



Glasgow Airport Access Project Audit of Outline Business Case

Transport Scotland
Executive Summary

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Client Name: Transport Scotland
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Project Manager: Graeme Dodds
Author: Joseph Campbell / Stephen Pauling / Graeme Dodds

Jacobs U.K. Limited

95 Bothwell Street
Glasgow, Scotland G2 7HX
United Kingdom
T +44 (0)141 243 8000
F +44 (0)141 226 3109
www.jacobs.com

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Executive Summary

1.1 Introduction

Jacobs UK Ltd was appointed by Transport Scotland to provide an independent audit of the Outline Business Case (OBC) for the Glasgow Airport Access Project (GAAP). The objective of the audit was to provide comfort to Scottish Ministers that the business case accurately and objectively reflects the interests of the Scottish economy, including inclusive growth ambitions.

This work involved the auditing of the OBC, and in particular the Strategic and Economic cases, and supporting technical submissions. In terms of model audit, it is limited to the audit of the Glasgow Airport Access Model (GLAAM) and the Glasgow Airport Employee Model (GLEAM) used for airport forecasting.

1.2 The Project

GAAP is a Glasgow City Region City Deal project that is being developed jointly by Glasgow City Council and Renfrewshire Council; the Project Team.

A number of studies were carried out between 2011 and 2014 to consider surface access options serving the airport. The Glasgow Airport Strategic Transport Appraisal Part 1 Study (2013), commissioned by Glasgow City Council, Renfrewshire Council, Glasgow Airport Limited and Transport Scotland, considered 80 options, seven of which were taken forward to the more detailed Part 2 Study (2014). This second study identified the Tram-Train option as the best performing option, followed by the Personal Rapid Transit (PRT) option. Both options were re-visited during the Strategic Business Case and subsequently taken forward for further analysis as part of the OBC. After the initial multi-criteria assessment within the OBC process, Tram-Train was identified as being the preferred option and assessed in more detail. As a result, the bulk of the OBC relates to the Tram-Train option.

1.3 Audit Process

The extent of the audit, which comprised an Interim and Final report, was to:

- review and analyse the OBC as a whole, but in particular the Strategic Case and the Economic Case;
- carry out model audit of the GLAAM and GLEAM models used for airport forecasting;
- review and analyse supporting technical reports relating to the Economic case;
- review and analyse adherence of the Strategic Case and Economic Case to the approved Assurance Framework; and
- highlight deficiencies, weaknesses, strengths and opportunities in the methodology, findings and presentation of the assessments.

The Interim Audit Report was based on the independent review of the OBC and its supporting documents. Following a process of review and analysis, it was laid out as a series of observations that resulted in 87 questions. Further to the Interim Audit Report, there was liaison with the Project Team, their consultants and other parties; Network Rail, ScotRail, and Glasgow Airport Ltd. This period was used to jointly and collaboratively examine the observations and questions raised in the Interim Audit Report, with a view to understanding and resolving as many of these as possible. The output of this process forms the basis of this Final Audit Report, with detailed reporting of the specific audit points contained Appendix A.

1.4 Rationale for the Project

Transport modelling work has been undertaken by the Project Team to determine the demand for travel on the Tram-Train, the impact on the transport network, and the consequential value for money. Some of the key issues raised in the interim audit were as follows:

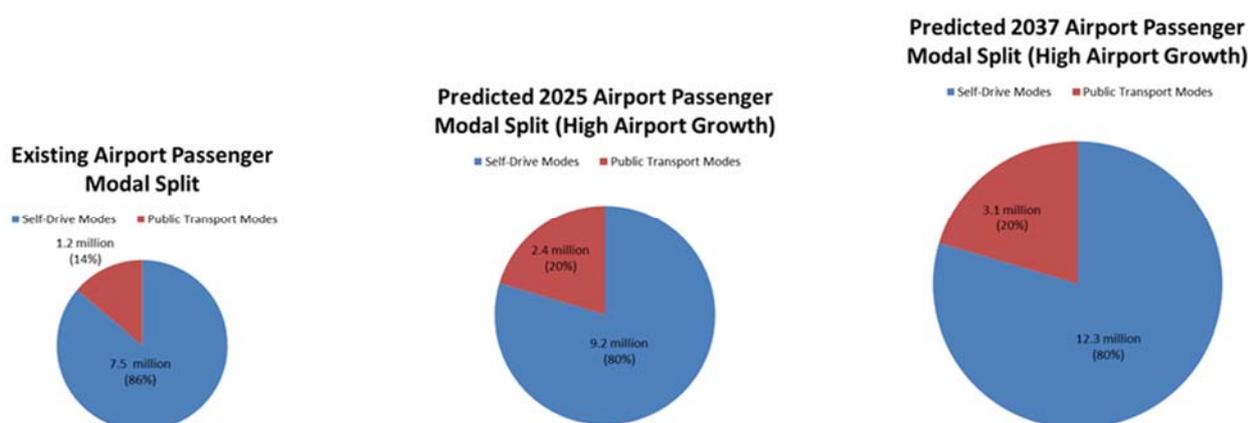
- the understanding of hourly/daily profiles within the demand forecasting;
- the understanding of the origin/destination of future airport demand; and
- the apparent low levels of use of the Tram-Train.

