The Demand model of the Danish National Model

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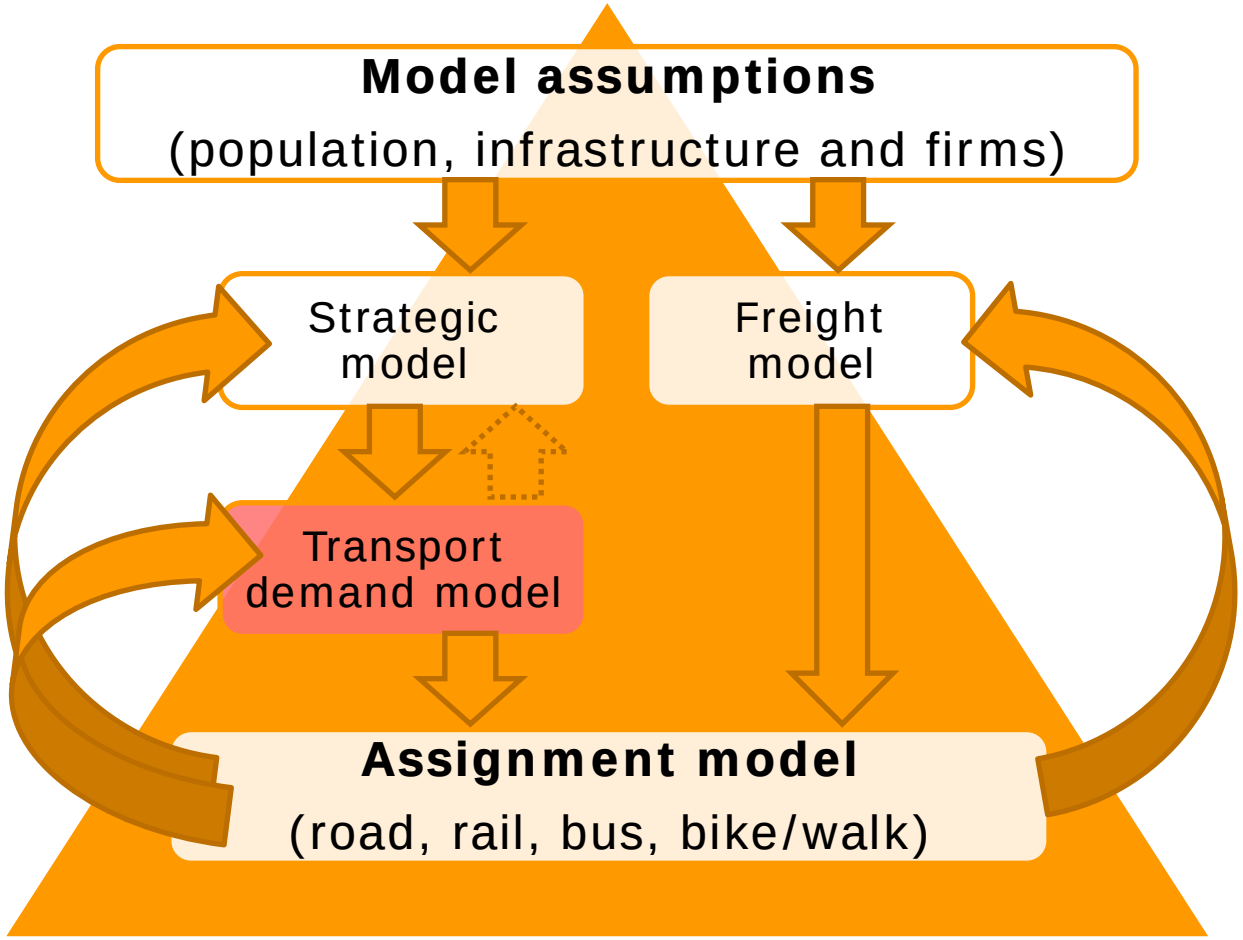
- Modelling daily transport activities
  - Primary tour activity model
  - Secondary tour activity model
- Discussion of “activity” versus “transport”
- Representation of activity chains as matrices
- Summary and conclusion

