This presentation was made by Charlene Rohr and Andrew Daly, both who are Senior Research Leaders at RAND Europe.

3 Webinars on Transport Modelling in Australia and Europe

RAND Europe will discuss their work:

1. Introduction and Sydney model (24 September)
2. Models of European cities and countries (22 October)
3. Long-distance Models (19 November)

We are describing a practice developed over 35 years and adapted to meet a wide range of local circumstances

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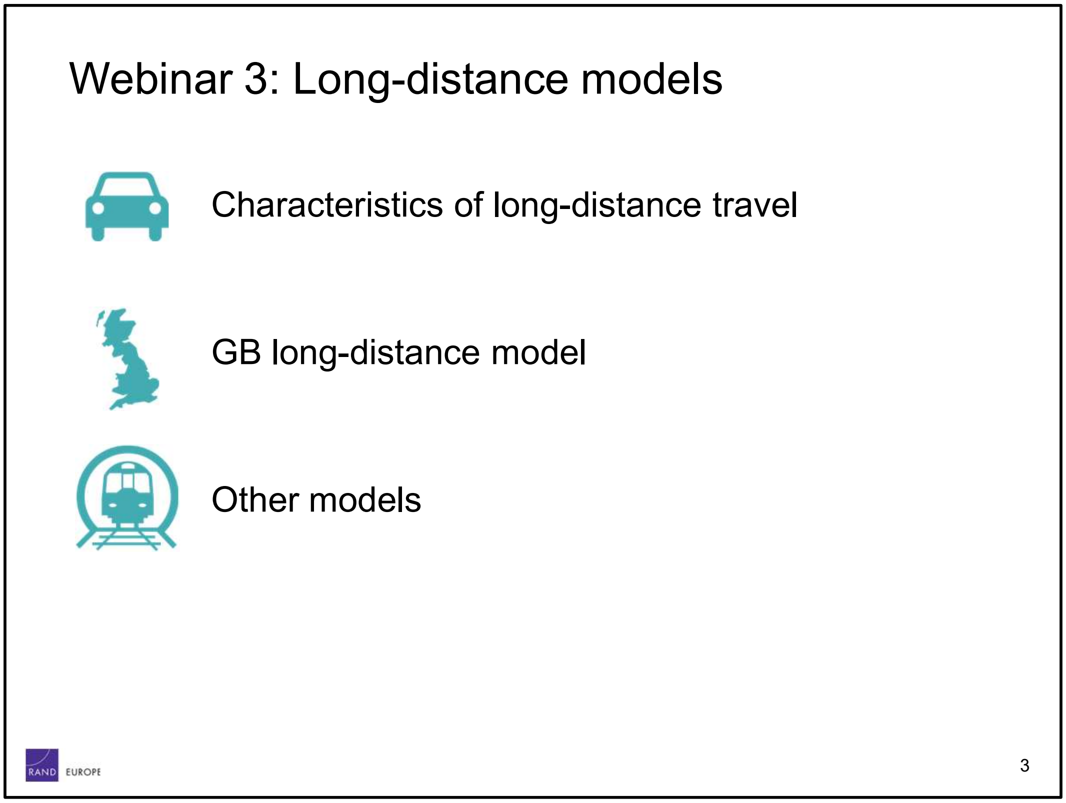
In this third webinar we discuss models of long-distance travel, with a particular focus on the British (GB) long-distance model. The presentation will demonstrate the distinct characteristics of long-distance travel and some of the particular policy requirements, both of which have an important impact on the design of long-distance models.



This webinar has three sections.

- First we will discuss some of the key characteristics of long-distance travel and some of the key policy questions in the GB context, both of which have impact on the design of long-distance model systems.
- Second we describe in detail the development of the GB long-distance model.
- The final section provides an overview of a number of other long-distance models we've worked on, and concludes with lessons learnt for modelling corridor studies and for modelling behaviour more generally.

Webinar 3: Long-distance models

Characteristics of long-distance travel

GB long-distance model

Other models

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Long-distance travel has a significant impact on total mileage but trip data may be sparse

- in Great Britain long-distance trips (50 miles and above) account for **30% of all miles travelled but just 2.3% of total trips**
  - as a result household interview data on these trips is sparse
- long-distance trips are made **less frequently than trips in general** (2005 National Travel Survey data)
  - 17.2 trips per week
  - 0.4 long-distance trips per week
  - half of individuals made no long-distance trips over 4 week period
- scarcity of data means **long-distance travel is not well represented** unless targeted surveys are employed
  - GB National Travel Survey data uses a recall survey to supplement all-trip travel diary

POST PRESENTATION ADDITION:
Analysis of the 2009 NHTS data shows that in the US, trips over 50 miles comprise 2.4% of total trips, remarkably close to the UK value, and 35.3% of miles travelled, a bit higher that the UK value while we believe is due to the inclusion of a low number of longer distance trips that in a UK context would be international (and as such excluded from the UK analysis).

The GB data describing long-distance travellers here comes from National Travel Survey data, using data between 2002 and 2006. In the 2002-05 data, the standard one-week NTS travel diary data was supplemented by a three-week recall survey of LD trips. In 2006, to address concerns about the ability of respondents to recall trips from a three week period, the recall period was reduced to one week.

Long-distance trip purpose distributions differ from those of all trips

Purpose	All trips	Long-distance trips (>50 miles)
Commute/education	23.4%	13.7%
Business	4.8%	16.4%
Personal business/shopping	42.7%	12.8%
Visiting friends & relatives	14.6%	24.0%
Holiday/day trip/other leisure	14.5%	33.2%
Total	**100.0%**	**100.0%**

Source: 2002–2004 UK National Travel Survey data (domestic travel only)

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We can see that the share of commute/education travel is lower for long-distance trips, and the share of personal business/shopping trips is also lower. For business, visiting friends & relatives and holiday/day trip/other leisure higher shares are observed for long-distance travel.

Mode shares also differ substantially

Purpose	All trips	Long-distance trips (>50 miles)
Car driver	48.3%	49.5%
Car passenger	26.2%	33.7%
Bus/coach	10.8%	4.9%
Rail	1.6%	10.0%
Air	0.0%	0.9%
Other	13.1%	0.9%
Total	**100.0%**	**100.0%**

Source: 2002–2004 UK National Travel Survey data (domestic travel only)

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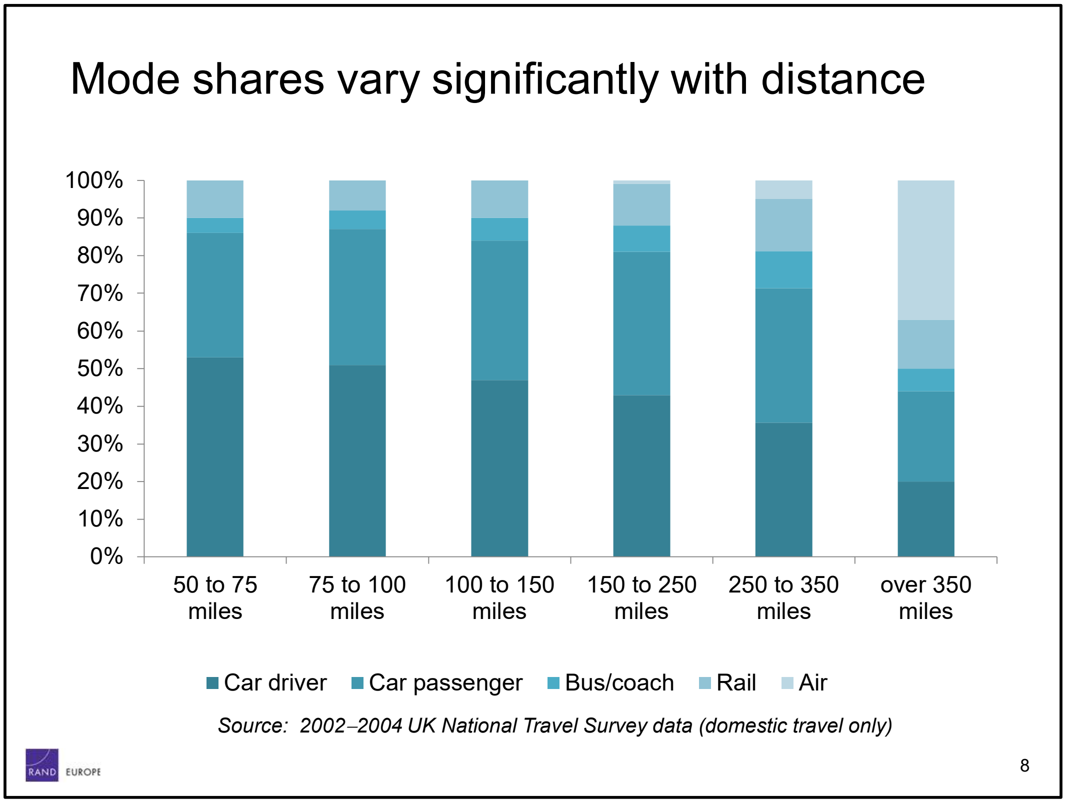
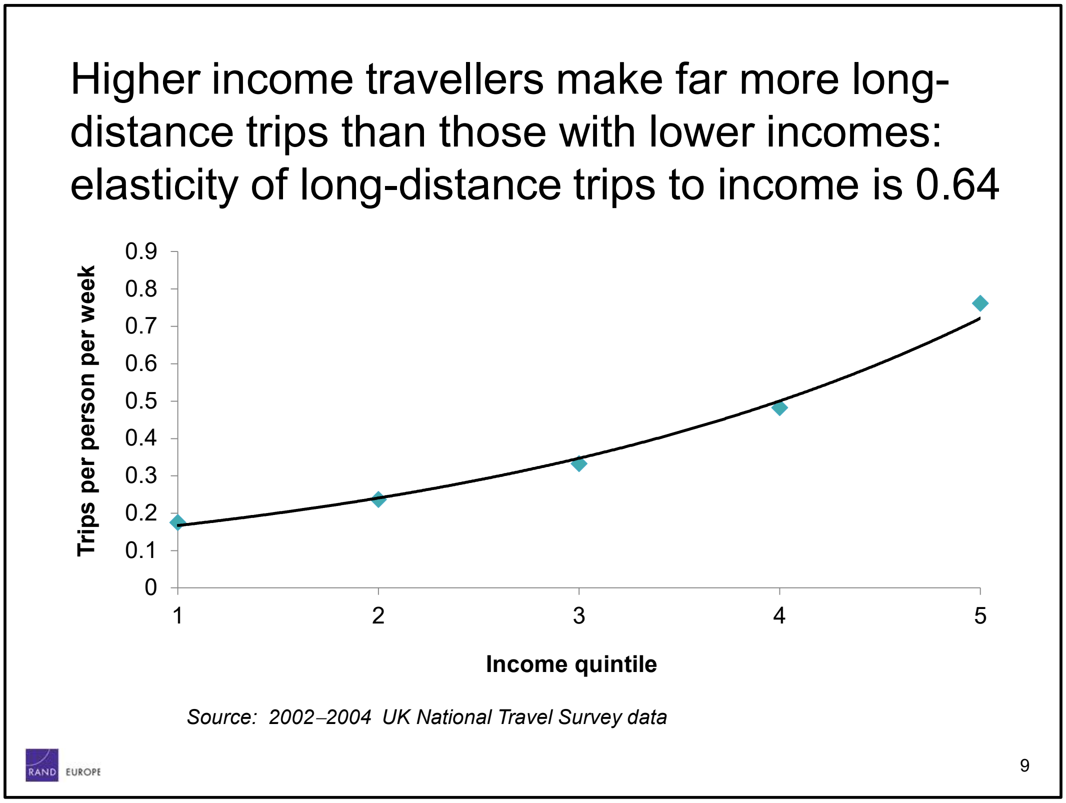
Other is mostly walk & cycle for all trips, but also includes taxi & motorcycles.

