REGIONAL MODELLING SYSTEM

Modelling Data Review Scoping Report

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National Transport Authority

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Foreword

The NTA has developed a Regional Modelling System (RMS) for Ireland that allows for the appraisal of a wide range of potential future transport and land use alternatives. The RMS was developed as part of the Modelling Services Framework (MSF) by the National Transport Authority (NTA), SYSTRA and Jacobs Engineering Ireland.

The National Transport Authority's (NTA) Regional Modelling System comprises the National Demand Forecasting Model, five large-scale, technically complex, detailed and multi-modal regional transport models and a suite of Appraisal Modules covering the entire national transport network of Ireland. The five regional models are focussed on the travel-to-work areas of the major population centres in Ireland, i.e. Dublin, Cork, Galway, Limerick, and Waterford.

The development of the RMS followed a detailed scoping phase informed by NTA and wider stakeholder requirements. The rigorous consultation phase ensured a comprehensive understanding of available data sources and international best practice in regional transport model development.

The five discrete models within the RMS have been developed using a common framework, tied together with the National Demand Forecasting Model. This approach used repeatable methods; ensuring substantial efficiency gains; and, for the first time, delivering consistent model outputs across the five regions.

The RMS captures all day travel demand, thus enabling more accurate modelling of mode choice behaviour and increasingly complex travel patterns, especially in urban areas where traditional nine-to-five working is decreasing. Best practice, innovative approaches were applied to the RMS demand modelling modules including car ownership; parking constraint; demand pricing; and mode and destination choice. The RMS is therefore significantly more responsive to future changes in demographics, economic activity and planning interventions than traditional models.

The models are designed to be used in the assessment of transport policies and schemes that have a local, regional and national impact and they facilitate the assessment of proposed transport schemes at both macro and micro level and are a pre-requisite to creating effective transport strategies.

1 Introduction

1.1 Overview

The National Transport Authority's (NTA) responsibilities include strategic transport planning, integrated public transport network development, walking and cycling promotion, public transport infrastructure provision, effective management of traffic and transport demand and the regulation of public transport services. Transport modelling has a fundamental role to play in helping the NTA deliver on these responsibilities. The Modelling Services Framework was commissioned in 2012 to support the NTA in developing and enhancing its transport modelling capabilities as well as supporting the modelling, testing and appraisal of transport and land use plans.

Under the NTA Modelling Framework, SYSTRA Ltd and Jacobs Engineering Ireland along with sub-consultants Minnerva Transport Planning have been tasked with advancing the modelling capability of the NTA in line with its national transport planning remit.

1.2 Purpose of Scoping Report 4

The purpose of this scoping report is to review the data needed to support the development of a regional modelling system. It is intended to support decision-making regarding the scope and functionality of the regional modelling system and to inform future data-gathering initiatives.

This note follows on from:

- "RMS Scope 1 Greater Dublin Area Model Review" which considered the National Transport Authority (NTA) roles and responsibilities with respect to policy and scheme appraisal needs and the consequent transport modelling requirements;
- "RMS Scope 2 Greater Dublin Area Model Review" which described the current regional model, assessed the model's strengths and weaknesses with respect to NTA's requirements and made suggestions for addressing weaknesses"; and
- "RMS Scope 3 Best Practice Approaches" which examined the guidance on and approaches used for regional transport modelling in major urban areas, drawing on experience in the US, UK and Europe and Australia.

Data collated to date is reviewed and remaining data gaps are identified. Recommendations are made regarding how these gaps might be filled. In cases where data gaps cannot be filled, the possible impacts on the new regional model are identified. Medium to long-term data collection and data management issues are also considered.

This note has been informed by the modelling expertise of the consultant team, discussions between the consultants and the NTA modelling team and a review of a wide range of datasets provided by the NTA and other organisations.

1.3 Report Contents

The content of the remaining sections of this note are summarised in Table 1.1 below.

Table 1.1 Summary of the Contents of this Note

Chapter	Description
Chapter 2	Overview of the data requirements of transport modelling, focussing on those which are relevant to the regional model
Chapter 3	Review of available existing data collated during the scoping phase
Chapter 4	Assessment of the remaining data gaps and the impact these are likely to have on decisions regarding the scope of the regional model
Chapter 5	Initial consideration of medium and longer-term data collection and data management issues, including consideration of the data needed to model future-year scenarios and to keep the base year models up to date.
Chapter 6	A summary of the main data-related issues and recommendations

2 Regional Model Data Requirements

2.1 Introduction

RMS Scope 3 identified numerous separate components that can make up regional transport models. In this chapter we summarise the data required for each potential element of the regional transport model. Emphasis is placed on the requirements identified in RMS Scope 1.

Data are required for a number of reasons in transport modelling including:

- To develop representations of transport demand and supply in the base year;
- For calculation of travel costs;
- To represent the relationship between travel costs and travel choices (e.g. how differences in costs between modes influence mode choice);
- For calibration, i.e. as a basis for adjusting model inputs and parameters to match observed travel patterns;
- For validation, i.e. as an independent check of how well the model matches observed travel patterns;
- As a basis for forecasting; and
- To derive parameters for post modelling analyses such as economic, safety and environmental appraisal.

This chapter identifies the data requirements to support the model components required to develop a regional model, identified in RMS Scope 3. Tables are included for each model component and structured as follows:

- **Description:** a summary of the component;
- **Typical Data Sources:** the types of data which are commonly used in the model component drawing on the review of international best practice (RMS Scope 3);
- **Dimensions:** How the data should be segmented considering spatial and temporal issues, and segmentation by person and trip characteristics; and
- Other comments where necessary.

2.2 Trip Generation and Car Ownership Modelling

2.2.1 Trip Generation Modelling

Trip Generation Modelling	
Description	■ Calculation of daily trip making produced by and attracted to each zone.
Typical Data Sources	**Data Requirements:** ■ Trip rates. ■ Population, employment, education places, retail floorspace and other data which explains generated levels of travel. **Data Sources:** ■ Household travel diary surveys. ■ Census data. ■ Geo-referenced databases on land use types, building locations etc. (e.g. GeoDirectory).
Dimensions	■ The drivers of travel demand must be segmented with separate trip rates calculated for each segment, as required by the demand model (see Section 2.3.11 below). ■ The data will be required for the base and forecast years.

2.2.2 Car Ownership and Competition Modelling

Car Ownership and Competition Modelling	
Description	■ Forecasting the levels of car ownership per model zone (ownership) and the probability of having access to a car to make a given trip (competition).
Typical Data Sources	**Data Requirements:** ■ Numbers of people, adults, licence holders and cars in each household. ■ Income which influences the level of car ownership. ■ Gender, age, economic activity and socio-economic group which may also influence car ownership. **Data Sources:** ■ Travel diary surveys. ■ Census data. ■ Household income surveys.
Dimensions	■ Car ownership can vary by area type. For example car ownership is typically high in rural areas with limited public transport services. A measure of public transport accessibility could potentially be used to calibrate and forecast car ownership or availability. ■ Data required for the base year to calibrate relationships between car ownership, car competition and independent variables (e.g. income) and to segment travel demand by car availability. ■ Independent variables are required for forecasting. ■ Car ownership and car competition estimates are required for each zone. Hence independent variables are required for each zone.

2.3 Demand Modelling

2.3.1 Representation of Transport Demand

Representation of Transport Demand	
Description	■ Matrices of transport demand between pairs of zones are required.
Typical Data Sources	**Inputs to this model component provided by other components:** ■ Generalised cost matrices (see Section 2.3.10) if demand matrices are to be synthesised using destination choice models (see Section 2.3.4). ■ Trip ends from the trip generation model (see Section 2.2.1). **Data Requirements:** ■ Origin / destination surveys. ■ Travel to work and education data. ■ Public transport ticket sales data. ■ Data on visitor numbers for major tourist attractions. ■ Hotel guest bed-nights. **Data Sources:** ■ Household travel diary surveys. ■ Census data. ■ Roadside interviews of car drivers and passengers. ■ At-stop or on-vehicle interviews of public transport passengers. ■ Practitioners are starting to make use of GPS and mobile phone tracking data. ■ Visitor and footfall data from major tourist attractions. ■ Hotel guest numbers from hotel operators or industry groups, tourism agencies, etc.
Dimensions	■ Matrices must be segmented as required in the demand model as discussed in Section 2.3.11. ■ Matrices must be split by mode (see Section 2.3.3) and time of travel (see Section 2.3.5). ■ Forecast year matrices are typically derived using calibrated base year matrices and growth estimates from the trip generation model.
Comments	■ Best practice for demand modelling is to represent home based demand as "tours", i.e., round trips starting and ending at home. Non home based demand may be treated as part of a complex tour (i.e. a tour with more than 1 from-home and 1 to-home leg) or as independent 1-way trips. ■ Matrices used in the assignment models (see Sections 2.4 and 0) are defined using independent 1-way trips. ■ Visitor data often does not record the production location (e.g. home or hotel). ■ Visitor data may only be available for attractions which sell tickets. ■ Travel diary surveys will not provide comprehensive spatial coverage but may be used to calibrate distribution models using gravity, logit or similar methods. ■ Census data will provide comprehensive spatial coverage of travel to work and education.

2.3.2 Trip Frequency

Trip Frequency	
Description	▪ A trip frequency response would determine the total level of trip making from each zone as a function of a measure of the Generalised Cost (GC) of travel. Parameters to determine the sensitivity of this relationship should be calibrated.
Typical Data Sources	**Inputs to this model component provided by other components:** ▪ GC matrices (Section 2.3.10). ▪ Trip ends from the trip generation model (see Section 2.2.1). **Data Requirements:** ▪ Trip rates. **Data Sources:** ▪ Household interview surveys.
Dimensions	▪ Frequency sensitivity parameters are required for each model segment.
Comments	▪ Frequency sensitivity parameters could be obtained from other models or research although this is not best practice. ▪ **A trip frequency** response **is unlikely to be required if walking and cycling modes are included in the mode choice stage.**

2.3.3 Mode Choice

Mode Choice	
Description	▪ The allocation of travel demand to modes depends on relative GCs. Parameters to determine the sensitivity of this relationship should be calibrated.
Typical Data Sources	**Inputs to this model component provided by other components:** ▪ GC matrices (Section 2.3.10). ▪ All mode demand matrices from the destination model (Section 2.3.4) or trip ends from the trip frequency model (Section 0). **Data Requirements:** ▪ Data for base year mode shares. **Data Sources:** ▪ Household travel diary surveys. ▪ Census data.
Dimensions	▪ Mode choice sensitivity parameters are required for each model segment. ▪ Mode constants, which reflect preferences between modes, would be calibrated using the same data if an absolute model form is used. ▪ Sensitivity parameters and mode constants could vary by geographic area or area type.
Comments	▪ Mode choice sensitivity parameters could be obtained from other models or research although this is not best practice.

