JACOBS

Technical Note

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Annex B

Introduction

Jacobs was commissioned by Transport Scotland in 2013 to undertake an appraisal of the Inverness to Aberdeen transport corridor[1].

Six options were being appraised against the Do-Minimum scenario. The Do-Minimum scenario comprises of the construction of: the Aberdeen Western Peripheral Route (AWPR); Aberdeen to Inverness Rail Improvements; A96 Inverness to Nairn (including Nairn Bypass); A96 Inveramsay Bridge; A96 Threapland Junction; Connection between the A9 and A96 to the East of Inverness; and Strategic Park & Ride.

The options appraised were:

- **Option 1** - Rail Enhancements / Rolling Stock Improvements to Provide an End-To-End Travel Time of Around 1hr 45mins, which comprises of improved infrastructure to accommodate either electrified or high powered diesel rolling stock along the rail network;
- **Option 2** - Rail Service Enhancements, to allow a 15 minute frequency into both cities, between Inverurie and Aberdeen and Nairn and Inverness, during peak periods. The remaining settlements which are within one hour of Aberdeen and Inverness will receive a 30 minute frequency, which forms part of the hourly service between both cities;
- **Option 3** - Targeted Trunk Road Improvements, including physical works to improve safety and operational efficiency of the A96, such as: WS2+1 sections; climbing lanes; hard strip provision; local realignments and junction improvements.
- **Option 4** - Targeted Trunk Road Improvements and New (Single Carriageway) Bypasses on A96, which comprises of single carriageway bypasses of Forres, Elgin and Keith, and Targeted Trunk Road Improvements (Option 3) for the remaining sections of the A96.
- **Option 5** - Dual Carriageway Bypasses and Dualling of Heavily Trafficked Sections of the A96 plus Targeted Trunk Road Improvements, including: dual carriageway bypasses of Forres, Elgin and Inverurie and dualling of heavily trafficked sections of the A96; single carriageway bypass of Keith; and Targeted Trunk Road Improvements (Option 3) for the remaining sections of the A96; and
- **Option 6** - A96 Full Dualling plus Targeted Trunk Road Improvements, thereby providing dual carriageway between Inverness and Aberdeen.

[1] Corridor is defined as the strategic transport network linking the cities of Inverness and Aberdeen.

The purpose of this Technical Note is to detail the methodology used in undertaking the economic assessment of each option.

Approach to deriving economic benefits

Although all options have been appraised, only five options were modelled with the Transport Model for Scotland (TMfS). Option 3 consisted of relatively small scale trunk road improvements along the corridor, with each location of works only possible through additional, more detailed analysis. Therefore, modelling of this option, using the strategic model (TMfS) was not undertaken.

The process used when deriving the likely economic performance of each option is shown in **Figure 1**.

