Bus Franchising in Greater Manchester Assessment

September 2019

Risk and Optimism Bias Supporting Paper

Risk and Optimism Bias Supporting Paper

Table of Contents

List of Tables

List of Charts

1 Overview

1.1 Purpose

1.1.1 This paper explains the treatment of risk and optimism bias in the Assessment.

1.2 Structure

1.2.1 This paper consists of the following 3 sections:

   i. Overview – this section sets out the purpose of the paper, structure and content overview;
   ii. Quantified Risk Assessment – this section outlines the approach to quantification of risks, relating to Section 20 of the Economic Case, and Sections 40.4 and 41.4 of the Financial Case; and
   iii. Optimism Bias – this section outlines TfGM's approach to the quantification of optimism bias for the purposes of the Economic Case, relating to Section 20 of the Economic Case.

2 Quantified Risk Assessment

2.1.1 A risk assessment has been conducted following HM Treasury's guidance in *The Green Book* (HM Treasury, 2018), regarding the identification and quantification of risk. The purpose of the Quantified Risk Assessment is to estimate the cost of specific uncertain events which may occur during the options – "they are specific to an intervention and may be quantified and managed" (HM Treasury, 2018).

2.1.2 As explained in the Management Case, a risk register has been developed with a categorisation of risk types; risk workshops were held to identify and categorise risks and to assign probabilities and values where risks could be quantified. The risk register is split into sub-sections for the Do Minimum Option, Franchising and Partnership.

2.1.3 The Assessment seeks to quantify the risks that TfGM and the GMCA could face and not those that are borne or transferred to the operators in any of the options. Risks faced by operators are considered in so far as they directly impact TfGM (e.g. if operators do not have the necessary information to price bids appropriately, this could have a cost implication for TfGM in terms of receiving bids that are less value for money – this is one of the risks recognised in relation to Franchising). Risks are identified but not quantified in the Do Minimum given that the risks are not incremental to the status quo and, as currently is the case, TfGM would need to respond by altering outputs (e.g. reduced concessionary spending / reduced outputs on tendered services).

2.1.4   As explained in the Economic Case, a Monte Carlo simulation is used to create a distribution of the likely risk cost through calculating the effect of different costs occurring randomly, based on their probability of occurrence, over a large number of iterations (10,000 iterations). The output demonstrates the required provision to cover project risks at different certainty levels, referred to as P-values.

2.1.5   The mean outcome (referred to as the P(Mean)) produced by the Monte Carlo simulation provides an output value that tends to the expected value of the underlying probability distribution. This value is included in the economic model given that *The Green Book* requires risks to be calculated on an expected value basis. For the Financial Case, the P(80) result was adopted. The P(80) percentile represents an estimate of the required risk provision to cover costs in 80% of scenarios and the 80th percentile risk level is consistent with the approach adopted to establish budgets and funding for other major TfGM projects. A sensitivity test at the 85th percentile is reported in the Financial Case.

2.1.6   The financial impact of a risk occurring is expressed as a range of values representing the potential extra costs (or reductions in revenue) associated with the risk. Pre and post mitigation values are included in the assessment. The attributes estimated for each quantifiable risk are therefore:

— the probability that the risk occurs;
— the cost incurred if the risk occurs (estimated at a minimum, most likely and maximum value);
— the reduction in either cost or probability due to mitigation; and
— the period when the risk may occur.

2.1.7   The phasing represents an estimate of when risks would be likely to occur and phasing is based on categorising risks as either:

i.   one-off risks, for example, risks that only manifest themselves in the transition phase; and
ii.   general risks, which could occur at any time during procurement or operations.

2.1.8   For the risks that it is possible to estimate at this stage, three possible outcomes were identified for each risk (a minimum, most likely and maximum value). A triangular probability distribution was applied to the three outcomes. The triangular distribution is commonly used for Monte Carlo modelling given that in situations where limited data is available and risks are required to be estimated by judgement, the precise distribution of

each risk is difficult to estimate, but it is more straightforward and reliable to estimate a minimum, maximum and most likely outcome for each of the risks.

