Mott MacDonald

Client:

HM Treasury
1 Parliament Street
London
SW1P 3AG
United Kingdom

Review of Large Public Procurement in the UK

July 2002

Mott MacDonald
St Anne House
20-26 Wellesley Road
Croydon
Surrey
CR9 2UL
UK
Tel : 44 (0)20[redacted]
Fax : 44 (0)20 8681 5706

Mott MacDonald

Review of Large Public Procurement in the UK

July 2002

Mott MacDonald

List of Contents

Page

Executive Summary S-1

Chapters and Appendices

Figures

Tables

Mott MacDonald

Acknowledgements

Mott MacDonald would like to express its sincere gratitude to:

All interviewees
BNFL
Flint and Neill Partnership
Highways Agency
HM Treasury
Home Office
Inland Revenue
Ministry of Defence
Mott MacDonald Study Team
Mott MacDonald Group
National Audit Office
NHS Executive London
Office of Government Commerce (OGC)
University of Bath
University of Reading
Various NHS Trusts
Vehicle Inspectorate

for their co-operation and support, without which none of this would be possible.

We would like to thank all involved and if we have omitted anyone from the above list, please accept our sincere apologies and our appreciation and thanks.

Executive Summary

HM Treasury commissioned Mott MacDonald to undertake a study to review the outcome of large public procurement projects in the UK over the last 20 years as part of an exercise to revise the Green Book[1]. The objective of the study is to provide guidance, for the public sector, to evaluate and reduce excessive optimism in project estimates during appraisals.

The paper demonstrates the existing high level of optimism in project estimates arising from underestimating project costs and duration or overestimating project benefits. In order for projects to be delivered to time and cost, the optimism in project estimates has to be minimised. An explicit method for determining optimism, based on the results of the study, in current and future projects has been developed and is described in Section 4. The term 'optimism bias' is used, both in the Green Book and in this paper, as a measure of optimism in project estimates. The study has identified the critical project risk areas that cause cost and time overruns, resulting in high optimism bias levels for different project types. To minimise optimism in project estimates and thus reduce overruns, these project risk areas have to be managed. This paper provides guidance for managing project risk areas through the application of best practice to minimise optimism in project estimates. The guidance is based on the results of the study, and takes into consideration optimism bias trends over time and the application of current procurement best practice.

WHAT IS OPTIMISM BIAS?

Optimism bias is the tendency for a project's costs and duration to be underestimated and/or benefits to be overestimated. It is expressed as the percentage difference between the estimate at appraisal and the final outturn. The average optimism bias levels recorded by the Mott MacDonald study for projects procured conventionally are shown in Table 1. Table 3 in Section 2.3.2 provides a breakdown of the optimism bias levels recorded for each project type (described in Section 2.1.2). The study results clearly show that historically there has been a tendency for project estimates to be highly optimistic.

Table 1 Recorded Average Optimism Bias for Traditional Procurement

Optimism Bias (%)			
Works Duration	CAPEX	OPEX	Benefits Shortfall
17	47	41	2

[1] 'The Green Book: Appraisal and Evaluation in Central Government' HM Treasury

WHAT IS THE SIZE OF OPTIMISM BIAS FOR CURRENT AND FUTURE PROJECTS?

Table 2 provides upper (U) and lower (L) bound optimism bias levels to be used when carrying out project appraisals. These U and L bound levels should be used for both traditional and privately funded projects, as both types of procurement are considered as alternatives at Gate 1 of the Office of Government Commerce's 'Gateway Review Process' (described in Section 3.3) and require effective risk management to reduce optimism bias. The rationale behind the table is described in Section 4. This paper only provides optimism bias guidance for capital expenditure (operating expenditure for outsourcing projects) and works duration due to data availability. Optimism should, of course, be considered in respect of all project estimates (i.e. costs, duration and benefits).

Table 2 Optimism Bias Guidelines

Project Type	Optimism Bias (%) [2]			
	Works Duration		CAPEX	
	U	L	U	L
Non-standard Buildings	39	2	51	4
Standard Buildings	4	1	24	2
Non-standard Civil Engineering	25	3	66	6
Standard Civil Engineering	20	1	44	3
Equipment/Development	54	10	200	10
Outsourcing	N/A	N/A	41*	0*

* The optimism bias for outsourcing projects is measured for operating expenditure, OPEX

WHAT CAUSES OPTIMISM BIAS?

Studies have shown that optimism bias is caused by a failure to identify and effectively manage project risks. The Mott MacDonald study identified five common project risk groups containing a number of project risk areas recorded as causing costs and time overruns, and benefits shortfalls. Table 5 in Appendix E contains a breakdown of these project risk groups into project risk areas. Note that the project risk areas identified in Table 5 should be managed for all projects types even if they have not been specifically identified as contributing towards optimism bias levels.

WHAT HAPPENS IF CAUSES OF OPTIMISM BIAS ARE NOT CONSIDERED?

Failure to consider and actively manage the causes of optimism bias will result in cost and time overruns, and benefits shortfalls over and above those that could be achieved if the causes are identified and actively managed. However, by taking account of risks when defining the nature and scope of a project and then developing strategies for the effective management of risks, it is possible to reduce the optimism bias and raise confidence levels in project estimates. Therefore the degree to which there is evidence that project risks have been identified and will be managed should be assessed

[2] Note that these values are indicative starting values for calculating optimism bias levels in current projects. The upper bound (U) does not represent the highest possible values for optimism bias that can result and the lower bound (L) does not represent the lowest possible values that can be achieved for optimism bias.

during project appraisals to reduce the likelihood of cost and time overruns, and benefits shortfalls when the project is delivered.

WHICH PROJECT RISK AREA CONTRIBUTES MOST TO COST OPTIMISM BIAS?

Table 6 to Table 9 contain a breakdown of project risk area contributions to optimism bias levels for individual project types. The contributions are expressed as a percentage of the relevant average optimism bias. In most instances, the inadequacy of the business case (i.e. inadequate requirements and inadequate project scope definition) was stated to be the major cause of project time and cost overruns.

HOW CAN OPTIMISM BIAS BE MANAGED?

A reduction in the levels of optimism bias in recent years was observed in the Mott MacDonald study. This is believed to have resulted from the introduction and use of the following tools, which have improved project delivery:

- Risk management
- Greater diligence at the project definition stage
- Partnering
- More controlled cost monitoring
- Value management
- Application of concurrent engineering.

Therefore through the application of current industry best practice, it should be possible to effectively mitigate project risks and reduce any likely optimism bias.

Section 3 in this paper provides best practice guidelines developed from the lessons learned from completed projects for minimising optimism during the preparation and execution of a project. In addition, Appendix H highlights several project management and risk management tools and methodologies, which enable the successful delivery of projects if applied effectively.

"In all things, success depends upon previous preparation, and without such preparation there is sure to be failure" Confucius (c.550 – c.478 BC).

1 Introduction

"Optimism in project estimates comes from a lack of experience, therefore the tendency to make optimistic project estimates can be minimised by learning from past projects." Anonymous

1.1 Background to Project Appraisal and Optimism Bias

HM Treasury commissioned Mott MacDonald to undertake a study (Mott MacDonald study) to review the outcome of large public procurement projects in the UK over the last 20 years as part of an exercise to revise the Green Book[3]. This paper uses the data from that study to provide guidance for use by the public sector as to the appropriate level of 'optimism bias' that should be applied to different types of projects during their appraisals. The guidance is also based on optimism bias trends over time and current procurement best practice.

The study is a detailed assessment of 50 major projects (with costs exceeding £40m in 2001 prices) in total, comparing their planned and actual performance. Analysis of these projects has enabled the calculation of optimism bias levels for certain project types and an assessment of optimism bias trend over time.

Project appraisals should be carried out throughout a project life-cycle especially when the business case is updated. Several key stages in business case development (e.g. strategic outline case, outline business case, full business case) are defined by the Office of Government Commerce (Appendix C contains a figure of the OGC Business Change Lifecycle)[4]. Project estimates tend to be optimistic and so when carrying out appraisals, optimism in estimates of project costs, duration and benefits has to be considered. Section 1.1.1 describes the definition of optimism bias, which is used to measure optimism during appraisals.

1.1.1 Definition and Explanation of Optimism Bias

Optimism bias is the tendency for a project's costs and duration to be underestimated and/or benefits to be overestimated. The Mott MacDonald study has attempted to measure several types of optimism bias (i.e. works duration, project duration, capital expenditure, operating expenditure, unitary payments and benefits shortfall) within the projects studied. Optimism bias is defined as a measure of the extent to which actual project costs (capital and operating), and duration (time from business case to benefit delivery (project duration) and time from contract award to benefit delivery (works duration) exceed those estimated. It is also a measure of the degree by which the benefits delivered by a project fall short of the benefits estimated. Optimism bias can be represented as follows:

$$Optimism\_bias = 100 \times \frac{(Actual - Estimated)}{Estimated}\%$$

An assessment of the typical optimism bias levels in the public sector provides an indication of the level of confidence within estimates of project costs (excluding the effects of inflation and change in

[3] 'The Green Book: Appraisal and Evaluation in Central Government' HM Treasury

[4] Figure 1 of the OGC Gateway Process Business Change Lifecycle Section B2

taxation), duration and benefits. All projects involve risk, which implies a cost to the bearer of that risk. Risk management in the public sector should aim to eliminate those issues that cause cost and time overruns, and benefit shortfalls. The project costs (capital and operating expenditure and unitary payments), duration or benefits are considered optimistic when they do not fully reflect the chances of cost and time overruns or shortfalls in the delivery of project benefits.

1.1.2 Optimism Bias and the Green Book

When allocating budgets, public bodies have to prioritise their investments, with the aim of maximising the value for money of their spending. This requires the use of appraisal methodologies.

An appraisal of a project should take a view of costs and benefits including:

- Expenditure on the provision of any capital assets and operation of the service
- Any residual value of capital assets at the end of the appraisal period
- Other costs and benefits which can be valued in money terms, in the form of revenues, cost savings and non-marketed impacts
- Quantified measures or at least a subjective evaluation of those costs, benefits or impacts that cannot easily be valued in money terms
- Operational efficiencies of the facility / asset to be provided
- Present and future demand for the facility / asset / service to be provided.

At any stage during the project life-cycle, the project costs and time required to deliver the project benefits are difficult to forecast accurately. Evidence has shown that public sector estimates tend to be optimistic.

It is important that the appraisal of costs, duration and benefits should include assessments of, and allowances for, the associated risks and uncertainties. An appraisal should also assess the risks and uncertainties associated with project risk areas that have not been valued monetarily.

The discount rate, – 6 % (six percent) – formerly recommended by HM Treasury for project and policy appraisal, implicitly included an allowance, over and above the cost of capital and social time preference rate, to reflect the impact of risks in public sector procurement. However, the guidance also recommended that, for the majority of projects, it is not appropriate to increase discount rates in appraisal to take optimism bias into account and reflect project risk. This treatment is too generic as risks will tend to vary from project to project. Also, it is an encouragement to select projects that have a profile of deferred costs.

Similar studies had been carried out previously and a reconciliation of the Mott MacDonald study with these studies is detailed in Appendix G.

1.2 Aims and Objectives

1.2.1 Aim

The aim of this paper is to assess the past delivery of major projects in the UK procured by the public sector over the last 20 years and from the lessons learned provide best practice guidance for reducing optimism in project estimates for current and future projects.

1.2.2 Objectives

1. Based on a sample of projects, to provide a measure of the average optimism bias at business case for each project type – for works duration, project duration, capital expenditure, operating expenditure, unitary payments and benefits shortfall

2. To provide an indication of critical project risk areas which have negative impacts on optimism bias

3. To determine patterns, if any, within the project sample

4. To provide a method for assessing optimism bias levels in current and future projects and to provide best practice guidelines both for reducing risks within project options and for managing project risks during the project life cycle.

2 Mott MacDonald Study

2.1 Sampling

2.1.1 Project Selection

HM Treasury provided a project list consisting of 60 projects (evenly spread across departments)[5] and Mott MacDonald identified an additional 20 projects. The aim was to gather a representative sample of projects procured traditionally and through the Private Finance Initiative (PFI) and implemented over the last 20 years (with values exceeding £40m at 2001 prices). Mott MacDonald was able to obtain sufficient information on a total of 50 projects for the statistical analysis. Appendix B lists the projects included in the study.

2.1.2 Project Type Allocation

In order to measure the average optimism bias levels for similar projects, the projects were initially divided into sectors (i.e. health, transport, prisons, power stations, defence, information technology, PFI and others). However, initial analyses indicated similarities across the sectors (e.g. typical prison projects recorded similar levels of optimism bias as typical hospital projects). Consequently, the projects studied were grouped according to project type as this was deemed more meaningful. The categories for project type are described below:

1. Standard buildings projects: Projects that involve the construction of buildings not requiring special design considerations i.e. most accommodation projects (offices, living accommodation, general hospitals, prisons, and airport terminal buildings) e.g. Woodhill Prison

2. Non-standard buildings projects: Projects that involve the construction of buildings requiring special design considerations due to space constraints, complicated site characteristics, specialist innovative buildings or unusual output specifications i.e. specialist/innovative buildings (specialist hospitals, innovative prisons, specialist barrack accommodation and other unique buildings or refurbishment projects) e.g. Chelsea and Westminster Hospital, which was located on a brown-field site, with restricted area and access and as a result required special design considerations

3. Standard civil engineering projects: Projects that involve the construction of facilities, in addition to buildings, not requiring special design considerations i.e. most new roads and some utility projects e.g. Yorkshire Link M1-A1

4. Non-standard civil engineering projects: Projects that involve the construction of facilities, in addition to buildings, requiring special design considerations due to space constraints or unusual output specifications i.e. innovative rail, road, utility projects and upgrade and

5 Initially, major departmental capital programmes were chosen, on the basis that they were self-evidently the most important. Within these, all projects satisfying the study requirements were selected, up to a maximum of ten per department. Where there were more than ten in a particular programme, only the largest were selected.

extension projects e.g. Jubilee Line Extension, which had to be constructed with innovative tunnelling methods in proximity to a landmark building (e.g. the Palace of Westminster)

5. Equipment & development projects: Projects that are concerned with the provision of equipment and/or development of software and systems (i.e. manufactured equipment, Information and Communication Technology (ICT) development projects) or leading edge projects e.g. MoD Defence Fixed Telecommunications Service (DFTS)

6. Outsourcing projects: Projects that are concerned with the provision of hard and soft facilities management services i.e. ICT services, facilities management or maintenance projects e.g. PRIME

2.1.3 Limitations of Study Sample

This is the first time optimism bias, recorded for completed projects, has been used to help provide greater accuracy in the appraisal process. Statistically, the sample of projects in the Mott MacDonald study is necessarily small because, in the time period studied, large public sector procurement was restricted to a relatively limited number of projects. The limited size of the sample is apparent when divided into project types, which do not contain the same number of projects in each category. These limitations have been considered when developing guidance for future appraisals.

2.2 Data Collection

2.2.1 Methodology and Rationale

In order to identify appropriate optimism bias levels to apply to current projects, Mott MacDonald adopted a three-stage approach. These stages are described in the sections that follow:

(i) Review of Completed Projects

In order to assess the optimism bias levels for current and future projects, it is necessary to review past projects and take onboard any possible lessons learned.

To achieve the objectives of the study, the optimism bias at business case (as well as at contract award) with respect to works duration, project duration, capital expenditure, operating expenditure, unitary payments and benefits shortfall had to be measured. In addition, the project risk areas giving rise to optimism bias had to be identified along with the contributions and impacts of each project risk area to the measured optimism bias.

(ii) Trends and Improvements

The best practice guidelines are based on the Mott MacDonald study results adjusted for changes and recent trends in the procurement and management of projects. The study results on their own should not be used directly as a benchmark for assessing optimism bias levels in current and future projects. These improvements include the introduction of risk management, improved procurement practices that involve greater diligence at the project definition stage, partnering, more controlled cost monitoring, value management, and application of concurrent engineering.

(iii) Current Practice Affecting Trends

Finally this paper presents, where possible, the most likely upper and lower bound values of optimism bias for each project type with respect to works duration, project duration, capital and operating expenditure and benefits shortfall. The study also provides an indication of critical project risk areas that must be mitigated to avoid high levels of optimism bias.

2.2.2 Project Summary Information Form Design

The project summary information form was designed to record both qualitative and quantitative data. The qualitative data was required to provide background information on the project and expand on project risk areas that have had an impact on the project. A large proportion of the qualitative data has not been used in the analyses. A blank template of the form used to capture summary information for the projects studied (the project summary information form) is included in Appendix D.

The key quantitative data required for the optimism bias analyses are as follows:

- Business case (BC) date and contract award (CA) date
- Works start and end dates as planned at BC and CA
- Actual works start and end dates
- Capital expenditure as planned at BC and CA
- Actual capital expenditure
- Operating expenditure as planned at BC and CA
- Actual operating expenditure
- Unitary payments at BC and CA
- Actual unitary payments
- Benefits shortfall (expressed as a percentage of benefits planned at BC).

In addition to the key data listed above, five project risk groups, each divided into a number of project risk areas have been identified. The list of project risk areas along with brief explanations can be found in Appendix E.

The five project risk groups identified in the Mott MacDonald study are as follows:

- Procurement related
- Project specific

- Client specific
- Environmental
- External.

For each of the optimism bias levels measured (time, capital and operating expenditures, unitary payments and benefits shortfall) a total score of 100% has been allocated amongst the project risk areas, with a view to determining their relative impacts on the optimism bias.

2.2.3 Issues with Data Collection

(i) Contingency allowances

Often when developing a business case, a contingency allowance is added to the estimate of net present cost (NPC) capital expenditure. In some cases Mott MacDonald experienced difficulties determining whether the figures quoted in the reference material used included contingencies.

(ii) Tender and Construction Cost Indices

In order to remove the influence of tender price and construction cost indices, the project costs were indexed to a common year for easy comparison. There was difficulty in determining the base year in which the expenditures quoted were expressed. When no base date was provided, it was assumed that the figures were priced in the year that the estimates or payments were made.

(iii) Measurement of Benefits

Where benefits shortfall is concerned, the difficulty lay in the fact that unlike time and money, benefits cannot be measured on a single scale. It was assumed that the actual benefits would be compared to the benefits estimated in the business case. However, some business cases did not give any indication of the benefits estimated. Moreover most projects did not have any post project appraisal that could provide an indication of how successful the delivery of benefits had been.

(iv) Measurement of Operating Expenditure

There was great difficulty in obtaining information on operating expenditure. Such information was only available on a small number of projects.