The issues are discussed further below.

1.4.1 Demand Modelling

The GAAP Project Team has developed models to forecast future airport passenger demand in 2025 and 2037 and this audit has focused on the outputs of these models.

The modelling work undertaken by the Project Team confirmed that the Tram-Train option is forecast to be the best performing of the interventions considered, with around 1.4m additional airport passengers travelling by rail by 2037. The resultant public transport mode share of passengers travelling to the airport in 2037 would be 20%, compared to 14% in 2015.



With reference to growth at the airport, there is limited analysis of the expected market or markets in which growth will occur (e.g. business, leisure, weekday, weekend) or in the potential destinations (e.g. UK/Europe, Middle East, US, Far East). Consequently, there is no analysis of when future demand will occur across the day, which is critical to understanding the case for the intervention and the potential volume of passenger traffic by time-of-day.

Considering the impact on the transport network the OBC, consistent with the SBC, highlighted the issue of congestion on the M8 Motorway as a constraint. Given that passenger demand models have forecast up to 4.8 million additional passengers travelling to the airport by road in 2037, there remains the question over the ability of the transport network to accommodate this level of growth, with such a high apparent continued reliance on the road network.

Based on the future passenger demand forecasts provided by the GAAP Project Team, when considering the impact of the Tram-Train scheme at an hourly level, the number of passengers predicted to travel via Tram-Train is modest. The relatively low numbers and occupancy forecast could be as a result of a number of issues:

- underestimation of the demand for Tram-Train in the modelling to date;
- the lack of intermediate stopping points limiting the opportunity to attract passengers;
- the route and location of the stopping points not reflecting the catchment area of passengers using the airport; and/or
- the route and location of the stopping points not reflecting the ultimate destination of inbound passengers.

There is little analysis within the OBC on the spread of passenger demand across the day or in relation to the origin / destination profile of inbound or outbound passengers. This is an important factor to consider in relation

to accessibility, given that the proposed Tram-Train does not serve any intermediate destinations other than Paisley Gilmour Street.

The current express bus service (First 500) has multiple pick-up / drop-off points throughout the city centre, which link to both accessibility and journey time as it relates to actual origin/destination. For some journeys, particularly for passengers arriving into Queen Street or Buchanan Bus Station, the journey time to the airport could be shorter when using the airport bus, when considering interchanges via Central Station. While this audit is not suggesting that the express bus meets the future demand requirements of the airport, the relationship between the proposed intervention and the origin / destination of passengers should be explored in greater detail to ensure that the proposals are robust in this regard.

The proposed operating hours of the Tram-Train are noted within the OBC as 18-hours on weekdays, 17-hours on Saturday/Public Holiday, and 15-hours on Sunday. The need to disaggregate the airport demand into daily profiles by origin and destination has been noted above, as even a 6am start time at Central Station would result in a number of passengers missing the first tranche of flights in the morning. Furthermore, in many cases the wider rail network does not become operational early enough in order to enable interchange at Glasgow Central in time for the early Tram-Train services. In short, it would be useful to understand the spread of demand through the day as early morning flights may not be accessible with the operating hours of the system.

In summary, future passenger demand forecasts are not sufficiently robust given that there is little detail on the spread of passenger demand across the day or in relation to the origin / destination profile of inbound or outbound passengers.

1.4.2 Benchmarking

A brief review of European airports has been carried out by the audit team to compare the future scenario at Glasgow Airport, against the existing arrangements at other airports. The review identified airports with a similar level of airport demand and/or distance from the city centre. The following points are relevant:

- with the Tram-Train in place the public transport mode share at Glasgow Airport will remain low compared to the airports considered;
- the airports considered are served by either a direct heavy rail link to the city centre, or by a tram/metro style service with a number of intermediate stops.; and
- the Tram-Train operating/infrastructure characteristics are unusual in comparison to established Tram-Train systems in Europe.