If we think about travellers, then we need to understand something about the long-distance travel market, where trains carry about 10% of all long-distance trips made in Great Britain. Air is only relevant at all for long-distance travel, but even then it accounts for just 1% of trips.



For trips up to 250 miles, car is the most important mode. Beyond 250 miles the importance of car drops off, as rail and air gain mode share, with air having a significant share for the longest trips of 350 miles above. This is mostly travel between the South East (including London) and Scotland.



We observe a clear relationship between total long-distance trip making and household income, whereby the long-distance trip rate in the top income quintile is 4.4 times as high as those in the bottom quintile. Therefore understanding the income distribution of the population is important in understanding demand for LD travel.

In the US, long-distance trip purpose distributions also differ from those of all trips

Purpose	All trips	Long-distance trips (>50 miles)
Earn a living	18.8%	23.4%
School/church	9.7%	3.5%
Family/personal business	42.9%	28.2%
Social & recreational	27.7%	41.4%
Other	0.8%	3.5%
Total	**100.0%**	**100.0%**

Source: 2009 National Household Travel Survey data

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As a comparison, the area of the UK is 57% of the area of California, and so some LD trips in the US will cover much longer distances than are possible in the UK.

As with the UK, there are significant differences between the LD and all-trip distributions. For LD, earn a living covers a higher fraction (we believe this covers both commute and employer's business) and social & recreation also has a higher share than for all-trips.

.. and the mode shares also differ from those of all trips

Mode	All trips	Long-distance trips (>50 miles)
Car	83.6%	93.7%
Transit	1.9%	1.3%
Air	0.1%	2.3%
Other	14.4%	2.8%
Total	**100.0%**	**100.0%**

Source: 2009 National Household Travel Survey data

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We see that car use higher for long-distance trips, transit use lower in the US.

Compared to UK, car is used more for long-distance travel, transit modes much less (mostly rail in the UK). Air use is higher in the US, which is of course much larger.

Some policy is focussed on long-distance travel, in a UK context…

- plans for a high speed rail line linking London to Birmingham, Manchester and Leeds are well advanced – 'HS2 project'
- also large rail electrification schemes which will increase the speed and frequency of key inter-city services
- Highways England are currently developing a number of schemes to relieve congestion on the strategic highway network
- for domestic travel, air is only relevant for long distance travel and becomes relevant only for the longest distance trips
  - airport expansion in the South East is a contentious issue at the moment

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HS2 is the second high-speed rail scheme to be considered in the UK (the first being the High Speed 1 line connecting London to the Channel Tunnel). It would link London, Birmingham, Leeds and Manchester.

The two intercity electrification schemes currently in progress or imminent are:

1) Great Western – London to Bristol and Cardiff
2) Midland Mainline – London to Derby, Nottingham and Sheffield

The case for the HS2 scheme

- reductions in travel times
  - journey times from London to Manchester (c.200 miles) reduced from over 2 hrs to 1 hr 15mins
  - value of time is key to valuing these travel time savings
- increasing capacity
  - rail demand has growth rapidly in recent years, the HS2 scheme would allow rail capacity currently used for long-distance services to be re-deployed
- economic benefits
  - aim is to revitalise economies in northern England
  - however, some commentators suggest scheme could actually increase the dominance of the economy in London and the South East

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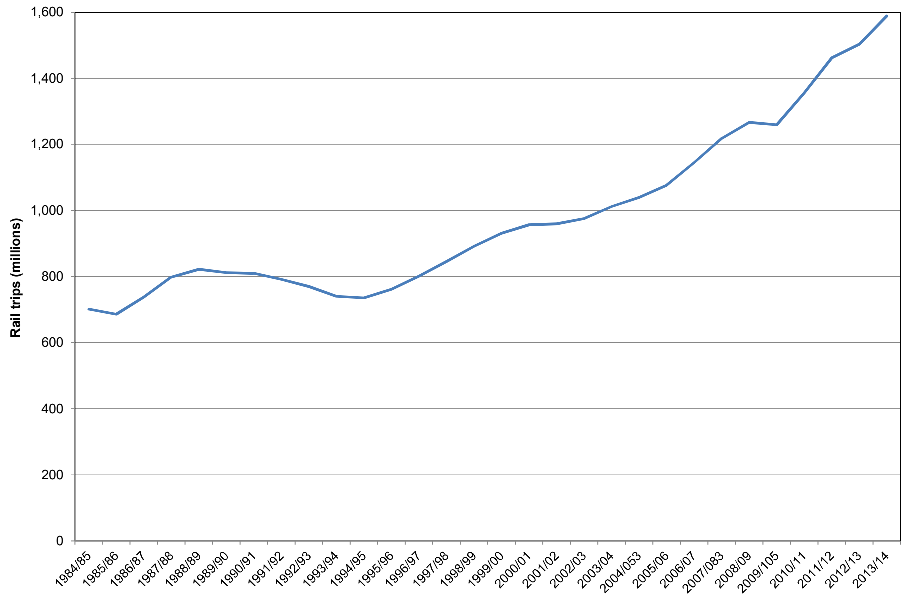
Rail trips have doubled over the last 30 years



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It should be noted that this increase has taken place in conjunction with increases in rail fares (in real terms), and periods of low GDP growth. A number of different theories have been put forward to explain this growth, including growth in city centre employment well served by rail (e.g. in service sector jobs), increasing road congestion, changes in technology such as smartphones that allow people to use time on trains productively, reductions in company car ownership due to taxation policy.

Webinar 3: Long-distance models

- Characteristics of long-distance travel
- GB long-distance model
- Other models

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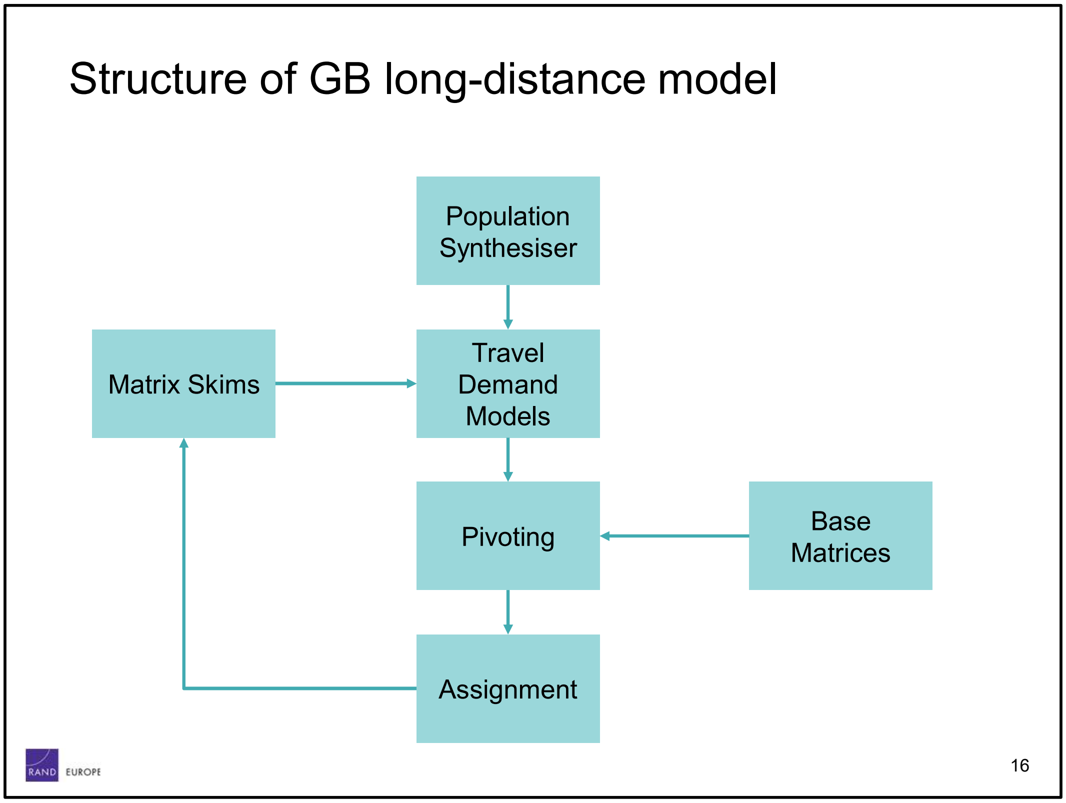
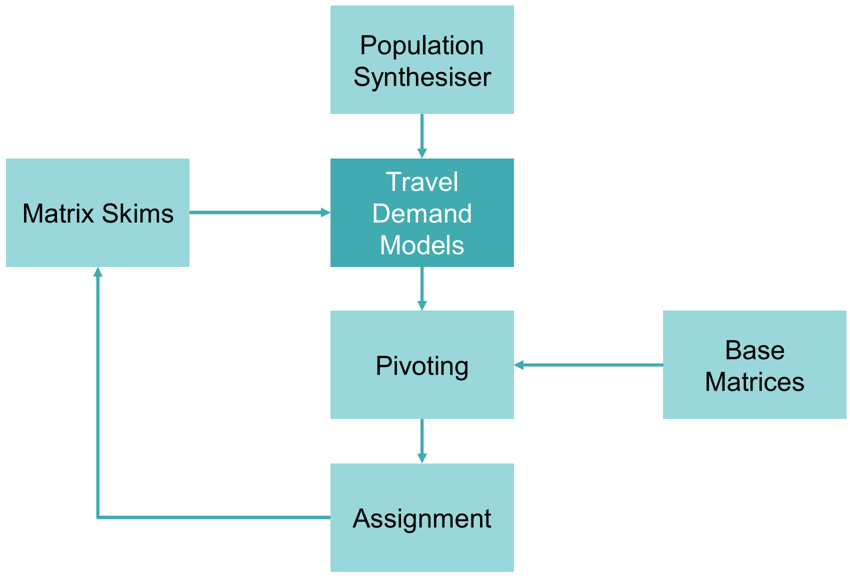
We are now going to describe in detail the development of the GB long-distance model, which was developed by RAND Europe and Scott Wilson (now URS) on behalf of UK Department for Transport.

Key reference:
Rohr, C., Fox, J., Daly, A., Patruni, B., Patil, S. and F. Tsang (2013) Modelling long-distance travel in the UK, Transport Research Record 2344, pp 145-152.



The overall structure of the long-distance model is similar to that used in the Sydney and European models described in the first two webinars. The Population Synthesiser predicts the population by zone and model segment, the segmented population is fed into the travel demand models which predict travel frequency and choice of mode and destination, using level-of-service data from road and rail networks (which include congestion and rail crowding). The model predictions are then used in the pivoting process to define changes relative to the base matrices to provide best-estimates of the future travel demand. These are then assigned to the networks, and skims are fed back into the travel demand models until demand and supply are in equilibrium.

Will describe development of the demand models



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The focus of the presentation is in the travel demand models.

