# JSP 507

# MOD GUIDE TO INVESTMENT APPRAISAL

# AND EVALUATION

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## FOREWORD

**Good appraisal is vital to sound decision-making and achieving value for money from the Defence budget. It requires flexibility and imagination. It is not a ritual to be gone through. Evaluation of projects following their implementation is also important. It requires us to identify (a) the benefits we seek for a policy or project, and (b) how we will know if they are secured. It enables us to learn from experience and improve the appraisal and implementation of future projects.**

**This guide has been produced by MOD's Division of Economic Statistics and Advice to provide practical assistance to practitioners and managers. It supplements the Treasury's "Green Book - Appraisal and Evaluation in Central Government", which describes the principles of appraisal and evaluation. This guide explains how to apply those principles.**

**I commend it to you and your staff.**

Jon Thompson

DG Finance

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# PART 1 – INTRODUCTION

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# 1.1 HOW TO USE THIS GUIDE

1.1.1 JSP 507 is intended as a practical handbook on the application of appraisal and evaluation in the MoD. It is designed to be used by staff responsible for producing appraisals, and planning and carrying out project evaluations. It is also for those overseeing, scrutinising, and reviewing appraisals and evaluation plans. The Guide contains advice on the processes involved and the techniques to apply when preparing appraisals and evaluations.

1.1.2 The Guide is divided into four parts:

- Part 1 - Introduction
- Part 2 - Managers' Guide, containing details of the policy on appraisal and evaluation, and an overview of the processes;
- Part 3 - Practitioners' Guide containing guidance on conducting investment appraisals and project evaluation;
- Part 4 - More Complex Issues containing detailed guidance on a range of topics whose application may only be required in specific cases.

## ***Training***

1.1.3 No guide or manual can give all the answers. Training in investment appraisal is provided by the Defence Academy who regularly provide a two-day training course called 'Investment Appraisal Skills' (E043). All staff tasked with undertaking an IA for the first time should attend this or a similar course. Some TLBs operate their own IA training courses.

1.1.4 The Financial Skills Certificate (FSC) includes elements covering Investment Appraisal and Evaluation. Ideally, all IAs should be undertaken or reviewed by an individual with Intermediate Level FSC certificate in Financial Planning, which includes the relevant Investment Appraisal and Evaluation elements.

## ***Further Advice***

1.1.5 For further information on any aspect of this guide, or questions not answered within the subsequent sections, contact any of the following members of the Division of Economic Statistics & Advice (DASA-DESA) as follows:

**DASA-DESA Appraisal & Evaluation Group: Points of Contact**

| Name | Job Title/E-mail | Project focus | Phone | TLB / TF Contact |
|---|---|---|---|---|
| John Ogilvie | DASA DESA-Appev-DD | PPP / PFI | 020 7218 4538 | DE&S |
| Phil McCrea | DASA DESA-Appev PC | Land / Personnel | 020 7218 6027 | Land |
| Andrew Harding | DASA DESA-Appev 1 | Sea / CIS / Nuclear | 020 7218 9455 | Navy |
| David Banks | DASA DESA-Appev 2 | Estates / Business change | 020 7218 6404 | DE / DSG |
| Neil Tyson | DASA DESA-Appev 5 | Air / Centre | 020 7218 7496 | Air / Centre |
| Ben Johnson | DASA DESA-Appev 6 | Sea / CIS / Nuclear | 020 7218 6609 | CJO |
| Tom Cornwall | DASA DESA-Appev 4 | Air / Centre | 020 7218 9455 | UKHO / Dstl |

## ***Appraisal Mini Guide***

1.1.6 In addition to this JSP, DASA-DESA has produced a Mini Guide to Appraisal and Evaluation, which gives brief details of the subject for those who need only a broad awareness. This is based on the summary in Section 1.2 and the checklists and templates in Section 2. The Mini Guide can be found on the DASA-DESA (Appraisal and Evaluation) team site on the Defence Intranet.

## ***Feedback***

1.1.7 To ensure that this Guide fully meets practitioners' requirements, it is important that it contains guidance on relevant and current investment appraisal issues. To aid the regular updating process, a feedback form is provided at the end of this section for your comments. This may be copied and forwarded to DASA-DESA.

## ***Feedback Form: MoD Guide to Investment Appraisal and Evaluation***

Your comments on the Guide are valued. We would find it helpful if you would provide feedback using the headings below. Please provide as much detail as possible, and continue on a separate sheet if necessary:

1. Sections of the Guide where additional explanation would be helpful:

2. Relevant investment appraisal issues that are not covered in the Guide:

3. Sections of the Guide that are superfluous or unhelpful:

4. Other comments or suggestions that may be helpful for future updates:

From:
Name

Post title

Address

E-mail address

Telephone

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# 1.2 SUMMARY

## ***What Is Appraisal?***

1.2.1 Appraisal is a systematic process, which entails being clear about objectives, thinking about alternative ways of meeting them, and estimating and presenting the costs of each potentially worthwhile option.

1.2.2 It enables decisions about the use of resources to be taken with better understanding of their implications. An appraisal sets out the objectives to be met; identifies a range of options which might meet them; and provides an objective assessment of the costs and benefits of each together with an assessment of their associated risks, to indicate which offers the best value for money.

## ***When should an appraisal be undertaken?***

1.2.3 Appraisal (or Investment Appraisal) should be undertaken whenever a decision has to be reached that would involve the commitment of new resources; or which would result in measurable benefits. Examples would include a suggested relocation, business change proposals, “spend to save” measures, and equipment procurement.

1.2.4 The effort and detail should be comprehensive, but proportionate to the value, length and complexity of the case. The key principles of and process for a well conducted investment appraisal are described in Section 2.

## ***What is a Business Case?***

1.2.5 The business case is a management tool and is developed over time as a living document as the proposal develops. The Business Case keeps together and summarises the results of the analysis needed to support decision making in a transparent way. A business case must be prepared for all proposals that would involve the commitment of resources or which would result in measurable benefits.

## ***Elements of a Business Case***

1.2.6 Business cases should contain the five elements defined by HM Treasury’s best practice ‘Five-Case’ Model. These are:

- **The Strategic Case.** This sets out why the proposal is needed, the background to the proposal, the requirement, any over-riding and binding constraints, and any dependencies.
- **The Economic Case.** This considers the options for delivery and the assessment of Value for Money (VfM) (see paragraph 2.1.11).
- **The Commercial Case.** This sets out the procurement strategy and considers the commercial viability of the proposal.
- **The Financial Case.** This establishes the affordability and financing of the proposal.
- **The Management Case.** This sets out how the proposal will be delivered in project and programme management terms, and the plans for evaluation of the proposal.

## ***Elements of an appraisal***

1.2.7 An appraisal (or investment appraisal) addresses the Economic Case. A well-conducted investment appraisal should include the following elements in sequence, addressing key issues relevant to each. These are:

- the options being considered and the reasons for their selection;
- short-listing of the options;
- the costs and benefits of the various options;
- assessment of risks;
- sensitivity analysis
- other factors leading to the choice of a recommended option.

A more detailed checklist of key points to consider when preparing a business case and an appraisal is provided at Annex A to Chapter 2.2.

## ***Appraisal Thresholds***

1.2.8 An appraisal that covers all the steps in this Guide is required in the circumstances below. Individual TLBs may have lower thresholds.

| **Criteria** | **Threshold** |
|---|---|
| Capital Investment | Exceeds £1M |
| Total resource consumption over Planning Review period | Exceeds £10M (excluding depreciation and cost of capital charges) |
| Novel or Contentious expenditure (see JSP 462) | All proposals regardless of value |

1.2.9 This is an approximate guide only. The presumption should normally be in favour of a full appraisal for borderline cases, unless there are compelling reasons otherwise.

## ***Costs and benefits to include in an appraisal***

1.2.10 The costs and benefits to include should be those which result from undertaking a particular appraisal option, sometimes called the incremental costs. Any past costs, resulting from previous decisions should therefore be excluded. These are referred to as sunk costs.

1.2.11 Costs and benefits considered should normally cover the period of the useful lifetime of the assets encompassed by the options under consideration, although if the appraisal concerns the contractual purchase of outputs and outcomes, the appraisal period may be different.

| **Elements to include in an IA:** | **Elements to exclude from an IA:** |
|---|---|
| • Capital costs plus full life costs;<br>Opportunity cost of assets being redeployed to this project;<br>Working capital, eg spares;<br>Operating costs / savings / income;<br>Residual value of assets;<br>Income;<br>Benefits;<br>Costs for other TLBs / OGDs;<br>Indirect costs;<br>Redundancy payments.<br>Relative price effects<br>Risk Assessment<br>Sensitivity Analysis<br>Optimism Bias | Financing costs;<br>Depreciation charge;<br>VAT;<br>Apportioned fixed overhead costs;<br>Sunk costs;<br>General inflation. |

1.2.12 The costs and benefits of each option should be expressed in real terms (i.e. constant price levels excluding general inflation). In order to compare options it is necessary to convert the annual costs and benefits to a ‘Net Present Value (NPV)’, by discounting at the Treasury Discount Rate (currently set at 3.5% in real terms).

## ***Scrutiny***

1.2.13 Once an appraisal has been completed, both it and the recommendation for action arising from it must be independently scrutinised in order to protect the position of the Budget Holder, and to ensure that value for money is likely to be achieved.

1.2.14 The Division for Economic Statistics and Advice, within Defence Analytical Services and Advice (DASA-DESA) must be consulted on all appraisals that will eventually be presented to Ministers or the Investment Approvals Board, or which will support submissions that will do so. Early engagement is encouraged. DASA-DESA will provide advice and assistance in the preparation of these and other appraisals and evaluation plans.

## ***Trading Funds***

1.2.15 Trading Funds are required to deliver a return on capital, at a rate determined by HM Treasury. In addition to the appraisal requirements outlined above, Trading Funds should undertake a separate test as a sensitivity on each project appraised to determine whether the project is expected to deliver the target return on capital.

## ***What is Evaluation?***

1.2.16 Evaluation is the retrospective analysis of how well a project, programme, or policy is delivering against its performance, time and cost parameters.

1.2.17 When decisions have been taken and implemented, it is then important to monitor and evaluate the outcome. Only in this way can we hope to learn from our experience, avoid mistakes, and improve the quality of future management decisions.

## ***What is the purpose of Evaluation?***

1.2.18 The main purpose of evaluation is to ensure that good practice is perpetuated, lessons are learned, and the Department avoids repeating costly mistakes. It is not a tool for apportioning blame, but a vital source of information for management decision making. It should also lead to improved project control and governance.

## ***What to Address in an Evaluation***

1.2.19 An evaluation should address three distinct and interlinked elements:

- Technical requirements and operational capability
- Financial and commercial control
- Project governance and control

1.2.20 The evaluation should assess what went well and why, and what didn't go well and why within all three elements. A suggested template for evaluation is provided at Annex to Chapter 3.7.

## ***When to Undertake an Evaluation***

1.2.21 Every project, programme, or policy requiring an appraisal should be evaluated. The extent and depth of evaluation should be commensurate with the value, length and complexity of the project. A straightforward, low value project may only require a short evaluation at the end of the project life. For larger, longer running projects and programmes, greater depth of evaluation will be required. For these, an evaluation should be undertaken after each major stage of the project lifecycle. Evaluation should also be carried out at other major project milestones eg a project manager leaving, in order to prevent a loss of valuable project knowledge.

1.2.22 Any project that stops or experiences any issues not previously envisaged should conduct a detailed evaluation of the issues, causes and remedial actions, including the effectiveness of remedial actions.

## ***Responsibility for Undertaking Evaluation***

1.2.23 The responsibility to ensure evaluation is conducted falls to the Senior Responsible Owner (SRO) or Senior Point of Accountability (SPA) and will usually be led by the project team, with external facilitation or support if required.

1.2.24 Evaluation should be carried out by existing project resources and be an integral part of the project process. The majority of effort and activity should complement other project controls such as risk management, stakeholder involvement and communication. The distribution of the evaluation should be such that lessons learned are communicated to others likely to benefit.

## ***Further Guidance***

1.2.25 Each TLB has a focal point to support the appraisal and evaluation process, to produce appraisals when appropriate, and:

- Provide the Senior Finance Officer (SFO), with an assurance that effective appraisal and evaluation processes are in place within their management area and staff adequately trained;
- Provide advice and guidance to others within their management area preparing appraisals and evaluations;
- Review business cases, appraisals, and evaluations undertaken within their management area to ensure compliance with TLB and departmental policy. This will include, as a matter of course, a review of business cases, appraisals, and evaluations that are to be submitted to a higher authority; and
- Maintain details (and copies) of business cases, appraisals, and evaluations undertaken within their management area and a record of when evaluations are due.

### TLB Appraisal and Evaluation Focal Points

| TLB / Trading Fund | Name | E-mail | Phone |
|---|---|---|---|
| Air Cmd | Wg Cdr Andy Trollen | Air CmdSecRes-RMH MPC SO1 MA (Trollen, A Wg Cdr) | 01494 495437 |
| Centre | Mrs Beverley Irving | CTLB SDM-Sec&Perf (Irving, Beverley Mrs) | 0207 807 0275 |
| CJO | Major David Rutherford | PJHQ-J8-ACS-SO2MA (Rutherford, David Maj) | 01923 955844 |
| DE+S | Mr Phil Boobier | DES FIN FGA-AE5(Boobier, Phil Mr) | 0117 9134340 |
| Defence Infrastructure Organisation | Mr Jason Slater | DE Fin-ICFP (Slater Jason Mr) | 0121 311 3233 |
| Defence Support Group (DSG) | Mr Eddie Dawson | DSG-Dawson Edward | 01264 383363 |
| Navy | Mrs Debbie Wood | FLEET-RP-FIN DECISION SPT MGR C1 (Wood, Debbie C1) | 02392 62 5203 |
| Land Forces | Mrs Sharon Goldie | LF-Res Inv Plans SO1-2 (Goldie, Sharon Mrs) | 96770 1341 |

| | | | |
|---|---|---|---|
| Met Office | Mr Simon Willis | simon.willis@metoffice.gov.uk | 01392 884183 |
| UKHO | Mr Jamie Tooze | Jamie.Tooze@UKHO.gov.uk | 01823 337900 Ext. 4396 |

1.2.26 Further advice should be sought in the first instance from your appraisal and evaluation focal point, and TLB guidance documentation. If they cannot help, they will refer the query to DASA-DESA.

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# PART 2 – MANAGERS' GUIDE

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# 2.1 THE PRINCIPLES OF APPRAISAL AND EVALUATION

**2.1.1 This section explains what appraisal and evaluation are, and what they are for. It explains why appraisals and evaluations need to be objective and well planned, and that special care and consultation with DESA is needed for cases going to Ministers.**

**2.1.2 An investment appraisal should be undertaken whenever a decision has to be reached which would involve the commitment of resources, or which would result in measurable benefits. Appraisal enables decisions to be made with a clear understanding of the costs and benefits of different choices.**

**2.1.3 The depth of appraisal should be commensurate with the scale, complexity, and sensitivity of the project, programme, or policy being appraised. An appraisal that covers all the steps in this guide is required when the capital investment exceeds £1million, or where total resource consumption over the planning period exceeds £10m. Some form of appraisal should be carried out on all expenditure proposals.**

**2.1.4 All projects programmes and policies subject to a full appraisal should also be subject to subsequent project or policy evaluation. Plans for this should accompany the investment appraisal.**

### ***What is Appraisal?***

2.1.5 Appraisal or Investment Appraisal (IA) is so called because its techniques have been developed mainly in the context of investment decisions. However, appraisal is equally applicable to decisions where no investment is involved.

2.1.6 Appraisal is a systematic process which entails being clear about the requirement, thinking about alternative ways of meeting the requirement, and estimating and presenting the costs and benefits of each potentially worthwhile option. It enables decisions about the use of resources or the generation of benefits to be taken with a better knowledge of their implications.

## ***Why Appraisal Matters***

2.1.7 In large measure public administration is about choices. Ultimately choices are made by Ministers or within a framework set by them. Ministers need the means to take informed decisions however, and it is government policy that investment appraisal techniques should be applied to major decisions involving the commitment of public funds. Government Accounting says:

> *"Investment appraisal (or more generally option appraisal) is an important part of good financial management, and it should always be applied to major capital developments."*

2.1.8 PUS, as Principal Accounting Officer, is answerable to Parliament, through the Secretary of State for Defence, for the efficient and effective use of MoD resources, and appears before the Public Accounts Committee to answer for the use of MoD resources. If decisions can be shown to be based on sound and thorough appraisals, and are properly evaluated, then the position of the Accounting Officer is protected.

## ***The Purpose of Appraisal***

2.1.9 An investment appraisal serves three main purposes.

- Its prime function is to give the responsible manager the information he or she needs to make a sound decision. As such, appraisal is an essential part of the search for best value for money.
- When a decision is outside the manager's delegated authority, then an appraisal will need to be presented as part of a submission for approval, and will form an important part of the case for gaining approval. A thorough appraisal that is well documented and presented will help to demonstrate that the project is soundly based and will smooth the process of gaining

approval.

- The appraisal also provides a record of what was expected to be achieved by the project and the factors on which the decision was based. It will be an important starting point for any later review or audit of the project, and in particular for project evaluation.

2.1.10 The aim is not to reduce decision taking to mere mechanics, but rather to place it on a rational and informed basis in which decisions are taken with a clear understanding of the costs and benefits of the available options.

## ***Value for Money***

2.1.11 Value for Money (vfm) is the optimal combination of:

- Economy – ie Cost of Inputs (I/M : Inputs/Money)
- Efficiency – ie Ratio of Output to Inputs (O/I : Outputs/Inputs
- Effectiveness – ie Value of Outcomes from Outputs (V/O : Value/Outputs

Hence vfm = I/M x O/I x V/O = V/M (Value / Money)

2.1.12 VfM can also be expressed as the optimal trade-off between time, cost and effectiveness. This does not necessarily mean choosing the lowest cost bid, nor highest performance regardless of the consequences. VfM is a relative concept which involves the comparison of potential and actual outcomes of alternative procurement options. VfM is only meaningful where options exist. Where there is only one option then there is no real way of assessing VfM and in these circumstances the key is to achieve the most acceptable cost.

2.1.13 VfM is rarely clear cut and achieving VfM will normally be a question of balancing competing factors. No single approach to determining VfM will be appropriate in all circumstances.

## ***The Main Forms of Appraisal***

2.1.14 As Government bodies are concerned with the well-being of the country, appraisals carried out by Government Departments will normally be prepared on the basis of the costs and benefits of using national resources. Here the cost is the ‘opportunity cost’, or loss of the alternative use to which those resources could be put (see paragraph 3.1.32). Transfers of cash for which no goods or services are provided in return (called 'transfer payments') are not included (see paragraph 3.1.44). These appraisals are called '**Economic Appraisals**'.

2.1.15 In some cases economic appraisals will take the form of a ***COST BENEFIT ANALYSIS (CBA)***, in which all of the costs and benefits of an activity are quantified and valued in monetary terms. The results of a CBA can be used not only to say which option is best, but also to indicate whether this option is worthwhile, i.e. does it provide a benefit exceeding its cost.

***Example***. *The Health and Safety Executive produces CBAs of all proposals for new health and safety regulations. This involves estimating the extra cost employers will face in complying with the requirement, and the benefits in terms of reduced likelihood of deaths, injuries, illness and interruptions to work. These benefits are then given a monetary value based on the results of research into the costs of accidents and peoples' willingness to pay to reduce the risk of death and injury. The net present value of the difference between the costs and benefits can then be calculated.*

2.1.16 As few activities within MoD produce benefits that can be valued in monetary terms, the use of full-blown CBA by MoD is extremely limited. One of the few areas where a CBA would be useful would be proposed health and safety or environmental measures that go beyond statutory requirements. DESA should be consulted as to whether and how a CBA might be prepared in such cases.

2.1.17 Instead, most MoD appraisals take the form of a ***COST EFFECTIVENESS ANALYSIS (CEA)***, which estimates the net present cost of alternative ways of achieving the same requirement. When there are differences in the extent to which the requirement is achieved, these will be noted, and as far as possible quantified, using measures which may be judgemental.

2.1.18 By including the status quo in the comparison of options, a CEA can establish whether <u>any alternative</u> option is worthwhile, as well as which option is best. It cannot though, on its own, establish whether the activity itself is worthwhile.

2.1.19 A highly formalised type of CEA is used for appraisal of new military equipment, and for other appraisals where the options to meet a requirement offer different levels of military or business effectiveness. This is the ***COMBINED OPERATIONAL EFFECTIVENESS AND INVESTMENT APPRAISAL (COEIA)***. Here, the total through-life costs of the options to meet a particular requirement are estimated in the *Investment Appraisal*. The individual parameters contributing to overall performance are identified, and each option assessed against each of these parameters in the *Operational Effectiveness Assessment*. The two separate assessments are then combined to identify the overall cost effectiveness of each option. Guidance on COEIAs is provided at Section 3.2.

## ***When An Investment Appraisal Should Be Undertaken***

2.1.20 An investment appraisal should be undertaken whenever a decision has to be reached which would involve the commitment of resources; or which would result in measurable benefits. Examples include:

- a new recruitment policy,
- a works or accommodation project,
- an equipment procurement,
- a suggested redeployment,
- estate rationalisation,
- support for military exercises;
- “spend to save” measures.

2.1.21 The depth of appraisal and the effort applied should be commensurate with the scale, complexity, and sensitivity of the project, programme, or policy.

## ***Investment Appraisal Thresholds***

| | |
|---|---|
| Capital investment | Exceeds £1m |
| Total resource consumption (over the planning period) | Exceeds £10M (excluding depreciation and cost of capital charges) |
| Novel or contentious expenditure | All proposals, regardless of value |

2.1.22 An appraisal that covers all the steps described in this Guide is required where the capital investment, ie expenditure on new assets, or on refurbishing existing assets, exceeds £1m; or where total resource consumption, ie operating costs (excluding depreciation and cost of capital charge), is expected to exceed £10m over the planning period. This is an approximate guide only; the presumption should normally be in favour of a full appraisal for borderline cases, unless there are compelling reasons otherwise. However, expenditure proposals below this level should still be subject to a business case that will need to address the same basic questions as those addressed in an investment appraisal.

***Example.*** *Suppose it is proposed to use a building with a book value of £4m as accommodation for a group of relocated staff. New IT will be installed at a cost of £0.5m. Total resource costs of the organisation being relocated will be £2.5m p.a.*

*For IA threshold purposes, the cost of new capital is £0.5m, (new assets, inclusive of project management fees), and would not need a full IA. But total of costs in the four years of the STP is £10m hence a full investment appraisal is required.*

2.1.23 Senior Finance Officers (SFOs) have discretion to set lower limits for mandatory appraisal. Where SFOs decide to apply lower limits for mandatory appraisal, these should be followed. It remains the case that the basic principles of appraisal should be applied to all investment decisions, whatever threshold is set. There may well be cases below the threshold where a full appraisal is appropriate because of the complexity or sensitivity of the project.

## *Who is Responsible for Undertaking Investment Appraisals?*

2.1.24 Effective appraisal, evaluation and scrutiny are fundamental requirements of HM Treasury delegations and spending authority. Investment Appraisal is a key part of the management decision-making process, and not merely a finance or audit responsibility.

2.1.25 SFOs are responsible to DG Finance for the coverage and quality of investment appraisal throughout their area of responsibility. They should make arrangements for monitoring, and should make sure that they are made aware of any decision which runs counter to the conclusions of an investment appraisal, and any case where significant expenditure is to be committed without appraisal. They are required to cover investment appraisal in their annual reports to DG Finance on Corporate Governance in their area.

2.1.26 Within TLBs, appraisals should be carried out by the line management area responsible for implementing the project, programme or policy. Additionally, where projects span TLB boundaries, responsibility for the appraisal lies with the lead TLB. Advice should be sought as required from finance staff, TLB Appraisal and Evaluation cells, DESA, and other specialists.

## ***Planning***

2.1.27 <u>It is important that appraisal is carried out in an open minded and objective manner, not used to support a decision which has already been made</u>. The appraisal should be carefully planned. The sponsor should ensure that the necessary resources are provided to carry out a thorough appraisal at the right time.

2.1.28 As part of the planning process the sponsor needs to consider who should be consulted and when, and to allow adequate time for this consultation. It is good practice to identify who will be involved in the eventual approval of the project, and to make sure that their staffs are consulted on the appraisal in draft and are content with it. That should reduce the risk of having to respond at short notice to queries or objections which are raised on the final submission, when a decision is needed urgently.

2.1.29 Care should be taken not to constrain unduly the conduct of the appraisal, for example by setting terms of reference that specify particular options, or a particular appraisal timescale.

## ***Cases for Ministers***

2.1.30 Particular care is needed in cases that go to Ministers for their approval. The investment involved may be quite small in financial terms, but these cases can be sensitive - because they involve redundancies or impact on the local economy, or because there is political interest in the subject. The Minister will undoubtedly seek advice from the appropriate Central staffs; so the sponsor of the project should ensure that these staffs have the opportunity to see the submission and supporting appraisal in draft, and to resolve any points of difficulty.

2.1.31 It is embarrassing to the Department when flaws in an appraisal are detected only after a submission has gone to Ministers. Likewise, it is embarrassing to Ministers when flaws are not found until after the Minister has gone public, say by approving the issue of a consultative document. Ministers are entitled to a better service from the Department. No submission should be put to Ministers until the sponsor is entirely confident that the submission and supporting appraisal will stand up to scrutiny.

## ***Scrutiny***

2.1.32 Once an appraisal has been completed, both it and the recommendation for action arising from it must be independently scrutinised, in order to protect the position of the Budget Holder, and to ensure that value for money is likely to be achieved. This scrutiny role is often filled by the Budget Manager. Additional information on Budget Holder/Manager responsibilities can be found in JSP 462.

2.1.33 Scrutiny should not be limited to the recommendation for action, but should encompass the requirement itself. Requirement scrutiny is designed to ensure that only fully justified requirements, which demonstrably contribute to the organisation's agreed outputs, are approved. A financial scrutiny is carried out to ensure that approved requirements are affordable, that they are regular and proper charges to the Defence Budget, and that they represent value for money. Scrutiny should also consider the options rejected, and must be completed before the proposal passes up the approvals chain.

## ***Role of DESA***

2.1.34 DESA is responsible for the formulation and dissemination of policy on Investment Appraisal and Project Evaluation throughout the Department, and the Head of DESA represents MOD in discussions with HM Treasury about interpretation of, and addition to, the Green Book.

2.1.35 DESA endorsement of all IAs which are to go to Ministers, and/or the Investment Approvals Board (IAB), or which will support submissions that will do so is required. DESA will provide advice and assistance in the preparation of these. Early engagement is recommended, and regular contact should be maintained with DESA throughout the period up until the main decision point. DESA also has a formal scrutiny role in the assessment of benefits presented in cases submitted to the IAB.

2.1.36 DESA's advice and assistance may be sought on any other appraisal though requests should normally be routed through the relevant TLB focal point. DESA will review a sample of such appraisals for DG Finance's Annual Health of Financial Systems report.

## ***TLB Appraisal and Evaluation Teams***

2.1.37 Appraisal and evaluation teams, within each TLB, act as a focal point for advice and expertise on these subjects, where they fall within the TLB's delegated authority. Staff should seek guidance from these cells in the first instance, and at an early stage. Proposals involving potentially novel or contentious expenditure must be brought to their attention as soon as possible.

2.1.38 DESA is responsible for scrutiny of all Category A and Category B projects, as defined by the SMART Approvals Guide. For appraisals originating within DE&S, scrutiny of Category C projects and below is the responsibility of their Appraisal and Evaluation cells.

2.1.39 SFOs and Agency Chief Executives are responsible to DG Finance for the coverage and quality of investment appraisal throughout their areas of responsibility. They should make arrangements for monitoring, and should make sure that they are made aware of any decision which runs counter to the conclusions of an investment appraisal, and any case where significant expenditure is committed without appraisal. They are required to cover investment appraisals and evaluations in their annual reports to DG Finance on the Health of the Financial Systems in their areas.

## ***Role of CAAS***

2.1.40 The Cost Assurance and Analysis Service (CAAS) is part of the Director Commercial (D Comm) team within Defence Equipment and Support (DE&S) of the Ministry of Defence (MOD). CAAS are mandated to be the authoritative source for Cost Forecasting, Cost Estimating and Cost Certification across the Department. Their key activities are:

- Cost Forecasting (CF): The development of risk based cost and schedule estimates using standard processes such as parametric, analogous and other estimating techniques. Cost Forecasting also supports MOD centre in the development of cost and schedule for future capability requirements within an industrial context.

- Cost Estimating (CE): The development of risk based cost and schedule estimates using benchmarking, bottom up and top down estimating techniques to support the pricing of principally non-competitive contracts for MOD project teams. The estimates are developed drawing upon industry analytics including the supplier's material, labour, recovery rates and machinery.

- Cost Certification (CC): The validation of costs and recovery rates using established certification and cost management techniques, accounting conventions and the regulatory frameworks. The costs and rates support the MOD's governance and decision making process through contract monitoring and evaluation.

Supported by:

- Industry Analysis (IA): The IA team works with MOD customers, engaging with suppliers at company, sector and industry level to improve efficiency and effectiveness and to help sustain key capabilities. It endeavours to build trust and openness and create strong and enduring relationships both within industry and the MOD itself.

- Data Management and Cost Analysis (DMCA): The DMCA team delivers: Cost Management Through Life (CMTL) which is the development and delivery of a consistent and coherent approach to cost, a Data Management System which provides a service to enable the effective analysis of data and an Information Management that provides advice, guidance and facilitation to embed sound Information Management principles and processes throughout the CAAS teams.

## ***What is Evaluation?***

2.1.41 Evaluation is the retrospective analysis of how well a project, programme, or policy is delivering against its performance, time and cost parameters.

2.1.42 When decisions have been taken and implemented, it is then important to monitor and evaluate the outcome. Only in this way can we hope to learn from our experience, avoid mistakes, and improve the quality of future management decisions.

## ***What is the Purpose of Evaluation?***

2.1.43 A fundamental requirement of HM Treasury delegation is that spending proposals are subject to effective appraisal and evaluation. Effective evaluation reinforces the accountability of Budget Holders for the resources under their control.

2.1.44 The main purpose of evaluation is to ensure that good practice is perpetuated, lessons are learned, and the Department avoids repeating costly mistakes. It is not a tool for apportioning blame, but a vital source of information for management decision making. It should also lead to improved project control and governance, and is essential to be able to gauge the level of optimism built into project estimates.

2.1.45 Evaluation is sometimes seen as a burdensome chore, tying up scarce resources for no immediate benefit. However, by analysing what went right and what went wrong on a project, and why, future performance can be improved and more value obtained from the defence budget. Evaluation should not be viewed as a post-mortem, but rather as a means of learning from experience.

## ***What to Address in an Evaluation***

2.1.46 An evaluation should address three distinct and interlinked elements:

- Technical requirements and operational capability
- Financial and commercial control
- Project governance and control

2.1.47 The evaluation should assess what went well and why, and what didn't go well and why within all three elements. A good evaluation distinguishes between what has happened as a result of active management of the project, and what has happened because of unforeseeable external factors. The temptation to attribute, unfairly, successes to the former, and failures or problems to the latter should be avoided, if the evaluation is conducted objectively.

A suggested template for evaluation is provided at Annex to Section 3.7.

## ***When to Undertake an Evaluation***

2.1.48 Every project, programme, or policy requiring an appraisal should be evaluated. The extent and depth of evaluation should be commensurate with the value, length and complexity of the project, programme or policy to ensure the efficient allocation of resources.

2.1.49 A straightforward, low value project may only require a short evaluation at the end of the project life. For larger, longer running projects, programmes, and policies, greater depth of evaluation will be required. For these, an evaluation should be undertaken after each major stage of the project lifecycle eg initiation, initial gate, main gate, contract award, in-service, and on disposal or termination. This should be planned for at project initiation, given that on any project, resources are limited.

2.1.50 Performing regular reviews at predetermined stages in the project lifecycle, where the team considers performance against expectations and discusses the reasons for differences, enables the timely identification of lessons that can be applied to the next stage of the project life cycle. Evaluation should also be carried out at other major project milestones eg a project manager leaving, in order to prevent a loss of valuable project knowledge.

2.1.51 Any project that stops or experiences any issues not previously envisaged should conduct a detailed evaluation of the issues, causes and remedial actions, including the effectiveness of remedial actions.

## ***Who is Responsible for Undertaking Evaluations?***

2.1.52 Evaluation is a line management responsibility, and thus the responsibility for project evaluation rests with the management area responsible for the project. Evaluation should be carried out by existing resources, with external facilitation or support if required, and be an integral part of the project process. The majority of effort and activity should complement other project controls such as risk management, stakeholder involvement and communication.

2.1.53 If a project is sponsored in one management area but executed in another, the two areas should agree on who is to undertake the evaluation. However, since the ultimate objectives of the project are those of the sponsoring area, the presumption should be that it is this area that carries out the evaluation. For example, a procurement project should be evaluated by the Customer for the equipment, and an accommodation project by the Garrison Commander. The Senior Finance Officer (SFO) in a TLB is responsible to DG Finance for ensuring the robustness of systems to support evaluation, as is the Chief Executive in an Agency. As part of this responsibility, SFOs and Chief Executives should ensure that procedures are in place in their areas to manage the process of project evaluation.

## ***Disseminating Lessons Learned***

2.1.54 One of the key reasons for undertaking evaluations is to learn lessons for the future. Lessons learned should be captured and disseminated across TLBs within the Department and with industry at various levels identified in the governance. Project staff should include plans for the conduct of an evaluation in the original appraisal, rather than simply stating that an evaluation will be carried out.

2.1.55 The distribution of the evaluation should be such that lessons learned are communicated to others likely to benefit. The evaluations of projects, policies or programmes that were reviewed by DESA prior to their approval should also be forwarded to DESA for collation and analysis of key lessons.

## ***Appraisal and Evaluation Within the Management Framework***

2.1.56 Both appraisal and evaluation form part of a framework for management of policies and programmes called the **ROAMEF** Framework (see *Figure 1a*). **ROAMEF** stands for Rationale, Objectives, Appraisal (of options), Monitoring, Evaluation and Feedback. *Rationale* is the need for the policy or programme. The *objectives* flow from the need identified as being unmet, whilst *appraisal* is the assessment of the possible options to meet those needs. *Monitoring* is the continuous review of the project operation, and *evaluation* is the assessment of the full effects of the project against a previously determined baseline. *Feedback* is communicating the results of evaluation to those concerned with the original project or with related projects. HM Treasury recommend this framework is applied by all Government Departments.

***Figure 1a: The ROAMEF Framework***

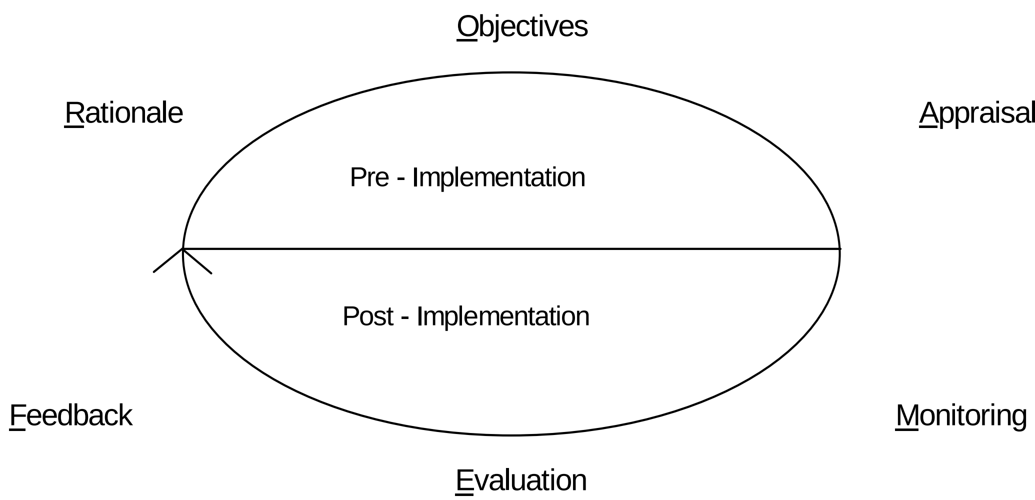
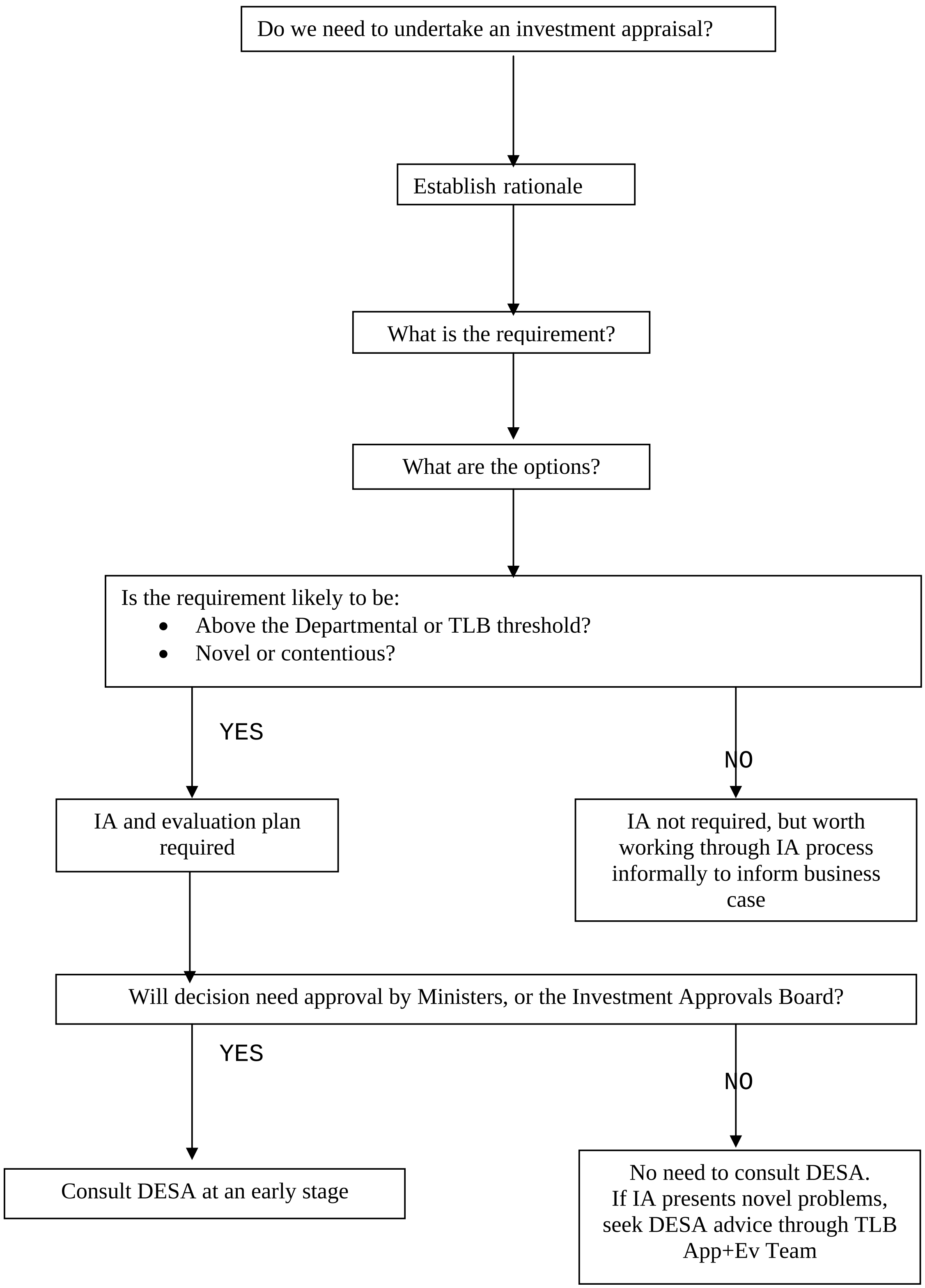


***Figure 1b: Investment Appraisal Overview***



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# *Annex A: Example of Appraisal for a Small Project*

## Future Organisation and Location of Naval Posting Management

**Objectives**

To identify, evaluate, and recommend the optimal future organisation and location for Naval Posting Management.

**Background**

It is an historical legacy that posting management of Naval and Royal Marines personnel is conducted within two separate management hierarchies in geographically separated sites at Devonport and at Portsmouth. A high level study has indicated there may be benefits in the quality of service and economies of scale that could be realised by combining the two organisations on to a single site.

**Options**

The following options have been identified:

> Option 1. Do nothing. Continue 'as is' with the existing management structure in the two separate locations.
>
> Option 2. Reorganise under a single management structure, but maintain the current locations.
>
> Option 3. Reorganise under a single management structure, and collocate at Devonport.
>
> Option 4. Reorganise under a single management structure, and collocate at Portsmouth.
>
> Option 5. Reorganise under a single management structure, and collocate at a new site.

**Assessment of options**

**Option 1.** Posting management would continue to be administered from separate sites with the associated inefficiencies of scale. Staff savings would not be realised. However, set against this no additional in-year costs would be incurred, and this option would maintain current business efficiency. This option is not costed, but the costing of other options reflects the additional costs and benefits relative to the 'do nothing' option.

**Option 2.** This option would realise some of the benefits of a unified organisation. However, no staff savings are realisable without collocation of the two existing organisations. As Option 2 is clearly sub-optimal to Options 3 and 4, it is not considered further.

**Option 3.** This option would realise the benefits of a unified organisation, and enable staff savings through collocation. However, the posting management organisation at Devonport is smaller than that located at Portsmouth. Even with a reduction in personnel numbers, there is insufficient room at Devonport to locate a unified organisation. Location at Devonport would also require installing new DII infrastructure for the whole organisation at a cost of £700k over the appraisal period. This option is not considered further.

**Option 4.** This option would realise the benefits of a unified organisation, and enable staff savings through collocation. A limited amount of building work will be required to reconfigure the existing office space at Portsmouth to provide sufficient space for personnel relocating from Devonport. Sufficient SFA and SLA exists to accommodate the small number of additional personnel in Portsmouth.

**Option 5.** Defence Estates have confirmed no suitable alternative sites are available, and there is insufficient funding available for both organisations to relocate.

**Sensitivity analysis**

**Time span.** The appraisal period is 5 years, as it is not considered realistic to assume that the organisation will remain unchanged beyond then, regardless of the recommendation. After relocation and infrastructure costs have been incurred in Year 0, Option 4 generates a net benefit in each year costed. Extending the appraisal period would increase the net benefit of Option 4.

**Building works.** Although there is uncertainty regarding the precise cost of the building works necessary in Option 4, the increase necessary to reverse the ranking of options is considered to be beyond the margin of error. The outcome is deemed to be not sensitive to changes in works costs.

**Manpower reductions.** Failure to achieve the proposed manpower reductions in Option 4 would remove the benefit of collocation. However, the reductions stem from activities that are clearly duplicated in the two existing organisations. There is considered to be no risk to operational output from the manpower reductions.

**Affordability**

Budgetary provision exists for the additional costs of building and infrastructure costs, and relocation.

**Evaluation**

As manpower reductions are due to be phased in during the first year, it is planned that an evaluation will be undertaken to assess the collocation at the end of Year 1. An outturn evaluation will be conducted at the end of Year 4.

**Recommendation**

It is recommended that Option 4 is the most cost effective option over the 5-year appraisal period. It generates a net benefit of £379k NPV over the appraisal period.

**Costings for Option 4**

| | Yr 0<br>£k | Yr 1<br>£k | Yr 2<br>£k | Yr 3<br>£k | Yr 4<br>£k | TOTAL<br>£k |
|---|---|---|---|---|---|---|
| DII Infrastructure | 225 | 70 | 70 | 70 | 70 | 505 |
| Relocation costs | 40 | | | | | 40 |
| Building works | 200 | | | | | 200 |
| Project management | 90 | | | | | 90 |
| Manpower reductions | (163) | (280) | (280) | (280) | (280) | (1,283) |
| Total | 392 | (210) | (210) | (210) | (210) | (520) |
| DF 3.5% | 1.0 | 0.966 | 0.934 | 0.902 | 0.871 | |
| Present Value | 392 | (202.9) | (196.1) | (189.4) | (182.9) | (379.3) |

Notes:

1. Common costs have been excluded.
2. Manpower reductions represent 8 staff at an average capitation rate in Year 0 of £35k (7 months in Year 0).
3. Relocation costs estimated at £5k for military personnel.
4. The benefit of accommodation released at Devonport not costed.
5. DII service charge is at a fixed rate per workstation.

# 2.2 THE ELEMENTS OF BUSINESS CASES AND APPRAISALS

**2.2.1 A business case must be prepared for all proposals that would involve the commitment of resources or which would result in measurable benefits. The business case must include five key elements:**

- **The Strategic Case;**
- **The Economic Case;**
- **The Commercial Case;**
- **The Financial Case;**
- **The Management Case.**

**2.2.2 An investment appraisal addresses the Economic Case. A well-conducted investment appraisal should include the following elements in sequence, addressing key issues relevant to each. These are:**

- **the options being considered and the reasons for their selection;**
- **short-listing of the options;**
- **the costs and benefits of the various options;**
- **assessment of risks;**
- **sensitivity analysis**
- **other factors leading to the choice of a recommended option.**

***What Is A Business Case?***

2.2.3 The business case is a management tool and is developed over time as a living document as the proposal develops. The Business Case keeps together and summarises the results of the analysis needed to support decision making in a transparent way. In its final form it becomes the key document of record for the proposal, also summarising objectives, the key features of implementation management and arrangements for post implementation evaluation.

2.2.4 Business cases can cover a wide range of types and levels of project, programme, or policy. The effort expended on developing the proposal should be proportionate to the likely costs and benefits.

**Business Case Structure**

2.2.5 Business cases should contain the five elements defined by HM Treasury's best practice 'Five-Case' Model. These are:

- **The Strategic Case.** This sets out why the proposal is needed, the background to the proposal, the requirement, any over-riding and binding constraints, and any dependencies.
- **The Economic Case.** This considers the options for delivery and the assessment of Value for Money (VfM) (see paragraph 2.1.11).
- **The Commercial Case.** This sets out the procurement strategy and considers the commercial viability of the proposal.
- **The Financial Case.** This establishes the affordability and financing of the proposal.
- **The Management Case.** This sets out how the proposal will be delivered in project and programme management terms, and the plans for evaluation of the proposal.

2.2.6 All of these aspects are important; however, their size will vary from proposal to proposal depending upon its nature and complexity. Some less complex business cases particularly those not involving significant new procurement, new systems or new building construction may need little or nothing by way of a commercial case and require a less complex management case.

2.2.7 Business Case Templates for proposals that will be approved within TLB or Project Team delegation are provided at Annexes A, B, and C. Cases seeking central approval must consult SMART Approvals Guidance.
(http://defenceintranet.diiweb.r.mil.uk/DefenceIntranet/Teams/BrowseTeamCategories/CommitteesAndBoards/InvestmentApprovalsBoard.htm)

## ***The Development Of The Business Case***

2.2.8 The business case should develop iteratively over time, often in 2 distinct stages with more detail being provided at each stage.

## Initial Gate Business Case (IGBC)

2.2.9 The Initial Gate business case seeks approval to undertake an assessment of the options (the Assessment Phase), within a defined Performance, Cost and Time (PCT) envelope, in order to determine which can best meet the requirement i.e. to reach, support and achieve a main investment decision at Main Gate. It includes an assessment of the risks and benefits of options for presentation at Main Gate. Issues should not, except in exceptional circumstances, be addressed in terms of a particular solution. The aim is to keep the options open, with specific recommendations being more appropriate to Main Gate approval.

2.2.10 An Initial Gate approval is normally required before formally engaging the private sector (e.g. by advertising the requirement in the MOD Contracts Bulletin and the Official Journal of the European Union). Exceptionally, the Initial Gate may be omitted for lower value and low risk cases with the agreement of the relevant Approving Authorities.

2.2.11 The key elements of the IGBC are:

- the Strategic Case – outline the capability gap and the requirement to make a robust case for change. Determine benefits, risks, constraints, and dependencies;
- the Economic Case – set out the long-list of alternative options, and an initially recommended shortlist for further examination. Indicative costs and benefits for short-listed options should be provided;
- the Commercial Case – set out a procurement strategy for the Assessment Phase (or equivalent);
- the Financial Case – discuss the likely affordability of the proposal,
- the Management Case –outline how the project will be set up and managed. Set out an exit strategy.

## Main Gate Business Case (MGBC)

2.2.12 The purpose of the MGBC is to revisit the IGBC in more detail and to identify a preferred option which demonstrably optimises VfM. It also sets out the likely Deal; demonstrates its affordability; and details the supporting Procurement Strategy, together with management arrangements for the successful rollout of the proposal.

2.2.13 Main Gate constitutes the main investment decision where the Department commits to the full cost of the programme. This is usually taken to be the point at which a Preferred Bidder (PB) is selected. By this stage, the risks remaining in the project should be well understood and there should be sufficient confidence to take a Main Gate decision.

2.2.14 The key elements of the MGBC are:

- the Strategic Case – revisited and revised if required.
- the Economic Case – the value for money position is clear, supported by an endorsed investment appraisal completed in accordance with JSP 507, or a should-cost model for single-source cases;
- the Commercial Case – the procurement strategy is clear and indicates whether there will be any further decision points post Main Gate;
- the Financial Case – affordability and funding issues resolved;
- the Management Case – the detailed plans for delivery and arrangements for the realisation of benefits, management of risk; and post evaluation are recorded.

## ***The Strategic Case***

2.2.15 The strategic case sets out the case for the proposal. It should set out the background to the proposal and the objective to be achieved. The fit with the wider public policy objectives and the department's corporate plan should also be explained. Any constraints to competition should be explained, and any interaction with or dependency on any other proposals, e.g. the fit with published targets such as Public Service Agreements. Lessons learned from previous experience in this area should be briefly set out.

### Background

2.2.16 The background to the project, programme, or policy should be explained in sufficient depth so that the reader can understand why the need has arisen, and why the requirement (which should be stated explicitly) has been defined as it has. Material that is merely of historical interest should be excluded.

### Requirement

2.2.17 It is necessary to establish how individual projects are linked to delivering final Defence outputs. Procuring an asset or service, or putting in place a scheme is not an appropriate requirement in itself. The requirement should generally be predicated on the need to, for example:

- provide further economies in the provision of an existing service;
- improve business effectiveness and service quality in terms of the required outcomes;
- improve efficiencies in the throughput of services;
- meet statutory requirements and obligations;
- meet policy changes;
- deliver new business and operational targets.

2.2.18 The requirement must be clearly set out so that its achievement can be monitored. Clarity in the setting of the requirement allows for scrutiny, and also assists in identifying the full range of options which may be available to deliver the proposal.

2.2.19 The requirement should be expressed clearly and concisely in terms of the outcomes, effect, or service to be delivered. It must not be expressed in a way that anticipates or pre-empts a particular solution.

2.2.20 A clear statement of requirement is necessary for three main reasons:

- Generating options

  Clearly defined objectives make the process of generating options much easier. Requirements should reflect only the absolute essentials. Options can be assessed against the objectives to see if they are worthy of consideration. Ill-defined objectives are likely to lead to unnecessary work; time spent considering unsuitable options is time wasted. However, objectives should not be set so tightly that they exclude otherwise worthwhile options and lead to costly re-workings at a later date. Care must be taken to ensure that options are not solution specific, nor should options be excluded solely on the grounds of affordability in an existing budget.

- Selecting the Preferred Option

  The selection of the preferred option involves an assessment of all the costs of delivering outputs. With clear objectives and an indication of their relative importance, it will be easier to identify and quantify all the costs and benefits involved.

- Evaluation

  Evaluation is the process of measuring the project outcomes against those forecast in the investment appraisal or against some other agreed baseline. The absence of detailed objectives makes this task difficult, if not impossible.

2.2.21 In the equipment environment a capability audit would be used to establish the Single Statement of User Need (SSUN). This sets the scope for the User Requirement Document (URD) in which more detailed and individual requirements and constraints are set out. More information can be found on the AOF (aof.mod.uk)

**Constraints**

2.2.22 Open and fair competition is a fundamental component of MoD acquisition policy in delivering affordable defence capability at overall long term VfM, and is a legal requirement in many circumstances. Competitive procurement helps to deliver VfM because it gives suppliers an incentive to reduce costs, increase productivity and encourage innovation by continually benchmarking them against their competitors.

2.2.23 The ability to run a competitive procurement may be affected by defence strategic considerations and market constraints. Project teams should identify whether any constraints apply, and where they do, seek early engagement with DASA-DESA or the relevant TLB Appraisal team, particularly where the existence of constraints potentially results in only one option being available to meet the requirement (for detailed guidance see Chapter 4.1).

**Dependencies**

2.2.23 Any actions or developments required of others should be considered if the ultimate success of the project, programme, or policy is dependent upon them.

## ***The Economic Case***

2.2.24 This is the essential core of the business case and sets out the demonstration of value for money. This section of the business case assesses the economic costs and benefits of the proposal to society as a whole, and spans the entire period covered by the proposal.

## Options

2.2.25 Options should be generated with reference to the requirement. As wide a range of options as possible should be considered in the early stages to reduce the likelihood of expensive and time consuming revisiting at a later date. Involving all those who have a legitimate interest in the outcome of the decision may help in this respect.