2.3.4 Destination Choice

Destination Choice	
Description	■ Distribution of travel demand from new developments assuming that GCs are as in the base year. ■ Allocation of demand between attraction zones in forecasting as a function of relative GCs. ■ Parameters to determine the sensitivity of the relationship between demand allocation and GCs should be calibrated.
Typical Data Sources	**Inputs to this model component provided by other components:** ■ GC matrices (Section 2.3.10) ■ Distributions for some new development areas, in particular those **that are specialist in nature (e.g. a hospital, sports stadium, science parks, etc.), could be copied from the base matrices.** ■ Trip ends from the trip frequency model (Section 0). **Data Requirements:** ■ Data for base year trip distributions (the proportion of trips for each GC band). **Data Sources:** ■ Household travel diary surveys. ■ Roadside and passenger interviews. ■ Census data.
Dimensions	■ Destination choice sensitivity parameters are required for each model segment. ■ Destination specific constants, which reflect the inherent attractiveness of each zone, would be calibrated using the same data if an absolute model form is used. ■ Sensitivity parameters and destination specific constants could vary by geographic area or area type.
Comments	■ Destination choice sensitivity parameters could be obtained from other models or research although this is not best practice.

2.3.5 Time of Day Choice

Time of Day Choice	
Description	▪ Allocation of demand between time periods in forecasting as a function of relative GCs. ▪ Parameters to determine the sensitivity of the relationship between demand allocation and GCs should be calibrated.
Typical Data Sources	**Inputs to this model component provided by other components:** ▪ GC matrices (Section 2.3.10). ▪ All day trip matrices from the destination choice model (Section 2.3.4). **Data Requirements:** ▪ Data on volumes of travel across the day are needed to define the time periods used in the model. ▪ Data for the proportion of travel in each time period. **Data Sources:** ▪ Traffic counts. ▪ Public transport passenger counts. ▪ Ticket sales data. ▪ Household travel diary surveys. ▪ Roadside and passenger interviews.
Dimensions	▪ Time period choice sensitivity parameters are required for each model segment. ▪ Time period constants, which reflect the preferences for travelling in each period, would be calibrated using the same data if an absolute model form is used. ▪ Sensitivity parameters and time period constants could vary by geographic area or area type.
Comments	▪ Time period choice sensitivity parameters could be obtained from other models or research although this is not best practice.

2.3.6 Parking and Park & Ride

Parking and Park & Ride	
Description	▪ Adjusting car demand to areas such as the city centre to reflect car parking supply. ▪ Potentially allocating parking between locations and type (e.g. short- or long-stay). ▪ Predicting the use of formal and/or informal park-and-ride.
Typical Data Sources	**Data Requirements:** ▪ Details of the availability and cost of the different forms of parking (residential, private non-residential, public on-street, public off-street etc.) and any restrictions on their use (limited duration of stay, ‘Residents only’, ‘Car Club’, Low Emission Vehicle only’ etc.). ▪ Future year parking charges and costs will be required for forecasting. ▪ Sensitivities of parking choices may be calibrated to replicate counts of the occupancy of each car park. ▪ Information on the proportion of drivers to each area who have access to a free parking space. ▪ Data which were not used to calibrate the parking model should be used to validate its performance. Aggregate revenue information

	may be used. **Data Sources:** ▪ Local knowledge. ▪ On-street and satellite photography (e.g. Google Earth) surveys of parking supply. ▪ Council transport and planning authorities. ▪ Data requests to main parking operators (or public transport operators, in the case of Park and Ride). ▪ Parking operator websites. ▪ Policy documents. ▪ Planning applications. ▪ Household travel diary surveys. ▪ Census data. ▪ Car park occupancy counts.
Dimensions	▪ If the parking model is to allocate between parking location and type then capacity and costs for each location and type will be required. ▪ Parking charges vary by duration and time of day.
Comments	▪ Private Non-Residential parking (e.g. workplace parking for employees) is particularly difficult to estimate, as it is often not visible from the street. The aerial photography provided via Google Earth™ or equivalent data sources is often out of date, so care is needed, if using this as a source of parking supply data. ▪ Data on the use of parking is often limited, so the available data is often all needed to calibrate the parking models. Known parking revenues for particular forms of parking (e.g. public on-street parking meters etc.) and/or off-street locations may provide appropriate validation benchmarks.

2.3.7 Vehicle Occupancy

Vehicle Occupancy	
Description	▪ Car occupancies may be fixed for each model year or could be modelled to be responsive to GCs.
Typical Data Sources	**Data Requirements:** ▪ Base year average car occupancies. ▪ Trends in car occupancy. **Data Sources:** ▪ Household travel diary surveys. ▪ Roadside interview surveys. ▪ Previous versions of household travel diary surveys and roadside interview surveys if available. ▪ Census data.
Dimensions	▪ Occupancies are typically found to vary between journey purposes. They may also vary by time of day and other demand segments such as car availability.
Comments	▪ RMS Scope 1 did not identify the need for variable car occupancy modelling.

2.3.8 Ticket Type Choice

Ticket Type Choice	
Description	■ A facility to predict the usage of each ticket type e.g. single, return, travel cards, etc.
Typical Data Sources	**Data Requirements:** ■ Detailed ticket price and sales data would be required to calibrate the sensitivity of choice of ticket to price, and potentially constants to reflect preferences for each type. **Data Sources:** ■ Data requests to main public transport operators.
Dimensions	■ Ticket type preferences are likely to vary by trip purpose (e.g. commuters are more likely to purchase weekly or monthly tickets) and potentially other demand segments.
Comments	■ RMS Scope 1 did not identify the need for ticket type choice modelling.

2.3.9 Smarter Travel Choices

Smarter Travel Choices	
Description	■ A means of predicting the impacts of smarter travel policies which cannot be directly represented in the assignment models, e.g. workplace and personal travel planning.
Typical Data Sources	**Data Requirements:** ■ Evaluation evidence on the efficacy of smarter travel policies which would be used to derive matrix adjustment factors. **Data Sources:** ■ Smarter travel research and policy documentation.
Dimensions	■ Policies may have different impacts depending on journey length, time of day, purpose, income and car ownership.
Comments	■ UK's Department for Transport have collated evidence on the impact of smarter travel policies in the LSTF Resource Library[1].

2.3.10 Generalised Cost Formulation

Generalised Cost Formulation	
Description	■ Parameters to combine various time and money cost components of travelling into GC.
Typical Data Sources	**Inputs to this model component provided by other components:** ■ Travel time, distance, toll and fare matrices from the road and PT assignment models (Sections 2.4 and 0) may be used in statistical estimation of GC coefficients to explain observed behaviour. **Data Requirements:** ■ Statistically estimated values of time which explain observed travel behaviour. ■ Hourly salary rates and other costs of employment (e.g. pension

[1] http://assets.dft.gov.uk/publications/local-sustainable-transport-fund-guidance-on-the-application-process/lstf-resource-library.pdf

	contributions, benefits, etc.) can be used to estimate values of time for employers business. ▪ Relationships between value of time and income, and parameters such as walk and wait time factors. ▪ Irish data on average fuel consumption rates (litre/km) and costs (€/litre) should be used to calculate operating cost parameters. **Data Sources:** ▪ Revealed preference surveys. ▪ Base year demand matrices. ▪ Stated preference Surveys. ▪ International research. ▪ Census and labour market data.
Dimensions	▪ GC parameters are likely to vary between demand segments such as purpose, car ownership or availability, and income or socio-economic group. ▪ Values of time and vehicle operating costs will change over time.
Comments	▪ A non-linear GC formulation may be required as experience indicates that the sensitivity of demand responses to travel costs reduces with journey duration and distance. ▪ Values of time are generally found to be correlated with economic variables such as income and GDP per capita. ▪ Forecasts of fuel consumption and prices will be required.

2.3.11 Demand Segmentation

Demand Segmentation	
Description	▪ Demand is segmented into categories so that all travellers within the same category can be considered to behave in the same way. In practice this means that GC coefficients (e.g. value of time or fuel costs) and choice sensitivity parameters are defined for each segment.
Typical Data Sources	**Data Requirements:** ▪ Data are required to define segments so that each segment represents a significant volume of travel, and exhibits different travel behaviour. ▪ Evidence of different travel behaviour for each segment. ▪ Information for splitting demand by age, income and car ownership or availability. **Data Sources:** ▪ Household travel diary surveys. ▪ Census data. ▪ International reviews of values of time, elasticities of demand and choice model parameters.
Dimensions	▪ Data to segment demand should ideally be obtained for individual zones or zone-pairs but some data sources may not support this level of detail. ▪ Travel diary surveys will provide information on how the proportions of travel in each segment vary by time of day.

2.3.12 Calibration and Demonstration Tests

Calibration and Demonstration Tests	
Description	▪ Calibration of individual model components is described in other sections. This section relates to ensuring that the overall model system produces realistic results. ▪ Calibration tests should include checking the elasticities of demand to car fuel cost, public transport fare and travel time changes. ▪ Demonstration tests entail making limited changes to forecast assumptions in order to understand how the model responds.
Typical Data Sources	**Inputs to this model component provided by other components:** ▪ Travel time, distance, toll and fare matrices from the road and PT assignment models (Sections 2.4 and 0) may be used in statistical estimation elasticities of demand to cost changes. **Data Requirements:** ▪ Evidence on the elasticities of travel demand. **Data Sources:** ▪ Census data. ▪ Household travel surveys.
Dimensions	▪ Elasticities typically vary between demand segments such as purpose, car ownership or availability, and income or socio-economic group. ▪ A back-cast scenario could be tested if historic forecasting assumptions and vehicle and passenger counts are available.
Comments	▪ If possible it would be preferable to obtain elasticities for the modelled area. Elasticities for the whole of Ireland or from international research could be used if necessary.

2.4 Road Network Model

2.4.1 Zones

Zones	
Description	▪ Definition of zone boundaries.
Typical Data Sources	**Data Requirements:** ▪ Zones should be aggregations or subdivisions of administrative or census areas. GIS files of these boundaries are required. ▪ Mapping of physical features which present barriers to travel is required. ▪ Information of the locations of car parks is useful in defining zones and ensuring that traffic can be accurately loaded onto the network. ▪ Information on land use types (e.g. commercial, residential, education etc.), and building locations for special trip generators/attractors (e.g. hospitals, airports, shopping centres etc.), is useful to determine the dominant land use type in an area to inform creation of zones which have homogenous uses. ▪ Geo-referenced data on total travel demand (e.g. from household surveys, roadside and passenger interviews, Census data) which can be used to calculate total trip making for each zone to ensure that each zone has an appropriate level of demand.

