contexts (SESAM).

LASAM and SESAM were developed by Sinclair Knight Merz, RDM and RHRM by Faber Maunsell and SRTM by Halcrow. In the following sections we describe each of these models and their primary roles in developing the surface access strategy for Stansted.

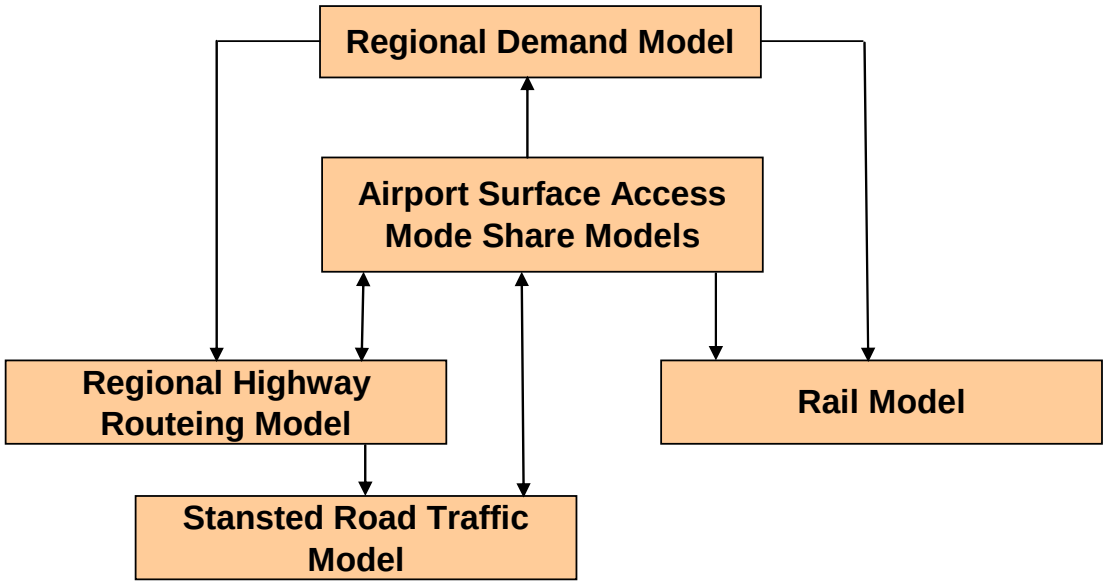

Figure 2 Components of Stansted modelling suite

4.2 RDM, the Regional Demand Model

RDM is a strategic regional transport demand model which forecasts the future patterns of the region's travel demand by mode, time and source of growth, reflecting the performance and capacity of the transport infrastructure. Its main characteristics are summarised in Table 2 and the overall RDM structure in Figure 3. The primary focus of the model is to understand and predict the patterns of longer distance inter-urban travel and, as a result, a detailed representation of short distance travel is not included. Model parameters have been derived from Variable Demand Modelling Advice (Department for Transport 2003 and 2005).

Table 2 Model characteristics

Characteristic	Description
Model type	Multi-modal travel demand model which forecasts the incremental changes in current travel demand patterns arising from future network, economic and land use scenarios for the region..
Study area	The whole of Great Britain, with most detail in the East of England Region, divided into 330 zones.
Travel demands	Current year travel matrices by mode are derived from existing surveys/other models. Airport demand derived from LASAM and SESAM outputs
Time periods	Am peak, inter-peak, pm peak and off-peak
Trip purposes	Home-based (HB) work, HB employers' business, HB other Non-home-based (NHB) employers' business, NHB other
Vehicle types	Cars, light goods vehicles, heavy good vehicles
Network inputs/ supply models	Sensitive to road congestion and rail passenger crowding: Road – RHRM Rail – PLANET Bus/Coach – bespoke network model
Travel choices	Models of trip frequency, mode choice, trip distribution and time period
Economic and planning inputs	Future trends in transport prices and the values of time Population and employment data by zone
Model responses	Sensitive to changes in: economic growth, regional development (population, land uses etc), rail service provision and capacity, regional bus and coach service provision, highway network infrastructure and capacity and the money costs of travel (fuel costs, road user charges, public transport fares etc)

Forecasts of highway and rail costs (journey times, fares etc) derive from external models (highway from the RHRM, rail from PLANET). Bus/coach networks have been developed within RDM to derive bus/coach costs. Planning assumptions (the development of population and employment) derive from Tempro, the UK Government advice on trip generation, while airport specific demands are sourced from LASAM and SESAM. Other important assumptions such as the growth in car ownership, values of time, fare price changes etc have been separately agreed with the UK Department of transport and are consistent across the entire model suite.