Choice data used for model estimation

- National Travel Survey (NTS) data, 2002 to 2006, limitations:
  - domestic travel only
  - geographical information aggregate at the destination end
  - group size information not recorded
- dedicated 2009 Household Interview (HI) undertaken to supplement:
  - more disaggregate destination information
  - group size recorded
- Stated Preference data (SP) to model choice between high-speed rail and existing modes
- total sample sizes:
  - NTS: 48,000 tours from 116,000 individuals (1 week survey, 1 or 3 wk recall)
  - HI: 14,500 tours from 65,000 individuals (2 week recall)
  - SP: 32,000 choice pairs from 3,000 individuals

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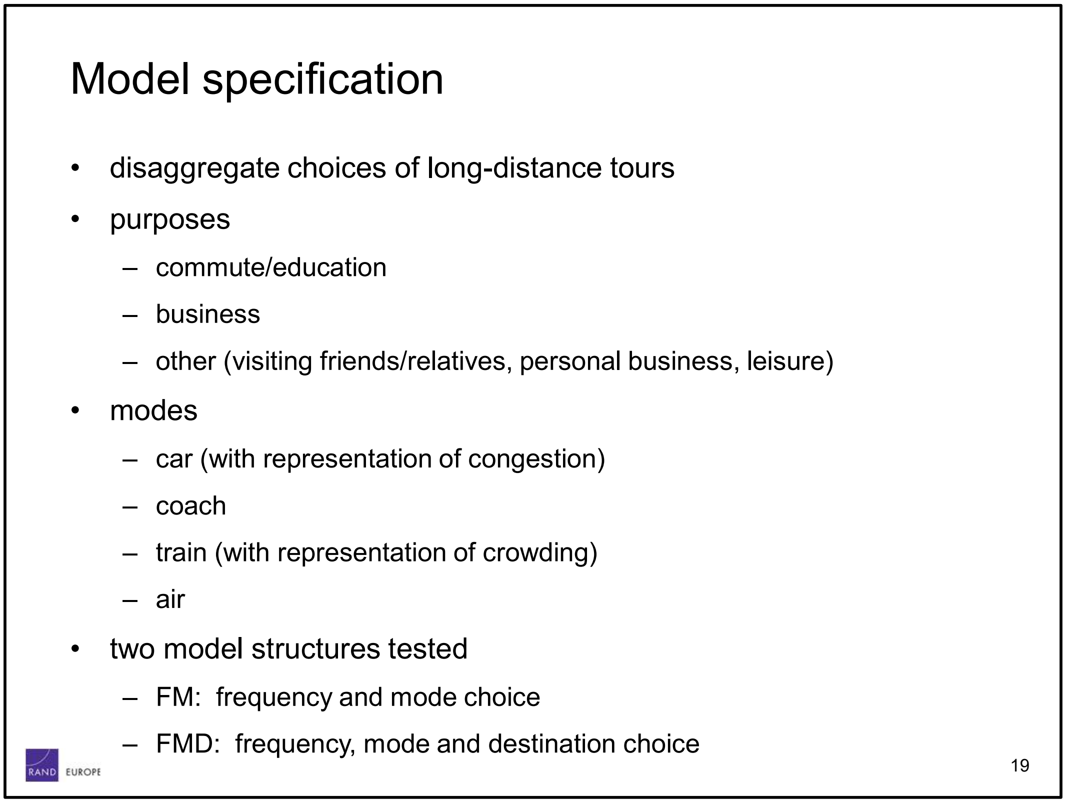
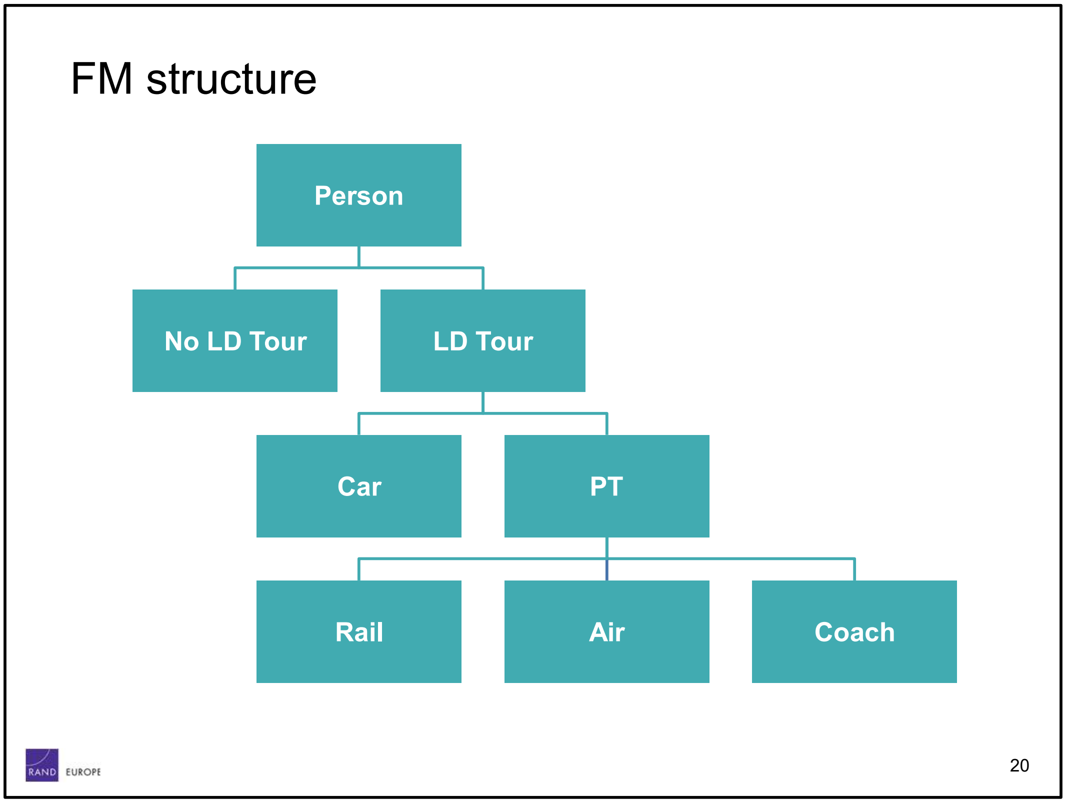
The model focusses on domestic travel only – so travel by foreigners was not recorded, nor were destination trade-offs between GB and non-GB destinations for residents.

The NTS and HI data were pooled together to estimate the models. SP data was analysed separately, and key parameters were drawn from that analysis to allow incorporation of HSR into the demand model. Ideally all three datasets would have been pooled for estimation, but budget and timescales did not allow this.



The specification of the model purposes and modes drew on the analysis presented earlier. For car, the highway network represents the impact of congestion, and for rail the impact of crowding is represented, and so the network models for both modes are run iteratively with the demand model to achieve an equilibrium position.

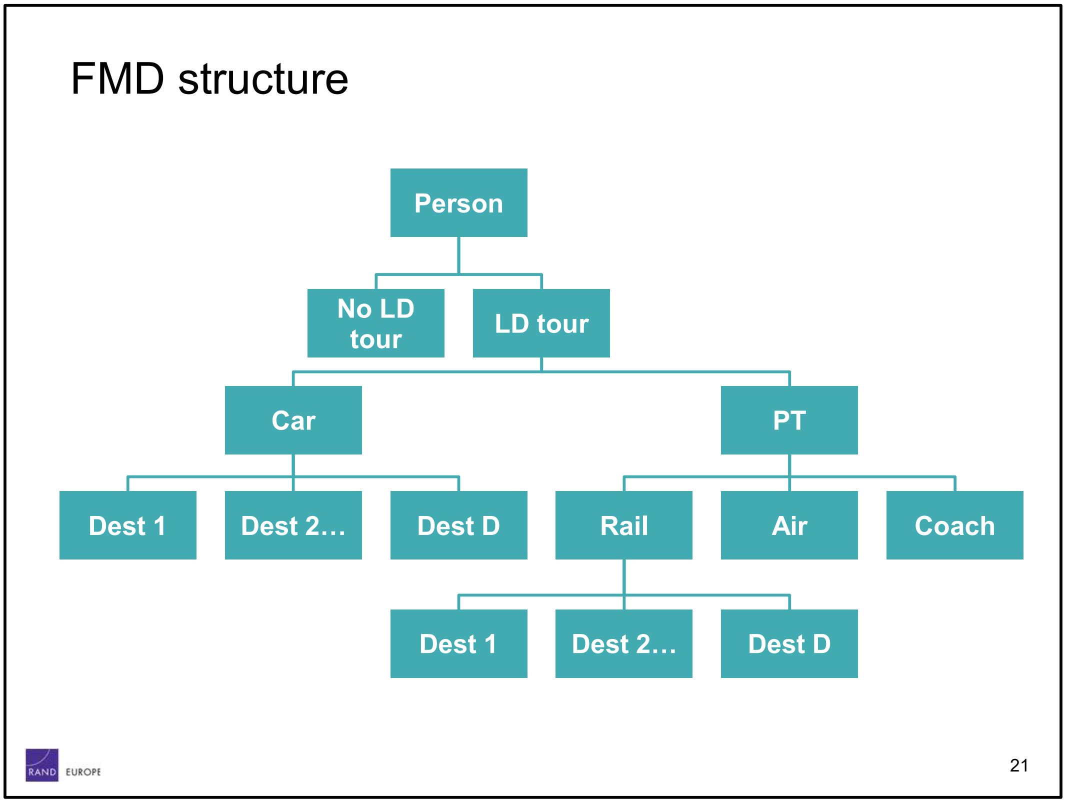
Two different model structures were tested, with and without destination choice. These are discussed further in the following slides.



One of the nesting structures tested from the revealed preference data (NTS and HI). It should be noted that an individual who is observed not to make a LD tour may make a short distance tour as well as not travelling at all.

The frequency models predict the probability of making a long-distance tour for a particular journey purpose on a given weekday as a function of traveller characteristics, including income, as well as accessibility, which is measured across all modes and destinations.

Analysis of stated preference data revealed HSR to be located in a rail nest, so existing rail users more likely to switch to air than travellers who currently travel by air, coach or car – will show this structure later on when we discuss the SP data.



In the structure presented, destination choice is shown at the lowest level of the nesting structure and is so the most sensitive to changes in utility. However, different structures were tested before arriving at the structure that best explained the observed choices.

FMD emerged as the best structure

- representing destination choice improved the quality of the models (c.400 zones)
- elasticity tests
  - FM models gave higher elasticities, particularly car cost mileage elasticity
  - FMD model elasticities judged more plausible – less mode switching was observed because of the additional degree of freedom (i.e. destinations)
- final structures have destination choice as the lowest (most sensitive) choice
  - consistent with most of the urban models presented in Webinar 2
- it should be noted that mode-destination accessibility impacts on travel frequency, so schemes which significant improve accessibility will result in the generation of additional long-distance trips

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Socio-economic terms for travel frequency

Term	Commute	Business	Other
Income (by band)	↑	↑	↑
Males	↑	↑	
Aged under 30			↓
Aged 30 to 59	↑	↑	
Retired			↑
Unemployed			↑
Households with children			↓
Households with no car			↓

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The arrows indicate whether the term(s) increase (↑) or decrease (↓) travel frequency for that purpose.

A key driver of long-distance trip making is household income. Analysis of the cross sectional 2002-06 NTS data demonstrated a strong link between income and travel frequency. An important stage in the frequency model development was to specify an appropriate form for the income terms. The shape of the curve at the top end is difficult to determine, as it depends on the median income assumed for the top band (>£75 k p.a.). Three different specifications for income were tested in the development of the frequency models:

- linear income terms, which assume ever increasing travel frequency with income increases over time;
- log income terms, which reflect a 'damping' of trip making at higher incomes; and
- banded income terms, whereby observed long-distance tour rates for specific income bands are identified.

Using banded income is the most conservative assumption as incomes rise, because the tour rate for the highest income band is assumed to remain constant, rather than to continue increasing as in the linear or logarithmic formulations.

