20 Risks and Uncertainties

20.1 Section Overview

- This Section highlights the key risks within the Project and how they should be managed.
- Some of the risks affecting the rapid transit scheme include; policy, construction, planning, residual, operational, vehicle purchase, maintenance, economic, demand and revenue risk.
- The proposal needs to take into account the likely impact of cost overruns and delays and who will be responsible for these risks. Forecast costs have taken an upper bound optimism bias factor of 44% for BRT and 66% for LRT (in accordance with DfT guidance) to account for the fact that costs estimates will be refined over time.
- Under conventional procurement, risk may not be priced into the procurement contracts and responsibility may not be with the appropriate party or rigorously managed resulting in cost inefficiencies or asset deterioration.
- Risks can be transferred to a private sector contractor by procuring the Project under a PPP arrangement. The market appetite for risks will inform the design of an appropriate PPP structure for the Project which will take into account project risks such as: bankability, insurability and the extent to which risk transfer to the private sector is achievable to deliver maximum value for money to the public purse.

20.2 Treatment of Risk and Uncertainty

In appraisals, there is always likely to be some difference between what is expected, and what eventually happens. Several studies have indicated that scheme cost estimates tend to underestimate cost and delivery times and overestimate benefits and revenue streams. As noted in the Green Book HM Treasury Guidance (2003) this is usually due to biases unwittingly inherent in the appraisal, and risks and uncertainties that materialise in the course of the project. As a result, it is important to identify and mitigate risks and make allowance for optimism bias.

In the context of cost estimate, “risk” refers to identifiable future situations that could cause an overspend or under spend to occur, while “optimism bias” is the demonstrated systematic tendency for project appraisers to be overly optimistic about key parameters, and in effect, results in an under estimation of scheme costs.

To address these effects the DfT have issued guidance (WebTAG Unit 3.5.9 – October 2006) to appraisers of the need to make explicit, empirically based adjustments to the estimates of a project’s cost, benefits and duration. This section focuses upon the estimation and treatment of scheme costs. Risks associated with patronage and benefits of each scheme are dealt with through sensitivity testing which is addressed later in this section.

20.2.1 Risk Management

Risk management is a structured approach to identifying, assessing and controlling risks that emerge during the course of the project lifecycle. Its purpose is to support better decision-making through understanding the risks inherent in the proposal and their likely impact. Table 20.1 overleaf presents the type of risks to be considered when appraising a rapid transit scheme: identifying the range of anticipated risks for each route; how they will be managed and how they will be assessed.

20.2.2 Optimism Bias

The DfT guidance (WebTAG Unit 3.5.9 – October 2006) follows the generic guidance on optimism contained in 'The Green Book' (HM Treasury 2003) and in 'The Supplementary Green Book Guidance on Optimism Bias' (HM Treasury 2003). It draws on the available evidence on optimism bias contained within the 'Review of Large Public Procurement' in the UK (Mott MacDonald 2002) and the more recently published 'Procedures for Dealing with Optimism Bias in Transport Planning' (Bent Flyvberg 2004).

As a project develops, it is expected that the scheme cost estimate will be refined over time, and hence it should be possible to better quantify and value risks, and to better capture the factors that contribute to appraisal optimism within the risk management process. Therefore, as the risk analysis improves as a scheme develops, it is expected that on average the risk-adjusted scheme cost estimate will increase while the applicable level of optimism bias will decrease.

For standard and non-standard civil engineering projects at the programme entry stage in the scheme development, the following upper bound levels of optimism bias uplifts are recommended:

- Road projects (i.e. bus-based rapid transit) 44% Upper bound level; and
- Rail projects (i.e. light rail transit) 66% Upper bound level.

These upper bound levels of optimism bias represent the optimism bias level to expect for current projects without effective risk management and limited scope definition, and are the starting point for calculating optimism bias for projects.

In line with the current Green Book guidance, as detailed in Supplementary Green Book Guidance on Optimism Bias (HM Treasury 2003), an optimism bias risk management appraisal should be undertaken for all options. However, as all scheme designs and costs are conceptual only at this stage, it has been assumed that all contributory factors have not been mitigated at this stage and the full optimism bias of 66% for LRT and 44% for BRT apply.