	Data Sources: ▪ Census data. ▪ Household travel surveys. ▪ Roadside and passenger interviews. ▪ Geo-referenced databases on land use types, building locations etc. ▪ Relevant web-sites, Google Earth etc.
Dimensions	▪ n/a.
Comments	▪ A separate zone would not be required for an area with a very small number of trips. Zones in the main modelled area should not contain very large numbers of trips as this will affect the accuracy of assignments, calculation of GCs, demand calculations, etc.

2.4.2 Networks

Networks	
Description	▪ Specification of networks for the Road Assignment model.
Typical Data Sources	**Data Requirements:** ▪ Road network topography and characteristics (e.g. link distances, junction-to-junction connections). ▪ Junction attributes such as saturation flows, junction types (roundabout, signal, give way, etc.), number of lanes, etc. ▪ Traffic signal settings. ▪ Formulae and coefficients for calculating saturation flows. ▪ Speed / flow relationships for limited access roads such as motorways. ▪ Free flow speed. ▪ Plans for network development. **Data Sources:** ▪ Existing road assignment models. ▪ GIS datasets of the road network. ▪ Google Streetview. ▪ Aerial and satellite photography. ▪ Signal setting/timing information from local councils. ▪ International research (e.g. Transport Research Laboratory publications). ▪ GPS or mobile phone tracking to obtain data on free flow speeds/travel times.
Dimensions	▪ A decision on the road categories to include in each area of the model is required.
Comments	▪ The aerial photography provided via Google Earth™ or equivalent data sources is often out of date, so care is needed, particularly in locations where there have been recent infrastructure changes (for example, the introduction of new cycle lanes etc.).

2.4.3 Assignment Parameters

Assignment Parameters	
Description	▪ Parameters that influence the routes between each zone-pair.
Typical Data Sources	**Data Requirements:** ▪ Values of time and vehicle operating costs. ▪ Gap acceptance value. **Data Sources:** ▪ Default Gap acceptance values from Saturn. ▪ See 'Data Sources' Section 2.3.10.
Dimensions	▪ Segments used in Road Assignment may be aggregations of demand modelling segments. If so, average values of time and operating costs must be calculated. ▪ Gap acceptance parameters should in general be consistent across the model but in some cases they may need to be adjusted to replicate the flows and delays which are observed at a junction.

2.4.4 Validation

Validation	
Description	▪ Traffic count data are required for model calibration i.e. adjusting model inputs to match observed flows, and for model validation i.e. checking model performance against counts which were not used in calibration. ▪ It is equally important to ensure that the model replicates travel times and delays to acceptable tolerances.
Typical Data Sources	**Data Requirements:** ▪ Traffic count data. ▪ Travel time and delay data. **Data Sources:** ▪ Manual traffic counts (MCCs). ▪ Automatic traffic counts (ATCs). ▪ Manual observations of queue lengths. ▪ Manual observation of journey times using the Moving Car Observer (MCO) method. ▪ GPS or mobile phone tracking derived data for travel times.
Dimensions	▪ MCCs and ATCs can both provide some segmentation of vehicle types. ▪ Traffic counts and journey time surveys are required for each modelled period.
Comments	▪ Calibration and validation count sets must be different. Counts are required across the whole of the modelled area. ▪ GPS based travel time data potentially offers extensive coverage across Ireland and can be averaged across many weeks or months. MCO data are generally conducted for just a few days. ▪ GPS data is believed to be biased in favour of freight, drivers travelling unfamiliar routes and fleet vehicles. GPS data providers may remove slow or fast moving outliers from results which may lead to some biases.

2.5 Public Transport Network Model

2.5.1 Networks

Public Transport Networks	
Description	■ Specification of networks for the PT Network model, including public transport service definitions (nodes traversed, frequency, transport mode, vehicle capacity etc.).
Typical Data Sources	**Data Requirements:** ■ Public transport service characteristics (routes, headways and sub-mode). ■ Rail, tram and walk link topography. ■ Plans for network and service development. **Data Sources:** ■ Road network model for road network structure. ■ Existing public transport models. ■ Google Streetview. ■ GIS network data for rail and tram links. ■ Published timetables and databases, e.g. in XML format. ■ Data requests to main public transport operators such as Dublin Bus, Irish Rail etc. ■ Relevant websites, e.g. Dublin Bus website. ■ Aerial and satellite photography. ■ Developed Road network. ■ Policy documentation.
Dimensions	■ Service patterns and frequencies may differ between time periods.
Comments	■ It is best practice to ensure that the road network structure is consistent in the road and PT assignment models.

2.5.2 Fares

Fares	
Description	■ Representation of public transport fares in the PT network model.
Typical Data Sources	**Data Requirements:** ■ Published fare tables. ■ Ticket sales data. ■ Future year fare policies. **Data Sources:** ■ Relevant web sites e.g. Dublin Bus website. ■ Data requests to main public transport operators.
Dimensions	■ Fares may vary between time periods. ■ Fares for different ticket types (single, return, travel card, etc.) will need to be averaged to derive fares which are representative for all travellers. Ticket sales data may be used to ensure that each ticket type is assigned the correct weight.
Comments	■ Distance data may also be needed if fares are to be modelled as a function of distance travelled.

2.5.3 Assignment parameters

Assignment parameters	
Description	▪ Parameters that influence the routes between each zone-pair.
Typical Data Sources	**Data Requirements:** ▪ Parameters to calculate crowding penalties, if crowding is modelled. ▪ Coefficients to convert walk time, wait time, in vehicle time, fares, and the number of boardings and / or interchanges to generalised cost. ▪ Parameters for the sensitivity of route choice to differences in GC. **Data Sources:** ▪ Research such as the Passenger Demand Forecasting Handbook, Transport Research Laboratory Report 593 "**The demand for public transport: a practical guide" and WebTAG Unit 3.5.6.**
Dimensions	▪ Crowding penalties and cost coefficients may vary between sub-modes. ▪ Sensitivity to differences in GC may very between demand segments.

2.5.4 Validation and Demonstration Testing

Validation and Demonstration Testing	
Description	▪ Passenger count data are required for model calibration i.e. adjusting model inputs to match observed flows, and validation i.e. checking model performance against counts which were not used in calibration. ▪ The accuracy of travel times must also be checked.
Typical Data Sources	**Data Requirements:** ▪ Public transport boarding and alighting data. ▪ Occupancy data. ▪ Timetable information. ▪ Aggregated patronage and revenue statistics. ▪ Travel time information. ▪ Ticket sales data. **Data Sources:** ▪ Cordon and screenline occupancy surveys. ▪ Data requests to main public transport operators such as Dublin Bus, Irish Rail etc. ▪ Boarding and alighting counts. ▪ Bus travel time surveys. ▪ Local knowledge and web-based travel planners to check the plausibility of modelled routes.
Dimensions	▪ Passenger counts and journey time surveys are required for each modelled period.
Comments	▪ Occupancy surveys are conventionally undertaken using roadside observations which may be inaccurate. ▪ In international practice it is uncommon to reserve a set of passenger counts for independent validation. Generally all counts are used in calibration. Aggregated patronage and revenue surveys may be used to validate individual sub-modes. ▪ Where possible, modelled bus journey times should be checked against observed journey times (rather than timetabled bus times).

2.6 Other Modes of Transport

2.6.1 Active Modes

Active Modes	
Description	▪ Representation of walking and cycling in the demand model. ▪ Potentially assigning walking and cycling demand to networks.
Typical Data Sources	**Data Requirements:** ▪ Matrices of walking and cycling demand. ▪ Cycle ownership data. ▪ Cyclist and pedestrian count data. ▪ Footpaths and pedestrian bridges which are not in the road network model. ▪ Passenger car units (PCUs) for bicycles if they are to be assigned to the road network. **Data Sources:** ▪ Travel diary surveys. ▪ Census data. ▪ Cyclist and pedestrian counts. ▪ Aerial and satellite photography, Google Streetview, on-line journey planners, etc.
Dimensions	▪ Matrices should be developed separately for walking and cycling as they will have different distributions. The matrices could subsequently be aggregated within the demand model. ▪ Matrices will be required for each time period and demand segment.
Comments	▪ Travel diary surveys will not provide comprehensive spatial coverage but may be used to calibrate distribution models using gravity, logit or similar methods. ▪ Census data will provide comprehensive spatial coverage of travel to work and education by active modes. ▪ Cycle use may be affected by factors including gender, age, household structure, dwelling type, etc. ▪ Pedestrian movements in the city centre may include many tourists who may not be represented in the travel demand matrices.

2.6.2 Taxis

	Taxis
Description	■ Inclusion of the volume of taxi traffic in the car matrices, or potentially treating taxis as a distinct mode.
Typical Data Sources	**Data Requirements:** ■ Taxi flows on links. ■ Taxi boarding and alighting data. ■ Taxi fare tables. **Data Sources:** ■ Travel diary surveys. ■ MCC data if taxis are identified as a separate category to car. ■ Taxi boarding, alighting and vehicle counts at key generators (e.g. the airport, Heuston Station, etc.) ■ Taxi operator websites. ■ Taxi regulators.
Dimensions	■ If taxis were modelled as a separate mode then data would be required for each modelled time period and demand segment.
Comments	■ Most regional models do not treat taxi as a separate mode. The type of data required will depend on the sophistication of modelling which is required. ■ Census travel to work and/or education data does not include taxi as a separate mode from car.

2.6.3 Freight

	Freight
Description	■ Deriving a matrix of goods vehicle demand for assignment within the road network model. ■ The relationship between travel costs and the distribution and mode share of freight demand could be modelled, or assumed to be fixed. Full freight modelling would usually start from an analysis of the amount (weight or volume) of different commodities being moved from place to place, with specific focus on ports, freight-handling facilities and other major generators of freight movements; and then estimate mode share as a function of time and money costs. A simpler own-cost elasticity model is an alternative approach.
Typical Data Sources	**Data Requirements:** ■ Goods vehicle counts. ■ Average tonnage per vehicle (if full freight modelling is to be employed). ■ Relationships between transportation costs and freight (tonnage or vehicle) demand (if full freight or elasticity models are to be employed). ■ Journey times for goods vehicles. ■ Operating cost and values of time for goods vehicles. **Data Sources:** ■ ATC and MCC counts. ■ Surveys of freight-handling firms, port operators, etc. (vehicle movements or tonnage). ■ Journey time surveys for goods vehicles. ■ GPS-tracking data may be available for heavy goods vehicles.