Investigations of the income elasticities for the three specifications revealed the lowest elasticities for the logarithmic formulation, as expected, and generally the highest elasticities for the linear formulation. Overall, on the basis of fit to the data and the income elasticities, the banded income models were judged most reasonable and so this model formulation was adopted in the final models.

In addition, long-distance travel frequency was found to be affected by:

- gender, men make more long-distance trips, for all commute and business travel
- car ownership, where households without a car are less likely to make Other journeys
- age, with a negative term for people under 30 for Other travel (meaning that they are less likely to make long-distance journeys) and with positive terms for persons aged 30-59 for commute and business
- positive unemployed and retired terms for Other travel
- a negative term for couples with children, indicating that these couples are less likely to make Other long-distance journeys.

In addition to these socio-economic terms, the frequency models incorporate an accessibility effect, indicating increased LD trip making for more accessibility origins.

Socio-economic terms for mode choice

Term	Rail	Air	Bus	Car
High income	↑ all purps	↑ business ↑ other		
Low income			↑ other	
Males	↓ other		↓ other	↑ commute ↑ business
Students			↑ commute	
Part-time workers			↑ commute	↓ business
Car ownership	↓ business			↑ all purps

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Again, the arrows indicate whether the mode is more or less likely to be chosen for a population segment and journey purpose.

In the model estimation procedure a number of important socio-economic characteristics which influence model choice for long-distance travel were identified, including:

- for car alternatives, car ownership terms (1 car, 2+ cars) for all purposes, a term for males for commute and business travel, and a (negative) term for part-time workers for business
- for rail, (positive) household income terms for higher income groups for all purposes, 2+ cars term for business, and a term for females for Other travel
- for air, (positive) household income terms for higher income groups for business and Other travel
- for bus/coach, (positive) part-time worker and student terms for commute (and education), and (positive) household income terms for low income households and a (positive) term for females for Other travel.

Two key effects are apparent, first that the likelihood of choosing car increases as household car ownership increases, for all purposes, and second that the likelihood of choosing rail and air increases with household income. It is noted that for all purposes the sensitivity to cost for mode and destination choices is reduced as household income increases.

Structural coefficients

	Commute	Business	Other
Frequency	0.72 (5.7)	1.00 (*)	0.51 (12.3)

For all purposes, frequency logsum term demonstrates an important effect of mode-destination accessibility on frequency

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The final model structure for existing modes has frequency choice at the top of the structure, followed by the choice between public transport and car modes, then the choice between public transport modes, and finally with destination choice at the lowest level.

This table summarises the structural parameters in the model (the structural parameter reflects the ratio of the lambdas for adjacent choices in the nest; it must not exceed one to maintain consistency with intuitive response characteristics). The t-statistics (shown in brackets) reflect the statistical significance of the term, measured relative to a value of one. Structural values have been fixed to 1 when free estimation gave unacceptable values greater than 1.

For all models we observe a significant impact of mode x destination accessibility (measured by the logsum) on frequency choice.

Note that not making a long-distance tour can mean making a short-distance tour as well as not travelling at all.

Structural coefficients

	Commute	Business	Other
Frequency	0.72 (5.7)	1.00 (*)	0.51 (12.3)
Public transport	1.00 (*)	0.57 (9.9)	0.50 (11.9)

Significant correlation between public transport modes for business and other

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For business and other travel, we observe significant correlation between the public transport modes (t-statistics give significance relative to a value of 1).

Structural coefficients

	Commute	Business	Other
Frequency	0.72 (5.7)	1.00 (*)	0.51 (12.3)
Public transport	1.00 (*)	0.57 (9.9)	0.50 (11.9)
Destination	0.28 (26.6)	0.80 (3.6)	0.73 (7.1)

Significant correlation between destination alternatives for all purposes

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For all purposes we observe significant correlation between destinations (t-statistics give significance relative to a value of 1), and that these are nested below mode choices.

Long-distance fuel cost elasticities

	Tours		Kilometres	
	Car	All modes	Car	All modes
Commute	-0.106	-0.074	-0.232	-0.156
Business	-0.068	-0.055	-0.103	-0.078
Other	-0.067	-0.049	-0.122	-0.098

Average fuel cost elasticity in the UK is around -0.3 (all trips)

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Five elasticity tests have been run for each model:
P1: 10% increase in fuel cost
P2: 10% increase in car time
P3: 10% increase in rail fare
P4: 10% increase in rail in-vehicle time
P5: 10% increase in income, impacting values of time, mode preferences and journey frequency

Fuel cost, rail fare and income elasticities are reported here.

The elasticities are first order values, i.e. they do not incorporate the effect of changes in highway congestion or railway crowding resulting from the test. They also reflect predicted behaviour for the NTS sample of observations. The income elasticity tests assume reductions in cost sensitivity in each income group and movement between income categories, which impact mode choices and journey frequency, but no car ownership changes. These were, however, incorporated in the complete model implementation.

The results are presented separately for each journey purpose, both in terms of total numbers of tours and total kms.

The fuel cost kilometrage elasticities of -0.23 for commute, and -0.10 for business, are judged to be reasonable. Theoretically we would expect higher elasticities for longer distance journeys, but this assumes that short-distance and long-distance markets are the same for any purpose, which clearly is not the case.

However, the fuel cost kilometrage elasticity looks low for Other travel, where the general expectation is that fuel price elasticities are higher than -0.3 for such discretionary travel, although it is noteworthy that there is little evidence on fuel cost elasticity values for long-distance Other travel.

Long-distance rail fare elasticities

	Tours		Kilometres	
	Rail	All modes	Rail	All modes
Commute	-0.356	-0.060	-0.543	-0.127
Business	-0.271	-0.035	-0.417	-0.049
Other	-0.608	-0.019	-0.865	-0.026

UK rail industry guidance suggested -0.85 to -1.00 on corridors where rail is competitive – model includes all areas
Consistent with values for Swedish long-distance model

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The resulting rail fare kilometre elasticities vary between 0.42 and -0.87. Our understanding is that rail industry guidance recommends long distance fare elasticities in the range -0.85 to -1.00 for corridors where rail is competitive relative to other modes. The values that are returned from the NTM model are generally low on this
basis but the model also includes many areas where rail is not competitive.

Rail fare kilometrage elasticities in the Swedish long-distance travel model SAMPERS range from -0.59 to -0.72, which is within the same range as the LDM values.

Long-distance income elasticities, changes in total mileage

	Total model elasticity	NTS analysis
Commute	0.75	0.81
Business	0.73	0.80
Other	0.28	0.42

Total elasticity response higher for commute and business

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NTS analysis fitted linear regressions to log(household income) again log(trip rate)

From the income elasticity tests we see higher sensitivity of long-distance trip making and kilometres to income growth for commute and business travel. This is consistent with separate analysis of the cross-sectional NTS data (using linear regression models of the log(household income) and log(trip rate)).

Long-distance income elasticities, changes in mileage by mode

	Air	Rail	Coach	Car	Total
Commute	n/a	1.26	0.57	0.55	0.75
Business	1.11	1.00	n/a	0.63	0.73
Other	0.65	0.46	-0.08	0.27	0.28

Income increases result in shifts to air and rail, coach declines for other due to lower income term

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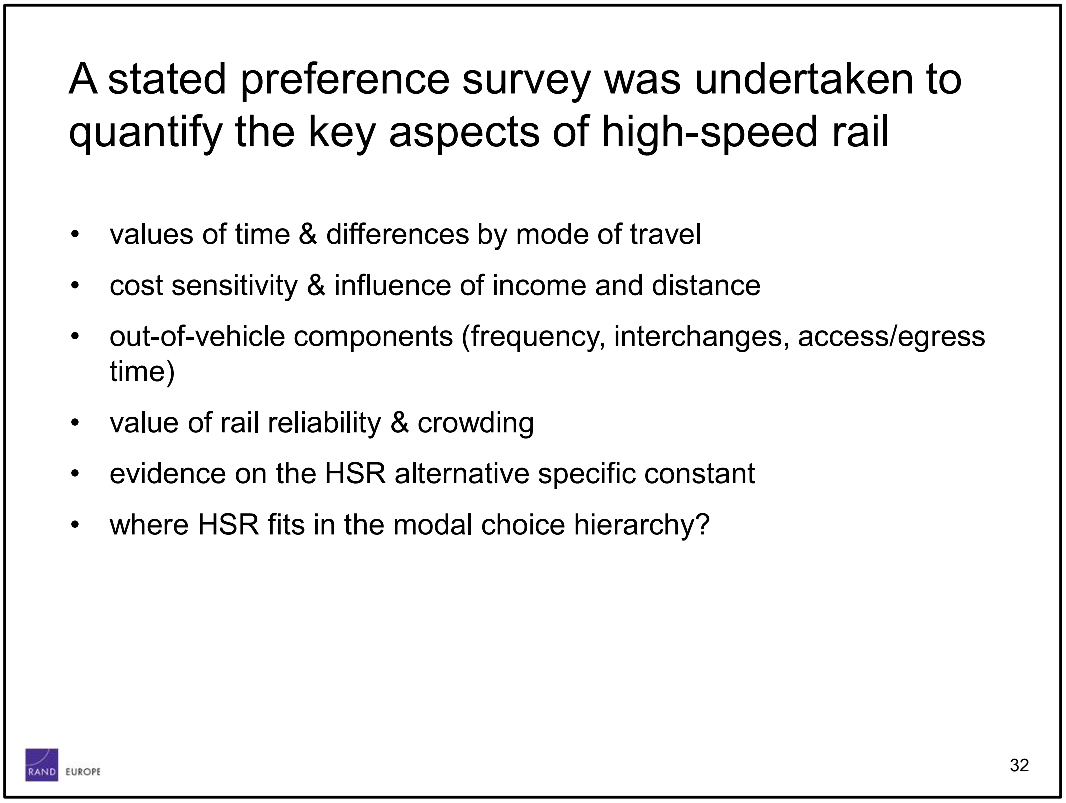
We also see substantial differences in income impacts by mode, with the highest income elasticities for air, followed by rail. There is a positive income elasticity for coach for commute travel, but a negative elasticity for Other travel. These shifts follow from the income specific terms placed on these modes.



Details of the Stated Preference (SP) modelling is available at:

Burge, P., Woo Kim, C. And C. Rohr (2011) Modelling Demand for Long-Distance Travel in Great Britain: Stated preference surveys to support the modelling of demand for high-speed rail, Santa Monica, Calif.: RAND Corporation, TR-899-DFT. Available at: http://www.rand.org/pubs/technical_reports/TR899

The specific objectives of the SP study were to:

- provide (parameter) values for the different service components in the mode choice modelling process that underpins the LDM demand forecasts, including:

    - values of time, and to test whether these vary differentially by mode of travel

    - cost sensitivity, and to test whether these vary by income group and distance

    - out-of-vehicle components, such as frequency, interchanges, access/egress time

    - rail service components, such as rail reliability and crowding

    - whether there exists an additional preference for HSR, over classic rail, above that which can be measured by service attributes

- where HSR fits in the modal choice hierarchy.

Respondents asked to make choices for journey recently made, across all feasible modes

If the following options were available, which would you choose for your journey between Stockport and Paddington?