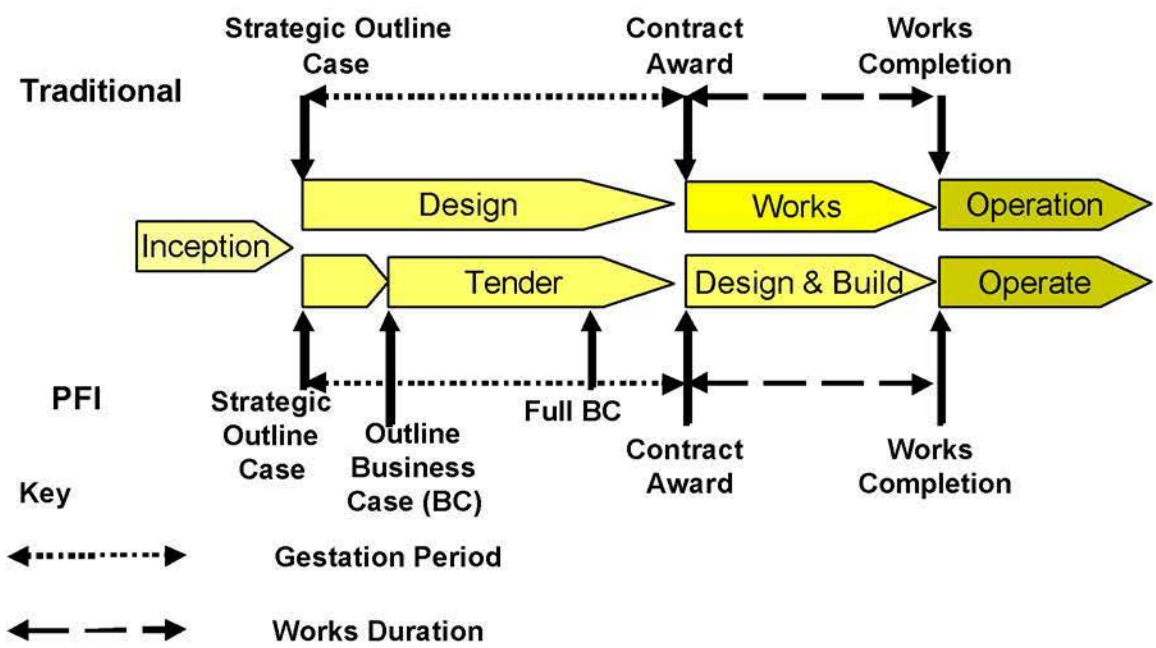
(v) Measurement of Unitary Payments

Unitary payments are only relevant to PFI projects as such payments are made from the client to the contractor to cover capital and operating expenditures during the operating phase of the project.

(vi) Estimates made at Business Case

The initial estimates quoted were based on business cases developed at different project life-cycle stages: strategic outline case, outline business case (BC) and full BC. The optimism bias levels for traditionally procured projects tended to be measured from either the strategic outline BC or the outline BC and also at contract award. Private Finance Initiative (PFI) projects tended to be based on the full BC as the outline BC was not available. A representation of the project life-cycle is given below.

Figure 1 Project Life-cycle



(vii) Project Risk Areas

The measurement of the relative impact of project risk areas is limited by the interviewee's interpretation of risk occurrence and the direct consequences on optimism bias. Guidance had been issued to all researchers/interviewers in order to provide an understanding of each risk area, so as to eliminate as much personal interpretation as possible.

(viii) Data Availability

The data collection process was only partly successful in providing all the information expected on all the projects reviewed. Of the 80 projects initially reviewed, only 50 projects had a reasonable amount of information, and were retained for analysis. Although most of the information required on the retained projects was available, some key data was lacking. When information was lacking on a specific aspect of a project, the project was excluded from the analysis of this particular aspect. Therefore the analysis of one aspect may have been based on a different number of projects as that for another aspect.

Information was more readily available for civil engineering and building project types as compared to equipment/development and outsourcing project types. Therefore the results relating to the civil engineering and building categories are based on a greater number of projects than those relating to the equipment/development and outsourcing categories.

2.3 Optimism Bias measured

2.3.1 Data Analysis

Once data collection was completed, the next stage in the study consisted of carrying out a statistical analysis on the database complied. The analytical procedure is described in the following paragraphs:

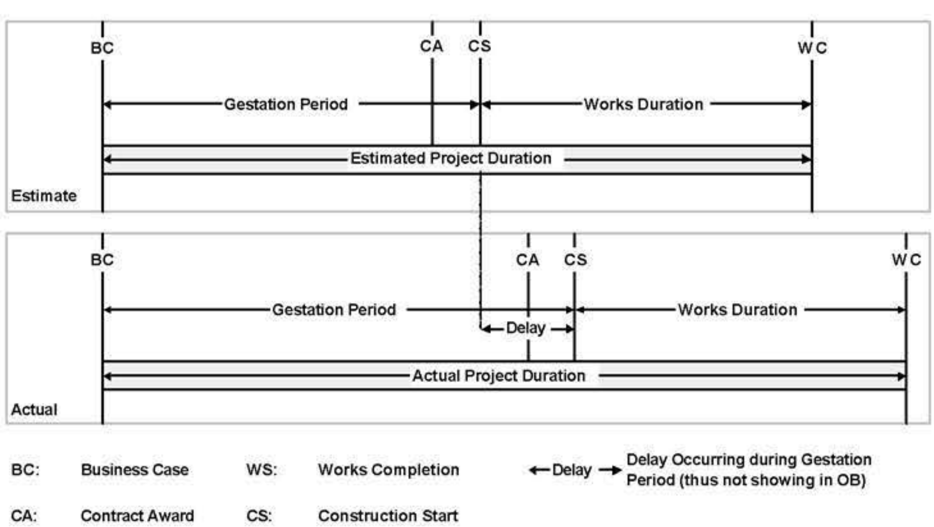
(i) Works Duration Optimism Bias

The actual works duration is compared to the works duration estimated at outline BC and contract award. The works duration refers to the implementation stage of the project, including design, mobilisation and construction. The works duration optimism bias can be represented as follows:

$$Works\_Duration\_Optimism\_Bias = 100 \times \frac{(Works\_Duration_{Actual} - Works\_Duration_{Estimated})}{Works\_Duration_{Estimated}} \%$$

The measured optimism bias does not give any indication of whether the project was delivered on time, but only reflects the extent to which the works duration had increased. The time lines shown below give an indication of how works duration optimism bias is determined. If the implementation stage started early and finished on the expected date, the works duration optimism bias will show an increase in works duration (i.e. be positive), but the project should not be considered as having been delivered late. If the works started two weeks late and finished two weeks late (i.e. works duration $_{actual}$ = works duration $_{estimated}$), the optimism bias measured will be 0%. However, this measure will fail to show that the project was delivered later than expected.

Figure 2 Estimated Project Time Line versus Actual Project Time Line



(ii) Project Duration Optimism Bias

The optimism bias on the overall project duration (from the gestation period through to the implementation stage) was also measured. The project duration overruns will be caused not only by delays during the construction of works but also by delays during the procurement of the project (i.e. prior to commencement of construction). The project duration optimism bias is highly dependent on the life-cycle stage at which the business case information is obtained (i.e. strategic outline case, outline BC or full BC) as a proportionately large amount of time may have passed between these stages. In addition, the length of the gestation period could be greater than 10 years resulting in unrealistically small project duration optimism bias. Therefore this paper does not present the results nor give guidance for project duration optimism bias.

(iii) Capital Expenditure Optimism Bias

The capital expenditure optimism bias provides a measure of the relative increase in capital expenditure from what was estimated at outline business case (and also at contract award) to the actual capital expenditure. The optimism bias is often partly due to the variations in tender price index (prior to contact award) and construction cost index (post contract award). In order to remove the influence of indices, the project costs (i.e. estimated and actual expenditures) were indexed to a common year.

For PFI projects the capital expenditure is provided through private finance. From the client's point of view, there is no capital expenditure. However during works implementation, the public sector may have to make up front capital payments as a result of the occurrence of risks that had not been transferred to the private sector. In this case the relatively small capital expenditure made by the client is expressed as a percentage of the contract price.

(iv) Operating Expenditure Optimism Bias

Operating expenditure data was unavailable for a large proportion of the projects resulting in an optimism bias based on very few projects.

(v) Unitary Payments Optimism Bias

Unitary payments optimism bias levels have only been recorded for PFI projects.

(vi) Benefits Shortfall Optimism Bias

The benefits shortfall optimism bias is based on a comparison of the benefits delivered with the estimated benefits at outline business case (and at contract award). As mentioned earlier, benefits are often not clearly defined, therefore best judgement had to be used when determining shortfalls. When a shortfall had been identified in the research, the shortfall was measured either based on the interviewee's perspective or based on the reduction in capacity of the project or its effectiveness in securing its objectives.

2.3.2 Results

The optimism bias values in Table 3 below represent the average optimism bias levels for each of the project types studied.

Table 3 Recorded Optimism Bias

Project Type		Optimism Bias (%)				
		Works Duration	CAPEX	Unitary Payments	OPEX	Benefits Shortfall
Traditional*	Non-standard Buildings	39	51	N/A	No Info	1
	Standard Buildings	4	24	N/A	No Info	No Info
	Non-standard Civil Engineering	15	66	N/A	No Info	5
	Standard Civil Engineering	34	44	N/A	No Info	No Info
	Equipment/Development	54	214	N/A	No Info	No Info
	Outsourcing	N/A	N/A	N/A	41	No Info
	All Traditional	**17**	**47**	**N/A**	**41**	**2**
PFI / PPP**	Standard Buildings	-16	2	1	N/A	0
	Standard Civil Engineering	No Info	0	0	N/A	0
	Equipment/Development	28	No Info	19	N/A	10
	Outsourcing	N/A	N/A	8	N/A	5
	All PFI / PPP	**-1**	**1**	**5**	**N/A**	**2**

* The optimism bias is measured from strategic outline case or outline business case.

** The optimism bias is measured from full business case. The capital expenditure optimism bias is measured as a percentage of the contract price.

Note: Do not use Table 3 for calculating the optimism bias levels for current projects. Guidance for calculating optimism bias levels for current projects is provided in Section 4.

The optimism bias levels for PFI / PPP projects were measured at the full business case stage, whereas the optimism bias levels for traditionally procured projects have been recorded at the strategic outline case and the outline business case stages.

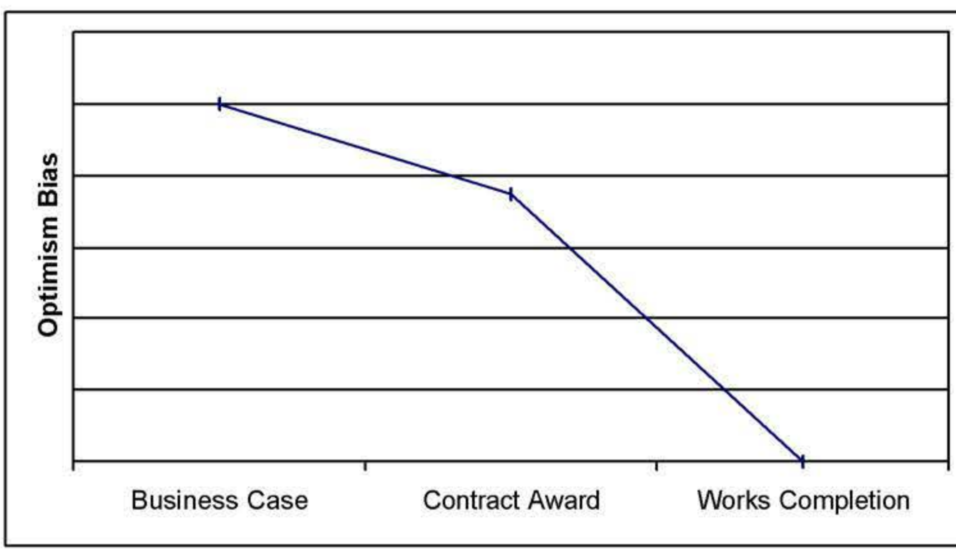
2.3.3 Observations

It is expected for standard projects to have smaller optimism bias levels when compared to non-standard projects and this is the case for the buildings project type. However, for civil engineering projects, the study shows a higher works duration optimism bias for standard projects as opposed to non-standard projects. The standard civil engineering project type mainly comprises of road projects, which tend to be susceptible to environmental impacts, giving rise to high works duration optimism bias in the study.

The Mott MacDonald study showed that the optimism bias levels for traditionally procured projects (at strategic outline case and full business case) were higher than for PFI projects (at full business case). This difference is attributed to the negotiated transfer of project risks from the public sector to the private sector, where project risks are passed to the party best placed to manage them consistent with achieving value for money and quality. However, the high level of diligence demanded by PFI procurement to establish the business case, was not observed for traditional procurement and may have contributed to the inadequacy of the traditional project business cases used in the study. For PFI projects, the project requirements are more clearly defined and a longer relationship is developed with the potential contractor and service provider, and the client, thus allowing potential problems to be resolved early.

The study also showed that the optimism bias for a project decreases through its project life-cycle as shown in Figure 3. As the project progresses, ideally the strategies for risk mitigation and management would be in place and the potential occurrence of certain project risk areas is likely to decrease with time (e.g. at the business case stage, obtaining planning permission is still uncertain while during construction, planning permission should have already been obtained and so the risk of not obtaining planning permission is no longer an issue. However, all conditional issues associated with planning permission still need to be addressed.).

Figure 3 Typical Optimism Bias during Project Life-Cycle



Therefore it is not surprising that the optimism bias levels in Table 3 for PFI / PPP projects are much lower than that for traditionally procured projects since more project risks are identified and mitigated at the full business case stage than at the strategic outline case and the outline business case stages.

Equipment and development projects, procured traditionally and/or through PFI, recorded high works duration, capital expenditure and unitary payments optimism bias levels. The optimism bias levels recorded during the study are within expected values, based on Mott MacDonald's experience of equipment and development projects, even though the exceptionally high capital expenditure optimism bias for traditionally procured equipment and development projects was greatly affected by a single project. These projects recorded high optimism bias levels as project requirements and scope tends to be harder to define as opposed to construction type projects. The project requirements tend to be less tangible. The geographical and technological aspects of the projects add further complications. An information technology development project could potentially cover several geographical locations locally or internationally. Each additional site could have different technological requirements or systems (e.g. communication technology in the UK is different from that in the USA). If critical project risks within such projects are not effectively managed, then these exceptionally high optimism bias levels are likely to occur.

2.4 Impact of Project Risk Areas

2.4.1 Data Analysis

The percentage contribution to optimism bias from each project risk area was determined during the data collection process. This enabled the calculation of optimism bias caused by individual project risk areas, which was then averaged over the project types. Projects that have negative optimism bias levels were not included in the average as no project risk area impacts would have been recorded.

2.4.2 Results

Table 6 to Table 9 in Appendix F list the project risk areas identified in the study and show their contributions to the optimism bias recorded for each project type. The contributions are expressed as a percentage of the relevant average optimism bias.

2.4.3 Observations

The tables of results in Appendix F give an indication of project risk areas most likely to cause overruns if sufficient risk mitigation strategies are not put in place. The top eleven project risk areas contributing to the recorded capital expenditure optimism bias are listed below in descending magnitude according to the maximum average percentage contribution recorded across the project types.

1. Inadequacy of the business case (58%)
2. Environmental impact (19%)
3. Disputes and claims (16%)
4. Economic (13%)
5. Late contractor involvement in design (12%)
6. Complexity of contract structure (11%)
7. Legislation (7%)
8. Degree of innovation (7%)
9. Poor contractor capabilities (6%)
10. Project management team (4%)
11. Poor project intelligence (4%).

All other project risk areas contributed less than 3% to the measured optimism bias. Based on Mott MacDonald's experience in other projects outside the study, the following project risk areas have also been known to contribute to optimism bias:

1. Design complexity
2. Information management
3. Technology
4. Site characteristics
5. Public relations.

The study showed that most of the traditionally procured projects in the sample were inadequately defined (in terms of requirements and project scope) in the approved business case and that minimal attention had been given to benefits and operating costs in the short, medium and long term. On the other hand, PFI / PPP procurement requires the projects to be defined around their benefits/requirements and not just project deliverables. Adopting this approach of defining a project based on its benefits may help ensure full delivery of benefits on traditional projects. All project business cases need to be based on correct and reliable project intelligence (e.g. reliable information about ground conditions).

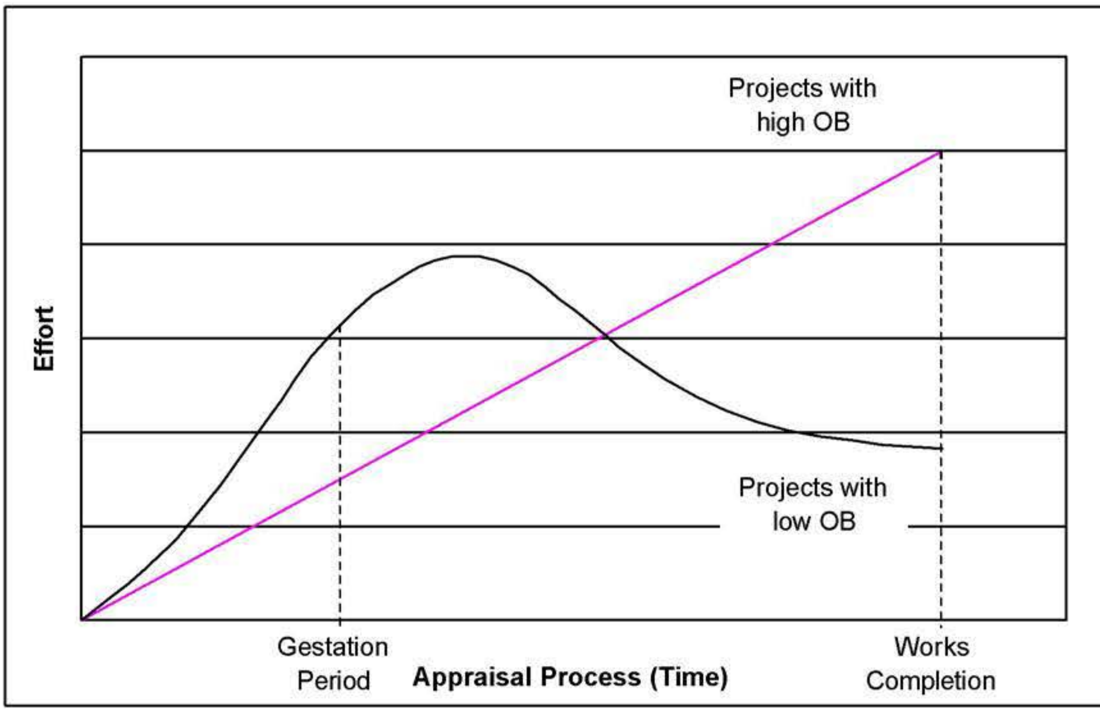
The study recorded a gestation period for PFI projects twice as long as that for traditional procurement, mainly due to the complexity of the contract structure. In addition, a large proportion of the PFI projects reviewed were the first of their kind to be procured in this fashion (e.g. the first PFI road, prison, hospital). No precedent or guidelines had been set to aid the procurement process up to contract award. However, despite this initial delay, approximately half of the PFI projects studied were delivered and ready for use on time. The other half of the projects ran to project construction programmes but overall project programmes were delayed due to long gestation periods, resulting in the late delivery of benefits.