RDM is capable of testing the regional travel impacts of a broad range of changes in transport and land use policy and the provision of infrastructure including changes in land use assumptions, highway travel costs, public transport fares, rail service provision and capacity, regional bus and coach service provision and highway network infrastructure and capacity.

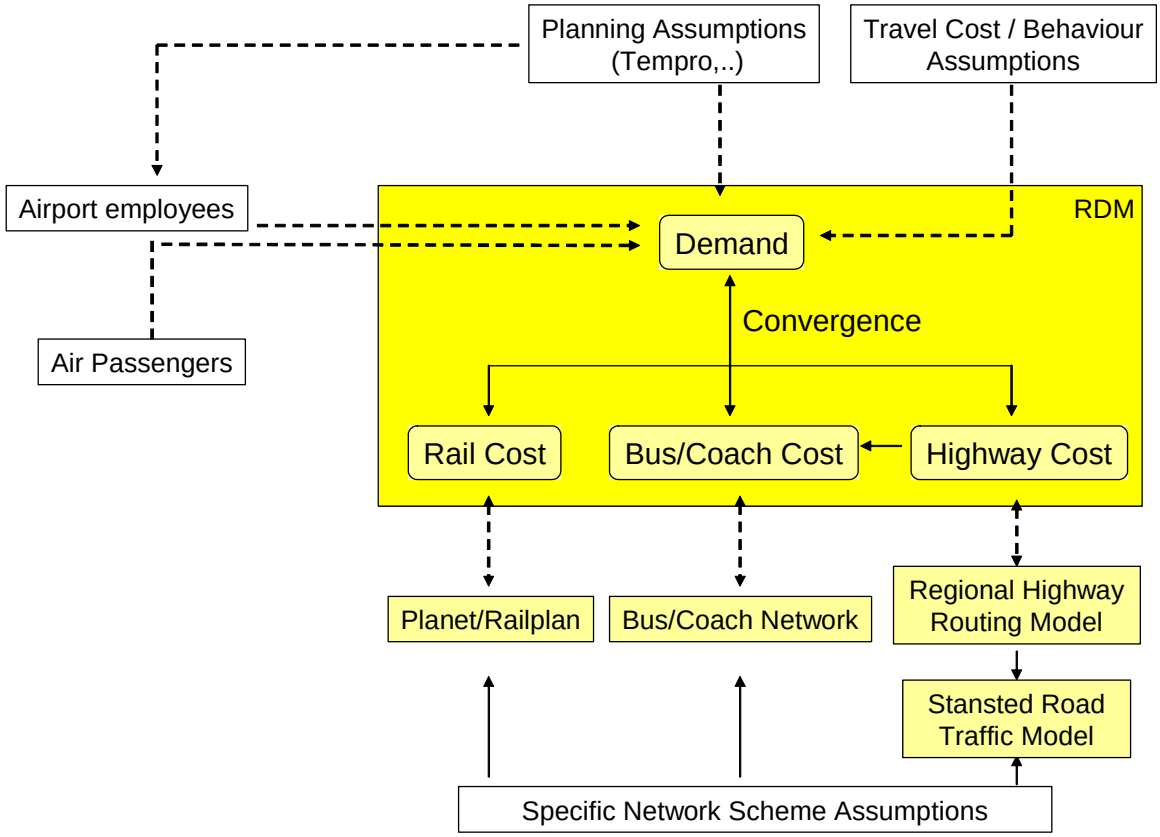

Figure 3 Overall RDM Model Structure

4.3 LASAM, the London Airports Surface Access Model

LASAM has two components (Figure 4): a mode share model that predicts the annual average surface access mode shares of air passengers at Stansted, and a Time Period Model, which provides busy day forecasts of demand on each access mode by time of day. Forecasts of the future growth in air passengers at Stansted are provided by BAA for input to the mode share model, together with busy day air passenger demand time profiles which are used in the Time Period Model.