2.2.26 The options considered in the appraisal should be clearly and simply described, and the reasons for their selection should be fully explained. The list of options must include an option that will act as the baseline for determining value for money. Depending on the circumstances of the case, this may be either:

- **'Do nothing'** i.e. where it is feasible to cease an activity; or
- The **'status quo'**, i.e. continuing the existing service at the same level and in the same way; or
- **'Do minimum'**, ie doing the least that has to be done to comply with the requirement (for example meeting minimum Health and Safety standards).

Consideration of the potential for private sector involvement in delivering the requirement should also be considered at this stage. Further guidance is provided in Chapter 4.1.

2.2.27 Those involved in generating options should be imaginative, not always opting for the obvious solutions. For example, if appraising a collocation project, sites other than those currently occupied should be considered. (Early contact should be made with the Defence Infrastructure Organisation (DIO) (Estate Rationalisation) team, who will be able to advise on the availability of Defence sites to meet specific requirements.) The availability of comparable facilities in other Commands and Services should be explored if the provision of new facilities is being contemplated. Options involving varying the scale or timing of a project should be explored as a means of potentially increasing VfM, as should all the individual elements.

2.2.28 Usually there will be a wide range of possible solutions to a specific problem. <u>It will be rare for there to be only one possible option</u>, and where this is the case, robust justification will be needed. You should consult your SFO, TLB Appraisal and Evaluation team, or DASA-DESA, in such cases. Where there is genuinely only one possible option available to meet the identified objectives, a costed investment appraisal is not required (see Chapter 4.1). However, it is still important to establish value for money, and the affordability of that option.

***Examples of options for a collocation project:***

- *Refurbish existing facilities;*
- *Maintenance by the private sector;*
- *Options to rent, build or purchase;*
- *Varying locations or sites;*
- *Provision of the service or facility by the private sector;*
- *Co-location with other agencies.*

**Short-listing the Options**

2.2.29 It is sensible to appraise in full (i.e. explicitly work through all the steps described in this guide) only those options that are considered feasible. However, the reasons for rejecting options without appraising them fully should always be made explicit. Reasons for exclusion might for example be obviously poor VfM or unacceptable or unmanageable risks. Potentially viable best VfM solutions must not be eliminated at this stage.

2.2.30 The short-list must:

- Include the ‘do nothing’, ‘status quo’, or ‘do minimum’ option, which provides the benchmark for assessing value for money; and,
- Transparently record the reasoning and evidence behind the rejection of each excluded option.

2.2.31 The shortlist must not:

- Rule out options because they are “radical”, or because their appraisal will be difficult, given the uncertainties that require resolution, or because they involve confronting vested interests;
- Reject options only because they have fewer benefits than some other more costly option;
- Prematurely discard options; or,

- Reject options on grounds of affordability, without confirming the overriding nature of the budget restraint.

2.2.32 Options should not be discarded without being appraised simply because they cost more than the budget provision in a specific year, or for a particular item, because they may nevertheless be better value for money in the longer run than ‘affordable’ options. In principle, funding can be increased by re-allocating funds. Ultimately, a judgement may be made that funding constraints are such that a second best option must be adopted. But unless the ‘unaffordable’ option is included in the appraisal, it will never be possible to make an informed judgement on the best way ahead. It is essential that the appraisal provides an audit trail that demonstrates that the full range of options has been considered; so options should not be ruled out at an early stage on affordability grounds.

2.2.33 If it will be difficult to reverse any decision, it may be particularly important to consider deferral, or implementation in a more flexible manner. All short-listed options must be capable of financial and non-financial analysis. However, not all need be subjected to a full appraisal (for example, because of their obvious inferiority). Best practice requires a presentation of a full range of options, if only in broad outline.

**Costs and Benefits**

2.2.34 Costs and benefits (quantified and unquantified) of each option should be set out clearly. To guard against error, and to ease the scrutiny process, costs and benefits should be presented on a ‘full cost’ basis rather than as differences from a baseline. Although decision-making is ultimately concerned with the differences between the costs of the options, and the two methods ought to give the same result, carrying out the costing on a ‘differential’ basis has the following disadvantages:

- there is a risk of making mistakes, either omitting items or double counting them as costs in one option and benefits in another;

- important information may be lost - a difference in staff costs of £100,000 per annum is much more significant if the total staff cost is £1m a year than if it is £10m;

- it becomes very difficult for someone scrutinising the appraisal to understand the figures and to form a judgement on the soundness of the appraisal.

2.2.35 There is a judgement to make about the amount of detail to include in the presentation. Investment appraisals should include discounted cash flow tables in which the costs and benefits of each option are expressed in real terms (ie constant price levels excluding general inflation). There should be sufficient detail for the key cost drivers to be identified, and to give the reader confidence that all cost elements have been included, but not so much that important information is difficult to disentangle. The assumptions on which the costings have been based should be clearly documented, and explanatory notes should give sources for all data.

2.2.36 It is not credible that future costs can be estimated to the nearest pound. Often estimates for major projects will only be accurate to the nearest £100,000 or £1m and should be rounded accordingly. Presenting more detail results in spurious accuracy and simply clutters the presentation. In smaller projects it may be appropriate to round to the nearest £1,000. The results of sensitivity and scenario analyses should be included in presentations and summary reports, rather than just single point estimates of expected values. It is also important to check that spreadsheets, after reduction and photocopying, can be read easily.

2.2.37 The level of effort to identify and quantify costs and benefits for each option should be commensurate with the scale and complexity of the project. When identifying costs and benefits, consideration should be given to whether options might generate losses or special payments.

**Optimism Bias and Risk**

2.2.38 In appraisals, there is always likely to be some difference between what is expected, and what eventually happens. As a result an assessment of the risks associated with each option must be made. At the early stages of a project, programme, or policy, when risk management proposals are relatively undeveloped, an explicit allowance for optimisim bias (see Chapter 3.6) should be made against all options, regardless of the size or complexity of the proposal.

2.2.39 Optimism bias is the demonstrated, systematic, tendency for project appraisers to be overly optimistic about key project parameters. Appraisers tend to overstate benefits, and understate timings and costs, both capital and operational.

2.2.40 As the business case develops, a more detailed assessment of individual risks and risk management will be required for larger projects. In these cases an optimism bias assessment will then be used as a ‘sanity check’ of the risk assessment. For small projects the risk premium may continue to be encompassed by a general uplift to offset and allow for undue optimism bias. As costs are firmed, the level of optimism bias will decrease (see paragraphs 3.6.21 – 3.6.23).

**Sensitivity analysis**

2.2.41 All appraisals must contain a sensitivity analysis to test the vulnerability of options to future uncertainties, such as changes to flying hours, equipment numbers, or Out of Service Date (OSD). The sensitivity analysis should be based on plausible variations to the assumptions made, perhaps based on evaluation of previous projects. The values at which key variables would cause costs or benefit values to change enough to affect the choice of preferred option should be explored. For example, how much would the cost of procuring a new IT system have to rise to outweigh the expected cost-savings it will provide? For further information see paragraph 3.6.75).

**Other factors**

2.2.42 The BC should show that every effort has been made to quantify all relevant costs and benefits. Sometimes there are genuinely unquantifiable costs and benefits associated with a proposal. Where this is the case they should be clearly explained along with the reasons why quantification can not reasonably be made. Where they are relevant to the choice of option, alternative methods may be used to support option selection. It is important however that such analysis is transparent and that it is not structured in such a way as to produce a biased or predetermined result.

2.2.43 Any such factors considered relevant to the decision should be agreed with DASA-DESA or the relevant TLB Appraisal and Evaluation team (see Section 3.5 for further details).

**Recommendation**

2.2.44 The recommended solution should be supported by a transparent and logical argument showing clearly why it has been chosen, and how the various factors (the costs and benefits covered by the appraisal, the risks and uncertainties involved, other business/operational factors, security, wider policy issues and affordability) have affected the choice.

**Writing up the Appraisal**

2.2.45 For small projects the presentation of the appraisal results covering these elements can be incorporated into the business case. However, for larger projects, particularly those covered by the SMART Approvals Guidance, separate Investment Appraisal and Business Case documents should be produced. When preparing separate Investment Appraisal and Business Case documents, it is not necessary to duplicate information required in the Business Case within the Investment Appraisal.

## ***The Commercial Case***

2.2.46 The commercial case is concerned with issues of commercial feasibility and sets out to answer the question "can the proposed solution be effectively delivered through a workable commercial deal or deals?" The first question, therefore, is what procurement does the proposal require, is it crucial to delivery and what is the procurement strategy?

2.2.47 The procurement strategy should be clearly set out in the commercial case and the ownership of any assets should be clearly defined and key contractual issues identified and explained, together with the proposed solution.

2.2.48 The allocation of risk must be clearly explained and the business case should include a risk table showing risk allocation and the steps which are being taken to mitigate risk. Any personnel implications also need to be fully explained and if TUPE is involved this has to be properly included in the delivery plans (see Chapter 3.4). (TUPE refers to the Transfer of Undertakings (Protection of Employment) Regulations 2006).

2.2.49 The commercial case should show key contractual milestones and delivery dates and should clearly set out the agreed accounting treatment. Detailed guidance can be found in the Acquisition Operating Framework (AOF) Commercial Toolkit.
http://www.aof.dii.r.mil.uk/aofcontent/tactical/toolkit/index.htm

## ***The Financial Case***

2.2.50 The financial case is concerned with issues of affordability, and sources of budget funding. It covers the lifespan of the scheme and all attributable costs. The case needs to demonstrate that funding has been secured and that it falls within appropriate spending and settlement limits.

The focus in this section of the case is on capital and resource requirements (near-cash or non-cash) and so here VAT and capital charges are included. The financial case is concerned with the budgetary impact.

2.2.51 Issues in addition to the proposal's affordability are:

- does the financial case identify and fill any funding gaps,
- does it contain provision for dealing with the financing of any time or cost overruns,
- does it fully explain and estimate any contingent liabilities that may result from the proposal?

## ***The Management Case***

2.2.52 The management case is concerned with the deliverability of the proposal and is sometimes referred to as programme management or project management case. The management case must clearly set out management responsibilities, governance and reporting arrangements, if it does not then the business case is not yet complete. The Senior Responsible Owner should be identified.

2.2.53 The management case should include a delivery plan with clear milestones which relate to but are at a more detailed level than contractual milestones. The management plan applies to any programme or projects required by the proposal. Programme and project plans must include business assurance arrangements. Where so-called controlled environments such as information and communications technology are involved or complex business systems then the use of PRINCE2 methodology is mandatory for programme and project management. Where significant change management is involved, a change management and stakeholder management plan should be included.

2.2.54 The management plan should also set out clearly any OGC Gateway Review arrangements, and should contain a benefit realisation plan and benefit register. The management plan should also include a contract management plan and arrangements where contracts are required. There should be a contingency plan with arrangements and plans for risk management and a risk register.

### **Monitoring and Evaluation**

2.2.55 All business cases should include a plan for monitoring their effects and a plan for subsequent evaluation. This should be more than an assertion that an evaluation will be carried out: it should show how the success or failure of the project will be measured; what data will be needed to support that measurement; and how that data will be collected; and when and by whom this is to be undertaken. These should include provision in both economic and financial cases for the associated monitoring and post implementation evaluation costs. This monitoring and feedback provision is essential to the longer term evolution of evidence based policy and without it the business case is not complete.

# ***Annex A: Business Case Template***

### *1. Issue*

State clearly in one sentence what the business justification is in support of: typically – 'this is to
seek approval of ... for £ … on … in support of …'

### *2. Recommendation*

Please provide a clear statement of what needs to be approved and noted (see Annexes for detail) (Source: SMART Approvals Guidance Version 10.3).

### *3. Timing*

Routine (unless there is a good reason for Priority, or, very rarely, Urgent treatment).

### *4. Case for Change*

#### A. Background

Please provide an overview of the context within which the investment will be made. In other words, the strategy, work programme, service, project or operation, which the investment supports.

#### B. Requirement

Please provide the compelling reasons for investment in the required services or assets, with reference to:

- The outcomes, effect, or service to be delivered;
- the Key User Requirements;
- the problems with the status quo.

#### C. Constraints

Please identify any defence strategic considerations or market constraints that affect the ability to run an open and fair competition (see JSP 507 paragraphs 4.1.18 – 4.1.20 for details).

### *5. Available Options*

Please provide a description of the main options (or choices) for investment, together with their relative advantages and disadvantages (a SWOT analysis).

Please bear in mind:

- that these options may differ in potential business scope, service solution, service delivery, implementation and funding, depending on the nature of the investment

- that the investment appraisal for each short-listed option should be contained as an appendix and prepared in accordance with the tools and techniques set out in JSP 507
- The IA results should be presented as follows:

| **NPV Costs (£M)<br>Price Base – FY….** | **Option 1 –<br>Do Nothing /<br>Do Minimum** | **Option 2 –** | **Option 3** |
|---|---|---|---|
| Base Cost | | | |
| Risk Adjustment | | | |
| **Total** | | | |

The options also have the following non-financial benefits….......”

### *6. Preferred Option*

On the basis of the above, please:

- state why the recommended option optimises value for money (VFM)
- describe the services and/or assets required.

### *7. Procurement Strategy*

Please state how the asset or service will be procured in accordance with the Government Procurement Agreement (WTO) and the EU Consolidated Public Sector Procurement Directive (2004).

This may involve the use of an existing contract; a call-off contract or framework agreement; or the requirement for a new procurement under the above.

### *8. Funding and Affordability*

Please indicate:

- the capital and revenue costs of the proposed investment
- how the investment will be funded
- any affordability gap (as appropriate).

| EPP/ESP as appropriate | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Total | | |
| FY | | | | | | | | | | | | | |
| Expected RDEL Cost | | | | | | | | | | | | | |
| Direct RDEL Provision | | | | | | | | | | | | | |
| Variance | | | | | | | | | | | | | |
| **Total RDEL Costs** | | | | | | | | | | | | | |
| Total RDEL variance | | | | | | | | | | | | | |
| Expected CDEL Cost | | | | | | | | | | | | | |
| CDEL Provision | | | | | | | | | | | | | |
| Variance | | | | | | | | | | | | | |

### *9. Benefits*

Please provide a summary of the **main** benefits associated with the investment, distinguishing between qualitative and quantitative; cash releasing and non-cash releasing; direct and indirect to the organisation, as appropriate.

All benefits should be profiled for the life of the Investment Appraisal, and presented as:

| Financial benefits | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Total | | |
| FY | | | | | | | | | | | | | |
| forecast benefits - INPUT | | | | | | | | | | | | | |
| forecast benefits - OUTPUT | | | | | | | | | | | | | |
| **Total Target benefits** | | | | | | | | | | | | | |

### *10. Risks*

Please provide a summary of the **main** risks associated with the investment, distinguishing between business and service risks during the design, build and operational phases of the project, as appropriate.

### *11. Management Arrangements*

Please indicate how the investment will be delivered successfully with particular reference to:

- project management arrangements
- business assurance arrangements (if applicable)
- benefits realisation monitoring
- risk management
- project evaluation
- contingency plans and exit strategy.

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# Annex B: Recommendation Section – Initial Gate

**Recommendation**

**The Approving Authority is invited to approve:**

**(a)** a**n Assessment Phase (or equivalent) designed …** [very short summary of purpose to be stated, e.g. "to establish the most cost-effective solution to the requirement to provide XXXXXXX capability to do XXXXXXXX"];

**(b) the Approved Budgetary Level (VAT inc) at ([50%] confidence) for the** [competitive or other procurement route to be stated] **[with contractor X for the] Assessment work of:**

**£X M consisting of:**

**£R total resource consumption (RDEL)**

**£R total indirect resource consumption (RDEL indirect)**

**£C capital expenditure (CDEL)**

**And to note:**

**(c) submission of the MGBC to the AA in [month, Year] at 50% confidence:**

**(d) the emerging Key User Requirements (at Annex xx); and [if applicable] outline total forecast benefits of £[X] as specified in the emerging Benefits Realisation Plan (at Annex xx)**

**(e) the 10%, 50% and 90% confidence levels for the cost of the project phases as appropriate (where available):**

| Project Phase | Direct Resource Cost (£M) | | | Capital Cost (£M) | | |
|---|---|---|---|---|---|---|
| | 10% | 50% | 90% | 10% | 50% | 90% |
| Assessment<br>(IG Estimate) | | | | | | |
| Demonstration & Manufacture<br>(IG Estimate) | | | | | | |

**(f) a planning assumption for service entry between [Month/Year] and [Month/Year];**

**(g) the concept phase [and any other sunk] costs of £[X] M;**

**(h) the Project Milestones and Plan of Work for the Assessment Phase (Annex xx or Para xx)**

**(i) the principal risks at this stage of the project (Annex xx);**

**(j) any significant features of the likely procurement and support strategy options, including any significant industrial implications and any scope for international collaboration, any plans to issue an OJEC notice, or a proposal to down-select a preferred bidder before Main Gate. Statements should be included regards the potential exportability of the project and the sustainability measures incorporated.**

## ***Annex C: Recommendation Section – Main Gate or Single Gate***

**Recommendation**

**The Approving Authority is invited to approve:**

**(a) the project [Title] proceeding to the Demonstration and Manufacture phases**[1] **with contractor X;**

**(b) the [Threshold level** if applicable**] Key User Requirements**[2] **(at Annex xx) and [*if applicable*] the Key Business Benefits Plan (at Annex xx);**

**(c) the Approved Budgetary Level (VAT inc) at [50%] confidence for the Demonstration and Manufacture phases of:**

**£[X] M consisting of:**

- **£R total resource consumption (RDEL)**
- **£R total indirect resource consumption (RDEL indirect)**
- **£C capital expenditure (CDEL)**

**(d) the 'not to exceed' ISD of [month and year] at X% confidence;**

**(e) the Approved Budgetary Level (VAT inc) for support costs (at [x%] confidence) of [ ].** The metric by which support costs will be the approved should be agreed with the scrutineers

**(f) [If applicable] the Approved band of total forecast benefits of £[X]M to £[X]M as specified in the Benefits Realisation Plan (Annex xx)**

**And note:**

**(g) the Objective level Key User Requirements at Annex xx** (if applicable)**;**

**(h) the 10%, 50% and 90% confidence levels for the cost of the project phases as appropriate:**

| Project Phase | | Direct Resource Cost (£M) | | | Capital Cost (£M) | | |
|---|---|---|---|---|---|---|---|
| | | 10% | 50% | 90% | 10% | 50% | 90% |
| Assessment | IG Estimate | | | | | | |
| | Actual Cost | | | | | | |
| Demonstration & Manufacture | IG Estimate | | | | | | |
| | MG Estimate | | | | | | |

**(i) Delivery of Full Operating Capability (FOC) in [Month, Year] at X% confidence and**

[1] Or as appropriate for the project type
[2] For equipment projects, approval should be sought at the Threshold level, with the Objective level KURs being noted.

**the 10%, 50% and 90% confidence levels [*and if applicable*, the emerging business change delivery date] of:**

**(j) [If applicable] The expected value of the total forecast benefits of £[X]M as specified in the Benefits Realisation Plan (Annex xx)**

| FOC | Confidence Levels | | |
|---|---|---|---|
| | 10% | 50% | 90% |
| MG Estimate | [MMM/YYYY] | [MMM/YYYY] | [MMM/YYYY] |

**(k) The procurement and support strategies [as summarised at….];** Including any plans/proposals for incremental acquisition and/or international collaboration Statements should be included regards the potential exportability or not of the project and the sustainability measures incorporated.

**(l) the principal risks to capability delivery (Annex xx);**

**(m) Any other significant features/implications of the proposal**. E.g. TUPE

# ***Annex D: Business Case Checklist***

The following checklist highlights some of the key points that should be considered when preparing a business case.

## The Strategic Case

### Justify the requirement

- What has generated the need for this expenditure?
- What capability gap has been identified?
- Express the requirement clearly and concisely – without a full understanding of the requirement, it is difficult to identify all the possible methods of addressing and meeting the need.
- What are the key objectives of the proposal?
- What outputs are required? When?
- Do not pre-empt the solution – ensure the requirement is expressed in output related terms that do not unnecessarily restrict the number of possible options.
- Decisions should not be taken prior to the completion of the IA.
- Are constraints and dependencies identified and managed?

## The Economic Case

### Develop possible options

- Need to consider all possible options for achieving the objectives.
- Always include do nothing / status quo / do minimum options.
- Options should not be constrained by affordability.
- When considering options for private sector delivery a value for money benchmark must be developed.
- There should be no presumption either in favour or against in-house versus private sector provision.

### Short-list the options

- No option should be rejected without properly supported explanations.
- Acceptable reasons for rejection include similar but inferior to another option, or not feasible.
- Not acceptable include discarding on grounds of affordability or not fully meeting user requirement.
- All assumptions should be supported.

### Time horizon

- A realistic timescale should be chosen depending on the nature and life of the project, eg life of the major fixed asset or period over which the service is required.
- Could involve replacement of assets in some options, eg computer systems.

**Identify and quantify costs and benefits**

- Costs and benefits should cover the whole life of the project and consider all impacts of the project regardless of budget area.
- Ignore sunk costs.
- Ensure costs and benefits are expressed in “real terms” See paragraph 3.1.13).
- Firm price contract costs should be deflated prior to discounting.
- Include opportunity costs, running costs and savings / receipts as appropriate.
- Include residual values where appropriate.
- “Contingencies”, “premia”, “running costs” or other generic headings should always be supported and explained.
- Use a 3.5% Discount Rate to calculate Net Present Value (NPV). (For project durations exceeding 30 years refer to paragraph 3.1.17).
- Include allowance for relative price inflation as appropriate.
- Exclude interest on capital, depreciation, VAT and general inflation.
- Ensure data and assumptions are recorded and agreed by stakeholders.
- Common costs should ideally be included (see paragraph 3.1.42).

**Risk Assessment**

- In larger projects, key risks should be assessed, evaluated and if possible, quantified, with particular emphasis on how it is intended to mitigate or manage them.
- An optimism bias assessment should be undertaken on all options, where appropriate.
- Is there a risk allocation table?

**Sensitivity Analysis**

- Sensitivity analysis of key variables should be undertaken in all cases.
- Plausible variations to assumptions should be applied to test the impact on the ranking of options.

**Non-quantifiable factors**

- Are there any costs and benefits relevant to individual options that have not been quantified in the appraisal?

**Recommendation**

- Of the options considered, which represents best value for money for the Department?
- If this is not the recommended route, state the justification

**Working papers**

- Should be clear and retained for audit purpose. They will also potentially assist in any Project Evaluation.

**DESA Consultation**

- DESA must be consulted on appraisals that will eventually be presented to Ministers or the Investment Approvals Board, or which will support submissions that will do so. DESA will provide advice and assistance in the preparation of these and other appraisals and evaluation plans.

**The Commercial Case**

Is the proposal commercially feasible / deliverable ?
What procurement is required; goods, services, land, buildings ?
What is the procurement strategy ?
What are the key contractual issues ?
There must be clear contractual key milestones and delivery dates
There must be clear agreed accounting treatment
What if any are the personnel implications and is TUPE applicable ?

**The Financial Case**

Focus on affordability; is full budget funding secured and budgeted by all parties ?
What are the impacts on income/expenditure a/c and on balance sheet if applicable ?
Are potential cost over runs provided for
Are there any contingent liabilities?
Any guarantees?

**The Management Case**

Is the proposal practically deliverable and what are the delivery plans ?
Are there clear delivery dates and detailed milestones ?

Does the proposal require programme or project management techniques?
Is there a contract management plan?
Change management requires a change management plan!
If in a controlled environment such as ICT use of PRINCE 2 is mandatory!
Does the plan include clear arrangements for OGC Gateway peer reviews?
Is there a contingency plan with arrangements & provision for risk management?
There should be a benefit realisation table and plan.

**Evaluation plan**

- Does the plan include monitoring arrangements (who when how and costs)?
- The appraisal should include a plan for any subsequent evaluation, ie what is to be evaluated, when will they be carried out, and by whom?

# PART 3 - PRACTITIONERS' GUIDE

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# 3.1. BUILDING CASH FLOW MODELS

**3.1.1 The starting point for an investment appraisal is to produce a cash flow model covering the whole life of the investment. All aspects of the activity should be considered, and the costs and benefits that will change as a result of the project should be quantified for each option. A standardised template spreadsheet is provided on the DASA DESA team site on the Defence Intranet.**

**3.1.2 Projects should normally be appraised over the expected useful life of the main asset, or the period of time that the service is expected to be required. Costs and benefits that are quantifiable should be valued according to their <u>opportunity cost</u> (i.e. the value of the best alternative use foregone), and discounted to their present value.**

**3.1.3 An appraisal should take account of risks and uncertainties in the estimates of costs and benefits.**

## ***<u>Introduction</u>***

3.1.4 Undertaking an investment appraisal requires a cash flow model to be produced, covering the whole life of the project. Costs and benefits related to the project should be estimated, normally at annual intervals. These estimates of capital cost, annual operating costs and estimated life are the difficult part of the process. The calculations required to appraise these cash flows are relatively straightforward.

3.1.5 All aspects of the activity should be considered whether or not they appear quantifiable (see Section 3.5 for how to treat costs and benefits which have no obvious money value). The costs and benefits that must be included are those which result from undertaking a particular appraisal option. They are sometimes called the *incremental costs*. They therefore ignore <u>any</u> past costs resulting from previous decisions, which are referred to as *sunk costs*.

3.1.6 One way of thinking about relevant incremental costs and benefits would be to consider the concept of **avoidability**. An investment appraisal should include all avoidable costs and benefits. Costs or benefits that will not change as a result of the project should not be included in the appraisal.

***Example****. In a major collocation, the level of headquarters costs may change from the current level, and differ according to the option chosen The incremental cost or benefit should be included for each option Where a minor reorganisation is being appraised, it is unlikely that any decision will allow HQ savings to be made. As there would be no change to HQ costs (i.e. they are unavoidable), they need not be included.*

3.1.7 Although important to concentrate on the incremental or avoidable costs it is better to show the full cost of the item for each option rather than just the difference in cost for that item measured against some baseline. This is because it is easier for the reader and it reduces the likelihood of error.

***Example****. An appraisal considering options for the basing of an RAF unit presented only differences in utilities and fuel costs against the base case and excluded staff costs as it was, mistakenly, assumed they would be the same in each option.*

## Discounting

3.1.8 In most investment appraisals, the estimated costs and benefits are spread over a number of years, and different options are likely to have very different cost/benefit profiles. In order to compare options it is necessary to convert these profiles to a common measure. This is done by 'discounting' the stream of annual costs and benefits to produce a Discounted Cash Flow (DCF). The total of such discounted cash flows over the appraisal period is called the Net Present Value (NPV).

3.1.9 The present value of a future sum of money is the equivalent sum now that would leave the recipient indifferent between the two amounts as to which to choose. The present value of £1 receivable in one year's time is that amount now which, together with interest, would accumulate to £1 in one year's time. Present value is the reciprocal of compound interest. Present value and compound interest look at the value of money in opposite directions.

3.1.10 Present value factors are used to discount the yearly cash flows in an investment appraisal. The net present value of a project is found by multiplying the net cash flows for each year by the relevant present value factors and summing the present value of each year's cash flow.

## Time preference

3.1.11 The process of discounting gives more weight to costs and benefits which arise earlier, because people generally prefer to receive benefits sooner rather than later, and to incur costs later rather than sooner. This is known as 'time preference'.

3.1.12 For individuals, time preference can be measured by the real interest rate on money lent or borrowed. Amongst other investments, people invest at fixed, low risk rates, hoping to receive more in the future (net of tax) to compensate for the deferral of consumption now. These real rates of return give some indication of their individual pure time preference rate. Society as a whole also prefers to receive goods and services sooner rather than later, and to defer costs to future generations. This is known as '*social time* preference'; the 'social time preference rate' (STPR) is the rate at which society values the present compared to the future. The STPR is also referred to as the Treasury Discount Rate (TDR).

## Discount rate

3.1.13 The discount rate is used to convert all costs and benefits to 'present values' so that they can be compared. The Treasury Discount Rate of 3.5% is set in real terms. Using this rate as the discount rate for investment appraisals means that the costs and benefits of a project must be expressed in real terms (i.e. <u>constant price levels</u> excluding inflation).

***Example****. Converting figures from nominal terms to real terms. HMT expects the GDP deflator to rise by 2.5% per annum. The figures in real terms (before discounting) are derived as follows:*

| ***Year*** | ***1*** | ***2*** | ***3*** | ***4*** |
|---|---|---|---|---|
| *a. Cash Flow (£m, nominal terms)* | *20.5* | *21.01* | *21.54* | *22.08* |
| *b. GDP Deflator (Year 0 = 100)* | *102.5* | *105.1* | *107.7* | *110.4* |
| *c. Cash Flow (£m, Yr 0 prices) (a/b x 100)* | *20* | *20* | *20* | *20* |

3.1.14 Where costs and benefits are expressed in nominal (or outturn) prices, it is necessary to make allowance for general inflation, normally by converting the current price series to real terms, or constant prices, with an inflation index (eg the Treasury's assumptions for the GDP deflator) (see paragraphs 3.1.56 – 3.1.61). The 3.5% discount rate can then be used. Alternatively, one can apply a nominal discount rate directly to the nominal or outturn prices, obtaining the nominal discount rate by compounding the GDP deflator to the 3.5% real discount rate. Hence if the GDP deflator is 2½% per annum, then the nominal discount rate would be 6.09%, calculated as (1.035 x 1.025) - 1 = 1.0609 – 1 = 6.09%.

***Example.*** *The contractual payments of a particular investment option are £250k per annum in real terms for 4 years. The GDP deflator is 2.5%. Using the real terms discount rate of 3.5% gives the following NPV:*

| *Year* | *0* | *1* | *2* | *3* |
|---|---|---|---|---|
| | *£k* | *£k* | *£k* | *£k* |
| *Costs* | *250* | *250* | *250* | *250* |
| *Net cash flow* | *250* | *250* | *250* | *250* |
| *Discount factors (3.5%)* | *1.0* | *0.966* | *0.934* | *0.902* |
| *Net present value (NPV)* | *250* | *241.5* | *233.5* | *225.5* |
| *Cumulative NPV* | *250* | *491.5* | *725.0* | *950.5* |

*Using the nominal terms discount rate of 6.09% gives the following NPV:*

| *Year* | *0* | *1* | *2* | *3* |
|---|---|---|---|---|
| | *£k* | *£k* | *£k* | *£k* |
| *Costs* | *250* | *250* | *250* | *250* |
| *Inflation* | $1.025^0$ | $1.025^1$ | $1.025^2$ | $1.025^3$ |
| *Net cash flow* | *250* | *256* | *263* | *269* |
| *Discount factors (6.09%)* | *1.0* | *0.943* | *0.888* | *0.837* |
| *Net present value (NPV)* | *250* | *241.4* | *233.5* | *225.5* |
| *Cumulative NPV* | *250* | *491.4* | *724.9* | *950.1* |

*Note that the cumulative NPV is the same in both cases, allowing for a minor rounding error.*

3.1.15 <u>The normal practice is to express all costs and benefits in real terms, i.e. at constant price levels, and apply the Treasury discount rate of 3.5%.</u>

***Example.*** *A project requires an immediate investment of £1m and is expected to generate cash costs of £250k and cash benefits of £300k each year for the next five years.*

| *Year* | *0* | *1* | *2* | *3* | *4* | *5* |
|---|---|---|---|---|---|---|
| | *£k* | *£k* | *£k* | *£k* | *£k* | *£k* |
| *Investment* | *1,000* | | | | | |
| *Costs* | | *250* | *250* | *250* | *250* | *250* |
| *Benefits* | | *(300)* | *(300)* | *(300)* | *(300)* | *(300)* |
| *Net cash flow* | *1,000* | *( 50)* | *( 50)* | *( 50)* | *( 50)* | *( 50)* |
| *Discount factors (3.5%)* | *1.0* | *0.966* | *0.934* | *0.902* | *0.871* | *0.842* |
| *Net present value (NPV)* | *1,000* | *(48.3)* | *(46.7)* | *(45.1)* | *(43.6)* | *(42.1)* |
| *Cumulative NPV* | *1,000* | *951.7* | *905.0* | *859.9* | *816.3* | *774.2* |

*The net present value of this stream of cash flows gives a present value cost of the investment of £774.2k. This could be compared with alternatives for the project, which may require a different level of investment and give rise to different levels of cost and benefit over the life of the project.*

3.1.16 Notice in the above example, as is common in MOD appraisals, that cash benefits or savings are shown in brackets to indicate that these items should be subtracted from costs in the calculations.

***Example.*** *A second option for the above project requires an immediate investment of £1.5m, is expected to generate cash costs of £100k, but is still expected to generate cash benefits of £300k each year for the next five years.*

| *Year* | *0* | *1* | *2* | *3* | *4* | *5* |
|---|---|---|---|---|---|---|
| | *£k* | *£k* | *£k* | *£k* | *£k* | *£k* |
| *Investment* | *1,500* | | | | | |
| *Costs* | | *100* | *100* | *100* | *100* | *100* |
| *Benefits* | | *(300)* | *(300)* | *(300)* | *(300)* | *(300)* |
| *Net cash flow* | *1,500* | *(200)* | *(200)* | *(200)* | *(200)* | *(200)* |
| *Discount factors (3.5%)* | *1.0* | *0.966* | *0.934* | *0.902* | *0.871* | *0.842* |
| *Net present value (NPV)* | *1,500* | *(193.2)* | *(186.8)* | *(180.4)* | *(174.2)* | *(168.4)* |
| *Cumulative NPV* | *1,500* | *1,306.8* | *1,120.0* | *939.6* | *765.4* | *597.0* |

*The net present value of this stream of cash flows gives a present value cost of the investment of £597k.*

*Comparing the two options shows the importance of considering the costs and benefits across the whole life of the project, rather than just focussing on the initial cost. In this project, the option with the higher initial investment but lower annual costs has the lowest cost in NPV terms.*

### The declining long-term discount rate

3.1.17 For projects with very long-term impacts, over thirty years, a declining schedule of discount rates should be used rather than the standard discount rate. The schedule of long-term discount rates is shown below:

| **Period of years** | **Discount rate** |
|---|---|
| 0 – 30 | 3.5% |
| 31 – 75 | 3.0% |
| 76 – 125 | 2.5% |
| 126 – 200 | 2.0% |
| 200 – 300 | 1.5% |
| 301 + | 1.0% |

Detailed discount rate tables are provided at Section 5 Appendix 3. Guidance on discounting in-year and mid-year cash flows is provided at Annex A.

**Payback**

3.1.18 A common technique for appraising investment projects in the private sector is the payback period. This measures the time taken for the cash flow (either discounted or undiscounted) from an investment to repay the original cost. Payback is a very imperfect measure though, since it takes no account of costs and benefits that arise after the payback point, and will in any case only be meaningful in the context of a project comprising an upfront investment with subsequent net savings. It should never be used as an alternative to NPV, although there may, on occasion, be a requirement originating externally for payback periods to be calculated in addition to NPV. In such cases, discounted rather than undiscounted costs should always be used in the calculation.

***Example***. *In the investment appraisal of proposals to replace MOD police by local service engagement soldiers in guarding of Army bases, in addition to showing the NPV calculated over 10 and 18 years, payback periods were calculated because the House of Commons Defence Select Committee asked for these. The payback periods were derived by estimating the cumulative NPV for each year; the payback period being the number of years before this changed from a negative to a positive value.*

***MPGS Pilot Scheme - Payback Periods***

| *(£m)* | *Yr 0* | *Yr 1* | *Yr 2* | *Yr 3* | *Yr 4* | *Yr 5* | *Yr 6* |
|---|---|---|---|---|---|---|---|
| *Savings less costs* | *-0.34* | *-3.28* | *1.61* | *1.59* | *1.56* | *1.57* | *1.55* |
| *DF (3.5%)* | *1.0* | *0.966* | *0.934* | *0.902* | *0.871* | *0.841* | *0.814* |
| *Present Value* | *-0.34* | *-3.17* | *1.50* | *1.43* | *1.36* | *1.32* | *1.26* |
| *Cumulative NPV* | *-0.34* | *-3.51* | *-2.01* | *-0.58* | *0.78* | *2.10* | *3.36* |

**Payback Period - Just over 4 years**

**Internal Rate of Return**

3.1.19 The Internal rate of Return (IRR) is the discount rate at which the net present value of an option is zero. In simple cases IRR will lead to the same decision as NPV. However, in more complex circumstances IRR and NPV can lead to different decisions. This will be the case when options are mutually exclusive.

IRR should not be used in MOD investment appraisals.

**Return on capital**

3.1.20 Trading Funds are required to deliver a return on capital, at a rate determined by HM Treasury. In addition to calculating the Net Present Value (NPV) of a project, Trading Funds should undertake a separate test as a sensitivity to determine whether the project is expected to deliver the target rate of return on capital.

## ***Spreadsheet Models***

3.1.21 A standardised template spreadsheet that is recommended to be used for all appraisals is provided on the DASA-DESA (Appraisal and Evaluation) team site on the Defence Intranet. When building a spreadsheet model to use in an appraisal, the following principles should be applied:

- Use separate sheets for inputs, calculations, and outputs;
- Break out calculations into simple blocks;
- Don't use 'constants' in formulae – make it an input;
- Use a consistent formatting and column order;
- Include a cover sheet with version control information.

## ***Determining the Time Horizon for an Appraisal***

3.1.22 It is not always obvious how many years' cash flows to include in an appraisal. The choice of the time horizon for an investment appraisal can have a significant effect on the outcome, and should always be long enough to cover all of the important cost and benefit differences between options. It should not be determined by the budgetary or planning system. Sometimes it will be necessary to apply different time horizons for different options (see paragraph 3.1.28).

3.1.23 The appropriate time horizon for an investment appraisal is determined by the economic or physical life of the main asset concerned or the period over which the service is expected to be required. The expected life of fixed (or capital) assets in investment appraisals should be consistent with those used in the Resource Accounts, as set out in JSP 472.

- Accommodation: Appraisals involving property, which normally has an economic life of at least 25 years (i.e. up to the point where major refurbishment becomes necessary), should normally have a time horizon commensurate with that, so long as the service is expected to be required for that length of time.

- IT Equipment: Appraisals where the main asset is IT equipment will have a much shorter time horizon, typically between five and seven years.

- Relocation / reorganisation: Appraisals involving relocation and/or reorganisation can present particular problems in determining the appropriate time horizon. In such cases, the appraisal will generally involve an up-front cost (for rationalisation) - differing between options - followed by differing streams of future savings. The ranking of options can be particularly sensitive to the length of the appraisal period chosen. The period should take into account the length of time the activity is likely to last, or the time before a further reorganisation is likely to take place. Where these are unknown, a *sensitivity test* of the ranking of options to differing appraisal periods should be carried out (see Section 3.6). For appraisals of reorganisations and/or relocations, it will generally be best to estimate the length of time the activity needs to last for a particular option to be preferred, and then consider whether or not this is plausible.

- Service contracts: Unless the decision has longer term implications such as the removal of future options, appraisals should be conducted over the length of the proposed contract or pricing period.

3.1.24 If the life of the main asset is longer than the appraisal period required, a residual value can be assumed at the end of the project's life and shown as a cash inflow at that point in time, as long as the capability or service being provided by the asset is likely to be required beyond the appraisal period.

## ***Base date***

3.1.25 It is conventional in the Public Sector to use the current year as a base for discounting. The base year is designated Year 0, and costs and benefits which fall within the current year should not be discounted. The Treasury 'Green Book' assumes that payments and receipts will take place mid-year beginning with the current year, and discount factors are also mid-year. Future cash flows will take place at twelve-month intervals. Judgement will need to be exercised as to the year in which cash flows will fall. In most cases the start date for all options is likely to be the same, albeit at an uncertain time in the future. As such the change in base date is in the main immaterial when distinguishing between options.

3.1.26 The standard 'text book' approach to investment appraisal, as used in the private sector, assumes that Year 0 is a single day (i.e. the first day of year 1), and cash flows after that date will take place at 12-monthly intervals. It is usually assumed that Year 0 represents the start of the project, so capital expenditure is likely to be incurred at that date. Assuming costs and revenues from the project will be generated as a result of that capital expenditure, these will normally be assumed to start from year 1 (i.e. in arrears). However, some cash flows other than the capital expenditure may start at Year 0, for example rental payments where the terms require payment in advance.

3.1.27 While investment appraisals within the public sector should always be comparable, the different approaches identified above indicate that Value for Money Benchmarks (VfMBs) may not be directly comparable with Private Sector bids because of the different assumptions made on the timing of cash flows. Adjustments will need to be made, when making comparisons with private sector bids, to ensure consistency.

## ***Comparing options with different lives***

3.1.28 If an investment appraisal contains options with different lives, a Net Present Value comparison is likely to be misleading because it will not be comparing like with like. (It will tend to make options with longer lives appear more expensive merely through the inclusion of running costs for a longer period.) Where the different lives are related to particular assets, it may be possible to adjust each option to the same length by including residual values at the end of a common period. Where this is not possible, the equivalent annual cost (EAC) of each option should be calculated; this measures the 'annuitised' NPV.

## Equivalent Annual Cost

3.1.29 The equivalent annual cost is the constant annual cost that, when discounted, is equal to the net present value of the total project cost over its lifetime. It represents a capital repayment and interest on the capital as an equal sum over the specified number of years. The equivalent annual cost of a project is calculated by dividing the NPV of the project by the cumulative discount factor for the number of years of project life. An alternative approach would be to multiply the Net Present Value by the appropriate annuity factor, where the annuity factor is the reciprocal of the cumulative discount factor. Annuity factors are provided at Section 5, Appendix 2.

***Example.*** *The appraisal of a project has considered two options to achieve the required objective:*

*The NPV cost of Option A, over a 5 year life, is £10m.*
*The NPV cost of Option B, over a 7 year life is £12m.*

*The Equivalent Annual Cost of Option A is calculated by dividing the NPV of £10m by the cumulative discount factor for years 0-4 of 4.6731 (1.0 + 3.6731) assuming a discount rate of 3.5%, to give £2.14m.*

*The Equivalent Annual Cost of Option B is calculated by dividing the NPV of £12m by the cumulative discount factor for years 0-6 of 6.3286 (1.0 + 5.3286) assuming a discount rate of 3.5%, to give £1.90m.*

*Option A has the lower NPV cost. However, selecting the preferred option by the NPV criteria would result in a poor choice.*

*As the two options have different lives, it is important to base the decision on Equivalent Annual Costs in order to compare like with like.*

*Option B should be selected as it has the lower EAC.*

## ***Costs and benefits to include in an appraisal***

3.1.30 A common difficulty is selecting which cash flows to include and which to exclude when appraising a project. Of particular importance are:

| Elements to include in an IA: | Elements to exclude from an IA: |
|---|---|
| • Capital costs plus full life costs;<br>• Opportunity cost of assets being redeployed to this project;<br>• Working capital, eg spares;<br>• Operating costs / savings / income;<br>• Residual value of assets;<br>• Income;<br>• Benefits;<br>• Costs for other TLBs / OGDs;<br>• Indirect costs;<br>• Redundancy payments.<br>• Relative price effects<br>• Risk Assessment<br>• Sensitivity Analysis<br>• Optimism Bias | • Financing costs;<br>• Depreciation charge;<br>• VAT;<br>• Apportioned fixed overhead costs;<br>• Sunk costs;<br>• General inflation. |

Investment appraisals must include all direct and indirect costs that will be affected by the options considered. They must not be so narrowly focused that wider consequences (eg for other budget areas) are ignored. The costs included in the appraisal should be those most likely to occur, with alternative scenarios considered in the analysis of risk and uncertainty (see Section 3.6). Projects are often divided into stages or phases for management reasons. Appraisals should consider projects in their entirety, except where individual stages are truly independent of each other (that is they provide benefits that are not dependent upon earlier or later stages).

## ***Relationships with other budget areas***

3.1.31 When identifying the costs and benefits to include in an investment appraisal, it is important to consider the implications for MOD as a whole, rather than just the budgetary impact for the branch undertaking the appraisal. The impact of the project on the economy as a whole should also be considered.

3.1.32 Soft-charging transactions, such as transactions between two TLBs or between two budget areas, do not involve cash flows and should not be recorded in an investment appraisal.

> ***Example.*** *In an appraisal that involved closure of a site as a cost-saving measure, the salaries of service personnel employed at that site were included as a saving.*
>
> *This was incorrect as the service personnel were to be transferred to other MOD locations. The cost of these personnel would transfer out of one budget and into another, but there would be no saving to MOD as the personnel would continue to be employed.*

## ***Opportunity Costs***

3.1.33 All costs and benefits that are quantifiable should be valued according to their opportunity cost; ie the best alternative use foregone.

3.1.34 Often, appraisal options require the use of existing MoD assets. These assets may have a number of competing, alternative uses. Potentially the assets could be disposed if they were not to be utilised within the option to be appraised, in which case, the sale proceeds foregone should be charged to the project. This is because the project must bear the cost of supporting the asset, foregoing the revenues from its sale. Without the use of this asset the project would have to bear the cost of a similar purchase from external sources. The value of the sales proceeds foregone represents the opportunity cost of the asset.

3.1.35 Alternatively, the asset may have alternative uses within MoD, if it is not utilised on the project being appraised. If there are competing opportunities for the use of an asset, the project cash flows must reflect the opportunity cost of that asset as the best opportunity foregone. In many cases this will be equivalent to the current market price. If an asset has no readily available market value, it will be appropriate to use a value based on depreciated replacement cost.

3.1.36 The opportunity cost of employing a member of staff is their market value as measured by the total cost of employing them (including employer's costs of National Insurance (ERNIC) and pensions).

3.1.37 If an appraisal option involves foregoing a receipt for disposal that has already been taken into the planning assumptions, the foregone receipt must be reflected as an opportunity cost at the start of the project.

3.1.38 When there is clearly no alternative use for an asset and it cannot be disposed of, the opportunity cost will be zero. Such cases will be relatively rare and full justification will always be required (see Section 3.3).

3.1.39 It is important to recognise that opportunity costs do not only occur at the start of a project. If a project has no claim on a particular asset until, say, Year 3 then the opportunity cost of the asset should be included in that particular year rather than at Year 0.

## ***Sunk Costs***

3.1.40 Sunk costs are any costs incurred or irrevocably committed to before the present investment decision is made. These costs do not result from the investment being considered and therefore should be excluded from the appraisal. They are effectively common to all options. It is only the costs that will be incurred in the future that are relevant to the investment appraisal.

***Example.*** *Suppose £400,000 has already been spent employing consultants to help provide information relating to a relocation decision. In the investment appraisal to establish the optimal relocation site, the £400,000 consultants' fee is a sunk cost and is irrelevant to the decision to be made.*

*If significant in relation to the future costs and savings being appraised, the inclusion of the £400,000 cost at the start of the project could lead to a misleading decision being taken. The consultants' fee should however be identified in the business case.*

***Example***. *Following receipt of new information about the costs of construction work, a revised investment appraisal of options for the future location of the Army Base Vehicle Depot was prepared.*
*Because contracts for certain infrastructure work had already been signed and the work begun, these infrastructure costs were already 'sunk' and not included in the revised appraisal as they were not relevant to the decision now being appraised.*

## ***Common Costs***

3.1.41 Where a cost is common to all options, excluding it from the investment appraisal will clearly not alter the comparison of options in terms of differences in net costs. Excluding common costs will, however, affect the comparison of these differences as a proportion of overall costs. Including common costs can thus help put the differences in cost between options into context.

***Example.*** *In a comparison of three options the Net Present Cost, excluding common costs, is estimated to be: Option A £12m; Option B £15m; and Option C £24m.*

*Whether the common costs are £1m or £100m does not alter the size of the differences between A and B (£3m), and A and C (£12m). It does though affect the comparison of these differences as a proportion of the overall costs of the activity.*

*If the common costs were £1m we could say that A was £3/£16m x 100 = 18.8% cheaper than B, and £12m/£25m x 100 = 48% cheaper than C.*

*If, on the other hand, the common costs were £100m, then A would be only £3/£115m x 100 = 2.6% cheaper than B, and £12/£124m x 100 = 9.7% cheaper than C.*

3.1.42 It is desirable to include those common elements that are central to the activity in the investment appraisal for two reasons:

- Firstly, all estimates of individual cost components are likely to be subject to some uncertainty. Having details of the cost differences between options in percentage as well as absolute terms provides an indication of how robust the ranking of options is likely to be.

- Secondly, what may appear to be a common element may after further investigation prove not to be common after all.

## ***Hidden costs***

3.1.43 When considering relevant costs, it is also important to think carefully about the full impact of particular options, so that costs which might not be immediately apparent are not inadvertently missed. It is common, for example, to include the costs associated with travel and subsistence in appraisals dealing with staff relocation. However, another significant cost associated with travel to meetings, travel to use facilities, etc., is likely to be the loss of productive staff time. Such lost time is a relevant cost since, without it, the same output could be produced with fewer staff, or more output could be produced with the same number of staff.

> ***Example.*** *A relocation investment appraisal identifies a 'greenfield' site as a possible option. The site is, however, some distance from the organisation's main customer, and it is estimated that around 10 staff per month will each spend around 10 hours travelling to meetings. This means that around 100 hours of potentially productive time are lost to the organisation each month. These costs could be included in an investment appraisal by, for example, multiplying the number of lost hours by an appropriate staff cost capitation rate.*

## ***Double Counting***

3.1.44 Double counting is the inclusion of the same cost or benefit more than once within the investment appraisal. <u>It is a common mistake</u>. An example of double counting would be the inclusion of financing charges in an investment appraisal. A further example would be the inclusion of the full cost of staff for each option in an appraisal, while also including the reduction in staff arising in some of the options in the saving calculated for those options.

## ***Transfer Payments***

3.1.45 Transfer payments are payments or receipts for which no goods or services are obtained in return. They merely involve a transfer of money from one section of the population to another, without affecting the overall level of national resources. Examples are taxes and subsidies, social security payments such as unemployment and sickness benefit, and in some cases, redundancy payments and contract cancellation payments. In MOD, Commercial Exploitation Levy (CEL) is another example.

3.1.46 Transfer payments should not be included in an investment appraisal. However, any administrative costs incurred in making transfer payments, where significant, should be included as they do impact on overall national resources. In addition there may be real impacts involved, for which the transfer payments may or not be an adequate proxy, which do need to be included (see Section 3.4 on redundancy). In any case transfer payments should be included, as appropriate, in affordability tests.

**Value Added Tax (VAT)**

3.1.47 In an investment appraisal, it is important to adjust for any significant differences between options in the treatment of indirect tax arising from different contractual arrangements, such as in-house supply versus buying in. Options attracting different VAT treatments should be compared as if either the same UK VAT payments or no UK VAT payments were made in all cases.

3.1.48 In practice this means that UK VAT, whether recoverable or non-recoverable, should be excluded from an IA.

3.1.49 VAT liability can alter significantly according to procurement and contract strategy. Indirect taxes paid to foreign governments (such as their equivalents of VAT) do represent a resource cost to the UK economy, and should always be included in economic appraisals. In the case of goods and/or services procured from abroad the question of whether VAT is received by the UK Government (and is thus a transfer payment), or by an overseas government (and is thus a resource cost to the UK economy), is complex. Guidance should be sought from FMPD Accounting Policy (VAT).

**Overseas Resident Companies**

3.1.50 No adjustments to investment appraisals should be made to any overseas based firm's bid for taxes paid to, and allowances granted by, foreign governments because IAs are concerned with value for money from the viewpoint of the UK taxpayers. While UK government taxes and subsidies are transfer payments, foreign taxes and subsidies represent opportunity costs. Thus, it would not be appropriate to make any adjustment for the fact that foreign governments may provide more generous allowances.

3.1.51 In general, tax havens should be recognised as just another foreign country and we should not be concerned if, for example, a Special Purpose Vehicle (a company formed by members of a consortium holding a PFI contract for the specific purpose of funding the significant upfront investment required) is not domiciled in the UK. However, in such cases judgement may be needed to assess whether "sharp" practices (eg. those that are not necessarily illegal but which are likely to prove politically sensitive) are being used for competitive advantage. In such instances, DESA should be given the opportunity to consult more widely.

## ***Contingent liabilities and cancellation payments***

3.1.52 A contingent liability is a commitment to a payment if certain events occur. Such liabilities need to be identified in advance as part of the appraisal, and the effect included in either the main estimates of cost, or in the assessment of risks and uncertainties.

3.1.53 One class of contingent liability is the cancellation costs that would have to be paid due to the premature cancellation of a contract. Cancellation payments may exceptionally include, not only payment for the actual cost of ending the contract prematurely, eg costs of dismantling any special plant, but also compensation to the contractor for loss of future income. The distinction is important since the latter is a transfer payment and should not be included in an appraisal.

***Example.*** *Consider an order for 1,000 missiles over a ten-year period, based on an initial batch of 500 with an option to purchase a second batch of 500. The contract price negotiated for the initial batch may either be based on:*

*(a) Covering all the firm's fixed or start-up costs (e.g. development costs, plant and machinery, training costs, set profit or rate of return on capital) in full; or*

*(b) Covering the firm's fixed or start-up costs by the total order of 1,000 missiles.*

*In purely contractual and financial terms, MOD might be penalised if it failed to order all 1,000 missiles, although clearly the scale of such a contingent liability would differ between the options. In terms of an economic appraisal, a contingent liability would exist under (b), but not (a) if MOD decided to cancel the order for the second batch of missiles. This is because in (a), MOD has already paid for the development and production costs in full, so any further payment would only represent compensation for the loss of future income with MOD receiving no goods or services in exchange. In effect, such a contingent liability represents a transfer payment.*

3.1.54 Contingent liabilities may also arise in relation to environmental issues, or in the contractual pricing of risk. In relation to environmental issues, there may be a legal or constructive obligation to incur remediation costs at the end of a project, or to incur de-commission costs for nuclear projects.