An interesting observation from Table 3 is the minimal difference in optimism bias between the standard and non-standard civil engineering projects. This is a reflection of the very nature of civil engineering, which is heavily influenced by the effect of ground conditions, the associated uncertainty, and the fact that its risk has traditionally been retained by the public sector. In addition the standard civil engineering project type optimism bias has been strongly influenced by a single project impacted by a major environmental issue.

In most instances, the inadequacy of the business case was stated to be the major cause of project time and cost overruns. It may also be argued that the third most significant project risk area, disputes and claims, is also a result of inadequate specification giving rise to variations and consequently claims. This fundamentally demonstrates the need to concentrate significant effort and diligence to ensure the business case comprehensively represents the real requirements of all project stakeholders, in terms of the agreed project scope and objectives.

Figure 4 illustrates the observed relationship between project team member effort and the resultant optimism bias. This shows that early effort spent managing project risks tends to result in low optimism bias.

Figure 4 Relationship between Optimism Bias and Effort



When preparing business cases, project sponsors should be looking to the future, both medium and long term (i.e. including provisions for whole lifecycle replacement and updates in the technological basis of projects). Especially as the study recorded changes in legislation and technology as the two most consistent external project risk areas contributing to high optimism bias. Good project intelligence is essential when preparing a business case. However, it is difficult to completely address all possible changes outside the project constraints i.e. external project risk areas.

An area of potential benefits shortfall is where the need for the services provided as a result of the project changes with time, effectively stranding the investment. This risk is increased where projects have unexpectedly long gestation periods and can be mitigated through scenario analysis at initial definition stage. Insufficient data was available to allow this area to be analysed in any detail.

2.5 Conclusions

2.5.1 Mott MacDonald Study Data Collection

The Mott MacDonald study has provided a measure of the typical optimism bias for the various project types identified.

The data collection process revealed difficulties with respect to gathering information on operating expenditure and benefits shortfall. Firstly, data on operating expenditure and benefits shortfall was broadly unavailable and, secondly, determining benefits shortfall was based on personal interpretation as benefits estimated at business case were not clearly defined.

The relative contributions to optimism bias by the project risk areas were successfully measured, although a large degree of best judgement was involved.

The Mott MacDonald study identified the critical project risk areas that need to be managed, by putting in place risk mitigation measures when developing a business case, to reduce the likely optimism bias. Also, optimism bias reduction is likely to be achieved at least in part through priced risk transfer and this should be taken into account in any analysis. The project risk areas that have not had an impact on optimism bias were effectively managed in the projects studied.

2.5.2 Mott MacDonald Study Results

The results of the study have shown that over the last 20 years, the public sector has tended to be optimistic in its estimates for projects over £40m in value although there was evidence of improvement over the same time period. The degree of optimism was dependent on the type of project and the maturity of the business case.

Optimism developed as a result of failing to manage all project risks. The 'inadequacy of business case' was identified as the most critical project risk area, with risk arising from inadequate definition of project requirements and method of implementation, and inadequate attention to risk mitigation in developing the chosen option. There was also insufficient consideration of possible changes in the need for the project during the life of any assets or term of a contract.

Optimism bias for projects is not sector specific, as similar levels of optimism bias were recorded for project types across sectors. Some project types, where high levels of optimism bias were recorded, are inherently more risky than others. The following project types are listed in descending order of inherent risk, based on capital expenditure optimism bias:

1. Equipment/development
2. Non-standard civil engineering
3. Non-standard buildings
4. Outsourcing
5. Standard civil engineering
6. Standard buildings

There is no correlation between project size and optimism bias, however there is a strong relationship between project size and the number of project risks. Major projects like those in the Mott MacDonald study and minor projects (approximately £10 m in value) have the same number of project risk areas whose project risks need to be managed. The number of project risks within project risk areas increases with size of project. Optimism bias measures the level to which project risks are not managed (i.e. low optimism bias reflects a high percentage of managed project risks, while a high optimism bias represents a low percentage of managed project risks). Therefore the level of optimism bias recorded for a project will be dependant on the project management and risk management capabilities of the project management team rather that the number of risks associated with the project.

The management of project risks for major projects is likely to require more money and effort than that for smaller projects. However, since optimism bias is measured as a percentage increase of project outcomes compared with the business case estimates relevant to the appraisal, similar levels of optimism bias can be expected for major and minor projects.

The data collection exercise identified shortcomings in record keeping, post-completion benefit appraisal, and allocation of operating phase costs within most of the projects studied. Once a project was completed, archiving of its records tended to be disorganised and post project reviews were not performed. As a result, lessons learned on that project were lost.

"Those who do not learn from the past are condemned to repeat it" Anonymous

Therefore Mott MacDonald recommends that a process actively promoting knowledge transfer and knowledge sharing should be put in place. Adopting the following will allow continued improvements through the lessons learned from completed projects:

- An open approach to sharing the successes and failures of major project procurements, through internal and external seminars, papers and similar
- Post completion, one year after completion and five years after completion audits to compare project outturns against projections, together with wide dissemination of lessons learned
- Methodical archiving of key project documents.

3 Recommendations for Current/Future Major Project Procurement

In order to translate the evidence from past projects into guidance to allow for optimism in current and future public procurement, it is necessary to understand the changes in both the external environment and normal procurement practice (e.g. preparation of business case) that have occurred since the projects studied were completed.

On the basis of the sample of projects analysed, this section identifies key changes and trends and comments on the relative importance of residual influences on optimism bias. This section also identifies sources of optimism bias that either lie outside the control of the project manager or are within the remit of project procurement.

3.1 Trends and Shifts in Optimism Bias

The study revealed evidence that lessons learned from past projects are currently improving the estimation of project costs, time and benefit delivery. This section identifies the principal causes of optimism bias evident during the study period, which may have changed between then and now.

3.1.1 Risk Allocation

In terms of procurement, there has been a general, but not universal, shift from input to output specified requirements and a change in the risk allocation between public sector and those implementing projects through the introduction of partnering, outsourcing arrangements and, in particular, the Private Finance Initiative (PFI). Both trends have reduced significantly the cost and time overruns and benefits shortfalls relative to both the outline business case and the position at contract award. There has also been an increase in pain-gain sharing of profits and losses, with the public sector and those implementing the projects having a common goal. The greater risk transfer and functional specification usually drives both parties in PFI projects towards completion of the project to cost and time. Risk transfer comes at a cost, which must be considered during the appraisal. When negotiating a contract, all aspects regarding the risk transfer (including caveats dealing with technology risk, obsolescence and changes in law) have to be considered to ensure long term value for money.

3.1.2 Service Operation

The inclusion of concessions within PFI / PPP projects has led to a change in roles for the operating stage of projects. As part of the PFI contract, the contractor is granted exclusive rights to provide a service or to exploit an asset during what is known as the service operation stage of a project. During this stage a payment, which is governed by a tariff structure or payment mechanism (normally based on availability and performance criteria with some dependence on volume usage), is made to the private sector contractor. The payments reflect the level of benefits enjoyed by the public sector client. However, it is too early within these contracts to comment substantially on the service operation stage, in particular its flexibility to changes in service requirements.

The linking of tariff structures and payments streams reduces the costs to the public sector as benefits reduce. This very significantly reduces optimism bias at both business case and contract award stages.

3.1.3 Public Sector Investment Appraisal Process

Institutional changes within the public sector and the processes used to evaluate project business cases have a strong impact on the likely level of optimism or conservatism in project preparation. The key issues here are the degree of rigour in project preparation and the level of commitment to ensuring that the business case is delivered. There is strong evidence of improvement in the quality of business cases during the period covered by the study. This is strengthened by the introduction of 'gateway' approaches (such as the OGC 'Gateway Review Process' as discussed in Section 3.3) to control the development of major projects. The key features of these methodologies are:

1. Several clearly defined stages are determined covering the project life-cycle from inception, through viability, design and construction to operation of the facility or capability provided by the project.

2. Between each stage is a 'gateway' through which the project must pass before proceeding to the next stage. Typically, the gateways will align with key decision points at which the actual commitment level is increased.

3. The stages and gateways should reflect specific issues that are common to a particular project type. For example, defence equipment projects are based on the Ministry of Defence's (MoD) guidelines for Smart Procurement. The aim of Smart Procurement is to enhance defence capability by acquiring and supporting equipment more effectively in terms of time, cost and performance (faster, cheaper and better). Smart Procurement involves a gateway process developed by the MoD to help appraise and deliver new equipment projects. It includes six stages: concept; assessment; demonstration; manufacture; in-service (available) and disposal. The initial gateway for procurement takes place after the concept stage where the decision to invest in assessing the value of the defence capabilities is made. The main gateway takes place at the end of the assessment phase when the decision to invest in procuring the capabilities is made. In principle, the decision to commit to performance, time and cost is separate from actually placing a contract with the industry, which takes place after the demonstration phase (i.e. it has been demonstrated that the equipment can actually be built).

However, optimism bias remains significant throughout the project life-cycle for unique projects, those with innovation or new technology, or projects with complex interfaces. In these cases alternative solutions or changes to business processes or project goals which can reduce risk have to be considered.

It is difficult to achieve full accountability and commitment to cost, time and benefit delivery within the public sector context due to movement of key project team members and level of decision-making authority delegated to project teams and public sector culture. Under traditional procurement, with limited levels of risk transfer, this optimism bias remains at the contract award stage. The problem is accentuated in politically important projects: if it is believed that once given the go-ahead a project cannot be allowed to fail, then there remains a strong incentive for optimism bias, even if applied implicitly.

Optimism can creep in during contract negotiations as caveats to contracts are added to achieve resolution. This does not necessarily mean that value for money is not achieved, but is likely to lead to optimism in both costs and benefits to the public sector.

3.1.4 Private Sector Risk Pricing

With increasing risk transfer from public to private sector within procurement contracts, the private sector's perception and pricing of risks becomes increasingly important. As experience of handling risk develops, adjustments are also made to the pricing of that risk transfer by both equity and debt providers.

In the case of projects with uncomplicated interfaces and low levels of innovation, there is evidence that private sector developers and contractors are delivering projects within their estimates and are able to demonstrate delivery of benefits. Basing cost estimates on past projects may lead to a slight negative optimism bias (i.e. conservatism).

However the unique, complex, innovative or publicly sensitive projects have not proved easy to deliver, especially where public sector interfaces are many and the core project objectives or delivery are affected by changes in political opinion. In the main this has manifested itself in longer negotiation times, higher pricing and poorer risk transfer to the private sector as compared to standard projects. Once a PFI project has achieved financial close, its chances of achieving its contractual objectives are good.

3.1.5 External Environment

Uncertainty in the external environment causes changes to both project costs and benefits. For example, changes in design or construction standards often lead to changes in project scope, which may result in cost and time overruns. Projects may be influenced by the following external project risks:

(i) Political Influences

The risk of changes in policy is normally carried by the public sector.

(ii) Social Changes / Public Relations

During the period of the study there has been increased public sensitivity to certain environmental issues, particularly those associated with road projects and a consequential change in the level of public activism. This has led to higher development costs and the need for good consultation. Some optimism bias remains.

(iii) Economy

Shocks such as the oil crisis and the macro-economic business cycle had a marked impact on some projects and the 1980s included significant economic and social changes. The current economic climate suggests that this cause of optimism bias may have reduced.

The optimism bias assessment does not consider the effect of tender and construction cost indices on capital expenditure. However, when appraising future and current projects, changes in indices can only be predicted and not guaranteed. If trends in the tender and construction cost indices are not taken into consideration, or not accounted for in the business case, then the behaviour of indices may influence the outturn costs of a project.

(iv) Institutional Influences

Many public projects have strong advocates. On several occasions there was evidence that costs had been aimed at the figure necessary to obtain approval, rather than robustly estimated and justified by the projects' benefits. Similarly, once ceilings were imposed on project costs, additional works were obtained through waiting for successive budget years. The project is most vulnerable to this bias at the business case stage. However, it can persist to the contract award stage especially where scope definition is incomplete or not functionally expressed, leading to changes in scope and cost. Once a project has gained momentum (especially politically), it is sometimes difficult to consider an alternative and so ultimately, the project goes ahead despite knowingly underestimating project costs and time.

(v) Legislation and Regulation

Issues such as change in legislation continue to influence variations in project costs and time. Health and safety legislation has been particularly influential on the projects studied. Projects need to allow for legislative and regulatory change, based on issues such as environmental remediation and any harmonisation within Europe. The private sector will not accept this risk (outside of regulatory risk normal in a business environment) except at a high price premium, so allowances should continue to be made in business cases. It is important to ensure that research is carried out in this area during the project life-cycle in order to anticipate potential changes and put in place mitigation strategies.

(vi) Market Size and Concentration

The balance of supply and demand, and the number and strength of competitors in any market, continue to influence pricing although it is uncertain as to how pricing will be affected. A possible scenario may occur where the number of competitors in the market is large, leading to low tender prices. Once the contract is awarded, the contractor may try to recoup his expenditure through claims, resulting in high capital expenditure optimism bias. Some of the optimism bias may be reduced through contractual arrangements. On the other hand, if the number of competitors in the market is small, high tender prices may have to be accepted due to the lack of competition. Therefore, market size and concentration is a possible source of optimism bias at the contract award stage. This includes concentration in the number of developers and contractors, the supply and demand of private finance and the number of major projects in progress.

(vii) Technical Novelty

"It must be remembered that there is nothing more difficult to plan, more doubtful of success, nor more dangerous to manage, than the creation of a new system." Machiavelli

There continues to be optimism regarding the extent to which technical novelty (uniqueness, innovation and utilisation new technologies) can be delivered. This is a major source of optimism bias in terms of time, cost and benefits delivery. Advancements in technology (e.g. information and equipment technology) are a form of innovation along with new methodologies (techniques) and systems.

Ideally technology should aid in the delivery of a project, rather than change its requirements. However, this may not be the case for equipment/development projects where the main benefit involves the application of technology to support an existing business. In these types of projects the chosen technology may dictate the requirements, design, limitations, length of development operation and maintenance regime for the project.

New systems should be designed around the current and future needs of a business. Appropriate technologies should be utilised to support the business processes required to address the needs of the business. By developing effective ways of working and making these standard throughout the business it should be possible to gain the full benefit of the supporting technology.

It should be noted that a project that requires the research and development of new technologies to deliver its benefits has no guarantee of delivery and therefore has a high risk of abandonment.[6]

3.2 Influence of Procurement Type

3.2.1 Traditional

Traditional procurement includes forms of contracts in which substantial risks, such as design, ground conditions and weather, remain with the public sector. The Mott MacDonald study has recorded large optimism bias for projects procured using this method of procurement. This is attributed to the large number of risks excluded from the contractor's price at the contract award stage (e.g. risk of ensuring fit for functional purpose).

There is a wide range of alternative capital procurement options available (e.g. turnkey contracting, or open book pain/gain sharing type contracts) which change the allocation of risk and incentives on contractors. These provide means to reduce optimism bias and should be considered on a case by case basis.

3.2.2 Private Finance

These projects include all PFI / PPP and concession type contracts. They are characterised by high risk transfer, including the transfer of operating risk. Commercial novelty, in the form of early PFI contracts, added cost to projects both directly at the negotiation stage through advisers' fees but also through the caveats negotiated in contracts that shifted risk back to the public sector. With growing experience in PFI and standardisation of commercial terms, the private sector is becoming more comfortable as it understands the risks involved. However, this does not apply to projects with significant technical innovation, unusual commercial structures or novel risk transfer, as these tend to experience considerably higher levels of optimism bias than standard projects. The projects assessed are all early PFI projects, so many of the issues identified are no longer significant sources of optimism bias.

[6] The guidance within this paper should not be directly applied for projects involving a large element of research.

The works duration overruns in these projects are low. However, the client needs to ensure during the preparation of the business case that adequate allowance is made for:

- Protracted contract negotiation (including legal, technical and financial advisory processes)
- Costs to the public and private sector of such negotiation
- Land acquisition and planning permissions
- Public relations - building a political consensus to support the project
- Variations in requirements over the length of the contract.

As more PFI / PPP projects have been commissioned, experience in dealing with these issues has grown and, as a result, the capital expenditure and works duration optimism bias levels for the client at contract award, associated with this method of procurement, are small when compared to traditionally procured projects. As experience has grown, there is now evidence of a reduction in the time and expense associated with the gestation period for these projects as the procurement process for these projects has become standardised. Previously, the gestation period for early projects was up to three times as long (and the advisory fees up to six times higher) than those for traditional procurement.

Unitary payments are made up of a capital aspect and an operating aspect. In order to minimise unitary payments optimism bias, it is necessary to determine critical project risk areas which impact on capital and operating expenditure optimism bias levels. Managing these project risk areas would reduce unitary payments optimism bias in the same way as capital and operating expenditure optimism bias for traditionally procured projects.

PFI / PPP projects procured more recently have benefited from the lessons learned during the procurement and implementation of earlier projects. Once experience was gained and precedent set, there has been greater understanding of contract structure and possible causes of time and cost overruns. Best practice guidance has also been prepared. Therefore, the expenditure and time overruns during the procurement process for more recent projects, of similar types, are significantly smaller.

The study revealed that most of the projects procured using a PFI / PPP procurement method would not have started as early as they did if public funds were required up front for the capital works. Some of the PFI projects within the Mott MacDonald study were considered low priority projects with regard to investments of public funding and would only be constructed many years later. However, with the introduction of private finance and satisfactory assessment of value for money, these projects were given the go ahead. In PFI projects the client pays for the benefits delivered over the duration of the service operation stage of the project (normally between 10 and 40 years). Payments are made once the works are complete and the new facility is ready for use.

A Public Sector Comparator (PSC) is prepared early on in the project life-cycle when PFI procurement is considered as an option. The PSC is not updated to the same detail as the business case is throughout the project life-cycle. When the PFI option is chosen and its business case developed, the PSC is also developed but to a smaller extent. Comparisons are made against the less developed PSC and so like-for-like comparisons are not performed.