LASAM is a development of an earlier model, the Heathrow Surface Access model which was used in the planning for Heathrow's fifth terminal and the Heathrow Express rail link. Using disaggregate techniques, it was estimated on the Civil Aviation Authority's annual surveys of air passengers and its characteristics are summarised in Table 3. It is implemented as an aggregate, incremental model (at the zonal level), with appropriate adjustments.

Experience with the new Heathrow Express rail service between Heathrow airport and central London was that the forecasts of peak loadings, which had not been based on formal modelling, were inaccurate. The Time Profile Model was developed to solve this problem. It relates the time profile of demand on the surface access modes to the time profiles of arriving and departing passengers at the airport gates, their dwell times in the airport terminal, and the variations by time of day in the distribution of air passengers by segment and their choices of mode. It also incorporates a vehicle module, relating the profile of passenger demand by mode to profiles of vehicles entering and exiting the airport.

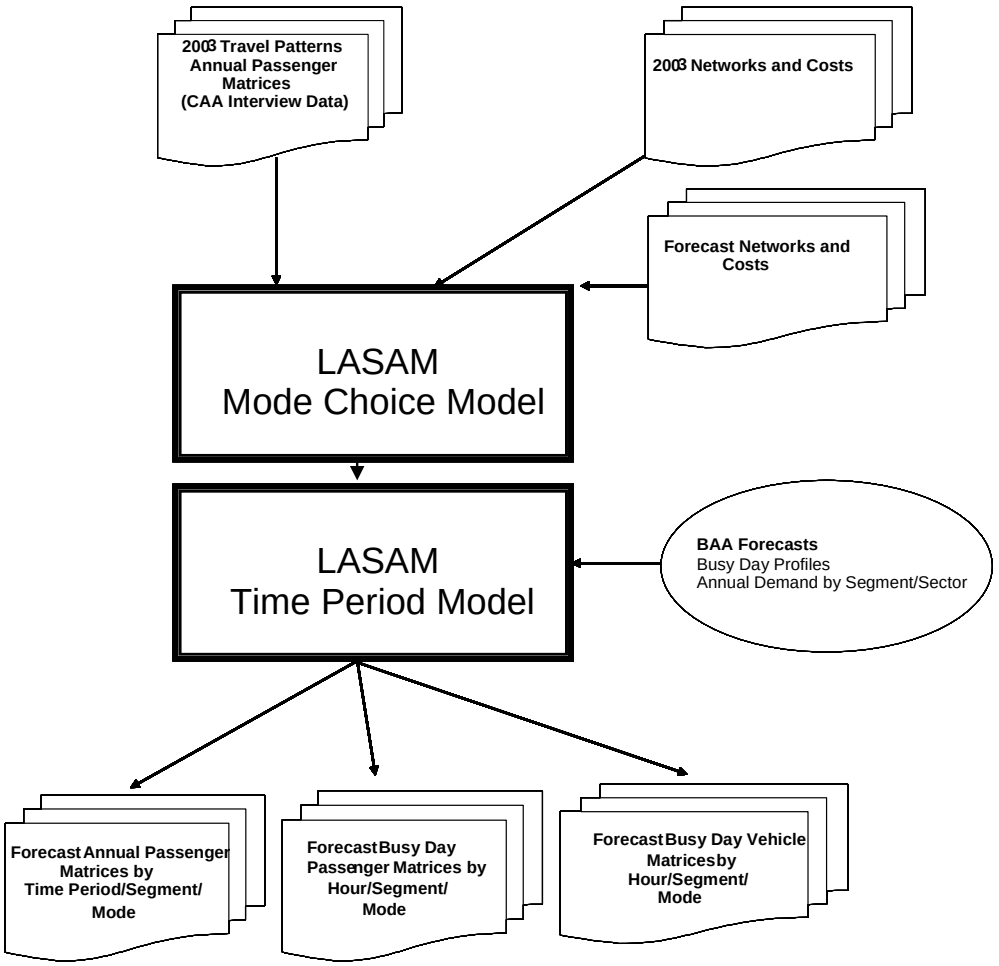

Figure 4 LASAM structure

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Table 3 Model characteristics