## ***Losses and Special Payments***

3.1.55 These may arise from events such as changes in policy or direction with subsequent cancellation of projects and contracts, and disposal of existing assets. An investment appraisal should examine whether any of the options being considered are likely to generate such losses or special payments. Further guidance can be found in JSP 462.

## ***Inflation***

3.1.56 It is important to distinguish the difference between a real return on an investment and a nominal (or money) return on an investment. This difference is concerned with the impact of inflation on the investment, and the way the return is calculated.

***Example.*** *Assume £1,000 is invested at the bank on 1 January. The bank quotes an interest rate of 7%, which represents the nominal rate of return or the return in money terms. If inflation during the year to 31 December is at the rate of 2.5%, the return in real terms is given by the following relationship:*

*(1 + nominal rate) = (1 + real rate) x (1 + inflation rate)*

*From above:*

*(1 + 0.07) = (1 + real rate) x (1 + 0.025)*

$$(1 + \text{real rate}) = \frac{1.07}{1.025} = 1.044$$

*Real rate of return = 4.4%*

*Inflation reduces the return in real terms. Here, some of the interest received would have to be reinvested in order to maintain the purchasing power of the investment.*

## ***Adjusting for relative price levels***

3.1.57 The valuation of costs or benefits in an investment appraisal should normally be expressed in "real terms" or "constant prices" (ie at a given constant price level), as opposed to "nominal terms" or "outturn prices".

3.1.58 Usually the price level chosen is the price level prevailing in the current year, or as close to the current year as possible. This would mean that the price base would be the same as (or close to) the base date for discounting (Year 0). In this case there is no need to forecast future changes in the general price level.

3.1.59 If necessary, the effect of expected future inflation in the general price level should be removed by deflating future cash flows by forecast levels of the relevant deflator (ie the GDP deflator).

***Example****. The price for a service starting in a year's time agreed under a firm price contract is £6m with even payments over 3 years. HMT expects the GDP deflator to rise by 2.5% per annum over that period. The cash flow in real terms (before discounting) is derived as follows:*

| ***Year*** | ***0*** | ***1*** | ***2*** | ***3*** |
|---|---|---|---|---|
| *a. Cash Flow (£m)* | *0* | *2* | *2* | *2* |
| *b. GDP Deflator (Year 0 = 100)* | *100* | *102.5* | *105.1* | *107.7* |
| *c. Cash Flow (£m, Yr 0 prices) (a/b x 100)* | *0* | *1.95* | *1.91* | *1.86* |

3.1.60 In many cases it can be assumed that there will be no change in relative prices over the appraisal period; i.e. the main cost categories of the activity being appraised are all assumed to move in line with prices in general. With this approach, there is no requirement to forecast either changes in the future general price level, or changes in the price of a particular good or service.

3.1.61 There are cases, however, where relative price change could be important and should be brought into the calculation. This can be done either in the estimate of costs/benefits in the appraisal itself, as part of a sensitivity analysis (see Section 3.6), or both.

3.1.62 Where particular prices are expected to change at a significantly higher or lower rate than general inflation, this relative price change should be calculated. Examples where relative price changes may be material to an appraisal include:

- high technology products, prices for which may be expected to fall in real terms;
- land prices, where the resource supply is scarce;
- wages, where productivity growth is expected to lead to wage increases above general inflation. If one option in an appraisal has a significantly higher labour content than another, relative prices would be important, since average earnings tend to rises faster than general inflation over the long run (see paragraph 3.4.10);
- building costs, where construction prices are very sensitive to prevailing market conditions.

Guidance should be sought from DASA DESA (Price Indices) Branch, or directly from the INDIGO system available on the Defence Intranet.

## ***Contracts Subject to Variation of Price (VOP)***

3.1.63 Another area where relative price change could be significant is in relation to contracts subject to a variation of price (VOP) formula. The index used to escalate the tender price will not always be expected to move in line with prices generally.

3.1.64 It should be noted that VOP arrangements will not normally form part of a contract of less than two years' duration. For long term contracts, it is possible that the early years will be firm price, and the remainder subject to VOP. In general, bids should be "firm" for contracts up to 5 years. For longer contracts the prices will normally be "fixed", with a Variation of Price (VOP) clause. This should ideally be linked to a general measure of output prices (Producer Price Index (Output) (PPI(O)), or Retail Price Index (RPI), not input prices.

***Example.*** *The price agreed under a contract subject to VOP is £10m with equal payments over 4 years starting this year. The VOP index is expected to increase by 2% per annum more than the GDP deflator. The cash flow in real terms (before discounting) is derived as follows:*

| ***Year*** | ***0*** | ***1*** | ***2*** | ***3*** |
|---|---|---|---|---|
| *a. Cash Flow (£m, before escalation)* | *2.5* | *2.5* | *2.5* | *2.5* |
| *b. VOP index (Year 0 = 100)* | *100* | *102* | *104* | *106.1* |
| *c. Escalated Cash Flow (£m, Yr 0 prices) (a/b x 100)* | *2.5* | *2.55* | *2.6* | *2.65* |

3.1.65 If relative price movements could have a significant impact on the costs of an option, DASA-DESA should be consulted. DASA-DESA (Price Indices) can provide forecasts of specific price indices relevant to MOD, and forecasts of movements in the indices used in VOP contracts.

## ***Apportioned Fixed Overhead Charges***

3.1.66 Differences in overhead charges when the underlying overhead costs are unaffected are transfer payments and should normally be excluded from appraisals, as being common to all options. Staff who prepare and scrutinise investment appraisals should always be prepared to question the basis on which costs are included.

***Example.*** *In an initial investment appraisal of options for collocating the Army Technical Support Agency, security costs for one option were based on the charges to be levied by the MOD agency which owned the site, and which included an apportionment of that agency's fixed costs. The resource cost of security for that option was thus overstated by including a transfer payment (i.e. the contribution to the fixed costs of the agency owning the site)*

# ***Annex A: Discounting in-year and mid-year cash flows***

**Payments at Intervals Other Than One Year**

1. In some appraisals, payments may occur part way through a year. The present value of such a payment may be found using the formula:

$$\text{Present Value} = \frac{£(\text{Payment})}{(1 + r)^n}$$

where:

r = discount rate

n = number of periods

even though n is not a whole number.

**Discounting Mid-Year Payments to Year Start or Year End Base**

***Example.*** *The present value now of a payment of £100 made in 11 months time, discounted at 3.5 per cent per year, is calculated as:*

$$\frac{£100}{(1.035)^{11/12}} = \frac{£100}{(1.035)^{0.9166}} = \frac{1}{1.032} = £96.90$$

**Date**

2. MOD investment appraisals should normally be based on annual discounting, rather than monthly, as implied by the above calculation.

3. To adjust a mid-year discount factor to a year-end discount factor requires the appropriate discount factor to be multiplied by $(1 + r)^{0..5}$. For a discount rate of 3.5 per cent, this adjustment is $(1.035)^{0.5}$ = 1.017.

***Example.*** *A payment of £150 at the middle of year 5 has a present value <u>at the middle of year 0</u> of £150 x 0.8420 = £126.30, and at the <u>end</u> of year 0 of £150 x 0.842 x 1.017 = £128.45*

4. The calculation shown above will not normally be required in MOD investment appraisals. For advice on timing of cash flows and discounting, please contact DESA.

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# 3.2 COST-EFFECTIVENESS ANALYSIS

**3.2.1 Business Case submissions to the Investment Approvals Board (IAB) and its delegated authorities must be supported by evidence based justification of Need & Numbers (N&N) and a Combined Operational Effectiveness and Investment Appraisal (COEIA) comparison of alternative investment options within the context of defence policy. The IAB considers a wide span of investment decisions ranging from acquisition of *operational* equipments, infrastructure and services necessary to the preparation for (eg training) and conduct of operations in theatre through to acquisition of *corporate*[3] equipments, infrastructure, and services necessary to the business functions of the MoD within the UK and its permanent bases overseas.**

## *Need & Numbers (N&N)*

3.2.2 Justification of the 'need' for a capability should normally draw on high level balance of investment analysis such that the 'need' for an 'operational' or 'corporate' capability can be determined within the overall context of defence policy and planning. In the case of 'operational' capability, for example, evidence of 'need' should be informed by the DCDS(Capability) high level operational analysis (HLOA) programme directed by Head of Equipment Plan in combination with specific and more detailed Head of Capability investigations within their specialist domains. Similarly for 'corporate' capability drawing on high level balance of investment analysis within, for example, the Defence Infrastructure Organisation (previously Defence Estates).

3.2.3 The aim is to demonstrate, via an auditable trail of evidence compiled and validated by subject matter experts (SME), that a Do Something Option provides a compelling case for upgrading or replacing an existing capability or, introducing a new capability. This is, in essence, a high level precursor to the Exploratory COEIA (see paragraph 3.2.10).

[3] Note that, for the purpose of discussion, the term 'corporate' relates to anything that is not intended to be deployed to a theatre of operation, eg buildings, corporate information technology (IT) systems, 'white fleet' transport services, partnering arrangements and so on.

3.2.4 'Numbers' or scaling can be addressed by quantification of the demand for a capability subject to policy and planning constraints. They must be addressed within the context of both short (circa 10 years) and longer-term (circa 20 years) timeframes to avoid acquisition of an unnecessarily short term solution which may need to be replaced at an earlier stage and at greater expense in WLC terms than a more enduring solution.

## ***Combined Operational Effectiveness and Investment Appraisal (COEIA)***

3.2.5 The function of the COEIA is to enable the evidence based comparison of investment options. This is usually shown graphically in a COEIA chart by plotting a Measure of Effectiveness (MoE) along the 'y axis' against Whole Life Cost (WLC) expressed in Net Present Value (NPV) terms derived through Investment Appraisal (IA) plotted along the 'x axis'.

**Cost-Effectiveness Analysis**

3.2.6 The COEIA essentially takes the form of a 'cost-effectiveness analysis'. This usually involves analysis of investment options where explicit mathematical representation of physical characteristics can be modelled to gain a quantitative measure of investment option effectiveness (sometimes referred to as 'hard' assessment). Where it is not possible to explicitly represent physical characteristics, recourse must be made to assessment of option benefits via qualitative assessment (sometimes referred to as judgemental or 'soft'[4]). In these circumstances the term Measure of Benefit (MoB) tends to be used in preference to MoE. Quantitative techniques are the preferred route at all times but it is recognised that it is not always possible to express the overall 'effectiveness'of an investment option in purely quantitative terms. In any qualitative assessment of benefit, cost should not be included as a contribution to effectiveness or benefit along the y-axis.

3.2.7 Cost-effectiveness is a *relative*, not an absolute, concept, even when the costs and effectiveness levels of options, taken separately, are well defined. In other words it can only be legitimately claimed that one investment is *more cost-effective than another,* not that it possesses some intrinsic, absolute "cost-effectiveness". It follows that to make any

[4] 'Guidance on the Use of Subjective Operational Analysis Methods in Support of Acquisition Decisions', Anneliese Handley, DSTL/CR43706, March 2010.

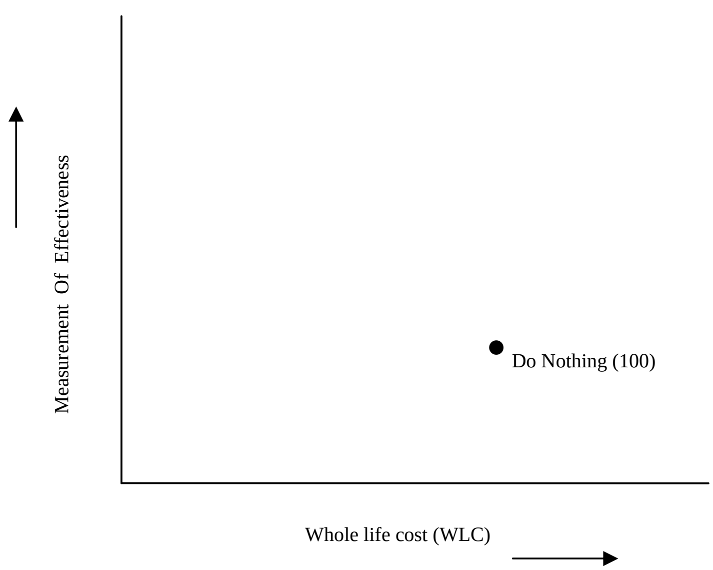
judgement at all about the cost-effectiveness of a system, a comparison must always be set up with some alternative.

## ***Presentation of the COEIA Chart***

***Example***

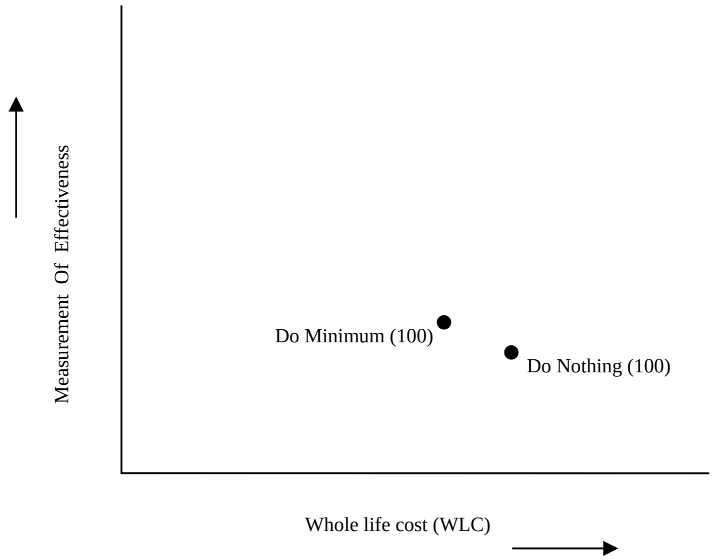
*Let us assume that we are aiming to buy a fleet of 100 reconnaissance vehicles. A measure of effectiveness has been derived from combat modelling. Four options have been identified; the first of these is the Do Nothing option, which assumes the existing fleet of reconnaissance vehicles are run on without modification. Increasing obsolescence and rising maintenance cost are likely to make this an expensive and not very effective option well to the right on the cost axis and low down on the effectiveness axis.*

***Figure 1: Do Nothing baseline***



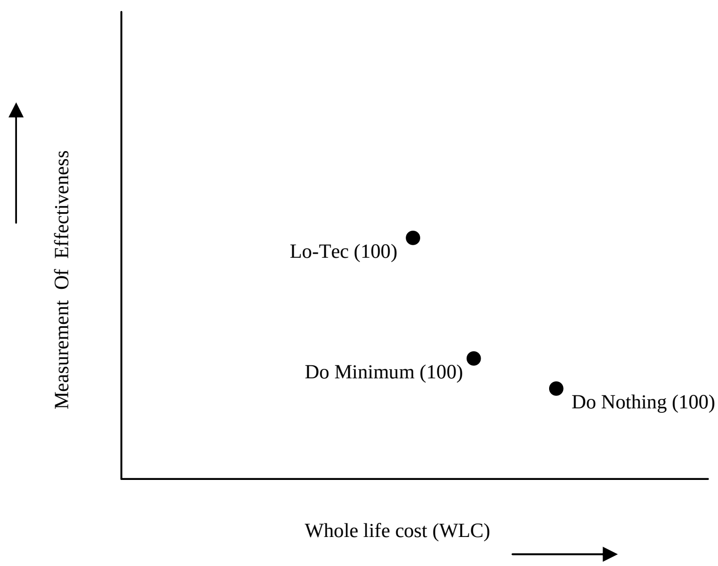

*The Do Minimum option aims to replace, let us say, the powerpack and upgrade of the surveillance sensors. These modifications will improve mechanical reliability and reconnaissance capability. From a small one-off expenditure we see a reduction in whole life cost due to less frequent maintenance periods and improved reliability. However, upgrade of the existing surveillance sensors is buying us only a small increase in effectiveness.*

***Figure 2: Do Minimum***



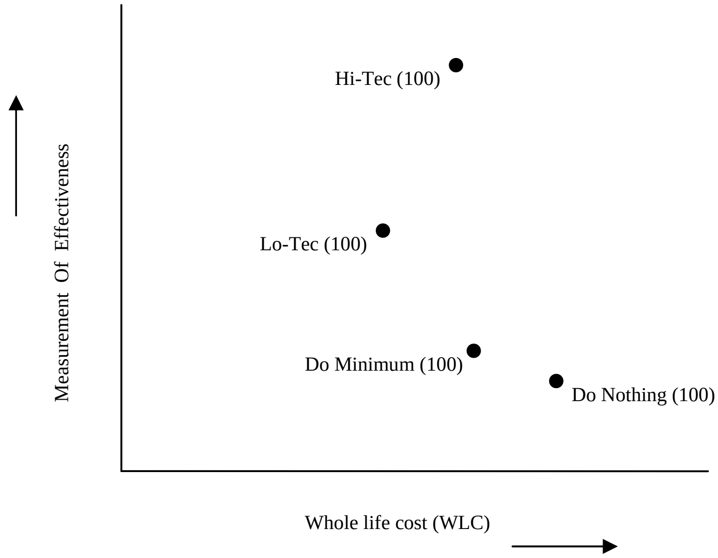

*It is only when we move to what we will call the Lo-Tec Option and replace the existing fleet with new vehicles together with procurement of new off-the-shelf sensor systems (based on proven technology) that we see substantial gains in both reduction of the lifecycle costs and increase in operational effectiveness (see Figure 3).*

***Figure 3 Lo-Tec Option***




*Finally, we consider a Hi-Tec Option with sensor systems based on emerging technologies. Although somewhat more expensive than the Lo-Tec Option, it potentially offers substantial benefits in terms of a gain in operational effectiveness (see Figure 4).*

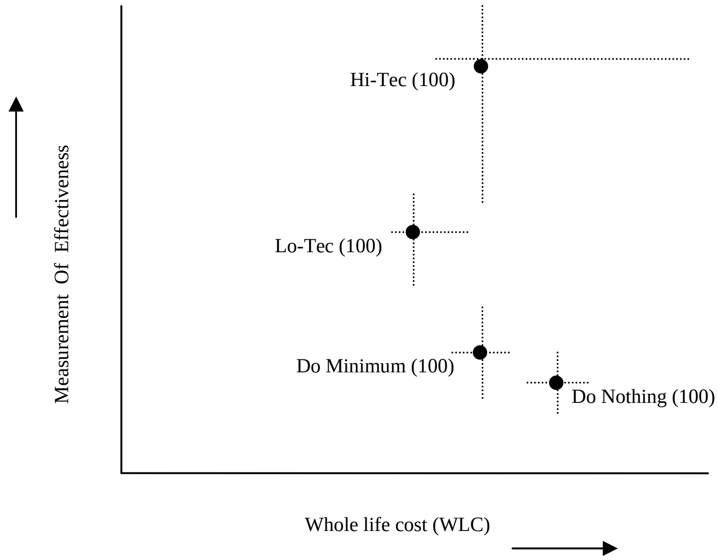
***Figure 4: Hi-Tec Option***




## *Uncertainty*

*We now introduce uncertainty in estimation of cost and effectiveness The vertical error bars indicate upper and lower bounds on measure of effectiveness obtained from, for example, Dstl combat modelling by consideration of best and worst performance expectations with regard to the surveillance, mobility and survivability aspects Similarly, the horizontal error bars indicate upper and lower bounds of the three point life cycle cost estimates provided by CAAS. Note the relatively large error bars associated with the Hi-Tec option (Figure 5) due to the uncertainties associated with development of emerging technologies which have yet to be proven in development trials In the worst case, the Hi-Tec option would provide little substantial improvement in operational effectiveness over the Lo-Tec Option and may in addition cost twice as much.*

***Figure 5: Bounding uncertainty with 3 point estimates***




## Equivalent-Cost or Equivalent-Effectiveness?

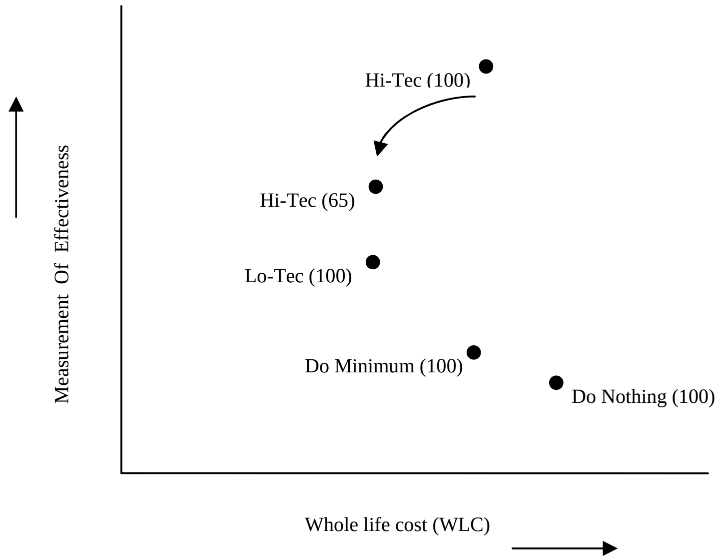
3.2.8 Equivalent-cost and equivalent-effectiveness comparisons correspond to vertical and horizontal slices of the cost-effectiveness relationship, and both lead to a point on the cost-effectiveness curve.

3.2.9 Cost is a single quantity, so that once the costing assumptions have been agreed, the construction of equal-cost mixes is a completely unambiguous process. Equal-cost comparisons are therefore quicker and easier to carry out than equivalent –effectiveness comparisons. Effectiveness may often have multiple attributes, on the other hand, making it less obvious what constitutes "equal-effectiveness". The constant-cost approach is not immune to this problem, since judgements may have to be made should the relative importance of different effectiveness attributes for equal-cost.

***Example***

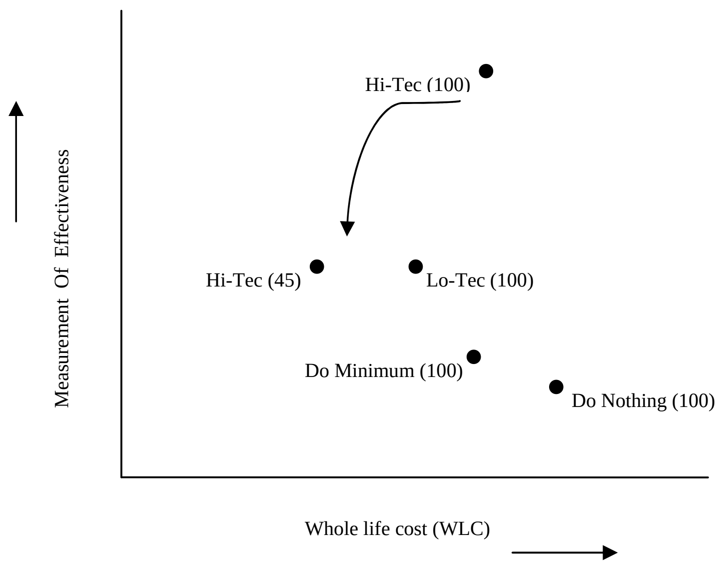
*Up to this point we have considered comparison of options within the context of a fleet size of 100 reconnaissance vehicles for each option. Figure 6 illustrates the effect of reducing the number of Hi-Tec vehicles to the point at which whole life cost equates to that of the 100 Lo-Tec vehicles. War gaming and combat modelling together with recalculation of whole life cost indicates that fewer Hi-Tec vehicles, in this case 65, are more effective than a greater number of Lo-Tec vehicles on the basis of an equal-cost-comparison.*

***Figure 6: Equivalent-cost comparison***




*Now let's reduce the number of Hi-Tec vehicles to the point at which operational effectiveness equates to that of the 100 Lo-Tec vehicles but at significantly lower whole life cost (see Figure 7).*

***Figure 7: Equivalent-effectiveness comparison***

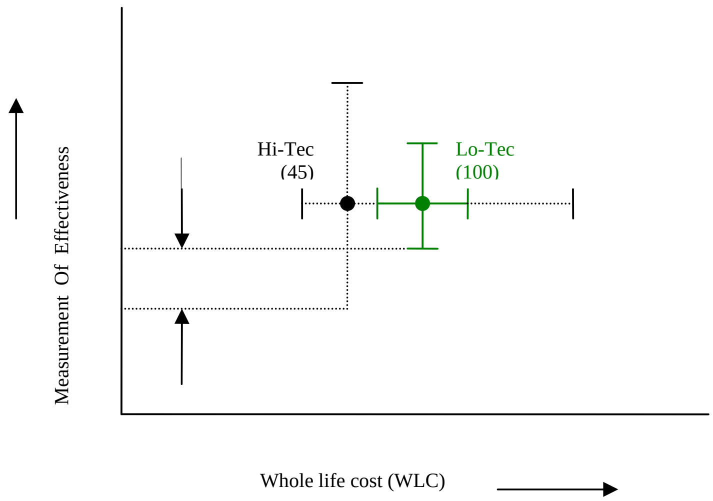



*In this example, it would appear that procurement of a fewer number(45) of high tech reconnaissance vehicles may prove a more cost and operationally effective option than a greater number of cheaper but less effective Lo-Tec vehicles.*

*However, let us return to consideration of the error bars or uncertainties in our estimates of effectiveness and cost. In the worst case, our 45 Hi-*

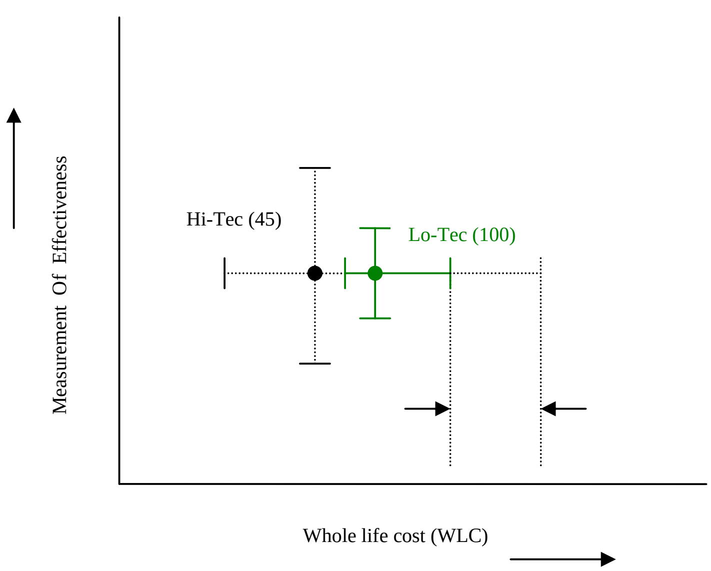
*Tec vehicles may be substantially less effective than the 100 Lo-Tec vehicles (see Figure 8).*

***Figure 8: Impact of uncertainty on effectiveness***




*When taking into account uncertainty we observe that the 45 Hi-Tec vehicles may not only be less effective but may potentially cost some 30-50% more in terms of whole life cost. Hence, we might observe that the lower risk route may be to opt for the Lo-Tec vehicle option rather than run the risk of an expensive and under-performing Hi-Tec option.*

***Figure 9: Impact of uncertainty on cost***



*This is just an illustrative example, but it goes some way to illustrate the importance of conducting three point estimates of both performance and cost covering worst case – where, in broad terms, nothing goes according to plan, best case – where everything goes exactly according to plan, and the most likely case which lies somewhere in between.*

## ***Exploratory COEIA***

3.2.10 It is good practice to undertake an Exploratory COEIA early in the Concept Phase, drawing and building on the N&N assessment to discard unviable options and identify options worthy of more detailed consideration in the Assessment Phase. This should provide MoD with sufficient understanding to be a well informed customer in preparation of ITT specification and tender assessment down-selection criteria.

3.2.11 The Exploratory COEIA may be faced with myriad alternative options with potential to offer solutions to an 'operational' or 'corporate' capability requirement. These options may be categorised as:

- Do Nothing - this is the baseline against which alternative options are to be compared,
- Do Minimum – e.g. options may include running on the existing equipment, infrastructure or service through refurbishment necessary to maintain current level of capability,
- Do New Investment Options – e.g. replacement by new acquisition of similar but improved equipment, infrastructure or service through 'off-the-shelf' options to development and acquisition of radical alternatives.

3.2.12 In such a case it may be acceptable, (subject to the explicit agreement of DScrutiny) to adopt a qualitative approach to sort the more promising options, typically making use of multi-criteria decision analysis (MCDA). The initial qualitative approach may be based on a hierarchical framework of scores and weights to establish the relative ranking of alternative options in terms of overall Measures of Benefit (MoB) <u>excluding</u> cost – drawing on <u>best available</u> data sources validated by Subject Matter Experts (SMEs).

3.2.13 In the case of projects within the 'operational' domain, <u>best available</u> data is typically compiled by SME assessment of technologies and concepts emerging from the MoD's research programme through to SME assessment of the availability of technology, concepts and off-the-shelf options available in the world-wide commercial market place.

Likewise, in the case of projects within the 'corporate' domain, best available data should be compiled by SME assessment of potential investment options that are likely to be most suited to be taken through to an Assessment Phase.

3.2.14 WLC comparison of these alternative options can also be considered at this early stage with best available data and assumptions again drawn from SME validation. The aim is to distinguish, on a relative comparison basis, between those options that would be expected to involve significantly higher WLC and / or significantly lower MoB than others by plotting MoB vs WLC. This offers an auditable mechanism by which myriad alternative options identified in the early Concept Phase can be reduced to a manageable handful which can then be subjected to more rigorous quantitative assessment.

3.2.15 The structure of a hierarchical decision analysis framework needs to be carefully devised and tested with scores and weights based on the judgements of SMEs, with an audit trail, within the context of representative 'operational' or 'corporate' scenarios[5] and sample situations (or vignettes). Once the number of alternative options has been filtered to a manageable handful, consideration can be given to more rigorous assessment drawing on quantitative assessment techniques. Figure 1 summarises the progress from the Exploratory COEIA drawing on best available data during the Concept Phase through to the Main Gate COEIA based on mature data[6] at conclusion of the Assessment Phase. The intention is to achieve convergence through an ever decreasing number of alternative investment options to the ultimate down-selection of the most cost-effective option.

## ***The COEIA and Affordability***[7]

3.2.16 Options may not be affordable either in gross terms (ie the total bid exceeds planned provision) or may be affordable in gross terms but not in profile (ie the bid profile exceeds the in-year funding available within one or more years.) Opportunities to overcome such affordability

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[5] Scenarios and sample situations for assessment of 'operational' investment options are drawn from the SAG scenarios handbook; there is not an equivalent to the SAG scenarios handbook for 'corporate' investment options and, hence, scenarios and sample situations must be developed to suit – DScrutiny and Dstl can advise.

[6] 'Mature data' is defined as ITT bid data which has been subjected to SME assessment with adjustments made as necessary to ensure that COEIA comparison of competing bid options is made on a level playing field.

[7] Affordability, for this discussion, is defined in terms of the planned provision of funds for acquisition excluding the support costs over the WLC period.

problems can be explored by considering trades across performance, cost and time (PCT) parameters. A profiling problem, for example, may be overcome by extending the period of acquisition with potential delay to Planned Assumption to Service Entry / In Service Date (PASE/ISD). A problem of gross affordability may perhaps be overcome by reducing numbers or reducing the scaling of infrastructure or a service provision. The consequential impact (on effectiveness or benefit) of delay or reduction in numbers can be explored within the COEIA via sensitivity analysis.

3.2.17 When options are modified to remain within an affordability constraint it is important to note that cost-effectiveness of the modified option is not necessarily a simple linear interpolation of 'effectiveness divided by cost' (see Annex B).

## ***Other Contributory Factors (OCFs)***

3.2.18 In addition to the quantitative analysis of alternative options, there may be relevant OCFs to consider before a conclusion on option selection can be drawn, i.e. factors that cannot be readily quantified but which may have potentially significant influence in reaching a decision (see Chapter 3.5 for Non-Quantifiable Costs and Benefits). This is typical of the majority of acquisition projects where, for example, the AWARD[8] tool (based on a hierarchical framework with scoring and weighting to assist down-selection of supplier bids) draws together the results of both quantitative N&N and COEIA assessment and the qualitative OCF judgements of SMEs.

## ***Planning and Reporting N&N and COEIA***

3.2.19 Planning of N&N and COEIA is drawn together in concise format for executive consumption, typically for scrutiny at 1* level, via a Concept of Analysis (CoA). Reporting of N&N and COEIA is drawn together in concise format via an Operational Analysis Supporting Paper (OASP). Planning (CofA) and Reporting (OASP) is the joint responsibility of the sponsor and the project team.

3.2.20 A Subject Matter Expert (SME) lead for Planning and Reporting of N&N and COEIA analysis should be appointed at Project Initiation with responsibility for delivery as set out in Figure 1 below:

[8] AWARD is used by DE&S Tender Assessment Panels to provide an auditable down-selection of supplier bids.

***Figure 1: Analysis Deliverables (N&N + COEIA)***

| | |
|---|---|
| **AT PROJECT INITIATION** | **PLAN**[1] (CofA) for N&N and Exploratory COEIA based on <u>best available</u> data and assumptions during the Concept Phase. Engage with DScrutiny staff now. |
| **AT INITIAL GATE** | **REPORT**[2] (OASP-IG) drawing together N&N and Exploratory COEIA based on <u>best available</u> data and assumptions from the Concept Phase.<br><br>**PLAN** (CofA) for the Assessment Phase N&N and COEIA ultimately based on <u>mature data</u> prior to Main Gate. |
| **AT MAIN GATE** | **REPORT** (OASP-MG) drawing together N&N and COEIA based on <u>mature data</u> from Assessment Phase.<br>[In the case of Incremental Acquisition, the PLAN (CofA) for N&N and COEIA to next decision point will also be required]. |
| **AT REVIEW NOTE** | **UPDATE** on any changes to CoA, N&N and COEIA evidence since last submission to approving authority to inform consequences of change to PCT parameters and underlying assumptions. |
| Note 1: PLAN = Concept of Analysis (CofA); Note 2: REPORT = Operational Analysis Supporting Paper (OASP) | |

## ***<u>Scrutiny and Assurance</u>***

3.2.21 Early engagement with relevant scrutiny and assurance contacts is strongly recommended and should be initiated via a kick-off meeting, see points of contact at Figure 2.

***Figure 2: Principal Scrutiny and Assurance Contacts***

| **Scrutiny/Assurance** | **Responsibility & Relevance to N&N and COEIA** |
|---|---|
| DScrutiny (SecEC) | Guidance on IAB procedure[9], business case format, kick-off scrutiny meeting and affordability |
| DScrutiny (Operational Analysis) | Guidance on preparation of 'Need and Numbers' (N&N) and COEIA to accompany business cases to Initial Gate, Main Gate and updates [eg to assess consequences of changes in PCT parameters] for Review Notes. |
| DScrutiny (Technical Scrutiny) | Guidance on evidence required including key user and system requirements, technology and system readiness levels, risks vs likelihood/impact/mitigation, priorities for test and evaluation. |
| CADD (Commercial Assurance) & Legal | It is important to establish, at an early stage, the rules governing exposure of decision criteria to potential suppliers to ensure compliance with EU procurement regulations – hence informing the scope, depth and delivery schedule of N&N and COEIA assessments required to support IG and MG decision points. |
| DASA-DESA (Division of Economic Statistics and Advice) | Independent scrutiny of VFM/IA. |
| DE&S-CAAS (Cost Analysis & Assurance Services) | CAAS provide guidance and assurance for three point through life cost and schedule estimation required for IG and MG business cases; independent assurance of IA input to COEIA. |
| Chief Information Officer | Communication and IS Projects. |

## Readiness Levels

3.2.22 Figure 3 outlines the Analysis Readiness Levels for N&N and COEIA with regard to Initial and Main Gates.

[9] Smart Approvals Guidance Version 10.3

***Figure 3: Analysis Readiness Levels (N&N + COEIA)***

| LEVEL | CRITERIA |
|---|---|
| **1 PROJECT INITIATION** | **A scrutiny kick-off meeting has identified the scope of the PLAN[1] (CofA) for N&N and Exploratory COEIA activities to be addressed within the Concept Phase to Initial Gate. See points of contact at Figure 4.** |
| **2** | The PLAN (CofA) TO INITIAL GATE, for the N&N and Exploratory COEIA, has been completed and scrutinised by DScrutiny. Subject Matter Expert (SME) practitioner leads have been appointed to deliver the N&N and COEIA. |
| **3 INITIAL GATE** | **REPORT[2] (OASP-IG) on N&N and Exploratory COEIA drawing on <u>best available</u> data is complete together with the PLAN (CofA) TO MAIN GATE. The N&N and COEIA elements have been scrutinised by DScrutiny with the IA aspect scrutinised by DASA-DESA and assured by DE&S-CAAS.** |
| **4** | SME practitioner leads have been appointed to deliver the REPORT (OASP-MG) on N&N and COEIA from the Assessment Phase at Main Gate; have appropriate access to data, assumptions, time and resource; are engaged with DScrutiny, DASA-DESA and DE&S-CAAS. |
| **5** | Draft REPORT (OASP-MG) on N&N and COEIA based on <u>mature data</u> has been reviewed by scrutineers and PLAN (CofA) to Main Gate adjusted to take account, for example, of unexpected results or changes in assumptions. |
| **6** | N&N and COEIA outputs based on <u>mature data</u> have been mapped onto the tender assessment framework such that consequences, for example, of PCT trades on overall effectiveness or benefit of options are readily determined prior to (and, if necessary, during) tender assessment. |
| **7 MAIN GATE** | **REPORT (OASP-MG) on N&N and COEIA based on <u>mature data</u> is complete. The N&N and COEIA elements have been scrutinised by DScrutiny. The IA has been scrutinised by DASA-DESA and assured by DE&S-CAAS.** |
| Note 1: PLAN = Concept of Analysis (CofA); Note 2: REPORT = Operational Analysis Supporting Paper (OASP) | |

### Verification and Validation

3.2.23 In all cases, models and methods must be accompanied by an up to date Verification and Validation (V&V) Logbook. Likewise, input data and underlying assumptions to the N&N and COEIA must be validated by SMEs and recorded via a Master Data and Assumptions List (MDAL). DScrutiny and Dstl can advise on the V&V and MDAL aspects of the N&N and COEIA. DASA-DESA and CAAS can advise on the V&V and MDAL aspects of the IA. Subject Matter Experts should be selected with care to ensure that they are appropriately qualified to provide authoritative, independent and non-advocate assessment of options, data and assumptions within the relevant domain.

## *<u>Plan (CofA) to Initial Gate</u>*

### Aim

3.2.24 The aim is to generate the N&N and COEIA evidence foundation for the business case at Initial Gate based on <u>best available</u> data and assumptions gathered during the Concept Phase. It is important to draw on previous experience, eg via literature survey, to minimise the burden of additional assessment work and to avoid making the same mistakes.

### Objectives

3.2.25 The objectives here are:

**Objective 1: CONTEXT for N&N and COEIA**.

Step 1: Define the <u>Capability</u> in terms of operational or corporate role(s).

Step 2: Identify relevant <u>Policy and Planning Assumptions</u> with potential to influence outcomes of the N&N and COEIA assessment of investment options:

- Defence Strategic Directions (DSD)/Defence Planning Assumptions (DPAs), e.g. readiness, concurrency and harmony guidelines.
- Government legislation relevant to the nature of the investment, geographical location, impact on environment and so on.

Step 3: Identify rules governing exposure of decision criteria to bidders to ensure compliance with EU procurement regulations.

Commercial and legal staffs should be consulted, following Project Initiation, to establish the rules governing exposure of decision criteria to bidders to ensure compliance with EU procurement regulations. This may have significant influence on the scope, timing and nature of N&N and COEIA analysis required to support Initial and Main Gates. Hence, guidance should be sought from DScrutiny prior to release of decision criteria.

Step 4: Define the Measure(s) of Effect or Benefit (MoEs/MoBs) by which investment options are to be compared.

MoEs and MoBs need careful consideration. They should be directly related to high-level capability objectives rather than lower-level measures of performance or benefit. Convention determines that an MoE/MoB is defined as a numerical quantity which increases with gain in effectiveness or benefit. There should be as few MoEs/MoBs as necessary, in order to simplify comparisons between options.

Step 5: Identify candidate Key User Requirements (KURs) – i.e. those requirements that may be expected to dominate in their contribution to the MoE/MoBs.

Step 6: Select the Scenarios and Sample Situations (Vignettes) within which investment options are to be assessed with regard to N&N and COEIA and outline the rationale for selection.

**Objective 2: PRIORITIES AND SCHEDULE FOR N&N AND COEIA OUTPUTS**

Determine the priorities and schedule for N&N and COEIA by mapping outputs against the evidence required at key decision points. Take care to make appropriate time allowances for requirement and data capture, engagement of appropriate SMEs across the Defence Lines of Development (DLODs), methodology preparation and testing, mapping onto tender assessment framework and so on.

Identification of priorities for N&N and COEIA analysis can be assisted by thinking about:

- performance drivers with potentially dominant impact on effectiveness/benefit or WLC,
- risks/uncertainties that may be expected to have significant impact on effectiveness/benefit or WLC,
- constraints, eg third party dependencies, affordability, manpower, policy, environmental.

Care should be taken during the Concept Phase to identify the necessary performance, cost and time (PCT) data which will be necessary for input to Main Gate N&N and COEIA such that potential suppliers can be informed of these requirements via the ITT for the Assessment Phase.

**Objective 3: NEED & NUMBERS**

Step 1: Demonstration of Compelling Need. The case for 'compelling need' should explain the consequences of any shortfall in terms of risk to capability together with assessment of the magnitude of the shortfall. In cases where there is no shortfall in capability, 'compelling need' should be explained in terms, for example, of opportunity to provide the same level of capability by alternative means but with significant reduction in WLC.

The magnitude of the capability shortfall should be demonstrated in the Concept Phase via comparison of a Do Something Option against the Do Nothing Baseline in terms of MoE/MoB and WLC within the context of representative scenarios. Potential 'Do Something Options' should be identified via SME survey of the type, range and performance characteristics of available options (e.g. 'do upgrade' or 'do similar' through to 'do radical' options) within the wider context of defence. This survey is, essentially, a pre-cursor to the more comprehensive generation of options to be considered within the Exploratory COEIA.

Step 2: Estimation of Scaling/Numbers. Select those scenarios that are likely to drive the scaling/numbers below which a viable capability cannot be established and, hence, provide the basis for a lower bound on WLC estimates

For projects within the 'operational' domain, map the capability on to each of the SAG scenarios to determine the extent of its utility with objective to select those scenarios that:

- drive the N&N case for equipment, infrastructure or service – and, hence, derive the minimum scaling/numbers required to provide a

viable capability within the context of DSD readiness, harmony and concurrency guidelines,
- provide the most demanding test of performance parameters and, hence, provide the basis for rigorous COEIA comparison of options and derivation of KURs.

In the case of projects within the 'operational' domain, a small number of SAG scenarios should be selected to represent the widest spectrum of sample situations within which the capability is likely to be deployed to provide adequate coverage for COEIA comparison of options.

**Objective 4: EXPLORATORY COEIA**

Typical outputs from the Exploratory COEIA include cost-effectiveness (or cost-benefit) comparison of generic acquisition options together with the findings of sensitivity analysis along the lines:

- identification of those PCT parameters with dominant impact on effectiveness or benefit enabling evidence based selection of KURs together with priorities for data capture, test and experimentation to be undertaken within the Assessment Phase,
- PCT trade-offs to maximise effectiveness or benefit within an affordability constraint - hence, informing the setting of threshold and objective levels of KUR performance,
- quantity vs quality, e.g. comparison of greater number of 'less expensive/less capable' options vs lesser number of 'more capable/more expensive' options,
- identification of other contributory factors, e.g. third party dependencies, policy, economic, sociological, technology and environmental factors

**Objective 5: EXPLORATORY IA**

Outline the methodology for assessment of Whole Life Cost with identification of lead SME responsibility for conduct and reporting of the Investment Appraisal. It is strongly recommended that DE&S-CAAS and DASA-DESA are called upon for guidance and advice at the outset. Assurance and scrutiny of the IA by DE&S CAAS and DASA-DESA respectively is mandatory for major business cases[10].

[10] Refer to SMART APPROVALS GUIDANCE VERSION 10.3.

## ***Plan (CofA) to Main Gate***

**Aim**

3.2.26 The aim is to generate the N&N and COEIA evidence foundation for the business case at Main Gate ultimately based on <u>mature data</u> at conclusion of the Assessment Phase.

3.2.27 The Plan (CofA) to Main Gate is prepared at conclusion of the Concept Phase prior to submission of Initial Gate (see Analysis Readiness Levels at Figure 3) Experience gained via the N&N and Exploratory COEIA during the Concept Phase is exploited to prepare the Plan (CofA) to Main Gate.

**Objectives**

3.2.28 The Plan to Main Gate builds on the Plan to Initial Gate set out in paragraphs 3.2.24 – 3.2.25 with the following updates:

**Objective 1: REVISIT THE CONTEXT FOR N&N AND COEIA** to identify any changes, e.g. to defence policy and planning assumptions, that may have influenced the original Initial Gate decision and, hence, will need to be taken into account at Main Gate.

**Objective 2: PRIORITIES & SCHEDULE FOR N&N AND COEIA OUTPUTS.** The PLAN for N&N and COEIA activities to accompany the Assessment Phase should clearly define necessary PCT data requirements such that bidders can be informed of these requirements via the ITT for the Assessment Phase.

**Objective 3: UPDATE OF N&N** to reflect the impact of any changes to policy, planning and other assumptions since Initial Gate.

**Objective 4: MAIN GATE COEIA** comparison of ITT bid options ultimately based on <u>mature data</u> at conclusion of the Assessment Phase. The mechanism for mapping COEIA conclusions onto the tender assessment process must be explained.

## ***Planning Notes for Initial & Main Gates***

3.2.29 In addition to the points set out in paragraphs 3.2.24 – 3.2.28 above, the Plan (CofA) must address the issues set out below.

## Development and/or Selection of N&N and COEIA Methodology

3.2.30 Always begin with a review of the literature to establish the potential for exploitation of existing evidence from previous projects and, indeed, existing assessment methodologies. Outline the analytical approach to be adopted together with identification of lead responsibilities for conduct and reporting of the N&N and COEIA assessments. Care is required where a new model or method is commissioned or modifications are made to existing models. Sufficient resource and time should be allowed for testing and to prepare/update the V&V Logbook.

3.2.31 The analytical approach to N&N and COEIA in the Concept Phase may typically be along the following lines:

- early Concept Phase: qualitative assessment aimed at reducing investment options from myriad to <u>manageable handful</u> accompanied by audit trail of SME down-selection rationale,
- later Concept Phase: quantitative assessment of the <u>manageable handful</u> to identify those generic options worthy of being taken through to the Assessment Phase.

A similar approach can be adopted in the Assessment Phase but with greater emphasis on quantitative assessment.

## Investment Appraisal

3.2.32 The Investment Appraisal element of the COEIA requires three point 10%/50%/90% estimates of Whole Life Cost (WLC).

3.2.33 The IA should capture all those elements over the WLC period where cost differentials may be expected between options, eg reliability may vary from one option to another with consequent impact on maintenance and repair costs to maintain similar levels of operational availability over the WLC period.

3.2.34 It is important to identify those aspects that dominate in driving the WLC from 10% estimate towards the 50% estimate and similarly those aspects that dominate in driving the WLC from 50% to the 90% estimate. Attention can then be drawn to these WLC drivers in the Assessment Phase such that risk of unexpected increase in costs through life can be reduced to a minimum.

## Sensitivity Analysis

3.2.35 The N&N and COEIA must explicitly recognise and deal with the existence of risk and uncertainty. Sensitivity analysis should be conducted along the lines of:

- ‘what magnitude in variation of PCT would yield a different conclusion to N&N and is such a variation likely?’,
- ‘what magnitude in variation of PCT would yield a different COEIA ranking of options and is such a variation likely?’.

3.2.36 Sensitivity analysis is a powerful tool by which dominant performance parameters can be identified with regard to their contribution to effectiveness or benefit, hence providing evidence to assist selection of KURs and associated performance bounds.

3.2.37 An upper bound is established as the value of performance above which there is insignificant increase in its contribution to overall effectiveness or benefit, in which case, it is not worth committing further expenditure to chase greater performance. A lower bound is established as the value of performance below which an acceptable level of overall effectiveness or benefit cannot be achieved.

3.2.38 Performance bounds of KURs are defined in terms of ‘threshold’ and ‘objective’. The ‘objective’ bound should be no greater than the upper bound whilst the ‘threshold’ value should generally be equivalent to the lower bound.

## Other Contributory Factors

3.2.39 Identify OCFs (see paragraph 3.2.18) that should be taken into account in arriving at a down-selection from alternative options.

## Data and assumptions, the MDAL and V&V Logbook

3.2.40 Arrangements should be made to ensure the timely availability and validity of data and assumption inputs to N&N and COEIA, e.g. inclusion of data and assumption requirements within IT specification. Data and assumptions should be recorded within a Master Data Assumptions List (MDAL) together with an up-to-date Validation & Verification (V&V logbook respectively. SMEs from both Dstl and CAAS will typically be engaged in contribution to and validation of the MDAL.

3.2.41 The MDAL is an important document as it not uncommon for the N&N and COEIA to be undertaken by different analysts. Indeed, the OE and IA aspects of the COEIA will normally be undertaken by different analysts but working to a common MDAL. Thus, the MDAL provides a common reference source of data and assumptions to minimise the risk of incoherency across N&N and COEIA evidence.

**Results Presentation**

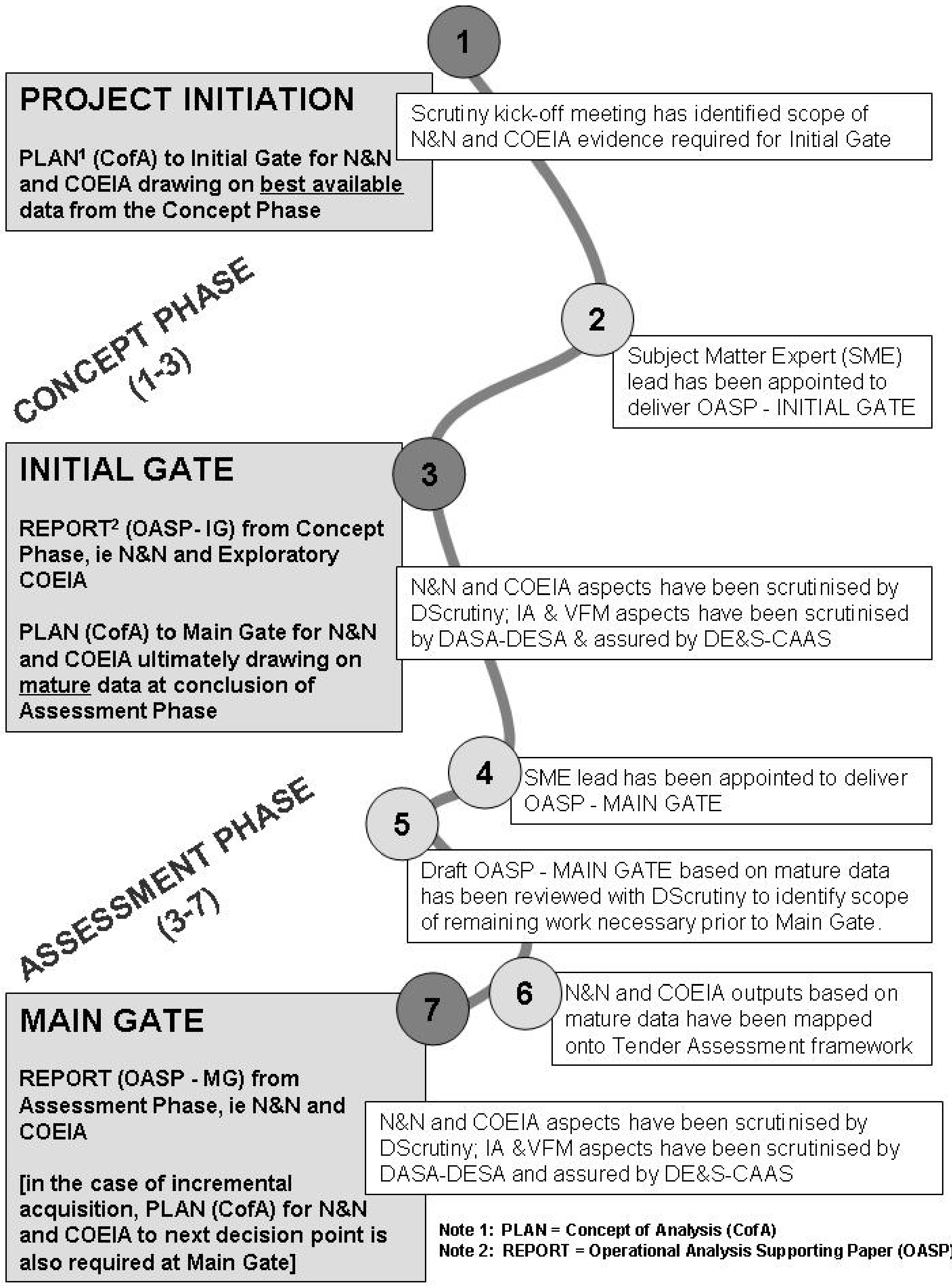
3.2.42 Indicate the format for presentation of N&N and COEIA results that will be reported. This may be an equivalent-cost comparison or an equivalent-effectiveness or benefit comparison (see paragraph 3.2.8).