3.3 Best Practice Guidance

3.3.1 General

"In all things, success depends upon previous preparation, and without such preparation there is sure to be failure" Confucius (c.550 – c.478 BC)

There are no absolute criteria to define what is 'best practice' in terms of project management and procurement. There are, however, new processes to help with the preparation of projects that have the potential to improve the delivery of projects in terms of costs, time and performance.

An example of such a process is the 'Gateway Review Process' now established by the OGC. This process combines the 'gateway' approach with a clear governance process and is supported by comprehensive guidelines and checklists to steer the review panel.

The key features of a clear governance process include:

- Defining the review process and criteria to be established at each gateway to allow the project to pass through
- Identifying appropriate and clearly defined project objectives
- Using a review team, independent from the project team preparing the business case or other document forming the basis of the review, to act as an auditor
- Basing the review on the entire project life-cycle, giving equal rigour to operational cost and benefits as well as capital costs
- Verifying that the project scope covers all that is necessary to provide the project benefits
- Ensuring that there are criteria established for measuring performance, i.e. can the benefits be measured
- Verifying that there is a suitable competent project management team in place and that key principles of risk and value management will be applied
- Ensuring that there is a clearly defined project sponsor who 'owns' all aspects of the business case.

It is also evident from the research that projects procured through PFI have been successful in achieving their projected works duration timescale with only minimal variation to either capital expenditure (covering initial fees, etc.) or to the forecast unitary payment. The nature of PFI procurement demands an extremely rigorous approach to defining the scope and performance criteria for the project. If properly applied, the review process within the gateway approach should ensure that a similar level of rigour has been applied in the preparation of the business case which, in turn, should begin to drive a far closer correlation between planned and actual cost, time and performance.

Major projects, by their scale, have inherent risks that can be compounded if the project is of a complex, innovative or highly technical nature. At the strategic outline case stage of these projects, it must be accepted that there will be high levels of uncertainty on many issues, though before commitments are made, there must be consideration of alternative options with reduced risks (e.g. by redefining functionality required, business processes or project scale). The OGC Gateway Review Process approves the project in stages, i.e. costs are only committed to achieve the next stage. The review team, therefore, has the authority not to allow a project to proceed unless they are confident that the required allowances for optimism bias are at an acceptable level commensurate with the project risks and stage of the process.

Equipment/development projects tend to involve high risk areas such as technological innovation, bespoke software and systems or complex business processes. In many cases complexity arises through a desire to achieve organisational goals using existing business processes and practices.

"Change should be a friend. It should happen by plan, not by accident." Philip Crosby

The realisation and acceptance of change to business processes can reduce risks, however this needs to be addressed at project definition stage. Resourcing and commitment to implement such change has to be considered equally important as a well managed capital procurement or outsourcing. In addition, these projects also suffer from over-ambitious functional goals and are often better broken down into achieveable projects of less ambition, but with provision for future integration. Also, when new information technology is involved, there must be a change in the way people work. It is more efficient to have standardised methods of working than trying to develop software that deals with the many different ways of working.

No matter how good the systems and processes are, it is the people who are responsible for formulating the business cases and managing projects. Very often, inputs at the early stage of a project, in terms of developing plans, strategies and budgets, can have a critical impact on the success or failure of the outcome. Ensuring the right quality of personnel or organisation in these roles can be categorised as a 'high impact and low value' procurement decision. The emphasis on these decisions must, therefore, relate to quality rather than price and incentives, with flexibility in appointment terms to allow for the inevitable changes in scope and strategy that will occur as the project definition evolves. A project management team that considers, and can effectively put into place, the key management tools highlighted in Appendix H is better placed to deliver a project to time and budget.

When good project plans are prepared in advance by experienced project managers, it is surprising how often the circumstances of projects fit in with the plans. This is no coincidence as this comes as a result of good project management (including risk management).

Projects lasting several years need to have effective induction, training, document control, knowledge transfer and handover processes to ensure that project knowledge is transferred efficiently. In long-term projects it may not be possible to allocate senior management team members for the full length of the project, therefore staggered replacement of senior team members and a minimum allocation (e.g. three years) are recommended to provide project stability.

More emphasis needs to be placed on spending money to increase efficiency, value for money and customer satisfaction rather than just saving money. This is in terms of people and contracts. Good staff should be retained through competitive salaries and incentive schemes. Contracts should be awarded on the basis of value, quality or past performance rather than price. Openness and flexibility will allow projects that are heading for high cost and time overruns to be redirected and control regained. Balancing capital, operating and maintenance costs is crucial.

3.3.2 Private Finance

To resolve the direct (commercial) and indirect (value for money) issues, the public sector will benefit from managing the PFI procurement process using the following principles:

- Ensuring a range of suitable project options is considered at the outset, especially including the fit of potential projects into wider strategic objectives, and whether existing processes, practices or structures should be adjusted to reduce the level of project risk e.g. adopting a standardised method of working rather than developing software to deal with the many different ways of working
- Making use of experienced and capable private sector expertise to advise the public sector
- Using a well managed output specification process that involves key stakeholders in a meaningful way and results in key stakeholder sign-off to a specification that effectively captures what the public sector wants
- Ensuring that projects are designed around benefit delivery
- Using comparators effectively to provide:
  - ⇒ Clear assessments of how much a public sector, traditionally procured, alternative would cost throughout the project life-cycle
  - ⇒ Sufficient definition of the information required from tenderers to enable a robust tender evaluation procedure to take place
  - ⇒ Effective evaluation of bids: providing the public sector, in particular, with real negotiating information and a thorough understanding of what each bidder is really offering
  - ⇒ Benchmarks of key cost items to establish the real quality of asset and service being offered, and to allow refinement of bids during each negotiating round
  - ⇒ Effective value engineering decisions
  - ⇒ A real understanding of the costs of transferring risks to the private sector
- Designing ITN (Invitation to Negotiate) and other bid documentation and processes to promote an effective flow of information, whereby the public sector can clearly understand what is being offered by the private sector and the private sector has a clear understanding of what it is committed to providing, thus ensuring a smooth transition from bid information to contract documentation
- Considering the affordability of private sector proposals
- Developing the payment mechanism pre-ITN and sign-off of the payment mechanism and associated performance measurement system before nomination of preferred bidder
- Having realistic risk transfer expectations: i.e. optimum/appropriate risk transfer following the principle of "risk transferred to the party best placed to manage it"

- Developing strategies to identify risks, avoid risks and manage risks owned by the public sector
- Effectively managing project issues (i.e. risk occurrences) with appropriate stakeholder involvement at each stage of issue resolution (e.g. mobilising the right expertise and interfaces between stakeholders at the right time)
- Developing robust processes pre- and post-financial close to ensure that assets really do meet the specifications laid out in the project agreement and supporting documentation
- Insisting on early facilities management (hard and soft services) involvement in contractors' design solutions. Resulting in easily maintained facilities.
- Taking account of funders' requirements in risk transfer and mitigation of risks at an early stage of the procurement process (when basic decisions are being made) to ensure that delays in achieving financial close, due to changes required by funders, are avoided.

PFI / PPP procurement has the potential to deliver significant benefits in the procurement of public sector assets and services. It is complex in terms of what it is trying to achieve (i.e. the complete resolution of issues associated with building and operating an asset over an extended period of time). However, there is no single aspect of PFI / PPP that is itself complicated. The issues that have arisen on PFI / PPP projects that have gone to financial close and beyond, have, with very few exceptions, occurred through flawed management of the interdependencies between different aspects of the process.

3.3.3 Risk Management

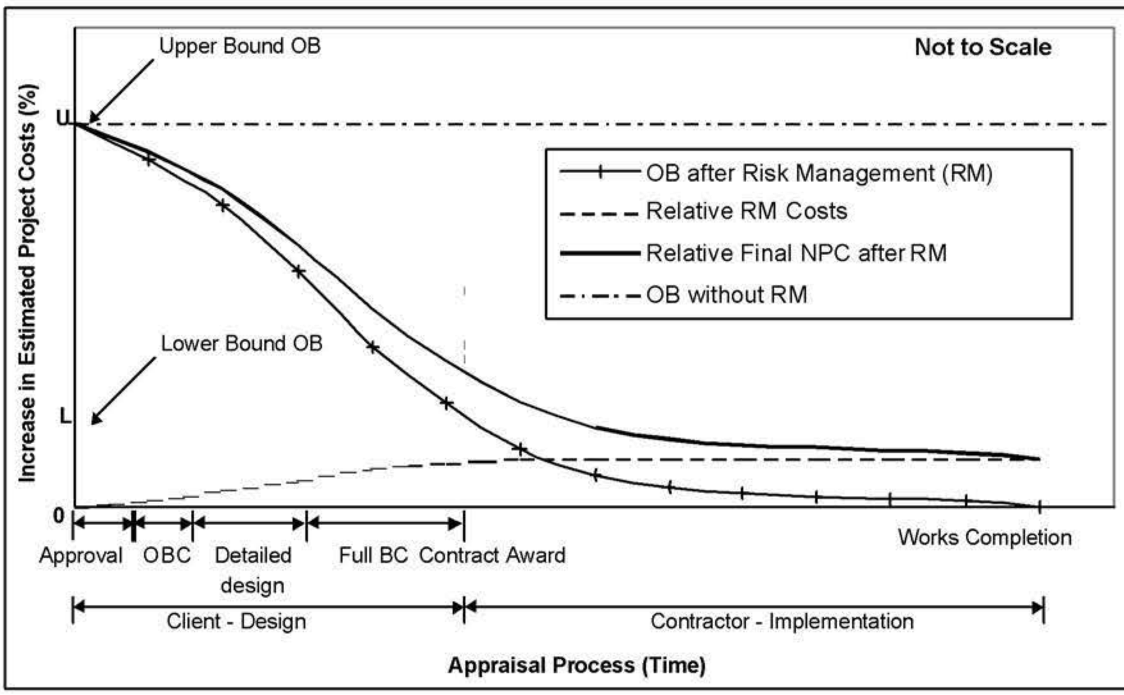
Risks can be managed by the application of recognised strategies to manage project risk areas. Expending more effort in developing the business case, identifying and clarifying stakeholders' requirements, obtaining confirmation of the requirements, analysing risks when evaluating options and, where appropriate, modifying required benefits to reduce risk should result in fewer problems later in the project life-cycle, paving the way for smoother project delivery.

When performing a project appraisal, note that:

- Only competent experienced appraisers who thoroughly understand the issues and risks associated with the project should perform its project appraisal.
- Business cases should also address project risk areas that have not had a negative influence on optimism bias levels
- The optimism bias should be fully assessed in line with the appraisal date, because the risk profile for a project will change during its project life-cycle
- The study showed conclusively that the single most important contributing factor to optimism bias was the inadequacy of the business case
- Implementing risk management strategies may come at a cost and, therefore, each management strategy must be financially worthwhile. When developing the business case,

minimise the total cost of managing residual risks and implementing risk management strategies. Figure 5 shows an example of the change in project costs arising from risk mitigation and managing residual risks during the project life-cycle of traditional projects if effective risk management is in place (this concept is relevant for all projects, including PFI / PPP projects).

Figure 5 Relationship between Cost of Risk Mitigation and Cost of Managing Residual Optimism Bias



Where upper bound optimism bias represents the optimism bias level to expect for a project without effective risk management and the lower bound represents the optimism bias level to expect with effective risk management by the time of contract award. See Section 4 for guidance on how to use upper and lower bound values when calculating optimism bias levels for current projects.

The management of successful projects has shown that appropriate emphasis should be applied to reviewing the project objectives, scope, specifications and definitions detailed in the business case to ensure that they are fully comprehensive and address the whole requirements of the project in the short, medium and long term. Effective risk management, scope definition and change management (including stakeholder management and communications management) all play important roles in project delivery. These management tools are further discussed in Appendix H.

Note that there may be a cost (i.e. cost for managing project risks including risk mitigation and risk occurrence) associated with reducing optimism in project estimates. For example if the scope of works for a project is not fully defined in its business case at the outset capital costs may increase as the business case is further refined and a more robust scope definition is prepared. Perform a review of project estimates when major changes are made to a project's scope to check whether the project estimates are still relevant.

4 Calculation of Optimism Bias

This section describes how to calculate the optimism bias for the estimated project costs and time. The calculated optimism bias will be used to replace the risk element in the 6% discount rate, formerly recommended by HM Treasury (see HM Treasury's 2002 edition of its Green Book for guidance). When calculating optimism bias experienced appraisers should apply a degree of best judgement.

When carrying out project appraisals, full allowance should be given for any suspected optimism in the costs and time figures originally proposed, giving regard to the outcomes of previous projects of a similar nature. By accounting for optimism more explicitly, project options can be compared more accurately with regard to costs and time. Table 4 provides indicative figures for optimism bias. It has been prepared by taking into consideration the results of the Mott MacDonald study and reductions in optimism bias levels observed over recent years to provide an upper bound (U) for optimism bias. The lower bound (L) in Table 4 allows for improvements in practice that were evident over the review period and new procurement practices known to have been implemented in the last five years.

Table 4 Current Practice Optimism Bias

Project Type	Optimism Bias (%) [7]			
	Works Duration		CAPEX	
	U	L	U	L
Non-standard Buildings	39	2	51	4
Standard Buildings	4	1	24	2
Non-standard Civil Engineering	25	3	66	6
Standard Civil Engineering	20	1	44	3
Equipment/Development	54	10	200	10
Outsourcing	N/A	N/A	41*	0*

* The optimism bias for outsourcing projects is measured for operating expenditure, OPEX

The upper bound values recommended for use when calculating optimism bias represent the optimism bias level to expect for current projects without effective risk management and bad scope definition, and are the starting point for calculating optimism bias for projects. These upper bound values reflect the average historic values because the average historic values are similar to the highest values for optimism bias currently being recorded for recently completed projects that have experienced high levels of optimism in their project estimates.[8]

The lower bound values identified represent the optimism bias level to aim for in current projects with effective risk management by the time of contract award. Ideally by the time of contract award

[7] Note that these values are indicative starting values for calculating optimism bias levels in current projects. The upper bound (U) does not represent the highest possible values for optimism bias that can result and the lower bound (L) does not represent the lowest possible values that can be achieved for optimism bias.

[8] In the case of current equipment / development projects Mott MacDonald has observed a tendency to abandon these types of project when optimism bias levels have reached 150%.

sufficient project risks should have been identified and effective risk management strategies developed to obtain the lower bound values for optimism bias during project appraisal. By identifying the project risks within each of the project risk areas for a project and adopting appropriate risk management strategies it is possible to gain a high level of confidence in the estimates for capital expenditure and works duration.

With the exception of outsourcing projects, the information gathered on operating expenditure and benefits shortfall was based on best judgement and was available only on a small number of projects. In addition, the information obtained on project duration was inconsistent (refer to Section 2.3). As a result this paper is unable to recommend sound upper and lower bound optimism bias levels for the operating expenditure (except for outsourcing projects), project duration and benefits shortfall for all project types. Guidance for unitary payments optimism bias for PFI projects has also not been provided as this optimism bias is affected by both capital and operating expenditure optimism bias and should be considered in this respect. Therefore the guidance in this paper is only for capital expenditure (operating expenditure for outsourcing projects) and works duration[9]. Optimism should, of course, be considered in respect of all parameters.

To calculate the optimism bias for project estimates during a project appraisal:

1. Decide which project type is appropriate for the project being appraised (see Section 2.1.2). Careful consideration needs to be given to the characteristics of a project when determining its project type. For example if half of a project satisfies the standard project criteria (e.g. new build on a greenfield site) and the other half satisfies the non-standard criteria (e.g. demolition and build on brownfield site, and refurbishment) it may be best to consider it as two projects under the same programme.

   For ease of determining a project type for building and civil engineering projects, a project is considered "non-standard" if it satisfies any of the following conditions: (a) it is innovative and/or unique; or (b) construction involves a high degree of complexity and/or difficulty.

   A PFI / PPP project that includes several project types (e.g. an element of standard building, non-standard building, standard civil engineering, outsourcing and equipment / development) should be considered as a programme with five projects.

   Where standard and non-standard elements of a project are physically separate (e.g. new build on greenfield site and refurbishment of existing estate), then these should be considered as separate projects under the same programme. A project's project type should be determined by its dominant project type characteristics. However, if a building or civil engineering project has a significant amount of standard or non-standard elements (more than 35%) that are not physically separate then this type of project can be considered a combined project.

   Outsourcing and equipment / development elements of a larger project should be considered as two projects within the same project programme.

[9] This paper does not provide explicit terms for translating works duration delays into monetary values, however, if key financial indicators are identified for delayed benefit delivery it should be possible to calculate the financial impact due to delays in works duration.

2. Use the appropriate upper bound value for optimism bias from Table 4 as the starting value for calculating its current optimism bias level (see Section 4.5 for guidance on calculating appropriate upper bound values for combine projects).

3. Reduce this upper bound optimism bias according to the extent to which the project risk areas are managed (see Sections 4.1 to 4.4 for examples). The project risks within each project risk area can be managed. If the project risk areas for a project have only been partially mitigated then the contribution to optimism bias can be reduced proportionally to reflect the amount that each project risk area has been mitigated. When calculating optimism bias, the extent to which these risks are mitigated is measured by a mitigation factor. The mitigation factor has a value between 0.0 and 1.0. Where 0.0 means that risks in a project risk area are not mitigated, 1.0 means all risks in a project risk area are fully mitigated and decimal values between 0.0 and 1.0 represent partial mitigation of the risks within a project risk area. Ideally the optimism bias for a project should be reduced to its lower bound optimism bias before contract award if the cost of risk mitigation is less than the cost of managing the residual risk.

4. Clear and tangible evidence must be observed, and independently verified, for the mitigation of risks in project risk areas before reductions in optimism bias should be made.

5. If the optimism bias at the appraisal stage is appropriately low, then the project should be allowed to proceed. If the optimism bias remains high, then approval should be withheld, or given on a qualified basis, requiring further research, planning, identifying and managing project risk areas and reviewing of project scope to reduce the project risks and likely optimism bias to an acceptable level. For instance, high optimism bias may be acceptable for a strategic outline business case and very small projects (projects below £1 m in value), but would not normally be acceptable at the full business case stage for large projects.

Figure 8 summarises the procedure for calculating optimism bias. Project appraisers should review all the project risk areas that have had a negative influence on project costs, time and benefit delivery, within the appropriate project type. Table 15 to Table 17 in Appendix I show the upper bound project risk area contributions (%) to overall works duration and capital expenditure optimism bias levels for each project type.