Table 20.1: Risk Management Strategy

Area of Risk	Type of Risk	Description	Risk Management	Treatment of Risk		
				Optimistic	Core	Pessimistic
Policy Risk	Policy Risk	The risk of changes of policy towards the concept of rapid transit	As guided by the RDS and RTS and the BMTP, rapid transit is a key element of the transport strategy for the BMA and the rapid transit schemes are a key component of that strategy	Not applicable	Not applicable	Not applicable
Risk on delivery of scheme	Construction risk	The risk that the construction of the scheme is not completed on time, to budget and to specification	The risk associated with delivering to time and budget is covered as part of the assessment of optimism bias for the core appraisal scenario. As the scheme is at programme level, the maximum level of optimism bias has been assumed.	Optimism bias remains as existing	Optimism bias remains as existing	Optimism bias remains as existing
	Planning risk	The risk that the rapid transit scheme cannot obtain planning permission	The RDS policy of urban hubs promoting sustained urban renaissance would be supported by rapid transit. Planning permission should be relatively straightforward for the sections of route that run mainly on-street. There is a higher risk associated with the elements of the route that are off-street and in particular for those areas of land that are not currently owned by the Department. The risk for any delay is accounted for by a change to the	Opening year remains as existing	Opening year remains as existing	Opening year delayed by 3 years

Area of Risk	Type of Risk	Description	Risk Management	Treatment of Risk		
				Optimistic	Core	Pessimistic
			assumed opening year as part of the sensitivity testing.			
	Residual risk	The risk to the uncertainty of the value of the physical asset at the end of the contract.	It has been conservatively assumed in all appraisals that no account is made for the residual value of the rapid transit vehicles at the end of the 60 year period.	Residual values not included	Residual values not included	Residual values not included
Risk on the operating of the scheme	Operational risk	The risk that operating costs for the rapid transit service vary from budget and that performance standards slip or that the service cannot be provided	This risk will be assessed through sensitivity testing. The calculation of rapid transit operating costs has been carried out using the Atkins OPSMODEL which has operational costs for a high quality rapid transit service derived from operational experience gained within the bus and rapid transit industry. Issues relating to performance standard and the provision of the service requirements will be subject to contract with the preferred operator of the service.	OPSMODEL -20%	Atkins OPSMODEL	OPSMODEL +20%
	Vehicle purchase risk	The risk that the rapid transit vehicle purchase costs vary from budget.	This risk will be assessed through sensitivity testing.	Budget estimate -10%	No adjustment from budget estimate	Budget estimates +10%
	Maintenance risk	The risk that the costs of keeping the rapid transit	This risk will be assessed through sensitivity testing.	Budget estimate	No adjustment	Budget estimates

Area of Risk	Type of Risk	Description	Risk Management	Treatment of Risk		
				Optimistic	Core	Pessimistic
		vehicles and stops in good condition vary from budget		-10%	from budget estimate	+10%
Risk on travel time savings to rapid transit user	Economic risk	The risk that travel time savings to rapid transit users vary from that forecast	This risk will be assessed through sensitivity testing.	BTM forecasts +10%	BTM forecasts	BTM forecasts -10%
Risk on demand and revenue	Demand risk	The risk that demand for the service does not match those forecast	This risk will be assessed through sensitivity testing.	BTM forecasts +20%	BTM forecasts	BTM forecasts -20%
	Revenue risk	The risk that the fare for the service does not match that assumed	This risk will be assessed through sensitivity testing.	BTM +25%	BTM (£1.20) single fare	BTM -25%

20.2.3 Sensitivity Tests

As outlined previously under the treatment of risk, there is a wide range of variables that are incorporated into the core economic assessment and the results will be sensitive to a change in any of them. For this reason, optimistic and pessimistic economic scenarios have been developed on the assumptions outlined in Table 20.1 previous. For an 'optimistic' scenario, the forecast demand was increased by 20%, the revenues increased by 25%, the operating costs reduced by 20% and the vehicle purchase costs were reduced by 10%. The opposite applies for the 'pessimistic' scenario.

With regard to residual risk, DfT appraisal guidance states that no residual value should be applied beyond year 60. In all cases the vehicles will need replacing in the next year after the 60 year appraisal period ends and is therefore zero in the last appraisal year. As a result, residual value has not been included in the 'optimistic' scenario calculations.