Characteristic	Description
Model type	Incremental model of air passengers' surface access mode choice operating on current air passenger travel demand matrices
Study area	The whole of Great Britain, 250 zones.
Current year travel demands	Current year travel matrices by mode are derived from Civil Aviation Authority surveys of air passengers
Time periods	Weekday am peak, pm peak, off-peak, weekend
Travel segments	9 air passenger segments, distinguishing UK and foreign residents on business and leisure travel, using domestic and international scheduled, charter and low cost flights,
Modes of transport	Coach, taxi, car park-&-fly, car kiss-&-fly (ie meet or greet), airport rail, other rail
Network inputs/ supply models (costs)	Highway – RHRM Rail - custom network Coach – timetables and fares tables
Travel choice	Models of mode shares and time of day
Forecast scenario inputs	Air passengers forecast by BAA Future transport networks Future trends in transport prices and the values of time
Model responses	Sensitive to air passenger characteristics including the time profile of demand, public transport services and fares, highway travel times, vehicle operating costs and tolls, taxi fares, parking and other road user charges.

The role of LASAM is to test how the characteristics of the developed airport and the components of the transport strategy affect air passenger's choice of mode and time of travel. It is sensitive to the future composition of air passengers, the characteristics of the transport networks and the associated fares and charges, including airport parking charges.

4.4 SESAM, the Stansted Employee Surface Access Model

SESAM forecasts airport employee mode shares and peak hour vehicle movements for the journeys to and from work. Its main characteristics are summarised in Table 4. The model was estimated using disaggregate techniques on the 2002/03 and 2005 Stansted Employee surveys.

Because airport employees' commuting times are different from other types of workers, in that there is a strong emphasis on shift work and relatively less travel at peak times, the model has been developed on a tour basis to allow for the influence of both the employee's start and finish times on mode choice. That is, the model is sensitive to the combined generalised cost of the trips to and from work, allowing for the specific time of the two journeys.

Current airport transport strategies give benefits to car sharing, and the model consequently distinguishes sole driver cars (one airport employee) from shared cars in which there is at least one airport employee passenger.

Table 4 Model characteristics

Characteristic	Description
Model type	Airport employee mode choice model for the journeys to/from work (aggregate implementation), on a tour basis
Study area	The area around the airport accounting for the majority of the commuter catchment, comprising 384 zones, of which 17 cover the airport itself, reflecting the different workplace locations.
Data source	Derived from BAA employee surveys
Time periods	Weekday am peak, pm peak and off-peak, weekend
Travel segments	Sensitive to employee job type
Modes of transport	Public transport, sole driver car, shared car
Network inputs/supply models	Highway – SRTM Public transport - custom network
Future scenario inputs	Airport employees forecast by BAA Future transport networks Future trends in transport prices and the values of time
Model responses	Sensitive to: airport employee characteristics, public transport services and fares (including the discounted Travelcard), highway travel times, vehicle operating costs and tolls, parking arrangements/constraints (including provision of preferential parking for shared cars)

The structure of the model is illustrated in Figure 5. The main inputs are BAA's forecasts of employees on the airport and their working times (shift distributions).