	▪ Elasticities or cost sensitivity parameters (if freight demand modelling is required).
Dimensions	▪ Freight demand should be segmented into different goods vehicle categories, e.g. light, medium and heavy. ▪ Matrices will be required for each time of day. ▪ Future year forecast matrices will be required. These could be calculated based on datasets of freight generators (e.g. from a regional economic model) or on relationships between freight movements and economic activity.
Comments	▪ In many regional transport models freight demand is assumed to be insensitive to changes in travel time and cost. ▪ In RMS Scope 1 it was identified that freight demand modelling was not a priority for the NTA. ▪ RMS Scope 3 concludes that it is best practice to include light and other goods vehicles separately in the road assignment model, but that freight demand modelling is time and resource intensive.

2.6.4 Airport Surface Access

Airport Surface Access	
Description	▪ Representation within the model of travel choices for air passengers for their trips to and from the Airport and recognising that these choices for surface access will be influenced by different factors not applicable to other demand segments – including higher-than-average proportion of visitors, luggage, differences in the value of time and perceived reliability, non-standard time of day profiles, and non-standard car availability.
Typical Data Sources	**Inputs to this model component provided by other components:** ▪ GC matrices (Section 2.3.10). **Data Requirements:** ▪ Present day and forecast air passenger numbers. ▪ Access and egress mode shares. ▪ Parameters to represent the sensitivity of airport access/egress travel choices to travel costs. **Data Sources:** ▪ Air passenger forecasts. ▪ Airport passenger surveys. ▪ Travel diary surveys.
Dimensions	▪ Air passenger travel demand matrices must be segmented by time of day. ▪ If a bespoke airport passenger access mode choice model is required demand segments may not be the same as used in the general demand model. For example long-haul and short-haul passengers make different travel choices.

2.7 Appraisal and Other Post Model Utilities

2.7.1 Economic and Financial Appraisal

Economic and Financial Appraisal	
Description	▪ Estimation of benefits for travellers (travel time and cost savings, etc.) and financial impacts of transport interventions.
Typical Data Sources	**Inputs to this model component provided by other components:** ▪ Travel demand and cost data. **Data Requirements:** ▪ Discount rate. ▪ Tax rates. ▪ Scheme costs. ▪ Inflation assumptions. ▪ Public transport operating costs. ▪ Annualisation factors. ▪ Appraisal values of time. ▪ Economic output data and elasticities of output to travel costs or accessibility. ▪ Relationships between journey time reliability and average speeds ▪ Willingness to pay for journey time reliability. **Data Sources:** ▪ Automatic traffic counts (for deriving annualisation factors). ▪ Household travel diary surveys. ▪ Engineering and design studies. ▪ Irish and international research and guidance.
Dimensions	▪ Forecasts of value of time and operating cost changes are required for the duration of the appraisal period. ▪ Values of time and operating costs are required for each demand segment. ▪ Annualisation factors are needed to apply to each modelled period to estimate benefits for a full year.
Comments	▪ Any inflation assumptions in scheme costs must be explicitly documented. ▪ Values of time used in the appraisal may differ from those used to model travel behaviour. Values used should be calibrated to replicate travel choices. Appraisal values should reflect the real impact on the economy and wellbeing. ▪ Annualisation factors for benefits are not the same as factors for travel demand. Decongestion benefits per traveller are generally higher for higher flow levels than for low flows.

2.7.2 Road Safety

Road Safety	
Description	■ Estimation of the number of road traffic accidents. ■ Monetary valuation of accidents.
Typical Data Sources	**Inputs to this model component provided by other components:** ■ Traffic flows and speeds on links and at junctions. **Data Requirements:** ■ Road traffic accidents per vehicle kilometre. ■ Accident cost data. ■ Monetary valuations for each accident severity category (e.g. damage only, slight, serious and fatal). ■ Discount rate. **Data Sources:** ■ Current and historic accident records. ■ Accident cost records from Insurance companies etc. ■ Stated preference Surveys to derive accident severity monetary values.
Dimensions	■ Estimates should be made for a number of accident severity categories. ■ Accident rates (per kilometre) vary by road type (e.g. motorway, dual carriageway, etc.) and speed limit. ■ Accident rates may change over time as a result of changes in vehicle technology, traffic engineering, driver behaviour, etc. ■ Monetary valuations will be correlated with economic variables (e.g. income or GDP/capita) which will vary year by year. ■ Road safety calculations should be undertaken for the full appraisal period.

2.7.3 Environmental

Environmental	
Description	■ Calculation of emissions and noise impacts of transport.
Typical Data Sources	**Inputs to this model component provided by other components:** ■ Traffic flows and speeds on links. **Data Requirements:** ■ Fleet make-up (age, engine size and fuel type). ■ Emissions rates for each type of vehicle. ■ Forecasts of how the fleet mix will evolve. ■ Monetary valuations of the impacts of each tonne of carbon. ■ (Potentially) monetary valuations of the impacts of changes in emission concentrations. ■ Monetary valuations of the discomfort, stress and health effects of exposure to noise. ■ Discount rate. ■ Population data. **Data Sources:** ■ Vehicle licencing data. ■ Vehicle ownership projections. ■ Irish and international research into emissions rates.

	▪ Number plate surveys and vehicle licencing databases. ▪ Census data. ▪ Road network model.
Dimensions	▪ Emissions rates are required for carbon, carbon monoxide, nitrous oxides, PM10 and volatile organic compounds. ▪ It is beneficial to have spatially detailed population data to improve the accuracy of noise and local air quality calculations. ▪ Impacts should be calculated for the full appraisal period.
Comments	▪ Monetary valuation of exposure to local air pollution is not yet common practice.

2.7.4 Physical Fitness

Physical Fitness	
Description	▪ Assessment of the impacts of travel choices on physical activity and hence health and quality of life.
Typical Data Sources	**Data Requirements:** ▪ Walking and cycling demand, travel time and distances can be obtained from the transport model. ▪ Relationships between activity levels and mortality. ▪ Monetary valuations of life and quality of life. ▪ Discount rate. **Data Sources:** ▪ Census data. ▪ International research.
Dimensions	▪ Monetary valuations will be correlated with economic variables (e.g. income or GDP/capita) which will vary year by year. ▪ Impacts should be calculated for the full appraisal period.
Comments	▪ The World Health Organisation's Health and Economic Assessment Tool (HEAT) for walking and cycling can be used to estimate the impacts of activity levels on mortality but not on illness and physical fitness.

3 Available Existing Data & Sources

3.1 Introduction

In this chapter we describe the various datasets that have been collated to date, or that are available if required.

To help structure this discussion the datasets are grouped by the modelling component which they would inform.

3.2 Trip Generation, Car Ownership and Demand Forecasting

3.2.1 2011 Census Data

Description: Demographic data (population by age band, number of households by household car ownership etc.) from the 2011 Census.

Relevant Modelling Aspects: These data will be used in the estimation of trip-rates and to estimate the vectors of trip productions and attractions by zone and journey purpose, within the trip generation model. They will also be used to calibrate the residents-car-ownership model.

3.2.2 Current Planning Data

Description: Data (other than population) which can be used to calibrate the trip-end model. Retail floorspace was available in 2006, but may not have been updated. The 2006 retail floorspace data were found not to be well correlated with shopping attractions. Employment by industry type is available for estimating trip ends.

Relevant Modelling Aspects: These data will be used to estimate the vectors of trip productions and attractions by zone for the non-POWSCAR journey purposes (commute and education) within the trip generation model.

Other Comments: It may be possible to use the NTA's settlement type data as an additional 'explanatory variable' within the calibration of the trip-end model.

3.2.3 Future Planning and Land-Use Scenarios

Description: Forecasts of demographic data such as population, employment, schools places and retail floorspace by zone.

Relevant Modelling Aspects: This information will be used to predict changes in travel demand over time, within the trip generation model.

Other Comments: Population and employment forecasts for each model zone will be required. These will be undertaken by NTA in conjunction with the Department of Environment, Heritage and Local Government (DOEHLG) and the relevant Local

Authorities, with a view to having an agreed set of forecasts by the end of 2013. Other data such as retail floorspace may be useful in the development of travel forecasts, depending on how the base-year trip-end model is calibrated.

These datasets are likely to evolve as relevant planning authorities revise their various local and regional development plans and forecasts. Therefore this dataset is considered as part of an ongoing 'Maintaining Planning Forecasts' process. We consider this form of data collection further in Chapter 5 of this report.

3.2.4 2006 and 2011 POWSCAR data

Description: The Place of Work, School or College - Census of Anonymised Records (POWSCAR) data (collected as part of the 2011 Census) provides detailed information about the home location and the normal place of work or education and the usual mode of travel between these home and work/education locations. The corresponding POWCAR data from the 2002 and 2006 Censuses provides corresponding data for travel to work only (i.e. the 2011 dataset is the first to include travel to education).

An estimation of employment, school and college spaces etc. (by zone) may be derived from the POWSCAR data.

POWSCAR also contains the following information about respondents:

- Car availability;
- Socio-economic group; and
- Age.

Relevant Modelling Aspects: POWSCAR data obviously provides an unrivalled source of information about base-year commuting and travel-to-education patterns within the Residents' Demand Forecasting model. It also provides information about the number of jobs and education spaces in different zones which may be used in the trip generation modelling.

The car availability data may be used to calibrate the car ownership model.

Socio-economic group could potentially be used to segment travel demand as an alternative to income.

POWSCAR includes data on all transport modes including walking and cycling.

Other Comments: The POWSCAR data need to be supplemented by other household travel diary information (e.g., to estimate trip-rates and time of day profiles which can be used to convert the POWSCAR matrices into daily Production-Attraction matrices and Origin-Destination trip-matrices for specific time periods.

The 2002 and 2006 POWCAR datasets can provide additional time series information on home to work travel patterns, providing potentially-useful information on changes in the commuting travel pattern over time. This may be useful in the calibration of demand responses if corresponding travel time and cost data can be obtained.

The POWSCAR dataset segments employment by employment type (e.g. industry, services, retail etc.) which can be used to estimate attractions for non-commuting journey purposes.

3.2.5 Household Travel Diary Surveys (2006 and 2012)

Description: The 2006 data set contains over 2,600 travel diaries providing detailed information about a full week's worth of travel by all **11+-year** old members of around 2,300 households selected from across the Greater Dublin Area. The number of diaries completed per sampled household is rather low (<1.15 diaries per household) compared to expected household size, possibly because the requirement to record a full week's travel has impacted on response rates. The dataset contains details of around 40,000 1-way journeys made by residents of the GDA, though this will include a large amount of 'duplication' where the same journey is made on more than one of the days of the recorded week and/or by more than one member of the household. 37,200 of these 1-way trip records include a valid trip purpose.

The 2012 data set contains around 10,000 travel diaries providing detailed information about travel over two consecutive days by all **4+-year old** members of around 4,500 households selected from across Ireland. The ratio of diaries to households is around 2.2, which is much closer to the expected average household size than the 2006 sample. Around 1,700 of the surveyed households were in the Greater Dublin Area, suggesting that around 3,700 of the travel diaries will have been completed by residents of the GDA. The dataset includes details of around 25,000 journeys in, from or to the GDA, though again this includes 'duplication' of journeys which are made on both days or where the same journey was made by more than one family member.