For the CITI rapid transit proposals, by applying a number of adjustments to the travel time, demand, revenue and costs variables to the preferred BRT option (Option 1A), the overall impact on the BCR is marginal and it continues to remain positive (between 3.0 and 5.8). A summary of the sensitivity analysis is shown in Table 20.2 overleaf.

For the EWAY rapid transit proposals, a number of adjustments to the demand, revenue and cost variables were applied to the BRT route which had returned the best BCR from the previous analyses – Route Option 4. As can be seen from Table 20.3 overleaf, the BCR remains positive (between 1.9 and 3.1).

For the WWAY rapid transit proposals, a number of adjustments to the demand, revenue and cost variables were applied to the BRT route which had returned the best BCR from the previous analyses – Route Option O3. As can be seen from Table 20.4 overleaf, the BCR remains positive (between 2.0 and 2.9).

Table 20.2: Sensitivity analysis for BRT CITI Scheme (Option 1A)

Assessment Element	Value in 2002 prices		
	Optimistic Scenario	Core BRT Option	Pessimistic Scenario
Table 1: Economic Efficiency of Transport System			
Consumer user benefits			
Travel time saving	£25.9m	£21.61m	£17.29m
Vehicle operating costs	-£7.62m	-£7.62m	-£7.62m
Business user benefits			
Travel time savings	-£4.41m	-£3.68m	-£2.94m
Vehicle operating costs	-£0.38m	-£0.38m	-£0.38m
Private sector provider impact			
Revenue	£15.5m	£12.43m	£9.32m
Operating costs	£1.91m	£0.64m	-£0.63m
Total present value of transport economic efficiency benefits	**£30.97m**	**£23.01m**	**£15.05m**
Table 2: Public Accounts			
Investment costs	£5.45m	£5.86m	£6.26m
Indirect tax revenues	-£0.11m	-£0.63m	-£1.16m
Total present value of costs	**£5.35m**	**£5.22m**	**£5.10m**
Table 3: Analysis of Monetised Costs and Benefits			
Consumer users (Table 1)	£18.3m	£13.99m	£9.67m
Business users and providers (Table 1)	£12.66m	£9.02m	£5.38m
Present Value of Benefits (PVB)	**£30.97m**	**£23.01m**	**£15.05m**
Present Value of Costs (PVC)	**£5.35m**	**£5.22m**	**£5.10m**
Net Present Value (NPV)	**£25.62**	**£17.79m**	**£9.95m**
Benefit Cost Ratio (BCR)	**5.8**	**4.4**	**3.0**

Table 20.3: Sensitivity analysis for BRT EWAY Route (Option 4)

Assessment Element	Value in 2002 prices		
	Optimistic Scenario	BRT Route 4	Pessimistic Scenario
Table 1: Economic Efficiency of Transport System			
Consumer user benefits			
Travel time saving	£130.88m	£109.1m	£87.26m
Vehicle operating costs	-£0.31m	-£0.31m	-£0.31m
Business user benefits			
Travel time savings	£10.69m	£8.91m	£7.13m
Vehicle operating costs	-£0.015m	-£0.015m	-£0.015m
Private sector provider impact			
Revenue	£27.13m	£21.71m	£16.28m
Operating costs	-£2.93m	-£5.72m	-£8.51m
Total present value of transport economic efficiency benefits	**£165.5m**	**£133.64m**	**£101.83m**
Table 2: Public Accounts			
Investment costs	£49.3m	£50.14m	£50.95m
Indirect tax revenues	£4.63m	£3.71m	£2.79m
Total present value of costs	**£53.97m**	**£53.85m**	**£53.73m**
Table 3: Analysis of Monetised Costs and Benefits			
Consumer users (Table 1)	£130.57m	£108.76m	£86.94m
Business users and providers (Table 1)	£34.89m	£24.89m	£14.88m
Present Value of Benefits (PVB)	**£165.46m**	**£133.64m**	**£101.83m**
Present Value of Costs (PVC)	**£53.97m**	**£53.85m**	**£53.73m**
Net Present Value (NPV)	**£111.49m**	**£79.79m**	**£48.10m**
Benefit Cost Ratio (BCR)	**3.1**	**2.5**	**1.9**

Table 20.4: Sensitivity analysis for BRT WWAY Route (Option O3)