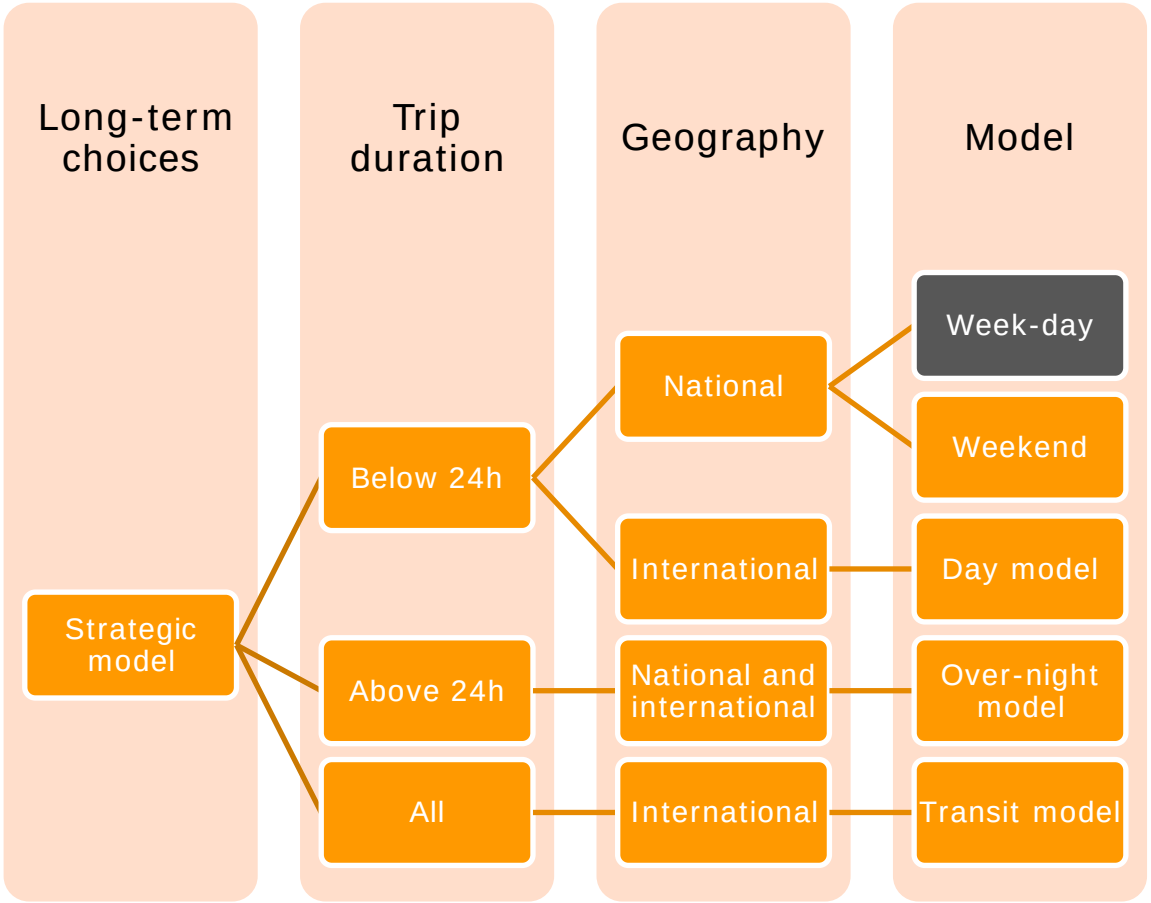
Introduction

- The model to presented will be part of the new National Model



Introduction

- Transport demand is modelled in five parallel models



All demand should be covered

- The aim of the National model is to predict and forecast transport that; (i) is carried out by Danish Citizens, and/or (ii) take place in Denmark
- It is a challenge to cover **all transport** as it involve many data and fairly advanced choice structures
- On the other hand, having demand represented by many parallel models also introduce a challenge of not doing **double counting**