3.2.43 There may be a case to consider equivalent annual cost (EAC) comparison of options where investment options with different whole life periods are to be examined. Guidance should be sought from DScrutiny and DASA-DESA in such circumstances.

**Mapping conclusions of N&N and COEIA on to Tender Assessment**

3.2.44 The mechanism for mapping N&N and COEIA conclusions onto the tender assessment process must be explained, typically drawing on the common medium of KURs. The mapping should aim to enable ready and rapid access to sensitivity assessment of the impact of trade-offs, e.g. to remain within an affordability constraint. To reduce the need for additional modelling at the tender assessment stage to a minimum, the N&N and COEIA should plan ahead to identify those PCT parameters that dominate in terms of their impact on overall effectiveness/benefit and WLC.

# Annex A: Typical Steps From Project Initiation To Main Gate



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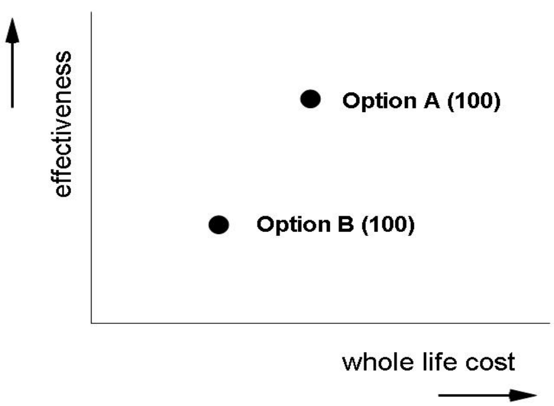
## ***Annex B: Why Cost-Effectiveness is Not a Single-Number***

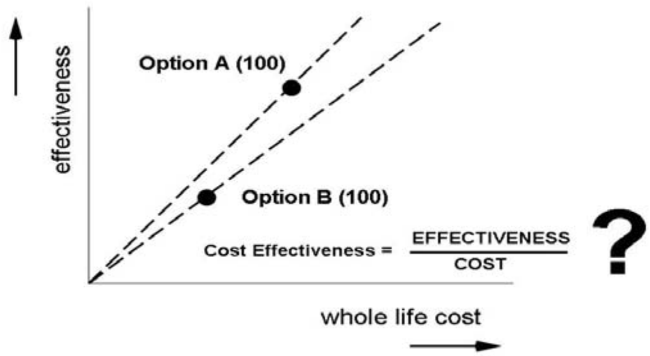
Cost-effectiveness often cannot be condensed into a single number (i.e. effectiveness / cost) because the relationship between cost and effectiveness is non-linear. Considering the example illustrated above, unit production cost is likely to increase with a reduction in total fleet size, leading to non-linear behaviour of the whole life cost estimates. Non-linear behaviour in operational effectiveness may also be expected with variation in the number of reconnaissance vehicles with consequent impact on tactical usage and deployment.

*Let us assume that we are aiming to buy a fleet of 100 scout vehicles. In this example, we will examine two options A & B. A measure of effectiveness has been derived via combat modelling together with…*

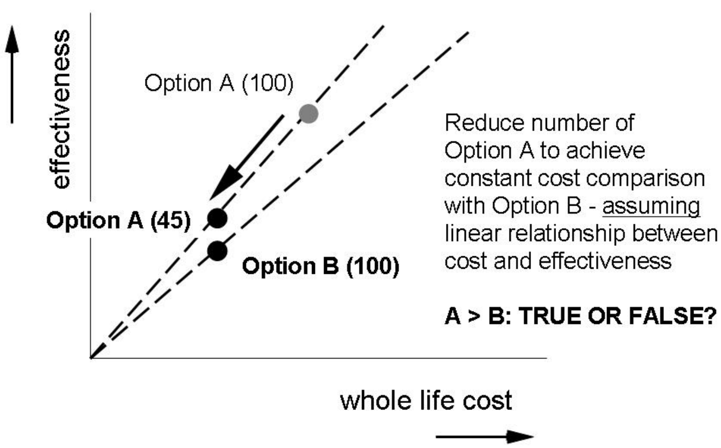
*…whole life cost (WLC) assuming a fleet of 100 vehicles for each option and plotted on the COEIA chart.*




*Let us now assume that only Option B (100 vehicles) falls within the bounds of affordability, ie Option A (100 vehicles) exceeds available funding in terms of acquisition cost. But what if we reduce the number of vehicles in Option A to achieve an approximate equivalent-cost comparison against Option B within the affordability constraint? (ie reduce the acquisition cost of Option A and recalculate the support cost to derive the revised WLC.)*

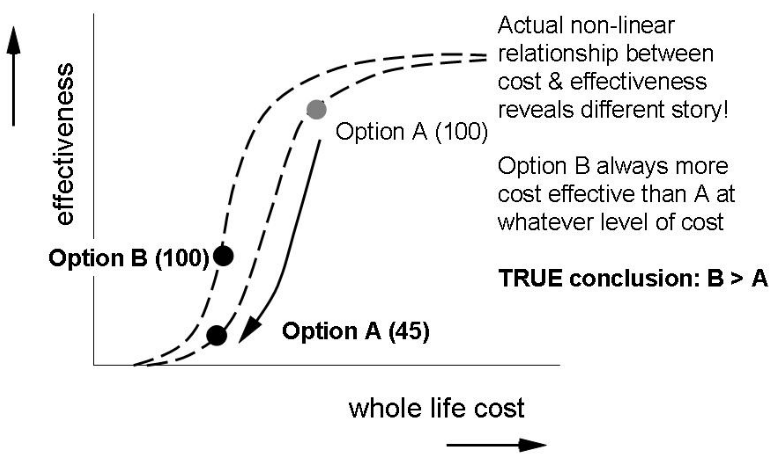



*The assumption of a linear relationship between cost and effectiveness (as represented by the dashed lines in the diagram above) leads to the conclusion that Option A (reduced fleet of 45 vehicles to achieve an equivalent-cost comparison with Option B) would provide a more cost effective solution than Option B(100 vehicles).*



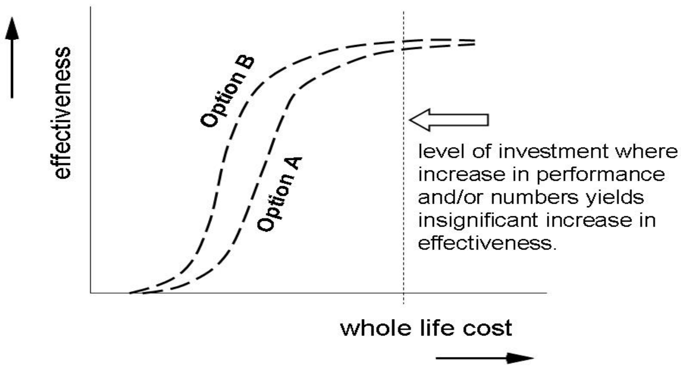

*A measure of effectiveness derived via re-run of combat modelling for the reduced fleet Option A(45 vehicles) together with re-assessment of WLC (assuming a reduced fleet of 45 vehicles) reveals a NON-LINEAR relationship between cost and effectiveness as illustrated in the chart. For example, unit production cost is likely to increase with reduction in total* *fleet size leading to non-linear behaviour of the WLC component. Non-linear behaviour in operational effectiveness may also be expected with variation in the number of scout vehicles with consequent impact on tactical usage and deployment. Thus the true conclusion is that Option B is always more effective than Option A at any level of equivalent-cost.*

*An identical conclusion is reached for comparison of options based on equivalent- effectiveness comparison where the whole life cost of Option B is always less than Option A.*




*Where the relationship between cost and effectiveness is non-linear, one requires mathematical representation of physical behaviour via modelling to capture:*

- *true equivalent cost (or equivalent effectiveness) comparison of Options A & B*
- *level of investment where increase in performance and/or numbers yields insignificant increase in effectiveness and, hence, renders further investment nugatory.*


effectiveness
Option B
Option A
level of investment where
increase in performance
and/or numbers yields
insignificant increase in
effectiveness.
whole life cost

# 3.3 FIXED ASSETS AND STOCKS

**3.3.1 This section discusses how the value of fixed assets and stocks should be taken into account in an investment appraisal.**

**3.3.2 Options that make use of fixed assets or stocks should include the cost of those assets. If the appraisal includes an option for the procurement of an asset, the appraisal must reflect the cash flows to acquire the asset. If the appraisal includes an option for utilisation of existing MoD assets, the appraisal must reflect the opportunity cost to use the asset.**

## ***Opportunity Cost***

3.3.3 All costs and benefits that are quantifiable should be valued according to their opportunity cost; ie the best alternative use foregone (paragraph 3.1.33). This is particularly important in the appraisal of projects involving land and buildings.

3.3.4 Opportunity costs should be entered in the year that an asset is first used. For assets in existing use for the purposes of the project this will be year 0.

3.3.5 It is recognised that establishing potential alternative uses for buildings and appropriate valuations for use in IAs might not be straightforward. Providing assumptions on opportunity costs used are clear, defensible and that sensitivity testing is undertaken where necessary to show that variations in these assumptions would not affect option rankings, this is usually sufficient.

3.3.6 When assets are disposed of or released for alternative use, the opportunity cost (depreciated as appropriate) must be entered as a receipt in the appraisal in the year that this happens.

### Valuation

3.3.7 The opportunity cost of an asset will be based on one of the following methods of valuation:

i) **Market Value.** This is the price at which a good or service could be bought or sold, and should be used wherever possible.

ii) **Depreciated Replacement Cost.** This is defined as the current replacement cost of the asset, adjusted for depreciation to reflect the asset's condition and age, and its functional, economic, and environmental obsolescence. These factors render the existing asset less valuable than a new replacement.

There are two approaches to depreciated replacement cost. One involves envisaging an exact replacement of the existing asset, which can be artificial if the skills and materials do not actually exist to replicate that asset. The second approach is to imagine a modern asset that is a functional substitute, even if it is smaller, or differently configured to reflect modern circumstances.

iii) **Existing Use.** This is an estimate of what it would cost to have the use of an asset similar to that being used. Appropriate valuations may be drawn from the Department's Fixed Asset Register.

iv) **Zero value.** Where there is clearly no alternative use for an asset and it cannot be disposed of, the opportunity cost will be zero. Such cases will be relatively rare, and full justification will always be required.

***Example.*** *A Glasgow-based MoD unit is considering moving to alternative accommodation in Glasgow. The unit currently leases its existing accommodation and there is a window of opportunity in the contract to break this lease at zero cost. The alternative accommodation is in a building that the MoD also leases but where this is no possibility of the MoD breaking this lease and it has many years to run. This alternative accommodation has spare office space and it is not possible for the MoD to sub-let this. There are no other MoD units in or around Glasgow that could move in and security considerations mean that no other public sector organisations could move in. In this situation it would seem that there is no feasible alternative use for the alternative accommodation, and its value might therefore be reasonably put at zero.*

## ***Residual Value***

3.3.8 If the life of the main asset is longer than the appraisal period required, a residual value can be assumed at the end of the project's life (see paragraphs 3.3.21, 3.3.26, and 3.3.45) and shown as an inflow at that point in time, as long as the capability or service being provided by the asset is likely to be required beyond the appraisal period (paragraph 3.1.24).

***Example:*** *An establishment that manufactures nuclear cores for submarines may have aphysical remaining life at the end of an appraisal period, but would have no residual value if it is known that successor submarines would be non-nuclear. There would, however, be remediation costs to consider.*

3.3.9 Even where an appraisal covers the full expected period of use of an asset, the asset may still have some residual value in an alternative use, in a second-hand market, or as scrap. These values should be included, and tested for sensitivity, as it may prove difficult to estimate the future residual value at the present time.

## ***Land and Buildings***

3.3.10 If a proposal involves the acquisition, management or disposal of legal rights in land and buildings, the value of those property rights needs to be taken into account, whether these interests are freehold, leasehold, a licence, or subsumed within a PPP/PFI contract. With new construction, the initial cost, lifetime costs and residual value will need to be considered.

3.3.11 The valuation of a site should be based on the most valuable possible use, rather than the highest value that could be obtained for its current use.

### Market Value

3.3.12 Wherever possible, 'open market' capital or rental values should be used. As noted above, valuation should normally be based on the alternative use with the highest market value. To assess the highest value reasonably obtainable, consideration must be given to the market demand for that use together with the planning situation.

3.3.13 Where the property has planning consent for a more valuable use, the valuation should reflect the market demand for that use. If there is a prospect of planning consent for an even more valuable use than that previously obtained, and there is a real economic demand for that use, then the appraisal should ignore both the existing use of the building and the existing planning consent. Instead, it should normally reflect the prospect of the best use and highest value of the site, in the way that the market would do.

3.3.14 If there is no planning approval, the potential for obtaining such approval should be estimated, and reflected in the valuation. Alternatively, the value of a property may be depressed by restrictions on development. It should be considered whether or not these can be lifted (and at what cost), and the result of this should be reflected in the valuation. In all cases, the prospect for obtaining a higher planning consent should be considered.

3.3.15 Property valuation is a complex area and professional advice should always be sought from Defence Infrastructure Organisation (DIO), who should be given sufficient time and authority to make all relevant investigations and inspections, and to hold any necessary meetings with local authorities.

**Depreciated Replacement Cost**

3.3.16 Where a property has been specifically designed, or has been extensively altered to meet a specific defence requirement, and there is only a limited or indeed no market for such modified property, it will be appropriate to use a value based on the 'depreciated replacement cost' (DRC) for the building, so long as there remains a defence requirement for the particular facility.

**Existing Use**

3.3.17 Where a property cannot be made self contained and offered with unrestricted access - i.e. the property is not 'alienable', an 'existing use' value can be used for both land and buildings if some alternative MOD or other central government use is reasonably likely within the near future. The existing use value would be based on an estimate of what a similar building would cost to rent or buy.

3.3.18 Including the value of land already owned means that an appraisal must also include the costs of retaining vacant land. It is sometimes argued that vacant land on MOD sites could not be used for any other purpose, because of the demands of security, and so the opportunity cost of this land is zero. However, it is generally possible, by the reorganisation of a land portfolio taken as a whole, to release land elsewhere. In practice, land that can be used for a MOD project nearly always has an opportunity cost.

3.3.19 Assessing the value of buildings in their most profitable use is fairly straightforward where the building can be readily adapted to different user requirements, such as standard office accommodation. However, many MOD properties may not be so easily adaptable to other purposes.

3.3.20 If there is no alternative use for the buildings, the property should be valued as the higher of:

- The value of the site, cleared of buildings and contamination and ready for redevelopment; or
- The value of the site and buildings in its current use.

## ***Cost elements: Land***

3.3.21 For options making use of existing land or where it is proposed to build new accommodation on the defence estate, the following cost elements will need to be considered:

- the value of the land at the beginning of the appraisal period;

- the residual value of land at the end of the appraisal period, which should reflect the best estimate of the real value at the end of the appraisal period;

- the disposal value of land sold or released during the appraisal period.

3.3.22 Estimates of future land values should be based on expert assessment, taking account of evidence reflecting long-term trends rather than short-term fluctuations. Although it can reasonably be argued that the value of land can be expected to rise in line with national income (since it is an asset whose supply is generally fixed), HM Treasury requirements to prevent Departments from holding onto assets to obtain real increases in value would normally prevent this assumption being adopted in IAs. The default assumption would be for the land to maintain its original real value (i.e. it does not depreciate or appreciate). Sensitivity testing can be undertaken where it can be expected that land values would rise (or fall) in real terms.

3.3.23 Where an appraisal option involves disposal of land, the market value of that land will need careful consideration. The future potential use of that site will have a significant impact on the market value. Advice may be sought from Local Authorities regarding the possibility of planning permission for the site; which would indicate a much higher market value than if the land were to be sold for arable use.

**Remediation costs**

3.3.24 Where disposal would require remediation for past contamination, these costs need to be included in the appraisal. Where land which is retained would need remediation, the cost of this remediation would need to be recorded as a future liability offsetting the residual value.

**Clawback**

3.3.25 Where land is to be disposed that requires remediation, contracts are sometimes entered into that entitle MOD to a share of any disposal proceeds following the contractor's remediation work. Likewise, in cases where it is likely that local authorities will give planning permission in the near future, MOD would expect to enter into a gain-share arrangement under which a share of the development proceeds would be clawed back by MOD. These potential future benefits to MOD must be included in an investment appraisal. However, care must be taken to avoid being too speculative, and depending on the level of certainty, it is probably best to deal with such issues in the risk and sensitivity analysis. Supporting evidence from DIO should be included in such cases.

## ***Cost elements: Buildings***

3.3.26 For options making use of existing freehold accommodation, or where it is proposed to build new accommodation on the defence estate, the following cost elements will need to be considered:

- for options making use of existing buildings, the value of those buildings along with any necessary refurbishment costs;
- for options involving new build, the cost of construction;
- regular maintenance and building running costs (heating, lighting, etc.);

- rates;

- the residual value of existing/new buildings, which are generally assumed to depreciate over time (though Service Family Accommodation and historic buildings should normally be assumed to maintain their real value. The residual value should reflect the market value of the building at the end of the appraisal. If there is no obvious market value, but continued MOD use beyond the appraisal period is reasonably likely, depreciated cost should be used;

- the disposal value of buildings sold or released during the appraisal period.

3.3.27 Costs for refurbishment and/or new build work will normally be provided by consulting chartered surveyors (through DIO). It is important to check the costings provided thoroughly to ensure that they properly reflect requirements, and to ensure consistency of assumptions between options, i.e. that like is being compared with like.

## ***Separable Value of Land and Buildings***

3.3.28 Land and buildings should be valued separately in an investment appraisal because, whereas the usual assumption is to hold land prices constant in real terms over time, the value of buildings (other than Service Family Accommodation and historic buildings) is usually assumed to decline over time. Separate records of land and buildings are likely to be kept in the fixed asset register.

3.3.29 However, should this not be the case, a technique to identify the separate values would be as follows:

a. assess the value of the site complete with buildings;

b. assess the theoretical value of the site without buildings;

c. the value of the buildings can be taken to be (a) minus (b).

## ***Disposal of Land and Buildings***

3.3.30 Departments have a duty to dispose of land and buildings surplus to requirements within three years and should not hold land speculatively. They are encouraged to obtain professional, specialist advice when doing this. The sale of freehold property, or the assignment or subletting of leasehold property, is likely to involve significant costs, (e.g. legal fees, marketing costs and removal costs). Situations can be complex where there is more than one occupier.

3.3.31 Where appraisal options include the release or disposal of assets, the estimated disposal receipts should be included in the appraisal regardless of whether the receipts may be utilized by the project or go directly to HM Treasury.

3.3.32 More detailed advice on property disposals can be obtained from the Office of Government Commerce (OGC).

***Example:*** *The table below presents two options. The first is to continue to use an existing building to deliver a defence output. The second is to relocate to a new building, on a different site. It is assumed that a new building would have a life of 40 years and that the existing building has 20 years of life remaining. Straight-line depreciation is assumed, so that after 20 years a new building will have half of its original value left. It is assumed that all construction is completed in Year 0 and that existing land and buildings are released at this time. Land and buildings are separated and land is assumed not to depreciate. Only opportunity costs, release values and residual values are presented. No running costs are included. The NPV figures are approximations, assuming a discount factor of 0.5 in year 19.*

| | *Year 0* | *Year 19* | *Yr 0-19* |
|---|---|---|---|
| ***Option 1*** ***Use existing building*** | | | |
| *Opportunity Cost and Residual Value of Existing Land* | *£4.0m* | *-£4.0m* | |
| *Opportunity Cost and Residual Value Existing Building* | *£6.0m* | *£0.0m* | |
| *Total* | *£10.0m* | *-£4.0m* | *£6.0m* |
| *NPV* | *£10.0.m* | *-£2.0m* | *£8.0m* |

***Option 2 New build***

| | | | |
|---|---|---|---|
| *Opportunity Cost Existing Land* | *£4.0m* | | |
| *Opportunity Cost Existing Building* | *£6.0m* | | |
| *Release Value Existing Land* | *-£4.0m* | | |
| *Release Value Existing Building* | *-£6.0m* | | |
| *Opportunity Cost and Residual Value New Land* | *£4.0m* | *-£4.0m* | |
| *Capital Expenditure and Residual Value New Building* | *£16.0m* | *-£8.0m* | |
| *Total* | *£20.0m* | *-£12.0m* | *£8.0m* |
| *NPV* | *£20.0m* | *-£6.0m* | *£14.0m* |

*The total NPV of <u>Option 1</u> is £8.0m, which consists of the opportunity costs for the land and existing building (which, since they are in year 0 and therefore subject to a discount factor of 1.0, are unchanged in present value terms) less the residual values. The residual value of the building is zero since it is assumed to have fully depreciated; the residual value of the land is the same as its opportunity cost as it is assumed not to depreciate. A discount factor of 0.5 is then applied, to arrive at the residual value in present value terms.*

*The total NPV of <u>Option 2</u> is £14.0m  In Year 0 the opportunity costs for the land and existing building are fully offset by their release values. It is assumed that an equivalent value of land is used for the site of the new building. This is entered in as a new opportunity cost. The capital cost of the new building is assumed to be £16m. The residual value of the new land utilised is the same as the original land utilised in option 1. The residual value of the building is half the capital cost using the above assumptions about economic life and straight-line depreciation. A discount factor of 0.5 is then applied, to arrive at the residual value in present value terms.*

*If we were to exclude all opportunity costs (but keep all release/residual values in) the NPVs of options 1 and 2 would be -£2.0m and £0.0m, respectively.[11] Option 1 still has the lowest NPV but the NPV gap is much smaller (£2.0m compared to £6.0m). To obtain the correct relative NPVs one would need to add the opportunity cost of the new land (£4.0m) to option 2.*

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[11] For option 1, year 0 is now £0.0m.  For option 2, year 0 is now £6.0m (the capital cost of the new building less the release values). The year 19 values are assumed to be unaffected in both options.

*This simple example can be extended to include two further options. Option 3 is to use an alternative existing building. This would involve releasing the existing land and buildings and utilising land and building elsewhere. On the assumption that the values of the land and building that are to be utilised are the same as those that are currently utilised, it can be shown (in the table below) that the total NPV is the same as that of option 1. This is what one would intuitively expect.*

*Option 4 is to demolish the existing building and rebuild on the same site. This involves a mixture of the costs from options 1 (the opportunity costs of the existing land & building) and 2 (the capital expenditure of the new building). However, the crucial difference to option 2 is that there is no release value for the existing building (as it is demolished). Thus the total NPV of this option is £6m higher than that of option 2.*

| | *Year 0* | *Year 19* | *Yr 0-19* |
|---|---|---|---|
| ***Option 3 Use existing building elsewhere*** | | | |
| *Opportunity Cost Existing Land* | *£4.0m* | | |
| *Opportunity Cost Existing Building* | *£6.0m* | | |
| *Release Value Existing Land* | *-£4.0m* | | |
| *Release Value Existing Building* | *-£6.0m* | | |
| *Opportunity Cost and Residual Value New Land* | *£4.0m* | *-£4.0m* | |
| *Opportunity Cost and Residual Value New Building* | *£6.0m* | *£0.0m* | |
| *Total* | *£10.0m* | *-£4.0m* | *£6.0m* |
| *NPV* | *£10.0.m* | *-£2.0m* | *£8.0m* |
| ***Option 4 New build on existing site*** | | | |
| *Opportunity Cost and Residual Value Existing Land* | *£4.0m* | *-£4.0m* | |
| *Opportunity Cost and Residual Value Existing Building* | *£6.0m* | | |
| *Capital Expenditure and Residual Value New Building* | *£16.0m* | *-£8.0m* | |
| *Total* | *£26.0m* | *-£12.0m* | *£14.0m* |
| *NPV* | *£26.0m* | *-£6.0m* | *£20.0m* |

*The opportunity cost of the building that is to be demolished is key. Obviously, the higher the value that is used here, the less likely it will be that demolition will emerge as value for money in the IA. It should always be considered whether the value used (market value or depreciated replacement cost) is realistic. Sensitivity analysis should be undertaken.*

## ***Land and Buildings used by British Forces Germany***

3.3.33 There are some factors that appear to be particular to the situation in Germany.

i) MoD does not own land, nor does it pay rental/leasing charges for it (except where part of the charge is part of leased SFA);
ii) Any new build can usually only be on the same site as the original building.
iii) MoD "owns" buildings in the sense that it has paid for their construction but there are major constraints in terms of how the MoD could realise any value from releasing them;
iv) The MoD has certain obligations in terms of leaving land and buildings in their original state (dilapidations charges);

3.3.34 On iii) and iv) the question of receipts or dilapidations in BFG is dependent upon how the property was acquired:

i) *Federal Property acquired using Operational, Mandatory or Support (OMS) funding.*

Federal property acquired using OMS funding does not attract dilapidation costs. It might attract receipts if BFG has made improvements to the property post build and the federal authorities have been able to sell the property at a profit.

ii) *Federal Property, including Jacklin property, provided to BFG free of rent by the federal authorities.*

BFG is required to return federal property in this category in a reasonable state of repair. If the property is below standard there could be a case for dilapidation charges. Equally, if BFG has made improvements then there could be a case for receipts.

iii) *Sterling funded new builds.*

Sterling funded new builds are new builds on federal land made available at no cost. If the federal authorities are able to sell the property then there would be an entitlement to receipts based on a percentage of the selling price after deducting the cost of the land.

3.3.35 In considering receipts from federal property it should be remembered that these accrue to DIO and are allocated to the global settlement pot which is used to offset the cost of dilapidation payments for federal property. It is also not unusual for it to take several years for agreement to be reached on any final settlement for receipts or costs for federal property. This is because receipts or costs are dependent on how quickly the federal authorities are able to dispose of the property or indeed are able to dispose of it at all. It is therefore likely to be difficult to establish with any high degree of certainty any receipts and dilapidation charges relating to specific assets. Nevertheless, best assessments of these should be included in IAs, with sensitivity analysis used to address considerable uncertainties involved.

**Leased Property**

3.3.36 BFG leases property, mainly SFA, on the commercial market. BFG is required to return leased property in a good state of repair. Since BFG does not make improvements to leased property, there are no receipts. BFG is responsible for the payment of agreed dilapidation charges to the landlord when the property is returned.

**Buildings**

3.3.37 Assuming there is an on-going MOD requirement for which the buildings could contribute to there would still be an opportunity cost and residual value (if the requirement is still there at the end of the appraisal period). Assuming we cannot sell the buildings this opportunity cost could only be the depreciated replacement cost. Should there be uncertainty about the enduring nature of the requirement sensitivity analysis should be undertaken on the residual value of the buildings. For example, this could highlight that new build is better VfM than refurbish an existing building only if we stay in Germany for x number of years.

**Land**

3.3.38 The same principles apply, although there are two uncertainties:

i) the degree of "competing MOD uses" for the land;
ii) the valuation of any opportunity cost.

3.3.39 On i), if the land that the MoD has free use of in Germany was plentiful and there are relatively few competing MoD uses (since the land is in Germany) then the opportunity cost is zero. Conversely, if the land that the MoD has free use of in Germany was in relatively short supply and there were many competing MoD uses, the opportunity cost would be the "market value" for the use of that land. For example, if there were two options in an IA for new build in Germany and one of these used twice the amount of land as the other we would wish to reflect this in the IA.

3.3.40 There will always be a need to review these issues on a project by project basis. If opportunity costs are possibly a discriminator between options, sensitivity analysis on this (and therefore also residual values) should be undertaken. In many cases, which use approximately the same amount of land in the same geographical area, opportunity costs for land won't be a discriminator between options.

## ***Options Using Service Accommodation***

3.3.41 Options using Service Family Accommodation (SFA) or Single Living Accommodation (SLA), will need to include costs to reflect such occupation.

3.3.42 Where new build accommodation is required, the costs will depend upon the likely method of procurement. If the building work is to be funded in the traditional manner (i.e. MOD-funded), the appraisal should include those elements identified in 3.3.26. If procured through the Private Finance Initiative (PFI), the payment stream to the PFI provider should be included in the appraisal.

3.3.43 The occupants will pay charges set by the Armed Forces Pay Review Body (AFPRB). This must be included in the appraisal, which will offset the cost to MOD of providing this accommodation.

3.3.44 The existence of an over-arching strategy or policy for Service Accommodation such as Single Living Accommodation Modernisation (SLAM) or Regional Prime Contracting (RPC) does not remove the need to demonstrate value for money in individual projects, unless the project is within the threshold set for Estates projects to adopt RPC. The value for money requirement is to show that the over-arching policy is delivering value for money, and that the individual project is coherent with the policy.

**Time Horizon**

3.3.45 The default economic life of SFA and SLA should be assumed to be 25 years. This is consistent with the DIO Core Site Strategy, and with the time at which major refurbishment would become necessary.

**Service Family Accommodation**

3.3.46 Where SFA is owned by Annington Homes, the IA should normally include the rent payable by MOD (figures available from DIO). This assumes that, if not used by MOD, SFAs would otherwise be surrendered. This is a simplified working assumption to be followed unless there is actual information to the contrary. A similar approach is required for bulk lease hire.

3.3.47 SFA that is not part of the Annington Homes Estate should be included in the investment appraisal in accordance with paragraphs 3.3.26 – 3.2.27 above. SFA is normally assumed to maintain its real value over time in the assessment of any residual value.

3.3.48 Where refurbishment is being considered as an alternative to new build, the cost elements assumed for the refurbishment option need to be justified, drawing on evidence from previous projects and / or site investigations. Receipts from feed-in tariffs resulting from compliance with Ecohomes standards should be quantified based on data from Department for Environment and Climate Change (www.decc.gov.uk), noting the limitations being introduced to the scheme that would impact on future projects.

## ***Equipment***

3.3.49 Equipment should be reflected in an investment appraisal using the same approach described for land and buildings above. Where equipment is purchased or redeployed on a project, the following cost elements should be included:

- cost of new equipment at beginning of appraisal period; or
- opportunity cost of redeployed equipment already owned by MOD;
- annual maintenance costs, running costs and service charges;

- fuel costs;
- the residual value of equipment at the end of the appraisal period;
- the disposal value of any items of equipment sold or released during the appraisal period.

3.3.50 The opportunity cost of equipment should normally be its market value. If it has been specifically designed or has been extensively altered to meet a specific defence requirement, there may be no readily available market value, in which case it will be appropriate to use a value based on depreciated replacement cost (DRC).

3.3.51 The residual value of equipment should reflect depreciation of the cost or opportunity cost of the equipment, over its estimated life. Where an appraisal is assessing the procurement of equipment, the appraisal period will normally be the equipment's estimated useful life; in which case the residual value would be zero, unless the equipment is expected to have any scrap value.

***Example.*** *An appraisal option requires the use of four vehicles to meet the service requirement The option will utilise existing vehicles that have a number of alternative uses. The vehicles are three years old and have an estimated life of seven years.*
*Estimated market values of £10,000 for each vehicle have been taken from the fixed asset register. A new vehicle of a similar type would cost £21,000.*
*The appraisal period for the project under review is set at 10 years.*

| ***<u>Year</u>*** | *0* | *1* | *2* | *3* | *4* | *5* | … | *10* |
|---|---|---|---|---|---|---|---|---|
| | *£k* | *£k* | *£k* | *£k* | *£k* | *£k* | | *£k* |
| *Vehicles-opportunity cost* | *40* | | | | | | | |
| *Vehicles-new purchase* | | | | | *84* | | | |
| *Vehicles-residual value* | | | | | | | | *(12)* |

*Given the estimated life of the vehicles, replacements would need to be purchased at the end of Year 4. The residual value of the original vehicles is assumed to be zero.*

*At the end of the appraisal period, the vehicles purchased at the end of Year 4 would have one year of useful life remaining. The residual value of these vehicles is calculated as their depreciated cost:*

| | | |
|---|---|---|
| *Depreciation charge per year* | = *£21,000 x 4 vehicles ÷ 7* | = *£12,000* |
| *Total depreciation charged* | = *£12,000 x 6 years* | = *£72,000* |
| *Residual value* | = *£84,000 - £72,000* | = *£12,000* |

## ***Leased or Rented Assets***

3.3.52 Where an asset is to be leased or rented, the following cost elements will need to be included:

- rental payments over the appraisal period;
- fitting out costs (where necessary);
- annual maintenance costs, running costs and service charges;
- any dilapidation payments on termination of lease.

***Example.*** *Assume property is to be rented at a rate subject to a 5 yearly open market review.*

*The market rate for this property is estimated at £0.6m, and is assumed to increase in line with general inflation each year throughout the appraisal period.*

*Fitting out costs are estimated at £0.5m.*
*Annual maintenance and utilities costs are estimated at £0.1m.*
*Annual rates costs are estimated at £0.2m.*
*Provision for dilapidation on termination of lease £0.5m*

*All figures are stated in constant prices as at Year 0.*
*The appraisal period is set at 25 years.*

| *Year* | *0* | *1* | *2* | *3* | *4* | *…* | *25* |
|---|---|---|---|---|---|---|---|
| | *£m* | *£m* | *£m* | *£m* | *£m* | | *£m* |
| *Rent* | | *0.6* | *0.6* | *0.6* | *0.6* | | *0.6* |
| *Fitting out costs* | | *0.5* | | | | | |
| *Maintenance/utilities costs* | | *0.1* | *0.1* | *0.1* | *0.1* | | *0.1* |
| *Rates* | | *0.2* | *0.2* | *0.2* | *0.2* | | *0.2* |
| *Provision for dilapidation* | | | | | | | *0.5* |

*Notice that maintenance and utilities costs are assumed to start in Year 1. Fitting out costs are assumed to be incurred in Year 1.*

3.3.53 Rental payments may be fixed for defined periods and subject to regular rent reviews. It is important in an investment appraisal to use current market rents, rather than necessarily the actual pattern of rental payments, because this is the true opportunity cost. If rented equipment that is not currently being productively used is utilised on a project, its opportunity cost would be zero.

3.3.54 For property rentals, advice should be sought from DIO on what assumptions should be made about future movements in market rents. In the absence of any market information to the contrary, a reasonable working assumption might be to assume constant real rents, although this is likely to depend very much on whether the lease includes both land and buildings, and in what proportions.

***Example.*** *Assume property is to be rented at a rate subject to a 5 yearly open market review. The market rate for this property is estimated at £0.6m.*

*Between rent reviews, rental payments are fixed in nominal terms. Assume that at each review the rent will return to the original real value.*

*Fitting out costs are estimated at £0.5m.*
*Annual maintenance and utilities costs are estimated at £0.1m.*
*Annual rates costs are estimated at £0.2m.*

*All figures other than the rental payments are stated in constant prices as at Year 0.*
*Inflation is assumed to be 2% per annum.*
*The appraisal period is set at 25 years.*

| *Year* | *0* | *1* | *2* | *3* | *4* | *5* | … | *25* |
|---|---|---|---|---|---|---|---|---|
| | *£m* | *£m* | *£m* | *£m* | *£m* | *£m* | | *£m* |
| *Rent* | | *0.588* | *0.576* | *0.565* | *0.554* | *0.6* | | *0.6* |
| *Fitting out costs* | | *0.5* | | | | | | |
| *Maintenance/utilities costs* | | *0.1* | *0.1* | *0.1* | *0.1* | *0.1* | | *0.1* |
| *Rates* | | *0.2* | *0.2* | *0.2* | *0.2* | *0.2* | | *0.2* |

*Notice that maintenance and utilities costs are assumed to start in Year 1.*

*Fitting out costs are assumed to be incurred in Year 1.*

*As inflation is assumed to be 2% per annum, the rent in real terms declines by 2% per annum in each of the years between reviews.*

*The calculation for rent in Year 1 is: £0.6m x 100 ÷ 102 = £0.588m.*

**Sunk costs**

3.3.55 Where a relocation is being appraised and the existing location is rented under a contract that cannot be cancelled and has time to run; any rent that is payable on the property would be treated as a sunk cost. This is because the rent on the existing property would become a transfer payment, as no goods or services would be exchanged for the rental payment.

## ***Stocks***

3.3.56 Where a project utilises stores that are held in stock by the Department, the relevant cost to the project of using these items is their replacement cost. This is the opportunity cost of the stores because if they are used on the project being appraised, they will need to be replaced for their original intended use, requiring the Department to carry additional stock.

3.3.57 If the stores have no other use than for the project being appraised, the cost to the project would be the disposal value of the stocks. The cost in this case represents the foregone opportunity to dispose of the stocks, as the project prevents a reduction in existing stock levels.

3.3.58 It is usual to assume that stocks will be released from the project at the end of the project's life, which will result in an opportunity benefit (or a residual value), in the final year of the project.

***Example***

*A project will utilise stocks that are currently held by the Department, and which will have to be replaced to meet the current requirements. The replacement cost of the stock is £2m. The project life is 10 years.*

| ***Year*** | ***0*** | ***…*** | ***10*** |
|---|---|---|---|
| *Stock: opportunity cost* | *£2m* | | |
| *Stock released (benefit)* | | | *(£2m)* |

***Example***

*A project for future through-life support of a helicopter fleet has two possible options for delivery:*

a) *In-house;*
b) *Contractor logistic support with the platform Design Authority.*

*Existing stocks are valued at £20M. Under option (b), the contractor will acquire the existing stocks at a notional value of £11m. This will be spread through the life of the contract by reducing the annual payments to the contractor.*

*The appraisal of both options should record the opportunity cost of stock in Year 0. Assuming the existing value of £20m represents the opportunity cost, this is the starting position for both options. As the project covers the remaining life of the helicopter platform, any stocks remaining at the end of the project would have zero value, so there is no residual value to consider in either option.*

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# ***Annex A: The Importance of Opportunity Costs***

## Example 1: Private Sector Electricity Plant on MoD Land

In the example below a private sector company states that it will give the MoD a 5% discount on its electricity for the next 20 years if the MoD allows it to build an electricity plant on its land without charge. Without any opportunity cost this looks a good deal, the total NPV of this option over 20 years is £14.0m compared to £14.7m for the status quo. (The example uses a constant real cost for electricity; in practice energy costs might be expected to rise in real terms which would make a percentage discount more valuable.) However, if the land had an opportunity cost of £2m this would not be a good deal, with the NPV of this option rising to £15.0m.  Omitting the opportunity cost would give an incorrect option ranking.

| | Yr 0 | Yr 1 | Yr 2 | ….. | Yr 19 | Total |
|---|---|---|---|---|---|---|
| Option 1 As-Is | | | | | | |
| Electricity Cost (£m) | 1.0 | 1.0 | 1.0 | ….. | 1.0 | 20.0 |
| NPV | 1.0 | 0.97 | 0.93 | ….. | 0.52 | 14.7 |
| | | | | | | |
| Option 2 Electricity Plant | | | | | | |
| Electricity Cost (£m) | 0.95 | 0.95 | 0.95 | ….. | 0.95 | 19.0 |
| NPV | 0.95 | 0.92 | 0.89 | ….. | 0.49 | 14.0 |
| MoD Land Opportunity Cost and Residual Value | 2.0 | | | | -2.0 | 0.0 |
| NPV | 2.0 | | | | -1.0 | 1.0 |
| Total NPV | | | | | | 15.0 |

## Example 2: Sell-Off or Retain MoD Oil Pipeline

In this example a comparison is being made between the MoD selling an oil pipeline that it owns and retaining it. The first half of the table shows that without including the opportunity cost (anticipated sale receipt) of the pipeline there is a clear NPV advantage for the sale option, option 2 (-£53.0m compared to £0.0m). The sale receipt more than offsets the service charge that the MoD would have to pay to the new owner for the services from the pipeline. However, this comparison notably fails to take into account that under option 1 the MoD still owns the pipeline at the end of the appraisal period. Putting in the opportunity cost of the pipeline would have helped to identify this key omission. In the second half of the table it is assumed that the pipeline has an economic life of 60 years and would therefore depreciate by a third after 20 years. Under this and the other assumptions used, option 1 (retain the pipeline) has a lower NPV and this represented better VfM. Omitting the opportunity cost would give an incorrect option ranking.

| | Yr 0 | Yr 1 | Yr 2 | ….. | Yr 19 | Total |
|---|---|---|---|---|---|---|
| Option 1 As-Is (Retain) | | | | | | **0.0** |
| | | | | | | |
| Option 2 Electricity Plant | | | | | | |
| Service Charge | 10.0 | 10.0 | 10.0 | ….. | 10.0 | 200.0 |
| NPV | 10.0 | 9.7 | 9.3 | ….. | 5.2 | 147.0 |
| Sale Receipt | -200.0 | | | | | |
| NPV | -200.0 | | | | | -200.0 |
| | | | | | | |
| Total NPV | -190.0 | 9.7 | 9.3 | ….. | 5.2 | **-53.0** |

| | | | | | | |
|---|---|---|---|---|---|---|
| Option 1 As-Is (Retain) | | | | | | |
| Opportunity Cost and Residual Value | 200.0 | | | | -133.3 | |
| NPV | 200.0 | | | | -69.2 | **130.8** |
| | | | | | | |
| Option 2 Electricity Plant | | | | | | |
| Opportunity Cost | 200.0 | | | | | |
| NPV | 200.0 | | | | | 200.0 |
| Service Charge | 10.0 | 10.0 | 10.0 | ….. | 10.0 | 200.0 |
| NPV | 10.0 | 9.7 | 9.3 | ….. | 5.2 | 147.0 |
| Sale Receipt | -200.0 | | | | | |
| NPV | -200.0 | | | | | -200.0 |
| | | | | | | |
| Total NPV | 10.0 | 9.7 | 9.3 | ….. | 5.2 | **147.0** |

In summary, opportunity costs are only common where every option in an IA starts with the same land and buildings (or other assets) and this stays the same throughout the whole appraisal period. Even where this is the case, we have seen from Section 3.1 that common costs should normally be included in IAs. However, it will usually be the case that different options in IAs will have variations in the land and buildings they use during the lifetime of the project. Omitting opportunity costs can therefore seriously distort the comparison of options. It may be possible to arrive at the correct relative NPV position of options by including the opportunity costs of additional land and buildings used in options (i.e. over and above those assets used to start with by all options) and by appropriate treatment of release/residual values. However:

- if opportunity costs are obtained for additional land and buildings used it should be little more difficult to obtain them for existing land and buildings;
- selective inclusion of opportunity costs raises scope for error;
- it would be illogical to include disposal values for assets for which the opportunity cost has not been included;
- without starting values how would release/residual values be calculated?

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# 3.4 PERSONNEL COSTS

**3.4.1 In many business areas within Defence, personnel costs form a significant part of total costs and these costs will tend to increase in real terms as earnings tend to rise in line with average increases in productivity. Changes to personnel, whether reductions in numbers or attempts to overcome turnover, are hard to achieve instantly. It is thus important that personnel costs, and changes in these costs, are estimated as accurately as possible. This section discusses how personnel costs and adjustments in them should be treated in an investment appraisal.**

## *Introduction*

3.4.2 The personnel costs associated with delivery of a service or capability need to be considered as part of an appraisal. Where personnel changes are being considered, the costs of transition from the current state to the future state should be properly thought through, balancing the need to cost all the impacts fully with the analysis being proportionate to the change being considered.

3.4.3 Full account should be taken of recruitment, relocation, and/or redundancy costs, and realistic timescales used. If it is envisaged that personnel would be transferred geographically or occupationally, this should be made explicit, and the contingency that transfer would not prove possible discussed and costed. Undesirable transition effects on labour force structure, such as shortages of particular skills, (see paragraph 3.4.34 below) may also incur amelioration costs and these should be included.

3.4.4 Changes in the outputs or service delivered by any changed personnel arrangements should be clearly explained. In the case of personnel reductions, it should be made clear what outputs, if any, would cease. If personnel numbers are to be reduced but outputs are not to be reduced, or to be reduced by less than the reduction in staffing, evidence that the increased average workload could be accommodated should be presented. If it is envisaged that work would be transferred to another area, the explicit acceptance of this by the area concerned should be obtained and presented and any costs appraised.

3.4.5 There is considerable variation in local staffing costs, both in terms of seniority in grade/rank at different locations, geographical Recruitment and Retention Allowances (RRA), and local labour market conditions. It is thus highly desirable that when costing proposals, estimates that take account of local staff mix, local staff costs, including typical travel and subsistence, and local wastage rates are used wherever possible. National rates should only be used as a last resort.

## ***Capitation rates***

3.4.6 Appraisals should focus on the incremental or avoidable costs and savings that would arise from the proposal. Changes in overheads, such as accommodation, healthcare, and training, should only be included where achievable as part of the overall proposal and evaluated directly. Thus "all-up" capitation rates, such as those used for full costing under the Wider Markets Initiative are **not** generally appropriate and should not be used.

3.4.7 Capitation rates should be computed to reflect local conditions as far as possible. They should be calculated separately for each grade/rank, and for each year of the appraisal period. They should, in general, comprise:

- Basic pay (National or London scales)
- Non-consolidated pay ("bonuses")
- London Weighting, where payable
- Recruitment and Retention Allowances payable
- Market Supplements payable
- Employers' national insurance contributions (ERNIC)
- Allowance for pension costs (SCAPE)
- Travel and Subsistence but only where local expenditures can be identified[12];
- Locally purchased training, but only where specific to the posts in question[13];
- Ground Training for military personnel (20% RAF, 26% Army, 32% RN /RM).

[12] But not a generic T&S allowance.
[13] The costs of training provided centrally should not be included. The developmental training of staff to be transferred should also not be included.

3.4.8 The following items should only be included where the option explicitly includes means to change these overheads and should be assessed directly, rather than rely on apportioned amounts in the full cost pay capitation figures:

- Centrally provided training;
- Accommodation costs[14];
- Any other overheads (e.g. healthcare, logistics support).

## ***Modelling Personnel Costs***

3.4.9 Forward costing has been complicated by the announcement of a two-year pay freeze for the whole of the public sector, mitigated by allowable increases of at least £250 for those earning less than £21,000 a year. DASA assumptions for PR12 are:

**Civilian personnel**

| 2011/12 change from prev yr | 2012/13 change from prev yr | 2013/14 change from prev yr | 2014/15 change from prev yr | 2015/16 change from prev yr | 2016/17 change from prev yr |
|---|---|---|---|---|---|
| +1.0% | 0% | +0.5% | +0.75%[15] | +1.5% | +3.0% |

**Military personnel**

| 2011/12 change from prev yr | 2012/13 change from prev yr | 2013/14 change from prev yr | 2014/15 change from prev yr | 2015/16 change from prev yr | 2016/17 change from prev yr |
|---|---|---|---|---|---|
| +1.35% | +1.0% | +3.0% | +4.5% | +4.5% | +4.5% |

The above figures are in nominal (cash) terms, and will need to be converted into real terms for use in an appraisal. DASA DESA should be consulted for more rank / grade specific details.

3.4.10 For costs after 2016/17, a 4.5% annual increase in nominal (cash) terms should be assumed for both civilian and military personnel.

[14] The impact on accommodation need should be noted in the appraisal, but it is up to Defence Estates to optimise the use of the estate as a whole. This could for example involve moving other units into accommodation being vacated so that savings may be realised in a quite unrelated location.
[15] Assumes that the withdrawal of non-consolidated pay ("bonuses") in 2011/12 is reversed.

## ***Redundancy Costs***

3.4.11 Redundancy costs need to be considered in an appraisal, unless the numbers and rate of reduction in staff can be demonstrated to be less than estimated likely natural wastage levels. The Civil Service Compensation Scheme terms were amended with effect from 22 December 2010 to a payout limit of 21 months' pay for voluntary redundancy and 12 months' pay for compulsory redundancy.

3.4.12 The cost of a redundancy payment should normally be included in an investment appraisal, even though it is strictly speaking a transfer payment. This is because most MoD redundancies have involved staff taking early retirement and therefore at least partly withdrawing from the labour force. Even though this may be rarer with the change in the CSCS terms, redundancy payments provide a cushion allowing individuals longer periods of job search and consequently are still likely to give rise to effects on labour supply. It is particularly important to consult DESA in these cases. The cost of the redundancy package can, normally, be reasonably assumed to equate to the economic loss associated with this reduction in the labour supply.

3.4.13 In the case of locally employed civilians (LECs) overseas, redundancy costs should normally be included as although any withdrawal from the labour force does not impact on the UK economy payments to foreign citizens represents a resource cost to the UK economy.

## ***Relocation Costs***

3.4.14 In appraisals considering the possible relocation of personnel, an estimate needs to be made of the proportion of mobile staff likely to relocate. This should be based on evidence from recent relevant comparator projects. Appropriate rates for civilian allowances and costs may be obtained from PPPA (20100801 – Change of work location and Travel and Subsistence Rates V1 –U). Default relocation costs for 2010/11 that may be used in an appraisal are:

| | |
|---|---|
| Civilian relocation cost per capita | £1,253 |
| Military relocation cost per capita | £25,625 |

## ***Output Efficiencies***

3.4.15 Some efficiency proposals will seek to deliver benefits that cannot be realised in cash from a physical reduction in personnel numbers. In many areas relating to reducing inputs of civilian staff, proportionate savings in staff time (so called 'fingers and toes') that do not translate into measurable reductions in civilian staff, or a measurable and desired increase in outputs, should not normally be included in an appraisal.

3.4.16 However, for benefits involving reductions in the number of military personnel the position is slightly different in that savings in military personnel are often not taken in cash but rather through redeployment to more front line or higher value military tasks (e.g. training/reducing overstretch in the absence of full manning). This should be included as a benefit in the appraisal, as long as evidence can be presented to support the delivery of an output benefit.

## ***Modelling personnel numbers***

3.4.17 Manpower models estimate the end-period personnel numbers by taking the period-start and then modelling the various in-period changes. There are a number of standard flows in and out of the personnel numbers including: recruitment, exits due to natural wastage, exits due to management policies, moves/relocations. The accuracy of the costs of transition will depend on both accurate modelling of the flows and the costs associated with each.

### Natural wastage

3.4.18 When considering changes to staffing numbers, account should be taken of normal staff turnover. Retirements, resignations, medical and other exits will continue to occur and some assessment needs to be made of their impact on the staffing profile during the appraisal period. Thus if a staff reduction over a number of years is contemplated, an estimate should be made of likely staff exits that would occur in any event. Such a rate will focus on exits that may be deemed to be independent of management action, such as resignation, age - or medically-related retirement. Transfers to other government departments may or may not be included in the exit rate calculation according to the prevailing economic conditions.[16]

3.4.19 This exit rate is likely to be related to both the age and length of service structure of the current workforce and the geographical location, as well as state of the (local) labour market, which will reflect economic conditions. As with pay rates, estimates of wastage rates used in appraisals and business cases should reflect local conditions as far as possible.

3.4.20 The profile of wastage rates would also be expected to vary over time to take account of expected economic activity. These factors are set by DASA to ensure consistency of approach. It should be noted that the last three years have seen historically low wastage rates. By 2014/15, it is assumed that rates will return to historical levels.

3.4.21 DASA(QuadService) Team can be contacted about suitable rates to be used[17].

**Disestablishing Posts**

3.4.22 Disestablishing a post will incur costs both due to the processes necessary around disestablishment and any exit payments made to postholders. It is recognised that there is a time lag between declaring an occupied post to be disestablished[18] and its eventual vacation. Even if the post-holder is put into the Redeployment Pool, the employing unit is still responsible for the staff costs until the employee moves to a new post or leaves the Department.

3.4.23 Default proportions of staff reductions that may be counted as effective are promulgated by ACDS(S&P)Strat-Man. The appropriate protocol assumption to adopt will be dependent on the scale of anticipated staff reductions.

[16] If public bodies in general are not recruiting staff, it makes little sense to include outward transfers to OGD's as events that can be assumed to continue as in the past.
[17] As a working rule, a population of least 100 is needed to compute a reasonably robust wastage rate. This may involve pooling a few years' data and/or a larger geographical area than a single site.
[18] And this must await Trade Union consultation, for which 30 working days are allowed.

## ***Structural issues and transition***

3.4.24 It is important to identify and expose any undesirable transition effects resulting from proposals involving personnel change. For example, it may be possible to reduce personnel numbers by freezing recruitment for a particular group, but this may be undesirable if a continuous throughput of new recruits is necessary to maintain delivering output. In this case amelioration in the form of apparently unnecessary recruitment or extra redundancies would have to be examined.

3.4.25 Where proposals would make more than marginal changes to the numbers in particular military trades, specialism, or branches, the manpower planning section of the PPO should be consulted, and their views on any structural implications for the trade or branch concerned recorded. In some cases changes may be "red carded" if they would do major structural damage. DASA Single Service manpower branches can provide modelling and forecasting assistance down to branch/trade/specialisation level in many cases.

3.4.26 Similarly, where a proposal would make more than marginal changes to the numbers in particular civilian professional groups, trades or specialism Heads of Profession or Trades Managers should be consulted about options. Further modelling may be needed if recruitment, training and promotion would be required to maintain an appropriate skills mix, as there may be consequential increased reductions of posts in other areas.