The travel diary survey also includes information on:

- Household size;
- Household car ownership;
- Income;
- Age;
- The number of persons travelling together; and
- Access to free or paid for parking.

Relevant Modelling Aspects: These datasets are clearly extremely useful in building and calibrating the residents' trip generation model. These data can also be used to inform the choice of car ownership/availability demand segments within the car ownership modelling (by identifying how different household structures and car ownership levels affect mode choice) and to calibrate demand model sensitivities.

The household size and car ownership data can be used in segmenting demand by car ownership or availability category. Income data may also be used to calibrate car ownership or availability models.

The income data may be useful to calculate values of time for employers' business travel, although additional information on non-salary costs will also be needed.

The travel diary survey data may also support the calibration of mode constants for use in the PT network model.

The travel diary surveys include data on all transport modes including walking and cycling.

Car occupancy rates can be derived for each demand segment.

Other Comments: if we assume that the calibration of model parameters and distributions would ideally require around 100 observations (to avoid a single response having more than a 1% impact on the relevant parameter value) then the set of 2,600 travel diaries in 2006 will support a subdivision of GDA travel into up to 26 equal demand segments, while the 3,700 GDA travel diaries in the 2012 dataset will support up to 37 equal demand segments. A standard split by three levels of household car ownerships and four economic status categories (Student/in-work/Unemployed/Retired) will therefore leave only one remaining 50/50 split of the 2006 data (e.g. City Centre vs Rest of GDA), while the 2012 data will support a 3-way split (e.g. City Centre/Inside M50/Rest of GDA). Combining the two datasets would support a 5-way split (or two separate 50/50 splits), provided the relevant travel behaviour has not changed significantly between the two surveyed years.

3.2.6 Smarter Travel Surveys

Description: Large-scale household baseline travel surveys were conducted in Limerick, Dungarvan and Westport as part of the baseline data collection for a program of Smarter Travel Initiatives in these three areas. The datasets for Dungarvan and Westport are of limited use in a GDA context, because of the difference in nature between these towns and the Greater Dublin Area. The Limerick dataset (involving details of over 5,800 1-way trips by Limerick residents) may provide some additional information on differences in trip rates and mode choice between different segments of the residents of a large Irish city.

We understand that a Smarter Travel monitoring programme is underway which may provide further household data in the near future.

Relevant Modelling Aspects: Use of data to calibrate residents' travel behaviour, additional insight regarding variations in car ownership and use (within the car ownership modelling) and potential uses within the validation of the residents' demand forecasting model.

The monitoring data can be used to estimate the impacts of smarter travel within the demand model.

Other Comments: Differences between Limerick and the GDA should be borne in mind if/when using this dataset. The Dungarvan and Westport datasets are of limited use in a GDA context, though these two datasets may be of use for other regional models

3.2.7 CSO QNHS

Description: The Quarterly National Household Survey (QNHS) began in September 1997, replacing the annual Labour Force Survey (LFS). It is a key data source for employment and unemployment in Ireland. It also collects information on special social topics. It produces figures on those at work and unemployed, economic sectors, male/female differences, participation rates, household composition and level of education by age and economic status and so on. Topics covered to date include housing/housing quality, crime and victimisation, recycling, travel to work and health. The QNHS is also the main inter censal source of population flows (emigration and immigration). This is an important function as changing population trends have to be measured regularly in a fast changing society.

Relevant Modelling Aspects: These data may inform the creation of future planning forecasts, particularly to identify economic and demographic changes which have occurred since the 2011 Census.

3.2.8 Rail, LUAS and Bus Ticket Data

Description: Table 3.1 below summarises the various public transport ticket data sets which are available.

Table 3.1 Available Public Transport Ticket Data

Source	Type	Date	Time Period(s)	Mode(s)	Geography	Disaggregation	Note
Rail Ticket Data	Ticket sales, stop-to-stop volumes plus boardings / alightings, zone tickets by place of issue	On-going	All	Rail	Complete network	By ticket type, e.g. single, return	Short Hop Zone: Full ticket sales data for 2011 includes single, return and point to point period ticket sales by origin/destination. Total zonal ticket sales for short hop zone and smartcard (monthly and annual) validations by origin/ destination (though some numbers appear questionable, probably due to station barriers not in operation and no incentive to validate monthly/annual if gate is open). No free pass or concessionary data obtained for integrated ticketing. No temporal data requested to date. Outer commuter and intercity: passenger and revenue for standard tickets (i.e. excluding concessionary - e.g. free travel pass - and webfares) for select ODs.
Multi-Modal Ticket Data (I.E.)	Ticket sales, by place of issue	On-going	All	Combined Modes, e.g. Rail plus Bus	Complete network	By ticket type, e.g. single, return	Also have validations of multi-modal tickets on Dublin Bus by location (i.e. by stage by route), but no temporal information.
LUAS Ticket Data	Ticket sales, boarding stop and alighting zone/stage	2011 received, more on request	All	LUAS	Complete LUAS Network (Red and Green Lines)	By ticket type, e.g. single, return	Ticket sale data for 2011 and 2012 received for integrated ticketing is by ticket type (i.e. number of zones travelled, single, return, 7-day, 30-day). No boarding stop data included. No temporal data included. No alighting zone/stop included. Taxsaver ticket sale data available zone to zone.

							2012 received for integrated ticketing - but permission for use of any data received for the purpose of the integrated ticketing model would need to be sought from the operators. This data is commercially sensitive and has been given for the purposes of integrated ticketing only.
Bus Ticket Data	Ticket sales, boarding stop and alighting zone/stage	On-going	All	Bus	Complete network	By ticket type, e.g. single, return	No source is known for alighting zone/stage for Dublin Bus. Full 2012 and 2011 ticket data received including taxsaver and multimodal. Boardings by route by stage by ticket type provided. No temporal data requested.
LEAP Ticket Data	Ticket sales, boarding stop and alighting zone/stage	On-going	All	Rail, LUAS, Bus	Complete network	By ticket type, e.g. single, return	Only single ticket on leap Data received for June/July 2012 showing trips by mode by fare. No geographic data obtainable directly from Leap (they have the "id" of the terminal that the card was "tagged-on"/"tagged-off", but no idea where they are, that information is only available from the operators and probably very difficult to get for bus as the terminals move around) Only the last 6 week of data is kept.
	Note that not only a relatively small proportion of PT journeys use a LEAP card						

Relevant Modelling Aspects: It will be possible to use these ticket data as an input to the development of the public transport demand matrix.

Other Comments: These data will not include any information about demand segment (journey purpose, car ownership, income, etc.). Factors derived from the travel diary surveys could be developed to split up the PT matrices as required.

The ticket sales data do not provide true origin (e.g. the home location) and destination locations. It is possible to estimate the true origin and destination zones by assuming catchment radii. These data are in origin-destination (OD) format rather than production-attraction (PA) as required for the demand model. It may be possible to derive factors from the travel diary survey and POWSCAR to convert from OD to PA format.

Care is needed to ensure that rail trips which do not require the purchase of a station-to-station ticket (e.g. season tickets) are included properly. Travel made using season tickets is often not fully reported in such datasets, and the alighting stage or station may not be recorded.

Most of the datasets listed above do not include time of day segmentation. Time of day segmentation could be estimated from other datasets including household surveys and station entry/exit counts.

Both Irish Rail and Luas data sets of ticket sales also include revenue as well as demand and could, therefore, be used to derive fare tables.

3.2.9 Park and Ride Supply Data

Description: Up-to-date data on the (official) car park capacity at each of the main Park and Ride rail and LUAS stations is readily available. In addition, the data relating to private non-residential parking capacity described in detail below will provide additional information about the capacity of informal on-street and off-street park and ride in the vicinity of the main public transport interchanges.

Relevant Modelling Aspects: Calibration and / or validation of the formal and informal Park and Ride modelling.

3.2.10 LUAS and Irish Rail Park and Ride Use

Description: Surveys of usage are likely to have been undertaken at LUAS and Irish Rail stations. At a minimum these would detail the number of vehicles occupying the car parks over the course of both AM and PM periods.

Relevant Modelling Aspects: Calibration of the public transport network model, in particular the Park and Ride component of the base-year demand.

3.2.11 Parking Capacity Data

Description: Details regarding the location, capacity and cost of all (or most) off-street and on-street Private Non-Residential car parking sites in South Dublin CC, Fingal, Dublin City and Dun Laoghaire Rathdown County Council Areas obtained from the Valuations Office and relevant County Councils (via the Dublinked website (http://www.dublinked.i.e./)

Relevant Modelling Aspects: Calibration of parking supply model (if required).

Other Comments: Our initial analysis of these parking data, including the identification of a number of data quality issues, is described in detail in a separate Scoping Report (*Data Review Note 2: GDA Parking Supply Data*).

3.2.12 Data on Parking Use

Description: Revenues of both on and off-street public car parks may allow for the derivation of car park use in non-private car parks.

Relevant Modelling Aspects: Calibration and validation of the parking model

3.2.13 Data Gaps

With reference to Sections 2.2 and 2.3 the following data gaps have been identified:

- Spatially extensive origin-destination data for non-POWSCAR purposes (e.g. interviews or GPS tracking data);
- Data on PT travel using season tickets;
- Visitor numbers and hotel bed guest-nights;
- Irish evaluation data on the impacts of smarter travel policies;
- Travel demand elasticities; and
- Parking utilisation.

3.3 Road Network Modelling

3.3.1 NavTeq Road Network

Description: GIS Road network layer (NavTeq or equivalent)

Relevant Modelling Aspects: NavTeq data or equivalent can be used as the one of the main dataset in the creation of the road network within the traffic model.

Other Comments: Street-level fully routable vector road network with many navigation attributes such as number of lanes, speeds, direction of travel and access restrictions with dates and times that they apply, named streets, many paths and pedestrian-only routes and bridges included**.**

3.3.2 Google Earth™

Description: Google Earth™ and Streetview™, and other aerial and satellite photography can be used to check network and junction detail. It can also be used to provide information about potential off-street walking routes (e.g. across parks etc.).

Relevant Modelling Aspects: Checking details of the coding the networks used in the road network (traffic, cycling and walking) models

Other Comments: The aerial photography provided via Google Earth™ and equivalent data sources are often out of date, so care is needed if using these as primary data sources.

3.3.3 SCATS Traffic Signal Data

Description: SCATS (Sydney Co-ordinated Adaptive Traffic System) adapts traffic signal phase duration to traffic flows in order to maximise network efficiency in a coordinated, automatic way. Historical data can be extracted from the system describing signal settings and traffic flows across a large part of the Dublin road network for particular times of a day.