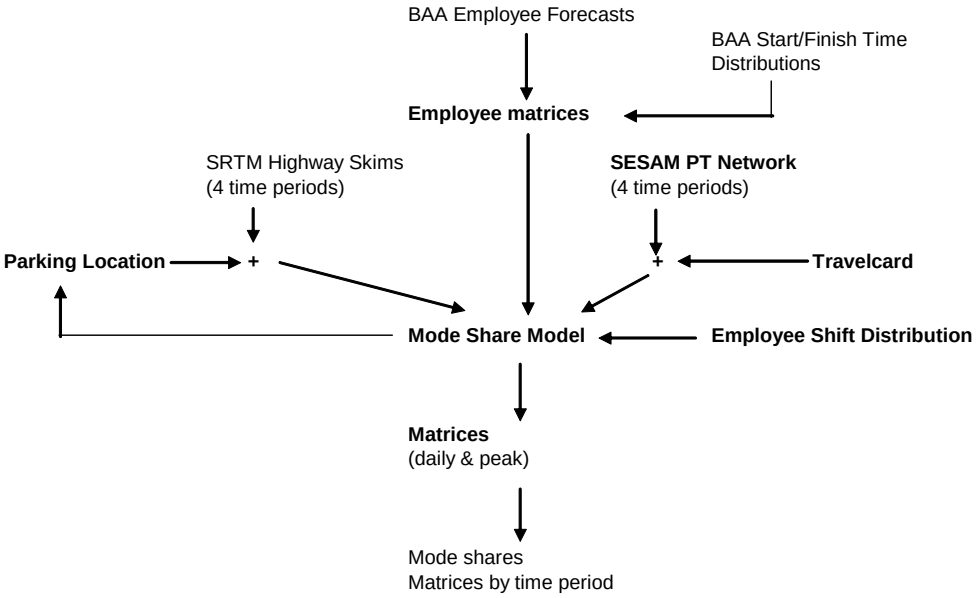

Figure 5 SESAM structure

Two other features are worth remarking on. Employees may acquire an Airport Travelcard giving much reduced public transport fares, and this is allowed for in the model. The second feature concerns airport parking: future airport strategies involve relocating some employee parking, thus requiring these employees to reach their workplace by a car park shuttle bus. SESAM is capable of forecasting the impacts of this type of strategy.

4.5 SRTM, the Stansted Road Traffic Model

The Stansted Road Traffic Model (SRTM) is a very detailed traffic model of the area on and around the airport which is used to undertake detailed operational assessment of the local airport network. It uses RHRM growth matrices which are applied to the base year SRTM matrices, ensuring consistency in both the regional and local traffic patterns (Table 5).

Table 5 Model characteristics

Characteristic	Description
Model type	Fixed matrix SATURN network modelling with intersection simulation
Study area	Covering an area from Cambridge in the north to the North Circular Road in London in the south, and from the A12 and Colchester in the east to the M1 and Luton in the west. Total zones in this cordon area of 349, including 17 airport zones.
Travel matrices	Current year derived from existing surveys using a combination of observed data, synthetic techniques and matrix estimation Forecasts derived from RHRM growth matrices. Airport demand derived from LASAM and SESAM.
Time periods	Morning peak hour, average inter-peak hour, evening peak hour
User classes	light and heavy goods vehicles; car non-business low, medium and high values of time, car employers' business air passengers airport employees airport miscellaneous

4.6 PLANET, the Rail Model

PLANET is the industry standard rail model, owned by the Department for Transport. Covering all of Great Britain, PLANET is an elasticity based demand forecasting tool,

encompassing demand responses to fares, and level of service (including crowding). Its role is to forecast the demand on the rail network, particularly informing the capacity analysis on the rail corridor between Stansted Airport and London.

Table 6 Model characteristics

Characteristic	Description
Model type	Emme/2 Public Transport assignment model
Study area	Great Britain, 1400 Zones.
Travel matrices	Base matrices based on ticket sales, survey (LATS) and count data Forecast reference case growth based on elasticity methods Forecast policy case demand adjusted by RDM factors. Airport demand derived from LASAM and SESAM.
Time periods	AM peak period, Interpeak period
User classes	business leisure commuting (including airport employees)

Rail costs from PLANET are provided to the RDM (Table 6) which in turn provides matrices of demand adjustment factors, which are applied to the PLANET reference case forecasts to account for the additional effects of transport strategies over the reference case.

4.7 RHRM, the Regional Highway Routeing Model

RHRM is a highway network model, using SATURN (Table 7). Its role is to forecast the route choice for relatively long journeys or journeys involving the trunk road network to input to the local highway network model SRTM.

Matrices of demand growth factors are provided by RDM which itself uses highway network data from RHRM in an iterative process, such that the demand forecasts are consistent with network performance.

Table 7 Model characteristics

Characteristic	Description
Model type	Fixed matrix SATURN network modelling with intersection simulation
Study area	The whole of Great Britain, with most detail in the East of England Region, divided into 670 zones.
Travel matrices	Current year derived from existing surveys using a combination of observed data, synthetic techniques and matrix estimation. Future year matrices derived from RDM. Airport demand derived from LASAM and SESAM.
Time periods	Morning peak hour, average inter hour, evening peak hour
User classes	light and heavy goods vehicles; car non-business low, medium and high values of time, car employers' business air passengers.

5 Summary and Conclusions

The overall model system is summarised in Figure 6. Forecasts of future changes in travel demand in the airport and region are made by the regional demand model RDM and the air passenger and airport employee models, LASAM and SESAM. All of these demand forecasts are sensitive to the characteristics of the future scenarios and the associated airport and regional transport strategies The impacts on the road and public transport networks are measured regionally by the highway model RHRM and the rail network model PLANET, with impacts on the road system local to the airport being represented in more

detail in the local roads model SRTM. Concerning the source of travel costs, RDRM and SRTM provide highway travel cost data for the airport models, and RDRM and PLANET provide highway and rail cost data respectively for RDM.