## ***Transfer of Undertakings (Protection of Employment) Regulations 2006 (TUPE)***

3.4.27 When activities current carried out by the Department are the subject of a business change review, and there is an option of commissioning the future delivery of the activity or service from another supplier, (i.e. a commercial company, charity, an organisation in the National Health Service, a Non Departmental Public Body or an employee spin-off Mutual or cooperative arrangement) under contract arrangements this is commonly referred to as Outsourcing. In these circumstances it is probable that a "relevant transfer" as defined in the Transfer of Undertakings (Protection of Employment) Regulations 2006 – (TUPE) will be created.

3.4.28 The TUPE Regulations give employment rights and protection to all staff that are in anyway affected by the transfer situation. The most significant of these is for those staff who currently perform the activity or service as their "principal purpose" (i.e. the work that they do the most of, or which has the most value). TUPE gives the staff the right to transfer to the commissioned supplier on the same employment terms and conditions that they with the Department, although some limited variations are permitted. Under Asset Management initiatives where part of a TLB business areas or a Trading Fund Agency may be sold this situation can also be a "relevant transfer" as defined in the TUPE regulations. Again the staff working that business area would have the right to transfer to the purchaser or company that will operate its services after completion of the sale.

3.4.29 TUPE places legal obligations on the Department and the commissioned supplier, which include the transfer of information and informing and consulting activities with employees' representatives (i.e. Trades Unions representatives).

3.4.30 If the Department intends to bring services currently performed by a commissioned supplier in-house, irrespective of the whether they were previously Outsourced or not, this can also be a "relevant transfer" and TUPE would apply. This is commonly referred to as Insourcing. The effect is that staff of the supplier will have the legal right to transfer into the Department.

3.4.31 The transfer of current pension arrangements (covering benefits for old age, invalidity or survivors) is not covered in the TUPE. The Pensions Act 2004 and supporting Transfer of Employment (Pension Protection) Regulations SI 2005/649 provides some protection – employees currently in an occupational pension scheme must be offered an occupational pension following the transfer but it does not have to match the original pension scheme. However, the Government's Fair Deal (for Staff's Pensions) policy19currently goes further by requiring the following arrangement to be made for Civil Servants that are subject to a TUPE transfer:

- The staff must be offered a pension scheme that provide "broadly comparable benefits" to the current public sector pension scheme that they belong to, (for example the Principal

[19] April 2011 - The Fair Deal policy is currently the subject of public consultation, following recommendations in Lord Hutton's review of public sector pension arrangements that it requirements may not be sustainable. A decision on the future of Fair Deal is expected in the summer 2011.

Civil Service Pension Scheme (PCSPS), National Health Pension Scheme, Teachers Pension Scheme. Comparability is certified by the Government Actuary's Department. (In special circumstances the Fair Deal policy does allow for alternative arrangements to be negotiated).

- Where appropriate to the public sector pension scheme and its sections, terms must be agreed between the pensions schemes involved to allow staff to transfer their accrued pension benefits between the two pension schemes on an equivalent basis if they wish to do so. This is referred to as a 'bulk transfer terms' arrangement (BTT).

- In contract relet (and similar) situations, Fair Deal arrangements will continue to apply for those former Civil Servants that remand eligible to be covered by the policy requirements.

3.4.32 The terms of the contract between the Department and the commissioned supplier will be interactive with the way that risks and liabilities created by the legal obligations of TUPE are managed.

3.4.33 Annex A identifies potential costs resulting from TUPE transfers from MoD.

## ***Short-term Personnel Shortfalls***

3.4.34 All personnel shortages (either overall or within particular groups) strain the system, but those in groups with skills that are crucial to the delivery of effective Operational Capability (OC) have a particularly critical impact and require urgent resolution. Regardless of the underlying causes, the Department has increasingly looked to stabilise the situation quickly by introducing Financial Retention Incentives (FRIs) to temporarily stem the outflow of personnel. Notable examples have been the FRIs made available to aircrew, submariners and Royal Signals in return for a guaranteed return of service. HM Treasury is inextricably involved in the FRI approval process and considers them to be a sign of management failure because the Department did not take action in sufficient time to prevent a crisis developing.

3.4.35 In general terms there are many types of FRIs, such as commitment bonuses and Immediate Pension Points, but this guidance is specifically concerned with the temporary and targeted remuneration initiatives that involve advance bonus payments in return for a commitment to a specified return of service. A template for submissions is provided at Annex B.

## Identifying Critical Shortages

3.4.36 The aim of manpower management is sustainable manning balance within all cadres to ensure the availability of sufficient people of the correct type at the right time. Sustainable Experience Profiles (SEP)[20] are key enabling tools and depend on good, accurate data and management systems. Such data are also vital to identify, forecast and monitor precisely turnover, hot spots, high risk groups, costs, the internal dynamics of cadres, and the extent to which the manning situation at any one time might threaten to jeopardise OC. Early and precise definition is essential when addressing a critical manning shortage. Furthermore, having identified a shortage, actual or potential, it is equally important to understand the causes before considering remedial action; attitude surveys, exit questionnaires and external analysis and forecasts of external markets may provide the requisite information, as perhaps might a formal manning review.

## Requirement

3.4.37 The most fundamental element of the investment appraisal is identifying the requirement and why this has arisen. By revealing those factors which are causing personnel shortfalls in certain trades, remedial measures can be better targeted and thus be more successful. The essential question to answer is; why are personnel leaving the service?

3.4.38 The requirement should be articulated in terms of a measurable output and not be specific to a particular solution. For instance, X number of service personnel retained for Y number of years.

3.4.39 The causes of a particular shortage are likely to be several and interlinked, and there will generally be more than one remedial option that is available. Different measures will be required to address different causes. The remedial measures may be of a financial or non-financial nature, be applicable across the board (eg increase in Specialist Pay or X Factor) or targeted (eg FRI), be slow (eg improvements to training output) or quick acting (eg FRIs), expensive or low cost etc. All must be considered and it is seldom appropriate to rely on one single measure. It should only be necessary to employ FRIs as part of a remedial, or pre-emptive, package when there is an urgent operational need to stem

[20] Known as Steady State Profiles (SSP) in the RAF.

quickly the outflow of personnel and secure a number of man years RoS from existing personnel pending longer term resolution of the underlying causes of a manning shortfall.

**Options**

3.4.40 A broad range of imaginative options needs to be developed. The "Do nothing" option should be considered even where it does not fulfil the requirement as it provides a valuable benchmark against which the value for money of alternatives can be assessed. This should be accompanied by a range of alternatives and there should be no presumption that a FRI is the most appropriate way in which to address personnel shortfalls.

3.4.41 The importance of identifying why a shortfall has arisen is in informing the range of options which may be considered. For example, if personnel are leaving due to operational pressures then it may be possible to address these pressures without resorting to financial measures. In contrast, if better paid employment outside of the military is identified as the cause of service personnel leaving then a FRI may be the most appropriate solution. However, no option should be ruled out without sufficiently compelling, evidence based, analysis.

3.4.42 In practice, it is likely that a number of factors will be working to cause personnel shortfalls. As such, it will be appropriate to consider hybrid options which offer financial incentives alongside other non-financial measures.

3.4.43 An unusual aspect of investment appraisals which contain FRIs as options is that the option space is continuous. Any combination of financial payment and return of service may be offered. It is therefore important to justify why a certain package is presented as an option where others are not.

**Assessment of Options**

3.4.44 A key aspect is to explain the mechanics which link the identified reasons for a personnel shortfall and the choice of a preferred option. A number of assumptions are normally made about the expected effects of different options and these are important in supporting the recommendation. These assumptions need to be underpinned by robust evidence to ensure that value for money is demonstrated.

3.4.45 Benchmarking options against previously implemented FRIs (which reiterates the need for good quality project evaluation), non-military careers and other viable comparators may be used to provide the evidence which demonstrates that an option represents value for money. Appropriate diversions from these benchmarks may be made to address issues which are specific to the case in hand. Again, it is important to provide robust arguments to justify why diversions have been made.

3.4.46 As discussed above, FRI options are unusual as an extremely wide spectrum of alternatives exists. It is recognised that identifying a direct link between the financial payment and return of service, and the level of uptake in the target trade is difficult. However, an investment appraisal needs to provide arguments which illustrate why a particular package has been chosen. Essentially, the question which needs to be answered is; why is the chosen FRI package deemed to be the best value for money within the range available?

**Sensitivity Analysis**

3.4.47 Sensitivity analysis needs to be undertaken to help establish whether the recommended option represents the best value for money combination of payment, return of service and other factors which may be included. This process tests the effects of changing assumptions on the choice between options. For example, assumptions about the level of uptake of a FRI may be altered. If the assumed level of uptake, for a given FRI package, were to decrease how much would remuneration need to increase by (or, alternatively, return of service decrease) in order to restore the desired level of retention? Alternatively, asking the question another way; given the current assumptions, what would be the effect on uptake of offering a more or less attractive FRI package?

3.4.48 Every effort should be made to provide evidence which underpins the recommendation. However, where evidence is limited, and there is a significant level of uncertainty, this should be openly recognised in the investment appraisal.

**Monitoring and Managing the Impact**

3.4.49 Proposals for FRIs must clearly define: critical success factors; objectives and Performance Indicators (PIs); arrangements for monitoring and reporting effectiveness and cost; and exit strategies. This monitoring must take place throughout the operation of the scheme and conclude with a detailed project evaluation including both positive and negative effects.

## Critical Success Factors

3.4.50 In simple terms, the aim of a package of measures to address a critical manpower shortage will be an end to or a reduction in the size of that shortage. Specific targets may be applied to the FRI itself (eg: % of the target population taking up the FRI; or the number of man year's RoS secured) but, as FRIs are likely to be introduced in tandem with other measures, targets should also be set in relation to the overall package. These targets too can take several forms (eg voluntary outflow rate, bearing or shortfall against requirement; etc) but, whatever targets are chosen, they must be set against target deadlines.

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## ***Annex A: TUPE Transfers from MOD - Potential Cost and Resource Drivers***

This annex seeks to describe some of the resource/cost headings that are directly associated with the possible TUPE transfer of MOD civilian staff to a commissioned supplier. The costs are identified either as a BID cost (i.e. a cost to the commissioned supplier, or a cost to be incurred by all bidders, which will be reflected in the contract price) or as a PROJECT cost (i.e. a cost to the MOD of preparing for or supporting the TUPE transfer.

### Bid Costs

#### Indemnification

The new employer either seek some form of indemnification through the contract terms or take out commercial insurance against any Employment Tribunal costs or legal expenses that arise from cases that they become liable for as the new employer. (Note that MOD will normally indemnify for all employment events affecting the transferring staff that occur prior to the transfer (even though a claim is only made following the transfer).

#### Contract Monitoring

The commissioned supplier is required to provide the MOD contract monitoring team with information (changes to T&C of service; TUPE disputes; court actions; tribunal proceedings; out of court settlements) throughout the life of the contract. They will include the cost of providing this information in their bid.

#### Trades Union/Employee Representative – resources to undertake duties.

The commissioned supplier may recognise a TU and provide both facility time and training time for any full or part time officials (from within the transferred staffing) for TU activities within their business. (Salary and overhead costs of staff involved may already be covered under other cost headings).

#### Redundancy payments

Where the new employer makes redundancies for economic, technical or organisational (ETO) reasons they will be required to pay redundancy compensation under the staffs' transferred employment terms (for example, but not limited to, Civil Service Compensation Scheme (CSCS). ("Value for money" may be achieved by giving the commissioned supplier a contractual indemnity, but this must be subject to negotiation and defined terms, (for example: number of redundancies covered, time limited, cost capped).

MOD may ask for a tender to be priced on two bases: with or without "Terminal Redundancy Costs". This is to cover the situation where either at the end of the contract there is no on-going requirement for the activity or the termination of part of the service requirement during the life of the contract, and there is no TUPE transfer available (either to a different supplier or to MOD) and redundancy compensation to the former MOD staff has to be paid (Note that the indemnification can only be in respect of former MOD staff, not any staff allocated to the delivery of the service by the supplier, or new staff that they engage during the course of the contract.

**Personnel Overhead Costs**

The bid will include an element of overhead cost per individual (resulting in a capitation rate like charge) this will include provision for HQ costs but also occupational health, maternity provision etc. It is important to check where funding lines for staff costs exist, if the Project affects staff across several TLBs/ business areas, but the contract payment falls to one TLB's budget. (Note that these costs may cover the total workforce that the supplier may use to deliver the service, of which the transferred MOD staff may only be a part).

**Actuarial Costs (Commissioned Supplier)**

It is normally expected that suppliers will have obtained at their own expense certification from the Government's Actuary's Department for the pension scheme(s) that they propose to offer, pursuant of the "Fair Deal for Staff Pensions" policy. However bidders may seek to recover such costs in their tender price. (Note that GAD certify pension scheme(s) in two ways, either generally – allowing the certified scheme to be used, while in date, for any transfer of staff in that pension scheme, or specifically for a single transfer situation covering a discrete group of staff )

**Future Pension Scheme**

Pursuant of the Fair Deal policy, the CBI estimates that the cost of providing a "broadly comparable pension scheme" can add 10 – 20% to the "employer contribution" element of the total pension contributions. Effectively this translates into increase of a similar percentage to the paybill for the transferring staff. The CBI suggest the additional costs come from the cost of public sector pension scheme(s) particularly PCSPS being understated; extra overheads in running a small scheme; extra investment risk and termination/continuity provision; and Pension Protection Fund levy. (Note, MOD does not fund through the contract price any provision for an existing deficit in the suppliers' pension scheme funds).

**Consultation with MOD and TUs**

The bidders may want to meet with the MOD, the project team and the TUs to present assurances and opportunities. Their bids will reflect their own project costs.

**Project Cost & Bid Costs**

**Bulk Transfer Terms (Pensions) (BTT)**

Pursuant of the Fair Deal policy, where appropriate to the public sector pension scheme and its sections, terms must be agreed between the pensions schemes involved to allow staff to transfer their accrued pension benefits between the two pension schemes on an equivalent basis if they wish to do so. This is referred to as a 'bulk transfer terms' arrangement (BTT).

Under these arrangements and subject to the take-up of the option by staff, funds are transferred between the pension schemes to "buy" the pension benefit in the new scheme. The BTT agreement made by the public sector pension scheme will be on a fair valuation basis and the funding transfer from the pension scheme will also be on this basis. However due to new pension scheme's views on risks – a more conservative view of actuarial factors, long-term investment strategy pension guarantee – it is common for additional funding to be sought.

The number of staff who choose to transfer their accrued pension is not known until some time after transfer and therefore the actual amount to cover the BTT is unknown. However, for transfers involving 50+ staff it can run into £million. As a one time cost MOD may finance the difference between the funding that will transfer from the pension scheme fund and the total amount needed to satisfy the terms of the BTT agreement directly to the commissioned supplier. The contractual terms will ensure that the payment flows to the pension scheme, and cover what terms will be available at the end of the contract to facilitate BTT arrangements being available them. (Note that final settlement of BTTs can take up to 12 months, and interim payments are normally required).

**Project Costs**

### Actuarial Costs - Project Team

Project Teams will commission GAD and (when appropriate) Aon Hewitts[21] to provided services/actuarial advice on pension related matters. GAD hard charge in accordance with Government rules recovery of costs and Aon Hewitts charges are at rates agreed with Cabinet Office annually through an enabling contract.

Actuarial advice may be required for the following:

- the validity of the bidders future pension costings
- the validity of bidders costing and actuarial assumptions for additional funding (over that provided by the public sector pension scheme) to support bulk transfer terms.
- presentations to staff about future pension and pension transfer arrangements

### Pension Scheme Costs

The PCSPS will continue to charge the project for its services until completion of all pension transfers, approximately 12 months after vesting day.

### Recruitment & Retention Allowance (RRA)

Some outsourcing projects choose to pay an RRA to staff assigned to the transfer to dissuade them from leaving. This could/should be built into for critical posts. Approval of a RRA in these circumstances requires approval via the TLB to DCP

[21] Aon Hewitts is the actuary appointed by Cabinet Office/Civil Service Pensions for the PCSPS

**Retained MOD Organisation – New posts, Redundancy Costs, Relocation Costs**

TLB Business areas must also manage the consequences for staff "affected" by the transfer (i.e. do not transfer to the commissioned supplier, but are in someway affected by the transfer of the activity). There is a range of costs that can arise which can be attributable to managing the MOD organisation going forward. The may include:

- new positions created,
- re-grading,
- additional/new training requirements
- position deleted
    - staff costs whilst in RDP,
    - redundancy compensation costs
- relocation costs for staff transferred to new locations.

The costs for these changes should be estimated and included in the project costs.

**Legal Costs**

The outsourcing project will need legal advice obtained from CLS – Commercial Legal. This service if "free" however, if it is necessary to use an external legal firm to support the project this will be included in the project costs.

**Presentations**

The project team will need to give staff assigned and affected several presentations. The abstraction and T&S costs for staff attending the presentations will need to be assessed. The new employer may also wish to make presentations. Their costs will be included in the bid – but abstraction costs will fall to MOD.

**Consultation**

The project team will need to allow sufficient elapsed time and meeting time for TU consultation. (Note: MOD policy is currently that there is a minimum 3 calendar month period between awarding a contract and the commencement of the service provision in which the Project will meet its legal obligation under TUPE to inform and consult the MOD TU about the transfer. This should be taking into account in project planning and particularly when assessing savings assumptions.

## ***Annex B: Template For Financial Retention Incentive (FRI) Submissions***

**ISSUE**

Intent – subject of the paper and associated 'in order to'.

**RECOMMENDATIONS**

Clear and succinct description of the papers recommendations.

**TIMING**

Internal deadlines and implications for delay.
Timing for consideration of the paper by the AFPRB.
Timing for commencement of the FRI.

**BACKGROUND**

Outline explanation of the problem.
Outline its causes, both internal and external factors (such as changes in the civilian marketplace, where they exist).
Outline the current and projected impact on Operational Capability (OC) (short, medium and long term implications).
Quantify second order effects associated with the issue.
Broad outline of the management initiatives already undertaken to mitigate the problem.

**ADDRESSING THE ISSUE**

Detailed explanation of the manning situation and proposed way forward:

**RECRUITING**

General statement on the current health of recruiting and predictions of future trends (context).
Specific statistics on recruiting, Gains to Trained Strength (GTS) and requirement for the specified Critical Manning Group.

**RETENTION**

General statement on current retention (context).
Outflow of specific Critical Manning Group, by reason.

Detail the current retention initiatives.
Supporting underlying evidence[22] and modelling.
Intended impact on the service and the individual.

**OPTIONS**

Desired outcome of the Retention Incentive (criteria for success).
Address the increased recruitment vice retention issues.
Impact statement for a 'Do nothing' option (benchmark).
Details of remaining options, including financial and non-remunerative and combinations thereof (complete package) for consideration:
Eligibility for the scheme.
Longevity of the scheme.
Justification and explanation of amount(s) proposed (supported by modelling).
Justification of associated Return(s) of Service (RoS) proposed.
Assessment of forecast Take Up Rates, including an assessment of sensitivity.
Potential impact on other cadres within and across the services.
Interaction with other incentives (draw through, etc).

**SELECTED OPTION**

Rationale for selecting preferred option (directly related to achieving the stated desired outcome and value for money).

**COST**

Costs - as required by the RP community:
Projected costs of proposal at 100% uptake.
Projected costs of proposal forecast at (%) uptake.
Statement from the TLB[23] or centre, as appropriate on affordability within existing resources and from the wider Defence perspective.

**POTENTIAL SAVINGS AND BENEFITS**

Projected impact on the maintenance of OC.
Forecast of man years achieved or increased length of service.
Non-financial benefits, such as larger and more experienced pool of personnel for pull-through to higher rank.

[22] Supporting data should come from DASA Single Services, except where unavailable.
[23] TLB for PPO delegations.

## MANAGEMENT CONTROLS

Regular assessment of Success Criteria and Performance Indicators (PI) to monitor desired and predicted changes in behaviour.
Exit Strategy(s).
Details of Project Evaluation, framework:

Responsibilities for conducting the evaluation[24].
Timeline(s) for conducting the evaluation.
Details of the associated PI.
Desired change to voluntary release rates.
Desired % of cohort taking up the FRI.
Monitor the Notice to Terminate of those on the 'benefits boundary'.
Review of Exit Surveys.

## INTERNAL COMMUNICATIONS

Internal communication policy and plan.

## DELIVERY

Any SPVA delivery or legal issues.

## CONCLUSION

Conclusion, as necessary.[25]

## ANNEXES

Supporting Annexes and Appendices should be used as necessary throughout the paper to provide detailed evidence and explanation, as required.

[24] Including any internally negotiated requirement for data collection and reporting from the appropriate DASA Single Service.
[25] Submissions should be succinct and, unless exceptional circumstance warrant, are not to exceed 8 sheets of A4 and supporting Annexes.

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# 3.5 OTHER OPERATING COSTS AND BENEFITS

**3.5.1 The principles and practice of dealing with a range of financial costs and benefits are set out in this section. On some proposals, there may be costs and benefits that are not directly quantifiable in monetary terms. These costs and benefits can often be quantified in relative terms.**

**3.5.2 Where procurement of goods or services exposes MoD to foreign exchange considerations, care must be taken in the appraisal of options and the assessment of foreign exchange uncertainty for approval purposes.**

***<u>Operating costs</u>***

3.5.3 Operating costs should include estimates of the costs of providing the services specified in the procurement, over the period specified. The exact nature of the costs will vary according to the service element; hence it is not practical to provide a universal checklist. However items which must be covered here include:

| DATA | ASSUMPTION |
|---|---|
| Staff costs, including accruing pension liabilities and any expected redundancy costs | See Section 3.4 |
| Raw materials and consumables | See Section 3.3 |
| Repairs and maintenance if not already dealt with under capital costs | Seek estimate from DIO |
| Costs for provision of DII | £3,371 per terminal and laptop per year including all MoD overheads |
| Water services | Seek actuals from finance support staff or contact DIO |
| Telephone | Seek actuals from DFN Business Support |
| White Fleet / Yellow Fleet / C Vehicles | Seek actuals: White Fleet – UK WF CMT; Yellow Fleet – TSMHS Service Mgr; C Vehicles – Asst Dmnd Mgr GSV IPT |

| | |
|---|---|
| Insurance premia or equivalent | See paragraph 3.5.6 |
| In-house management costs | These need to be added to the cost of outsourced options but given the transfer of responsibilities inherent in outsourcing, the relevant figure will be lower under outsourced options |
| Business rates | Seek actuals from finance support staff |
| Electricity | Seek actuals from finance support staff |
| Payments to contractors or suppliers of service | Use expected contractual payment profile. This must be in real terms and adjusted for any increases due to relative price effects or VoP clause. |

3.5.4 Where operating costs are expected to change as a result of undertaking a particular appraisal option, careful consideration must be given to the cost, timing, and duration of transition before steady state is achieved. Allowance should be made for expected changes in relative or real prices, i.e. where the price of a particular input is expected to rise faster than the average price level (see paragraph 3.1.56). DESA should be contacted for advice on relative price adjustments.

3.5.5 Forecasts of the expected operating costs should reflect and reasonably foresee improvements in service delivery or efficiency savings that may be achieved over the life of the proposal (e.g. due to 'learning' effects or foreseeable technical progress).

**Insurance**

3.5.6 When comparing the cost of in-house provision to deliver an output against a commercial private sector solution, a cost for insurance should normally be included within the Value for Money Benchmark (see Section 4.1). Even if insurance is not taken out the commercial premium is a good proxy for the value of that risk. Care needs to be taken to avoid double counting.

***Example.*** *Some projects use a notional insurance charge as a first approximation of the value of a risk where more detailed data on the costs of risk are not available. Care must be taken in such circumstances, as a notional insurance charge would cover some risk that may have been valued explicitly elsewhere. A project that includes a notional insurance charge for loss of or damage to a warehouse used for storing spare parts, has also estimated the cost of the risk of fire destroying the property. This risk would be covered by any such notional insurance and has therefore been double counted.*

3.5.7 Insurance can be a help when costing and allocating risk. Much of the public sector historically does not use commercial insurers (except for some special cases, such as vehicles and lifts), nor do they self-insure (through a captive insurance company). This is because commercial insurance would not provide value for money for the government because the size and range of its business is so large that it does not need to spread its risk, while the value of claims is unlikely to exceed its premium payments. However, the government still bears the costs arising from uninsured risks and there are many examples of projects where the public sector has been poor at managing insurable but uninsured risk (for example, the stores containing Chieftain tank spares burned down).

3.5.8 When comparing public sector delivery against private sector, the VfMB should include an estimate of the value of such uninsured risks, taking into account the likelihood of such costs arising. A notional insurance premium could be estimated on the basis of past losses or the costs of commercial insurance could be taken as a first approximation to the value of the risk borne by government. In the exceptional cases where the government uses commercial insurance the cost of premiums should be included in VfMBs but care should be taken not to double count the risk insured.

## ***Deferred Consideration / Novel Financing***

3.5.9 Consider, for example, a proposal that involves sale of a property portfolio to a private contractor, who then contracts to provide office services to the public sector using the assets. An apparent saving may be secured by allowing the initial transfer of the ownership of the assets to go through for a peppercorn payment in return for a reduction in the unitary fee charged for provision of the office services. Such an arrangement involves an implicit loan of the value of the properties to be repaid over the course of the service contract. The arrangement may appear attractive to both parties because the contractor's cost of funds may exceed by a significant margin the public sector standard Discount Rate. However, it must be demonstrated that the proposal is value for money, as well as affordable. In such a case it is important to take account of:

- The implicit risk that remains in the public sector as a consequence (eg the default risk on the implicit loan should the contractor sell assets and then fail, or should the public sector charge on the assets prove inadequate);
- The fact that the private contractor's incentive to deliver good service is weakened precisely to the extent that they have effectively received payment in advance;

## ***Supplies from Overseas and Foreign Currency Denominated Transactions***

3.5.10 Wherever possible, as long as it can be shown to provide value for money, direct contracts involving supplies or services from overseas, whether from UK suppliers or foreign companies, should be based on firm prices denominated in sterling. In most circumstances contracts should not be subject to an exchange rate variation (ERV) clause; such clauses result in the department bearing all the exchange rate risk, which is likely to be concealed from the centre, making it more difficult to manage. In many circumstances, overseas suppliers or their agents can cover the risk of exchange rate variation by taking forward cover. The contractor sells his expected sterling receipts for the MOD contract in the forward exchange market, thus giving him a guaranteed payment in his own currency. In no circumstances should Project Teams (PTs) seek to enter into their own forward buying arrangements.

3.5.11 In some circumstances bidders may not wish to quote a firm sterling price. There are also goods for which foreign currency is the recognised means for trading, even when purchased domestically (for example bulk fuels purchases and aircraft parts). Usually the alternatives will be either a fixed or firm price contract denominated in a foreign currency or a fixed price contract denominated in sterling (and subject to an ERV clause). In these circumstances, the sterling cash flows used in the appraisal should be based on the exchange rates forecast to apply at the time payments are to be made by MoD. For investment appraisals, the US dollar and euro rates used should be those published in the most recent publication of the DESA online Monthly FOREX Monitor [26]. For time periods beyond those in the Monitor, and for other currencies, advice should be sought from DESA (General Branch).

3.5.12 The future foreign currency payments converted into sterling may be in nominal terms. They will need to be converted into constant prices by adjusting for general UK inflation as set out in Section 3.1.

***Example***: *The price for a service starting in a year's time agreed under a firm price contract is $80m with even payments over 4 years. The $:£ exchange rates are taken from the DASA DESA online FOREX monitor. HMT expects the GDP deflator to rise by 2.5% per annum over that period.*

*The cash flow in real terms (before discounting) is derived as follows:*

| ***Year*** | ***1*** | ***2*** | ***3*** | ***4*** |
|---|---|---|---|---|
| *a. Cash Flow ($m)* | *20* | *20* | *20* | *20* |
| *b. Exchange rates* | *1.664* | *1.762* | *1.812* | *1.731* |
| *c. Cash flow (£m)* | *12.02* | *11.35* | *11.04* | *11.55* |
| *d. GDP Deflator (Year 0 = 100)* | *102.5* | *105.1* | *107.7* | *110.4* |
| *e. Cash Flow (£m, Year 0 prices) (c ÷ d x 100)* | *11.73* | *10.80* | *10.25* | *10.47* |

3.5.13 The same principle applies to the purchase and disposal, or rental, of property overseas, or overseas works projects paid for in foreign currency. The foreign currency payments and receipts should be converted into sterling on the basis of the exchange rates forecast to apply when they are due.

3.5.14 A contract involving supplies or services from overseas may be subject not only to exchange rate variation, but also to a VOP clause, typically using an overseas' price index. To convert the stream of future payments into constant sterling prices will involve trying to forecast not only the future exchange rate, but also the future movements in that overseas price series relative to the UK GDP deflator series. Advice in such cases should always be obtained from DESA (PI) Branch.

[26] The Monitor rates reflect a central projection exchange rates looking out 5 years. The projection is updated monthly and as a result is likely to differ from those rates used for Planning Round (PR) purposes and those achieved in MOD's own forward buy programme. As the projection is a weighted average over a period of time it is likely to deviate from the exchange rate one could obtain on any given day. Therefore, the Monitor rates should not be used to inform price negotiation; such rates should be obtained from DESA Gen.

3.5.15 Where bids are in firm sterling prices there will be no foreign exchange uncertainty to take account of. However, it should be noted that in some cases the forward rate obtained by the contractor, and hence the sterling price may not be finalised until contract signature. Until then, the contractor may give only an indicative cost estimate. If MoD's decision on the purchase is likely to take several months, the appraisal should take account of possible changes in the exchange rate before contract signature. If so, the initial appraisal should use the contractor's indicative quote. An assessment, using DESA recommended exchange rates, should also be made of the robustness of the value for money decision conditional on any exchange rate variations during the period up to a final cost being secured.

## ***Foreign Exchange Uncertainty***

3.5.16 Only after having taken into account any FOREX uncertainty present in the various options can a fair and appropriate comparison to be made of their cost distributions. PTs should consider how foreign exchange uncertainty may affect the relative ranking of options as well as the absolute accuracy of their cost forecasts[27].

3.5.17 For smaller projects, where Monte Carlo simulation has not been conducted, sensitivity analysis should be used to test the robustness of the option rankings. PTs should consult the FOREX Monitor in order to assess the likelihood that future sterling volatility may alter their value for money recommendation. In addition, for projects where Monte Carlo Simulation has been undertaken, uncertainty in future exchange rates should form part of the cost modelling. The example below outlines the procedure. Distributions to be employed are available from the Monthly FOREX Monitor for the US dollar and euro. For other currencies, advice should be sought from DESA Gen. The distribution derived from the model will give an indication of the risk implied due making payments in foreign currency and allow a comparison to be made between the various options.

3.5.18 The distribution derived using the FOREX uncertainty bounds can also be used to determine the FOREX risk allocation as described in SMART approvals guidance V10.1. This approach provides an approval figure that projects can work to and influence delivery against with an

[27] PTs should also recognise that because the foreign expenditure will be converted in their accounts at close to spot rates, the sterling costs may fluctuate significantly.

appropriate risk management strategy and some independent protection against the requirement for re-approval due to FOREX volatility. PTs should ensure they are familiar with the SMART approval requirements which apply when contracting in foreign currency.

**Assessing FOREX uncertainty**

3.5.19 In order to assess the exchange rate uncertainty, it is necessary to:

1) Identify the foreign exchange requirement at the 50% technical risk by year (we recognise there can be interactions between FOREX and technical risks, but these interactions are put to one side as the different impacts cannot readily be separated). Technical risk is defined as all risk and uncertainty not attributable to foreign exchange variation;

2) use triangular distributions for the foreign exchange rates using the most likely, max and min values recommended in the (on line) Monthly FOREX Monitor;

3) divide the foreign exchange requirement (by year) by the triangular distributions generated by the Monte Carlo simulation (by year) allowing for the correlations between years (see the Monitor);

4) for the total cost and overall distribution add (statistically as part of the Monte Carlo analysis) the results from each year together: this gives a distribution (in sterling) of the likely outturn;

3.5.20 Using the final distribution, confidence intervals can be calculated in order to assess the level of risk associated with the various options. In addition, this distribution can be used to calculate the 'FOREX risk allocation' as described in SMART Approvals guidance V10.1.

### Numerical example using Predict! Risk Analyser

| | | Year 0 | Year 1 | Year 2 |
|---|---|---|---|---|
| Spend | USD 50% | 2.3 | 0 | 5.1 |
| Max | | 1.4459 | 1.4502 | 1.5119 |
| Min | | 0.8675 | 0.8701 | 0.8141 |
| ML | | 1.1567 | 1.1601 | 1.163 |
| Correlation | | | 0.75 | 0.75 |

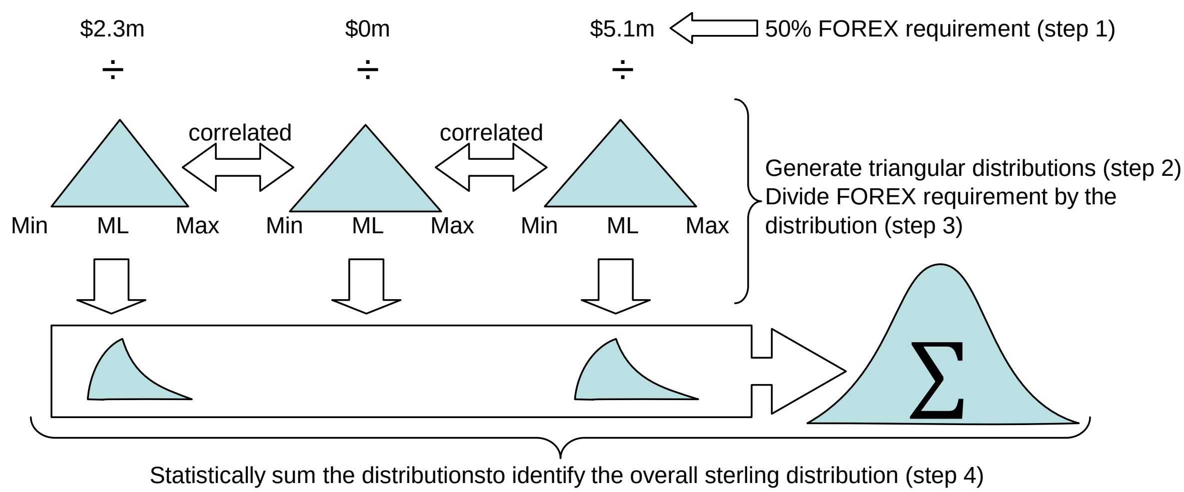
This is the 50% USD profile of the costs (step 1)

These are the USD exchange rate spreads and correlations from the latest DASA DESA FOREX monitor (figures for illustrative purposes only).

This box contains USD profile divided by the Monte Carlo generated triangular distribution from the above values for each year (step 2 and 3)

This box contains the Monte Carlo sum of the annual distributions (step 4).

### Graphical Example




## ***Third Party Revenues***

3.5.21 Forecasting potential income from third parties can be a particularly difficult aspect of the VfMB, especially where there is little or no historic data available. Forecasts often suffer from being too optimistic. The two key variables of price and quantity should be identified separately but the inter-relationship between these two variables (or demand curve) should not be overlooked.

## ***Wider National Economic Effects***

3.5.22 It is inappropriate to include the wider macro-economic effects or benefits in an economic appraisal, even when the choice is between domestically produced and overseas produced equipment. Acceptance of an uncompetitive bid or project does not lead to a sustainable increase in, for example, employment in the economy as a whole. There may be employment benefits to particular sectors of the economy, but public expenditure would have to be lower than otherwise elsewhere unless taxation and/or interest rates were higher than otherwise. In either case, these benefits would be offset by losses to other sectors either through lower public expenditure or the "crowding out" of private sector activity. The attention of Ministers should, however, be drawn to the impact on employment in particular localities, and also to the impact on the defence industry, when these are significant.

## ***Estimating the Value of Benefits***

3.5.23 Although Cost Effectiveness Analysis is used for the majority of MoD appraisals, benefits should be valued unless it is clearly not practicable to do so. Even if it is not feasible or practicable to value all the benefits of a proposal, it is important to consider valuing the differences between options.

3.5.24 Real or estimated market prices provide the first point of reference for the value of benefits. There are a few exceptions where valuing at market prices is not suitable (see Section 4.2). If the market is dominated by monopoly suppliers, or is significantly distorted by taxes or subsidies, prices will not reflect the opportunity costs and adjustments may be required and specialist economic advice will be needed.

3.5.25 Benefits fall into four main categories, which are described below.

Benefit categories

| **Benefit** | | **Example** |
|---|---|---|
| Financial | Quantitative | Operating cost reduction, revenue increase |
| Non-financial | Quantitative | Number of customer complaints, reduction in road accidents, number of government departments on-line |
| Non-financial | Qualitative | Staff skills, staff morale |
| Outcomes | Quantitative and qualitative | Improved standards of healthcare |

It is also useful to identify financial savings that release cash for other uses.

## ***Benefits Management in Business Change Projects***

3.5.26 Estimation of benefits is particularly important when appraising Business Change projects. The identification and quantification of benefits for the investment appraisal should be an element of, and complementary to, the wider process of benefits management.

3.5.27 Benefits management is the identification of potential benefits, their planning, modelling and tracking, the assignment of responsibilities and authorities and their actual realisation as a result of investing in business change. The aim is to ensure that desired business change or policy outcomes have been clearly defined, are measurable, provides a compelling case, and to ensure that the change or policy outcomes are actually achieved.

3.5.28 The processes described briefly below should be incorporated into a Benefits Realisation Management Plan, which must be submitted to DASA DESA for endorsement. The planning process needs to:

- Identify and prioritise tangible and intangible benefits;
- Generate ownership of and commitment to the benefits from relevant parties;
- Develop measures and quantify benefit opportunities;
- Build benefits management action plans to identify the activities, timelines, responsibilities, interdependencies and resources required to achieve benefits;

- Implement an on-going benefits tracking and reporting process;
- Agree how information on benefits delivered will be acted upon during the life of the project.

Further details on benefits management can be found on the Office of Government Commerce website (www.ogc.gov.uk).

3.5.29 The process should begin with by identifying the potential benefits of the project, potentially using a facilitated workshop to brainstorm ideas. The outcome of this should be a relatively high-level Benefits Network model or Benefits Linkage Chart showing the relationship between the end benefits, the sequenced intermediate benefits, and the enabling benefits that must be achieved first.

3.5.30 The relevant parties for each benefit should be identified. The defined benefits can at this stage be allocated to specific project outcomes. In the assessment Phase, a Benefit Profile should be completed for each benefit. This should be updated whenever there is a change to any of the required input data. An example template for a Benefit Profile is at Annex B.

3.5.31 A Benefit Realisation Plan should then be prepared. This is a complete view of all the Benefit Profiles in the form of a schedule, and includes when each benefit will be realised and who is responsible for realisation. Most of the information required for completion can be taken from the Benefits Profile. An example template for a Benefit Realisation Plan is at Annex C. The Benefit Realisation Plan must be consistent and coherent with the figures recorded in the investment appraisal.

## ***Non-Quantifiable Costs and Benefits***

3.5.32 Some costs or benefits may be difficult to quantify, but with some imagination it may be possible to quantify them using the discounted cash flow methodology.

3.5.33 Where the cost or benefit is measurable in non-monetary terms (for example, noise pollution in terms of numbers of people affected, and the decibel levels to which they are exposed), it may be possible to assign a monetary value to it by looking at the opportunity cost of avoidance. With noise pollution, the opportunity cost might be estimated by comparing the values of property not subject to noise with those that are.

3.5.34 For non-productive time spent travelling for example, the opportunity cost could be proxied by a pay capitation rate. Taking an imaginative approach, it will often be possible to identify such an indirect pricing mechanism to quantify costs and benefits.

3.5.35 In establishing overall VfM, non quantifiable factors may be relevant which might include:

- Supplier track record
- Potential relationships and behaviours
- Capacity
- Financial robustness
- Flexibility and responsiveness
- Reliability of the supply network.

3.5.36 Project teams should agree which VfM factors should be considered for their acquisition activity with DASA-DESA or the relevant TLB Appraisal and Evaluation team. Annex A details some of the areas that should be considered when determining whether the non quantifiable factors are relevant to the project. Further guidance is available in the Commercial Managers' Toolkit within the Acquisition Operating Framework (aof.mod.uk).

**Multi-Criteria Analysis**

3.5.37 There may, however, still be instances where even an indirect price cannot be derived; or, where derivation is possible, the effort involved may be disproportionate to the benefit from including it in an appraisal. An alternative approach to use in such cases is 'weighting and scoring', sometimes called "multi criteria analysis".

3.5.38 This technique aims to aggregate a number of genuinely unquantifiable costs and benefits into a single score, and thereby facilitate comparison between options. The weighting and scoring process can be broken down into the following steps:

- list the unquantifiable factors and weight them in accordance with how they impact on the appraisal objectives. It is easier to use weights that sum to a round number such as 100;

- score each option against each of the unquantifiable factors, on a scale of eg 1 to 10;

- multiply the weights by the scores to give a weighted score for each factor for each option;
- sum the weighted scores for each option to give a Total Weighted Score.

3.5.39 The higher the score, the greater the positive contribution of an option to the achievement of the appraisal objectives. The example below paragraph 3.5.42 illustrates how the methodology may be applied in practice. In order to maximise the usefulness of this approach, all those with a legitimate interest in the outcome of the appraisal should be involved in deciding the factor weights.

3.5.40 Technical experts should also be involved where necessary in option scoring. The value of this technique lies in making the decision-making process more rational and transparent, both to those directly involved, and to outsiders.

**Sensitivity Testing of Weighting and Scoring Analysis**

3.5.41 It is important to consider the composition of the total score as well as the total score itself. Small changes in the weights or option scores should not have a disproportionately large impact on the outcome, and sensitivity tests should be carried out to test that the results are robust.

**Taking Account of Weighting and Scoring Results in the Final Decision**

3.5.42 At times, the outcome of this approach may conflict with the results of the analysis of costs and those benefits that can be quantified in money terms. Management must make a judgement on the relative importance of the costs and benefits assessed in the two sets of analyses. Scrutineers will be conscious of the subjectivity associated with the selection of the unquantifiable factors and their weights. Explanation of the factors and the selection of weights will be expected within the supporting text.

**Example.** Basing of RAF Aircraft

Having identified the costs and benefits of Sites A, B and C, it is found that three factors which will impact on the decision have no market price and cannot be valued on any other money basis. The three factors are: low level flying; staff morale; and suitability of terrain for training. Discussion amongst all those with responsibility for, and a legitimate interest in, the basing decision resulted in the following factor weightings:

| **Factor** | |
|---|---|
| Good Training Terrain | 50 |
| Minimise Low Level Flying | 30 |
| Maintain Staff Morale | 20 |

Having studied the three sites the following scores were given (on a scale of 1 to 10 with 10 the highest):

| | **Option** | | |
|---|---|---|---|
| **Factor** | 1 | 2 | 3 |
| Good Training Terrain | 5 | 4 | 1 |
| Minimise Low Level Flying | 3 | 2 | 5 |
| Staff Morale | 1 | 6 | 7 |

Multiplying the weights and scores for each factor gives a Total Weighted Score for each option as follows:

| | | **Option** | | |
|---|---|---|---|---|
| **Factor** | **Weight** | 1 | 2 | 3 |
| Good Training Terrain | 50 | 250 | 200 | 50 |
| Minimise Low Level Flying | 30 | 90 | 60 | 150 |
| Staff Morale | 20 | 20 | 120 | 140 |
| **Total Weighted Score** | **100** | **360** | **380** | **340** |

# ***Annex A: Non Quantifiable VfM Factors***

Key issues to consider when determining which non quantifiable VfM factors are relevant to the project are detailed below. It should be recognised that this is not an exhaustive list and teams should consider any other issues that may be relevant to the VfM decision.

## Supplier Track Record

Where the supplier has a good track record, this can be provided as evidence that VfM is likely to be achieved.

- Past, present and projected future performance.
- Track record of efficiencies.
- Key skills retention.
- Previous performance measurement.

## Potential relationships and behaviours

The existing or potential relationship with the supplier can be identified to determine whether VfM is likely to be achieved.

- Shared goals.
- Understanding of complimentary or conflicting business drivers.
- Mutual risk management.
- Visibility of business plans.
- Visibility of costs and risks.

## Capacity

Consideration of whether the supplier has the capacity to deliver the requirement.

- Assessment of the resources of the supplier.
- Assessing whether the supplier has suitably qualified personnel to supply the requirement.
- Assessment of the facilities, capacity and asset ownership of the supplier.
- Long term strategic plan of the supplier.

**Financial Robustness**

Teams should be assured that suppliers are financially robust to ensure VfM is delivered.

- Determine the financial robustness of supplier.
- Understanding the future strategy of the supplier.
- Understanding the key business drivers of the supplier.

**Flexibility and Responsiveness**

Responsiveness of suppliers improves efficiency and effectiveness and can be included in the VfM assessment.

- Surge capacity.
- Delivery time.
- Turn around time.
- Innovation.
- Incremental capability.
- Interaction with existing contracts.

**Reliability of the supply network**

An efficient and reliable supply network that optimises the process of acquiring inputs from suppliers and converting these into a finished product will help to deliver VfM.

- Determine the agility and responsiveness of the supply network.
- Joint visibility of the supply network.
- A reliable and tested supply network.
- Determine the security of the supply chain.

## ***Annex B: Benefit Profile***

<table>
<tr><th colspan="7">Benefit Profile</th></tr>
<tr><td rowspan="3">INITIAL DETAILS</td><td>Ref No</td><td></td><td>Short Benefit Description</td><td colspan="3">[ the thing you are going to measure ]</td></tr>
<tr><td colspan="3">Detailed Description of Benefit/Disbenefit</td><td colspan="3"></td></tr>
<tr><td colspan="3">How will the benefit be measured</td><td colspan="3">[How will you know that the benefit has been achieved? The cost of measuring must be contained.]<br>[Who is responsible for measuring the benefit]</td></tr>
<tr><td rowspan="7">MANAGEMENT COMMITMENT</td><td colspan="6">BENEFIT CATEGORISATION</td></tr>
<tr><td colspan="3">Benefit Type (Input, Output, Cost Avoidance, Assisted)</td><td colspan="3">[State benefit type]</td></tr>
<tr><td colspan="3">Benefits Impact (External, Strategic, Key Operational, Support)</td><td colspan="3">[State impact]</td></tr>
<tr><td colspan="2">Tangible - Financial/Non-Financial</td><td>[State]</td><td colspan="2">Confidence Level</td><td>[Definite / expected / possible]</td></tr>
<tr><td colspan="2">Intangible</td><td>[Yes/No]</td><td colspan="3"></td></tr>
<tr><td colspan="6">DEPENDENCIES</td></tr>
<tr><td colspan="2">Benefits Dependencies within this project</td><td>Ref No</td><td colspan="3">Dependencies on other Programmes</td></tr>
</table>

| | | | |
|---|---|---|---|
| | | | |
| | | | |

| BUSINESS ACTION | REQUIRED BUSINESS CHANGES | |
|---|---|---|
| | **[***List business changes required - e.g. relating to Culture, People, Organisation, Process, Technology***]** | **Who is responsible for delivering these changes?** |
| | | |

## ***Annex C: Benefit Realisation Plan***

| Ref No. | Short Description of Benefit | Internal/ External to ISS | Start Date mm/yyyy | Value £ Ms *(this column can be extended if necessary)* | | | | How will the benefit be measured | Who is the Benefit Owner | Who is responsible for realisation |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | FY XX/XX | FY XX/XX | FY XX/XX | FY XX/XX | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
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# 3.6 OPTIMISM BIAS, RISK, AND UNCERTAINTY

**3.6.1 This section provides guidance in each of the following areas:**

- **Optimism bias;**
- **Risk management;**
- **Risk register;**
- **Risk mitigation;**
- **Quantifying risk;**
- **Three point estimates;**
- **Monte Carlo analysis;**
- **Sensitivity analysis.**

## ***Introduction***

3.6.2 There is always likely to be some difference between what is expected, as reflected in an appraisal, and what eventually happens. This is due to biases inherent in the appraisal, and risks and uncertainties that materialise. As a result, risk management strategies should be adopted for the appraisal and implementation of all policies, programmes or projects.

3.6.3 An appraisal should take proportionate account of risks and uncertainties in the estimates of costs and benefits. The components of an appraisal should be presented in a way that allows the most important risks and uncertainties to be readily appreciated. It can sometimes be helpful to quote the value that a key quantity would have to take to alter the ranking of options. Appraisal should also assess the risks and uncertainties associated with factors that have not been valued in monetary terms.

### Definitions

3.6.4 In the context of appraisals, the following definitions are usually applied:

- *Risk:* An event which may or may not occur, where the probability of occurrence and financial impact are susceptible to measurement.

- *Uncertainty:* An event that will occur, which has more than one possible outcome.

## ***Optimism Bias***

3.6.5 Optimism bias is the demonstrated, systematic tendency to be overly optimistic about key project parameters. There is a demonstrated tendency for projects to overstate benefits, and underestimate timings and costs.

3.6.6 To redress this tendency, explicit allowance for this bias should be made in all projects for which it is applicable (see paragraph 3.6.16), regardless of their size or complexity. Adjusting for optimism should provide a better estimate, earlier on, of key project parameters. Application of optimism bias is designed to complement and encourage, rather than replace, the practice of calculating project specific risk adjustments. It is also designed to encourage more accurate costing. Accordingly, adjustments for optimism may be reduced as more reliable estimates of relevant costs are built up, and project specific risk work is undertaken.

3.6.7 Table 1 provides adjustment percentages for generic project categories that should be used in the absence of more robust evidence. It has been prepared from the results of a study by Mott McDonald[28] into the size and causes of cost and time overruns in past projects.

**Table 1: Recommended Adjustment Ranges**

| | **Optimism Bias %** | | | |
|---|---|---|---|---|
| **Project Type** | **Works Duration** | | **Capital Expenditure** | |
| | Upper | Lower | Upper | Lower |
| Standard Buildings | 4 | 1 | 24 | 2 |
| Non-standard Buildings | 39 | 2 | 51 | 4 |
| Standard Civil Engineering | 20 | 1 | 44 | 3 |
| Non-standard Civil Engineering | 25 | 3 | 66 | 6 |
| Equipment/Development | 54 | 10 | 200 | 10 |
| Outsourcing | N/A | N/A | 41* | 0* |

[28] 'Review of Large Public Procurement in the UK', Mott MacDonald (2002), available at www.hm-treasury.gov.uk/greenbook

* The optimism bias for outsourcing projects is measured for operating expenditure.

3.6.8 Adjusting for optimism bias should be viewed as a process, rather than an event. **Optimism bias should be assessed at each key stage in a project's approval process**. For medium and larger projects, this would require assessments at the Concept Phase, and prior to Initial Gate and Main Gate approval.

**Estimating optimism bias**

3.6.9 There are four steps to follow in the evaluation of optimism bias, as follows:

| | |
|---|---|
| Step one | Determine appropriate project type(s) |
| Step two | Start with upper bound estimate |
| Step three | Reduce each optimism bias factor according to degree of mitigation |
| Step four | Multiply cost estimate by overall risk mitigated optimism bias factor |

***Step One – Determine appropriate project type***

3.6.10 Each option within a project must be reviewed to determine the appropriate project type or types. Careful consideration needs to be given to the characteristics of each option within a project to determine the project type from the list at Table 1. The definitions of the project types are as follows:

- **Standard building projects** are those 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.
- **Non-standard building projects** are those 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.

- **Standard civil engineering projects** are those that involve the construction of facilities, in addition to buildings, not requiring special design considerations e.g. most new roads and some utility projects.
- **Non-standard civil engineering projects** are those that 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.
- **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.
- **Outsourcing projects** are those that are concerned with the provision of hard and soft facilities management services e.g. ICT services, facilities management or maintenance projects.

3.6.11 The project type should be determined by the dominant characteristics of an option. An accommodation project requiring new build on a green field site may be easy to categorise as a standard building project. However, MoD projects are rarely so straightforward. The 'do minimum' option for this project might be to refurbish existing accommodation rather than new capital build. In principle it would seem that capital expenditure optimism bias would still be relevant in such an option.

3.6.12 An option that includes several project types (e.g. an element of standard building, outsourcing and equipment/development) should consider optimism bias separately for each element. This may well be the case for options involving private sector delivery.

***Example:*** *The preferred option for the Sea King Integrated Operational Support consolidates a number of support contracts into a single through life support contract transferring availability and stores risk to a partner. The dominant characteristic of this option is outsourcing, although there may be a small element of capital cost for equipment or buildings.*

*The Value for Money Benchmark retains multiple support contracts with in-house management of those contracts. As with the partnering option,* *outsourcing is the dominant characteristic, although the proportions of capital costs may be higher.*

3.6.13 Where an option includes several project types that cannot be physically separated, it is considered a combined project. Where one of the project types is not significant the project should be identified according to its dominant project type characteristics.

3.6.14 To calculate the appropriate upper bound values for combined projects the following approach is recommended:

- Determine the percentage split for each identified project type (use best judgment).
- Identify the upper bound values for each project type.
- Multiply each percentage of capital expenditure by the appropriate upper bound optimism bias.
- Add the optimism bias contributions together to determine the resultant optimism bias percentage.

3.6.15 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 (30 x 51.4)* | - |
| **Standard building** | *70* | *24* | *16.8 (70 x 24)* | - |
| **Combined building** | *100* | - | - | *32.1 (15.3 + 16.8)* |

3.6.16 As optimism bias factors have only been established for capital costs and works duration, the estimation of optimism bias will not be readily applicable for all projects.