Demand in the different models

- Week-day, weekend, and international day model consider only trips that start at home and return before 03.00.
  - If we allowed non-home based trips, it would conflict with the overnight model
  - People working at night will be addressed in the overnight model
- The weekday and weekend model only consider Danes
- International day trips, represents only trips that starts or ends in Denmark and is below 24h
- International transit traffic represents only foreigners and only trips starting and ending outside Denmark
- Overnight trips cover all trips that start or ends in Denmark, is carried out by Danes or foreigners and have a duration above 24h
- Transit is for trips that starts and ends outside Denmark

Distance versus duration

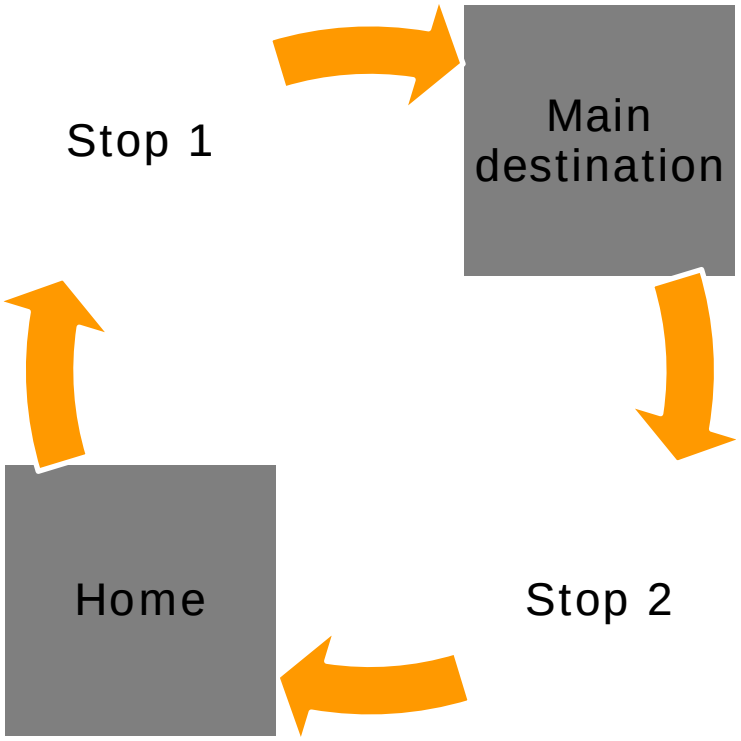
- In the model we do not have seperate models for long-distance trips
- Rather we are focused on the time duration of the trips
- There are two motives for this;

  (i) Today, time rather than the exact distance, is what matters (there has been a much stronger growth distance than overnight trips)

  (ii) To be able to model substitution effects between long- and short distance trips, we cannot stratify on distance

Modelling daily transport

- The model will consider only the two most important tours per individual per day
  - The importance of the tour will be classified according to a ranking based on the trip purpose (e.g. work will dominate leisure)
- Each of the two tours, will be represented by a home, a main destination, and two potential intermediate stops