Assessment Element	Value in 2002 prices		
	Optimistic Scenario	BRT Route 4	Pessimistic Scenario
Table 1: Economic Efficiency of Transport System			
Consumer user benefits			
Travel time saving	£39,279,202	£32,732,688	£26,186,134
Vehicle operating costs	£3,383,841	£3,383,841	£3,383,841
Business user benefits			
Travel time savings	£4,802,647	£4,002,206	£3,201,765
Vehicle operating costs	£166,884	£166,884	£166,884
Private sector provider impact			
Revenue	£27,645,159	£22,116,127	£16,587,096
Operating costs	£11,537,103	£10,133,301	£8,729,498
Total present value of transport economic efficiency benefits	**£86,814,836**	**£72,535,027**	**£58,255,218**
Table 2: Public Accounts			
Investment costs	£24,776,690	£25,289,527	£25,802,363
Indirect tax revenues	£5,612,975	£4,672,463	£3,731,952
Total present value of costs	**£30,389,665**	**£29,961,990**	**£29,534,314**
Table 3: Analysis of Monetised Costs and Benefits			
Consumer users (Table 1)	£42,663,042	£36,116,509	£29,569,975
Business users and providers (Table 1)	£44,151,794	£36,418,518	£28,685,243
Present Value of Benefits (PVB)	**£86,814,836**	**£72,535,027**	**£58,255,218**
Present Value of Costs (PVC)	**£30,389,665**	**£29,961,990**	**£29,534,314**
Net Present Value (NPV)	**£56,425,171**	**£42,573,037**	**£28,720,903**
Benefit Cost Ratio (BCR)	**2.9**	**2.4**	**2.0**

20.3 Identified inherent risks

Risk assessment involves the identification of risks inherent in the scheme, an understanding of the probability of their occurrence, and a quantification of the associated outcome. The inherent risks for the rapid transit scheme can be divided up into the following areas:

20.3.1 Design level uncertainty

At every stage of the design process up until physical construction of the rapid transit assets there is some level of design uncertainty. This level of design uncertainty translates into a range of cost outcomes, of which an estimate is the most likely outcome within this range. As the designs for the scheme become more detailed this level of uncertainty should reduce thus tightening the confidence interval around the estimate.

As the project is at an early stage of conceptual planning and engineering for all of the schemes, the capital costs have been estimated through the application of standard unit cost rates. For the elements of EWAY for which preliminary design work has previously been completed, the detailed cost estimates (updated to 2007 prices) have been used. The design work on major structures for the schemes which may be required, such as widening roads or strengthening bridges for LRT has also been limited. There is consequently uncertainty over both the nature of the project and the prices which will be charged for its components.

While design level uncertainty is most significant for capital costing, there are also impacts on operating costs and revenue (for example, staff costs, maintenance costs and revenue capture) over the operating life of the rapid transit schemes, referred to as operational, maintenance, revenue and demand risk.

20.3.2 Adverse events with impact on cost and delays

Unforeseen circumstances and events with cost implications, timing implications, or both, can and will occur during the life of the rapid transit scheme. Adverse events resulting in delays are of most relevance when they have a direct impact on delivery of the scheme. For example, an unexpected planning delay or legislation change could lead to an overall delay in opening, even where the work programme has been rescheduled to accommodate it. Adverse events can also have negative implications for operating costs and revenue although they rarely have timing implications for those items.

Quantification of the implications of delays comprises a number of different aspects. At the construction subcontractor level, delay results in on-costs associated with the use of more resources than expected (e.g. higher staff and rental costs). Delivering the Rapid Transit scheme under a PPP will involve additional cost implications due to the complex contractual relationships between contractors and financiers. Under a PPP, the private sector will not normally be paid until the project is available for use. So the private sector will have to fund the additional interest costs of any delay and the possible permanent loss of PPP payments if the delays do not result in extension of the concession length.

Under traditional procurement, delays do not translate into similar financial consequences being recognised, although there is still an economic cost as the project benefits are deferred and these risks have to be taken into account by the public sector when planning the development.

In order to quantify the financial effect of delays, there needs to be an understanding of who takes the risk and what the underlying financial exposure is. To use the example above of a planning application being rejected, this is often a public sector risk. If the private sector is taking all the construction cost risks and is not being paid until operation starts, then there would need to be a mechanism that would compensate the private sector for the lost payments caused by the delay to opening. The financial value of risk depends on structure and financing options. At this stage it is simpler to make a judgement on an overall contingency.