Relevant Modelling Aspects: The SCATS data can be used to inform the coding of signalised junctions within the traffic model.

3.3.4 Guidelines on a Common Appraisal Framework for Transport Projects and Programmes[2]

Description: Department of Transport guidelines for the appraisal of transport projects and programmes. Parameters are provided for:

- Values of time for working time, commuters and others for year 2002;
- Vehicle operating costs (by vehicle and fuel type) for year 2002;
- Accident valuations by severity type for year 2002;
- Annual growth factors for the above parameters;
- Pollutant emissions rates by vehicle and fuel type; and
- Monetary costs per gram of pollutant for year 2002.

Relevant Modelling Aspects:

- GC parameters for the demand and assignment models;
- Economic and financial appraisal;
- Road safety appraisal; and
- Environmental appraisal.

3.3.5 Project Appraisal Guidelines[3]

Description: National Roads Authority guidelines for appraisal of roads projects. Parameters are provided for:

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www.transport.ie/upload/general/11801-DOT_COMMON_APPRAISAL_FRAMEWORK1-0.PDF

[3] www.nra.ie/policy-publications/project-appraisal-guideli/

- Forecasts of traffic growth between 2006 and 2040 for seven regions of Ireland;
- Discount rate;
- Appraisal period;
- Road maintenance costs (year 2009);
- Values of time by vehicle type and purpose (year 2009);
- Accident rates by road type and severity type;
- Accident valuations by severity type for year 2009;
- Fuel costs and non-fuel vehicle operating costs for year 2009;
- Fuel tax rates;
- Costs per tonne of carbon and other greenhouse gases;
- Traffic seasonality factors;
- Vehicle occupancy rates by vehicle type and journey purpose;
- Annual growth factors for the above parameters.

Relevant Modelling Aspects:

- GC parameters for the demand and assignment models;
- Economic and financial appraisal;
- Road safety appraisal; and
- Environmental appraisal.

3.3.6 Classified and Volumetric Traffic Counts (2009 – 2013)

Description: A total of 690 traffic counts, of which 583 have been successfully linked to the GDA road network, representing snap shots of GDA traffic taken between 2009 and 2012 at around 423 different locations across the GDA.

At a national level, a total of 8,495 traffic counts have been collected from local authorities as part of the regional data collection programme. These counts provide a representation of traffic at approximately 4,021 different locations across the country taken between 2009 and 2013.

Relevant Modelling Aspects: Calibration and validation of the traffic model (and the cycling network model, if required).

Other Comments: Further details of these traffic counts, including maps showing their locations, are provided in *Data Review Note 1: Existing GDA Traffic Data*.

3.3.7 Annual Multi-Modal Canal Cordon Counts (1997-2011)

Description: Passenger count survey covering cars, bus, rail, LUAS, taxis, pedestrians and cyclists crossing the ‘Canal Cordon’ round Dublin city centre during weekday peak period (0700-1000) from November 1997 to 2012 (with some gaps)

Relevant Modelling Aspects: Calibration and / or validation of the various network models (including any ‘back-casting’ tests). Potentially calibration of the mode, destination and time of day choice if corresponding travel time and cost data are available.

3.3.8 Journey Time Survey Data

Description: The NTA commissioned moving-observer journey time surveys on 22 routes (16 Radial, 5 Orbital, and the Port Tunnel) to capture speed samples at peak and inter-peak times. Similar surveys are conducted each year from 2006 to 2009, and then again in 2012.

Relevant Modelling Aspects: Validation of the traffic model.

Other Comments: Further details of these journey-time datasets, including maps illustrating their locations, are provided in are provided in *Data Review Note 1: Existing GDA Traffic Data*.

3.3.9 Administrative and Census Boundaries

Description: GIS tables to define administrative and census boundaries. All official boundaries are available.

Relevant Modelling Aspects: Zones should be defined as groups of administrative or census areas, or by splitting such areas.

3.3.10 GeoDirectory

Description: GeoDirectory is a geo-referenced database of all buildings in Ireland which is maintained by Ordnance Survey Ireland and An Post. It includes fields for building use (residential, commercial, both or unknown) and building group type (e.g. shopping centre, industrial estate, etc.).

Relevant Modelling Aspects: GeoDirectory data can be used to determine the dominant land use type in an area to inform creation of zones which have homogenous uses.

3.3.11 Data Gaps

With reference to Section 2.4 the following data gaps have been identified:

- saturation flow formulae and parameters;
- speed/flow relationships and free-flow speeds;

- plans for network development; and
- queue length surveys.

3.4 Public Transport Network Modelling

3.4.1 Public Transport Service Pattern Information (e.g. as used in the NTA's Journey Planner

www.nationaltransport.ie/public-transport-services/journey-planner/

Description: Up-to-date detailed public transport service pattern information (routing, stopping patterns and timetables) for all official timetabled public transport services in Ireland.

Relevant Modelling Aspects: Specification of base year PT service patterns including scheduled journey times.

Other Comments: The NTA's database of current public transport service patterns is particularly useful, in that it contains detailed routing information (in addition to the stop-to-stop-based version of the timetables), which enables the public transport services to be allocated accurately and easily to specific routes through the road and rail networks.

If the data can be obtained in raw form (e.g. XML format) automated processes can be applied to convert the timetable information for use in the PT network software.

3.4.2 LUAS Census 2006 and 2011

Description: Full weekday (0500 – 0200hrs) boardings, alightings and loading surveys undertaken across the entire (Red and Green line) LUAS network in 2006 and November 2011

Relevant Modelling Aspects: Calibration and/or validation of the public transport network model. The 2006 data may be useful to assess the validity of the GDA model through backcasting.

3.4.3 GDA Rail Census 2011

Description: All-day weekday boardings, alightings and loading surveys undertaken across the entire DART, Connolly and Heuston Rail Commuter Lines in November 2011

Relevant Modelling Aspects: Calibration and/or validation of the public transport network model.

3.4.4 National Rail Census 2012 and 2013

Description: In 2012 and 2013 the National Transport Authority commissioned Iarnród Éireann to conduct a National Census of Rail patronage which, for the first time, recorded information on boardings and alightings of passengers at every train station in the country on one day of the year. This Census provides a detailed and reliable snap-shot of rail usage across the network. The Census was undertaken on November 15th 2012 by means of headcounts, by enumerators, of numbers of individuals' boarding and alighting each train service at each station on that day1. Prior to 2012, the Census was carried out at stations in the Greater Dublin Area (GDA) only.

Results of the 2013 survey will be made available during March 2014.

Relevant Modelling Aspects: Calibration and/or validation of the public transport network model.

3.4.5 Luas Passenger Boarding and Origin-Destination Survey in Autumn 2012

Description: Full Day boardings / destinations and hourly flows for both Red and Green Lines, surveyed in October (for 2 x weekend days and 1 x weekday) in each year from 2005 to 2013.

Relevant Modelling Aspects: Calibration and/or validation of the public transport network model.

3.4.6 Bus Cordon Count 2006 2012

Source	Type	Date	Time Period(s)	Mode(s)	Geography
Bus Outer Cordon	Loadings	2011	0700 to 1000 hours and 1400 to 1500 hours	Bus	Outer ring around Dublin
Canal Cordon	Link Counts and occupancy	November 1997 to 2012 with some gaps	0700 to 1000	Car, Bus, Rail, LUAS, Taxi, Walk, Cycle	Outer ring around City Centre

Description: These cordon data are mainly from the yearly survey of bus loadings crossing the Dublin canal cordon during the AM week-day peak (0700 – 1000) and weekday Inter-peak (1400-1500) from 2006 to 2011. Both inbound and outbound directions are included from the 2010 and later surveys. The 'Outer Ring' cordon was surveyed in 2011 only and for the inbound direction only. No PM counts appear in any of the surveys.

Relevant Modelling Aspects: Calibration and / or validation of the public transport network model.

3.4.7 Automatic Vehicle Location Data

Description: GPS tracking of buses which is used by to manage services, monitor performance and for real time passenger information displays.

Relevant Modelling Aspects: Calibration and / or validation of bus speeds in the public transport network model.

3.4.8 Data Gaps

With reference to Section 0 the following data gaps have been identified:

- Bus occupancy data is limited to the Canal and Outer Ring cordons; and
- Plans for network and service development.

3.5 Other Transport Modes

3.5.1 Port Survey(s)

Description: Origin - destination patterns for HGVs travelling to Dublin Port.

Relevant Modelling Aspects: Can be used in the calibration of the freight/goods vehicle modelling and the calibration of the network traffic model, by providing a detailed 'row and column' in the relevant goods vehicle matrix.

Other Comments: Care is needed to ensure that both Ro/Ro and container pick-up/drop-movements off are included in the relevant HGV totals. Additional investigation is required to determine whether there is corresponding HGV survey data for Dun Laoghaire, which would enable any (probably slight) differences in the patterns of Irish origins and destinations served by these two ports.

3.5.2 CSO Road Freight Transport Survey 2011

Description: 51-page summary of Irish road freight statistics, including a region-to-region break-down of HGV movements – available for download from the CSO web-site[4].

Relevant Modelling Aspects: Use of the survey data to calibrate various different aspects of the base-year freight model.

3.5.3 Data on Airport Passengers (Current and Forecast)

Description: Data on recent trends in the number of passengers passing through Dublin airport (by traveller type) and future growth scenario(s).

Relevant Modelling Aspects: Airport modelling (and the relevant zone trip-end in the demand model).

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[4] ww.cso.i.e./en/media/csoie/releasespublications/documents/transport/2011/roadfreight11.pdf

3.5.4 Airport Survey 2011

Description: Travel diary-style data including origin and destination, journey purpose, surface access mode, etc. for a sample of around 23,000 travellers travelling to and from Dublin airport between August and November 2011 (including weekdays and weekends).

Relevant Modelling Aspects: Derivation of base year demand to and from the airport.

Calibration of an airport surface access model, if required.

Other Comments: POWSCAR will provide information about the commuting patterns of airport employees.

3.5.5 Taxi Fares

Description: The NTA Taxi Regulation division will be able to provide taxi fare table.

Relevant Modelling Aspects: Derivation of fare information if taxis are to be modelled as a separate mode.

3.5.6 Cycle Journey Planner

Description: A web site[5] that provides information on cycling routes in Dublin. The underlying mapping data could be used to identify off-road cycle routes which could improve the accuracy of cycle generalised costs and be used if bike trips are to be assigned to a network.

Relevant Modelling Aspects: identifying and mapping cycle routes which are not in the road network model.

3.5.7 Data Gaps

With reference to Section 2.6 the following data gaps have been identified:

- Walking and cycling counts, except for the canal cordon;
- Cycle ownership data;
- Some factors which may affect cycle use including household structure, dwelling type, etc.;
- Taxi boarding and alighting counts;
- Spatially comprehensive freight movement surveys (vehicles or tonnage); and
- Freight operating costs and values of time.