3.6.17 Optimism bias should only be applied to new expenditure, rather than to opportunity costs of existing assets.

3.6.18 The 'outsourcing' category should only be used for options concerned with provision of services by the private sector, such as hard and soft facilities management services, and activities such as equipment maintenance, support, and overhauls.

3.6.19 In some circumstances, such as an ongoing in-house service contract, or for MOD training exercises, where there are no capital costs involved, adjustments for optimism bias are not appropriate. Sensitivity analysis should be used in such cases to test the potential impact of optimism on key parameters.

***Step Two – Always start with the upper bound***

3.6.20 Use the appropriate upper bound value for optimism bias from Table 1 above as the starting value for calculating the optimism bias level. **These upper bound values must always be used, unless robust evidence exists to use a different value**.

***Step Three – Consider whether the optimism bias factor can be reduced***

3.6.21 The tables at Annex A show the percentage contributions to the upper bound of various factors for each type of project, and for two types of optimism bias – capital costs and works duration.

3.6.22 The extent to which these contributory factors are mitigated can be reflected in a mitigation factor. The mitigation factor has a value between 0.0 and 1.0, where 0.0 means that contributory factors are not mitigated at all, 1.0 means all contributory factors in a particular area are fully mitigated and values between 0.0 and 1.0 represent partial mitigation.

3.6.23 Optimism bias may be reduced in proportion to the amount that each factor has been mitigated. **Evidence to support any mitigation claimed (e.g. from past projects) must be documented, and must be independently endorsed (e.g. by CAAS, Partnering Support Group (PSG), or relevant TLB Appraisal and Evaluation team)**. **DASA DESA reserve the right to increase the level of optimism bias on any project where the evidence for mitigation is not compelling, and highlight this to the Approving Authority.**

***Example – Capital Expenditure***

*Suppose we examine the capital expenditure and works duration optimism bias levels for a non-standard building. For simplicity, suppose the initial estimated most likely capital expenditure is £100M. The upper bound capital expenditure optimism bias value for a non-standard building project is 51% (see Table 1).*

*If contributory factors are not effectively managed, the estimated final capital expenditure, taking into account optimism bias, is calculated as follows:*

$$£100M + (51\% \times £100M) = £151M$$

*For this example the mitigation factors have been identified for each of the contributory factors 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 Annex A and the mitigation factor represents the degree to which contributory factors are managed. No mitigation has been identified or claimed for contributory factors.*

| ***Contributory Factor*** | ***% 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 each of the five contributory factors 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).*
- *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 optimism bias is eg £700,000). 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*

*contributory factors 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 risk is £10,000 say).*
- *The proposed site has been owned 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 are required to confirm the site ground characteristics (cost of managing this 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 x 0.4) + 6 + 1 ≈ 24 %*

*Resultant capital expenditure optimism bias =*
*(100 % - 24 %) x 51 ≈ 39 % (the adjustment to be applied)*

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

*£100m + (39 % x £100m) = £139m*

*The estimated final capital expenditure for this example taking into account optimism bias and the cost of risk management, is calculated as follows:*

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

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

***Step Four – Apply the optimism bias factor***

3.6.24 **In small projects, or where the project is at an early stage of development**, optimism bias should be applied as an explicit adjustment to the single point cost estimates in the investment appraisal in the absence of specific risk adjustments. The most likely estimate of the capital costs should therefore be multiplied by the relevant optimism bias factor. The resulting figure equates to the expected value or "mean" estimate.

3.6.25 **In medium and large sized projects**, three point estimates of individual costs and risks will have been input, and the outputs will be expressed as levels of confidence. For these projects, optimism bias should be treated as an independent "top down sanity check" of risk, which is then compared with the existing calculation of confidence figures using a "bottom up" approach.

3.6.26 The resulting figure should equate to the expected value or "mean" cost estimate. If the optimism bias adjusted cost is close to the "mean" cost estimate, no further investigation is required.

3.6.27 If the optimism bias adjusted figure is close to, or exceeds, the 90% cost estimate, this should not be ignored. The 90% cost estimate should be reviewed, as the implication of the "sanity check" is that insufficient consideration has been given to an aspect of risk.

***Example:*** *The confidence estimates of capital expenditure for a standard buildings project are as follows:*

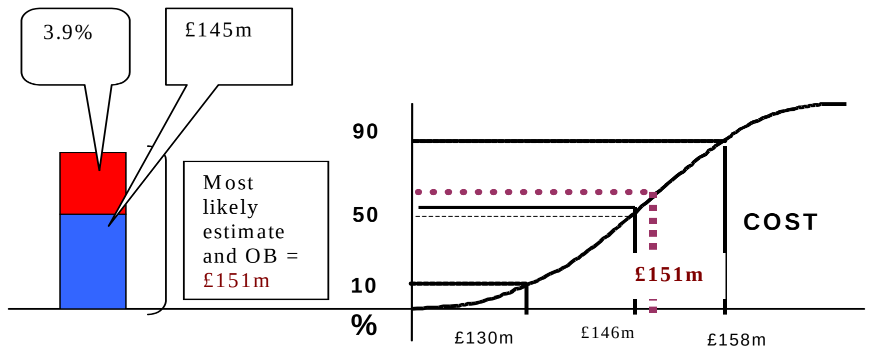
| | |
|---|---|
| *10%* | *£130m* |
| *50%* | *£146m* |
| *90%* | *£158m* |

*The most likely estimate of cost is £145m.*

*The mitigated optimism bias percentage to be applied to the capital expenditure has been estimated as 3.9%.*

*The forecast capital expenditure for this example, taking into account optimism bias, is £151M, which is calculated as follows:*

$$£145m + (3.9\% \times £145m) = £151m$$




3.6.28 However, it does not mean that the 90% estimate is necessarily wrong. As long as both the original risk assessment and the optimism bias adjustment have been reviewed, and the outcome documented, the comparison of the optimism bias adjusted figure to the 90% cost estimate should not be viewed as a pass or fail test. It is not always sensible or required for the 90% cost estimate to exceed the more crudely estimated optimism bias adjusted cost.

3.6.29 As long as the option is categorised as a single type (e.g. standard buildings), it should be relatively straightforward to identify the appropriate capital cost to apply the optimism bias factor to.

3.6.30 With combined projects involving outsourcing it would seem appropriate that the total costs for the option should be apportioned between capital costs and outsourcing, so that the optimism bias adjusted cost estimate for the option becomes:

Most likely cost estimate + (capital costs x capital cost optimism bias factor) + (operating costs x outsourcing optimism bias factor)

## Residual Values

3.6.31 In many cases, particularly in respect of highly specific Defence equipment, optimism bias will affect not only the original cost and timing of delivery, but also residual values. The impact on the residual value will be in exactly the same proportion as the impact on the original cost, i.e. if optimism bias inflated the original cost by 20%, this flows through to the residual value in exactly the same way.

3.6.32 However, in some cases the residual value will reflect the open market valuation, and have no relation to the original cost. This particularly applies to conventional constructions, e.g. office and residential accommodation. In these cases, the impact of optimism bias on original cost will not affect residual values as the residual value reflects supply and demand for second-hand housing and office blocks in the market place.

**Operating costs and benefits**

3.6.33 Due to a lack of available data, Mott McDonald was unable to recommend sound upper and lower bound optimism bias levels for operating expenditure (except for outsourcing projects) or benefits shortfall. Optimism bias should still be considered for these parameters. If there is no other evidence to support adjustments to operating costs or benefits, appraisers should use sensitivity analysis to check switching values. This should help to answer key questions such as:

- By how much can we allow benefits to fall short of expectations, if the proposal is to remain worthwhile?
- How likely is this?
- How much can operating costs increase, if the proposal is to remain worthwhile?
- How likely is this to happen?
- What will be the impact on benefits if operating costs are constrained?

**Works duration**

3.6.34 The same principles as for capital expenditure apply for estimating the length of time it will take to complete the capital works. Once an initial estimate is made, the upper bound optimism bias percentage should normally be applied. If the project has advanced, and the contributory factors leading to works duration optimism bias have been addressed, then the percentage optimism bias may be reduced, along the lines set out for capital works bias.

3.6.35 The application of optimism bias adjustments to works duration should be reflected in a delay in the receipt of benefits. This will be shown in the net present value calculations. The appraisal period may need to be extended to reflect the expected delay in benefits' stream, but different periods should not usually be set for different options.

***Example – Works Duration***

*A similar process as in the previous example 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 contributory factors 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)*

*Now apply the same risk management strategies as in the earlier capital expenditure example for each of the contributory factors listed in the table below.*

*Note that, the "% contribution to optimism bias" values in the table below have been taken from Annex A and the mitigation factor represents the degree to which the contributory factors are managed.*

| ***Contributory Factor*** | ***% 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 x 0.4) + 5 + 3 = 23.8%*

*Resultant works duration optimism bias =*
*(100 % - 23.8 %) x 39 ≈ 29.7% (the adjustment to be applied)*

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

$$28 \text{ months} + (29.7\% \times 28 \text{ months}) \approx 36.3 \text{ months}$$

*This figure for the works duration after implementing risk management strategies is lower than the 39-month duration calculated if contributory factors are not effectively managed.*

3.6.36 The optimism bias adjusted estimate should be compared against the 90% estimate for works duration. This method of assessment can be applied throughout the project life cycle for a project.

## ***Risk***

3.6.37 It is good practice to add a risk premium to provide the full expected value of each option. As the previous section explained, in the early stages of an appraisal, this risk premium may be encompassed by a general uplift to a project's value in an appraisal, to offset and adjust for undue optimism.

3.6.38 In medium and large projects the first stage in valuing risks is to establish a risk register. The purpose of the risk register is to identify, quantify and value the extent of risk relating to the project or policy. It can be used to identify the bearer of each risk, provide an assessment of the likelihood of each risk occurring, and estimate its impact on project outcomes, and identify any risk mitigation activities.

3.6.39 Once all the relevant risks have been captured on the risk register, it is necessary to quantify and assess the timing of the possible consequences. A useful starting point is to qualitatively assess both probabilities and impacts into categories of high, medium, or low. This will help to identify the key risks, and those whose probability and impact are sufficiently low to ignore.

3.6.40 The ultimate objective is to be able to integrate all the consequences of all risk elements to obtain the net present expected value of the costs and benefits of the project. An expected value provides a single value for the expected impact of all risks. It is calculated by multiplying the likelihood (probability) of the risk occurring by the size of the impact, and summing the results for all the risks and outcomes.

Detailed guidance on risk assessment can be found on the AOF (aof.mod.uk).

3.6.41 Although often done in the private sector, it is never appropriate to handle risk in public sector appraisals by adding a premium to the discount rate.

**Risk management**

3.6.42 Risk management is a structured approach to identifying, assessing and controlling risks that emerge during the course of the policy, programme or project lifecycle. Its purpose is to support better decision-making through understanding the risks inherent in a proposal and their likely impact.

3.6.43 Effective risk management helps the achievement of wider aims, such as: effective change management; the efficient use of resources; better project management; minimising waste and fraud; and supporting innovation.

**Risk register**

3.6.44 A risk register is a useful tool to identify, quantify and value the extent of risk and uncertainty relating to a proposal. A risk register can be used to identify the bearer of each risk and uncertainty associated with the project being appraised, provide an assessment of the likelihood of each risk occurring, and estimate its impact on project outcomes.

3.6.45 A risk register lists all the identified risks and the results of their analysis and evaluation. Information on the status of the risk is also included. The risk register should be continuously updated and reviewed throughout the course of a project.

3.6.46 For a large project, this process is likely to be a complex exercise as the number of separate risks and the scope of the inter-relationships involved may be very substantial. In these cases, and especially for novel projects, workshop or "brain-storming" sessions involving: financial and economic advisers, design, engineering and insurance professionals, professional negotiators, actuaries, lawyers and especially the managers or operators of the business or service will help to achieve a comprehensive coverage of all risk areas.

3.6.47 A risk register is best presented as a table for ease of reference and should contain the following information:

- Risk number (unique within register);
- Risk type;
- Author (who raised it);
- Date identified;
- Date last updated;
- Description;
- Likelihood of risk arising;
- Interdependencies with other sources of risk;
- Expected impact;
- Bearer of risk;
- Countermeasures; and
- Risk status and risk action status.

3.6.48 The risk register must be as comprehensive as possible. Even if you consider it difficult to quantify the impact or likelihood of a risk eg force majeure, it is important to be able to demonstrate that you have not just overlooked it. Figure 1 describes the main general types of project risk that you are likely to encounter. The aim should be to explore each of these in further detail and produce a more detailed project specific breakdown. JSP 525 shows categories of risk, which correspond to those in the Treasury "Orange Book". There is no direct correlation between the two lists.

3.6.49 For an example of a risk register and further information on the identification of risks and successful project and risk management refer to the Office of Government Commerce website. (OGC - Home)

## Figure 1: Types of project risk

| | |
|---|---|
| ***Availability risk*** | *The risk that the quantum of the service provided is less than required under the contract.* |
| ***Construction risk*** | *The risk that the construction of the physical assets is not completed on time, to budget and to specification* |
| ***Decant risk*** | *The risk arising in accommodation projects relating to the need to decant staff/clients from one site to another.* |
| ***Demand risk*** | *The risk that demand for the service does not match the levels planned, projected or assumed. As the demand for a service may be (partially) controllable by the government, the risk to the public sector may be less than that perceived by the private sector.* |
| ***Design risk*** | *The risk that the design cannot deliver the services at the required performance or quality standards* |
| ***Inflation risk*** | *The risk that actual inflation differs from assumed inflation rates.* |
| ***Legislative risk*** | *The risk that changes in legislation increase costs. This can be sub-divided into general risks such as changes in corporate tax rates and specific ones which may discriminate against PFI projects.* |
| ***Maintenance risk*** | *The risk that the costs of keeping the assets in good condition vary from budget.* |
| ***Occupancy risk*** | *The risk that a property will remain untenanted - a form of demand risk.* |
| ***Operational risk*** | *The risk that operating costs vary from budget, that performance standards slips or that the service cannot be provided.* |
| ***Planning risk*** | *The risk that the implementation of a project fails to adhere to the terms of planning permission, or that detailed planning cannot be obtained, or, if obtained, can only be implemented at costs greater than in the original budget.* |
| ***Policy risk*** | *The risk of changes of policy direction not involving legislation.* |
| ***Residual value risk*** | *The risk relating to the uncertainty of the value of physical assets at the end of the contract.* |
| ***Technology risk*** | *The risk that changes in technology result in services being provided using non optimal technology.* |
| ***Volume Risk*** | *The risk that actual usage of the service varies from the level forecast.* |

## Risk mitigation

3.6.50 There are a number of approaches that might be taken to mitigate the impact of the identified risks. These are outlined below:

- **Active risk management** – Effective management of risks involves:
    - identifying possible risks in advance and putting mechanisms in place to minimize the likelihood of their materialising with adverse effects;
    - having processes in place to monitor risks, and access to reliable, up-to-date information about risks;
    - the right balance of control in place to mitigate the adverse consequences of the risks, if they should materialise; and
    - decision-making processes supported by a framework of risk analysis and
    - evaluation.

- **Early consultation** – Experience suggests that costs tend to increase as more requirements are identified. Early consultation will help to identify what those needs are and how they may be addressed.

- **Avoidance of irreversible decisions** – Where options involve irreversibility, a full assessment of costs should include the possibility of delay, allowing more time for investigation of alternative ways to achieve the objectives.

- **Pilot Studies** – Acquiring more information about risks affecting a project through pilots allows steps to be taken to mitigate either the adverse consequences of bad outcomes, or increase the benefits of good outcomes.

- **Design Flexibility** – Where future demand and relative prices are uncertain, it may be worth choosing a flexible design adaptable to future changes, rather than a design suited to only one particular outcome. For example, different types of fuel can be used to fire a dual fired boiler, depending on future relative prices of alternative fuels. Breaking a project into stages, with successive review points at which the project could be stopped or changed, can also increase flexibility.

- **Precautionary Principle** – Precautionary action can be taken to mitigate a perceived risk. The precautionary principle states that because some outcomes are so bad, even though they may be very unlikely, precautionary action is justified. In cases where such risks have been identified, they should be drawn to the attention of senior management and expert advice sought.

- **Procurement / contractual** – risk can be contractually transferred to other parties and maintained through good contractual relationships, both formal and informal. Insurance is the most obvious example of risk transfer.

- **Making less use of leading edge technology** – If complex technology is involved, alternative, simpler methods should also be considered, especially if these reduce risk considerably whilst providing many of the benefits of the option involving leading edge technology.

- **Reinstate, or develop different options** – Following the risk analysis, the appraiser may want to reinstate options, or develop alternative ones that are either less inherently risky or deal with the risks more efficiently.

- **Abandon proposal** – Finally, the proposal may be so risky that, whatever option is considered, it has to be abandoned.

3.6.51 By reducing risks and uncertainty in these ways, the expected costs of a proposal are lowered or the expected benefits increased.

3.6.52 The Acquisition Operating Framework (AOF) (aof.mod.uk) contains information on all aspects of risk assessment and management. In addition, further guidance on risk management can be obtained from Risk Analysis and Management for Projects (RAMP), the Office of Government Commerce (OGC), the National Audit Office (NAO), HM Treasury, and the Cabinet Office.[29]

[29] Reference can be made RAMP: Risk Analysis and Management for Projects or the OGC (http://www.ogc.gov.uk) for a range of materials including 'Managing a Successful Programme', HM Treasury: Management of Risk: A Strategic Overview (The 'Orange Book'), NAO: Supporting Innovation: Managing Risk in Government Departments. Also available are: Management of Risk: A Practitioner's Guide, published through the Stationery Office, and the Risk Portal found on the Cabinet Office website.

## Quantifying risk

3.6.53 Once all the relevant risks have been captured in the risk register, it is necessary to quantify and assess the timing of the possible consequences.

3.6.54 The best methods for quantifying the impact of identified risk will depend upon the information sources available. As a general rule the best approach should be to use empirical evidence whenever it is available. When it is not, common sense approximations should be used rather than aiming for unrealistic or spurious levels of accuracy. The impact of this in practice will depend on the nature of the risk.

3.6.55 Even when it appears that costing a risk is impossible at first, it should be listed and returned to later, to refine when information comes to hand. Ignoring difficult risks is not an option, as such risks do ultimately affect the prices charged to the public sector for the asset or service being procured. Therefore, even though these risks may not be specifically costed at first, it will benefit the project manager to identify the risks and to be sensitive to factors affecting these risks.

3.6.56 When assessing the consequences of any risk, you should not restrict your thinking to the direct effects. Think as widely as possible to ensure all knock-on effects are included. This is particularly relevant where the event causes delay and is on the critical path. This requires a little care, as there will be interaction between different risk events. The effect of some risks is to affect the costs of either the construction or operation of the project, which will already have been assessed for their "normal" degree of uncertainty. For example if a property-based service is not available on time, the possible knock on effects will include:

- the cost of renting alternative premises or continuing to use existing premises;
- the costs of servicing this property;
- lost management time as a result of litigation;
- if appropriate, increased insurance premiums, or, alternatively, self- insurance; and
- inability to meet contract commitments.

3.6.57 The ultimate objective is to be able to integrate the consequences of all risk elements into appraisals and plans to obtain the net present expected value of the costs and benefits in the project. Care must be taken to avoid double counting the same risk, e.g. incorrectly counting the cost of insurance products available to cover a particular risk (whether taken up or not) and, in addition, adding in the impact of the risk covered by such insurance. It is also important to make a sensible assessment of when the consequence of each risk will arise as this will affect the NPV of that consequence.

**Estimation of Likelihood of Risks**

3.6.58 Having identified the risks and assessed the potential consequences, it is then necessary to assess the likelihood or probability of each of the possible consequences occurring.

3.6.59 A key practical issue is how to arrive at the relevant probabilities, in a manner that is reasonable, consistent and transparent. A database of outturn costs in previous similar procurements (and comparisons with original estimates) is an ideal source of information. However, in most cases, this type of high quality information is currently not available and the objective should be to devise an approach that is as close to the ideal as possible.

3.6.60 Even if no formal database is available internally, the estimation of probability should be based on experience rather than arbitrary estimates. All internal sources of Departmental/organisational data should be exploited as fully as possible. Cost outturn data should be the most recent and relevant available.

3.6.61 There are some risks where the probability of the event occurring is low but the risk cannot be dismissed as negligible because the economic impact is high eg. collapse of a bridge. In this case a small change in the assumed probability can have major effect on the expected value of the risk, however, it is always preferable to include a value rather than ignore the risk altogether. Project managers should also be prepared to revisit initial estimates as the negotiations develop, if they consider that they have learnt something new that materially affects the initial estimate. Ultimately the test of the accuracy of estimates of probability will be actual outturn figures.

## Three point estimating

3.6.62 Estimates are a combination of opinions and informed views, before the event, of what something will cost, how long it will take to complete, or how it will perform. For any activity a range of outcomes is to be expected, and uncertainty describes the variation inherent in an estimate. Three point estimates are used to define a range of possible outcomes in numerical terms so that quantitative risk analysis and subsequent sensitivity analysis may be carried out to better inform decisions. Assumptions, judgements, and data used in the three-point estimating process need to be recorded in the Master Data and Assumptions List (MDAL).

3.6.63 In forecasting terms, a three point estimate is an estimate of the range of possible out-turns from a minimum to a maximum**;** with the most likely out-turn appropriately located between these two extremes. It is a methodology for describing the valuation of risk and the limits of variability of uncertainty that surround forecasts in a format suitable for further, useful, analysis.

3.6.64 The three figures needed for cost, time or performance are defined as follows:

- **Minimum -** This is an optimistic estimate of what might happen, assuming that everything goes about as well as possible.
- **Most Likely -** This is the estimator's best bet, the sort of estimate that is right more often than any other (i.e. the *mode*, in statistical language).
- **Maximum -** This is a pessimistic extreme, assuming that the worst tends to happen, but excluding the very remote - e.g. "Acts of God".

3.6.65 It is important to understand what is defined as the "most likely" figure, or "mode", and how this differs from the definitions of mean and median.

- **Mode** – the value in a distribution with the greatest frequency. In other words, the most likely single value.
- **Mean -** the numerical average. It is obtained by summing all the values in a distribution and dividing by the number of values. This is also referred to as the "expected value".

- **Median** – the 50th percentile value. The median splits the area in half ie it is the value that has below it half of the measurements in the distribution – the "mid-point".

3.6.66 It is clear that some subjective judgment is called for in order to generate sensible maximum and minimum estimates. There is always scope for argument over the choice of the three values. However, we shall almost certainly end up with a more realistic picture than if we were to rely on a single point estimate.

3.6.67 Three point estimates may also reveal something of the quality of the input data since a wide range of values generally means less confidence in the final figure than an estimate with a narrow range of predicted outcomes.

3.6.68 A three point estimate is, however, not really complete unless the full shape of the variation from minimum, through most likely, to maximum is specified. This is achieved by selecting a particular type of probability distribution. The most commonly used in cost modelling are:

- Triangular Distribution – This distribution allows skewed estimates to be modelled, eg estimates that display a disproportionately high maximum in relation to the most likely and minimum values.
- Pert (or Beta) and Normal Distributions – These distributions are more sophisticated than the triangular, but equally as flexible. Their shape has the useful property of exhibiting a flat portion around the most likely, which places more belief around the most likely estimate than the triangular.

3.6.69 The three point estimates form an input for quantitative risk analysis. They allow risk and uncertainty to be described statistically thereby allowing a number of individual estimates to be aggregated. The aim of aggregating individual estimates is to derive a more realistic overall figure for cost, schedule or performance with a measure of its variability. The aggregation method used in the vast majority of computer models is random simulation; more commonly termed 'Monte Carlo' simulation.

3.6.70 One of the most common forms of model output is the Histogram. All simulation "slices" from a Monte Carlo analysis are combined to give a graphical output as depicted in Figure 1. This output represents the variation of total project schedule or cost, with the x-axis depicting total project duration/cost and the y-axis depicting the relative frequency of each discrete value of total project duration/cost.

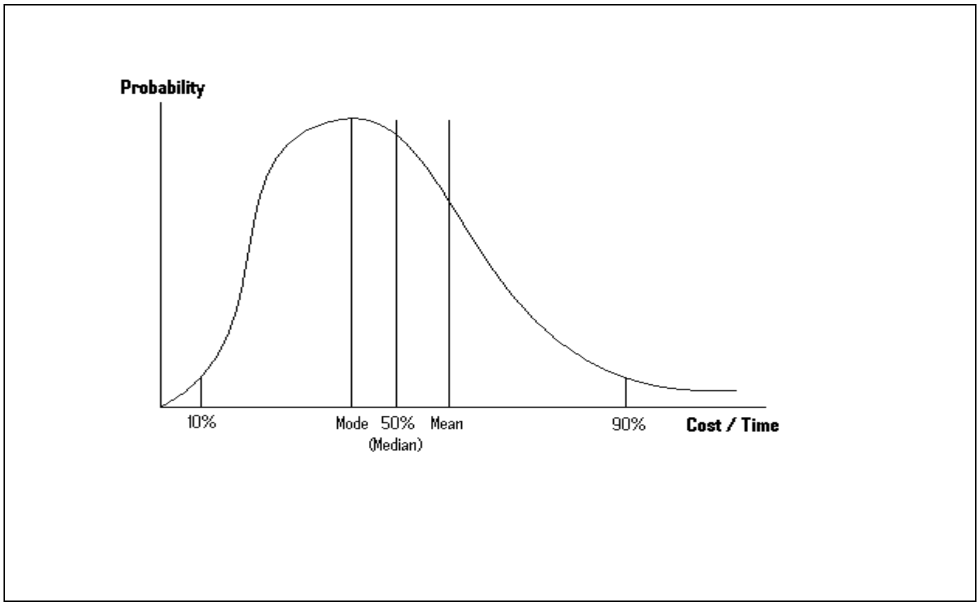



Figure 1: **Graph showing 10%, 50% & 90% confidence figures**

3.6.71 In relation to risk management, the key feature of the SMART Approvals process is that projects are required to submit cost and schedule information, with associated confidence figures, derived through quantitative analysis.

- Approvals are given against the 50% confidence figures, equating to the highest acceptable cost and latest acceptable date for the phase(s) being approved. These cost and time figures are considered as a project's **"Approval Limit"**.
- The 50% Confidence Figures, are currently used to determine affordability, set EP/ESP funding and drive the planning assumptions for all Lines of Development. These cost and time figures are best considered as a project's **"Baseline Target"**.
- To give the IAB a complete picture, 10% and 90% Confidence Figures for both cost and time are also required, these are noted. The 10% cost and time figures are best considered as a project's **"Stretch Target"**.
- The mean, or expected cost, should also be shown.

3.6.72 Detailed guidance on three-point estimating, and quantitative risk analysis is provided in "Quantitative Risk Analysis – Process Guide for Risk Practitioners", available on AOF (aof.mod.uk).

**Monte Carlo analysis**

3.6.73 Monte Carlo analysis is a risk modelling technique that presents both the range and the expected value of the collective impact of various risks. It is useful when there are many variables with significant uncertainties. Monte Carlo analysis allows an assessment of the consequences of simultaneous uncertainty about key inputs, and can take account of correlations between these inputs. It involves replacing single entries with probability distributions of possible values for key inputs. The calculation is then repeated a large number of times randomly (using a computer program) to combine different input values selected from the probability distributions specified.

3.6.74 The results consist of a set of probability distributions showing how uncertainties in key inputs might impact on key outcomes[30]. It can be a useful technique, but expert advice (e.g. CAAS) is required to ensure it is properly applied, especially when risks are not independent of each other.

[30] The following example was adapted from "Measuring costs and benefits – a guide on cost benefit and cost effectiveness analysis" National Audit Office (NAO) and Vose, D (1996)

***Example***

***Allowing for uncertainty in an analysis of costs***

*The table below gives the costs of various parts of a construction project, broken down into excavation (E), foundations (F), structure (S), roofing (R), and decorations (D). All costs are independent of each other. The model for total cost is as follows:*

***Total cost = E + F + S + R + D***

***Costs for construction project (£)***

| | ***Minimum*** | ***Best Guess*** | ***Maximum*** |
|---|---|---|---|
| ***Excavation (E)*** | *30,500* | *33,200* | *37,800* |
| ***Foundations (F)*** | *23,500* | *27,200* | *31,100* |
| ***Structure (S)*** | *172,000* | *178,000* | *189,000* |
| ***Roofing (R)*** | *56,200* | *58,500* | *63,700* |
| ***Decoration (D)*** | *29,600* | *37,200* | *43,600* |

*From this information we can produce a best guess of £334,100 for the total cost of the project. However, we can also conclude a possible range from £311,800 to £365,200. Suppose the project would not go ahead unless the total cost is unlikely to exceed £350,000; how much assurance can we take from these figures that the total cost will be less than £350,000?*

*By undertaking a Monte Carlo analysis, we can simulate many possible values of the input variables, weighted so that the 'best guess' value is more likely than the extreme values. The total cost is calculated for each simulation, giving a distribution of values for total cost. The precise weighting depends on the probability distributions specified for each variable.*

*Using triangular distributions, it can be concluded that the most likely total cost is £334,000; and that the chance of total cost exceeding £350,000 is less than 1%.*

## ***Sensitivity analysis***

3.6.75 Sensitivity analysis is fundamental to appraisal. It tests the effect on individual options of varying the projected value of important variables.

3.6.76 It is essential that uncertainties in estimates of operating costs and benefits are taken into account in **all** projects by, at the very least, undertaking a sensitivity analysis. Sensitivity analysis shows how changes to assumptions affect NPV and option rankings. The purpose is to ensure the ranking of options is robust to potential changes in key variables such as the demand for services or asset numbers.

3.6.77 Sensitivity tests should be well designed; it is not sufficient to show the implications of an arbitrary variation around a particular cost/benefit. Some indication of the likely range of variation is needed.

3.6.78 Sensitivity analysis should always be based on plausible variations, wherever possible backed up by detailed market knowledge or previous experience (perhaps drawn from evaluation of previous projects).

***Example***

*Procurement of a new machine costing £2M, is expected to produce staff savings of £300k per year for 10 years, based on saving 15 posts at an average cost per post of £20k. Using a discount rate of 3.5%, the NPV of the costs and benefits is £580K.*

| *Year* | *Cash flow* | *£m* | *CDF* (3.5%)* | *NPV(£M)* |
|---|---|---|---|---|
| *0* | *Cost of system* | *2* | *1.0* | *2.0* |
| *0-9* | *Annual savings* | *(0.3)* | *8.6077* | *(2.58)* |
| | | | | *(0.58)* |

*Sensitivity tests would be:*

- *What if the machine installation only saved 10 posts?*

*The savings would only be £200k and this would change the NPV from a saving of £580K to a net cost of £280K.*

- *What if the average cost of each post saved was £22K?*

*PV of staff savings would rise, and NPV would increase to £840K.*

**CDF = Cumulative Discount Factor*

3.6.79 The limitations of sensitivity analysis should be recognised; in that it only allows one variable to be changed at a time although a number of the variables may be inter-dependent.

**Scenario analysis**

3.6.80 Sensitivity analysis can be taken a stage further by combining individual tests into plausible scenarios (so- called 'scenario analysis'). In the example below, for instance, one plausible scenario is that pay increases in real terms, <u>and</u> staff savings are less than expected. It can be useful to develop 'best case' and 'worst case' scenarios which bring together all the individual tests which have beneficial or adverse effects upon the individual options which are considered to be plausible.

***Example***

*An investment appraisal for a new IT system consists of an up-front cost of £10m, and expected savings of £1.5m per annum as a result of 100 fewer staff. Discounting these cash flows over a 10-year period at a discount rate of 3.5% shows an NPV saving of £2.91m.*

| *Year* | *Cash flow* | *£m* | *CDF* (3.5%)* | *NPV(£m)* |
|---|---|---|---|---|
| *0* | *Cost of system* | *10* | *1.0* | *10.0* |
| *0-9* | *Annual savings* | *(1.5)* | *8.6077* | *(12.91)* |
| | | | | *(2.91)* |

**CDF = Cumulative Discount Factor*

*As the savings from introducing the system are a constant annual amount, the present value may be found by multiplying the constant annual sum by the cumulative discount factor at 3.5% for years 0 to 9.*

*Past experience of similar IT projects may suggest that staff savings could be as low as 75, implying annual savings of £1.125m (£1.5m x 75 ÷ 100). Recalculating the NPV with this assumption yields an NPV cost of £0.32m.*

| *Year* | *Cash flow* | *£m* | *CDF* (3.5%)* | *NPV(£m)* |
|---|---|---|---|---|
| *0* | *Cost of system* | *10* | *1.0* | *10.0* |
| *0-9* | *Annual savings* | *(1.125)* | *8.6077* | *(9.68)* |
| | | | | *0.32* |

*Past experience has also shown that staff salaries tend to rise in real terms (i.e., over and above the general level of inflation). A relative price effect of 2% per annum, for instance, would raise the real value of the projected savings, so that the NPV saving becomes £4.06m.*

3.6.81 As a variant of scenario analysis, it may also be useful as a check on the robustness of option rankings to determine what changes in key assumptions would be required for rankings to switch. Robustness can then be discussed in terms of the likelihood of such changes materialising.

3.6.82 As a general rule, when setting up investment appraisals on computer spreadsheets, early thought should be given to the analysis of uncertainties. This will allow key assumptions to be built into models in such a way that sensitivity analysis can be virtually automated.

## ***Annex A: Upper bound guidance by project type***

| | **Non-standard Buildings** | | **Standard Buildings** | |
|---|---|---|---|---|
| Upper Bound Optimism Bias (%)[31] | 39 | 51 | 4 | 24 |
| | Works Duration | Capital Expenditure | Works Duration | Capital Expenditure |
| Contributory factors to Upper Bound Optimism Bias (%)[32] | | | | |
| **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 | | |

[31] Note that these are only indicative starting values for calculating optimism bias contributions, because a project's optimism bias profile will change during its project life cycle.
[32] Contributions from each 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.

| | **Non-standard Civil Engineering** | | **Standard Civil Engineering** | |
|---|---|---|---|---|
| Upper Bound Optimism Bias (%)[33] | 25 | 66 | 20 | 44 |
| | Works Duration | Capital Expenditure | Works Duration | Capital Expenditure |
| Contributory factors to Upper Bound Optimism Bias (%)[34] | | | | |
| **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 | | |

[33] Note that these are only indicative starting values for calculating optimism bias contributions, because a project's optimism bias profile will change during its project life cycle.
[34] Contributions from each 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.

| | Equipment/ Development | | Outsourcing | | |
|---|---|---|---|---|---|
| Upper Bound Optimism Bias (%)[35] | 54 | 200 | - | - | 41 |
| | Works Duration | Capital Expenditure | Works Duration | Capital Expenditure | Operating Expenditure |
| Contributory factors to Upper Bound Optimism Bias (%)[36] | | | | | |
| **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) | | | | | |

[35] Note that these are only indicative starting values for calculating optimism bias contributions, because a project's optimism bias profile will change during its project life cycle.

[36] Contributions from each 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.

# *Annex B: Optimism bias contributory factors*

## 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

- 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 interested parties was 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 (meaning the scope and requirement)**

- Project scope poorly defined
- Potential for requirement to change
- Number of services were not anticipated
- Output specifications were not defined clearly
- Oversight in facilities required
- All relevant parties were not involved and so their needs were not defined and included in business case

### 11. Large Number of Interested Parties

- 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

- No research on current and future demand for the product or service
- Insufficent consideration of sensitivity analysis
- 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

- Lack of comprehensive site investigations
- Potential for land to be contaminated

- 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 interests

**19. Economic**

- Change in market demand resulting in a change in funding priorities
- Sharp correction in economic prospects

**20. Legislation / Regulations**

- Change in required standards

**21. Technology**

- Unanticipated technological advancements
- Computer virus
- Limits in technology

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# 3.7 EVALUATION

**3.7.1 Evaluation is the retrospective analysis of how well a policy, programme or project is delivering against its performance, time and cost parameters. It is conducted at key stages throughout the project lifecycle and includes an assessment of the reasons for any variance from the expected outcomes, and any lessons learned.**

**3.7.2 The key elements of the evaluation process are:**

- **An evaluation of performance against achieving the technical requirements or operational capability, project governance and control, and financial and commercial criteria, capturing any lessons learned;**
- **An evaluation at each of the major stages of a policy, programme, or project;**
- **All projects that require an investment appraisal should conduct evaluation, commensurate with the value, length and complexity of the project.**

## ***What is the Purpose of Evaluation?***

3.7.3 Organisations that fail to learn from mistakes are likely to repeat them. The main purpose of evaluation is to ensure that good practice is perpetuated, lessons are learned, and the Department avoids repeating costly mistakes. It is not a tool for apportioning blame, but a vital source of information for management decision making. It should also lead to improved project control and governance. By evaluating a project continuously through life it should be possible to identify strengths and weaknesses for projects of a similar nature, or for the future of the project being evaluated.

3.7.4 Effective evaluation can be of real benefit to the Department. In addition to improving the quality of future decision-making, and expanding corporate knowledge, experience in carrying out evaluations will increase the skills brought by Project Managers to new projects.

## ***What to Address in an Evaluation***

3.7.5 Evaluation addresses three distinct and interlinked elements:

Technical requirements and operational capability

The technical performance of a project is determined by how well it delivers the Key User Requirements (KURs). These will evolve throughout the project into the User Requirement Document (URD), Statement of Requirements (SOR), and finally, the capability delivered into service. The evaluation should quantify any deviation from the baseline scope or specification.

Financial and Commercial Control

Financial and commercial criteria should be measured against the financial baseline agreed in the business case. The evaluation should track the costs and savings, measured against this baseline, including the extent to which risk transfer is achieved where expected, and the contract price when delivered. The evaluation should quantify any deviation from the baseline business case and ultimately **an assessment of both the achieved value for money and the benefit delivered**.

Project Governance & Control

The final part of the evaluation should examine the project governance and control processes in place to deliver the project to time, cost and quality. This should include the management of requirements, the procurement and delivery into service. The evaluation should include an assessment of the effectiveness of project controls and governance to manage these throughout the project lifecycle. The evaluation of External Assistance must include an assessment of the skills and knowledge transfer achieved.

3.7.6 Key benefits of evaluation for the Department comprise the ability to avoid repeating mistakes and to actively pursue good practice leading to being able to identify and pursue successful outcomes. Therefore both what went well and what did not go well should be assessed. This will enable the Department to pursue successful approaches and reduce the incidence of approaches that have proven to be less successful.

## ***The Focus of Evaluation***

3.7.7 At each stage throughout a project's development the focus of evaluation will have a different emphasis. At the outset of a project the focus will primarily be on the technical requirement (KUR and scope) and the financials. After Main Gate, tight project governance and control will be the main concern and towards the end of a project evaluation will address the financial aspects to determine VfM. The extent to which the emphasis will change will depend on the type of project and each project's progress. Each evaluation should, nonetheless, consider all of the three areas at every stage.

## ***When to Undertake an Evaluation***

3.7.8 Every project, programme, or policy requiring an investment appraisal should conduct evaluation. The extent and depth of evaluation should be conmmensurate with the value, length and complexity of the project to ensure the efficient use of resources. A straightforward, low value project may only require a one page evaluation. For the larger, longer running projects and programmes, greater depth of evaluation will be required. For these, issues and solutions must be considered in greater depth in order to extract the appropriate lessons and future mitigations.

3.7.9 Category C projects and above should be subject to continuous evaluation. Application of this principle requires evaluation to be conducted at each of the major stages of a project. These are likely to be: initiation, Initial Gate, Main Gate, contract award, in-service, throughout service depending on the length and type of project, and on disposal if appropriate. For smaller projects, key development stages may be compressed and evaluation may only consist of an evaluation at the IA stage and at final outturn. All projects should produce an Outturn Evaluation that compares the project outturn to the original or any revised business case.

3.7.10 Evaluation should also be carried out at other major project milestones, e.g. a project manager leaving, in order to prevent the loss of valuable project knowledge.

3.7.11 In addition, any project that stops or experiences any issues not previously envisaged should conduct a detailed evaluation of the issues, causes and any remedial actions, including the effectiveness of the remedial actions.

## ***Consolidation of PE***

3.7.12 A larger project, with a series of evaluations at major stages, will need to consolidate previous evaluations to provide a holistic commentary over a longer period of the project's life. This allows the capture of lessons learned over a number of stages and recognises that the performance of the project over the longer term may well be different to the sum of individual stages.

3.7.13 It is recommended that the consolidation of an individual project's evaluations should, as a minimum, certainly happen prior to the disbanding or significant down-scaling of the project (this may be after a contract award for a large service project, or in-service for a building. However, very long projects may gain benefit from consolidating more regularly.

3.7.14 Once a project is in-service then the through life benefits should be captured in the Through Life Management Plan (TLMP), but there are still likely to be lessons learned that should be published and disseminated as other evaluations.

## ***Who is Responsible for Evaluation?***

3.7.15 It is the responsibility of the Senior Responsible Owner (SRO) or Senior Point of accountability (SPA) to ensure evaluations are conducted and will usually be led by the Project Team. Evaluation should be a complementary, concurrent, but separate activity, to other project control mechanisms such as Peer Review. The majority of effort and activity should complement these other controls. If a project is sponsored in one management area but executed in another, the two areas should agree on who is to undertake the evaluation. However, since the ultimate objectives of the project are those of the sponsoring area, the presumption should be that it is this area that carries out evaluation. In-house finance staff should usually be able to supply information on costs, and customers may need to be consulted to establish whether the project delivered satisfactory levels of effectiveness, in a timely manner.

## ***Planning for Evaluation***

3.7.16 The timescales and resources required to conduct evaluation should be incorporated into the project or programme plan with other key activities and milestones. It is recommended that the resources and the occasions for conducting an evaluation for any particular project are included in the IA presented for approval.

3.7.17 For larger projects, a "lessons learned" log should be maintained alongside other project control documents such as the risk register and issue log. This information could be used as the basis for a structured, facilitated workshop with major stakeholders to capture the key lessons at each stage of the project.

## *Role of Appraisal and Evaluation Teams*

3.7.18 DESA are happy to provide advice and assistance to staff planning or undertaking evaluations.

3.7.19 A copy of each evaluation undertaken should be forwarded to the relevant TLB Appraisal and Evaluation Team. The evaluations of projects, policies or programmes that were reviewed by DESA prior to their approval should also be forwarded to DESA for collation and analysis of key lessons. The Appraisal and Evaluation Teams are responsible for tracking and monitoring completion of evaluations, collating finished evaluations and entering relevant, concise and contextualised information into a Lessons Learned database. Lessons Learned should be reviewed, prioritised and disseminated on a regular basis. This is to ensure lessons are fed back into the assurance and scrutiny processes and into best practice guidance and training.

3.7.20 Records should be kept of which projects are expected to complete an evaluation, at what stage, and at what time. Projects should then report their compliance against this plan. This will enable Appraisal and Evaluation Teams to put projects at similar stages in contact with each other, thereby increasing the relevance and value of the lessons learned.

## *Addressing Evaluation Evidence in Appraisals*

3.7.21 Lessons learned from other projects should be included at the investment appraisal stage of a project. Projects should be able to demonstrate that they have taken into account the good practice of other projects, show they have mitigated against risks that materialised, and taken action to avoid problems encountered on similar projects. This will also be useful within the Peer Review process to help demonstrate that a realistic assessment of likely risks has occurred. This will also contribute to accurate planning of timescales and contingency.

## ***Outturn Evaluation***

3.7.22 The first step in the process is to establish what is to be evaluated, and how outturns can be measured.

**Determining the Scope**

3.7.23 The activity to be evaluated needs to be clearly specified. The evaluation might be of a project, programme or policy, particular aspects of the activity, or of key common issues affecting a number of activities. Objectives, outcomes and outputs should be defined and quantified as precisely as possible. It is important to distinguish between the objectives and outcomes, and the outputs and targets.

3.7.24 The availability of output and performance measures and targets, and other monitoring data, and how they relate to the objectives should be reviewed. If this information is inadequate, consideration should be given to the collection of additional data, although ideally, data needs would have been considered at the outset of the project.

3.7.25 Setting the boundaries for the Outturn Evaluation enables resources to be concentrated on answering the questions that offer the greatest potential value to the Department (financial and non-financial).

**Defining the Rationale, Aims and Objectives**

3.7.26 It is crucial to be clear about why the project was undertaken and what the project was expected to achieve. Objectives and outputs, which should be related to the aims and objectives of the organisation should be identified and quantified. In the absence of clearly established objectives, the evaluation should seek to define them. For example, is the output of a new works project a new building, or is it delivery of business benefits from co-location or a new working environment? In other words, consider what the project is delivering in terms of business benefits.

**Establishing the Baseline**

3.7.27 The baseline for comparison must be identified. This requires deciding the benchmark against which the project outturn will be compared. This would normally be the appraisal supporting the original business case, but where none has been carried out, it will be necessary to determine a counterfactual. This is a hypothetical view of what would have happened if the policy had not been implemented, or the project not carried out. It allows an estimate to be made of 'additionality', i.e. how much of the change observed after the project comes into effect is genuinely additional and attributable to that project. There are a number of ways of establishing a counterfactual, but it can be complex and assistance should be sought from DESA.

3.7.28 The baseline should include an estimate of costs, timescales, and a statement of the expected benefits and savings. It is neither necessary nor desirable to attempt a comparison of actual project outturn with the forecast outturn of options not implemented. Effort should be devoted to the collection of appropriate information on which to judge the success of the chosen option in meeting its objectives. This will involve comparing the actual project outturn with the costs and benefits forecast in the appraisal, or with the counterfactual.

***Example***. *Take a project/policy to increase the number of 18- year-old recruits into military service from 500 per annum to 1,000 per annum between 2001 and 2006, by increasing advertising expenditure from £1m to £3m. If, in 2007, the requisite number of 18 year olds have been recruited each year, the policy may well appear to have been successful and good value for money. However, if Government policy changed over the same period, so that 18 year olds were no longer entitled to social security benefits, then this too could be expected to have had a positive impact on recruitment.*

## Collecting Information

3.7.29 A primary source of information should be the appraisal document itself. The information requirement should be determined at the appraisal stage and before project implementation, and thought should be given as to how the information will be collected. While much of the information needed for the evaluation should be available from existing in-house systems, it may be necessary to set up new mechanisms; failure to put these in place at the outset can be difficult to redress when the time comes for evaluation.

3.7.30 Some data will exist already, for example, the cost of new buildings, staff salaries. It may also be necessary to obtain further information from different sources, such as a staff survey, to establish the impact on morale. Difficult areas will be "what would have happened otherwise?" For example, if staff morale has fallen, is it as a result of the move, or should other factors be taken into account? This can be checked by reference to a control group, eg survey other MOD staff, in a different location, or to which the change did not occur.

3.7.31 Problems arise where no appraisal was produced. In these circumstances, it is necessary to determine as far as possible, what situation existed before the project was begun, and use this as a baseline.

**Comparing with Baseline**

3.7.32 The technical methodologies used for appraisal and evaluation are similar. Each should identify and measure, where possible, both the direct and indirect benefits of the policy, programme or project. The main difference is that evaluation tends to be based on actual data, and appraisal on forecasts and projections. The evaluation should include the following:

- An assessment, quantified where possible, of what happened;
- A comparison with the target outturn; and
- A comparative assessment of one or more counterfactuals (i.e. alternative outturns given different states of the world, or different management decisions).

3.7.33 Where possible the comparative assessment should include a 'control group', to whom the activity was not applied.

3.7.34 It is usual to take as a benchmark for comparison, what would have happened if the activity under consideration had not been implemented. It is also useful to consider the consequences of implementing one or more of the alternatives considered during appraisal. Occasionally it may be appropriate to consider an option that was not originally appraised, as long as it was feasible at the time of implementation.

3.7.35 The evaluation should assess the success of the project, programme or policy in achieving its objectives, and also how this achievement has contributed to the wider outcomes. If the objectives were not achieved, the evaluation should establish why that was the case.

3.7.36 Information on actual outturns should have been gathered as part of the implementation of the project, and these should be compared with the estimates, adjusting to a common price base. Variations between actuals and estimates should be explained, including any changes to the original requirement. The evaluation report should include an analysis of the effectiveness of the project, and what the results imply for the future.

**Assessing Value for Money**

3.7.37 The assessment of value for money is determined by a combination of the economy, efficiency, and effectiveness of the project in achieving its objectives. Economy relates to the procurement of inputs at the lowest possible cost. Efficiency is measured by the ratio of inputs to outputs, and effectiveness is the degree to which the stated objectives were met. Specific indicators and performance standards need to be determined for all three aspects. This can be complex and advice should be sought from DESA.

3.7.38 To make an accurate assessment of the value for money of a project, one must be clear on the degree to which the desired outputs are due to the policy or to other factors outside of the project's sphere of influence. A good evaluation distinguishes between what has happened as a result of active management of the project, and what has happened because of unforeseeable external factors. The temptation to attribute successes to the former, and failures or problems to the latter, should be avoided.

**Presenting the Results**

The results of an evaluation should summarise:

- The main things that went well and led to success of the project;
- The main lessons regarding planning, scoping and governance of the project;
- Other projects where these lessons may be applicable.

3.7.39 The results obtained should generally lead to recommendations for the future. These may include, for example, changes in procurement practice, delivery, or the continuation, modification, or replacement of a programme.

3.7.40 Analysis of the costs and benefits should encompass the extent to which objectives were achieved, and benefits and savings realised. Any lessons which may have wider implications should be highlighted, together with any recommendations for future action.

**Disseminating Results**

3.7.41 Evaluation is a learning tool for the whole Department. Without full dissemination of the results this learning opportunity is lost and may result in the same mistakes being made time and time again, whilst successes go unnoticed.

3.7.42 The results and recommendations from the Outturn Evaluation should feed into future decision-making. The methods used to achieve this will generally require senior management endorsement. Efforts should be made to disseminate the results widely. Evaluation reports and the research that informs them should be placed in the public domain unless there are good reasons, in terms of security or commercial confidentiality, for not doing so.

## ***Disclosure***

3.7.43 Staff undertaking evaluations should be aware of the guidance available on “Disclosure”. This is a legal requirement to release to a court of law (or during the process of arbitration) all documentation relating to a subject that may be in dispute.

3.7.44 It is important to remember that the aim of evaluation is to identify good practice and areas which need improvement. Evaluation should not be used to apportion blame, or to expose serious errors and failures. Other mechanisms exist to consider culpability, serious failures (and fraud), and lie outside the scope of guidance on evaluation. They include internal audit and NAO reviews, as well as civil and criminal court proceedings.

## ***Annex A: Evaluation Template***

Unique reference no: [*to be completed by database administrator*]

**Name of project:**

**Stage of project:** (Key history / approvals / date of any previous evaluations)

**Type of project: Estates / Equipment / Business Change**

**TLB:**

**Total value of project:**

**Key words:**

**Summary of project: (3 lines max.)**

**Purpose of the Evaluation**

Identify scope and focus of the evaluation. Identify strengths and weaknesses for the future of the project being evaluated, for projects of a similar nature, or indeed if conducted at an appropriate stage.

**Financial and Commercial Control**

The purpose of this section is to compare the actual cost of the project to the agreed budget, include a commentary on any variance and assess, retrospectively, the achieved value for money of the project and the benefits delivered, with a view to improving future investment decisions.

- Has Value for Money been delivered?
- Compare actual costs and benefits to those expected in the IA. Why are there differences?

- Benefits
    - What benefits were claimed at the outset of the project?
    - What are the benefits that are now expected to be realised form the project?
    - Explain the variances
    - Have any additional benefits been realised?
- Did the project deliver to budget?
    - what were the estimated costs for the last stage?
    - what was your agreed budget for the last stage?
    - what was the actual direct cost of the last stage?
    - explain the differences, if any, between the estimated and actual cost?
- Commentary on commercial issues arising from the last stage?
    - what was the issue and how was it resolved?

**Project Governance & Control**

- Objectives
    - what were the project objectives in the last phase?
    - were the project objectives met? Explain
- Timescales
    - did the project deliver to time?
    - if so, what were the reasons for success?
    - if not, what were the reasons for delay?
- Risks
    - look at the risk register, identify which risks did **not** materialise
    - was this due to luck or effective mitigating action? Explain
    - identify which risks **did** happen? (these may have been unexpected). Why did these occur and what was done about them?

  - assess the extent of risk transfer (e.g. risk transferred away from MOD to supplier) achieved through the project
  - Did the project have any dependencies?
  - Were the dependencies recognised?
  - Did any issues arise from the dependencies?

- Governance arrangements
  - what mechanisms are in place to feedback problems or delays to the Project Team?
  - how well did these work?
  - did Project Team meetings occur at regular intervals?
  - How effective were any joint working relationships?
  - Were all relevant parties fully consulted?

- Skills and knowledge transfer
  - Assess the success of transfer compared to that expected. This is particularly relevant to External Assistance cases.

**Technical requirements**

- What technical issues and solutions occurred?

- What service management issues occurred? How were these resolved?

- Requirement
  - is the original requirement still valid?
  - are the original assumptions still valid?

**Summary**

Identify the main things that went well and led to the success of this project

| |
|---|
| 1.<br><br>2.<br><br>3.<br><br>etc |

Identify the main lessons which, with hindsight, would have improved the planning, scoping and governance of the project.

| |
|---|
| 1.<br><br>2.<br><br>3.<br><br>etc |

Are there other projects that you know of where these lessons may be applicable?

| |
|---|
| |

**Follow up Actions**

To include distribution list and dissemination plan.