To effectively appraise the optimism bias for a proposed project option using its business case, the proposed strategies for the mitigation of project risks and management of project risk areas should form part of the business case.

The optimism bias calculated using this guideline could be checked using one of the following:

- An independent review of a project at key stages according to the OGC Gateway process
- Internal audit (or other internal mechanisms)
- Other semi-independent departmental body.

4.1 Example 1 (Part 1) – Capital Expenditure

Suppose we examine the capital expenditure and works duration optimism bias levels for a non-standard building (e.g. a specialist hospital). For simplicity, suppose the initial estimated NPC of capital expenditure (i.e. the project estimate for capital expeniture) is £100 m. The upper bound capital expenditure optimism bias value for a non-standard building project is 51 % (see Appendix I, Table 15).

If project risk areas are not effectively managed, the estimated Final NPC capital expenditure, taking into account optimism bias, is calculated as follows:

£100 m + (51 % x £100m) = £151 m

For this example the project risks have been identified for each of the project risk areas listed in the table below and effective risk management strategies are in place to manage them. Note that the '% Contribution to Optimism Bias' values in the table below have been taken from Table 15 and the 'Mitigation factor' represents the degree to which the project risks within the project risk areas are managed.

Project Risk Area Name	***% Contribution to Optimism Bias***	***Mitigation Factor***	***Cost of Risk Management***
Poor Contractor Capabilities	*5*	*1.0*	*£0*
Design Complexity	*3*	*1.0*	*£140,000*
Inadequacy of the Business Case	*23*	*0.4*	*£700,000*
Poor Project Intelligence	*6*	*1.0*	*£10,000*
Site Characteristics	*1*	*1.0*	*£40,000*

The following are simple examples of successful strategies for effectively managing the project risks within the project risk areas identified in the table above:

- *Only contractors that have successfully delivered this type of project before are to be considered (cost of managing this risk £0).*
- *The design has recently proven successful on a project of a similar size and nature and key design team members are appointed that have successfully produced and supervised the implementation of this design (cost of managing this risk is £140,000 say).*
- *Treasury/OGC best practice is being used to prepare and develop the business case and all areas of the strategic outline case have been competently addressed (only 40% mitigated in the example, as more detail is required – the cost of managing this risk reduction in OB is £700,000 say). Sufficient time is to be allowed to adequately define the project scope (this may result in major changes to a project and its costs that require a review of project estimates), identify project risks and develop appropriate risk management strategies.*
- *Detailed research has already been performed to confirm current and future demand and project sensitivities, although a review of the research should be performed to confirm the results/recommendations are sound (cost of managing this project area risk is £10,000 say).*
- *The Trust has owned the proposed site for at least 20 years during which comprehensive site investigations were performed within the last five years. Therefore only a site inspection, desk study of existing records and a limited site investigation is required to confirm the site ground characteristics (cost of managing this project area risk is £40,000 say).*

The resultant capital expenditure optimism bias (i.e. the upper bound optimism bias minus the managed optimism bias contribution) is calculated as follows:

*Managed optimism bias contribution = Reduction in optimism bias = 5 + 3 + (23 * 0.4) + 6 + 1   24 %*

*Resultant capital expenditure optimism bias = (100 % – 24 %) * 51   39 %*

Therefore the forecast NPC capital expenditure for this example (excluding the cost of risk management), taking into account optimism bias, is £139 m, which is calculated as follows:

£100 m + (39 % x £100m) = £139 m

Whereas the estimated final NPC capital expenditure for this example taking into account optimism bias cost of risk management, is approximately £140 m, which is calculated as follows:

£139 m + £(0.0 + 0.14 + 0.70 + 0.01 + 0.04) = £139 m + £0.89 m = £139.89 m

This figure for the final NPC capital expenditure after implementing risk management strategies is lower than the £151 m calculated for final NPC capital expenditure if project risk areas are not effectively managed.

4.2 Example 1 (Part 2) - Capital Expenditure

Ideally at contract award, the lower bound optimism bias for capital expenditure should be achieved through sufficient risk mitigation provided the cost of risk mitigation is less than the cost of the residual risk.

If we now consider the above example at contract award, the resultant capital expenditure optimism bias after effective management of project risks should approach/be equal to the lower bound optimism bias of 4 % for non-standard buildings. To achieve this lower bound value, a 92 % reduction in optimism bias contribution is required. Therefore we need to have identified the project risks within each of the project risk areas and put in place effective risk management strategies. As a result the remaining % contribution to optimism bias is 8 %, which is calculated as follows:

Managed optimism bias contribution = Reduction in optimism bias = 92 %

*Resultant capital expenditure optimism bias = (100 % – 92 %) * 51 ≈ 4 %*

In this case the estimated final NPC capital expenditure, taking into account optimism bias and cost of risk management, is £104 m plus the cost of risk management, which is calculated as follows:

(£100 m x ((100 % + 4 %) / 100 %)) + cost of risk management = £104 m + cost of risk management

Therefore if for example the total cost of managing project risks is £7 million, then the final NPC capital expenditure would be £111 m (i.e. £104 m + £7 m).

4.3 Example 2 (Part 1) – Works Duration

A similar process as in the example of section 4.1 can be performed to calculate works duration optimism bias levels at outline business case for our non-standard building, where the upper bound works duration optimism bias value for a non-standard building project is 39 %. Suppose the estimated works duration is 28 months.

If project risk areas are not effectively managed, the estimated works duration taking into account optimism bias, is calculated as follows:

28 months + (39 % x 28 months) 38.9 months (a delay of approximately 11 months)

If now apply the same risk management strategies as in the 4.1 Example 1 (Part 1) for each of the project risk areas listed in the table below. Note that, once again, the '% Contribution to Optimism Bias' values in the table below have been taken from Table 15 and the mitigation factor represents the degree to which the project risks within the project risk areas are managed.

Project Risk Area Name	***% Contribution to Optimism Bias***	***Mitigation Factor***
Poor Contractor Capabilities	*5*	*1.0*
Design Complexity	*2*	*1.0*
Inadequacy of the Business Case	*22*	*0.4*
Poor Project Intelligence	*5*	*1.0*
Site Characteristics	*3*	*1.0*

The resultant works duration optimism bias (i.e. the upper bound optimism bias minus the managed optimism bias contribution) is approximately 30%, calculated as follows:

*Managed optimism bias contribution = Reduction in optimism bias = 5 + 2 + (22 * 0.4) + 5 + 3 = 23.8 %*

*Resultant works duration optimism bias = (100 % - 23.8 %) * 39 29.7 %*

Therefore, the estimated works duration, for this example taking into account optimism bias, is approximately 36.3 months, calculated as follows:

28 months + (29.7 % x 28 months) 36.3 months

This figure for the works duration after implementing risk management strategies is lower than the 39 month duration calculated if project risk areas are not effectively managed.

This method of assessment can be applied throughout the project life-cycle for a project (e.g. strategic outline case, outline business case and full business case).

4.4 Example 2 (Part 2) – Works Duration

Ideally at contract award, the lower bound optimism bias for works duration should be achieved through sufficient risk mitigation if the cost of risk mitigation is less than the cost of managing the residual risk.

Assume that the above applies to this example and the resultant works duration optimism bias is equal to the lower bound optimism bias, 2 %, for non-standard buildings.

If we now consider the example of section 4.3 at contract award ideally the works duration optimism bias after effective management of project risks should be equal to the lower bound optimism bias, i.e. 2 %, for non-standard buildings. In this case the estimated works duration, is approximately 28.6 months, which is calculated as follows:

28 months x (100 % + 2 %) 28.6 months

4.5 Calculating Upper Bound Values for Combined Projects

Where a building or civil engineering project has significant standard and non-standard elements that can not be physically separated it is considered a combined project (where one of the elements is not significant the project should be identified according to its dominant project type characteristics). To calculate the appropriate upper bound values for combined projects the following approach is recommended:

(a) Determine the percentage split for standard and non-standard the parts of the capital value of the building or civil engineering project (in accordance with the project type descriptions in Section 2.1.2 – use best judgement).

(b) Identify the upper bound values for the standard and non-standard parts.

(c) Multiply each percentage of CAPEX by the appropriate upper bound optimism bias.

(d) Add the OB contributions together to determine the resultant optimism bias percentage.

The following table shows a worked example of the calculated resultant upper bound optimism bias level for capital expenditure for a combined building project:

Project Type	***Percentage of CAPEX (%)***	***Upper bound OB (%)***	***OB Contribution (%)***	***Resultant OB (%)***
Non-standard building	*30*	*51*	*15.3*	*-*
Standard building	*70*	*24*	*16.8*	*-*
Combined building	*100*	*-*	*-*	*32.1*

The works duration optimism bias can be determine in the same way. The following table shows a worked example of the calculated resultant upper bound optimism bias level for works duration for a combined building project:

Project Type	***Percentage of Works Duration (%)***	***Upper bound OB (%)***	***OB Contribution (%)***	***Resultant OB (%)***
Non-standard building	*30*	*39*	*11.7*	*-*
Standard building	*70*	*4*	*2.8*	*-*
Combined building	*100*	*-*	*-*	*14.5*

Experienced appraisers can use their best judgment.

5 Conclusions

The optimism bias recorded for projects in several recent studies have proved that there is a tendency for project managers and project owners to underestimate costs and time, and overestimate benefits for a project.

Failure to consider and actively manage the causes of optimism bias tends to result in an accumulation of unforeseen cost and time overruns, and benefit shortfalls. However, by developing strategies for the effective management of project risk areas, it is possible to reduce the optimism bias and raise confidence levels in project estimates.

The reduction in optimism bias with time, as observed in the Mott MacDonald study, is most likely attributed to the introduction of risk management, improved procurement practices (based on greater diligence at the project definition stage), partnering, more controlled cost monitoring, value management, and the application of concurrent engineering.

The Mott MacDonald study has strongly indicated that the most important contributing factor to optimism bias was the inadequacy of the business case (e.g. project scope not clearly defined and/or stakeholders' interests not addressed). Appropriate emphasis should be applied to reviewing the project objectives, scope, specifications and definitions detailed in the business case to ensure they are fully comprehensive and address the holistic project requirements in the short, medium and long term.

The application of current industry best practices, recognised strategies to manage all project risk areas and effective project management will reduce the optimism bias recorded in future projects. This study recommends that prudent levels of optimism bias should be assumed in project costs and time estimates until good practice in procurement has been demonstrated and independently verified.

Appendix A Glossary

Glossary

Benefits Shortfall	The percentage by which the delivered benefits fall short of the benefits expected in the business case.
Business Case	The document that initiates the commitment to undertake the project: under current practices it would include the user requirements, benefits, objectives, project scope and investment appraisal. This document may also be referred to as the strategic outline case, outline business case or full business case.
CAPEX	Capital expenditure.
Capital Expenditure Optimism Bias	The percentage by which the actual capital expenditure exceeds the expenditure expected in the business case.
Client	Government department or body sponsoring the project.
Combined Project	A building or civil engineering project that has a significant amount of standard or non-standard elements that are not physically separate.
Concurrent Engineering	Developing individual components in parallel (e.g. prefabrication of slabs or bridge girders offsite while insitu work is carried out onsite). This is also where construction activities are performed (e.g. foundation works) while the detailed design (e.g. for the superstructure) is being finalised.
Contract Award	The point in time when the major contract within the project, typically for construction, is made legally binding.
Cost of Risk Management	The specific additional project costs required to effectively manage project risks within project risk areas.
Equipment & Development Projects	Projects that are concerned with the provision of equipment and/or development of software and systems (i.e. manufactured equipment, Information and Communication Technology (ICT) development projects) or leading edge projects.
Final NPC Capital Expenditure	The current value forecast for expected outturn project costs (excluding inflation), which includes the costs for the initial estimated NPC capital expenditure, costs for optimism bias and costs for risk management calculated at the time of a project appraisal. Note that for a project appraisal at works completion the final NPC capital expenditure will consist of the initial estimated NPC capital expenditure and the actual cost of managing project risks because the value of optimism bias reduces to zero at works completion. Also see 'Initial Estimated NPC Capital Expenditure' and 'NPC Capital Expenditure'.

Gestation Period	The period between the approved outline business case and the contract award committing physical commencement of the works.
Initial Estimated NPC Capital Expenditure	The project estimate for capital expenditure (which is the current value forecast for expected outturn project costs excluding the cost of inflation, optimism bias and risk management costs) proposed in the business case. Also see 'NPC Capital Expenditure' and 'Final NPC Capital Expenditure'.
Invitation to Negotiate, ITN	A stage in the PFI procurement procedure under which the client invites a selected number of tenderers to negotiate the terms of a PFI contract
Leading Edge Projects	Projects which have not been undertaken before, and rely mainly on innovative processes or technology for delivery.
Mitigation Factor	A multiplier identified as a decimal number between 0.0 and 1.0 that represents the level to which project risks within a project risk area have been managed. The mitigation factor for a project risk area is determined during project appraisal. Where 1.0 = fully mitigated (i.e. no residual risks).
Mott MacDonald Study	The study of 50 major projects procured in the UK that were completed within the past twenty years, undertaken by Mott MacDonald in March 2002.
NPC	Net Present Cost. The current value excluding inflation - not to be confused with Net Present Value (NPV).
NPC Capital Expenditure	The current value forecast for expected outturn project costs (excluding inflation and cost of managing project risks), which includes the costs for the initial estimated NPC capital expenditure and costs for optimism bias calculated at the time of a project appraisal. Also see 'Initial Estimated NPC Capital Expenditure' and 'Final NPC Capital Expenditure'.
Non-standard Buildings Projects	Projects which involve the construction of buildings requiring special design considerations due to space constraints, complicated site characteristics, specialist innovative buildings or unusual output specifications i.e. specialist/innovative buildings e.g. specialist hospitals, innovative prisons, high technology facilities and other unique buildings or refurbishment projects.
Non-standard Civil Engineering Projects	Projects which involve the construction of facilities, in addition to buildings, requiring special design considerations due to space constraints or unusual output specifications e.g. innovative rail, road, utility projects, or upgrade and extension projects.
Optimism Bias, OB	The percentage by which the actual capital, operating expenditure or time of works duration exceeds (or, in the case of benefits, is less than) that expected at the business case stage.

OPEX	Operating expenditure.
Operating Expenditure Optimism Bias	The percentage by which the actual operating expenditure exceeds the expenditure anticipated in the business case.
Outsourcing Projects	Projects that are concerned with the provision of hard and soft facilities management services e.g. ICT services, facilities management or maintenance projects.
Partnering	A structured management approach to facilitate team working across contractual boundaries. Its fundamental components are formalised mutual objectives, agreed problem resolution methods, and an active search for continuous measurable improvements.
Project Duration	The entire project life cycle, starting at time of the approved outline business case, including gestation period and works duration, through to works completion.
Project Estimate	An initial estimate for capital expenditure, operating expenditure, works duration, project duration or project benefits identified in the business case. Also see 'Initial Estimated NPC Capital Expenditure'.
Project Risk	An event, specific to a project, whose occurrence would cause a negative impact on the delivery of that project in terms of costs, time and/or benefit. Sometimes defined as the impact of a potential threat to a project that can affect the achievement of the objectives for an investment.
Project Risk Area	A categorisation used to group related project risks (see Appendix E). The grouping of project risks in to areas (project risk area) allows an assessment of optimism bias and effective risk management.
Project Risk Groups	A grouping of related project risk areas (see Appendix E) according to their source of origin.
Project Stakeholders	The parties involved in the negotiation, design and delivery of a project (e.g. the government department, executive agency, funders, project companies, designers, construction/supply contractors, advisors, public bodies and user groups).
Standard Buildings Projects	Projects which involve the construction of buildings not requiring special design considerations i.e. most accommodation projects e.g. offices, living accommodation, general hospitals, prisons, and airport terminal buildings.
Standard Civil Engineering Projects	Projects which involve the construction of facilities, in addition to buildings, not requiring special design considerations e.g. most new roads and some utility projects.
Traditional Procurement	Non-PFI / PPP procurement (also known as conventional procurement).

Utility Projects	Projects which relate to the provision of electricity, water, gas and telecoms
Value Management	A strategic approach to achieving maximum value in a project consistent with the organisation's broad business goals. It is a structured team approach to problem solving that can be applied to the objective setting, concept, design and construction stages and the on-going management of projects. A value management exercise aims to attain optimum value by providing the necessary functions at the least cost without prejudice to required quality and performance.
Works Duration Optimism Bias	The percentage by which the time taken for the actual works programme exceeds the estimate for time allowed in the business case.
Works Completion	The point in time at which the physical elements of the project are completed and it can begin to be used for the purpose it was intended to fulfil.
Works Duration	The time between contract award and works completion. Also known as the implementation stage of a project starting at contract award including mobilisation, detailed design, and construction / execution of the works through to works completion. This is a measurement of time rather than money.