Tour types

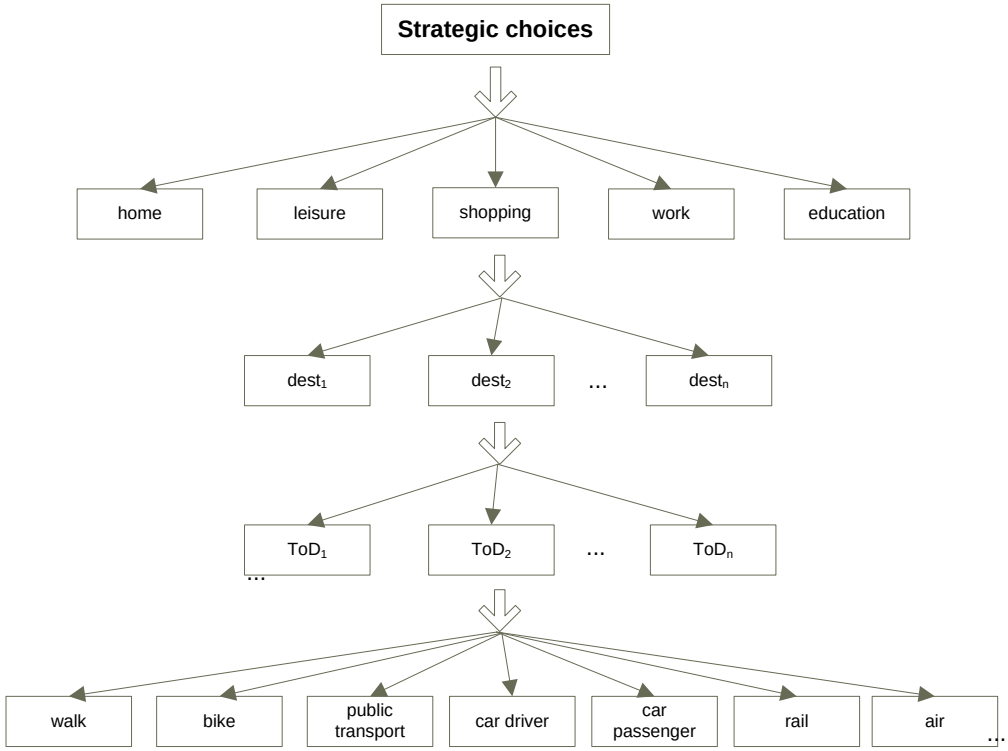
- There will be four tour types;

  (i) home-work-home
  (ii) home-work-stop-home
  (iii) home-stop-work-home
  (iv) home-stop1-work-stop2-home

- For each respondent, a total of 8 trips per day is modelled
- The fact that a small amount of the demand is “excluded” make no difference as we apply a pivot-point approach
  - The model will be “pivoted” around a fixed baseline matrix

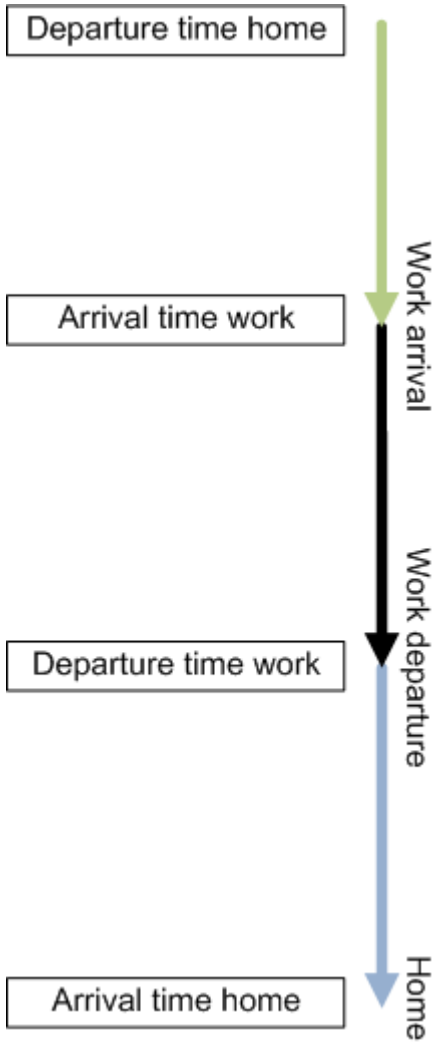
The primary tour model

- First, we distinguish between home and out-of-home activities
- If out-of-home activities is choosen, we consider choice of **destination**, **time-of-day**, and choice of **mode**