2.1.9   Under a triangular distribution, the impact value that materialises in each iteration of the simulation can be anywhere between the minimum and maximum values estimated, with the risk being more likely to occur around the most-likely outcome identified than at the extremes. The triangular distribution incorporates skew of the distribution in that potential moves do not need to be symmetrical (for example some risks can have a higher downside than upside).

2.1.10   Another commonly used distribution is the Normal Distribution, but this does not allow for skew in this way, and would also require the estimation of other parameters such as the standard deviation, which are less tangible and cannot easily be estimated with the same degree of accuracy as the minimum, maximum and most likely outcomes that are the three parameters of the triangular distribution.

2.1.11   The risk model also distinguishes between capital risk (relating to the purchase of depots) and resource or revenue based risks. This allows the financing strategy to assign capital risks to prudential borrowings whilst resource based risks must be financed in the period in which they occur.

2.1.12   Risks are defined and quantified in a way such that it is reasonable for them to be modelled as independent risks. There are some instances in which two risks may be mutually exclusive, so the occurrence of one means the other will not arise. This is accounted for in the simulation by ensuring that such risks cannot occur simultaneously. An example relates to a risk in the transition period relating to the risk of procurement challenge – the costs associated with defending an unsuccessful challenge to procurement would not occur at the same time as the costs associated with a successful challenge (whilst in theory TfGM may receive challenges from multiple operators, this is taken account of in the estimation of the probability of challenge itself).
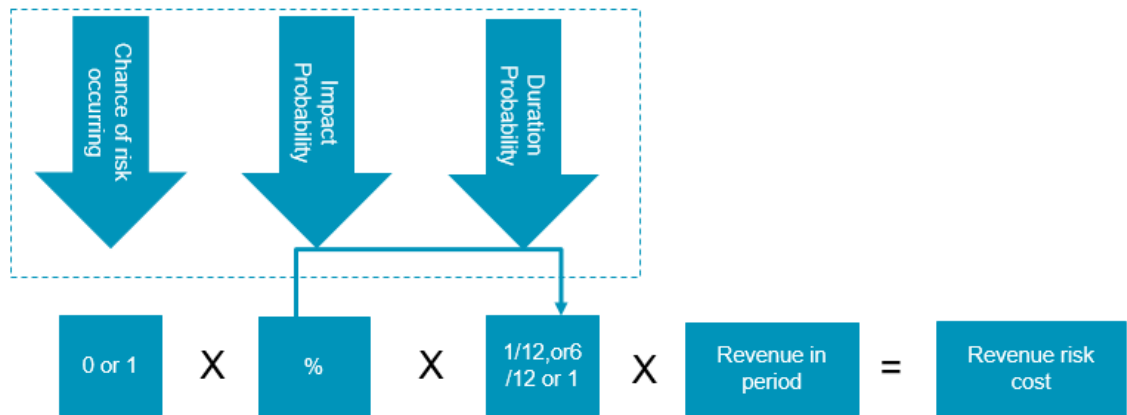
Revenue Risk

2.1.13   For risks during the implementation and management of the Franchising scheme option that have a specific impact on revenue, a separate risk quantification exercise was performed. A number of risks were identified that could potentially impact demand and revenue; rather than attempting to value these individual risks individually, an overall scenario based methodology has been used to value revenue risks. This enables revenue risk

to be considered in aggregate, as revenue risk is inherently difficult to predict and factors affecting revenue are also often linked.

2.1.14   The assessment of revenue risk considers 'influence-able' or endogenous type risks that TfGM could reasonably control and mitigate (such as poorly executed network design); it does not consider the impact of economic and exogenous type risks such as adverse changes in population growth, demographics and car ownership. These are not specific uncertainties (risks) that can be quantified – sensitivity tests are conducted on key factors such as these in the Economic and Financial Cases.

2.1.15   The risks impacting revenue are identified on the risk register and were categorised in terms of their impact size and likely duration of the impact should the risks occur. The impact parameters are as follows:

    i.   High impact – 5% of revenue
    ii.   Medium impact – 2.5% of revenue
    iii. Low impact – 1% of revenue

2.1.16   The duration parameters are as follows:

    i.   Long duration – 12 months
    ii.   Medium duration – 6 months
    iii. Short duration – 1 month

2.1.17   These parameters enable the modelling of risks up to a maximum impact of 5% of a given year's revenue – in the case of a high impact and long-duration risk. This allows for sufficient flexibility in modelling endogenous revenue risk. As explained above, the revenue risk analysis does not seek to quantify exogenous factors such as a decline in population growth.