It is also important to distinguish between adverse events that are insurable and will be normally insured for a project such as the rapid transit schemes with those that are either uninsured or uninsurable. Analysis of the nature and magnitude of risks will enable a judgement to be made as to events that are insurable and the associated insurance premiums. The costs of such risks should then be included in the cost estimates in the form of insurance premiums. Insurable risks and any eventual costs will be borne by the developer.

At this early stage of design and project definition, risks have been kept to broad categories (as detailed in Table 20.1 previously) and individual risks within each heading will be looked at in further detail if the project develops.

20.4 Risk Transfer under PPP

The decision taken on the procurement option for each of the rapid transit schemes will have a significant impact on the responsibility of risk specifically risk allocation, potential value for money position and the resultant accounting treatment. The optimal allocation of project risks lies at the heart of the rationale for Public Private Partnerships. Under conventional procurement, risks may not be explicitly priced into infrastructure procurement contracts; and responsibilities and incentives may not be placed with the appropriate party. The result can be that project risks may not be rigorously managed, resulting in cost inefficiencies or asset deterioration. The PPP process seeks to overcome these issues through the following means:

i) *Whole of life costing:* The public sector is often not incentivised to manage the costs of assets over their useful lives, with a consequence that essential maintenance expenditure may be deferred. Under a PPP arrangement, it is more likely that minimum whole of life costing of the rapid transit scheme will be achieved;

ii) *Performance related payments:* The PPP payment mechanism links Government payments to the level of performance specified in the contract;

iii) *Innovation:* The PPP procurement model specifies outputs, rather than inputs. This allows the maximum scope for private sector innovation to the benefit of the project; and

iv) *Transfer of risk:* The Government (DRD) can make an assessment of the optimal level of risk transfer, weighing the advantages against the risk premium sought by the private sector to achieve overall best value for money for the project (i.e., minimize risk-adjusted whole of life cost to DRD).

It is important to note that this early stage in the projects lifecycle, PPP is currently only a main consideration for the implementation of the LRT option. It is felt that bus rapid transit could be funded and operated solely by the public sector.

20.4.1 Demand Risk

As noted in Table 20.1 previously, demand risk relates to the risk that the number of users of the rapid transit facilities is lower than expected meaning that the revenue received does not meet the targets. There are advantages for DRD to transfer this risk as it will incentivise any PPP contractor to maximise patronage and ticket collection. However, the full transfer of demand risk would probably still require a clear and fixed Government position on fare levels, integrated ticketing and transport regulation. This would severely restrict the Government's policy flexibility. There are a number of ways of sharing the demand risk, and balancing incentivisation with flexibility, which will be developed further.

The commercial structure adopted will also affect the handling of demand risk. If there is a separate operating contract then this is likely to have a shorter length. In this case DRD would essentially be taking the long term demand risk.

It should be noted that the demand risk with the CITI rapid transit scheme is much greater than with the EWAY and WWAY schemes. This is because the CITI rapid transit scheme will be serving a major brownfield site, the development of which has only just started. The demand forecasts for CITI are derived from the modal split aspirations and public transport usage as outlined in the Titanic Quarter Transport Masterplan document. They are very much dependent on the level of development aspired to in the Titanic Quarter being realised and the level of public transport usage envisaged by Titanic Quarter Limited and their consultants.

20.5 Conclusion

Risk issues impact all areas set out in this SOC and all stages of the rapid transit scheme development process. Whilst risk can be estimated and managed throughout the project life, it is in its very nature uncertain. The risk transfer achieving the optimal value for money outcome and the treatment of risk differ will depend significantly on the procurement option chosen however the risks that face the rapid transit schemes will remain similar.

The ability to transfer the risk to the private sector is the major benefit of PPP procurement however it does carry other cost implications which the private sector will require remuneration for. In conventional procurement all the risks and costs are borne by the public sector.

Optimism Bias must be included in forecasting costing when assessing the monetary impacts of a proposal to reflect the fact that as a project develops, it is expected that it will be easier to quantify and value risks.

The treatment of risk on the project will continue to be developed throughout the procurement stages to ensure:

- Best value risk transfer;
- A commercial structure that maximises competitive interest; and
- Proper treatment of whole life costs.