Time-of-day choice

- As the model consider tours, we will consider the joint departure time decision
  - The departure from home combined with the departure from work
  - Alternatively, the arrival to work combined with the arrival to home
- If we recognise that activities conclude only after it starts and p define time-intervals, there will be a total of p*(p+1)/2 choice combinations
- The definition of the time interval will be a balance between precision and dimensionality
  - Currently 10 intervals are suggested

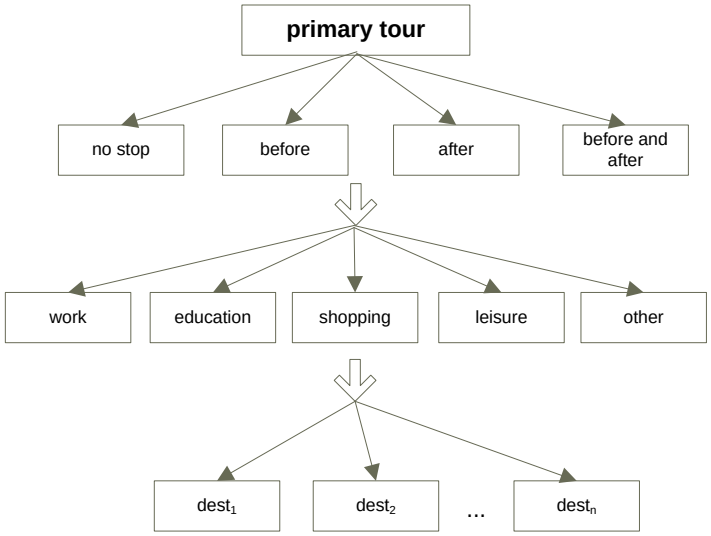


Destination choice

- The number of zones at the most detailed level is 3.670 and as a result, the choice-tree will be enormous
  - For each respondent we will around 5.5 million choice alternatives
- There are two solutions to the issue
  - Random sampling of the destination choice (can reduce the dimensionality from 3.670 zones to around 30-40 zones, without significant bias)
  - Sequential estimation, where we “break” the choice three into smaller sections (logsums are then feed between the different models)

Intermediate stop activity model

- The stop activity model is concerned with stop activities to and from the main destination
- The model will not consider time-of-day choices
  - It is assumed that the time-of-day choice is defined through the main activity
  - This could be an argument for defining activities according to “arrival to work” and “arrival to home” as the time of the intermediate activities will be included



Extensions of the activity based design

- The model is largely dictated by the TU data structure
- An general characteristics of TU is that activities are derived only from transport and not the other way round
  - If people stay at home, we will not monitor their activities (only if they do not travel at all during the day we will aske about a main activity)
  - When people travel, we will not monitor their activities ”on-board”
- These limitations could introduce some bias in how we address labour-marked effects and measure productivity changes
- The modelling of individuals rather than families, is another limitation
  - Not considered a big problem as we will model strategic family decisions jointly in the ”strategic model”

Representations of activities as matrices

- When applying a model with up to 4 destinations (including the home), the dimensionality of the matrix will be very large when applied to a zone system of 3.670 zones
  - However, if we disrupt the linkage between the different trips, we disconnect the dependency between the main destination and stop activities
  - Rather we suggest dividing matrices into two parts; (i) a ”sparse” matrix that represents 3 and 4 dimensional trips, and (ii) a ”complete” matrix consisting of only 2 dimensional trips

Conclusion and summary

- The demand model will consist of five parallel models for week-day, weekend, international day trips, overnight trips, and transit
- The paper has focused on the daily transport as represented in the week-day model
- Demand will be represented in up to two tours per individual
- Each tour will at maximum consist of 4 destinations (including the home)
- The choice set for the primary tour will include
  - Choice of activity, destination, time-of-day, and mode
- The choice set for stop activities will include
  - Stopping pattern, stop activity and destination
- Matrices will be divided in sparse and non-sparse versions