2.1.18   The average profile of the risks then determines the likelihood of whether, once the revenue risk occurs in a given year, the overall impact on revenue is high/medium/low and short/medium/long duration.

2.1.19   In a given year, the probability that one of these scenarios is activated is modelled at a 50% probability. The probability is deemed to be higher during transition and modelled at a 75% probability. These probabilities are intended to be prudent as it is plausible there are also positive factors in a given year that could influence revenue.

2.1.20   In summary, the impact of revenue risks occurring in a given year is calculated as follows:

Chart 1: Revenue Risk Calculation

2.1.21 By way of example, if the risk occurs within a given iteration of the Monte Carlo model for a given year, and occurs with Medium Impact and Medium duration (the chance of which is determined by the average profile of the revenue risks as explained in paragraph 2.1.18), the impact value in that iteration of the model would be calculated as follows:

2.1.22 $Revenue\ risk\ cost = 1\ \times 2.5\% \times \left(\frac{6}{12}\right) \times Revenue\ in\ period$

'System One' Risk

2.1.23 A further specific 'System One' risk has been added to the QRA for the Franchising scheme option. This risk is to reflect expected lost revenue from trips that are currently made on single tickets which would no longer be purchased as a result of the move to all-network tickets with the Franchising scheme option (other than on certain routes where discount tickets would be sold). Currently some passengers may be purchasing an operator-own period ticket and also one or more singles from another operator (potentially for an unforeseen journey), rather than buying a System One ticket. In a franchised market, this would not be necessary (other than on certain routes as mentioned), and this represents revenue lost.

2.1.24 The National Travel Survey (NTS) reports the proportions of different tickets sold in Greater Manchester and this data was used in order to inform an estimate for the amount of revenue that would be lost. Given that the survey results vary by year and there is inherent uncertainty in the data, a risk based approach was used to estimate the impact of this phenomenon. Data for the last four years until 2017 (base year of modelling) was used in order to calculate a minimum, middle and maximum value.

2.1.25 The Monte Carlo analysis undertaken reflects this inherent uncertainty in impact value and different potential levels of risk. The following values

(quoted as a percentage of annual ticket revenue) are the parameters of the triangular distribution used to model the risk within the Monte Carlo model:

    i.   Minimum impact 0.24%
   ii.   Most likely impact 0.87%
  iii.   Maximum impact 2.14%

3   Optimism Bias

3.1.1   As outlined in the Economic Case (Section 20), Optimism Bias is the tendency for project appraisers to be overly optimistic about infrastructure cost estimation. *The Green Book* requires explicit adjustments to be made in this regard to address this tendency. As explained by WebTAG (2017), "Optimism Bias uplifts are only required in the Economic Case" (p10).

3.1.2   The Green Book provides empirically based Optimism Bias ranges for different types of scheme. TfGM has undertaken an exercise to assess appropriate optimism bias factors to apply as a cost adjustment.

3.1.3   When applying optimism bias, a 'project type' category must be selected from The Green Book. This determines the upper and lower bounds of optimism bias to be applied and the factors to consider when performing mitigation.

3.1.4   The depot acquisition and improvement costs were assigned to the "standard buildings" project type, as bus depots are by definition relatively simple sites comprising of maintenance, washing and fuelling facilities, staff facilities and hard standing for bus parking. The equipment/development category has been applied to information systems costs as these predominantly have the characteristics of an IT project. Finally, all other forecast operating costs were assigned to the outsourcing category as this is most relevant as it is the only category which explicitly applies to operating expenditure.

3.1.5   A mitigation assessment has been undertaken to consider the appropriate values to apply within the 'Upper Bound' and 'Lower Bound' Optimism Bias ranges for the relevant project type in Franchising and Partnership, considering to what extent TfGM has mitigated the contributory factors to Optimism Bias, as set out in the Green Book supplementary guidance on Optimism Bias (HM Treasury, 2013).