Appendix B Project List

B.1 Traditionally Procured Projects

<u>Non-standard Buildings</u>

1. Manchester Airport Terminal 2 Phase I
2. Refurbishment of Victoria Barracks, Windsor
3. Chelsea & Westminster Hospital
4. Guy's Hospital Phase III (Thomas Guy House)
5. Leeds General Infirmary Phase 1
6. Bullingdon Prison
7. British Library

<u>Standard Buildings</u>

8. Terminal 4 Heathrow Airport
9. DPA HQ Abbey Wood
10. Great Ormond Street Hospital for Children
11. Medway Maritime Hospital
12. Salisbury Hospital – Phase I
13. St Mary's Hospital Phase 1B
14. Belmarsh Prison
15. Blakenhurst Prison
16. Doncaster Prison
17. Elmley Prison
18. Holme House Prison
19. Lancaster Farms Prison
20. Moorland Prison
21. Woodhill Prison

Non-standard Civil Engineering

22. Coulport Explosive Handling Jetty
23. Mount Pleasant Airfield Phase I
24. Electrification of the East Coast Main Line
25. Waterloo International Terminal
26. Limehouse Link Road
27. Jubilee Line Extension
28. Tyne and Wear Metro
29. Dinorwig Pumped Storage Scheme
30. Isle of Grain Power Station
31. Heysham 2
32. Sizewell B Power Station
33. London Water Ring Main
34. Thames Barrier

Standard Civil Engineering

35. A34 Newbury Bypass
36. A564 Derby Southern Bypass
37. M60 Denton to River Medlock (Contract 1)

Equipment / Development

38. Faslane Shiplift

Outsourcing

39. Inland Revenue / EDS Strategic Partnership - EAGLE Project

B.2 PFI / PPP Procured Projects

Standard Buildings

40. Fazakerley Prison
41. The Joint Services Command and Staff College
42. Wythenshawe Hospital

Standard Civil Engineering

43. A1(M) widening between Alconbury and Peterborough
44. A55 Llandegai to Holyhead Trunk Road
45. Second Severn Crossing – Concession Agreement
46. The Yorkshire Link – M1-A1 Lofthouse to Bramham Road

Equipment / Development

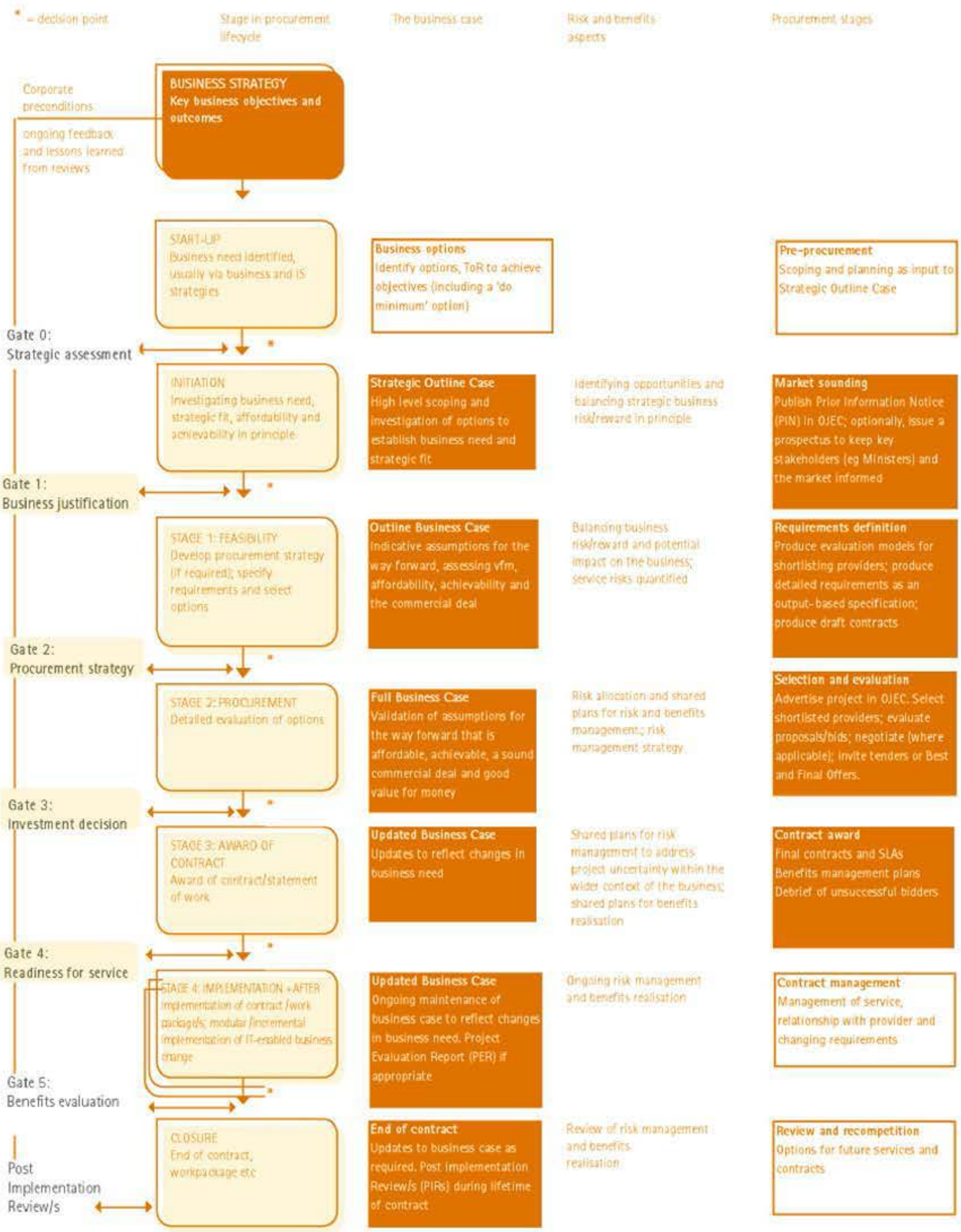
47. MOD Defence Fixed Telecommunications Service (DFTS)

Outsourcing

48. IT2000
49. PRIME project
50. DSS Focus 95

Appendix C OGC Business Change Lifecycle

Figure 6 OGC Business Change Lifecycle (Gateway Process)



Appendix D Project Summary Information Form

Project Summary Information Form (Sheet 1)	
Project Type:	
Name of Authority:	
Funding Method:	
Project Title:	

Project Description:	**Background:**
	Procurement Type:
	Parties involved:

Objectives:	

Benefits:	

Summary Time, Cost (CAPEX and OPEX) and Benefit Table

Year	Procurement Stage Completed	Length of operation (mths)	Duration of Project Development			Costs			Benefit (% of estimated)
			Works Start Date	Works End Date	Capital Works duration	CAPEX (£ mil)*	OPEX (£mil/Yr)*	Unitary Payment (£mil/Yr)*	
	Outline Business Case	P	P	P	P	P	P	P	100% P
	Contract Award	P	P	P	P	P	P	P	P
	Capital Works	A	A	A	A	A	A*	A*	A*
	Post Completion[10]	A	A	A	A	A	A*	A*	A*

Where: P = Planned, A = Actual recorded at works completion and A* = Actual recorded during operation

[10] Applicable only to projects where post completion works was performed.

Project Summary Information Form (Sheet 2)						
Relative % Impact of Influencing Factors on Total Time, Cost Overruns and Benefits						
Project Risk Group	**Project Risk Area**	**Time Impact (%)**	**CAPEX Impact (%)**	**OPEX Impact (%)**	**Unitary Payment Impact (%)**	**Benefits Impact (%)**
Procurement	Complexity of Contract Structure					
	Contractor Involvement in Design					
	Contractor Capabilities					
	Government Guidelines					
	Dispute and Claims Occurred					
	Information management					
	Other (specify)					
Project Specific	Design Complexity					
	Degree of Innovation					
	Environmental Impact					
	Other (specify)					
Client Specific	Inadequacy of the Business Case					
	Large Number of Stakeholders					
	Funding Availability					
	Project Management Team					
	Poor Project Intelligence					
	Other (specify)					
Environment	Public Relations					
	Site Characteristics					
	Permits / Consents / Approvals					
	Other (specify)					
External Influences	Political					
	Economic					
	Legislation / Regulations					
	Technology					
	Other (specify)					

Key Influences:	**Description**

References:	**Description**

Appendix E Project Risk Areas

Table 5 Project Risk Areas

Project Risk Groups	Project Risk Areas [11]	Project Risk Type Description
Procurement	Complexity of Contract Structure	Where the complexity of the contract structure is likely to result in a delay to the contract being signed or impact on works duration, costs and benefits achieved.
	Late Contractor Involvement in Design	Where the late involvement of the contractor in the design is likely to lead to redesign or problems during construction.
	Contractor Capabilities	Where the contractor's capabilities/experience of managing projects of a similar nature is likely to impact on his ability to perform the works programme on schedule and/or to the required quality.
	Government Guidelines	Where existing government guidelines for procurement may not provide the Client with the necessary guidance to procure adequately.
	Dispute and Claims Occurred	Where disputes and claims are likely to occur if no mechanisms exist to manage effectively adversarial relationships between project stakeholders.
	Information management system	Where effective information management and communication methods are essential to enable the delivery of the project.
	Other (specify)	Where other influencing factors that relate to procurement are likely to affect the project outcome.
Project Specific	Design Complexity	Where the complexity of design (including requirements, specifications and detailed design) is such that it needs significant management to reduce the impact on project outcomes.
	Degree of Innovation	Where the degree of innovation required due to the nature of a project requires unproven methods to be used to deliver the project.
	Environmental Impact	Where the nature of the project has a major impact on its adjacent area where there is a strong likelihood of objection from neighbours and the general public.
	Others (specify)	Where other project specific influencing factors are likely to affect the project outcome.
Client Specific	Inadequacy of the Business Case	Where project scope changes are likely to occur as a result of the poor quality of requirement specifications and inadequate project scope definition.
	Large Number of Stakeholders	Where project scope changes are likely to occur as a result of conflicting requirements or bad co-ordination of project stakeholders.
	Funding Availability	Where project delays or changes in scope are likely to occur as a result of the availability of funding (i.e. departmental budget spent or insufficient contingency funds).
	Project Management Team	Where the Client project management team's capabilities/experience of managing projects of a similar nature is likely to impact on the project outcome.
	Poor Project Intelligence	Where the quality of initial project intelligence (e.g. preliminary site investigation, user requirements surveys, etc) is likely to have a significant impact on the likelihood of the occurrence of unforeseen problems.
	Others (specify)	Where other Client specific influencing factors are likely to affect the project outcome.
Environment	Public Relations	Where a high level of effort is required to address public concern about the project, which may have a significant impact on the project outcomes.
	Site Characteristics	Where the characteristics of the proposed environment for the project are highly sensitive to the project's environmental impacts (e.g. Greenfield site with badger setts, or contaminated brownfield site).
	Permits / Consents / Approvals	Where there is a likelihood of significant delays obtaining necessary permits, consents or approvals.
	Others (specify)	Where other influencing factors that relate to the proposed environment for the project are likely to affect the project outcome.
External Influences	Political	Where the project outcomes are sensitive to political influences.
	Economic	Where the project outcomes are sensitive to economic influences.
	Legislation / Regulations	Where the project outcomes are sensitive to legislation and regulation changes.
	Technology	Where the project outcomes are sensitive to technological advancements.
	Others (specify)	Negative influencing factors that are external to the project that have an impact that are not identified above.

[11] Each identified project risk area has a negative impact on the delivery of a project in terms of time delays, costs overruns and benefit shortfalls as described

E.1 Examples of Project Risk Areas

Procurement

1. Complexity of Contract Structure
   - Details of risk transfer had to be clarified
   - Payment mechanism had to be defined
   - Unforeseen amount of negotiation required on terms of contract
2. Late Contractor Involvement in Design
   - Value management was necessary but contractor was not involved early enough to allow for it
   - The design could not be built due to construction problems (e.g. access)
   - Contractor provided design / construction feedback at a late stage resulting in a redesign
3. Poor Contractor Capabilities
   - Contractor was inexperienced
   - Site health and safety standards were not met
   - Construction was not carried out to the necessary standards
   - The contractor had insufficient resources
4. Government Guidelines
   - No precedent or guideline had been developed to procure a leading edge project
5. Dispute and Claims occurred
   - Dispute over interim payments
   - Claims for changes in scope
   - Claims for late release of information by other stakeholders
6. Information Management Systems
   - The interfaces between the stakeholders were not managed efficiently resulting in information not being transferred effectively.

Project Specific

7. Design Complexity

   - The construction was to take place over an existing mine, thus requiring complicated foundations.
   - The design had to be built in difficult conditions e.g. a hydropower station

8. Degree of Innovation

   - New generation design
   - Unusual site conditions requiring innovative solutions e.g. large wind forces, chemical nature of soil and soil contamination

9. Environmental Impact

   - Contamination e.g. nuclear power station, Incinerator
   - Noise pollution e.g. airports
   - Impact on wildlife e.g. new road through protected area

Client Specific

10. Inadequacy of the Business Case

    - Number of services were not anticipated
    - Output specifications were not defined clearly
    - Oversight in facilities required
    - All stakeholders were not involved and so their needs were not defined and included in business case

11. Large Number of Stakeholders

    - Different public sector parties having differing interests in the project
    - Process of obtaining approval took longer than expected due to number of parties involved

12. Funding availability

    - Difficulties in obtaining financial backing for project
    - Additional funding was made unexpectedly available later on in the project thus changing project scope

13. Project Management Team

- The project management team was inexperienced in delivering a project of this nature.
- Inadequate review of drawings by the project manager before construction

14. Poor Project Intelligence

- Insufficient ground investigation
- The detailed design was based on insufficient site information
- Insufficient surveying of existing conditions e.g. for refurbishment of buildings

Environment

15. Public relations

- Opposition from the local community (with regards to traffic and construction noise and environmental impact)
- Environmental protests

16. Site Characteristics

- The presence of badger setts within construction site
- Underground stream requiring protection during construction
- Archaeological findings

17. Permits / Consents / Approval

- Parliamentary Bill required for project initiation
- Difficulties in obtaining planning permission, possibly resulting in an appeal to the Secretary of State

External Influences

18. Political

- Opposition by a major political party
- Impact on sensitive constituencies
- Lacks support from key political stakeholders

19. Economic

- Change in market demand resulting in a change in funding priorities
- Crash in stock markets

20. Legislation / Regulations

- Change in required standards

21. Technology

- Unanticipated technological advancements
- Computer virus
- Limits in technology

Appendix F Recorded Project Risk Areas Optimism Bias Tables

Table 6 Average Recorded Optimism Bias for Traditional and PFI / PPP Projects

		Traditional Projects				PFI / PPP Projects			
Recorded Optimism Bias (%)[12]		**17**	**47**	**41**	**2**	**-**	**1**	**5**	**2**
		Works Duration	**Capital Expenditure**	**Operating Expenditure**	**Benefits Shortfall**	**Works Duration**	**Capital Expenditure**	**Unitary Payments**	**Benefits Shortfall**
Risk Area Contributions to Recorded Optimism Bias (%)[13]		**Traditional Projects**				**PFI / PPP Projects**			
Procurement	Complexity of Contract Structure	3	5		4				
	Late Contractor Involvement in Design	2	3						
	Poor Contractor Capabilities	8	5		1				
	Government Guidelines								
	Dispute and Claims Occurred	10	12						
	Information management	< 1	1						
	Other (specify)	< 1	< 1		4		86		
Project Specific	Design Complexity	4	2		12				
	Degree of Innovation	5	3		12				
	Environmental Impact	1	3						
	Other (specify)	9	4		1			5	
Client Specific	Inadequacy of the Business Case	24	38	100	5	15		34	25
	Large Number of Stakeholders	1							
	Funding Availability	2	1		16	55		55	75
	Project Management Team	2	2						
	Poor Project Intelligence	3	3					6	
	Other (specify)	2	1						
Environment	Public Relations		< 1				4		
	Site Characteristics	4	2				9		
	Permits / Consents / Approvals	< 1	< 1						
	Other (specify)	1	1						
External Influences	Political	3				30			
	Economic	8	6		33				
	Legislation / Regulations	3	3		2		2		
	Technology	2	< 1						
	Other (specify)	1	5		11				

[12] This table should not be used for calculating optimism bias levels for current projects.

[13] Contributions from each project risk area are expressed as a % of the recorded optimism bias. Note: The sum of individual percentages contributions in each column may not add up to 100% due to rounding errors.

Table 7 Average Recorded Optimism Bias for Building Projects

Recorded Optimism Bias (%)[14]		Non-standard Buildings				Standard Buildings			
		39	51	-	1	4	24	-	-
		Works Duration	Capital Expenditure	Operating Expenditure	Benefits Shortfall	Works Duration	Capital Expenditure	Operating Expenditure	Benefits Shortfall
Risk Area Contributions to Recorded Optimism Bias (%)[15]		Non-standard Buildings				Standard Buildings			
Procurement	Complexity of Contract Structure	2	1	-	50			-	-
	Late Contractor Involvement in Design	4	2	-		5	2	-	-
	Poor Contractor Capabilities	5	5	-	50	9	9	-	-
	Government Guidelines			-				-	-
	Dispute and Claims Occurred	11	16	-		10	29	-	-
	Information management			-				-	-
	Other (specify)			-				-	-
Project Specific	Design Complexity	7	3	-		4	1	-	-
	Degree of Innovation	< 1		-		3	4	-	-
	Environmental Impact			-				-	-
	Other (specify)	3	8	-				-	-
Client Specific	Inadequacy of the Business Case	32	35	-		42	34	-	-
	Large Number of Stakeholders			-		8		-	-
	Funding Availability	2		-				-	-
	Project Management Team	4	2	-			1	-	-
	Poor Project Intelligence	< 1	< 1	-			2	-	-
	Other (specify)	6	2	-			< 1	-	-
Environment	Public Relations			-			2	-	-
	Site Characteristics	5	1	-		10	2	-	-
	Permits / Consents / Approvals	< 1	< 1	-				-	-
	Other (specify)	4	3	-				-	-
External Influences	Political	9		-				-	-
	Economic		13	-			11	-	-
	Legislation / Regulations	5	7	-		9	3	-	-
	Technology			-				-	-
	Other (specify)		2	-				-	-

- No information was available

[14] This table should not be used for calculating optimism bias levels for current projects.

[15] Contributions from each project risk area are expressed as a % of the recorded optimism bias. Note: The sum of individual percentages contributions in each column may not add up to 100% due to rounding errors.

Table 8 Average Recorded Optimism Bias for Civil Engineering Projects

		Non-standard Civil Engineering				Standard Civil Engineering			
Recorded Optimism Bias (%)[16]		15	66	-	5	34	44	-	-
		Works Duration	Capital Expenditure	Operating Expenditure	Benefits Shortfall	Works Duration	Capital Expenditure	Operating Expenditure	Benefits Shortfall
Risk Area Contributions to Recorded Optimism Bias (%)[17]		Non-standard Civil Engineering				Standard Civil Engineering			
Procurement	Complexity of Contract Structure	2	9	-	3			-	-
	Late Contractor Involvement in Design			-			5	-	-
	Poor Contractor Capabilities	2	6	-		14		-	-
	Government Guidelines			-				-	-
	Dispute and Claims Occurred	18		-			31	-	-
	Information management	1	3	-				-	-
	Other (specify)	1	1	-	4			-	-
Project Specific	Design Complexity	5	3	-	12			-	-
	Degree of Innovation	15	7	-	12			-	-
	Environmental Impact		2	-				-	-
	Other (specify)			-	1	58	39	-	-
Client Specific	Inadequacy of the Business Case	10	39	-	5			-	-
	Large Number of Stakeholders			-				-	-
	Funding Availability		2	-	17	5		-	-
	Project Management Team	1	4	-				-	-
	Poor Project Intelligence	3	4	-		15	10	-	-
	Other (specify)			-				-	-
Environment	Public Relations			-				-	-
	Site Characteristics		2	-		8	5	-	-
	Permits / Consents / Approvals			-				-	-
	Other (specify)			-				-	-
External Influences	Political			-				-	-
	Economic	27	1	-	33		10	-	-
	Legislation / Regulations	1	3	-	2			-	-
	Technology	7	1	-				-	-
	Other (specify)	5	12	-	11			-	-

- No information was available

[16] This table should not be used for calculating optimism bias levels for current projects.