Considering these and other airports with different characteristics, it can be seen that point-to-point services (e.g. airport to city centre) generally draw more patronage to and from the city and its wider region when the airport is located further away from the city (within reason) as the city centre station is able to act as a genuine hub for transfer. Airports that are located closer to the city centre, similar to Glasgow, achieve higher levels of public transport patronage by methods such as:

- Stuttgart: Incorporation into the local S-Bahn network with two lines giving a 10-minute frequency at peak, linkage to the city centre (27 mins) and linkage to intermediate stops to and beyond the city centre; and
- Copenhagen: Incorporation of national/international rail services (linking directly to centres across Denmark and Sweden), and Metro Line 2 services (providing 4 minute frequency at peak and 15 minute journey time to the city centre) that link more widely to and through the city.

1.5 The Impact and Interaction with the Rail Network

The success of the Tram-Train link to Glasgow Airport will rely on the successful integration with the existing rail services and operation of the National Rail network. The audit of the scheme has therefore included a review of the impact on the rail network, particular on the section between Paisley Gilmour Street and Glasgow Central Station, including the operation of Glasgow Central Station. Some of the key issues raised in the interim audit were as follows:

- the consideration of the impact of the Tram-Train on the rail network;
- the ability of Glasgow Central station to accommodate the Tram-Train; and
- the impact on the local rail services.

The issues are discussed further below.

1.5.1 Impact on the Rail Network

Currently there is up to 70% capacity utilisation on the Glasgow to Paisley rail corridor during peak periods. Introducing up to four Tram-Trains per hour onto this busy rail corridor will increase this utilisation to between 85% and 90%, based on independent analysis Network Rail have undertaken of the route. At these levels, it is highly likely that the introduction of Tram-Train will cause a degradation of service performance in all scenarios.

There are existing operational challenges on this corridor. At the moment these issues, which predominantly relate to trains not presenting themselves in the correct order, creating conflicts at the various junctions on the route, are not sufficiently serious to trigger regular Public Performance Measure (PPM – how rail performance is measured) failures. However, analysis undertaken suggests the impact of the introduction of Tram-Train could worsen the PPM by up to 5%, meaning PPM failures with Tram-Train in place would be far more likely.

The Project Team has undertaken analysis that they believe shows that options exist to mitigate some of these negative impacts on the performance of other rail services currently using this corridor. Two key options have been presented:

- To extend most Ayrshire service journey times between Kilwinning and Paisley Gilmour Street by 2.5 minutes. This so-called “recovery opportunity” would see most trains commence their journey into Glasgow from the Ayrshire coast 2.5 minutes earlier than is the case today, though departure times from Paisley Gilmour Street to Glasgow would be maintained.
- To consider delivering a grade separation at Airport Junction, where the Tram-Train would leave the Inverclyde line to reach the Airport. This would be designed to reduce conflicts between services from Gourock and Wemyss Bay heading to Glasgow Central, and Tram-Trains heading towards the Airport.

These two options, while potentially reducing the negative impact on performance from the introduction of Tram-Train, present their own unique challenges. In addition, they are unlikely to be acceptable because of their wider impacts in any case. By lengthening most journey times from Ayrshire to Glasgow by 2.5 mins, over the course of a year, the economic dis-benefit to existing rail users would be up to £4.1m. In addition, by changing the way performance is assessed at a mid-point in the corridor (in this case at Paisley Gilmour Street) would be a significant departure from the current approach to measuring performance that is adopted throughout the rest of the country. Adding a grade separation is a potentially expensive element that has not yet been accounted for in the scheme business case, and no costs for this option have been shared by the Project Team to date. Nevertheless, even with including these two options, the performance of Ayrshire and Inverclyde services is worse in all scenarios after the introduction of Tram-Train than it is today.

Regardless of the mitigations proposed, (some of which are unlikely to be acceptable because of their impacts, e.g. extending journey times to Ayrshire services), introducing up to four Tram-Trains per hour to the Glasgow to Paisley rail corridor means that overall performance will be worse than it is today.

1.5.2 Impact on Glasgow Central Station

The other area where significant operational challenges exists is at Glasgow Central station. At present a procedure known as “Double Docking” (where two trains use the same platform) is commonly used to accommodate services on the Paisley corridor, given the limited number of platforms. While analysis undertaken by the Project Team suggests Glasgow Central could accommodate up to four Tram-Trains per hour, this analysis is somewhat flawed, as it has not fully considered the impact in the longer-term (such as to the end of Control Period 6 in 2024) of additional or longer services.

ScotRail is developing proposals to lengthen trains on the Paisley corridor; a key method to address growing demand. The challenges of “Double Docking” mean that the presence of Tram-Trains would make lengthening the existing services more of a challenge. This would be because there would be a lack of available platform capacity to accommodate longer trains at Glasgow Central in future.