3.1.6   Specific risks of cost overrun have been identified in relation to depot acquisition costs, IS costs and ITS costs. In these cases, the mitigation assessment deems the relevant contributory factors to Optimism Bias as mitigated, in order so that the Economic Case does not account for the risk of cost overruns in both the QRA and Optimism Bias.

3.1.7 The cost category, project type, and optimism bias percentages are set out in Table 1:

Table 1: Optimism Bias Percentages

COST CATEGORY	OPTIMISM BIAS 'PROJECT TYPE'	UPPER BOUND %	LOWER BOUND %	MITIGATED % APPLIED TO BASE COST
Depots acquisition	Standard Buildings	24%	2%	2.00%[1]
IS Systems / Licences / Renewals	Equipment/ Development	200%	10%	10%
ITS	Equipment/ Development	200%	10%	38.97%
Transition Costs	Outsourcing	41%	0%	8.75%

3.1.8 The key reasons for the Optimism Bias levels are as follows:

i. Depots acquisition – The lower bound has been applied because specific risks have been quantified as part of the QRA to account for the depot related risks (Risks F012, F037, F039, F079). This includes the risk that the preferred option to negotiate and purchase strategic depots post mayoral decision cannot be achieved and TfGM needs to put alternative arrangements into place.

ii. Systems / Licences / Renewals – The lower bound has been applied because specific risks have been in quantified in the QRA to account for the risk of potential cost overruns in respect of upfront costs, development costs and ongoing operational costs (Risks F106, F107 and F108).

iii. ITS – Optimism Bias is partially mitigated given that detailed work has been undertaken in respect of ITS costs, and a specific risk has been quantified to account for the risk that a combined ETM/AVL solution cannot be procured (Risk F105).

iv. Transition costs – The level of Optimism Bias is partially mitigated due to the work undertaken to understand the market, the nature of the scheme costs and the initial market engagement that has been completed to validate the proposed commercial model for Franchising.

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[1] The upper bound (24%) is applied to initial improvement costs on depots.

Franchise Payments

3.1.9   As explained in the Green Book Supplementary Guidance on Optimism Bias (HMT, 2013), due to lack of available data, "Mott MacDonald was unable to recommend sound upper and lower bounds for operating expenditure, (except for outsourcing projects)" (p5). Franchise payments are not what HMT would usually regard as outsourcing (it is not a service moved from in-house to outsourced with corresponding structural changes, but costs incurred by private sector operators both prior and following the introduction of franchising), but this is the closest analogy.

3.1.10   The franchising payments that TfGM would pay to operators is operating expenditure from the point of view of bus operators, but outsourcing costs from the point of view of TfGM. Therefore, the appropriate range to consider for Optimism Bias as per the Green Book guidance is 0% - 41%.

3.1.11   In deciding what level of Optimism Bias to apply within this range, it is crucial to note that the interventions as defined (the options of Franchising and Partnership) would alter the market structure, but would not change the fundamentals of running the bus network.

3.1.12   This means that there is not significant estimation involved in calculating the cost of running the network – the elements that make up this cost, and how it is incurred is the same as in the current market, and therefore the same as the cost currently being incurred by incumbent bus operators. Estimation of these costs has used sources in operators' statutory accounts and an exercise was undertaken to use what operator data was available to check these costs and ensure an accurate estimate was being made. Given that Optimism Bias is applied to account for the demonstrated systematic tendency for appraisers to underestimate costs, it would therefore not be appropriate to apply Optimism Bias to franchising payments.

3.1.13   Under the Franchising scheme option, operators would be incentivised to control costs while delivering the specified service. In terms of the key elements of cost, there is no reason to believe that choices would be made that would increase costs as this would make them less competitive in bidding for contracts.

3.1.14   The supplementary guidance to *The Green Book* on optimism bias suggests considering performing sensitivities when it is deemed not appropriate to apply Optimism Bias to operating costs. Therefore, a sensitivity test was performed to allow for variation in the operator margin around the central case to be modelled and its impact understood – refer to the Economic and Financial Cases of the Assessment.

4 Bibliography

1. HM Treasury (2013). *Supplementary Green Book Guidance – Optimism Bias.*
2. HM Treasury (2018). *The Green Book.*
3. WebTAG (2017). *TAG Unit A.1 Scheme Costs.*