[17] Contributions from each project risk area are expressed as a % of the recorded optimism bias. Note: The sum of individual percentages contributions in each column may not add up to 100% due to rounding errors.

Table 9 Average Recorded Optimism Bias for Equipment / Development and Outsourcing Projects

Recorded Optimism Bias (%)[18]		Equipment /Development				Outsourcing			
		54	214	-	-	-	-	41	-
		Works Duration	Capital Expenditure	Operating Expenditure	Benefits Shortfall	Works Duration	Capital Expenditure	Operating Expenditure	Benefits Shortfall
Risk Area Contributions to Recorded Optimism Bias (%)[19]		Equipment /Development				Outsourcing			
Procurement	Complexity of Contract Structure	13	11	-	-	-	-		-
	Late Contractor Involvement in Design		12	-	-	-	-		-
	Poor Contractor Capabilities	30		-	-	-	-		-
	Government Guidelines			-	-	-	-		-
	Dispute and Claims Occurred			-	-	-	-		-
	Information management			-	-	-	-		-
	Other (specify)			-	-	-	-		-
Project Specific	Design Complexity			-	-	-	-		-
	Degree of Innovation			-	-	-	-		-
	Environmental Impact	9	19	-	-	-	-		-
	Other (specify)			-	-	-	-		-
Client Specific	Inadequacy of the Business Case	48	58	-	-	-	-	100	-
	Large Number of Stakeholders			-	-	-	-		-
	Funding Availability			-	-	-	-		-
	Project Management Team			-	-	-	-		-
	Poor Project Intelligence			-	-	-	-		-
	Other (specify)			-	-	-	-		-
Environment	Public Relations			-	-	-	-		-
	Site Characteristics			-	-	-	-		-
	Permits / Consents / Approvals			-	-	-	-		-
	Other (specify)			-	-	-	-		-
External Influences	Political			-	-	-	-		-
	Economic			-	-	-	-		-
	Legislation / Regulations			-	-	-	-		-
	Technology			-	-	-	-		-
	Other (specify)			-	-	-	-		-

- No information was available

[18] This table should not be used for calculating optimism bias levels for current projects.

[19] Contributions from each project risk area are expressed as a % of the recorded optimism bias. Note: The sum of individual percentages contributions in each column may not add up to 100% due to rounding errors.

Appendix G Comparison with Other Studies

G.1 University of Bath

The *Bath Pilot study*[20] included 60 projects (mainly new build) completed between 1993 and 1998 with a combined value exceeding £500 m. Each project had a minimum value of £1 m. Cost estimate risk contingencies were excluded from only a quarter of the projects.

The *Bath Stage Two study*[21], on the other hand, included 66 projects (building and infrastructure, new build and refurbishment) with a combined value of £500 m. The values of the projects ranged between £0.2 m and £100 m.

In order to compare like-for-like, the 'percentage construction cost increase from budget' measured in the two Bath studies were compared to the capital expenditure optimism bias levels measured during the Mott MacDonald study. The 'percentage construction programme increase from pre-tender estimate' measured in the Bath studies were also compared to the works duration optimism bias levels measured during the Mott MacDonald study. Table 10 shows the results for each study:

Table 10 Comparison of Bath and MM Studies

Study Name	Project life-cycle stage	Median Capital Expenditure Optimism Bias (%)	Median Works Duration Optimism Bias (%)
Bath Pilot	Approval	6	6
Bath Stage Two	Pre-tender	1	12
Mott MacDonald*	Outline Business Case	19	7

* Optimism bias based on average over all projects for which information was available = 38% for CAPEX and 15% for works duration

There is a difference between the optimism bias measured in the Mott MacDonald study and that of the Bath studies, especially for capital expenditure. This may be due to the following:

- The Mott MacDonald study included some projects that were at the forefront of project procurement as well as some projects that were innovative in construction and design. These project types tend to have high optimism bias levels.

- The initial estimated NPC capital expenditures quoted in the Mott MacDonald study do not include risk contingencies whereas a large proportion of the Bath study projects included risk contingencies. The Bath studies' inclusion of risk contingencies within the initial capital expenditure estimates will reduce the optimism bias measured. Where known, the Mott MacDonald study has excluded risk contingencies from the initial cost estimates because the guidance for optimism bias in the Green Book will be used to estimate the risk of capital expenditure overrun related to the initial cost estimate.

[20] 'Constructing the Best Government Client. Pilot Benchmarking Study'. University of Bath, October 1998

[21] 'Constructing the Best Government Client. Pilot Benchmarking the Government Client Stage Two Study'. University of Bath, December 1999

G.2 HM Treasury: Central Unit of Procurement (CUP)

Public departments provided an annual return to HM Treasury's Central Unit of Procurement (CUP) recording progress on works projects. This was used to monitor performance, establish trends and plan CUP's programme of future guidance. The CUP study investigated construction project cost and time overruns and was based on information provided in 1994-95. Projects are reported first in the year that construction starts, then annually until completion and, finally, after full commercial settlement. For most departments, only projects with a forecast outturn cost greater than £1m were reported. A total of 807 projects were included in the study with an average value of £10.9 m. All cost estimates have been brought to a common cash price basis by removing, where necessary, the calculated effect of inflation (using tender and cost price indices where appropriate).

Table 11 Comparison of CUP and MM Studies

Study Name	Project Life-cycle Stage	Average Capital Expenditure OB (%)	Average Works Duration OB (%)
CUP	Approval	12.0	8.5
CUP	Pre-tender	11.6	7.2
Mott MacDonald	Outline Business Case	37.6	15.4

There is a significant difference in optimism bias levels recorded by the two studies. The Mott MacDonald study is based on projects implemented in the last 20 years whereas the CUP study is based on projects implemented more recently (in the last 5 to 10 years). The CUP study was carried out every year from 1990 to 1994 and the results show that both the capital expenditure and works duration optimism bias levels for the approval stage decreased from past to present (See Table 12). The average results for the Mott MacDonald study are similar to the results of the CUP study for 1990 to 1991. However the average results of the Mott MacDonald study are higher than the CUP results recorded for 1994 to 1995. This discrepancy is attributed to the fact that the Mott MacDonald study results are averaged over 20 years.

Table 12 Results of CUP study from 1990 to 1995

Name of Measurement	Measured Optimism Bias by Year (%)				
	1990-1991	1991-1992	1992-1993	1993-1994	1994-1995
Capital Expenditure OB	37.6	23.0	19.2	13.8	12.0
Works Duration OB	19.1	14.5	14.8	11.0	8.5

G.3 HM Treasury: Supply Estimates

The Supply Estimates (SE) study dataset includes 283 capital projects with a value of at least £10 m (at 2001 prices) undertaken between 1981 and 1998 and are listed in SE and Departmental Reports. HM Treasury provides the Supply Estimates and the projects cover a range of government departments.

The results of the Supply Estimates study were grouped into project sectors: defence, health, criminal justice, transport, Inland Revenue, Customs and Excise, and Department of Social Security. The Mott MacDonald study was divided into similar sectors to allow comparison of results with the SE study.

Table 13 Comparison of Supply Estimates Publication and MM Studies

Study Name	Average Optimism Bias (%)									
	Defence		Health		Criminal Justice		Transport		Average	
	CAPEX	Works Duration	CAPEX	Works Duration	CAPEX	Works Duration	CAPEX	Works Duration	CAPEX	Works Duration
SE	36.0	23.7	7.8	9.3	16.0	20.6	21.5	15.1	19.3	18.1
Mott MacDonald	68.2	16.3	37.9	-0.4	31.6*	15.1*	48.0[1] 50.5[2] 159.3[3]	34.4[1] 3.6[2] 37.1[3]	37.6	15.4

* The optimism bias is based solely on Prisons

[1] Highway projects, [2] heavy rail projects, [3] light rail projects

The average capital expenditure optimism bias measured in the SE study is about half of that for the Mott MacDonald study. This is due to the presence of one or two projects within each category that experienced very high optimism bias levels as measured in the Mott MacDonald study. These projects tended to be non-standard or innovative and so are expected to have high optimism bias due to their design complexities.

It is unknown if the effect of inflation has been excluded when measuring optimism bias in the SE study. If this is not the case, then the effect of inflation or variation in price indexes may explain the correlation between size of projects and optimism bias. Larger projects tend to have longer works duration as compared to smaller projects and are thus more vulnerable to price fluctuations. There is little difference in the works duration optimism bias.

Analyses carried out on the SE study showed a statistically significant tendency for the cost overrun to increase with the size of the project in all sectors. However, the Mott MacDonald study did not show a relationship between project size and optimism bias. Mott MacDonald's major project experience has shown that as a project increases in size, its complexity also increases and an increased effort is required to control the project in terms of managing project staff, programme, communications, project stakeholders, resources and variations. More project risks within project risk areas are associated with larger projects, which would be expected to contribute to a larger optimism bias. However, the lack of correlation can be explained due to the active mitigation of risks based on previous experience of project managers and/or increased works duration and capital expenditure allowances made during the strategic planning stage as project size increased for the projects studied.

For example, when comparing the construction of a minor bridge to the construction of a major 150-foot bridge over a river, it can be expected that the latter project will be exposed to greater risks e.g. more project stakeholders (local councils, local residents, Environmental Agency), increased ground risks (ground properties may be more variable due to presence of river), increased public relations issues (bridge may affect view of river, local residents may be against possible increase in traffic flow) and changes in construction standards. Without risk mitigation strategies in place, the optimism bias levels of the major bridge construction project are expected to be higher than that of the minor bridge project. However, if the project manager for the major project has had similar construction experience, then he may put in place strategies (e.g. public consultation, more ground investigation) to mitigate expected risks or include risk contingencies, in terms of capital expenditure and time, in the business case estimates. The actions of the experienced project manager could reduce the optimism bias levels for the major bridge construction project.

G.4 Second Supply Estimate Study (Larger Capital Value)

This study examined projects with an average capital expenditure greater than £100 m. The capital expenditure optimism bias has been measured from full business case unlike the Mott MacDonald study that principally considered the strategic outline case and outline business case and also the contract award stage.

Table 14 Comparison of Supply Estimates and MM Studies

Study Name	Project Life-cycle Stage	Average Capital Expenditure OB (%)
Mott MacDonald	Strategic Outline Case/ Outline Business Case	38
Supply Estimates	Full Business Case	37
Mott MacDonald	Contract Award	21

As a project life-cycle progresses, the optimism bias levels for a project should decrease. Since both studies consider similar projects (with overlapping project lists), it is to be expected that the Mott MacDonald study results fall on either side of the SE result as the optimism bias levels were measured at project life-cycle stages on either side of the full business case stage.

The similarity between the SE optimism bias result and the Mott MacDonald optimism bias result measured at outline business case is of interest. The Mott MacDonald study includes a number of PFI projects that tended to have significantly lower optimism bias levels as compared to traditionally procured projects, thus reducing the average optimism bias.

G.5 Reconciliation Conclusions

There are significant differences between the findings of the Mott MacDonald study and those of the three similar studies. Some explanations for these have been identified, although a full reconciliation cannot be provided. Although the evidence is somewhat mixed, the following conclusions are relevant:

- All the major studies that have researched this area in detail have found optimism bias, although of varying magnitudes.
- The detailed review of the projects in the Mott MacDonald study has shown that, if key project risks are not managed, then high levels of cost and works duration overruns are very likely to occur. The other studies also found many instances of very high optimism bias, although with lower mean and median values overall.
- The aim of the guidance provided in this paper is, ultimately, to prevent high levels of cost and works duration overruns. The prescribed adjustments, therefore, tend to be based prudently on the higher levels of optimism bias that the Mott MacDonald study has found, rather than the lower levels found in the other studies. The emphasis is on setting high initial

optimism bias levels, which can be reduced if good practice in project management can be demonstrated.

- The upper bound optimism bias guidance, nevertheless, are lower than the Mott MacDonald study findings, given some recent improvements in procurement, and the omission of the most significant outliers in the Mott MacDonald study.
- The other studies did not investigate in such depth the causes of optimism bias, which is a key part of the Mott MacDonald analysis, and of the prescribed guidance.

Appendix H Project Management Tools

H.1 Identifying Project Options

The process of identifying appropriate project options is very important and has a high impact on whether projects experience high levels of risk during execution, benefits shortfalls and/or time and cost overruns. When developing project options the requirements of all project stakeholders should be obtained and understood. When considering the appropriateness of a project option, the following questions should be answered:

Benefit Delivery:

- Are the project benefits achievable?
- Would fewer benefits be acceptable?
- Would a completely different outcome deliver the same underlying need (e.g. low risk expansion of a local daycare facility instead of high risk expansion of a major hospital)?

Strategy:

- Does the option fit into wider strategic objectives?
- Are the objectives appropriate?

Change:

- Is the option sensitive to changes initiated by external factors (e.g. changes in demographics, legislation and technology)?
- Does the option have potential for change and improvement in business processes?

By answering these questions prior to finalising the strategic outline case, it is possible to maximise benefit delivery by excluding those project options which may not deliver the required benefits, do not fit with the overall business strategy and / or are likely to be subject to substantial changes during execution.

H.2 Managing Project Risks

Risk management and mitigation play an important role in appraising, procuring and implementing projects. The optimism bias associated with a project is closely linked to the risks (mitigated or residual) inherent within the project. The results of the Mott MacDonald study and the best practice guidelines within this paper aid in several critical stages involved in risk management processes.

An example of risk management methodology is Risk Analysis and Management for Projects (RAMP) developed jointly by actuarial and civil engineering professions. This is a proven method for managing project risks. This section contains a short description of the RAMP approach for managing project risks.

RAMP is a comprehensive framework within which risks can be managed effectively and financial values placed upon them. It aims to achieve as much certainty as possible about a long term and uncertain future. In the case of a new project, the RAMP process covers the project's entire life-cycle, from initial conception to eventual termination. The process facilitates risk mitigation and provides a system for the control of the remaining risks.

The RAMP process consists of four activities described in the following subsections.

H.2.1 Process Launch

The 'baseline' objectives, scope and plans for the project are defined. This should be part of the development of the business case. Information gathering forums could aid in determining project stakeholders' requirements and potential issues that could affect the project outcomes.

H.2.2 Risk Review

This activity involves:

- The identification of risks and the listing of these in a "risk register"
- The evaluation of the likelihood and possible impact of each risk identified
- The identification of mitigation measures to:
  - ⇒ Avoid the risk (eliminate the likelihood of occurrence) or reduce the likelihood of occurrence
  - ⇒ Reduce the impact of occurrence
  - ⇒ Transfer the management of a risk, and the consequences of its occurrence, to the party best placed to manage the risk
- The development of contingency plans to address residual risks
- Acceptance of the risk

The measures are incorporated in a risk mitigation strategy and a risk response plan is prepared.

The identification of risks can be aided by check-lists, risk matrices and other prompt aids. The project risk areas identified in the Mott MacDonald study act as a check-list that highlights critical risks areas relevant to specific project types. The RAMP process highlights the importance of not eliminating or ignoring any risks, as seemingly minor risks can combine to have a major impact on project outcomes. Similarly, project risk areas that have not been recorded as having an impact on projects, within the Mott MacDonald study, must still be considered when preparing mitigation measures.

The evaluation of the likelihood and impact of risks is known as risk analysis. It is important to determine qualitatively and quantitatively the likelihood, potential consequence and timing of the risk and its impact. In choosing risks for further detailed analysis, it will be necessary to ensure that the likely benefit accruing from refining the estimate is worth the effort and cost involved. This is part of the OGC Gateway Process (discussed in Section 3.3.1) in which a project is approved in stages and costs are only committed to achieving the next stage. The assessment of optimism bias in projects gives the total impact of risks on project outcomes. The relative impacts on optimism bias by project risk areas have also been successfully measured.

If the risks (and optimism bias) are deemed to be unacceptable, then risk mitigation measures must be developed to reduce the likelihood and impact of risks and the optimism bias. The methods of risk mitigation must be financially worthwhile. Risks arising during the implementation stage as well as operating stage have to be mitigated. An example of a mitigation measure for reducing the risk of high maintenance costs would be changing the balance of capital to current costs in the specification of the construction of the project, resulting in the 'over-engineering' the project. Careful analysis would need to be undertaken to determine whether such an over-engineered project is financially worthwhile over the whole life of the project. Some external risks e.g. technological advances, may not have appropriate mitigation strategies and will be considered residual risks. Contingency plans should be prepared to manage residual risks.

The risk review activity should be carried out at key stages or decision points throughout the project life-cycle, just as the assessment of optimism bias should be.

H.2.3 Risk Management

This activity should be conducted between risk reviews and involves implementing the risk mitigation strategy and risk response plan. The project activities should be monitored to identify new or changing risks in order to develop or modify the mitigation strategy. This process would ensure that the optimism bias decreases through the project life-cycle.

H.2.4 Process Close-down

A post-project appraisal is carried out to determine the success of meeting project objectives and delivery of benefits. A comparison is made between the risks and impacts that occurred during the project life-cycle and those anticipated at the business case stage. The optimism bias with reference to the business case should be assessed. The lessons and results of the post-project review should be placed in a database for future reference.

Performing post-project reviews, which record the things that worked well, those that could be done better and those that failed altogether, can be of immense benefit to future projects.

H.3 Risk Allocation and Procurement

A further and key means of managing risk is through appropriate structuring of the commercial deal between the public sector and a private sector contractor. As a general rule risks should be allocated to the contractor when it is better able to manage them than the public sector. Various contracting approaches are available which need to be considered on a case by case basis, for example turnkey procurement can be highly effective for projects in single locations with clearly defined interface points and functional requirements.

H.4 Change Management

The results of the Mott MacDonald study have emphasised that the most important stage of any project is the development of the business case: when benefits, requirements and scope of works are defined. This is because the failure to identify all of the project stakeholders and their requirements, and to address them in the detailed design, will result in dissatisfaction and a product that does not perform as required.

When preparing the requirements (i.e. output specifications) for outline business cases, the incorporation of change management strategies has proved essential for successful project delivery, especially in equipment and development and outsourcing projects.

Change management (sometimes confused with change control) involves the identification of the impacts (i.e. to business, people, technology, etc.) due to the project and the development and management of strategies to ensure the smooth implementation and acceptance of the project outputs. The change management activities (e.g. impact of change and change readiness assessments, communications management, and stakeholder management) support the smooth delivery of project deliverables and should form part of the project management activities. Most projects fail due to bad change management (e.g. project communications problems and poor stakeholder management). Change management involves key project management activities that are usually left out of project management training and management systems.

Therefore, project managers who can manage change and people effectively have a better chance of delivering projects on time, within budget and to the required quality.