	Car	Air	Existing rail	High speed rail
Expected travel times:				
Time to get to train station / airport		15 mins	5 mins	15 mins
Waiting time at airport		1 hour		
Time spent in car / train / airplane	3 hours 30 mins	1 hour	2 hours 30 mins	1 hour 10 mins
Time to get from train station / airport		30 mins	5 mins	10 mins
Total Travel time	**3 hours 30 mins**	**2 hours 45 mins**	**2 hours 40 mins**	**1 hour 35 mins**
Percentage of trips "on time" (arrive within 10 mins of expected arrival time)	**90% on time**	**90% on time**	**85% on time**	**99% on time**
Service frequency		**One flight every 2 hours**	**One train every 20 mins**	**One train every 30 mins**
Interchanges			**Need to make 1 interchange**	**Need to make 2 interchanges**
Total travel cost and crowding	**£37 return**	**£113 return** **All seats will be taken**	*Standard class:* **£88 return** **You will have a seat, but others will be standing around you** *First class:* **£154 return** **3 in every 6 seats will be taken**	*Standard class:* **£130 return** **4 in every 6 seats will be taken** *First class:* **£227 return** **4 in every 6 seats will be taken**
Which woul				*ndard*
Or do not make journey	☐			

99.2% of respondents indicated that they were able to undertake the choice exercises

Each respondent was asked to participate in two stated preference choice experiments: (first) one relating to choices between currently available modes for long distance travel, and (second) one where an additional high speed rail alternative was introduced with varying level of service.

Respondents were asked to consider all available mode choice alternatives, simultaneously, for the journey they had been observed to make, that is a maximum of 3 (car, air and classic rail) or 4 (car, air, classic rail and high-speed rail) alternatives, plus an option not to make the journey. Respondents were not presented with alternatives which were not possible for their journeys, specifically car alternatives were not presented to respondents who did not have access to a car and air alternatives were not presented to respondents for whom air was not a sensible alternative.

Each mode alternative was described by the following attributes:

Journey time: with separate components for access and egress, wait time and in-vehicle time for rail and air journeys, as well as total journey time, on the basis that reduced journey times are the main advantage of high-speed rail services, but that access and egress times are also an important consideration with respect to the attractiveness of high-speed rail.

Journey time variability: measured as 'percentage of journeys that arrive within 10 minutes of expected arrival time' to be consistent with statistics collected by Train

Operating Companies (TOCs), again on the basis that high-speed rail may offer significant improvements in rail time variability (and that this should be measured directly in the stated preference choice experiments, rather than being incorporated in the alternative-specific constant).

Rail and Air service frequency: on the basis that demand for high-speed rail services may be affected by service frequency.

Rail interchanges: on the basis that these may impact demand for rail services.

Travel cost and crowding: travel costs were presented for either single or return journeys, and for the individual or group (depending on the conditions for the observed journey). Separate costs were presented for First and Standard class rail services, with separate crowding levels. Crowding levels were simply described (see table of levels below).

The service levels for the observed mode were based around respondent's reported service levels for a recent long-distance journey. Service levels for alternative modes were derived from data provided from networks. Each attribute was varied across 4 levels.

The order of the alternatives in both experiments was varied across respondents (although the order for each individual respondent remained the same), in order to control for potential ordering bias in the responses. The order of the attributes were not varied between respondents as this was considered to be of a lesser concern than any potential left-right biases in the choice of mode which otherwise would have been confounded in the mode-specific constants.

Because of the complexity of the experiments, direct questions were included in the survey to examine whether respondents were able to undertake the choice experiments. 99.2% of the survey respondents indicated that they were able to undertake the choice exercises, with only 23 of the 3,045 respondents reporting problems. These 23 respondents were excluded from the demand model estimation procedure.

The models provide some important insights

- cost sensitivity for long distance trips is complex, varying by
  - purpose
  - income
  - mode
  - cost of trip
- best model incorporated a logarithmic cost function only
  - reflects diminishing sensitivity to unit changes as costs increase (so marginal impact of a £1 increase is lower for a £100 journey than for a £10 journey)
  - but brings challenges for application, as it leads to low elasticities

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The model results provide substantial evidence that sensitivity to travel cost on mode choices varies depending on the purpose of travel, household income and the cost level (that is the sensitivity to a unit change in cost diminishes as costs increase).

In the model estimation procedure, both linear and logarithmic (damped) cost functions were tested. The models providing the best fit to the SP data have a series of logarithmic cost terms that vary by income indicating that those from lower income households exhibit greater cost sensitivity than those from higher income households. With this specification no statistically significant linear cost component was found once the repeated measures nature of the SP data was taken in to account. This formulation does, however, bring challenges, as it was found to lead to low demand elasticities when applied within the wider model system. This is an area that would benefit from further research.

Other journey components are also important when evaluating HSR

- a lot of the public don't understand HSR
  - want HSR, but want a service that stops at stations convenient for their journeys!
  - access/egress times need to be considered
- the evidence from this long distance analysis
  - access/egress time valued between 1 and 2 times in-vehicle time
  - interchange penalty valued between 14-26 minutes of travel time
    - important in the context of Heathrow proposition, which requires an interchange
  - crowding only seemed to matter at higher occupancy levels once all seats are taken

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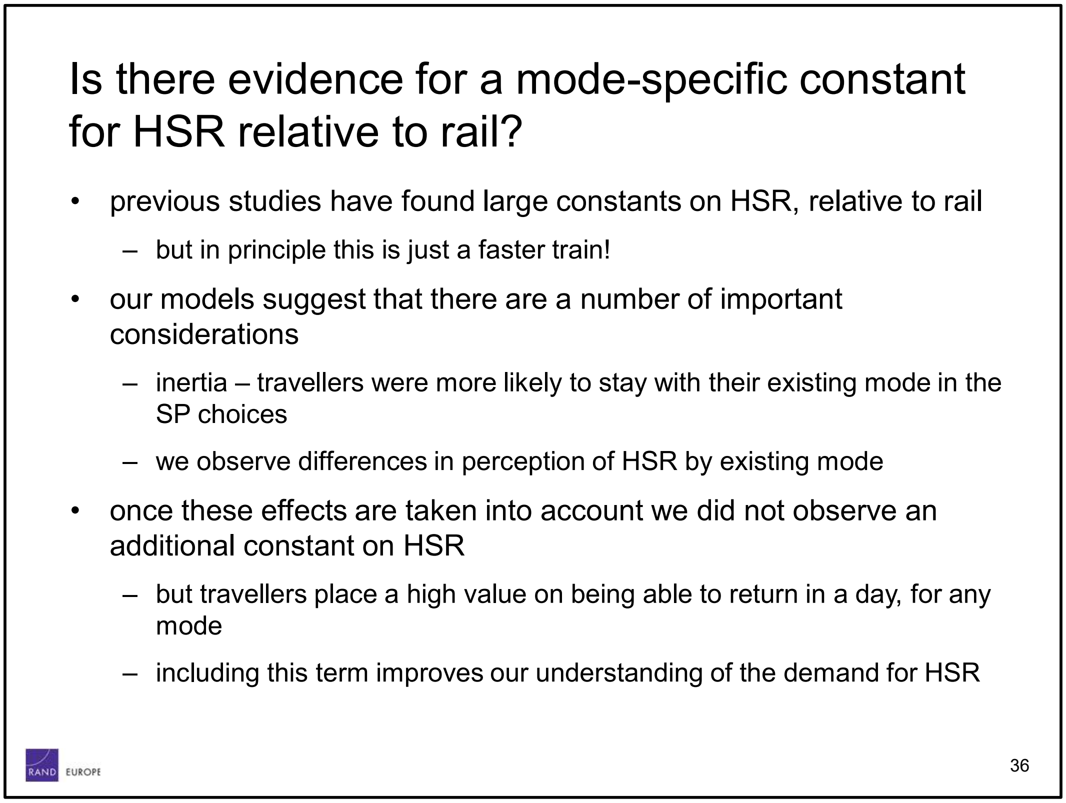
This slides provides the values for important journey time components.



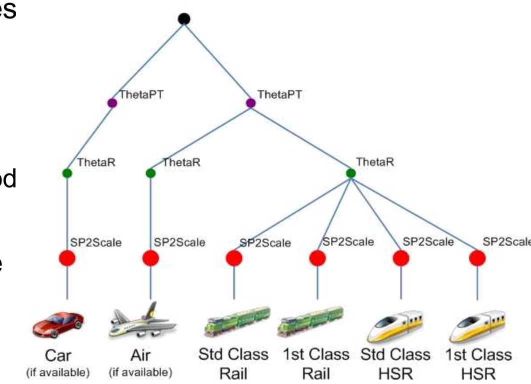
The research also provides useful insight in to whether there exists an additional preference for HSR over classic rail. The structure of the stated preference exercises allowed other attributes (such as reliability and crowding), that may have been confounded in mode-specific constants in previous studies, to be taken in to account and isolated.

It should be noted that the HSR constants calculated in the model are specified such that they act in addition to the rail constants, i.e. they describe the marginal perceived benefit of HSR over and above conventional rail.

We find that when we take account of inertia (i.e. that travellers were more likely to choose the mode they used for their last journey), and when we incorporate mode-specific constants for HSR, and when we take account that travellers place a high value on being able to make a return journey in a day, that there is little evidence for including an additional constant on the HSR alternative, over and above that applied to conventional rail.

Where does HSR fit in the mode choice hierarchy?

- SP choices presenting all modes gave us good data for testing hierarchy
- Tested many nesting structures
  - Rail class above and below mod
- Concluded that HSR and conventional rail sit at the same level of the nest



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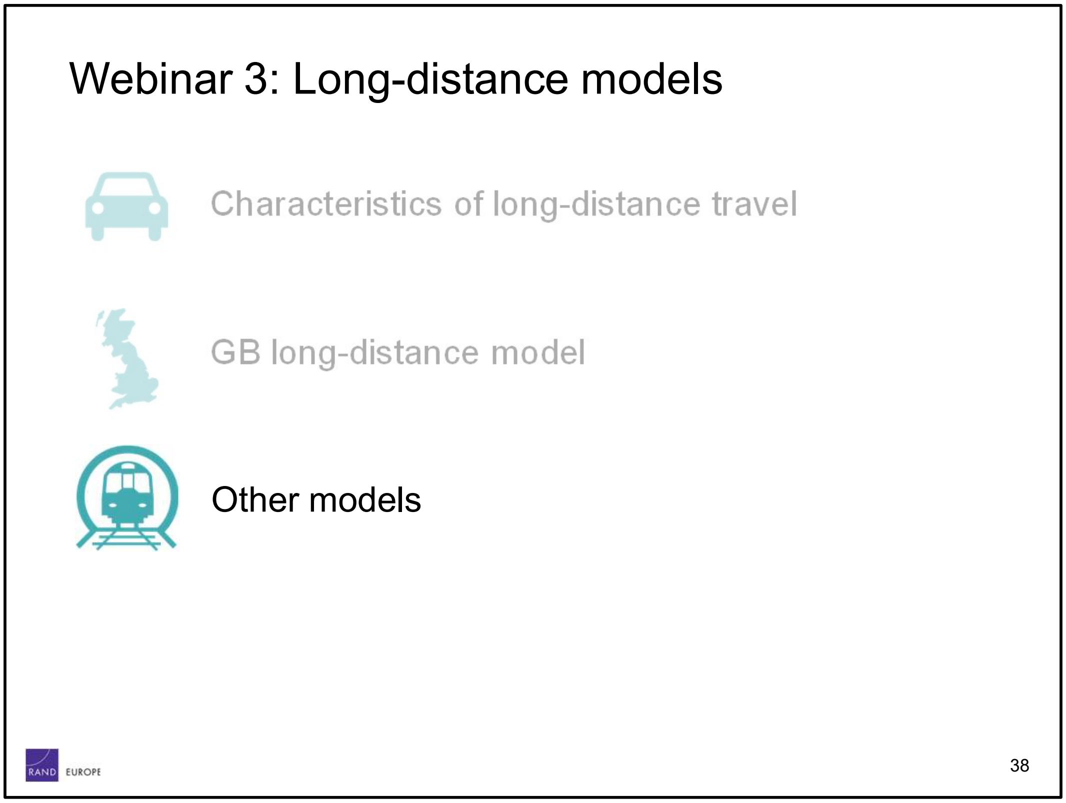
The evidence produced through this study, after testing a number of different nesting structures, suggests that HSR should be incorporated in the same nest as conventional rail, which then sits within a further public transport nest with air.