A further challenge of Tram-Train at Glasgow Central is that at 37.2 m in length, their capacity utilisation is low, with around 250 passengers on board when fully loaded. Compare this to say a seven coach class 380 to Ayr, which is 161 m long, and can carry 756 when fully loaded¹. This is especially the case when it is considered that a Tram-Train would still take up a whole train “path”. The OBC to date has not considered this issue.

Proposals such as those contained in the Scotland Route Study (2016) highlight potential additional services into Glasgow Central station, (for example, electrification of the East Kilbride line) after 2019. The Project Team has discounted such risks beyond 2019. However, introducing Tram-Train, given its impact on utilising the very small amount of available platform and approach capacity at Glasgow Central, means this is a significant risk to the proposals that has so far not been considered.

With the exception of the Tram-Train length point above, it should be noted that many of the impacts reported in this section would equally apply to any additional rail services operating between Paisley Gilmour Street and Glasgow Central Station and are therefore not unique to the Tram-Train scheme. It does however highlight the need for the project to be considered within the wider context of the rail network in the West of Scotland.

The planning for Tram-Train in the Business Case to date, does not adequately address its potential impacts at Glasgow Central beyond 2019, from adding in new services, to lengthening existing ones.

1.6 Economic Case

Some of the key issues raised in the interim audit were as follows:

- The compliance in line with HM Treasury guidance;
- the level of confidence and risks assumed to date; and
- the consideration of the wider economic impacts.

The issues are discussed further below.

1.6.1 Approach to Cost Estimation

The ‘Green Book Appraisal and Evaluation in Central Government’ is a document written by HM Treasury providing guidance on how and when an optimism bias should be used, which is dependent on the type of project and the stage the project is at. The Green Book guidance is supplemented by The Department for Transport’s ‘Transport Appraisal Guidance’. The guidelines suggest that Optimism Bias levels should be set at 40% at OBC stage, however it is noted that in relation to the proposals, Optimism Bias levels of 66% have been assumed and while this is contrary to Green Book guidance, it is perhaps indicative of the level of project development that currently exists.

Notwithstanding this, given that GAAP is at OBC stage, it would be expected that the project is further along the design development process, with risks sufficiently identified and quantified. As such, while Optimism Bias levels could be viewed as appropriate given the existing project uncertainties, it is the view of the audit that the project is not currently at OBC stage in terms of scheme costing and design. A similar concern exists with respect to the optimism bias, as outlined in section 1.6.2.

1.6.2 Cost Estimates

A review of the cost estimates provided within the OBC has uncovered a number of key issues. Firstly, the estimate has not been measured to Rail Method of Measurement 1, which is the industry standard for

¹ Based on data provided by ScotRail for a seven coach class 380 = 490 seated and 266 standing.

quantification of works involving rail transport. This makes it difficult to determine what is included and how these compare to other rail projects.

The GAAP Project Team has proposed various mitigation measures to counter impacts of the proposed Tram-Train on the existing and future operation of the rail network, one of which includes the provision of a grade separation at Airport Junction. The costs associated with what is likely to be an expensive grade separated junction have not been included within the scheme to date and the cost implications of this proposal require to be fully assessed, with subsequent updating of the Benefit Cost Ratio (BCR) calculation, in order to ensure the OBC is suitably robust. Based on examples elsewhere, the potential cost of adding such a grade separated junction could represent a significant additional cost to the scheme.

A summary of key points in relation to cost estimates are as follows:

- construction Costs – most rates appear reasonable with some notable exceptions:
 - Drainage costs appear to be exceptionally low;
 - Connection of tram line to main line may be significantly overpriced, however this may be due to lack of detail concerning the type of connection required; and
 - Plain line track may be overpriced by up to one third.
- preliminaries –
 - Percentage for contractor's prelims is low for a rail project.
- design –
 - Levels of design cost provided are only suitable for very simple design work and considered inadequate.
- inflation –
 - The methodology used to calculate inflation is a departure from best practice for cost plans at this level of development;
 - The method in this estimate may be used once a detailed cost estimate, programme and expenditure profile have been put together to advise precisely how much work will be carried out every year. Without these, the annual value of work is based on arbitrary percentages.

Furthermore, given that the developmental is only at OBC stage, it is uncertain whether the overall contingency level of 9% is considered adequate given the lack of clarity on delivery, operational and ownership models and other parameters, and the complexity of delivering within a busy rail corridor.

There should be greater clarity in the makeup of the contingency element within the OBC, and the disaggregation of the same into the constituent risk elements and pure contingency element. Without this, the contingency appears to be a fully top-down allowance, rather than having been built from an evidence base.