The use of project management skills and tools coupled with change management skills and tools provides a better chance of successfully delivering large projects. This is because the change management tools are specifically designed to manage the people and external interfaces/influences of the project environment.

H.5 Stakeholder Management

An essential part of project management is to ensure that key stakeholders are identified early and their expectations managed so that they remain fully supportive of the project and its proposed goals, objectives and outputs. The following questions have to be considered:

- What / who is a stakeholder?
- How should their needs and objectives be assessed?
- How should potential conflicts be managed or identified?
- What power does each stakeholder have?

The involvement of all stakeholders should be managed in order to gain a thorough understanding of the project requirements (outputs specifications). All key stakeholders should be involved in the clarification and confirmation of their requirements so that all requirements are met in the outline design and ultimately the detailed design. For example it is especially important that facilities management requirements are addressed in a design solution, therefore early facilities management involvement is essential. The work required to deliver the objectives also need to be identified. Failure to sufficiently identify, clarify and agree the requirements of a project early will result in an optimism bias close to the upper bound or even abandonment of the project in extreme cases.

Implementation barriers will result if key project stakeholders' expectations are not effectively managed. Examples of implementation barriers are implementation delays due to key stakeholder requirements not being met, mistrust, anger, marginalisation, indecision, lack of support, and rejection of the final product. Stakeholder requirements should be reviewed on a regular basis as they may change as the project progresses.

At each of the decision-making points during the project life-cycle, the stakeholders will have an input to contribute. Therefore, it is essential that all stakeholders are identified and participate in the early stages of procurement, and effective stakeholder management is applied to identify and agree the requirements for the project. For example, the early stage of defence equipment projects are influenced by various stakeholders, both inside and outside the MoD with an interest in the project outcomes (i.e. the Defence Procurement Agency, the Head of Defence Export Services, scientists, the users, industry and more).

Large projects have a hierarchy of requirements. There are business requirements at the top level, then requirements for the new facility/system/equipment and finally project requirements. The lower level requirements must not be completed at the expense of the higher level requirements. For example, in an ICT development project a project team may have a requirement of completing the programming of a module by 19 May, and the deadline can only be met by cutting some corners that violate certain larger system requirements dictated by the business requirements. This would not only compromise the performance (i.e. benefit on completion) but the business requirements will also not be met. Project managers should always consider the business requirements.

H.6 Communications Management

"No society, whether human or animal can exist without communication." Anthony Burgess

In addition to the technical complexity of large technology projects (i.e. equipment and development and outsourcing projects), "communication" has emerged as a key factor influencing their successful delivery. Project leaders should customise their communication style to meet the needs of their project team. This becomes a more critical requirement for large technology projects.

There is little difference between managing large and small technology projects other than projects become harder to control as the number of project stakeholders and management challenges increase. Bad communication exponentially increases the possibility of serious mistakes occurring, whereas effective communication aids in smooth project delivery.

When assessing large-scale projects, the following four sets of activities should be used.

- Task management and control
- Managing relationships and communication among team members
- Managing application and solution design
- Managing logistics and administration.

The project manager has to have an understanding of his own as well as his team members' strengths and weaknesses in order to delegate work effectively.

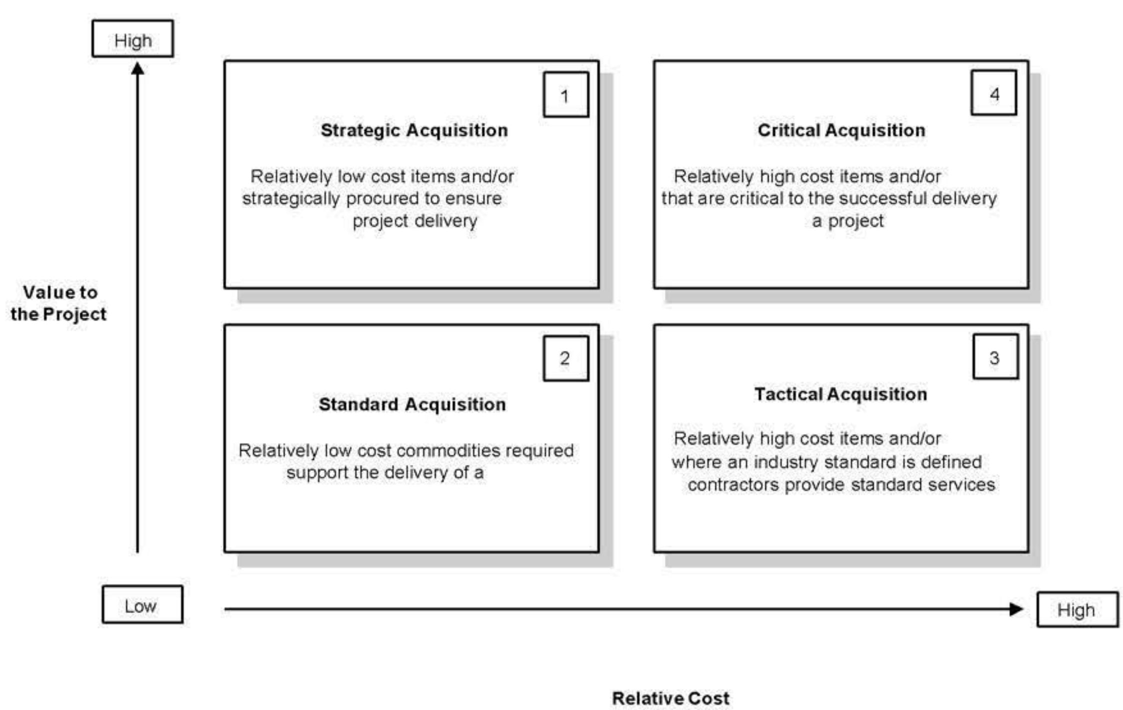
When critical project information has to be communicated to the whole team, a team meeting should be arranged to ensure the same message is communicated. This would increase the chances of success.

A communications plan identifying all communication or reporting activities, their intended audience, the desired objective of the communication, the mechanism/media to be used, the frequency, the deadline/schedule and the owner/author should be prepared as part of the full business plan. This will help ensure that project communications are focused and timely and stakeholders' expectations are managed. A continual review of performance is important with the feedback and lessons learned shared among the team.

H.7 Purchasing Decision-making Process

During the procurement and implementation of a project, a balance between value to the project (i.e. contribution to the successful delivery of project benefits) and cost has to be achieved through a decision-making process. The objective should be to deliver the best value for the money spent. There currently is a tendency to rely solely on cost (i.e. choosing the cheapest option without considering the value to the project of the item/service purchased). The following figure describes the relationship between the value to a project of an item/service purchased and the relative cost to the project.

Figure 7 Relationship between Value to Project of Item/Service Purchased and Relative Cost to Project



Items/services that have high value to the project should not be purchased on price alone. Their value to the project should be strongly emphasised. These purchases and decisions have been classified as 'Strategic Acquisition' and 'Critical Acquisition' in the figure. 'Standard Acquisition' and 'Tactical Acquisition' do not have high impacts on the successful delivery of the project and so consideration based on cost will be more acceptable. Examples of the four different types of acquisitions are:

1. Strategic Acquisition (e.g. project managers, key consultants and advisors)
2. Standard Acquisition (e.g. office consumables and secondary consultants not involved in key decision making processes)
3. Tactical Acquisition (e.g. bulk resources and general contractors)
4. Critical Acquisition (e.g. specialist contractors and suppliers)

Appendix I Project Risk Areas Optimism Bias Tables for Current / Future Projects

Table 15 Optimism Bias Upper Bound Guidance for Buildings Projects

Upper Bound Optimism Bias (%)[22]		Non-standard Buildings		Standard Buildings	
		39	51	4	24
		Works Duration	Capital Expenditure	Works Duration	Capital Expenditure
Risk Area Contributions to Upper Bound Optimism Bias (%)[23]		Non-standard Buildings		Standard Buildings	
Procurement	Complexity of Contract Structure	3	1	1	
	Late Contractor Involvement in Design	6	2	3	2
	Poor Contractor Capabilities	5	5	4	9
	Government Guidelines				
	Dispute and Claims Occurred	5	11	4	29
	Information management				
	Other (specify)				
Project Specific	Design Complexity	2	3	3	1
	Degree of Innovation	8	9	1	4
	Environmental Impact				
	Other (specify)	5	5		
Client Specific	Inadequacy of the Business Case	22	23	31	34
	Large Number of Stakeholders			6	
	Funding Availability	3		8	
	Project Management Team	5	2		1
	Poor Project Intelligence	5	6	6	2
	Other (specify)	1	2		< 1
Environment	Public Relations			8	2
	Site Characteristics	3	1	5	2
	Permits / Consents / Approvals	3	< 1	9	
	Other (specify)	1	3		
External Influences	Political	13			
	Economic		13		11
	Legislation / Regulations	6	7	9	3
	Technology	4	5		
	Other (specify)		2		

[22] Note that these are only indicative starting values for calculating optimism bias contributions, because a project's optimism bias profile (contributions from project risk areas) will change during its project life-cycle.

[23] Contributions from each project risk area are expressed as a % of the recorded optimism bias. Note: The sum of individual percentages contributions in each column may not add up to 100% due to rounding errors.

Table 16 Optimism Bias Upper Bound Guidance for Civil Engineering Projects

		Non-Standard Civil Engineering		Standard Civil Engineering	
Upper Bound Optimism Bias (%)[24]		25	66	20	44
		Works Duration	Capital Expenditure	Works Duration	Capital Expenditure
Risk Area Contributions to Upper Bound Optimism Bias (%)[25]		Non-Standard Civil Engineering		Standard Civil Engineering	
Procurement	Complexity of Contract Structure	4			
	Late Contractor Involvement in Design	< 1			3
	Poor Contractor Capabilities	2		16	
	Government Guidelines				
	Dispute and Claims Occurred	16			21
	Information management				
	Other (specify)	1	2		
Project Specific	Design Complexity	5	8		
	Degree of Innovation	13	9		
	Environmental Impact		5	46	22
	Other (specify)	3			18
Client Specific	Inadequacy of the Business Case	3	35	8	10
	Large Number of Stakeholders				
	Funding Availability		5	6	
	Project Management Team		2		
	Poor Project Intelligence	3	9	14	7
	Other (specify)				
Environment	Public Relations				9
	Site Characteristics		5	10	3
	Permits / Consents / Approvals				
	Other (specify)				
External Influences	Political	19			
	Economic	24	3		7
	Legislation / Regulations		8		
	Technology	6	8		
	Other (specify)	< 1	1		

[24] Note that these are only indicative starting values for calculating optimism bias contributions, because a project's optimism bias profile (contributions from project risk areas) will change during its project life-cycle.

[25] Contributions from each project risk area are expressed as a % of the recorded optimism bias. Note: The sum of individual percentages contributions in each column may not add up to 100% due to rounding errors.

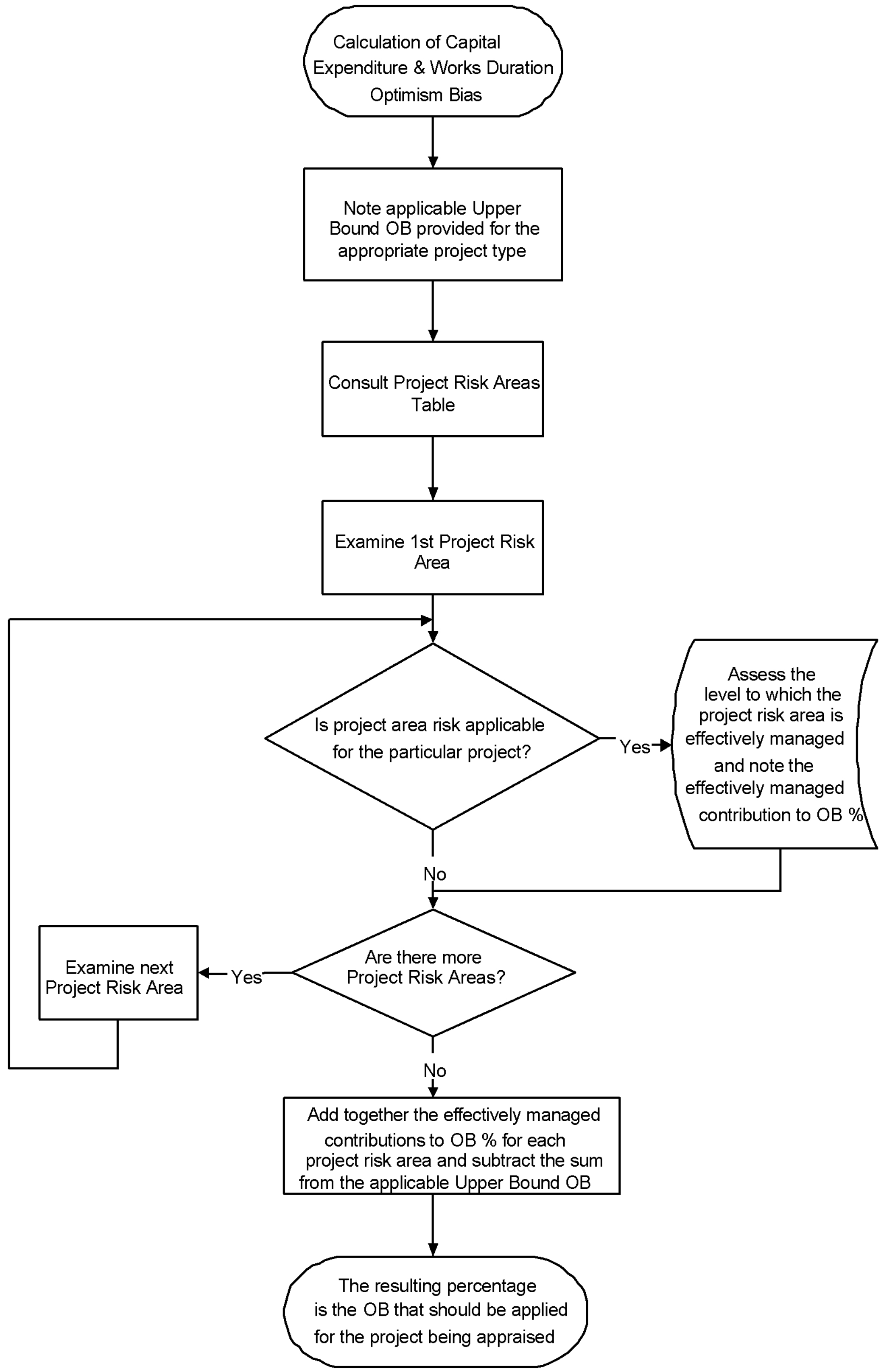
Table 17 Optimism Bias Upper Bound Guidance for Equipment/ Development and Outsourcing Projects

		Equipment / Development		Outsourcing		
Upper Bound Optimism Bias (%)[26]		**54**	**200**	**-**	**-**	**41**
		Works Duration	**Capital Expenditure**	**Works Duration**	**Capital Expenditure**	**Operating Expenditure**
Risk Area Contributions to Upper Bound Optimism Bias (%)[27]		**Equipment / Development**		**Outsourcing**		
Procurement	Complexity of Contract Structure	13	7	-	-	
	Late Contractor Involvement in Design		7	-	-	
	Poor Contractor Capabilities	11	4	-	-	
	Government Guidelines			-	-	
	Dispute and Claims Occurred			-	-	
	Information management		5	-	-	
	Other (specify)			-	-	
Project Specific	Design Complexity		10	-	-	
	Degree of Innovation	20	17	-	-	
	Environmental Impact	9		-	-	
	Other (specify)			-	-	3
Client Specific	Inadequacy of the Business Case	20	18	-	-	52
	Large Number of Stakeholders			-	-	
	Funding Availability			-	-	
	Project Management Team		5	-	-	
	Poor Project Intelligence	4	4	-	-	32
	Other (specify)			-	-	
Environment	Public Relations			-	-	
	Site Characteristics			-	-	
	Permits / Consents / Approvals			-	-	
	Other (specify)			-	-	
External Influences	Political			-	-	
	Economic			-	-	
	Legislation / Regulations	4	5	-	-	
	Technology	19	18	-	-	9
	Other (specify)			-	-	

[26] Note that these are only indicative starting values for calculating optimism bias contributions, because a project's optimism bias profile (contributions from project risk areas) will change during its project life-cycle.

[27] Contributions from each project risk area are expressed as a % of the recorded optimism bias. Note: The sum of individual percentages contributions in each column may not add up to 100% due to rounding errors.

Figure 8 Calculation Procedure



Data Input Table – Do Not Delete

Item	Location	Bookmark name	X[1,2]	Record of input[3,4]
Report Title – first line	Pages i and ii	T1		Review of Large Public Procurement in the UK [5]
Report Title – second line	Pages i and ii	T2		Phase II Paper
Report Title – third line	Pages i and ii	T3		July 2002
Report Title or Heading – first line	Left aligned in headers	HL1		Review of Large Public Procurement in the UK
Report Title or Heading – second line	Left aligned in headers	HL2		Phase II Paper
Group Name	Right aligned in headers – first line	HR1		Mott MacDonald
Client/Associate (where applicable)	Right aligned in headers – second line	HR2		HM Treasury
Project Number	Footers	PRJNR		200505
Report Number	Footers	RPTNR		02
Revision Letter	Issue and Revision Record on page ii and footers	REV		04
Date of issue or report	Page i, Issue and Revision Record on page ii and footers	DATE		July 2002
Initials of word processor	Footers	INI		PCF

Notes [1] This column contains the 'Bookmarks'. Do not enter data directly into this column or any other column in the table. Similarly, do not delete data in the columns.

To enter data, right click at the centre of the particular cell in column 'X' and choose 'Update Field' from the menu to enter data through the dialogue box. Do not enter a void in any of the dialogue boxes, otherwise an error message will be displayed. Enter a couple of blank spaces instead.

[2] If you delete a 'Bookmark', you will need to recreate it in the same place with the same name using 'Insert + Fields + Mail Merge + Ask'.

[3] This column and the appropriate locations in the report contain the 'Bookmark References'. These references can be updated by changing the 'View' from 'Normal' to 'Page Layout' and back again.

[4] If you delete a 'Bookmark Reference', you will need to recreate it in the same place with the same name using 'Insert + Fields + Links and References + Ref'. To help locate a reference (or any other 'Field Code') highlight the codes using 'Tools + Options + Field shading + Always'.

5 Do not insert 'Carriage Returns' to split 'Bookmark references' in the report titles on pages i and ii, otherwise the title will not display correctly. Where a title line is too long, shorten it by changing the appropriate 'Bookmark' entry. Please see the guidance on the previous page regarding font name and size for the main title.