These other models have been developed for separate corridor studies, as usual applying methods with a common core but extensive adaptation to local circumstances. They apply to corridors to and from southern England and in NW Europe.

Corridor model summary

Model	Region	Context
Eurotunnel Car Market Shares Model	UK to France and beyond	Market for Le Shuttle (car) versus car ferry services
Union Railways	UK to France, Belgium and beyond	Market for Eurostar services from London to Lille, Paris & Brussels
High Speed Line - South	Netherlands to Belgium and France	Market for high speed services linking Amsterdam with Paris via Brussels
Scilly Corridor Model	S.W. England (Cornwall)	Renewal of ferry for travel between Isles of Scilly and English mainland
Great Belt Study	East to West Denmark	Management of the fixed link and remaining ferry and air lines
Fehmarn Belt Study	Germany to East Denmark	Decision on fixed link across the Fehmarn Belt

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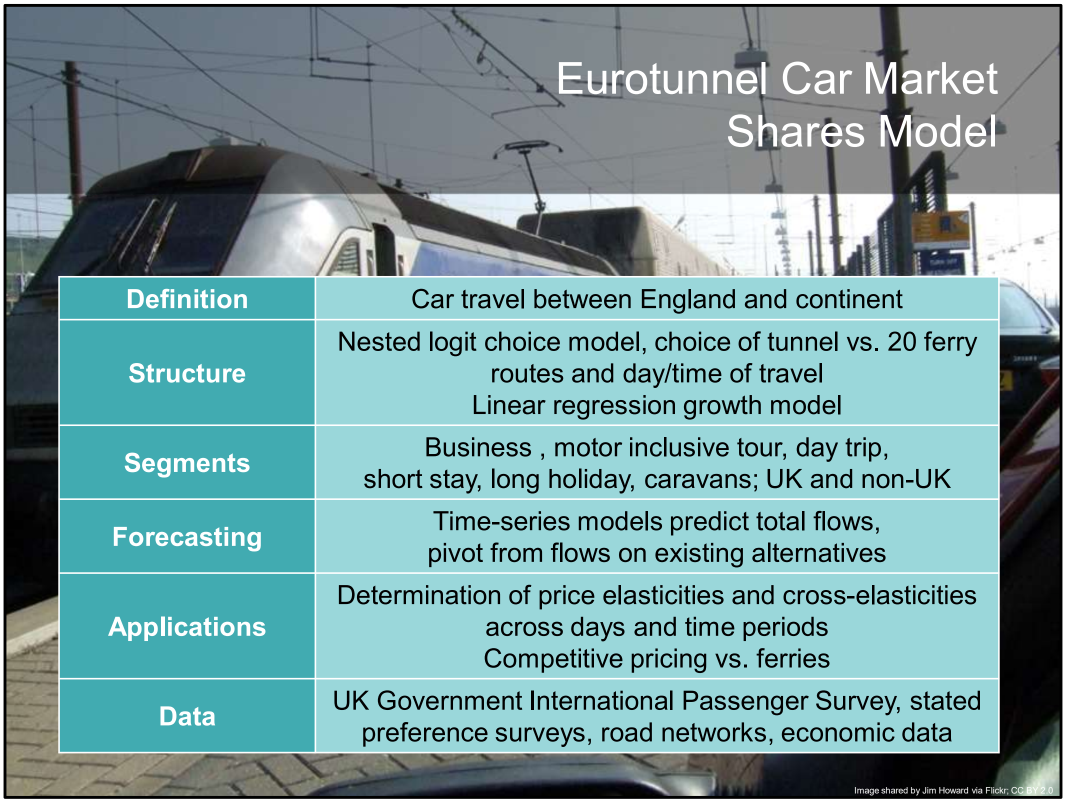
There are 4 services through the Channel Tunnel: passenger and freight through trains and passenger and freight shuttle services. The shuttle services accept road vehicles onto trains and take them between the two tunnel termini in England and France.

The car shuttle is largely a double deck train (single deck for larger vehicles, as for freight vehicles) and loaded from platforms as shown. Cars drive through the train to park. On-board facilities are very limited (WC only) but there are shops at the termini. Journey time is about 35 minutes.



Definition	Car travel between England and continent
Structure	Nested logit choice model, choice of tunnel vs. 20 ferry routes and day/time of travel Linear regression growth model
Segments	Business , motor inclusive tour, day trip, short stay, long holiday, caravans; UK and non-UK
Forecasting	Time-series models predict total flows, pivot from flows on existing alternatives
Applications	Determination of price elasticities and cross-elasticities across days and time periods Competitive pricing vs. ferries
Data	UK Government International Passenger Survey, stated preference surveys, road networks, economic data

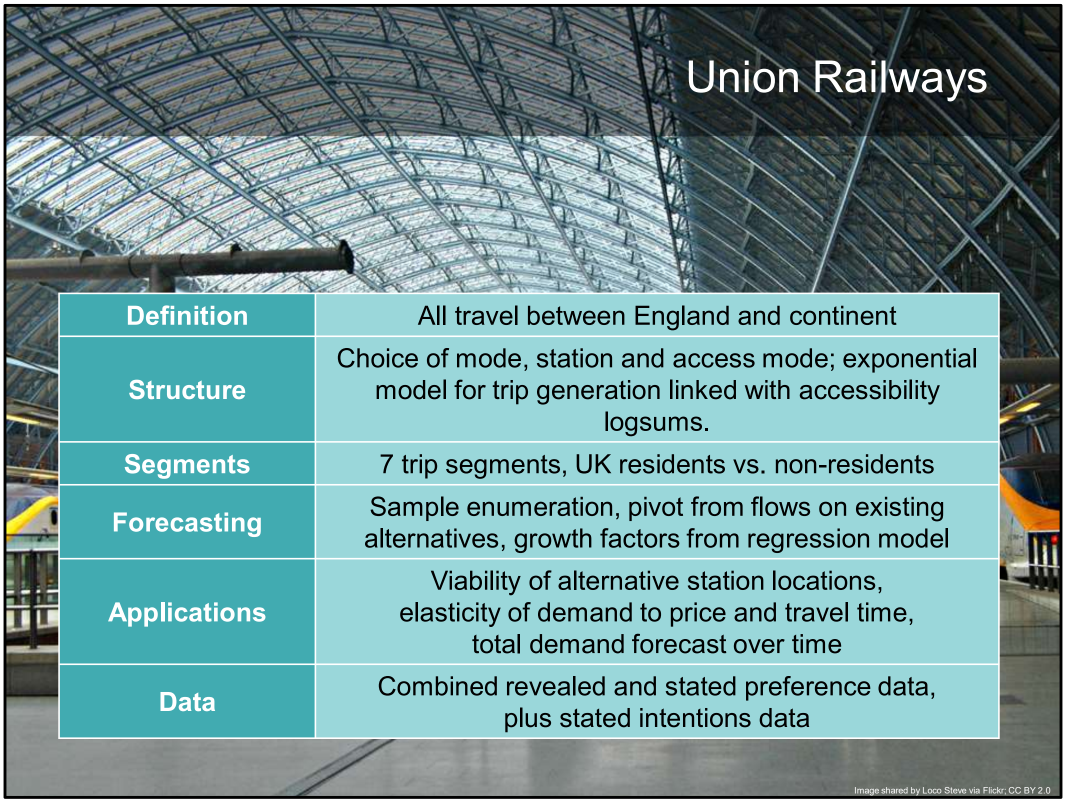
Segments are those traditionally used to analyse international travel to/from UK and have grown up in conjunction with the data collection (International Passenger Survey, IPS).

Peak times are e.g. Friday and Saturday late afternoon and evening, so a day/time choice model was developed to represent these peaks, which are premium priced, against lower-demand periods (e.g. Monday). Most travellers are UK based, which makes the peaking worse.

Ferry services vary from 2-hour crossings at the Dover strait, in direct competition with the tunnel, to much longer crossings to western France and Spain or from northern England to Holland and Germany. Ferries offer a rest, food and entertainment, so it is not just competition on time.

Tunnel opening put some ferry services out of business but there is still a surviving business. The tunnel is quite expensive because of the high debts that have to be serviced.

These are the through trains from London to Lille, Paris and Brussels. They now run from St Pancras station in London, a magnificent modernised Victorian building, but part of he project was to investigate the viability of other stations in England. Finally there are 2: Ebbsfleet on the London Orbital Motorway and Ashford near the tunnel portal. Stratford in East London (site of the 2012 Olympics) appeared viable to us on demand grounds but was rejected by the railways for operational and security/migration reasons.



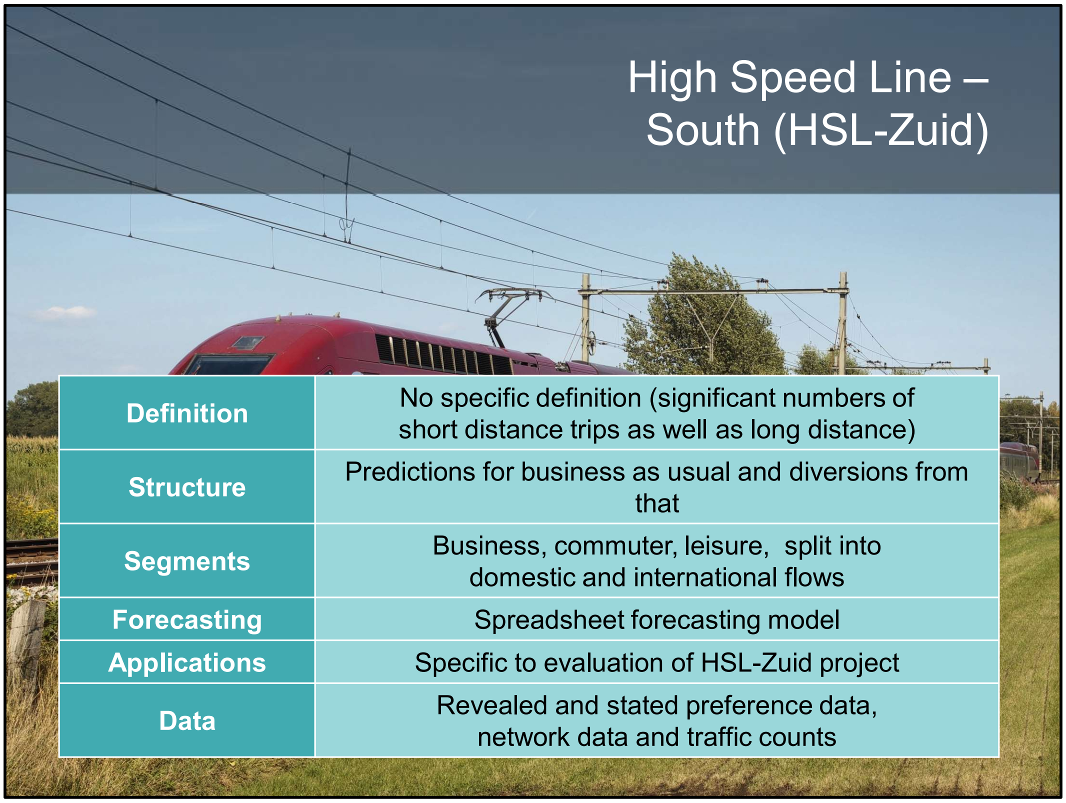
Definition	All travel between England and continent
Structure	Choice of mode, station and access mode; exponential model for trip generation linked with accessibility logsums.
Segments	7 trip segments, UK residents vs. non-residents
Forecasting	Sample enumeration, pivot from flows on existing alternatives, growth factors from regression model
Applications	Viability of alternative station locations, elasticity of demand to price and travel time, total demand forecast over time
Data	Combined revealed and stated preference data, plus stated intentions data

The segments are similar to those of Eurotunnel, derived from same IPS data.