# PART 4 - MORE COMPLEX ISSUES

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# 4.1 INVOLVING THE PRIVATE SECTOR

**4.1.1 The extent of involvement of the private sector can vary from minor elements of a proposal being contracted-out through to full privatisation, with various forms of contracting, outsourcing, partnering and PFIs in between. Careful consideration needs to be given to which procurement route is likely to be most effective. In some cases, the appropriate balance between public and private sector provision will be clear. In others, the best solution must be identified across a range of public, private and partnership options. The key objective is to ensure that taxpayers get value for money.**

4.1.2 Private sector provision may be more likely to provide a better solution where the scope for the following is greatest:

- Innovation to reduce costs or to improve observable outcomes;
- Generating additional revenue flows by sales to third parties;
- Reduction in risk of cost overrun or benefit shortfall;
- A contractor is able to exploit economies of scale in the provision of services (e.g. IT support or facilities maintenance);
- Savings in whole life costs and/ or for improved outcomes through effective design (e.g.: where a broad range of services may be provided in association with an asset, or when many inputs must be integrated in delivering a service, or where whole life and operating costs are importantly determined by good design);
- Clear specification of quality standards in absolute terms or in terms of client satisfaction;
- Ability of private sector to control discrete elements of the project without excessive oversight or interference; or,
- Clear boundaries and interfaces between public and private sectors.

4.1.3 Provision by the private sector may be less appropriate where:

- Risks which threaten the viability of a project are outside the control of the contractor (and these risks cannot be separated contractually from the project);
- The predominant risks are ones where the public sector has the comparative advantage in managing them;

- A large degree of discretion is required in determining the quality of services, and quality is not observable; or,
- Bidding costs are large in proportion to the value of the project (although there may be means of reducing these costs).

## ***Risk transfer***

4.1.4 When faced with significant risks, transferring part or all of it to the private sector should be considered. The governing principle is that risk should be allocated to whichever party from the public or private sector is best placed to manage it. The optimal allocation of risk, rather than maximising risk transfer, is the objective, and is vital to ensuring that the best solution is found. Accordingly, the degree to which risk is transferred depends upon the specific proposal being appraised.

4.1.5 Successful negotiation of risk transfer requires a clear understanding by the procuring authority of the risks presented by a proposal, the broad impact that these risks may have on the suppliers' incentives and financing costs, and the limits to risk transfer which might still be considered for value for money.

4.1.6 Where the private sector has clear ownership, responsibility and control, it should be encouraged to take and mitigate all of those risks it can manage more effectively than the procuring authority. If the procuring authority seeks to reserve many of the responsibilities and controls that go hand-in-hand with service delivery and yet still seek to transfer significant risk, there is a danger that the private sector will increase its prices.

4.1.7 A risk allocation table can be a useful tool to identify the bearer of each risk relevant to a proposal. An example of this is set out below:

**EXAMPLE OF RISK ALLOCATION TABLE**

| Risk | Scale | Bearer | | Key Issues |
|---|---|---|---|---|
| | | **Purchaser** | **Provider** | |
| Obsolescence | Low | | √ | Assets require low levels of technology |
| Demand Risk | Med | √ | | … |
| Design risk | High | | √ | … |
| Residual Value | Low | √ | | … |
| 3rd party revenues | Low | | √ | … |
| Regulatory change | High | √ | | … |
| Etc | … | … | … | … |

## ***Competition Policy***

4.1.8 Open and fair competition is a fundamental component of MoD acquisition policy in delivering affordable defence capability at overall long term Value for Money (VfM), and is a legal requirement in many circumstances. Competitive procurement helps to deliver VfM because it gives suppliers an incentive to reduce costs, increase productivity and encourage innovation by continually benchmarking them against their competitors. Competitive procurement is MoD’s default procurement route.

**Legal Obligations**

4.1.9 The following Procurement Law applies:

- MoD is required by the Public Contracts Regulations 2006 (also known as the Procurement Regulations) to advertise and to run a competitive procurement process for contracts for goods, works or services except where exempt under Article 346 of the Treaty for the Functioning of the European Union.
- MoD procurement is also subject to EU Treaty principles, including equal treatment, transparency and non-discrimination that should apply to all MoD procurements that fall within the

scope of the Treaty even where the Procurement Regulations do not apply.

**Non-legally binding Obligations**

4.1.10 Teams should continue to adhere to the European Defence Agency's Code of Conduct on Defence Procurement to contract for goods and services that benefit from the Article 346 exemption and are above the threshold of Euro 1 million.

**The benefits of competition**

4.1.11 Competitive procurement delivers benefits by tackling two basic problems. Firstly; there is an asymmetry of information between MoD and its suppliers in that the latter are far better informed about the likely cost of providing a particular capability, yet have an incentive to overstate these costs to the customer in order to increase their profits. Secondly, once a contract has been signed suppliers may have an incentive to act in ways which benefit their interests at the expense of the customer.

4.1.12 Competition partly resolves these issues by providing a benchmarking function in that it allows the MoD to compare prices across a range of suppliers, giving it more information. Firms competing for the contract have an incentive to bid as low as possible (whilst still earning an acceptable amount of profit) in order to maximise their chances of winning. This will tend to force firms' bids down closer to their true costs of production making them a better indicator of their costs.

4.1.13 After a contract has been signed, competition exerts pressure through a different mechanism. If a supplier knows that the MoD has a range of potential alternative providers, the incentives for them to engage in behaviour which might lead to unsatisfactory performance and hence risk them losing future business, are reduced.

**Limitations of competition**

4.1.14 The key limitation on the use of competition in defence procurement is the small number of potential suppliers, with most areas of the market having only a handful of firms capable of acting at the prime contractor level. This is exacerbated by significant barriers to entry in the form of the large up-front capital investments and the required technological expertise. These make it difficult for new firms to 'break into' the market, making the consequences of a firm exiting the market on the level of competition more severe.

4.1.15 A consequence of this is that MoD procurement decisions can have a significant impact on the structure of the market. As a result of losing a particular competition a firm may no longer have sufficient orders to sustain its industrial capacity. The nature of the competitive process means that unless they can somehow sustain this capacity the firm will slowly be driven out of the market by their rivals, reducing the level of competition in the long run.

4.1.16 This can lead to 'winner takes all' type competitions in which firms have a strong incentive to submit overly optimistic bids in order to win the contract, with the expectation that when problems emerge in the future they will be able to renegotiate terms because the MoD is already locked into the contract and / or there are no credible alternative suppliers left in the market.

4.1.17 More broadly, the adversarial nature of competition discourages defence firms from being completely open with the MoD for fear that information might leak to their competitors, giving them a commercial advantage. Where a project contains significant technological or programme risks this reduced openness may result in problems not being identified and dealt with early, leading to shortfalls in performance on time / cost / effectiveness.

**Constraints on Competitive Procurement**

4.1.18 The ability to run an open and fair competitive procurement may be affected by defence strategic considerations and market constraints. Project teams should identify whether any constraints apply, and where they do, seek early engagement with DASA-DESA or the relevant TLB Appraisal and Evaluation team.

4.1.19 The following **defence strategic considerations** may constrain the opportunity for open and fair competitive procurement:

- *National security* which includes the protection of UK sovereignty, overseas territories, assets, people and information. Competitive procurement may have to be limited to suppliers who have appropriate facilities and personnel in the UK or the contract may have to be structured so that it uses other protective measures such as firewalls between elements of the contract. In exceptional cases, where it can be clearly demonstrated that UK sovereign capability needs to be retained for reasons of national security, MoD will seek delivery from the UK industrial base. A capability will be regarded as being 'retained in the UK industrial base' if the people possessing the skills and the facilities representing that capability reside in the UK and the requisite Intellectual Property RIPR can be effectively utilised in the UK. Due regard needs to be given to the impact of foreign control laws on the ability to effectively exercise the IPR and the impact this could have on third party use of the IPR for MoD.

- *Security of Supply* which is the ability to guarantee and be guaranteed the supply of goods and services that are essential to military operations to prosecute the Government's foreign and security policies. The cost of ensuring security of supply for critical capabilities (what in many circumstances may be the UK premium) must be balanced against the risk and likely impact of the chosen procurement strategy not providing adequate support to the Armed Forces on military operations and will be judged on a case by case basis with regard to long term value for money and affordability. Investigation of the proposed supply network will be required to inform analysis of the impact of security of supply issues on the procurement decision. In doing so care must be taken that the analysis concentrates on the requirement specified in the draft contract and not the supplier's ability to complete an essentially different procurement in the future. Security of supply does not imply a presumption of exclusive domestic supply. There are many defence industrial capabilities that are not critical to national security and there may be a sufficient number of reliable global suppliers to provide confidence that the UK will be able to meet its requirements.

- *UK Operational Sovereignty.* The Defence Industrial Strategy (Dec 05) (DIS) identified those capabilities, which are considered essential to retain within the UK. Where UK sovereign capability is required but there is insufficient work to sustain a competitive market within the UK into the future, an appropriate contractual mechanism such as an alliance of UK domiciled companies may be formed. However any such approach must be subjected to rigorous evaluation of the VfM and affordability implications and there may be competition law and procurement law implications to consider.

4.1.20 The scope for full and open competitive procurement may be further influenced by the following market factors:

- *IPR.* Access by MoD to sufficient rights to enable a third party to utilise IPR on MoD's behalf is fundamental to achieving competitive procurement for many MoD requirements from research and technology right through the procurement cycle to disposal. Where there is a sole source of supply because MoD does not possess any or sufficient IPR, or where the risk would be too great to place work with another party (for instance where Airworthiness Certification would be jeopardised should work be placed with a party other than the Design Authority), then teams should consider whether there is any opportunity to reformulate the requirement or obtain licensing to open up competitive procurement.

  - *Single Source Worldwide.* In some circumstances there may only be a single source of supply worldwide. If there is a single source of supply worldwide, teams should consider whether there is any opportunity to promote competitive procurement for example reformulating the requirement or stimulating the market. A detailed cost/benefit and risk analysis should be undertaken to ensure that such an approach would deliver long term VfM.

- *Limited Market Opportunities.* There may be a lack of suppliers with the required capacity to deliver the requirement or a lack of 'real' competitive pressure in the market. Where there are limited market opportunities defence firms may find themselves in a position where a competitive procurement becomes a 'must win' situation with failure to secure a contract likely to result in a particular industrial capability being run down due to lack of work and becoming unsustainable. Given the small number of firms capable of acting at the prime contractor level such a situation could lead to an erosion of MoD's ability to compete similar contracts in the future. Teams should consider whether the likely impact on long term VfM is large enough to justify the use of some other procurement approach, such as alliancing, to sustain the long term availability of essential industrial capability, subject to the usual value for money and affordability considerations. However, it is important that MoD does not sustain companies that would otherwise be unviable entities due to the legal and presentational issues involved.

**Increasing the Opportunities for Competitive Procurement**

4.1.21 Recognising the potential constraints imposed by strategic considerations and market structure, teams should look to use other opportunities to promote competitive pressure to ensure VfM is achieved. The following should be considered:

- *Review of the Defence Strategic Considerations.* Where competitive procurement is constrained due to defence strategic considerations, teams should review the nature and scope of the constraints to establish which are overriding and to consider the potential for trade offs.
- *Licensing of IPR.* Where competitive procurement is constrained due to the lack of rights to utilise requisite IPR, then teams should consider whether licensing IPR is a viable option to enable competitive procurement.
- *Encouraging Competition in the Supply Network.* Where it can be clearly demonstrated that security considerations and/or market structure prohibit the use of competitive procurement and a single source is selected, competitive procurement to deliver VfM should be encouraged throughout the supply network in line with the Codes of Best Practice[5] where this does not compromise UK national security and is both feasible and appropriate. The team should also demonstrate how the benefits from encouraged competition further down the supply network will feed through to the MoD.
- *Reformulation of the Requirement.* Teams should consider whether the requirement could be reformulated or redefined to bring the competitive procurement process to bear.
- *Stimulation of the Market.* It should be assessed whether the market could be stimulated to enable a competitive procurement to be held.
- *International Collaboration*. International collaboration can deliver better value to the customer through the sharing of overheads and the benefits of economies of scale, encouraging the evolution of the global defence technological and industrial base.
- *Co-operation with Other Government Departments (OGDs).* Acquisition teams should consider whether acting collectively with

[2] MoD/Industry Commercial Policy Group Guideline Number 5, Defence Acquisition, The Commercial Framework, Codes of Best Practice

OGDs to meet competitive requirements will deliver better VfM compared to separate Departmental action.
- *Security of Supply*. There are a number of formal Security of Supply arrangements in place with other nations which can provide assurances to the UK in emergency situations.

## ***Assessment of Value for Money***

4.1.22 Project teams should identify whether any constraints apply and, where they do, provide a full written explanation of their impact and the steps taken to maximise competitive procurement. Teams should not approach HM Treasury for consideration of their proposals until such work has been completed. All teams are required to provide evidence for the audit trail and obtain independent assurance from DASA-DESA or the relevant TLB Appraisal and Evaluation team. An outline of evidence required is provided at Annex A.

4.1.23 Where over-riding binding constraints to competition can be demonstrated, a should-cost model must be prepared to assist in the assessment of value for money.

4.1.24 Where no such constraints exist, but the qualitative assessment of options results in there being only a single viable option, value for money must also be assessed by reference to a should-cost model.

### Should-cost modelling

4.1.25 Should-cost modelling is the process of determining what a product or service should cost based upon its component raw material costs, manufacturing costs, production overheads, and reasonable profit margins. It provides an objective estimate of cost based on analytical techniques applied to historic data from reasonable comparators. A should-cost estimate provides a good benchmark for industry costs, and provides the understanding required to negotiate the best arrangement with industry.

## ***Routine Re-provisioning Decisions***

4.1.26 Routine re-provisioning or renewal of contracts do not require an investment appraisal or value for money assessment providing the following criteria apply:

- A requirement exists and has been established by an existing contract;
- Value for money has been satisfactorily delivered, evidenced by evaluation;
- There have been no changes in circumstance from the original procurement.

An example of this may be where there is a requirement for the purchase from the Original Equipment Manufacturer of spares in support of a particular equipment. If there is no other supplier for the spares it can be a straightforward choice between buying and not buying. The same may also be true when purchasing repair/servicing, Post Design Services (PDS) or, where Intellectual Property Rights, Contractual Terms, or Design Authority status applies. Other examples could be where operational constraints limit the available options, or a long-term contract with options to renew or extend. However, options may not be limited by time or resource constraints due to poor planning or management decisions or by departmental strategies. **Agreement must be sought from DASA DESA or the relevant TLB Appraisal & Evaluation team in all such cases, and this does not remove the requirement to assess optimism bias, risk, and affordability**.

4.1.27 Where there are any other significant factors to be considered, such as potential alternative suppliers or innovative support packages, an appraisal must be undertaken.

## ***Business Improvement Policy***

4.1.28 The overriding objective is to provide defence outputs offering best value for money affordable to the taxpayer. As part of the process of ensuring a fair comparison can be made between the true costs and risks of undertaking activities commercially and those of retaining activities in-house an investment appraisal must be produced.

4.1.29 In reviewing activities, there is a need to:

a. set clear objectives;

b. ensure that the scope is fully defined and robust;

c. consider the full range of options to meet the requirement including in-house options;

d. undertake a fully detailed risk assessment;

e. achieve the best value for money outcome within available funding.

4.1.30 The scoping and feasibility stages of each review will determine the eventual means of securing improvement. In determining the appropriate scope, consideration should be given to the potential impact on MoD employees inside and outside the project boundary. Whatever the eventual outcome, the review process is likely to result in new ways of delivering services and TUs will need to be involved. Management must keep the TUs fully informed and consult with them as appropriate and at the appropriate level. The process must be as transparent as possible recognising commercial sensitivities, to ensure that Trade Unions and staff understand how an objective decision will be reached. It should be borne in mind that MOD policy for interaction with TU's is clearly set out in the Employee Relations Policy located in the People Services pages of the Defence Intranet and any failure to adhere to its direction is likely to delay, rather than expedite the project.

4.1.31 TLBs or Trading Funds considering proposals for the external provision of services will need to address the full resource implications of such projects. Potential projects must be given proper priority and be effectively managed. If the potential benefits from commercialisation appear to be relatively small, and are likely to be outweighed by the costs of competition or the increased MOD management costs, the work should be retained in-house.

4.1.32 Management must approach consultation with an open mind and seek to achieve agreement by creating a relationship with the Trade Unions based on mutual trust through openness, explanation and the exchange of views. Consultation is likely to involve informal dialogue as well as the formal processes set out in the Employee Relations Policy section of People Services on the Defence Intranet.

4.1.33 An important part of the scoping work will be the agreement of the requirement. This should reflect the capability required, expressed in output terms. It will not necessarily equate to the scope of work that may be contracted to industry. The requirement will form the basis for developing options for the delivery of the required capability. In drawing up the requirement, management must engage the Trade Unions and the workforce as fully as possible at the earliest practicable stage.

## Options

4.1.34 Once the scope of the work has been identified and the requirement has been agreed, the context of the review will determine the nature of the assessment. Where work is currently conducted in-house, TLBs and Trading Funds will need to ask:

a. Should some or all of the work be retained in-house, and if so how can efficiency improvements be made?

b. Where it is judged that best value for money could be achieved by commercialisation of some or all of the work currently conducted in-house, how should this be done?

4.1.35 Where work is currently provided under contract with the private sector, the issues are likely to be:

a. How is the existing contract performing?

b. Does the opportunity exist for de-scoping i.e. bringing some or all of the work back in-house, perhaps as part of a wider in-house efficiency initiative?

c. Where contracts must be re-competed, how best should this be done?

## Value for Money Benchmark

4.1.36 Reviews of business activities will always need to establish the most cost-effective option for delivering that activity. Part of this examination will need to be an assessment of whether any in-house processes currently in place can be improved. Whenever a project includes an option for delivery of the requirement through a commercial bid, an appropriate Value for Money Benchmark (VfMB) must be developed.

4.1.37 The purpose of the VfMB is to test the value for money of commercial bids. It can take a number of different forms and may incorporate in-house provision, bought-in services, or a mixture of the two:

a. In the majority of cases the VfMB will be an assessment of the cost of how MoD would deliver the defined output as the best alternative to commercial bids (i.e. a 'would cost' model). It should not be constrained by affordability. The VfMB is likely to be based on existing methods of delivering the requirement, but should take into account all reasonably foreseeable efficiencies in delivering the defined output. Trade Unions should be consulted and invited to provide suggestions for possible efficiencies and new working practices. Every effort should be made to provide realistic and deliverable cost estimates. However, it would not be usual to seek firm prices from industry to inform the VfMB.

b. In larger or more complex cases, additional effort will be appropriate to establish an operationally achievable, fully deliverable, robust benchmark. Construction of a Fully-resourced VfMB requires the establishment of a dedicated team and budget to provide the necessary resource to fully develop 'do better' or 'do different' options. A Fully-resourced VfMB can add value to the competition process as it offers a challenging, deliverable solution. However, significant costs will be incurred, and the Department needs to be confident in advance of incurring such cost there is a reasonable prospect of its recovery; i.e. that this option can deliver a value for money solution.

c. A 'Should cost' model is an assessment of what a commercial solution to deliver the defined output should cost. This is appropriate where the activity is not currently provided, and could not be provided, in-house e.g. construction. The 'should cost' model is a theoretical construct of how the project team considers a commercial provider would deliver the requirement. The costs of each delivery element would be estimated from information gathered from existing sources (e.g. past contracts, CAAS pricing), and from relevant external sources (e.g. market soundings, sector consultants). It is not an achievable solution, but provides a target to inform contract negotiations with commercial bidders.

4.1.38 The appropriate form of VfMB to adopt must be agreed with and endorsed by DESA, or the relevant TLB Appraisal and Evaluation team for projects within TLB thresholds. Trade Unions must be informed and consulted. DESA is the final arbiter in the process.

**Risk**

4.1.39 To be a valid benchmark against which private sector bids can be compared fairly, the VfMB must reflect not only certain procurement costs but also the risk that additional costs may arise, which under industry proposals would fall to the supplier. During the procurement process, risks should be identified, and ways in which these risks can be mitigated considered. It is necessary to assess the impact of these risks on costs, estimate their probabilities, and explore and appreciate the sensitivity of these estimates. In many cases, adjustments to the original cost estimates will be needed to arrive at the final risk adjusted VfMB. Comprehensive accounting for risk is required to ensure that valid and informed comparisons can be made amongst the bids and between the bids and the VfMB.

**In-House Efficiencies**

4.1.40 There will be circumstances where the best course of action for the Department may be to continue to deliver activities in-house but to improve the efficiency of the existing business process. Reasons may include;

a. the activity is not suitable for commercial treatment (perhaps because it is too specialised or because business processes are too inextricably linked with tasks, which for military reasons must be kept in-house),

b. risk cannot be satisfactorily transferred to the private sector.

The onus is on the Department to pursue all possible means of improving the efficiency of activity delivery.

4.1.41 In examining the scope for more cost effective solutions, it is important that management and workforce alike should realise there should be no presumption that any previously successful In-House Bid (IHB) or VfMB should be maintained indefinitely. However, the Department is not required to compete work won previously by IHBs if, following rigorous investigation, they believe that commercialisation offers poor prospects of better value for money or the cost of conducting the tender exercise outweighs the benefits that might accrue from commercialisation. This would need to be revisited periodically to test that it remains valid. In such cases, it will be up to management to engage the Trade Unions and the workforce in order jointly to pursue all available means of improving and reducing the cost of that activity in-house.

4.1.42 The Department should examine the scope for efficiencies in undertaking activities in an innovative manner. For example, they might consider the potential scope for "bundling" similar activities to increase the potential for synergies or economies of scale to be realised. On the other hand, too large a span in bundling can result in over complication and unnecessary overheads. TLBs or Trading Funds will want to take into account experience elsewhere in the Department in deciding which activities can be delivered and provide better value for money. It is for MOD as informed customer to decide how best to meet its requirements, but the Trade Unions must be consulted fully at all times. The aim must be to ensure that a comprehensive range of options are considered at the outset and the optimum solution should be arrived at following assessment of all relevant factors such as their viability, economic appraisal and consistency with business plans.

**Bid Evaluation**

4.1.43 The Trade Unions must be invited to appoint an independent observer as part of the bid evaluation process, as set out in the Employee Relations Policy located in the People Services pages on the Defence Intranet.

## ***Review of Existing Outsourced Contracts***

4.1.44 Where activities are already provided by a commercial contractor, a review of all options should consider whether the services could be provided more cost effectively in the future. At contract expiry, the contract will normally be re-let following competition amongst external providers. It might be possible to undertake activities more effectively in-house through imaginative and innovative approaches rather than continue to pursue the commercial solution. In such circumstances the existing commercial operation, together with much of its working practices and corporate knowledge would be transferred in-house. TLBs and Trading Funds will need to clearly demonstrate at the outset that the introduction of competitive in-house proposals offer even better value for money (for example by building on the experience of the commercial sector) when compared with existing commercial arrangements. In such circumstances, a VfMB should be developed in consultation with the Trade Unions, and considered alongside other commercially-based options.

## ***Extending Life of Existing Outsourced Contracts***

4.1.45 The negotiation of an extension to a contract beyond its original performance, cost and time envelope will be the exception and not the rule and will require a clear business case. Extending an existing contract will usually be a short-term measure, and must not be used to circumvent a competition for re-let. Value for money must be demonstrated and subjected to appropriate scrutiny in all such cases. Legal and Commercial Policy advice must be sought at an early stage to ensure that the MOD's obligations under the EU Services Directive and competition law are complied with and that the Department's industrial and competition policy is followed. Trade Unions must be informed and given the opportunity to be consulted.

## ***External Assistance***

4.1.46 External Assistance can be summarised as the procurement from the private sector of consultancy assistance. Cases seeking to procure External Assistance must include all the elements of an appraisal as set out in Section 2.2. In addition, the following specific points apply:

- Internal consultancy resources must be considered before External Assistance is engaged. Alternative options for meeting the specified requirement must therefore include the option of MoD internal resources, even if that would require re-prioritisation of other tasks.
- Trade Unions must be consulted on all proposals to procure External Assistance, initially on an informal basis, which may lead to a formal consultation period where TUs believe it necessary.
- Skills Transfer from the External Assistance provider to MoD staff is required unless it can be demonstrated not to be appropriate. The approach to ensure the transfer of skills must be set out.
- Cases must comply with DCP-EF-03-08-01 dated 11 June 2010 'External Recruitment Freeze'.

4.1.47 Where there is a requirement to extend an existing contract, an evaluation must be undertaken to assess the performance of the contractor. As long as the criteria set out in paragraph 4.1.26 apply, an investment appraisal is not required.

## ***Disclosure of Financial Information to Industry***

4.1.48 It is important that a disclosure strategy is drawn up before the project team engages with industry. Project teams planning to release financial information to industry should consult with Partnering Support Group (PSG) and DESA, and provide documented approval from the Senior Responsible Owner (SRO) for the project. The documented disclosure strategy should be referred to in the Concept of Analysis and Initial Gate Business Case, or equivalents, Additional guidance is provided at Annex A.

4.1.49 The data shared with suppliers on particular programmes and projects will vary depending on the procurement strategy being followed, and individual circumstance. The underlying principle is to ensure disclosure is consistent with MOD securing the best value for money solution to the taxpayer. However, there is a need to protect information whose disclosure could harm security or international relations, undermine internal policy or prejudice MOD's position in negotiations with suppliers.

4.1.50 Where there is effective competition and adequate funding available, it is not usually necessary to release financial information as the competitive process will ensure value for money is delivered.

4.1.51 Where there is competition but the affordability of the requirement is in doubt, an indication of the overall funding allocation (affordability envelope) and, where relevant, the profile of that provision can be made. This may prevent nugatory activity from being undertaken, and the competitive process should ensure the data provided does not coincide with MoD's willingness to pay.

4.1.52 In a non-competitive environment the extent to which MoD may be prepared to disclose data must be judged on a case by case basis. Relevant guiding factors will include: the position of a project in its lifecycle; potential sensitivities of international partners when the project is a collaborative one; and the nature of the relationship already established with specific companies. Examples of information that may be disclosed include:

a. An indication of the overall funding allocation (affordability envelope) and, where relevant, the profile of that provision. This should only be considered where the affordability of the requirement is in doubt, and must not indicate MoD's willingness to pay.

b. 'As Is' or 'baseline' costs. This may help MoD and industry to gain a better understanding of the existing operation. It will also help to ensure a comprehensive and robust profile of the costs of the current arrangements is produced;

c. Details of technical efficiencies. Validation with industry will ensure both parties have confidence that costs are robust and the solutions are deliverable.

d. Known planning assumptions across the life of the project, e.g. known out of service dates.

Examples of information that would not normally be released include;

a. Relative price inflation, such as project specific earnings inflation. This is because it could become self-fulfilling.

b. Details of operational (non-technical) efficiencies applied to the VfMB. This would undermine the willingness of the Trade Unions to suggest such efficiencies or engage in the process.

4.1.53 Under no circumstances should the following information be released to industry, whether in a competitive or non-competitive environment:

a. Costed risk adjustments, in total, or by constituent parts;

b. Total VfMB figure inclusive of risk.

## ***Fallback or Exit Strategy***

4.1.54 There is no guarantee that the VfMB or the commercial bids will be affordable. Where the VfMB is unaffordable through-life, a modified version that is affordable needs to be developed, even if the resulting option provides lower capability. The affordable fallback option will be used to help demonstrate the relative benefits of the commercial bids.

4.1.55 Financial provision should be continually reviewed to check the affordability position of the options being developed, with regard to assumptions on eg balance sheet treatment, and the ability to flex between RDel and CDel.

4.1.56 Solutions that are affordable through-life may have short-term affordability shortfalls from one year to the next. Attempts to smooth short-term affordability peaks and troughs with industry must take full consideration of the changes in risk profile this is likely to bring.

## ***Bid Evaluation***

4.1.57 There are software packages that are available to help assess commercial bids. The most commonly used such package in the MoD is AWARD. These packages offer advantages to the Department in setting out in a structured and transparent way the criteria by which bids will be evaluated. Transparency is a key part of compliance with the Public Contracts Regulations. However, it should be stressed that the use of AWARD or similar packages do not negate the need for an IA or COEIA. Advice should be sought from DESA and D Scrutiny staff before tender evaluation criteria are issued to bidders to ensure that the criteria by which a winning bid is selected is consistent with achieving best VfM, as demonstrated through an IA/COEIA. Most importantly, price or cost should not be included in any tender evaluation weighting and scoring of bids. Cost needs to be kept separate for two reasons. First, cost is usually a binding constraint, i.e. there will often be an upper limit within which the project needs to keep. Second, within any such constraint, cost is something that is traded off against the 'benefit' of the project. The benefit of the project will be represented in the operational effectiveness part of the COEIA. Any combined weighted scores in a tender evaluation should be consistent with this. Early engagement with technical scrutiny staff is therefore essential.

## ***Assessing Value for Money Through-Life***

4.1.58 When the Department is considering entering into partnering arrangement at the investment level, or an LTPA, or any form of non-competitive contract, the business case must establish how the continuing value for money will be assessed through the life of the agreement or contract. Clear performance targets must be established, against which industry's performance will be assessed.

4.1.59 Details should be provided in the business case of the regular reviews, targets, and quality standards that will be used to assess and manage industry's performance. A range of measures should be adopted to ensure through-life value for money is achieved in non-competitive, partnering arrangements. These are discussed in the paragraphs below:

**A robust "should-cost" benchmark model**

4.1.60 This can be built up on the basis of input quantities and rates using data available about the methods of delivering the design or service anticipated. Additionally a "top down" check can be carried out, comparing the total cost with that of the nearest similar projects.

**Transparency**

4.1.61 Transparency of contractor data needs to support three different activities, all being part of through life VFM:

a) checking that costs are genuine
b) undertaking activities designed to predict outturn costs and highlight potential overruns or risk crystallisation
c) controlling and managing costs, or verifying the contractor's cost management activities.

4.1.62 The project team and the contractor should agree the data set that is needed for fulfilling the three requirements above. Amounts must be properly allocated to the contract, and regular checks will ensure that the coding remains accurate. The project (or business) open books need still to reconcile to the primary books of the contractor, and periodic reconciliations checked. Ability to drill down to task and related cost lines should exist – these need not be reported regularly, but should be accessible. Open book should not be regarded as purely about financial information. Activities drive costs and therefore records relating to activities should also be part of the transparency, e.g., risk registers, schedules, performance evaluations, meeting minutes.

4.1.63 Open book reviews need to go hand-in-hand with the performance monitoring and intervention regime. It will need to work through the supply chain and identify achievement against performance targets for individual subcontractors.

**Robust cost control and cost and programme management regime**

4.1.64 Using the transparency of the open book arrangements agreed, the project team should interface with contractor systems and controls to ensure it can interrogate the project and the cost drivers. Project teams need to be able to challenge the cost structure and have levers to ensure that the contractor fixes problems with cost. The cost management and control system as a whole needs to be assured by the project team at the outset and on a continuing basis.

4.1.65 For a business or sector, the equivalent would be along the lines of a robust business plan jointly agreed and annually updated by the project team and contractor, verified by the project team against industry best practice, with targets and milestones and a measurement regime.

**Fallback options and commercial levers**

4.1.66 The business case should provide details of costs and mechanisms for an exit strategy, should the partnering solution fail for any reason. It should identify in the case of investment decisions, the mechanisms in place to limit increases in price at the renegotiation points. Structures which tie the project team to the contractor, such as punitive termination arrangements or lack of freedom to consider non-sovereign contractors, limit the availability of fallbacks and thereby of commercial levers.

**Incentive payments**

4.1.67 Incentives form a key part of maintenance of value for money. They can include gainshare arrangements; i.e. shares of savings against current baseline, or shares of both gain and pain against an agreed target of savings or improvements. Incentive payments should be made for challenging achievements, rather than merely stripping out existing inefficiencies, ie a target is preferable to a gainshare below current levels, which is left as optional.

**Governance and assurance provisions**

4.1.68 Arrangements need to be in place to keep the long term contract robust and challenging. If the parties are working well together, then a comfortable and non-challenging relationship may arise. Boards of governance, supported by independent assurance that all control and monitoring mechanisms are working appropriately are needed. A key element in the governance of the partnering arrangement will be regular evaluation, as described in Section 3.7.

4.1.69 A plan for future project evaluation must be included within the business case at each approval point. The Trade Unions may have valuable contributions to make when undertaking evaluations and their views must always be sought.

## ***Wider Markets Initiative***

4.1.70 The Wider Markets Initiative (WMI) encourages the public sector to adopt a more entrepreneurial approach to making the most effective and efficient use of public assets, by using capacity which is surplus to normal requirements, but which must for wider strategic or other reasons be retained within the public sector, to generate income. This generally involves marketing the assets to private individuals or companies for revenue, which can then be used to fund activities within the public sector. Holders of assets can run Wider Markets projects themselves; or they may choose to engage a private sector partner.

### Wider Markets Guidance

4.1.71 Policy on wider markets is set out in "Selling into Wider Markets: A Policy Note for Public Bodies" HM Treasury 2002 (http://www.hm-treasury.gov.uk/media/ED8AB/New_WM_Guidance.pdf).

4.1.72 When seeking to exploit irreducible spare capacity under this initiative, regulations covering partnering and outsourcing apply in the normal way. Consideration must be given to the following issues:

- Treatment of fixed assets;
- Allowance for additional costs to achieve third party income;
- Need to appraise WMI against alternatives such as PFI.

## ***Private Finance Initiative***

4.1.73 Guidance for assessing value for money in relation to the Private Finance Initiative (PFI) is located on the MOD PFU and DASA DESA (Appraisal and Evaluation) teamsites on the Defence Intranet, and is not considered further in this Guide.

## ***Novel Financing***

4.1.74 Consider, for example, a proposal that involves sale of a property portfolio to a private contractor, who then contracts to provide office services to the public sector using the assets. An apparent saving may be secured by allowing the initial transfer of the ownership of the assets to go through for a peppercorn payment in return for a reduction in the unitary fee charged for provision of the office services. However, such arrangements must demonstrate value for money, in addition to the potential budgetary benefits.

4.1.75 Such an arrangement involves an implicit loan of the value of the properties to be repaid over the course of the service contract. The arrangement may appear attractive to both parties because the contractor's cost of funds may exceed by a significant margin the public sector standard Discount Rate. However, in such a case it is important to appraise:

- The implicit risk that remains in the public sector as a consequence (eg the default risk on the implicit loan should the contractor sell assets and then fail, or should the public sector charge on the assets prove inadequate);
- The fact that the private contractor's incentive to deliver good service is weakened precisely to the extent that they have effectively received payment in advance.

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## ***Annex A: Demonstrating the Policy - Providing Evidence for the Audit Trail***

The following questions should be considered simultaneously when providing evidence for the audit trail.

1. **Circumstances where Defence Strategic Constraints apply to the requirement.**

   **Defence Strategic Considerations**
   - Why do Defence Strategic Considerations apply to the requirement?
   - Can these be relaxed?
   - Are they tradeable?
   - Can a Security of Supply arrangement be used where appropriate?

   **Market Constraints**
   - Is there a competitive market? **If yes, use a competitive procurement approach**.
   - Can the market be stimulated through market sounding, promoting the requirement beyond the market segment from which it is usually procured, aggregating requirements or breaking requirements down? **If yes, use a competitive procurement approach.**
   - Can the requirement be reformulated to enable competitive procurement e.g. breaking the requirement down to allow a single source to deliver the protected element (subject to the Defence Strategic Considerations) whilst other elements are procured through competition? **If yes, use a competitive procurement and a sole source approach for the protected element.**
   - Does the MoD have access to IPR to enable competitive procurement? **If yes, use a competitive procurement approach and a sole source approach for the protected element.**
   - Can the IPR be licensed? **If yes, use a competitive procurement approach through licensing the IPR**.
   - Where a non-competitive procurement approach is justified, can competition be encouraged in the supply network?

2. **Circumstances where Defence Strategic Considerations do not apply to the requirement**

- Is there a competitive market? **If yes, use a competitive procurement approach**.
- Can the market be stimulated through market sounding, promoting the requirement beyond the market segment from which it is usually procured, aggregating requirements or breaking requirements down? **If yes, use a competitive procurement approach.**
- Can the requirement be reformulated to enable competitive procurement e.g. breaking the requirement or aggregating requirements to stimulate industry's interest? **If yes, use a competitive procurement approach.**
- Does the MoD have access to IPR to enable competitive procurement? **If yes, use a competitive procurement approach.**
- Can the IPR be licensed? **If yes, use a competitive procurement approach through licensing the IPR**.
- Can the protected element (subject to IPR restrictions) be procured through a single source arrangement whilst other elements are procured through competition? **If yes, use a competitive procurement approach and sole source for the protected element.**
- Where a non-competitive procurement approach is justified, demonstrate how competition be encouraged in the supply network.

## ***<u>Annex B: Disclosure of Financial Information to Industry</u>***

When considering releasing financial information to industry, the key questions that must be addressed are:

- **Why** is it necessary or beneficial to release information?
- **What** information is it appropriate to release?
- **When** is the appropriate time to release information?

The answers to these questions may be different for each individual project, and Project Team Leaders must decide what is right for their project. **The aim will always be to achieve a better deal for MoD without compromising its negotiating position and securing best VfM to the taxpayer.**

The Project Team Leader is accountable for the scale of the cost information released, and is required to demonstrate that its release is appropriate in order to optimise the potential for a value for money outcome. A record of the rationale applied must be incorporated into the Disclosure Strategy documentation, and addressed as part of the evaluation process for the project.

**Key factors to be considered**

The release of financial information should only occur after the consideration of all relevant factors by the Project Team. The following provides a summary of the key factors:

- The assessment of the relative strength and practicability of effective competition.
- Is it necessary to release cost information or will the underlying assumptions be sufficient?
- A judgement on the potential added value likely to be gained by the project in terms of cost, time and performance
- What other non-financial information is being disclosed? Is it compatible with the cost disclosure information?

- What outcome is required as a result of disclosure?

- Is disclosure likely to weaken MoD's negotiating position?

**Benefits**

There are benefits from disclosure of information to industry in certain circumstances:

- A full understanding on how business is currently conducted.

- An awareness of the Authority's future requirements.

- Identification of the key cost drivers and where efficiency gains may be possible.

- Validation of technical efficiencies that could be incorporated into the VfMB in order that all parties have confidence the costs are robust and the solutions are deliverable.

- An opportunity to understand the business processes, in particular, where transfer of risk benefits and business re-engineering can be made to best effect.

- Improve understanding of the capability deliverable from the funding available.

- Provides an indicative target for industry to aim at.

- The identification and understanding of risk.

- Prevents nugatory activity when affordability is severely constrained.

**Risks**

The risks associated with disclosure of information to industry include:

- Bidders may be inclined to bid just below the indicative target figure provided. This can be mitigated by emphasising that meeting the target is unlikely to be sufficient to secure the deal. Value for money does not necessarily mean selecting the cheapest option.

- Loss of negotiating leverage. This should not be affected if negotiations are pursued following extant commercial guidance.

- The unnecessary transfer of intellectual capital.

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# 4.2 NON-MARKET IMPACTS AND SUSTAINABLE DEVELOPMENT

**4.2.1 The valuation of non-market impacts is a challenging but important element of appraisal, and should be attempted wherever feasible and appropriate. This chapter outlines techniques on how to value non-market impacts, and some typical applications such as health benefits, prevented fatality, design quality, the environment and distributional impacts. These approaches can be complex but are equally as important as market impacts.**

**4.2.2 In the future the delivery of Defence capability will be increasingly threatened by interlinked environmental, social and economic challenges such as climate change, natural resource depletion, energy security, water scarcity and population growth. Investment appraisals must, therefore, make appropriate allowance for sustainable development issues such as the effects of energy use, Greenhouse Gas (GHG) Emissions, and the effects of climate change.**

## ***Non-Market Impacts***

4.2.3 The valuation of non-market impacts is a challenging but important element of appraisal, and should be attempted wherever feasible and appropriate. Where market values are not available for an identified cost or benefit, there are a number of approaches to attributing a value for inclusion in an appraisal, the most commonly used of which are outlined in paragraphs 4.2.4 – 4.2.53 below.

## ***Willingness to Pay and Willingness to Accept***

4.2.4 The preferred method of valuation is to simulate the market by estimating the ‘willingness to pay’ (WTP) or ‘willingness to accept’ (WTA) a project’s outputs or outcomes. Willingness to pay for a little more of a service is a reflection of the value placed by consumers on an increment of that service. The amount consumers are willing to pay depends to a large extent on the levels of income available to them, so valuations are usually obtained by averaging across income groups.

4.2.5 The quantification of potential social, health or environmental impacts normally requires an alternative approach to valuation. Techniques to establish money values for this type of non-market impact generally involve the inference of a price, through either a revealed preference or stated preference approach[37].

## ***Boundary Values***

4.2.6 “Willingness to pay” and “willingness to accept” are not practical methods for valuing defence benefits in MoD appraisals, as the public is disconnected from the costs and benefits of defence, and so cannot make informed judgements on this issue.

4.2.7 The 'boundary value' concept attempts to circumvent this problem by treating the government as the prime consumer of defence capability. Assuming that MoD decisions are made on a rational basis using all available information, inferences can be made from these choices as to the implicit minimum value of the benefit to society they are expected to generate.

4.2.8 For example if the MoD procures a military system with a discounted Whole Life Cost (WLC) of £30bn, then it can be inferred that the benefit of that system expressed in discounted monetary terms must be equal to or greater than £30bn. Thus this figure represents the lower, “boundary value” of the expected benefit the MoD believes that system will deliver.

4.2.9 In order to be of use in the Investment Appraisal process these boundary values need to be expressed in discounted terms as Net Present Values (NPVs). This arises from the fact that the timing of the incidence of benefits and costs arising from a project may not coincide.

4.2.10 For example, when procuring a new piece of equipment there is commonly an initial phase for development and manufacture. During this period the project generates costs but delivers no benefits. The benefit is only realised once the system enters into active service.

[37] For more information see Treasury Green Book

4.2.11 An example of an area in which the "boundary value" can be useful is in considering the trade-off of capabilities between existing projects. When one project impinges on the effectiveness of another, the "boundary value" of the latter can be used to arrive at some monetary measure of capability loss.

4.2.12 The key assumption we make in this form of analysis is that the decisions are made independently. For example, the MoD procures a new aircraft (decision 1) but some years down the line puts in place a project which will reduce the capability of that aircraft (decision 2). It is assumed that decision 1 was made without foresight of / any reference to decision 2. This means that the boundary value derived from the project's WLC is completely independent from the later decision.

4.2.13 Given the potential complexity of the issues relating to the implementation of this concept, DESA should be consulted before any attempt is made to incorporate a "boundary value" argument into an Investment Appraisal.

***Example***

*TOPMAST is a personnel project whose strategic goal is to improve the manning rates for the new naval platforms coming into service over the next decade*[*]*. Currently, technological limitations mean that legacy platforms can only spend 220 days per year on active deployment with the remainder spent in port for maintenance etc. New platforms coming into service in the near future however, will be capable of active deployment for up to 300 days per year.*

*The manning systems currently in place cannot deliver 300 days active deployment per year without a prohibitive increase in personnel. The TOPMAST programme aims to solve this problem with a moderate increase in personnel and a change in manning patterns to free up additional resources. A key consideration is thus; what is the value of unlocking the additional capability from these new platforms coming into service?*

*Let us assume that the discounted WLC of a new fleet of naval platforms is estimated to be £10bn. When the decision to procure this system was made, it was done so under the assumption that the full 300 days of active deployment would be delivered. Given that the platform will only have value when on deployment, it follows that the £10bn figure represents a* *lower bound on the value of the platform, conditional on it being on active service for 300 days per year.*

*We make the assumption that the decisions to acquire the platform and to implement TOPMAST are completely independent allowing us to apportion the value of the platform over its active service. Without TOPMAST only the current 220 days service will be delivered, this represents an over 25% loss in terms of the platform's potential deployment.*

*It follows then that the opportunity cost of not implementing TOPMAST is approximately 25% or £2.5bn worth of the whole life value of the project. Thus if the cost of TOPMAST is small relative to this economic benefit the argument weighs in favour of implementation.*

**Figures used are hypothetical and for illustrative purposes only*

## ***Valuing Time***

4.2.14 Within central government, the Department for Transport's (DfT) approach to valuing time in the appraisal of road schemes and other projects is well established.[38] This approach uses different values for 'employers' time and 'own' time (or working and non-working time).

4.2.15 The value of employees' time-savings (working) is the opportunity cost of the time to the employer. This will be equal at the margin to the cost of labour to the employer: the gross wage rate plus non-wage labour costs such as national insurance, pensions and other costs that vary with hours worked.[39] This approach is often used in the appraisal of relocation/location decisions where time is "lost" when traveling to and from meetings at different locations.

## ***The Value of a Prevented Fatality or Prevented Injury in relation to ALARP Determinations***

4.2.16 A benefit of some proposals is the prevention or reduction in the risk of fatalities or injuries.

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[38] See DfT website for additional guidance: http://www.dft.gov.uk

[39] 6 DTI uses 27 per cent as an adjustment for non-wage labour costs, while HSE uses 30 per cent. See Labour Cost Survey (LCS) 1992

4.2.17 Many projects will need to demonstrate that their proposals achieve the level of risks in the workplace commensurate with Health and Safety legislation, typically requiring risks to be "As Low As Reasonably Practical" (ALARP).

4.2.18 A risk is ALARP if the costs of reducing it further are "grossly disproportionate" to the benefits from further risk reduction. Put simply, if:

$$\frac{\text{Costs}}{\text{Benefits}} > 1 \text{ X DF}$$

where DF is the 'disproportion factor', then the measure can be considered not worth doing for the risk reduction achieved. DFs that may be considered gross vary from upwards of 1 depending on a number of factors including most importantly, the baseline risk in terms of the magnitude of the consequences and the frequency of realizing these consequences. As part of the ALARP case, the analysis should justify an appropriate DF. DESA should be consulted for advice on what an appropriate DF should be.

4.2.19 For ALARP, two conditions apply. First, there needs to be conformity to "relevant good practice"[40]. Second, a cost benefit analysis (CBA) using the monetary values for preventing fatality or injury should be used to show whether further risk reduction measures (via alternative options) are reasonably practicable. For example, if the recommended proposal is for the least costly option, but involves a higher risk of fatality than an alternative, this will need to be justified by demonstrating that the costs of proceeding with the alternative option are grossly disproportionate to the benefits, i.e. the reduced risk of fatality.

4.2.20 The application of ALARP principles are not relevant in the cases of rescue and conflict. With rescue, intervention is an ethical imperative which respects the equal social value for all potential victims. Rescue thus demands disregard of budgetary and resource considerations. Taking account of costs and benefits of consequences or side impacts of lifesaving interventions is also inappropriate (unless these involve putting others at significant risk of hazards that would warrant rescue). In conflict, operational considerations are paramount though these would naturally include the minimalisation of casualties. In the majority of

[40] For a definition and wider explanation of "relevant good practice" see HSE website (www.hse.gov.uk)

equipment projects, this is captured in Operational Effectiveness analysis, which would feed into the eventual COEIA (see Section 3.2).

4.2.21 The appropriate starting point for valuing the benefit of a prevented fatality or injury is to measure the typical individual's WTP for a reduction in risk of death (or their willingness to accept a new hazard and the ensuing increased risk).

4.2.22 The willingness of an individual to pay for small changes in their own or their household's risk of loss of life or injury can be used to infer the value of a prevented fatality (VPF). The changes in the probabilities of premature death or of serious injury used in such WTP studies are generally very small.[41]

4.2.23 In the UK, the main measure of VPF incorporates the 'extra' value placed on relatives and friends, and any further value placed by society on avoiding the premature death of individuals. Accordingly, the addition of an individual's WTP for the safety of others to his 'own' WTP for 'own' safety may lead to double counting.[42]

4.2.24 The baseline value applied in MOD should be the Department for Transport's (DfT) value for preventing a road fatality as this is taken by the Health and Safety Executive (HSE) to be also appropriate for health and safety. The current DfT figure includes lost output, emergency staff costs and medical care. Whilst these are road specific, the largest part is the WTP itself.

4.2.25 DfT also provide monetary values for the prevention of non-fatal injuries on the same basis. Again, these are appropriate for health and safety as the largest part of the figure is WTP. Given the pattern of injuries in transport and industrial accidents, this can significantly increase the appropriate VPF in MOD.

4.2.26 The latest DfT figures[43] for prevention of casualties (at 2007 prices) by severity of casualty are:

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[41] Franklin (2000), chapter 7, suggests that individuals systematically undervalue small risks, possibly introducing a downward bias in estimating VPF.

[42] This augmentation of the 'own' WTP-based figure is legitimate only if concern for others' safety takes the form of 'safety-focused altruism' where despite being concerned for others' safety, people are indifferent to other determinants of their overall well-being. For cases that are intermediate, some augmentation of the 'own' WTP-based figure is justifiable. (M W Jones-Lee, (1992))

[43] See Department for Transport website for further information and any updates to the values (www.dft.gov.uk)

| **Average value of prevention per casualty by severity and element of cost** | | | | |
|---|---|---|---|---|
| 2007 | | | | £ June 2007 |
| Injury Severity | Lost Output | Human Cost | Medical& Ambulance | Total |
| Fatal | 556,660 | 1,080,760 | 970 | 1,638,390 |
| Serious | 21,830 | 150,180 | 13,230 | 185,220 |
| Slight | 2,310 | 10,990 | 980 | 14,280 |

4.2.27 Whilst the baseline WTP incorporates a societal element related to the lost output, this element will clearly be far higher amongst highly trained MOD personnel. It is legitimate to include training investment as an addition to the WTP figure. In some cases, this could increase the baseline VPF from around one million pounds to as high as several million pounds. Finally, equipment losses can also significantly increase the VPF figure in MOD, again by several million for operations using significant amounts of equipment.

4.2.28 For an ALARP CBA, the costs should be calculated in accordance with JSP 507 guidance. The benefits should include the reduction in risk to members of the public, to workers and to the wider community, in accordance with the values outlined in the Table above. Analysis will also need to be conducted in order to determine the various probabilities associated with the risks. Finally, future health and safety benefits should not be discounted at rates greater than 1.5%.

4.2.29 The results of any CBA associated with major accident hazards will be subject to uncertainty owing to the need to estimate how severe and how often the accidents occur. Such uncertainty will need to be captured in accordance with JSP 507. The recommendation will need to be demonstrated as robust by using appropriate sensitivity analysis.

4.2.30 Given some of the complexities associated with ALARP considerations, DESA should be contacted prior to any ALARP CBA being conducted.

***Example***

*An explosion in an MOD owned chemical plant would lead to 20 fatalities and 100 serious injuries.*

*The probability of this explosion occurring has been estimated at $1x10^{-5}$ per annum and the plant has an estimated life of 25 years.*

*There are two proposals available. Proposal 1 costs £128,810 and reduces the risk of an explosion to $1x10^{-8}$ per annum. Proposal 2 eliminates the risk completely and costs £150,000.*

*The benefits of Proposal 1 (for simplicity, no discounting is undertaken) are calculated as follows:*

| | | Value (£,2007) | | Probability | | In service life of plant | | Benefit (£) |
|---|---|---|---|---|---|---|---|---|
| *Fatalities* | *20 x* | *1,638,390* | *x* | $(1x10^{-5} – 1x10^{-8})$ | *x* | *25* | = | *8,184* |
| *Serious Injuries* | *100 x* | *185,220* | *x* | $(1x10^{-5} – 1x10^{-8})$ | *x* | *25* | = | *4,626* |
| *Total Benefits* | | | | | | | | *12,810* |

*The sum of £12,810 is the estimated benefit of reducing the risk of the major accident explosion at the plant. In this case, the DF will reflect that the consequences of such an explosion are high and a DF of 10 is likely. Thus, it can be presented as reasonably practicable to spend somewhere in the region of £128,100 (10 x £12,810) to reduce the risk of the explosion.*

*The benefits of Proposal 2 are:*

| | | Value (£,2007) | Probability | | In service life of plant | | Benefit (£) |
|---|---|---|---|---|---|---|---|
| *Fatalities* | *20 x* | *1,638,390 x* | $1x10^{-5}$ | *x* | *25* | = | *8,192* |
| *Serious Injuries* | *100 x* | *185,220 x* | $1x10^{-5}$ | *x* | *25* | = | *4,631* |
| *Total Benefits* | | | | | | | *12,823* |

*In order to determine whether the additional cost of Proposal 2 is reasonably practicable over and above Proposal 1, we use our ALARP equation:*

$$\frac{\text{Costs}}{\text{Benefits}} > 1x10 \quad \rightarrow \quad \frac{(150,000 – 128,100)}{(12,823 – 12,810)} = 1685 > 10$$

*Thus, the additional cost to benefit ratio of eliminating the risk over and above Proposal 1 is 1685, which (assuming a DF of 10) means Proposal 2 is not worth undertaking.*

## ***Valuing Health Benefits***

4.2.31 Health impacts are rarely a question simply of lives lost or saved. In policy areas that affect mainly health, an alternative approach is often used, to take account of changes in life expectancy (including expected life years where lives are lost or saved), and changes in the quality of life. This approach is known as the quality-adjusted life year (QALY).