In summary, there are concerns regarding the robustness of the cost estimate as presented in the OBC.

1.6.3 Value for Money

The economic appraisal, as reported in the OBC, concluded that the BCR would fall between 2.8 and 3.7 for the four trains per hour Tram-Train service. This appears to demonstrate high value for money. However, as outlined above, there are elements of the cost estimation that are considered to be underestimated or not included to date, which would consequently lead to an overestimation of the BCR.

In addition, there are a number of detailed observations relating to the comparison of the Tram-Train against the PRT option, as reported in the "Glasgow Airport Access Project Modelling Support – Airport Demand Forecasting and User Benefits" (December 2016) report that have not been fully explained in the documentation. These include; the apparent high values of time for airport passengers used in the analysis, and

the disproportionate increase in revenue compared to passenger numbers of the Tram-Train compared to the PRT.

1.6.4 Wider Economic Impacts

The OBC does not report on wider economic impacts. The “Glasgow Airport Access Projects, Economic Impacts” report (September 2016) sets out the importance of Glasgow Airport to the economy rather than the impact of improved surface access. The information contained in the report outlines the economic context at both a UK and Glasgow level. However, there is little analysis of the direct economic benefits that are considered to stem from the scheme, and any commentary is generally qualitative in nature.

Given the scale of intervention it would be reasonable to see some analysis as to how the investment would impact on use of the airport, ability of employers to recruit and retain staff and the scale of catalytic employment around the airport. This could be based on a survey approach or a full land use and transport interaction model, for example using Transport Scotland’s TELMoS model.

There is also little discussion on how improved accessibility could lead to regeneration and development around the airport or how it could enable those in the wider area to access more employment opportunities, linked with other City Deal schemes.

It is considered that improved access to Glasgow Airport and the provision of a direct service to the city centre will lead to some direct economic benefits to the region. However, the lack of quantified data in the OBC and supporting documentation makes it difficult to determine and comment on the scale of such benefits.

There are also concerns in relation to the potential impacts that the Tram-Train will have on the economies of Ayrshire and Inverclyde. Whilst there would be a benefit resulting from the improved airport access options by public transport, as outlined above, in order to accommodate the Tram-Train the proposed mitigation impact of an additional 2.5-minutes to Ayrshire services inbound to Glasgow creates significant promotional issues. While it is common in transportation schemes to have disbenefits, effective promotion relies on the overall net ‘gain’ from an economic and policy perspective to be high. The forecast levels of airport patronage for Tram-Train do not represent the type of ‘step-change’ that would be necessary to carry the 2.5-minute disbenefit. Such an increase may also result in economic dis-benefits to the Ayrshire and Inverclyde region. This issue has not been considered by the Project Team.

Taking the shorter- and longer-term situation into account, and the competing needs in terms of capacity, a decision to proceed with Tram-Train at present could significantly impact the ability to realise the shorter-term opportunity gains associated with heavy rail services, such as the electrification to East Kilbride. Similarly, proceeding now with Tram-Train could result in abortive work if a more comprehensive solution comes forward through STPR2; taking into account the cumulative needs of city deal, the city/city region context, and the sector/geographical needs in south-west Glasgow and Renfrewshire

In summary the issue of wider economic benefit has not be addressed to any great extent in the OBC. This may result in an underestimation of the full benefits of the project.

1.7 Conclusions

Based on the information reported to date there is no reason to suggest that the Tram-Train is not the best performing option of those considered, however there are a number of key concerns regarding the robustness of the OBC which make such a conclusion difficult to substantiate at this stage. A summary of the key concerns are as follows:

- future passenger demand forecasts are not sufficiently robust given that there is little detail on the spread of passenger demand across the day or in relation to the origin / destination profile of inbound or outbound passengers;
- impacts of the proposed Tram-Train on the existing and future operation of rail network and on operations in Central Station have not been robustly assessed within the OBC;

- the impacts of the Tram-Train, and associated mitigation measures on the rail network, on the wider economy have not been robustly assessed;
- the level of confidence and risk assumed to date are not commensurate with the level expected at the OBC stage; and
- costs within the OBC have been underestimated.

1.8 Recommendations

Following the independent review of the Glasgow Airport Access Project Outline Business Case, it is the recommendation of this audit that the GAAP Project Team address the issues raised within this audit. Furthermore, the GAAP Project Team should re-visit the Strategic Business Case and the list of potential interventions in order provide comfort that the most appropriate airport access intervention is selected, that not only effectively serves the future demand associated with the airport, but meets the needs of and is not detrimental to the wider City Deal Region and Scottish economies.