The model represented car ferry, bus, air and rail modes. in a nested structure with through trains with further modelling of access mode and access station. Attention was given to access from north of London with rail connection to the international train.

The forecasts from the model turned out to be higher than what actually happened but lower than what the client would have liked! Partly our forecasts were to high because we did not include the impact of low cost airlines, partly because we anticipated too much demand from outside London. However, demand has subsequently built up, particularly to Paris, to levels around what we were forecasting.

This line (Thalys) runs from Amsterdam to Brussels and Paris with branches to Germany and southern France. There are several stops en route at important cities (Rotterdam, Antwerp) as well as airports (Schiphol, Charles de Gaulle), so that domestic traffic within The Netherlands at least must be considered. Premium fares are charged.



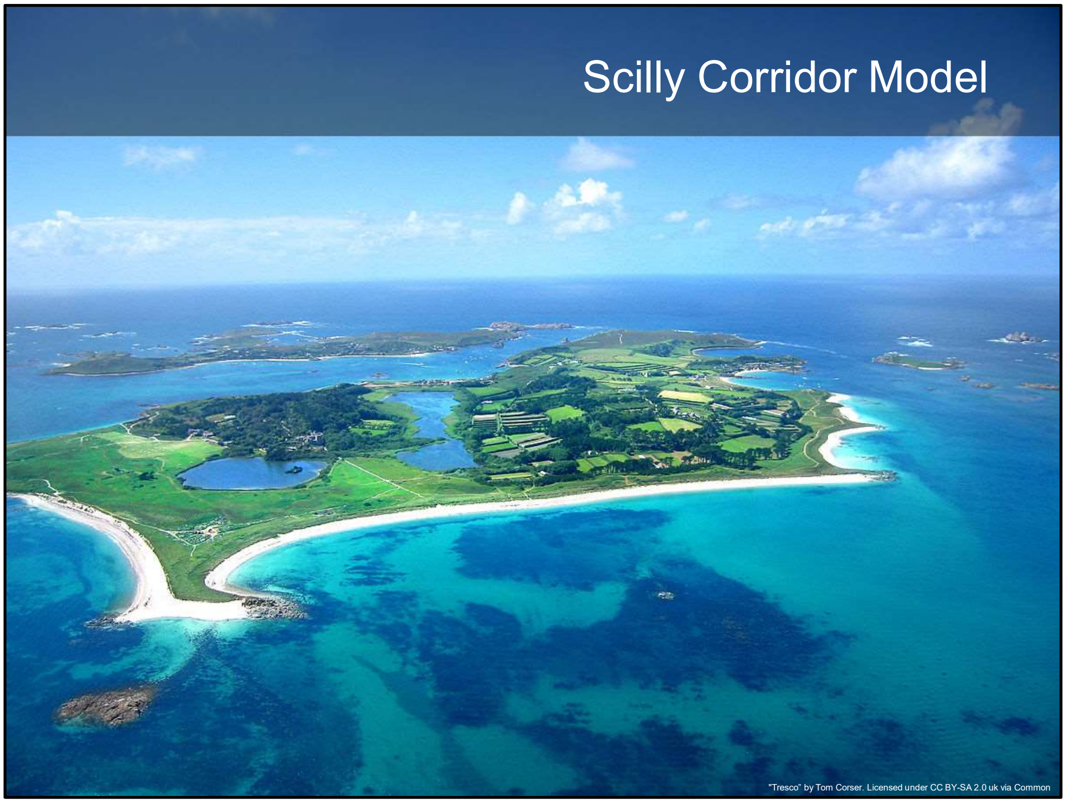
High Speed Line – South (HSL-Zuid)

Definition	No specific definition (significant numbers of short distance trips as well as long distance)
Structure	Predictions for business as usual and diversions from that
Segments	Business, commuter, leisure, split into domestic and international flows
Forecasting	Spreadsheet forecasting model
Applications	Specific to evaluation of HSL-Zuid project
Data	Revealed and stated preference data, network data and traffic counts

Segmentation and surveys were designed specifically for this study.

The forecast was based on a do-minimum and then diversions from that were based on the SP modelling of switching to the fast train. Switching models can give greater insight than models that are not based on do-minimum, but they work less well when there are multiple policy changes.

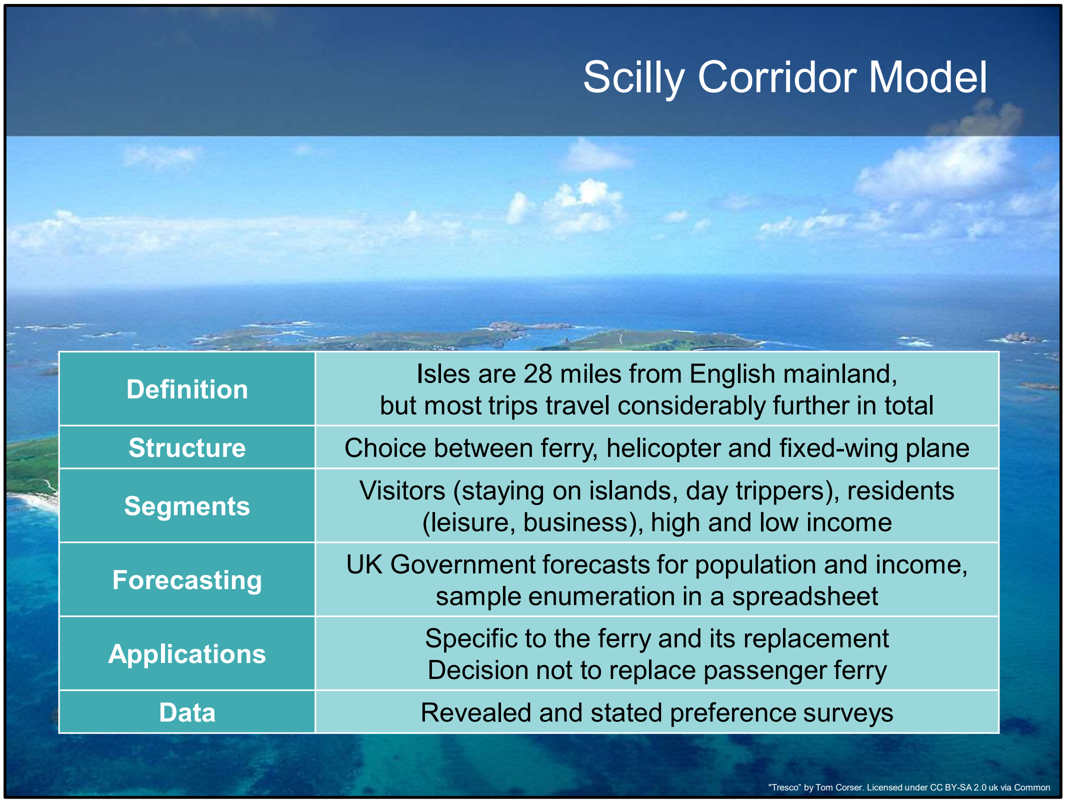
A key innovation was the use of a spreadsheet-based system that could be transferred to the client.



The islands are in the Atlantic, off the SW tip of the British mainland. The climate is very temperate, with warm winters and mild summers, suitable for horticulture, holiday and retirement.

Transport options were ferry (summer only), helicopter (subject to weather) and fixed-wing from three English airports. The ferry was reaching the end of its life and the issue was whether to replace it. Recently the helicopter service was also discontinued, but the ferry life has been extended to 2018 by a refit. What will happen then is uncertain!

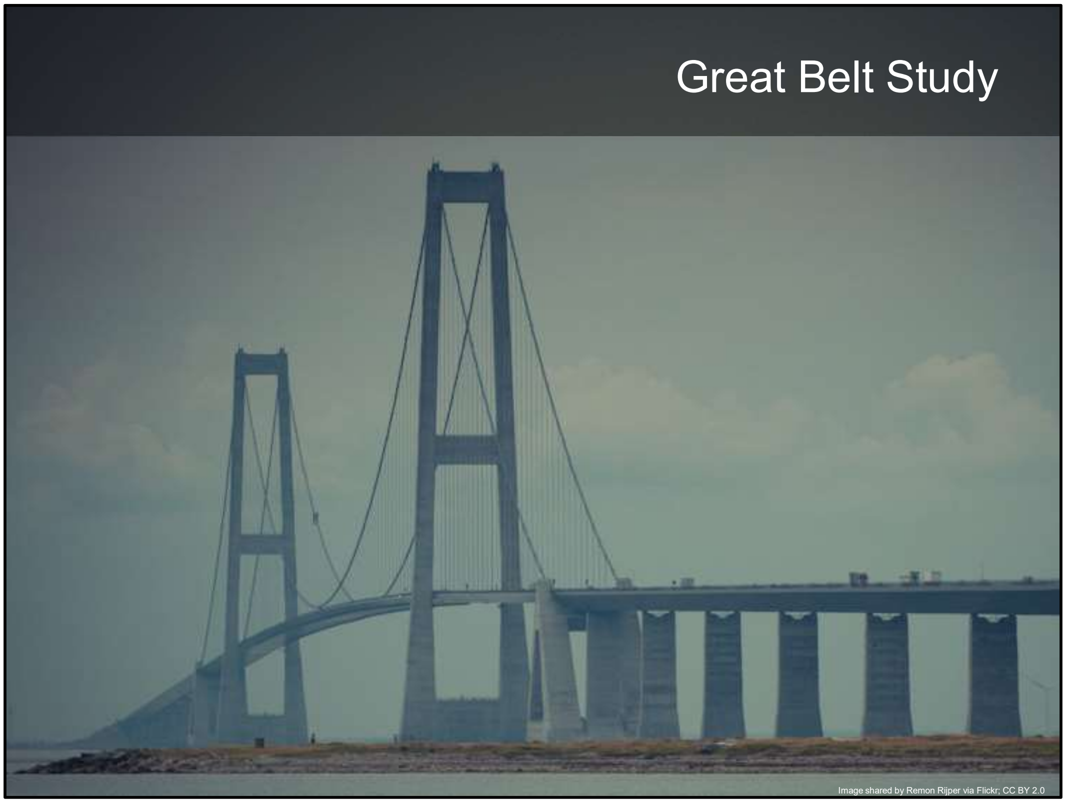
"Tresco - aerial photo6 edit" by Tom Corser www.tomcorser.com. Licensed under CC BY-SA 2.0 uk via Commons - https://commons.wikimedia.org/wiki/File:Tresco_-_aerial_photo6_edit.jpg#/media/File:Tresco_-_aerial_photo6_edit.jpg



Segments could be designed for the study and intercept surveys and SP were conducted.