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[5] www.journeyplanner.transportforireland.ie/cp/XSLT_TRIP_REQUEST2?language=en

3.6 Appraisal and Other Post Model Utilities

3.6.1 DoT and NRA Guidance on Economic Appraisal

Description: DoT and NRA's guidance documents are discussed in Sections 3.3.4 and 3.3.5. These documents include many of the parameters required to undertake appraisals of All of the parameters needed to use the outputs from the models to undertake economic appraisal of transport schemes.

Other Comments: The NTA has previously undertaken or commissioned studies to determine key statistics such as value of time and vehicle operating costs for use in their existing models. These would provide a strong basis for similar values in the future model.

The UK's WebTAG extensive guidance (www.dft.gov.uk/webtag/) can be used to provide an additional source of relevant default transport behavioural parameters.

3.6.2 Traffic Fleet Data (age, fuel type, engine size)

Description: The Department of the Environment provide annual statistical bulletins on all registered vehicles including emissions characteristics, taxation class, age, where registered, etc.

Relevant Modelling Aspects: Appraisal (Traffic Emissions)

3.6.3 Wider Economic Impacts and the Appraisal of Rail Schemes in Ireland[6]

Description: An analysis undertaken by RPA into the application of the UK DfT approach to wider impact appraisal in the Irish context. The approach is applied to the Luas Broombridge scheme as a case study. This work made use agglomeration elasticities derived in the UK rather than bespoke research in Ireland. The following data were developed from Irish sources:

- Gross Value Added per worked (by industry sector and Electoral District) from the Central Statistical Office National Accounts data;
- Employment (by industry sector and Electoral District) from the 2006 Census; and
- Mean salary by employment sector from the 2003 National Employment Survey.

[6] www.itrn.ie/uploads/Part%201.pdf pages 45-61

Relevant Modelling Aspects: This paper sets out an approach and identifies data sources which can be used for wider economic impact appraisal including agglomeration, output changes in imperfectly competitive markets and labour market impacts.

3.6.4 Data Gaps

With reference to Section 0 the following data gap has been identified:

- Traffic composition (split by light and heavy vehicles) and speed should allow some modelling of noise levels however there are no data on gradient, road surface quality, and other features that are required to model noise propagation. This information may be available from National Car Test statistics.

4 Data Gap Assessment

4.1 Introduction

In this chapter we consider the implications of the identified data gaps on the scope of the regional model.

4.2 Trip Generation, Car Ownership and Demand Modelling

Gap	Implications
Spatially extensive origin-destination data for non-POWSCAR purposes	■ Non-POWSCAR purposes will have to be synthesised. ■ The Travel Diary Surveys do not include enough data to support more than a simple 2 or 3 geographic sector system such as 'City Centre/Inside M50/Rest of GDA' for synthesis of travel demand. In particular, they will not support much analysis of regional variation in infrequent journey purposes, modes or more-complex-tours. ■ The travel diary surveys do not support the ability to accurately model work-related trip-chaining (e.g. visits to a series of customers) or the calibration of household-based activity modelling where the number of different combinations of travel demand by different household members will quickly exceed the amount of data available to estimate the relevant mode and time-of day choice parameters.
Data on PT travel using season tickets	■ Evidence on the proportion of travel using season tickets is required.
Visitor numbers and hotel bed guest-nights	■ Data on visitor bed-nights could be obtained from Fáilte Ireland and other sources and disaggregated to the relevant zoning system ■ Visitor number data could be used as a starting point in the estimation of trip-end information for zones containing key visitor attractions taking care to avoid double-counting of visits made by Irish residents. ■ However, it would not be straightforward to link these two sets of 'trip-ends' to create a matrix of visitor travel patterns and there would be a large number of significant gaps in the visitor number data (e.g. Grafton Street, O'Connell Street, the Temple Bar area, Trinity College, Marley Park etc.). ■ It will therefore be difficult to create robust modelling of visitor travel in Dublin, unless additional data collection is undertaken to plug some of the gaps listed above.
Irish evaluation data on the impacts of smarter travel policies	■ Monitoring surveys are being undertaken at present.
Travel demand elasticities	■ Elasticities from other countries may be used as a comparator.
Parking utilisation	■ If data on the utilisation of different parking locations or types were collected it could be used to calibrate models to reflect the cost of parking and capacity restraint.

Key points:

- Synthetic demand matrices for non-POWSCAR purposes can be produced, but the travel diary data does not support calibration of parameters for detailed area types, trip chaining or activity models.
- A model can be developed using simple-tours and one-way trips which is consistent with best practice. The more common "triangular tours" involving a single intermediate stops could also be synthesised.
- Evidence on travel using PT season tickets (for non-POWSCAR purposes) is required.
- The representation of non-GDA residents may not be robust.
- Data on the impacts of smarter travel in Ireland are being collected. International evidence is also available.
- It would be beneficial, but not essential, to obtain information of elasticities of travel demand to fuel, fare and travel time to improve confidence in model responsiveness.

4.3 Road Network Modelling

Gap	Implications
Saturation flow formulae and parameters	▪ Relationships from existing Irish models (if the basis of these is understood) or UK Transport Research Laboratory can be used.
Speed/flow relationships and free-flow speeds	▪ Can be obtained from existing Irish models (if the basis of these is understood) or UK guidance.
Plans for network development	▪ Must be collated with input from the NTA.
Queue length surveys	▪ Not essential.

Key points:

- Inputs may be obtained from existing models but the provenance must be understood. UK research is also available.
- Network development plans must be collated.

4.4 Public Transport Network Modelling

Gap	Implications
Bus occupancy data is limited to the Canal and Outer Ring cordons	▪ Validation will be limited unless more data are collected.
Plans for network and service development	▪ Must be collated with input from the NTA.

Key points:

- There is currently limited data for bus passenger flows. An extensive PT survey programme is planned for 2014.
- Network development plans must be collated.

4.5 Other Transport Modes

Gap	Implications
Walking and cycling counts, except for the canal cordon	■ Limited validation is possible. ■ The influence of cycling on congestion may not be accurately modelled.
Some factors which may affect cycle use including household structure, dwelling type, etc.	■ Additional data may be required if it is important that cycle matrices are accurate to support analysis of policies affecting this mode. ■ The Limerick Sustainable Travel Baseline Survey data may provide additional insight into variations in cycle use across different demand segments.
Data on taxi use by non GDA residents	■ A major component of taxi use cannot be estimated.
Taxi fare tables	■ To be obtained from the NTA (Taxi Regulator).
Taxi boarding and alighting counts	■ Accuracy of any taxi modelling would be unknown.
Spatially comprehensive freight movement surveys (vehicles or tonnage)	■ We have not identified a source of data which can be used to estimate the amount of goods vehicle travel to/from individual zones other than the two main ports. ■ The CSO Freight Traffic Survey of regional HGV movements could be disaggregated using indicators such as population, jobs, retail floorspace, etc. This disaggregation is unlikely to include the impacts of significant local generators/attractors of goods vehicle traffic.
Freight operating costs and values of time	■ Best estimates of will have to be used or bespoke surveys commissioned.

Key points:

- Pre-loads of cycle flows in key areas would be relatively simple to observe. Any new cycle counts should distinguish between official 'Dublin bike hire scheme' and other bikes. However, given the increasing importance of active travel from a policy perspective, a more-sophisticated modelling of cycling (i.e. within the main mode and destination choice) should be considered, at least for the two POWSCAR journey purposes.
- Walk flows cannot be accurately modelled due to a lack of counts data for calibration and validation.
- At present there is insufficient data to model taxis as a separate mode. Pre-loads could be established for key areas based on simple surveys. Historic taxi licencing statistics may be useful to provide information on taxi use trends.

- There are significant gaps which will impact on the reliability of LGV and HGV matrices. Matrix estimation could be used to adequately reproduce observed goods vehicle flows on links but it is unlikely that the resulting matrix will accurately reflect actual demand between zones.
- Additional classified counts in the vicinity of known significant freight attractors/generators would help improve the local calibration of the goods vehicle matrix produced by the matrix estimation process.
- There is insufficient data to develop multi-modal freight forecasting or logistics models.

4.6 Appraisal and Other Post Model Utilities

Gap	Implications
Willingness to pay for reliability improvements and relationships between average speeds and reliability	▪ UK research indicates that reliability can be a significant component of appraisals. The UK guidance (WebTAG Unit 3.5.7) could be referred to.

Key points:

- Further research and data collection would be required to appraise reliability impacts. UK values and research could provide an approximate basis for such assessment.

4.7 Summary of the Main Data Gaps

The main implications of the data gaps for model functionality are as follows:

- Complex tours and activity modelling is not supported by available data. These approaches would exceed best practice requirements.
- Data on how to adjust the volume of PT demand to account for season tickets is required.
- Representation of travel by non-GDA residents cannot be represented reliably.
- The reliability of modelled bus use away from the city centre cannot be established.
- Walking and cycling demand can only be approximated. Further data collection will be needed if measures that affect these modes are to be analysed.
- At present there is insufficient data to model taxis. The implications will generally be limited with the exception of some areas of the city centre and at major transport hubs.

- The OD pattern of LGV and HGV demand cannot currently be reliably determined, although the total volumes can be predicted from CSO data. Further data collection will be required if freight policies are to be assessed, or to support the assessment of specific road schemes.
- UK guidance and values can be used to appraise travel time reliability impacts in the absence of Irish data.

5 Future Data Collection and Management

5.1 Introduction

In this chapter we consider medium and long-term aspects of data collection and management, with a particular focus on the data that will be needed after the relevant base-year models have been created.

This consideration is structured as follows:

- Issues associated with the future collation, management and use of the currently-available datasets;
- Ongoing collection/collation of data needed to model future-year travel conditions;
- Collection and management of data needed to inform future updates of the base-year transport models; and
- Consideration of potential new sources of data.

Each of these aspects is discussed briefly in turn below.

5.2 Managing the Currently Available Datasets

The NTA and others have devoted a significant amount of resource to the task of providing the various datasets described in this note to the consultants team. It would therefore be advisable to devote a small amount of additional effort to help ensure maximum future potential 're-use' of these datasets.

This could/should include:

- Recording metadata describing the origin, scope, caveats, potential pitfalls, etc. associated with the dataset;
- Producing a summary of the linkages between the various modelling aspects and the datasets used to construct, calibrate and/or validate them, as an Excel or Access database and/or in diagrammatic format;
- Version control information identifying the date(s) when the current version of the dataset was created and/or last-updated;
- An electronic link to the current version of the datasets (where possible);
- Maintaining GIS-based information regarding the locations(s) which the data relates to – particularly relevant to traffic counts, bus patronage counts, traffic signal settings, etc.; and
- Recording contact details of an NTA individual or department who are best-placed to support any future re-use of the data set.