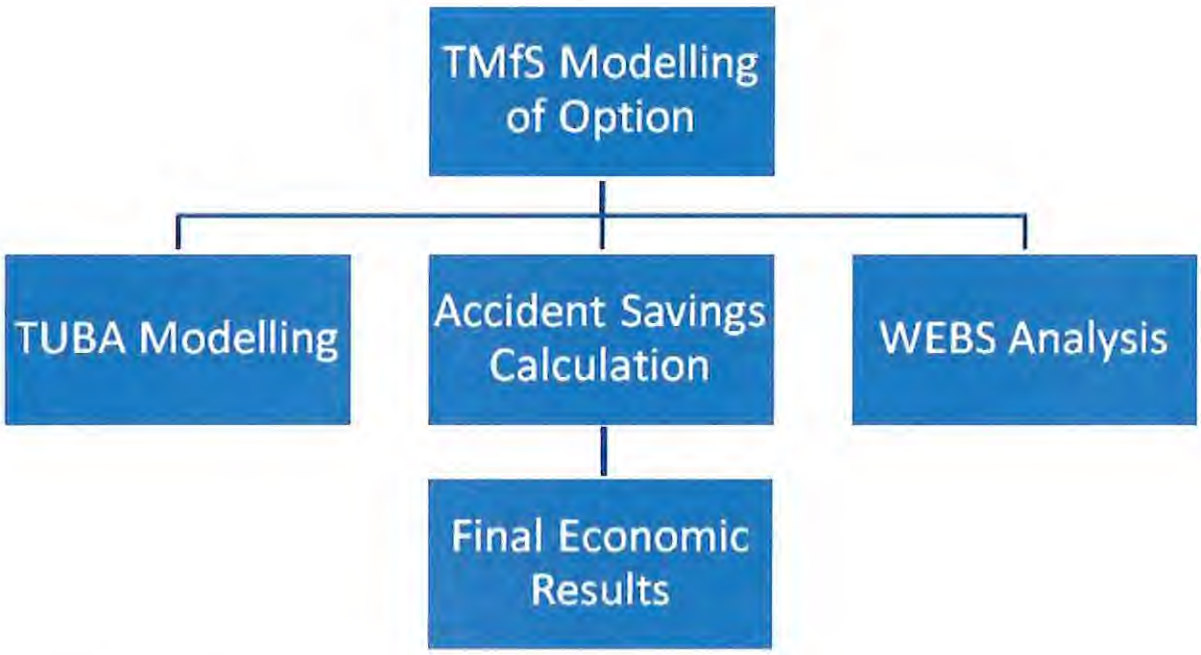

Figure 1 Economic Assessment Modelling Process

TMfS Modelling of Options

As detailed above, Options 1, 2 4, 5 and 6 were modelled using the TMfS:12. Each option was modelled assuming an opening year of 2032, with a future year model at 2037 also tested, in order to provide a future year assessment for the TUBA analysis. The output from the TMfS models has been used to determine the Transport Users Benefit Analysis (TUBA); Wider Economic Benefits (WEBS) analysis and allowed potential savings form reduced accidents to be calculated.

TUBA Modelling

TMfS output[2] was input to TUBA software to provide detailed results on the economic performance of each option. Peak hour matrices were provided for AM, Inter peak (IP) and PM models from TMfS. TUBA requires annualisation factors to obtain results at an annual level, therefore factors of 559 (AM), 3596 (IP), and 650 (PM) were assumed when undertaking the analysis.

Initial TUBA results indicated significant model noise; therefore trips between zones intuitively not impacted by the tested option, were removed to provide more realistic results.

Table 1 indicates the elements to the overall economics assessment that were derived through TUBA.

WEBS Analysis

In order to obtain the Wider Economic Benefits associated with each option it was necessary to issue TMfS outputs to David Simmonds Consultancy (DSC). This process involved testing each option in TMfS with the Do-Minimum demand at each year (e.g. 2022) and issuing the trip costs to DSC, to enable the following model years' land-use demands (e.g. 2027) to be developed. This allowed the 2027 Do-Minimum demand to be tested in TMfS, and this iterative process to be repeated until the 2032 opening year model results were obtained. Benefits associated with Agglomeration economies (WB1) were obtained directly whilst Increased output (WB3) was calculated as 10 per cent of the overall Public Transport journey time benefits. **Table 1** indicates the elements to the overall economics assessment that were derived through WEBS.

In addition to providing input to the Benefit / Cost calculations, the WEBS analysis undertaken by DSC provided forecast population and employment changes for each option.

Accident Analysis

To provide an indication of what monetary savings may occur should the number of accidents be reduced, average accident costs have been analysed. This involved using the modelled traffic flows and default accident rates in order to calculate costs for each of the modelled options. Based on the default accident rates for the various road categories along the route, the total number of accidents under the Do-Minimum scenario at 2037 has been calculated. The rates from DMRB have been factored, using the appropriate Beta value for the road category, to obtain the default rates at 2037. These rates have then been applied to the model flows on each of the sections along the route.

Using the average accident costs for each road category allows an overall accident cost for the A96 at 2037 to be calculated. As the road categories change at various locations, depending on the option being modelled, different accident rates and costs apply, therefore providing different overall accident costs on the route for each option. The following assumptions were used when classifying road types for each option:

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[2] TMfS output used for TUBA consisted of aggregated costs for each model link based on speed, distance, time and also origin destination matrix.

- Option 3: Same as Do-Minimum, other than 4 sections of 2+1 carriageway (approximately 2km of 2+1 between Forres and Elgin, Elgin and Fochabers, and Keith and Huntly and a 5km section between Huntly and Inverurie);
- Option 4: As Option 3, however with 'rural single' sections replacing 'urban single' sections in Elgin and Keith;
- Option 5: Rural Dual Carriageway assumed on all sections between Inverness and Fochabers Bypass, and also at Inverurie. 2+1 on section between Huntly and Inverurie (as per Option 3).
- Option 6: Rural dual carriageway for entire length of existing A96.

The accident costs derived in 2037 were discounted to 2010 prices, and then interpolated for a 60 year period, to obtain the overall accident savings over the appraisal period, based on an opening year of 2032. **Table 1** indicates the elements to the overall economics assessment that were derived through this manual accident calculation.

Cost Assumptions

A range of detailed scheme costs for the A96 Inverness to Nairn (including Nairn Bypass) route options were used to determine average construction, preparation and land costs per kilometre of upgrade in Quarter 1 2014 prices. Forty four percent of the construction costs were added as optimism bias, along with de-trunking costs at one per cent. Phasing of individual schemes was assumed, based on perceived priority. The base costs were then inflated in real terms in line with the assumed increase in tender prices up to the year of expenditure for each scheme. This assumed tender prices rising at four per cent per annum against a two per cent rate of inflation in the general economy, giving a net two per cent increase per annum in real terms. The option costs, inclusive of real construction price inflation and optimism bias, were then deflated to average 2010 prices using the change in the Retail Prices Index (RPI) between 2010 and Q1 2014, converted to Market Prices using a 19 per cent Indirect Tax correction factor, and discounted to 2010 at 3.5 per cent per annum using the assumed spend profile used to determine the construction price inflation component of the cost. All options, with the exception of Option 5 (Partial upgrade), assumed the same spend profile as Option 6 (Full upgrade), with all expenditure incurred by 2030. For Option 5, expenditure on each section upgraded to dual carriageway was assumed to align with the same dates as under Option 6, with zero expenditure in the sections not upgraded.