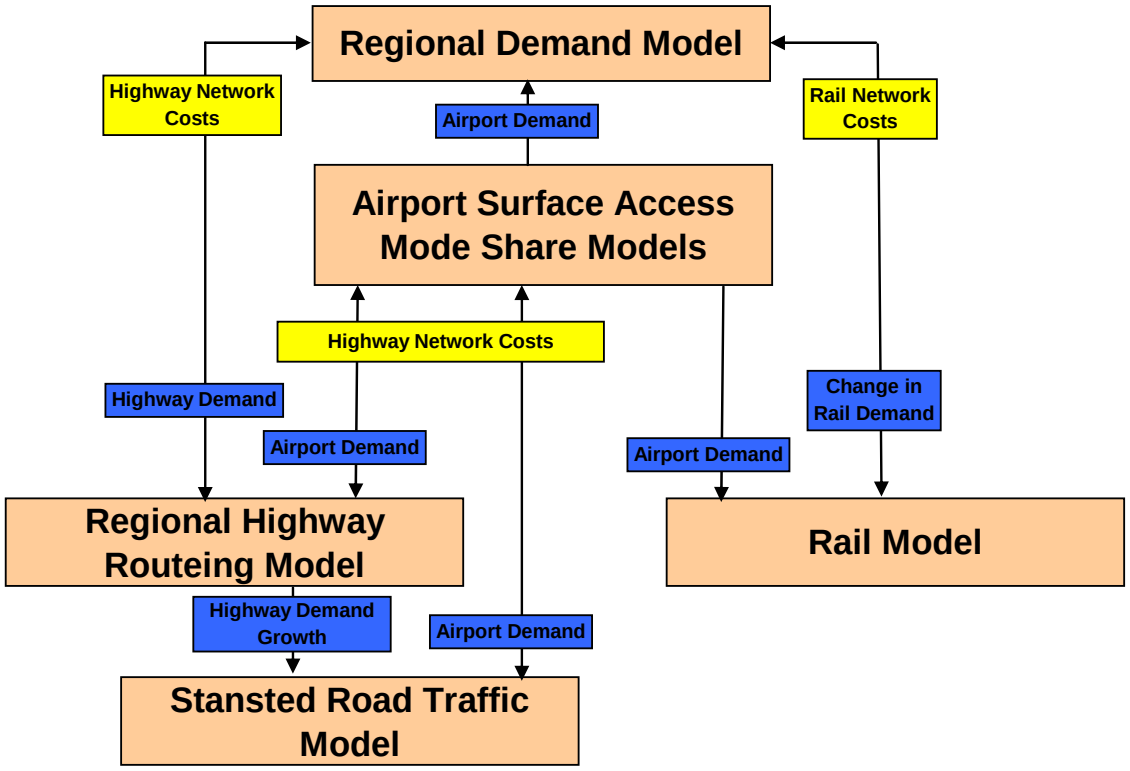

Figure 6 Travel demand and cost linkages in the model system

The key features of comprehensive, linked model suite are:

- an integrated and internally consistent multi-modal model system;
- designed to comply with the relevant governmental advice and standards;
- designed to forecast the increased demand arising form a developed airport, with specific models for the 2 major airport demand segments: air passengers and employees;
- and to measure the impact of this growth on the local and regional road and public transport networks,
- allowing for the impacts on the transport networks of the significant changes in other regional demand expected over the forecasting period;
- the model system is specifically designed to be sensitive to the characteristics of the region and airport future development scenarios, the future development of transport network infrastructure and services, and the components of regional and airport transport strategies.

This complex and comprehensive model system accords with the UK requirements generally for multi-modal modelling and for detailed and explicit treatment of travel demands in forecasting. It is largely feasible because of the extensive survey data bases which are collected as a matter of course in the UK. It is also supported by the historic development of major multi-modal models (in the recent UK-wide multimodal studies and for the London airports), which provide many databases and techniques which may be drawn upon, and the

central coordination by the UK Department for Transport in relation to models and their inputs.

As we have explained, this comprehensive transport model system is reliant on substantial past investment in survey data, transport models and techniques. While new data has been collected and new or enhanced models developed, this comprehensive model system could not have been envisaged without the benefit of the substantial past investment in shared data and models.

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