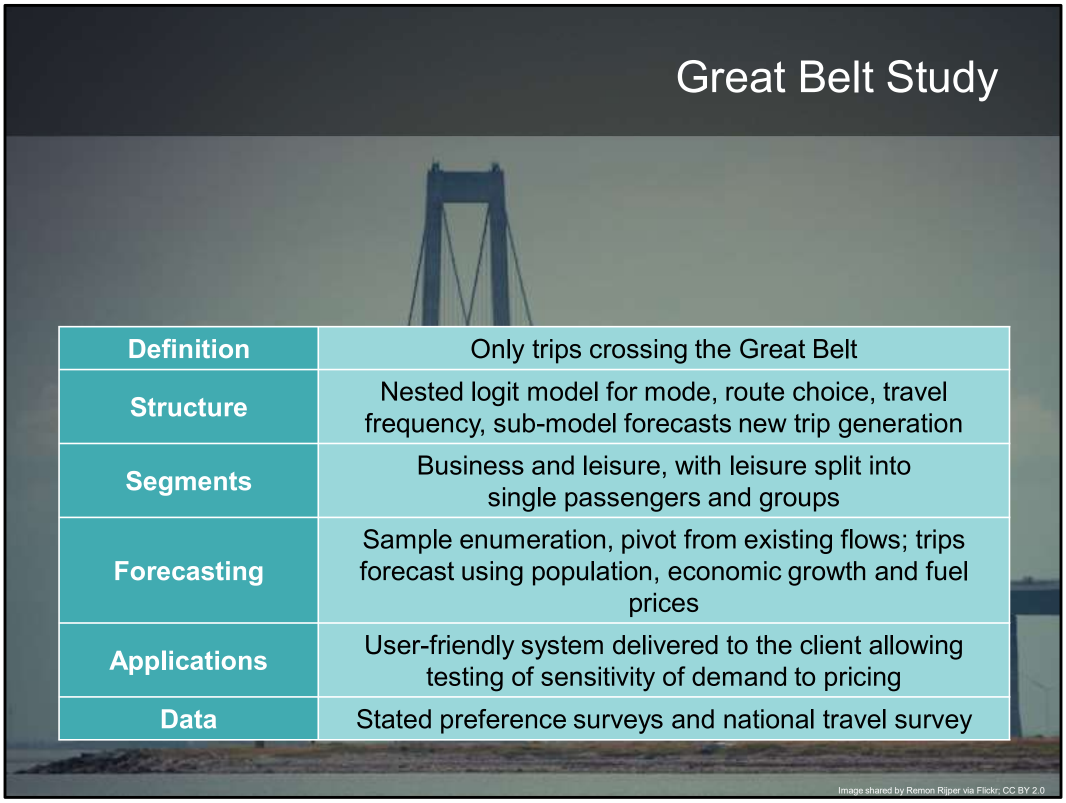
Scheduling turned out to be important, as if 1 return ferry trip per day was made day-trippers could not get much benefit, while with 2 trips there was a good market for day trips. Otherwise cost was the key variable.

A spreadsheet system was set up to calculate demand and net benefit over a 60-year period as required by UK practice.



Denmark comprises a densely developed eastern part (Sjaelland and neighbouring islands) and a largely agricultural western part (Jutland, Funen and neighbouring islands). The eastern part is much smaller but contains Copenhagen and about half of the population. The Great Belt separates the two parts and was a barrier to road and rail travel, so that there was a substantial internal air market, considering the small size of the country.

The fixed link comprises a low western road and rail bridge from Funen to the small island of Sprøgø, together with a rail tunnel and high road bridge (photo) from the island to Sjaelland. The eastern bridge would have been the longest suspension bridge in the world, but a longer bridge was completed in Japan a few months before it opened.



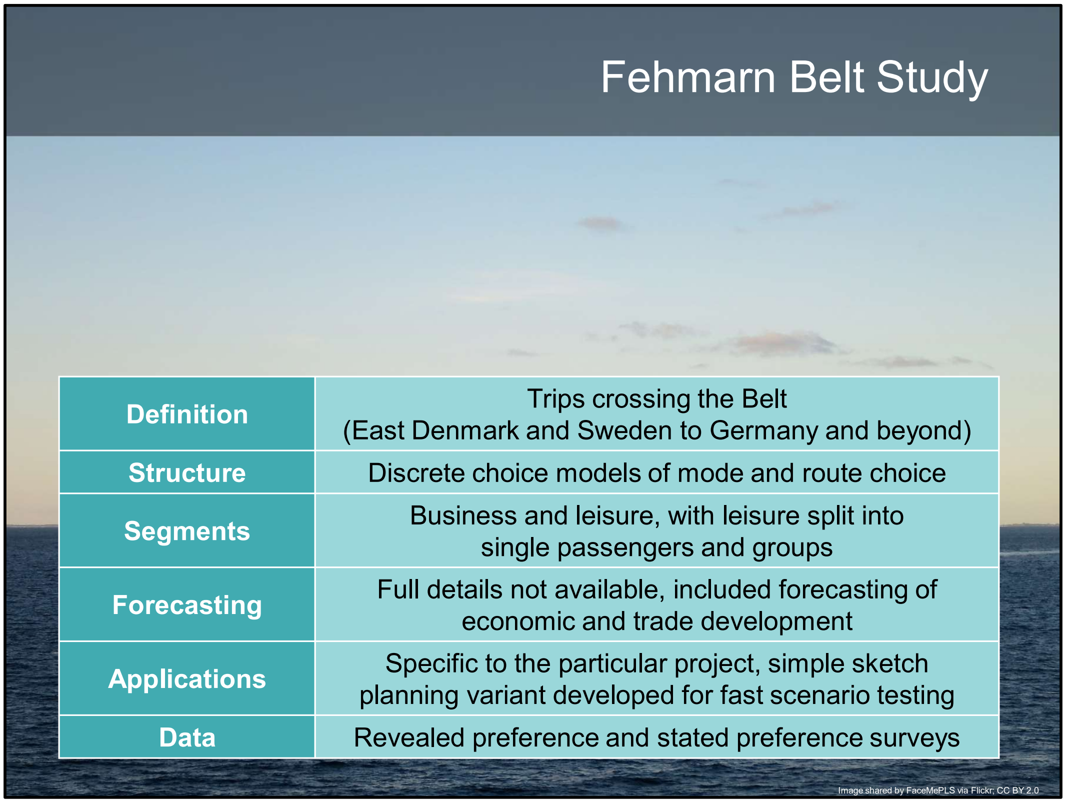
Definition	Only trips crossing the Great Belt
Structure	Nested logit model for mode, route choice, travel frequency, sub-model forecasts new trip generation
Segments	Business and leisure, with leisure split into single passengers and groups
Forecasting	Sample enumeration, pivot from existing flows; trips forecast using population, economic growth and fuel prices
Applications	User-friendly system delivered to the client allowing testing of sensitivity of demand to pricing
Data	Stated preference surveys and national travel survey

Objectives of modelling were to forecast traffic and revenue for road and rail links and to investigate the viability of ferry services in direct or indirect competition.

The results were quite good: mode and route splits were predicted accurately and the growth of leisure traffic was also well predicted, but the growth of business traffic was underestimated after the first year.

This strait between East Denmark and Germany crosses the main route from Scandinavia to the continent and in particular from Copenhagen to Hamburg. The options were a bridge (the water is quite shallow) or a tunnel.

This study was conducted by a large Danish-German consortium (we were part of the Danish side) but it was probably too soon after German reunification to make an investment in international transport links German policy in the 90s was very much concentrated on reintegrating East Germany with the west. A new study, to which we have also contributed) may lead to a positive decision about this fixed link.



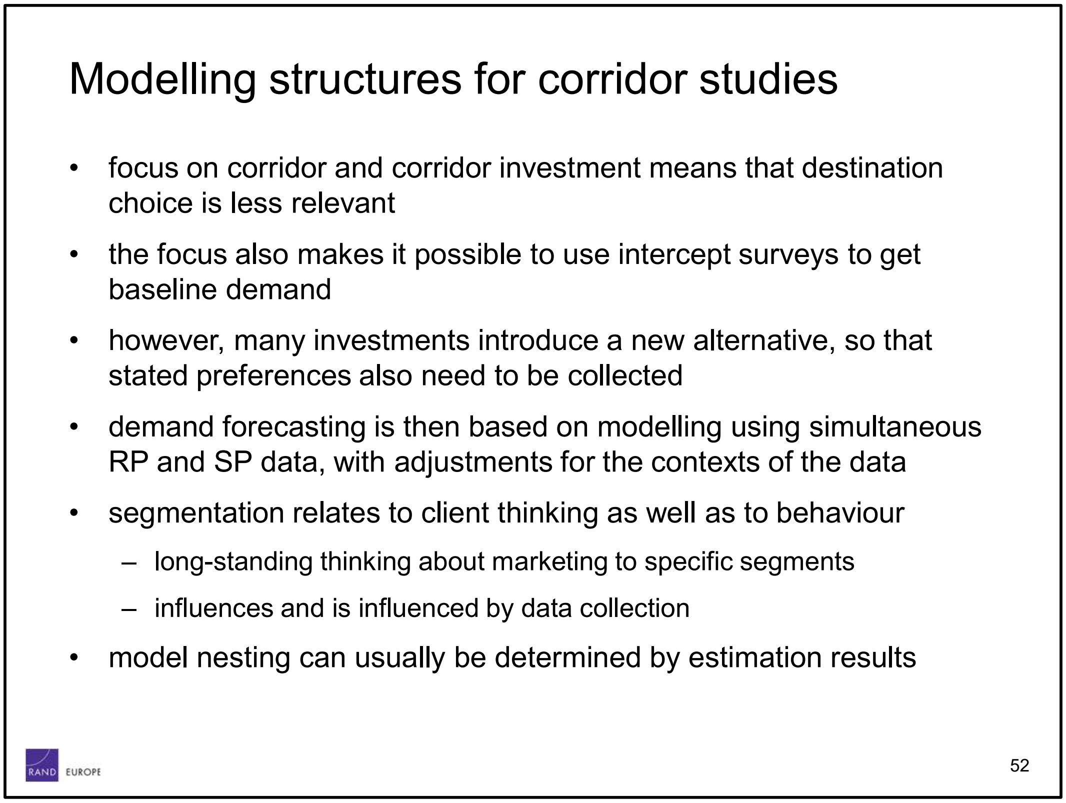
Fehmarn Belt Study

Definition	Trips crossing the Belt (East Denmark and Sweden to Germany and beyond)
Structure	Discrete choice models of mode and route choice
Segments	Business and leisure, with leisure split into single passengers and groups
Forecasting	Full details not available, included forecasting of economic and trade development
Applications	Specific to the particular project, simple sketch planning variant developed for fast scenario testing
Data	Revealed preference and stated preference surveys

The market is complex, with many rail and road vehicle ferry routes, a land route via the Great Belt and Jutland, as well as air travel and (for freight) ship transport. A multilingual survey was needed (e.g. many of the trucks were from Holland). We also used data collected for the Sweden-Denmark connection.

Segmentation was influenced by the Great Belt work and discussions on the Danish side.

Model parameters were provided to the German partners, who made the main forecasts, and to Danish partners, who developed a rapid-response forecasting system. Forecasting was difficult because of the rapid economic development and reorientation to the west of East Germany and Poland.



While some of the choice situations are complicated and predictions are difficult for the new alternatives being introduced, the corridor focus (often a single link) simplifies assignment and other aspects of forecasting, as well as giving a clear screenline for intercept surveys.

Clients have differing points of view, as governments or operators, with consumer surplus or profit as objectives.

What do we learn about modelling behaviour?

- it's easier to model choice between alternatives than participation rates
- it's easier to model generation rates in RP data than from SP or stated intentions
  - respondents don't know what the alternatives are to compare with an imagined new journey
- scaling RP and SP is possible if the same decisions are observed, but the correspondence is not guaranteed
  - but often, no better approach can be found
- forecasting can be successful but we are still learning

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These are general points learned from the studies which may help in similar future situations.

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