Maintenance costs were assumed to be a percentage of the combined construction, land, preparation and supervision costs and were assumed to occur with a flat profile over the years 2023 to 2032 inclusive, although in reality expenditure is likely to be later and therefore discounted more. For Option 5 and Option 6, maintenance costs were assumed to be ten percent. For Option 4, maintenance costs were assumed to be three per cent, while under Option 3, maintenance costs were assumed to be two per cent to reflect the greater similarity of these options to the Do-Minimum. No maintenance costs were included for the rail based options.

Driver Frustration

Benefits associated with a reduction in driver frustration have been monetised through the development of the Outline Business Case for the A9 Dualling. Similar benefits are possible through the dualling, or partial dualling, of the A96, therefore this has been included within the

sensitivity results included within the economic assessment. The potential benefits of reduced driver frustration have been derived using the overall travel time savings calculated within the TUBA analysis. This analysis indicated approximately £1bn of travel time savings through the dualling of the entire route, over the 60 year appraisal period. Based on an assumption that driver frustration benefits would equate to approximately fifteen per cent additional travel time savings, a further £150,000,000 of savings have been accrued in Option 6. As Option 5 includes approximately half of the length of dualling as Option 6, the additional benefits from reduced driver frustration have been calculated as approximately £75,000,000.

Table 1 Transport Economic Efficiency Requirements and Source of Data

TEE REQUIREMENT	ELEMENT	SOURCE
ENVIRONMENT	Global Air Quality - CO2	TUBA
SAFETY	Total Discounted Savings	Accident Analysis
ECONOMY (TEE)	Travel Time	TUBA
	User Charges	TUBA
	Vehicle Operating Costs	TUBA
	Revenues	TUBA
	Grant/Subsidy payments	TUBA
ECONOMY (WEBS)	Agglomeration economies – WB1	WEBS
	Increased Output – WB3	WEBS
Cost to Public Sector	Public Sector Investment Costs	Jacobs Highways
	Public Sector Operating & Maintenance Costs	Derived from Public Sector Investment Costs
	Grant/Subsidy payments	TUBA
	Taxation Impacts	TUBA

Economic Results

Table 2 contains the detailed economic results, following the collation of the various elements of the economic assessment process.

Table 2 Economics Results Table

	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6
ENVIRONMENT						
Global Air Quality - CO2	0	482	623.1	2077	-19559	-29785
Physical Fitness	0	0		0	0	0
SAFETY						
Total Discounted Savings	0	0	18074	10,304	125,121	213,503
ECONOMY						
Travel Time	11512	96423	40110.9[3]	133703	751407	1006660
User Charges	374	-12083		148	2590	4373
Vehicle Operating Costs	900	1880	5181.9[4]	17273	-46916	-76500
Private Sector	0	0	0	0	0	0
Investment Costs	0	0	0	0	0	0
Operating & Maintenance Costs	0	0	0	0	0	0
Revenues[5]	1951	28896	0	-4392	-20357	-27382
Grant/Subsidy payments	-1951	-28896		4392	20357	27382
ECONOMY (WEBS)						
Agglomeration economies - WB1[6]	29713	68357		-213	206478	346662
Increased Output - WB3[7]	287	2872		7774	36867	51024
Wider benefits from improve labour supply - WB4						
Cost to Public Sector						
Public Sector Investment Costs	126336	168448	169517	202409	749816	1344364
Public Sector Operating & Maintenance Costs				10120	64528	123714
Grant/Subsidy Payments	-1951	-28896	0	4392	20357	27382
Revenues						
Taxation Impacts	289	4905	653	2178	-35875	-53924
Cost to Funding Agency	0	0		0	0	0
Present Value Benefits (PVB)	12497	81797	63337	161327	848518	1172175
Present Value Cost to Government (PVC)	124385	139552	169517	216921	834701	1495460
Net Present Value (NPV)	-111888	-57755	-106181	-55594	13817	-323286
Benefit Cost Ratio to Government (BCR)	0.10	0.59	0.37	0.74	1.02	0.78
BCR (including WEBS)	0.34	1.10	0.37	0.78	1.31	1.05
BCR to FA						
Driver Frustration					75499.5	150999
PVB (WEBS + Driver Frustration)	42497	153025	63337	168888	1167362	1720860
BCR (WEBS + Driver Frustration)	0.34	1.10	0.37	0.78	1.40	1.15

[3] Option 3 Travel Time Savings assumed to be approximately 30 per cent of Option 4 savings
[4] Option 3 User Charges assumed to be approximately 30 per cent of Option 4 charges
[5] Revenues are assumed to be the opposite of the Grant / Subsidy benefits
[6] Sum of Net Present Value of WB1 for all areas in corridor (see David Simmonds Consultancy Report)
[7] Based on 10 per cent of journey time savings for PT users (TUBA)