This formal approach to managing these various datasets will be particularly useful for datasets such as demographic data, traffic counts, public transport patronage data, traffic signal data, etc. which are being added to or amended continuously over time.

However, care is needed to ensure that the data management process does not become overly-bureaucratic or end up requiring more resources than re-collating the information from scratch each time it is needed.

5.3 Predicting Do Minimum Changes - Data Required to Model Future-year Scenarios

Once the task of building a robust model of current travel and a general forecasting capability has been completed, the next data-related requirement will be an ability to estimate the inputs which determine how the supply and demand for travel will change over time.

The relevant inputs include:

- Demographic changes including total population and/or the proportions within the various ‘life-stages’ which affect travel behaviour, household composition, etc.;
- Economic scenarios and their effect on population, employment levels, car ownership, value of time distributions, fuel prices, etc.;
- Land-use development scenarios – in particular the location, scale, type and timescale of developments which individually or cumulatively will change the demand for (and/or supply of) transport;
- Other assumed changes in supply (including fuel prices, public transport fares, operator response to overcrowding, Do Minimum changes to road capacity, etc.); and
- Any changes in travel behaviour among some or all demand segments (‘hearts and minds’ campaigns, ‘cycling critical mass’, changes in car ownership patterns, etc.).

The collation of these various ‘future-year’ assumptions should take place in parallel with the construction of the base-year model, so that the relevant information does not delay the subsequent use of the model.

To facilitate this, those responsible for constructing the base-year model should identify which inputs are likely to change and, where possible, suggest the data or assumptions needed to predict these changes.

The task of keeping track of the various combinations of assumptions and input files which will make up these different future-year scenarios is non-trivial and relevant resources for setting up and maintaining the relevant ‘scenario management’ process is likely to be ‘money well spent’.

5.4 Monitoring Actual Changes - Data Required to Model Future-year Scenarios

In addition to the short-term need to 'predict' future changes as part of modelling future-year conditions, there is a related need to keep track of actual changes in transport supply and demand which take place over time.

The list of attributes which need to be monitored is very similar to that described in the previous section, but the process for monitoring these changes tends to be significantly different, involving a continuous process of recording relevant changes to the transport supply and demand, rather the periodic creation of well-defined future-year scenarios.

The attributes which are likely to be of most importance with this category are:

- Demographic data;
- New land-use developments;
- Changes to the road network and/or junction performance (lane markings, banned turns, introduction of bus or cycle lanes, changes to signal timings, etc.);
- Changes to public transport services;
- Changes to public transport fares;
- Changes to parking capacity, cost and/or restrictions;
- Fuel consumption and costs;
- Variables such as income and GDP which affect values of time;
- Records and forecasts of air traffic and freight;
- Validation and calibration datasets (counts, journey times, etc.).

The NTA should consider the most-effective mechanism for collating these changes, distinguishing between:

- Being aware of what changes have taken place;
- Obtaining/maintaining the necessary details of the changes; and
- Updating the model to reflect the changes.

5.5 'Before and After' Monitoring for Scheme Assessment

In addition to a general requirement to monitor changes to inform future updates of the model, there is likely to be a specific need to undertake 'Before and After' monitoring of the impacts of transport schemes, a) to assess the impacts of the scheme itself and b) to assess the model's ability to correctly predict these impacts

The data which will come into this category will tend to vary from scheme to scheme and so cannot be specified in detail here.

However, we would recommend that this aspect in considered carefully for each intervention being tested by the model, particularly the need for good ‘Before’ data, since construction activities may affect travel patterns.

Related to this, of course, is the need to check (and update) the calibration and validation of the model in the specific corridors relevant to the scheme being appraised. The data used for this review will often form part of the ‘Before’ monitoring data, increasing the importance and cost-effectiveness of any additional data collection carried out for this combined modelling review and ‘Before and After Monitoring’.

5.6 Other Data Required for Future Updates of the Model

During this Scoping Phase and the subsequent model construction, calibration and validation the NTA and the consultants should maintain a list of datasets which would have improved or facilitated the relevant aspect of the model construction/calibration/validation.

This list and the corresponding business cases for plugging the main data gaps in time to inform some future upgrade of the model should be reviewed periodically throughout the model development process.

The initial content of this list will be all of the data gaps identified in the previous sections as restricting the functionality or robustness of the regional model and which have not been ‘filled’ during this initial model development.

Potential New Data Sources

There is also an important need to continually consider and review potential new data sources. In particular, as the amount of Bluetooth, Wi-Fi, GPS and other mobile device tracking technology continues to grow, there is likely to be a rapid increase in the (potential) availability of data on journey times, congestion, mode choice, routing, travel demand etc.

This topic is too broad to include a full description here and will, instead, be included in a stand-alone note considering the opportunities which these technologies may offer to inform (or in some case replace) various aspects of the transport modelling.

A ‘Think-Piece’ prepared by SYSTRA (under the MVA name) for the UK DfT in 2012 is likely to form the starting point for this follow-up note and will be supplied to the NTA as ‘background reading’.

6 Summary and Recommendations

6.1 Summary

Based on a review of the data available to support the development of a Regional Modelling System it can be concluded that there is sufficient robust and recent data available to develop a modelling system which will serve all the essential NTA modelling needs (as identified in Scoping Report 1) and which will be in line with international best practice for regional model development.

The data gaps identified in this note will mean that the regional model developed will have some limitations – for example, the available data will not support very detailed modelling of active modes, taxis or freight movements. However, these limitations are understood and will not impact on the quality and functionality of the regional modelling system that will be developed.

Some further data collation is required in order to use the model for forecasting.

Recommendations for data collection are presented in the following two tables. The first table includes recommendations for the initial model development phase. The second table considers ongoing application and maintenance of the model.

6.2 Recommendations for Model Development

No.	Recommendation	Timing
	Trip Generation, Car Ownership and Demand Modelling	
D1	The demand model should use simple tours, one-way journeys and potentially tours with a single intermediate stop. The initial review (RMS Scope 3) suggested that there was insufficient data for activity modelling, this has now been confirmed.	n/a
D2	Evidence on the number of trips made per day by season ticket holders should be collected to ensure the volume of PT demand is representative.	Short term. Essential for the initial model development.
D3	Data to develop representation of visitor demand in city centres should be collected.	Longer term. Not essential for the model, although without such data there will be some diminution in the accuracy of travel patterns and flows in city centre.
D4	Data on parking supply, costs and utilisation should be obtained, at least for city centres.	Short term. Parking cost and capacity can greatly influence travel choices, e.g. lack of parking supply may limit growth in car trips to city centres.

No.	Recommendation	Timing
D5	A literature review of Irish transport demand elasticities should be undertaken	Short term. The realism of model responses to cost changes must be established.
	Road Network Modelling	
D6	UK parameters and approaches for saturation flow and speed/flow relationships should be used unless there is well documented information for Ireland	Low priority. Junction designs and driver behaviour are very similar in Ireland and the UK.
	PT Network Modelling	
D7	Bus passenger flow data should be collected. Surveys are planned for 2014.	Short term. Without such data the reliability of modelled bus flows outside of Dublin city centre cannot be determined.
	Other Transport Modes	
D8a	The regional model should not be used for detailed analysis of walk and cycle flows.	Low priority. Detailed analysis of walk and cycle flows was not identified as a requirement in RMS Scope 1.
D8b	If a strong case for the need of such analysis of active modes is made then count data will be required to calibrate the active mode matrices.	Low priority.
D9	Smarter choices evaluation evidence should be collated and analysed to provide matrix adjustments which can be used in the models	Longer term. Not required for initial model development. Will be needed if further smarter choice measures are to be modelled. International evidence could be used in place of Irish data for initial work.
D10a	LGV and HGV matrices should initially be developed using matrix estimation techniques. The regional model should not be used for detailed analyses of LGV and HGV policies.	n/a.
D10b	If a strong case for the need of such analysis of LGV and HGV is made then data will be required to develop robust OD patterns and for calibrate and validation	In RMS Scope 1 it was identified that freight demand modelling was not a priority for the NTA.
D11	If a strong case for analysis of taxis is made then a scoping exercise will be required.	Low priority. RMS Scope 1 did not identify the need for detailed modelling of taxis.
	Appraisal and Other Post Model Utilities	
D12	Reliability appraisal can be based on UK guidance, however, advice should be given on applicability, or adjustments to parameters to apply in Ireland.	Short term. UK experience indicates that reliability benefits can be very

No.	Recommendation	Timing
		significant.

6.3 Recommendations for Model Application and Maintenance

No.	Recommendation	Timing
A1	Schedules of land use and transport supply proposals must be collated. These must include information on the likelihood and timing of implementation. They should be periodically updated and include actual changes that occur after the model base year.	Short term. Essential for forecasting.
A2	A unified record of the datasets which can be used for model development or application should be developed.	Medium priority. Model development does not require this, but it would enhance the ease and efficiency of model revisions and updates.
A4	Demographic and economic parameters for future years including populations, employment, retail floor space, school places, income, value of time and vehicle operating costs must be forecast.	Short term. Essential for forecasting.
A5	A database of public transport services and fares should be maintained which can be readily formatted for use in the PT network model	Longer term. Would facilitate model updates.
A6	NTA and its advisors should keep abreast of potential new data sources such as mobile phone and GPS tracking data.	Longer term.
A7	Evaluation studies of transport interventions are recommended so that the impact of the schemes can be assessed, and to improve modelling of subsequent schemes.	Ongoing.
A8	A list of data gaps and summary business cases for filling the gaps should be maintained.	Ongoing.

6.4 Summary and Conclusions

The following high priority actions to collect data for the initial development of regional models have been identified:

- Identifying data to establish the number of trips made per day by season ticket holders;
- Establishing the cost, location and supply of car parking in city centres;
- Developing target elasticity values for variables such as car fuel, travel time and public transport fare;
- Collecting bus passenger count data. This is being undertaken by NTA in 2014; and
- Specifying how UK guidance on the appraisal of travel time reliability should be applied.

In the longer term the reliability of the model for some applications could be enhanced if further data were collected. The priorities for additional data collection will be determined by NTA's policy agenda. With the data that are currently available or readily collectable the models should not be relied upon for analysis of taxi travel; walking and cycling routes and flows; or how goods vehicle operators and drivers change the timing, load size, vehicle choice or depot locations in response to cost changes. Goods vehicle routing will be well represented in the regional model suite.

Collation of data including land use changes, transport schemes, population and employment forecasts, and demographic data need to be collated during the model development phase so that model testing forecasting can commence once the base models are available.

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No. XXXXXXXX 22-12-2016