4.2.32 The EuroQol instrument provides a simple and consistent framework for measuring general health and deriving QALY values and is the most commonly used measure of health benefits in Europe. It weights life expectancy for health-related quality of life over time.

4.2.33 The comparison of health interventions may reveal the impact of different factors on clinical effects. For example, working out the relationship between dosage and response of a particular medicine is a necessary prior step to properly valuing a policy for the provision of that medicine. In some cases, such as when the benefits of an intervention are measured in 'natural' units (e.g. reduced incidence of a disease or lower blood pressure rates), it may be appropriate to undertake an appraisal on the basis of its cost effectiveness.[44]

4.2.34 It is difficult to determine whether a health programme should be funded, or how large it should be, without first allocating a monetary value to the projected health gains. Valuation is also important when health impacts are to be weighed against non-health impacts. There are a number of techniques available, including undertaking a survey to estimate an individual's WTP for certain health benefits.[45] Once WTP is known, appraisers can compare the marginal benefits of an intervention against its marginal costs.

[44] It is also possible to appraise a proposal on the basis of its 'cost utility' if there is an appropriate measure of the benefit of an intervention in terms of human welfare

[45] The interim Interdepartmental Group on Costs and Benefits (IGCB) report, *'An Economic Analysis of the National Air Quality Strategy Objectives'* provides an example of how to conduct an economic analysis including health benefits.

4.2.35 An example of a broad approach to estimating acute health impacts is set out below:[46]

**Measuring short term health benefits associated with reductions in air pollution [47]**

**A five-step approach to valuing health impacts**

1. Estimate the annual average concentration of pollutants and resident population in each 1km grid square of the country.
2. Assign the baseline level of the given health-related and pollution affected events to each grid square e.g., daily deaths, hospital admissions for the treatment of respiratory diseases.

3. Combine the data from (1) and (2) and apply a dose-response function linking pollutant concentrations with the relevant effects. Dose-response functions are expressed as a percentage increase in the baseline rate of health outcome per unit concentration of pollutant. Three outputs can be derived:

   - The current effect on health of the relevant pollutant per grid square;
   - The benefit to health per grid square produced by the fall in concentrations of air pollutants expected to occur;
   - The benefit to health produced by reducing the concentration of pollutants in each grid square, in accordance with the proposed policies which aim to meet the objectives.

4. Sum the results obtained in (3) to estimate the total reduction in the number of cases of each health effect (which has an accepted dose-response function) associated with meeting or approaching the objectives.

5. Apply monetary values for each health effect to transform quantitative estimates into monetary estimates.

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[46] Further guidance on the assessment and valuation of health impacts is given in the Department of Health's (DH) '*Guidance on Policy Appraisal and Health*' (1995) and '*Evaluation of Health Technologies for Use in the NHS: Good Practice Guidelines*' (1999). HSE guidance on the valuation of health impacts is included in GAP23, '*Regulatory Impact Assessment – Policy Appraisal*', June 2002.

[47] See *An Economic Analysis to Inform the Review of the Objectives for Particles Air Quality Strategy* available on the Defra website (http://www.defra.gov.uk).

## ***Valuing Design Quality***

4.2.36 Design quality is an important element of all public sector building projects and should be assessed during appraisal. Limiting property valuation to traditional methods without consideration of the costs and benefits of design investment can distort the decision making process. Good design will not always result in the lowest initial capital cost. However, over the period of the contract a higher initial investment can, when expressed as a discount value, result in the lower whole life costs.

4.2.37 The benefits of good design include:

- Simplification and savings in cost, by ensuring that capital costs are competitive and that savings can be achieved on running costs;
- Increased output and quality of service through enhancement of the environment in which a service is provided; and
- Staff recruitment and retention.

4.2.38 Where good design has a direct economic impact, such as staff retention or patient recovery times, it may be possible to calculate the costs and benefits directly. However, it is often difficult, if not impossible, to calculate the monetary value of many of the benefits of good design, such as civic pride, educational achievement or user experience. In such instances, it may be necessary to use contingent valuation or a similar technique. For smaller projects, where contingent valuation may prove too complicated, research studies can help with comparisons and benchmarking to ensure good design is accounted for.

4.4.39 Detailed guidance on evaluating and delivering design quality can be found in:

- *The Value of Good Desig*n, Commission for Architecture and the Built Environment (CABE)
- *Achieving Well Designed Schools Through P*FI, CABE
- *Better Civic Buildings and Spac*e, CABE
- *Treasury Guidance Note 7: How to Achieve Design Quality in PFI projects*
- *Improving Standards of Design in the Procurement of Public Building*s, CABE/OGC
- *The CABE website* (http://www.cabe.org.uk)

## ***Sustainable Development***

4.2.40 To ensure the continued delivery of effective and efficient capability, Defence must improve its resilience by adapting to a number of inter-linked environmental, economic, and social threats, and by playing its part in mitigating them. This will have significant benefits for Defence. For example:

- Reduced reliance on fossil fuels in theatre presents us with a significant opportunity to reduce the amount of fuel that has to be transported to the front line; a costly, risky and logistically resource intensive activity;

- Considering issues such as the effects of climate change and resource depletion/availability in our equipment, infrastructure and policy planning now will cost less than trying to adapt in the future;

- Using less resources, energy, fuel and water and producing less waste will save money across Defence;

- Developing positive relationships with local communities in the UK and overseas can increase support for Defence, generating favourable conditions in which to conduct our business, as well contribute to the success of military operations.

- Remaining compliant with legislation will protect the reputation of Defence, as well as avoid financial consequences such as clean-up costs.

4.2.41 Strategic direction for MOD's sustainability programme comes from the Sustainable Development Strategy which sets out the Sustainable Development (SD) targets, as part of wider Government targets to which MoD is a key contributor given its size and spend. The strategy requires that sustainability is embedded throughout Departmental processes, including decision-making, to ensure that we take full account of the environmental and social impacts of our decisions alongside other criteria.

4.2.42 Sustainability and environmental impacts should be considered in all projects, programmes, and policies, and included where appropriate. All projects submitted to the Investment Approvals Board (IAB) must take sustainability and environmental impacts into consideration, and all business cases taken by the Board must comply with MoD's Sustainable Procurement (SP) policies. In addition, submissions to the IAB must include a statement to show how SD issues have been taken into consideration.

4.2.43 Sustainable Procurement (SP) is a process whereby organisations meet their needs for goods, services, works, and utilities in a way that achieves value for money on a whole life basis in terms of generating benefits not only to the organisation, but also to society and the economy, whilst minimising damage to the environment.

## ***Including Sustainability in Investment Appraisals***

4.2.44 Sustainability needs to be incorporated into the appraisal process when defining the requirement, in determining the option set, down-selecting the option set, and in quantifying the costs and benefits of the short-listed options.

4.2.45 When establishing the requirement it is important to ensure it does not compromise the future. In defining the user requirements, consideration should be given to building performance criteria into the specification to encourage suppliers to provide more sustainable solutions. Examples of appropriate criteria might be: '*minimum 15 miles per gallon fuel consumption*' or '*10% by value of re-used / reclaimed / recycled materials*'. Failure to meet the specification would render a solution non-compliant. Consideration of such criteria would need to be underpinned by assessment of the likely costs and benefits involved, and reference to any binding legislation or Government policy.

### Sustainability criteria to consider when estimating whole life costs

4.2.46 Whole-life costing is a key tool in obtaining best value for money. For example, energy efficient products often have higher capital costs than less energy efficient products, but this may be more than offset by reduced operating costs. The key is to ensure the IA reflects realistic whole life costs that make allowance for future increases or decreases in real terms.

4.2.47 Caution must be exercised to ensure there is no risk of double-counting in the IA. SD factors may already be internalised within costs and benefits normally recognised in investment appraisals; e.g. within the cost of fuel, so there would be no requirement to make any further adjustment to the whole life cost estimate.

**Fuel / Energy / Raw Material costs**

4.2.48 The IA must reflect an estimate of the long-run price, rather than the price at the date the IA is prepared. The key is to reflect the most realistic future price allowing for scarcity and incorporation of arrangements for reflecting social and environmental detriment, for example through higher duties.

4.2.49 Guidance from DASA DESA must be sought before commencing any quantitative assessment of fuel, energy, and other raw material costs for inclusion in an investment appraisal. They in turn will consult colleagues in relevant other Government Departments.

4.2.50 Sensitivity analysis is to be undertaken to ensure the recommendation is robust to plausible changes in assumptions.

**Equipment / Building / Infrastructure costs**

4.2.51 Adaptability – eg to future climate change - will affect the timing, cost, and scale of periodic refurbishment or upgrading. A more adaptable solution may have a longer useful life and residual value than one with more restrictive configuration.

4.2.52 Quality – over-design and over-specification may result in more expensive and more regular refurbishments than accepting a lower specification using high quality materials.

4.2.53 Operational energy efficiency – this will be reflected in the estimated running costs of equipment or a property, its residual value, and potentially its estimated useful life.

4.2.54 Air conditioning – will have a substantial impact in terms of energy use, but may be necessary to achieve a comfortable working environment. Older air conditioning systems will tend to have higher running costs than new systems. Air conditioned buildings may allow a higher density of personnel to be accommodated than buildings without air conditioning.

4.2.55 Pollution – remediation or clean up costs should be included in the final year of the appraisal, or in the year of disposal of infrastructure if earlier.

4.2.56 Water – a similar approach to that for fuel and energy costs should be adopted, as above.

4.2.57 Waste – should be minimised, and material re-used and recycled where possible.

4.2.58 Waste management - allowance should be included for establishing a space for collecting and storing waste material and costs of complying with legislative requirements for waste management.

4.2.59 Transport – accessibility of locations to different transport options may influence location decisions, particularly sites that are heavily dependent on private car use. The cost of providing car parking spaces should be compared to provision of alternate transport options. Rationing of and charging for car parking spaces should be considered as part of the IA.

4.2.60 Disposal – remediation or clean up costs should be included in the final year of the appraisal, or in the year of disposal of the asset if earlier. The estimates should reflect current environmental legislation, whilst recognising the potential for more stringent legislation to be introduced over time. Disposal costs should be shown explicitly in the appraisal rather than being netted off against any expected proceeds from sale.

**Operational support**

4.2.61 In the context of planning operational support, SD needs to go wider than the natural environment and take account of the long term desired outcome from the operation and how to ensure its achievement is not compromised by short term considerations. For example, options for the delivery of catering in theatre should consider issues such as opportunities for local sourcing, and the overall Government objective including local economic development. Therefore this will not always mean selecting the cheapest catering solution at the expense of local development.

## ***Energy Use and Greenhouse Gas (GHG) Emissions***

4.2.62 Valuing energy use and greenhouse gasses is vital in order to ensure that full account of changes in energy use and GHG emissions is built into decision making. It is necessary for proposals that have a direct impact on energy use and supply and those with an indirect impact through planning, construction, land use change or the introduction of new products that use energy.

4.2.63 The Department of Energy and Climate Change have produced a spreadsheet calculation toolkit designed to convert increases or decreases in energy consumption into changes in greenhouse gas emissions (http://www.decc.gov.uk/en/content/cms/statistics/analysts_group/analysts_group.aspx). This spreadsheet also contains the latest assumptions for carbon values, energy prices, long run variable energy supply costs, emission factors, and air quality damage costs over the 2028 – 2050 period. For many proposals with a relatively modest impact on energy use and / or emissions, the spreadsheet toolkit will complete all of the calculations required.

4.2.64 Where a proposal is likely to require the use of large quantities of imported materials such as steel, concrete or bio fuels some of this material may be from countries without carbon pricing arrangements and so the material costs will not include the cost of the GHG used in their production. Such large scale projects need to identify and include this material at a value which is adjusted to take account of the carbon emission, in such cases guidance should be sought from DECC at (GHGappraisal@decc.gsi.gov.uk ).

4.2.65 The following paragraphs explain the calculations which are performed by the spreadsheet. A few very large scale (so called non marginal) proposals may be on a scale which would be big enough to affect the long run assumptions for factors such as the marginal cost of energy which underlie the tables provided in the DECC guidance. In such cases the spreadsheet tool and tables should not be used and alternative analysis will be required, guidance on which should be sought from DECC at (GHGappraisal@decc.gsi.gov.uk ). Whether the proposal is likely to be 'significant' in this sense is a decision that must ultimately be taken by those responsible for appraising the policy in question, advice may however be sought from DECC at <GHGappraisal@decc.gsi.gov.uk >.

4.2.66 A policy that changes energy use will translate into changes in emissions and changes in energy supply. A value for the former is arrived at by converting all emissions into tonnes of carbon dioxide equivalent (paragraphs 4.2.81 – 4.2.83) and then valuing them using the carbon valuation methodology (paragraphs 4.2.84 – 4.2.86), whereas changes in energy supply are valued using estimates of the long-run variable costs of energy (paragraphs 4.2.89 – 4.2.92).

## Quantifying Greenhouse Gas Emissions

4.2.67 Energy use is converted into a corresponding amount of $CO_2$[48] by multiplying fuel use (in kWh, therm, tonne or litre) by a fuel-specific (and unit specific) marginal emission factor:

$$\Delta \text{ Emissions} = [\Delta \text{ fuel}_F \text{ x Marginal Emission factor}_{\text{Fuel}}]$$

4.2.68 Marginal emission factors for electricity and different fuel types are maintained by DECC at:
http://www.decc.gov.uk/en/content/cms/statistics/analysts_group/analysts_group.aspx
The emissions factors will be kept under review and updated as necessary as they are subject to considerable uncertainty in the long-term, particularly in the electricity sector where it is unclear what type/mix of generation will constitute the marginal source of electricity supply.

4.2.69 All changes in GHG emissions should be presented in tonnes of carbon dioxide equivalent ($tCO_2e$). The table below shows the equivalence factors:

Table 1: Emission Factors for converting Greenhouse Gas Emissions into Carbon Dioxide Equivalents

| **Greenhouse Gas** | **Greenhouse Gas Global Warming Potential per unit weight** |
|---|---|
| Carbon Dioxide ($CO_2$) | 1 |
| Methane ($CH_4$) | 21 |
| Nitrous Oxide ($N_2O$) | 310 |
| HFC – 134a | 1,300 |
| HFC – 143a | 3,800 |
| Sulphur hexafluoride | 23,900 |
| Carbon Dioxide as Carbon | 3.67 |

[48] Prior to 2007, figures for changes in GHG emissions were presented in terms of carbon ©. Any such figures should be converted into units of CO2e using the conventional conversion factor of 44/12 (e.g. 1 tonne of C emissions is equivalent to 1 x (44/12) = 3.67 tonnes of CO2e).

***Example***

**How to use an emissions factor to convert changes in energy use into changes in emissions for appraisal of policy A**

*An energy efficiency programme is being considered which reduces the use of gas by householders. Gas consumption is cut by 10GWh (10 million Kwh) relative to the "do nothing" option in each year between 2011 and 2020. Table 2 below demonstrates how this change in energy use is multiplied by the appropriate marginal emissions factor to calculate the change in emissions.*

Table 2: Calculating changes in emissions

| | 2011 | 2012 | 2013 | … | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|
| Change in energy use, GWh | -10 | -10 | 10 | … | -10 | -10 | -10 |
| Emissions factor (Natural gas), $tCO_2/GWh$ ($kgCO_2/Kwh$) | 183.6 (0.184) | 183.6 (0.184) | 183.6 (0.184) | … | 183.6 (0.184) | 183.6 (0.184) | 183.6 (0.184) |
| Emissions saving, $tCO_2$ ($MtCO_2$) | 1836 (0.0018) | 1836 (0.0018) | 1836 (0.0018) | … | 1836 (0.0018) | 1836 (0.0018) | 1836 (0.0018) |

**Valuing Greenhouse Gas Emissions**

4.2.70 The changes in GHG emissions derived above, expressed in tonnes of carbon dioxide equivalent, now need to be valued in monetary terms.

4.2.71 The EU Climate and Energy Package (December 2008), introduced separate emissions reduction targets for the traded sector (that is those emissions covered by the EU Emission Trading System), and for the non-traded sector (that is those emission not covered by the EU Emission Trading System). The presence of separate targets in the Traded and Non-Traded sectors implies that emissions in the two sectors are essentially different commodities. Changes in emissions which occur in the traded sector are valued at the Traded Price of Carbon (TPC), whereas changes in emissions in the non-traded sector are valued at the Non-Traded Price of Carbon (NTPC). These traded and non-traded prices are currently different, but will converge, becoming equal in 2030 and subsequently following the same trajectory. This is based on the assumption that there will be a functioning global carbon market by 2030.

4.2.72 The traded and non-traded carbon values to be used in economic appraisal over the 2008 to 2100 period may be found at:

http://www.decc.gov.uk/en/content/cms/statistics/analysts_group/analysts_group.aspx

The Traded Price of Carbon will be updated annually.

***Example***

**How to use the traded and non traded carbon values for option appraisal**

*An energy efficiency programme is being considered which reduces the use of gas and electricity by householders. UK electricity consumption (traded) is cut by 15GWh while household gas consumption (non-traded) is cut by 10GWh. These are annual differences from the counterfactual "do nothing" option for each year between 2011 and 2050. Tables 3 and 4 show how to value the emission reductions using the new carbon values. These monetary savings can then be discounted in the usual way.*

Table 3: Valuing the reduction in traded sector emissions

| | 2011 | 2012 | 2013 | … | 2048 | 2049 | 2050 |
|---|---|---|---|---|---|---|---|
| Change in energy use, GWh | -15 | -15 | -15 | … | -15 | -15 | -15 |
| Marginal emissions factor (electricity), tCO2/GWh (KgC02/Kwh) | 390 (0.39) | 390 (0.39) | 390 (0.39) | … | 25 (0.025) | 24 (0.024) | 23 (0.023) |
| Emissions saving, tCO2 (MtCO2) | 5850 (0.0058) | 5850 (0.0058) | 5850 (0.0058) | … | 380 (.00038) | 359 (.00036) | 339 (.00034) |
| Traded carbon price, 2009£/tCO2 | 14.3 | 14.5 | 14.7 | … | 187 | 194 | 200 |
| Value of savings, thousand 2009£ | 84 | 85 | 86 | … | 71 | 69 | 68 |

Table 4: Valuing the reduction in non-traded sector emissions

| | 2011 | 2012 | 2013 | … | 2048 | 2049 | 2050 |
|---|---|---|---|---|---|---|---|
| Change in energy use, GWh | -15 | -15 | -15 | … | -15 | -15 | -15 |
| Marginal emissions factor (electricity), tCO2/GWh (KgC02/Kwh) | 390 (0.39) | 390 (0.39) | 390 (0.39) | … | 25 (0.025) | 24 (0.024) | 23 (0.023) |
| Emissions saving, tCO2 (MtCO2) | 5850 (0.0058) | 5850 (0.0058) | 5850 (0.0058) | … | 380 (.00038) | 359 (.00036) | 339 (.00034) |
| Non-traded carbon price, 2009£/tCO2 | 14.3 | 14.5 | 14.7 | … | 187 | 194 | 200 |
| Value of savings, thousand 2009£ | 84 | 85 | 86 | … | 71 | 69 | 68 |

## Mapping fuel emissions into traded and non traded sectors

4.2.73 Table 5 shows how to map emissions from different fuel types into the traded and non-traded sectors. For example, emissions from gas (not used by large electricity producers) should be included in the non-traded sector whereas emissions from electricity production should be included in the traded sector.

Table 5: Example of attribution of emissions to the traded and non traded sector

| **Traded (organisation in the EU ETS)** | **Non Traded** |
|---|---|
| Electricity (all grid electricity is generated by organization in the EU ETS) | Gas and coal for domestic heating |
| Coal and gas (used in organisations in the EU ETS) | Petrol and diesel used for road transport |
| Aviation from 2012 onwards | Fuel/oil used for domestic heating |

## Emissions Embedded in Imported Materials

4.2.74 This is unlikely to be relevant to any Defence appraisal except where a very large scale project includes substantial quantities of imported materials such as cement, steel, or bio fuels. In such circumstances DASA-DESA must be consulted.

## Valuing Changes in Energy Use

4.2.75 Changes in energy use, for the purpose of economic appraisal, should be valued at the long-run variable cost of energy supply. More precisely:

Value of energy use = changes in energy/fuel use by type of energy/fuel * long-run variable supply cost of relevant energy/fuel

4.2.76 The supply cost reflects the long-term variable cost components of energy supply and therefore excludes costs (such as head office overheads) that will continue to be incurred at the same level in the long run despite marginal changes in energy use. The variable costs exclude carbon costs, since these are valued separately, and also excludes taxes and other charges.

4.2.77 A reduction in the use of energy saves resources from production through to supply and includes both the economic value of the energy commodity itself and the change in capital costs associated with transmission and distribution. As these delivery costs are likely to vary by end user, variable supply cost values should therefore be specific to the sector in which the savings occur. The variable supply costs for different energy types and end-users can be found in Tables 4 to 9 of DECC guidance. These tables provide projected costs for a central fossil fuel price scenario. Tables 10-29 of DECC guidance provide costs for low, high and high-high fossil fuel price scenarios and should be used to test the sensitivity of the policy appraisal to changes in fossil fuel prices.

4.2.78 These estimates of the long-run variable supply costs for different fossil fuel prices should not be considered forecasts, but as estimates to assist in policy appraisal. If costs for different energy types and end users beyond 2050 are required for policy appraisal, values should be taken to be constant at the 2050 level.

## Accounting for the UK's Renewable Energy Strategy

4.2.79 The EU Climate and Energy Package creates a target proportion of energy consumption which is to be delivered from renewable sources. The target follows a rising trajectory to reach 15% of capped gross final energy consumption by 2020. [49]

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[49] As defined in the Renewable Energy Directive, the definition of gross final energy consumption (gfec) in the target is capped by setting a maximum value on the level of aviation within gfec at 6.18% of the uncapped level of gross final energy consumption.

4.2.80 Changes in final energy consumption in 2020 (with the exception in most cases of changes in aviation consumption [50]) will change the absolute level of renewable energy supply that the UK is required to achieve. Reductions in energy consumption in 2020 will therefore be associated with an avoided cost of renewables. Similarly, policy measures that lead to renewable deployment in 2020 that is not counted under the Renewable Energy Strategy analysis (to be verified with DECC) would also be associated with an avoided cost. Although there are interim targets for renewable energy to 2020, for the purposes of analysis, it is suggested that only changes in final energy consumption in 2020 are counted as having an avoided cost of renewables to be included in Impact Assessments.

4.2.81 Note that the following figures are based on the 2008 Renewable Energy Strategy consultation, which will be updated. There are complications in valuing the avoided costs of renewables through reducing UK final energy consumption in 2020. For example, delivering a MWh of renewable energy in any particular year requires support to investors in the renewable energy plant that continues over a significant period. The Renewables Obligation has been extended to 2037 for this reason. Reduced final energy consumption in 2020 would therefore deliver cost savings for more than a decade.

4.2.82 Any reduction in the amount of renewable energy required avoids costs and these should be valued in addition to the savings in emissions and variable energy supply costs from the reduction in energy use.

4.2.83 The marginal cost of delivering renewable energy to meet the UK renewable energy target has been estimated to be £120/MWh (in 2009 prices) in 2020 over and above the displaced energy and carbon costs. The target level of renewable energy delivery in 2020 is 15% of final energy consumption. Reducing final energy consumption by 1 MWh in 2020 will reduce the quantity of renewable energy required by 0.15 MWh. This suggests the avoided costs of renewables would be approximately £18/MWh (in 2009 prices) in 2020.

4.2.84 For illustrative purposes all changes in final energy consumption should be valued at £18/MWh. Owing to the uncertainty inherent in this

[50] A change in UK aviation consumption in 2020 that leaves the level of aviation consumption above 6.18% of gfec will not have any effect on the level of the renewables target. Changes that bring the level below 6.18% would reduce the target.

figure, the costs and benefits of a policy should be presented both with and without the impact of the policy on the costs to the UK of the renewable energy target. Changes in the level of renewable energy delivered should be valued using the marginal cost of delivering it from other sources: £120/MWh.

### Valuing Direct Rebound Effects

4.2.85 Policies that save energy (such as insulation) reduce energy bills and increase consumers disposable income, which may in turn lead to greater consumption of energy. This is known as the "rebound effect".

4.2.86 The welfare derived from this increased energy use should be counted as a social benefit within the appraisal. Only the resource and emission savings of the net reduction in energy which results from the energy saving policy should be valued, however.

4.2.87 When valuing the welfare benefit of direct rebound effects the full retail price (including tax) should be used. This is based on the assumption that consumers are willing to pay at least the full retail price for the welfare they gain from the increased energy use. For example, if an energy efficiency measure has the technical potential to reduce energy consumption by 100 units and still leave the level of "comfort" unchanged, but the consumer chooses to only reduce consumption by 40 units, then the rebound effect amounts to 60 units of energy and the net change in energy use is 40 units of energy. These 40 units are valued in accordance with the rest of this guidance, accounting for resource cost and emissions savings. The 60 units are valued at the full retail price, as a welfare benefit (i.e. an increase in "comfort").

4.2.88 The spreadsheet tool published by DECC can help with valuing rebound effects.[13] For further information on the rebound effect please contact GHGappraisal@decc.gsi.gov.uk.

### Security of Energy Supply

4.2.89 A policy that has a major impact on energy consumption or production could affect security of energy supply – i.e. the ability of the UK to meet its energy needs. Quantitative evidence where possible (see below), and a qualitative assessment where not, should be provided to assess the security of supply impact of a policy. This is unlikely to be relevant to most MoD procurement projects but may be relevant to the appraisal of policy options related to energy security. DASA-DESA should be consulted in all such cases.

## Air Quality Impact

4.2.90 Air pollution can generally be defined as airborne chemicals, particulates and biological materials that cause harm to humans or damage the environment. Under this definition, there are three key groups of impacts: adverse health impacts (including mortality and morbidity), immediate environmental impacts (such as acidification and soil eutrophication), and long-term environmental impacts (which include climate change). Air quality policies typically focus on the human health and immediate environmental impacts, while climate change policy focuses primarily on the long-term climate change potential. Given this definition, there are clear links between climate change mitigation policies and air quality policies. Though the majority of overlaps are mutually beneficial i.e. a policy option designed to reduce $CO_2$ will also reduce other air pollutants (and vice versa for air quality policies), this is not always the case; in some cases, trade-offs will exist. [51]

4.2.91 To help realise the synergies and minimise any trade-offs, policymakers should build the air quality impacts of their policy into their appraisal process, where possible, using monetary values. The Interdepartmental Group on Costs and Benefits (IGCB), a Defra-led panel of experts, has developed a number of monetisation methodologies to aid such policymakers, which include:

- Where any policy is expected to reduce air quality below national obligations, then the abatement cost of restoring compliance should be factored into the appraisal. This should be undertaken through an estimation of the cost of offsetting measures (the "abatement cost" approach.

- For any policy where there are minor, air quality impacts of below £20m or lasting less than 20 years, an online calculator can be used to monetise impacts (the "damage costs" approach) [52]:

[51] Information on the potential synergies and trade-offs between climate change mitigation and air quality can be found in the 2007 Air Quality Environment Group (AQEG) report "Air quality and climate change: a UK perspective".

[52] For further information on air quality impacts, please contact igcb@defra.gsi.gov.uk or visit http://www.defra.gov.uk/environment/quality/air/airquality/panels/igcb/pathway.htm.http://www.defra.gov.uk/environment/qualit y/air/airquality/panels/igcb/tools.htm.

- Where the change in emissions arising from the policy is known, use Damage Costs Calculator, which relates emissions to monetary values.

- Where the change in emissions arising from the policy is not known, use the Activities Costs Calculator, which links a wide range of actions and technologies with the associated level of emissions generated that are then valued monetarily.

4.2.92 Air quality, as with most environmental assets, is subject to a number of major threshold and equity factors, which are protected through the establishment of minimum standards on ambient concentrations, emissions and exposure. These standards are delivered through national and international obligations covering these areas. To reflect the importance of these standards, any policy, programme or project which is expected to result in non-compliance should estimate and cost the necessary measures to restore compliance. This approach is known as the “abatement cost” approach.

4.2.93 The impact pathway approach follows the source of the emission to its dispersion in the atmosphere, and the resultant exposure to estimate a range of end points (such as health impacts) that are valued. Impacts therefore vary based on a range of considerations (such as dispersion and toxicity) that arise from differences in geographical location and population exposed. At present, this approach has been used to estimate the impact of four different air pollutants: nitrous oxide (NOx), sulphur dioxide ($SO_2$), ammonia ($NH_3$) and particulate matter ($PM_{10}$).

4.2.94 “Damage costs” are based on the impact pathway approach, but have been calculated using a range of representative emissions in order to estimate an average marginal effect for each additional tonne of gas introduced into the atmosphere. These primarily value health impacts, [53] though non-health impacts are also included.

## ***Wider Environmental Impacts***

4.2.95 Many policies can have incidental but significant impacts – both positive and negative - on the wider environment beyond GHG emissions

[53] Health impacts: Morbidity and mortality impacts used in the model are based on recommendations by the Committee on the Medical Effects of Air Pollution (COMEAP). Health impacts evaluated in the model are linked to incidences of respiratory or cardiac disease, but do not include others where the evidence is less robust, for example, long-term exposure effects or increased likelihood of asthma in children.

and the air quality impacts discussed above. Landscape, biodiversity, noise, water quality and quantity, and flood risk all need to be considered in appraising policy options.

4.2.96 In many cases there are ancillary benefits to reducing our dependence on fossil fuels such as improved air quality covered earlier. Other climate change mitigation policies may risk damaging the natural environment. It is important to include these impacts in analysis to ensure the most cost effective approach is being taken.

4.2.97 While impacts on the environment often do not have any market prices, it is important to try and use evidence on non market values attached to environmental impacts where feasible. There are different methodologies for obtaining monetary values resulting from change in the environment. [54] This enables environmental impacts to be valued on a consistent basis with other financial costs and benefits.

4.2.98 Where the expected policy impact on the environment is significant, an ecosystem services framework[55] can aid comprehensive analysis of the impacts. This methodology provides a broader framework for considering all the environmental impacts of a policy and identifying the economic end points that can be valued.

4.2.99 Defra has produced detailed guidance on assessing wider environmental impacts at http://www.defra.gov.uk/environment/index.htm. This includes a checklist of questions on wider environmental impacts and a step by step guide to how to go about assessing, quantifying and valuing any environmental changes. Assessing the environmental impacts of Defence projects, programmes, and policies is a complex area. However, it is important that these impacts are included in appraisals where appropriate and taken into account in decision making. DASA-DESA should be consulted for further advice.

## ***Effects of Climate Change***

4.2.100 Policies, programmes or projects may be directly or indirectly affected by a changing climate. It will be particularly important to

[54] For more details on environmental valuation methods, see DEFRA web page on tools for environmental valuation (currently under
construction).

[55] Ecosystem services are defined as services provided by the natural environment that benefit people. For more details, see "An introductory guide to valuing ecosystem services", Defra (2007): http://www.defra.gov.uk/environment/policy/naturalenviron/ using/value.htm

consider the risks and effects of climate change if a policy, programme or project:

- Has elements affected by the weather and climate, including variability and extremes, and assumes a stable climate;
- Has long-term lifetimes, implications or implementation periods;
- Involves significant investment or has high value at stake;
- Provides or supports (critical) national infrastructure;
- Involves decisions with significant irreversible impacts;
- Has significant interdependencies with other Government activities or the wider economy; or
- Addresses contingency planning or business continuity needs.

This is relevant to major Defence acquisition programmes, where the capability may have to operate in a wide variety of geographical locations and climatic conditions, and is likely to be in service for a long period of time.

4.2.101 A risk assessment should be made of how climate change could affect a policy, programme or project. The depth of the assessment should be proportionate to the costs, benefits and risks involved. The extent to which climate change will affect an activity depends on the vulnerability and adaptive capacity of the activity:

- *Vulnerability* is the extent to which an activity is susceptible to the effects of climate change, including climate variability and extremes. It is context specific, and may depend on thresholds. For example, temperatures above a certain level may damage road surfaces. However, a road surface in direct sunlight is more vulnerable to higher temperatures than a road surface in shade.*Adaptive capacity* is the ability to adjust to climate change risks (including climate variability and extremes). This will be constrained by factors such as the information available, and the incentives individuals and organisations face.

4.2.102 Risk assessment should take a structured approach. Initial screening should focus on identifying potential climate factors that may pose a threat (or opportunity), and how these could affect the activity or capability. Once these are identified, more detailed risk analysis should be undertaken to explore how the effects of climate change are transmitted and the non-climate factors that enhance or diminish these effects. The aims of the activity or capability will need to be defined clearly enough to allow analysis, particularly for deriving forecasts in terms of parameters that affect the activity or capability.

4.2.103 Risk assessment should consider direct and indirect effects. Many activities or capabilities will be directly influenced by climate change, because their objectives or elements of their design and operation are dependent on climatic factors. Failure to allow for projected changes in climate may lead to significant future costs or missed opportunities. It could also have an adverse impact on operational effectiveness. Where an activity or capability is not directly affected by climate change, it could still be affected by changes in other areas and sectors. For example, the impact of climate change on sea levels could affect the location and access to harbours.

4.2.104 Important factors to be aware of include:

- Timing. Particular attention should be paid to activities that have long-term time horizons, life-times, or implications;
- Thresholds. Threshold effects may exist where risks become particularly intolerable, and these may depend on other activities or the wider economy;
- International effects. Events elsewhere in the world triggered by climate change could have effects on activities that operate solely within the UK; andFlexibility. Given uncertainty over the future climate, decisions that would be difficult or expensive to revise in future should receive additional scrutiny.

4.2.105 Taking action to reduce risks or take advantage of opportunities from climate change is called **adaptation**. Adaptation will contribute to sustainable development.

4.2.106 Adaptation measures should be aimed at adjusting an activity or capability to account for the effects of climate change, and they should be flexible.

4.2.107 Uncertainty over the future impacts of climate change means the ability to use and value flexibility is critical. Real Options Analysis provides a framework to incorporate the uncertainty of climate change and the value of flexibility into decision making.

## Real options analysis

4.2.108 A "Real Option" is an alternative or choice that becomes available through an investment opportunity or action. For example, designing an activity with the flexibility to upgrade in the future provides an option to deal with more (or less) severe climate change. Real Options Analysis recognises that information about uncertainty changes over time (for example, from learning or research). With sufficient flexibility the activity can be amended in the light of new information. But this flexibility does not detract from performance if it is not needed. When the value that this flexibility creates is not incorporated, the "true" value of the options Net Present Value (NPV) will be systematically underestimated.

4.2.109 A Real Options approach (see Chapter 4.4) will be particularly suitable for policies, programmes or projects which have three core features: uncertainty, flexibility, and learning potential.

4.2.110 Uncertainty surrounding the effects of climate change highlights the importance of flexibility as a part of an adaptation strategy. Where flexibility is limited, the benefits of acquired information cannot be realised.

4.2.111 Flexibility can be defined as the ability to respond to unforeseen changes e.g. energy production from renewable resources, policies introduced to reduce congestion and discourage use of private transport, or water conservation technology in response to climate change. Flexibility to respond to new information can therefore be valuable, although waiting for new information should not be used to justify delaying action.

4.2.112 A decision tree can be used to qualitatively map out and understand the sequence of actions, decision points and events along an activity's path. The tree should consider the range of options available (now and in the future), how information is likely to be acquired, and should incorporate monitoring and evaluation of progress.

4.2.113 For a more quantitative real options analysis, streams of costs and benefits should be compared over time and discounted to generate an NPV and account for the flexibility in the structure of the activity. This should build on the qualitative decision tree analysis, populating the tree with costs, benefits and probabilities associated with different options. Sensitivity analysis should also be used to examine the implications of alternative climate change scenarios.

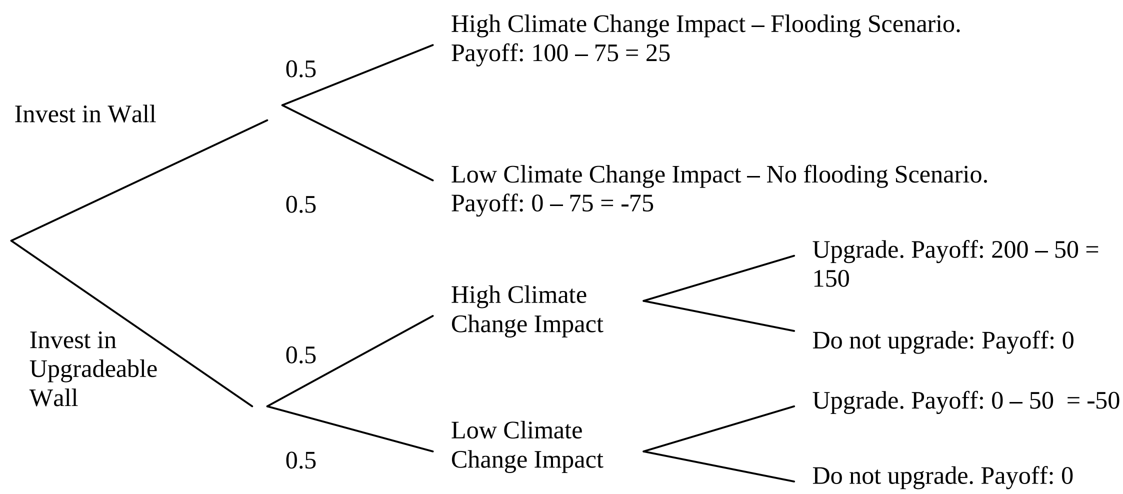
4.2.114 Further guidance on the application of real options should be sought from DASA DESA.

***Example***

*Consider a project to protect a munitions storage facility against the impacts of flooding as a result of climate change. There are two options: invest in a flood protection wall; or invest in a wall which has the option to upgrade in the future.*

*There is assumed to be an equal probability of high or low climate change impacts in the future. The standard wall costs £75, and has benefits of £100 from the reduced effects of flooding on the munitions site. The upgradeable wall costs £50, with the upgrade costs being £50. The upgradeable wall would give benefits of £200 from reduced effects of flooding, i.e. upgraded wall performs better in the event of a flood than £75 wall.*

*The information about expected values can be set out in a decision tree:*




*Expected Value (EV) of investing in the standard wall (for simplicity, no discounting is undertaken in this example):*

*EV = (0.5 x 25) + (0.5 x -75) = -25*

*For the upgradeable wall, if the impacts of climate change are low, then upgrading is not justified as the payoff is negative (-50). Since the investment costs of the upgrade under this circumstance are not realised in practice, they are not incorporated in the EV calculation. The EV of investing in the upgradeable wall is:*

*EV = (0.5 x 150) – 50 = 25*

*Flexibility to upgrade in the future is incorporated in the EV calculation and therefore, the best value for money option is to purchase the upgradeable wall with the option to switch in the future.*

## ***Distributional Impacts***

4.2.115 'Distributional impacts' is a term used to describe the distribution of the costs or benefits of interventions across different groups in society. Proposals might have differential impacts on individuals, amongst other aspects, according to their:

- Income;
- Gender;
- Ethnic group;
- Age;
- Geographical location; or
- Disability.

4.2.116 The impact of a policy, programme or project on an individual's well-being will vary according to his or her income; the rationale being that an extra pound will give more benefit to a person who is deprived than to someone who is well off. In economics, this concept is known as the 'diminishing marginal utility of additional consumption'.

4.2.117 Broadly, the empirical evidence suggests that as income is doubled, the marginal value of consumption to individuals is halved: the utility of a marginal pound is inversely proportional to the income of the recipient. In other words, an extra £1 of consumption received by someone earning £10,000 a year will be worth twice as much as when it is paid to a person earning £20,000 per annum.

4.2.118 The relative prosperity of a household affected by a proposal is determined not only by its income, but also by its size and composition.

For example, a single person on £100 a week is better off than a couple on £100 a week.

4.2.119 Other distributional issues may also arise, and should be considered during appraisal. A proposal may have differing impacts according to age, gender, ethnic group, health, skill, or location. The starting point for assessing distributional impacts is identification, i.e. working out who and what groups will be affected.

4.2.120 In the main, it is not appropriate to consider distributional implications of each option in MOD Investment Appraisals. However, if proposals involve significant redundancies, explicit adjustment for distributional implications may be required, as the individuals receiving the redundancy payment may be different income groups. In such instances, DESA should be contacted for advice.

# 4.3 GUIDANCE ON LOCATION CHOICE: CHOOSING LOCATIONS FOR GOVERNMENT BUSINESS

## *Introduction*

**4.3.1 This section provides advice on how to carry out a broad assessment of the wider impacts of relocation. In reaching recommendations on the optimal location, analysis of these wider impacts is included in the business case alongside the standard value for money assessment developed in the Investment Appraisal. Where these assessments differ as to the ranking of options, consideration will need to be given to possible trade-offs between wider impacts and value for money. However, in any such exercise the latter should be accorded greater weight.**

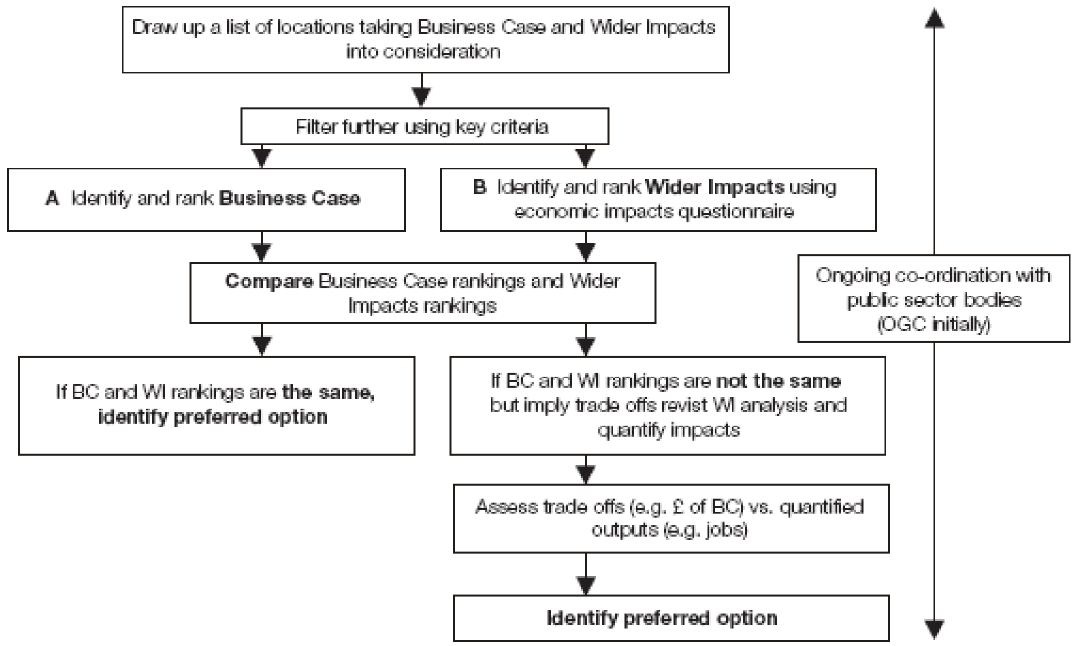
4.3.2 We begin by highlighting some general principles for the assessment of wider economic impacts, which is followed by a consideration of the underlying theory. The key issues are then translated into a practical 'questionnaire' for practitioners to follow to inform their initial thinking when assessing the economic impacts associated with particular options. The wider theoretical material is intended for use if more in-depth analysis of economic impacts is required at a later stage in the decision-making process. We then consider the wider policy impacts of location options.[56]

Further advice is available from DESA, Defence Estates (DE ES&P) and DGMO.

## *Comparing wider impact and business case assessments*

4.3.3 The process for drawing together the business case and wider impact assessments for options to arrive at a recommended preferred option is summarised in the flow chart below:

[56] This guidance is based on "Guidance on Location Choice – Choosing Locations for Government Business (see http://www.ogc.gov.uk/embedded_object.asp?docid=1004667




## ***Proportionality***

4.3.4 The framework should be applied proportionately, according to the scale and likely impact of a given relocation. Ultimately this requires judgment (which should not be based purely on numbers of staff but also type of activity), but a guide to what is likely to be appropriate in different situations is set out below:

- The smallest and/or least consequential relocations (e.g. relocating a unit of 20 back-office staff) need only follow the guidance on drawing up an options list. A preferred option can then be chosen with reference to the business case alone.

- Medium-sized relocations (e.g. a unit of 200 back-office staff; or 50 senior staff) and/or those likely to have moderate wider impacts should attempt to perform a broad ranking of location options for wider impact (e.g. using the economic impacts questionnaire), using this to inform a judgment about the optimum location. Quantification of impacts will generally not be required.
- Larger relocations (certainly all those involving over 500 staff), and /or those likely to have large wider impacts should attempt to quantify the magnitude of these effects. This will allow for a more robust analysis of any trade-offs should the business case and wider impact rankings suggest different preferred options. Advice will need to be sought from DESA, Defence Estates and DGMO.

Projects should consult OGC who will advise on whether an organisation's approach to assessment is appropriate given other developments in the location.

## ***General principles***

- Central public sector bodies' presence in the London and South East regions should be restricted to only those activities which really need to be there. No new business should be established in the Greater South East (GSE) unless there are over-riding business reasons to do so;

- Some functions which have links with other public sector activity might benefit from clustering in a limited number of locations, rather than being widely dispersed. Such clustering could have both business benefits (including attractiveness to staff) and would maximise economic and social impacts.

- Other, more self-contained functions (back-office work: finance, personnel, IT, transactional services, customer contact centres) should also consider locating outside major conurbations outside the GSE in order to take advantage of possible cost savings.

## ***Drawing up an options list***

4.3.5 Options for the location of Government business moving out of London and the South East may be drawn from any part of the UK outside London, the South East and East of England Government Office regions. When putting together a business case, a range of locations should be considered, possibly varying from large cities to small towns. While consideration should initially concentrate on the existing Defence Estate, and DE need to be consulted about likely available sites, other "greenfield" sites may need to be considered.

4.3.6 In England, those local authority areas in the top 20% of the Indices of Deprivation 2004 are locations with, potentially, the most to gain from Government business relocation and any quality assessment of wider impacts will need to consider their potential suitability. This list of deprived areas does not preclude the consideration of, and ultimate relocation to, other locations outside the GSE.

4.3.7 In Scotland, Wales and Northern Ireland there are active relocation agendas, covering their own institutions. The potential benefits of relocating to Scotland, Wales and/or Northern Ireland should be considered, and this should be complementary and sensitive to devolved administrations' own strategic agenda. Further information on particular locations, labour markets and other key data is available from the respective devolved administrations.

4.3.8 If, in a most exceptional case, there is a business case for relocating into the GSE, it will need the approval of the Chief Secretary to the Treasury. Moves within the GSE may also need the Chief Secretary to the Treasury's approval. In such a case, it will need to be demonstrated that:

- There is an over-riding business need for remaining in the GSE;
- The location has been compared, in detail, with at least two locations outside the GSE; and
- OGC support the accommodation proposal on value-for-money grounds.

It will then be for the Chief Secretary to consider the merits of the proposal, on a case-by- case basis. Any such proposals will need to be discussed in advance of submission with the HM Treasury/Defence Diplomacy and Intelligence (DDI) Spending Team.

## ***Identifying the wider impacts of options***

4.3.9 One of the conclusions of the Lyons Review stated that the disadvantages to London of Government departments relocating away from the GSE are likely to be short-lived and outweighed by the benefits to other areas. Other activity, including in the private sector, is likely to 'fill the gap' left by departing public sector business However, organisations will clearly need to consider carefully, and address, the potential impact on staff.

## ***Ongoing co-ordination with other public sector bodies***

4.3.10 Central public sector bodies must co-ordinate their location decisions. OGC provides the central co-ordination. Co-ordination is vital for the following three key reasons:

- Co-ordination amongst public sector bodies can maximise the business and wider benefits of clustering activity in regional centres.

- Best use needs to be made of the existing public sector accommodation, including making appropriate use of accommodation being vacated by other bodies, especially in the context of the efficiency agenda. Vacation of accommodation (especially in London) also needs to be carefully co-ordinated and phased.

- Best use must be made of personnel, including bodies of staff in particular locations becoming redundant in their existing roles as part of the current efficiency programme, which could sensibly be used in other, relocated roles.

4.3.11 Co-ordination of these aspects can be achieved through frequent and ongoing liaison with OGC's Property Co-ordination Team in the first instance (and Cabinet Office on workforce issues – see below), and thereafter any other relevant individual bodies. OGC's Electronic Property Information Mapping Service (ePIMS) can provide information on existing public sector accommodation, and lists of locations outside the GSE where properties are becoming vacant. OGC can also advise on the emerging location options for other public sector bodies with whom you may wish to 'join up', in a regional cluster.

4.3.12 The Cabinet Office has established the Efficiency and Relocation Support Programme (ERSP) to provide information and support to affected staff. As part of this programme, the Cabinet Office has included protocols to ensure that opportunities for redeployment of civil servants are maximised. They should be engaged through DGMO.

## ***Economic impacts***

### General principles

4.3.13 In general, the assessment of the wider economic impacts of location options should take a view of the implications both for receiving (new) locations and sending (existing) locations. However, there is a clear presumption that when dealing with a move from a 'high performing' area – the GSE areas for our purposes – a consideration of the impact on the sending location will not be required. This is due to the microeconomic characteristics of such regions – they are likely to remain high-performers after Government moves out. Indeed, they may even benefit from Government relocations if the ‘free space’ (capacity) is opened up for higher productivity private sector activity.

4.3.14 Exceptionally, it may be appropriate to evaluate the effect on specific deprived locations within the high performing regions – those at the most deprived end of the Indices of Deprivation 2004, particularly where the public sector is a main employer. In all cases, however, there will be important social and people-related impacts to address.

4.3.15 Similarly, it will be appropriate to assume that relocations from one ‘non-GSE’ area to another would have broadly neutral wider economic impacts. As such, the case for relocation would rest primarily on the business case. However, there is a presumption that greater local economic impacts would be expected from a relocation to (or from) a deprived location.

4.3.16 The most useful geographical unit of analysis for the consideration of wider economic impacts is likely to be the Travel to Work Area (TTWA), although there are others which may be more applicable for particular locations where TTWA may not fit effectively.

4.3.17 Note that we recognise that a positive impact on a region or sub-region arising from the relocation of public sector activity is not automatic. Even within the new, receiving location there is potential for the positive benefits sought to be offset by consequences both foreseeable and unintended. This is a driving factor in ensuring that location decisions are methodically worked through so that any potential downsides can be mitigated as far as possible. For example, the original Review highlighted that Government relocation may be a necessary condition for the improvement of the fortunes of some localities but is unlikely in all cases to be a sufficient one. It is, therefore, very important that central public sector bodies consider creatively how positive impacts will actually be accrued, and to work through the risks. This is a role in which the OGC can actively advise.

**Theory: the six key drivers of regional economic growth**

4.3.18 For each option on the options list, some assessment of likely economic impacts on both receiving and sending locations should be made, relative to the other options. This may often only require a qualitative, rather than a quantitative, relative assessment, depending on the size and impact of the relocation. The consideration of impacts should be carried out within the framework of six key drivers of regional economic growth which emerged as part of analysis supporting the HM Treasury, DTI and ODPM joint PSA on regional economic performance. This broad framework is also consistent with the analysis conducted by Experian Business Strategies to support the Review. The six key drivers comprise of five factors contributing to productivity, and one relating to employment. The six key drivers of regional growth are discussed in more detail later in this section but in summary they are:

- Skills
- Investment
- Innovation
- Competition
- Enterprise, and
- Employment

4.3.19 The recommended approach to the assessment of economic impacts is to consider each of these areas in turn, noting that the most important drivers are likely to be employment, skills and investment – with the latter two impacts being most relevant over the longer term. For each driver, an intelligent qualitative assessment should be made of likely impacts under each option. This may often, particularly at the initial stage, be ranking the impact as 'high', 'medium' or 'low'; the aim at this stage is to differentiate between the options in a considered way. Taking the drivers in turn:

**Employment**

4.3.20 Job creation is clearly a key economic impact which Government business can have on the area in which it is based. Jobs can be created as a direct result of the business (i.e. Government is the employer). At the same time, these direct jobs can create indirect and induced employment through multiplier effects.

4.3.21 To clarify, indirect jobs are those created as a result of Government buying goods and services in the local area (e.g. from printers, cleaners and consultants). Induced jobs are those created as a result of Government employees spending their incomes in the local area, on all kinds of goods and services from, for instance, food to holidays.

4.3.22 The magnitude of the multiplier effect will depend on:

- The grade of work relocated (the higher the grade of work/staff the greater the indirect and induced effects);
- The degree of clustering of public sector activity in an area (the higher the level, the greater scope for providers of support services to move into, or grow in the area, thus boosting indirect employment). Clustering is also likely to be necessary to attract higher grade staff, with associated multiplier benefits.

4.3.23 However, to balance this, some of the jobs created may be at the expense of reduced employment elsewhere in the area – displacement (or in the specific context of private sector jobs, 'crowding-out'). Crowding-out arises because the incoming Government business reduces the number of people working for existing private sector employers. This can happen as competition for staff increases and existing firms lose people to the new employer.

4.3.24 The magnitude of offsetting crowding-out effects will depend on:

- The level of spare capacity in the receiving labour market (the more the better, i.e. the less crowding-out will occur). For example, the number of unemployed people who could relatively easily – perhaps with appropriate training – move into the new public sector jobs;
- The extent to which public sector pay is higher than that in the private sector for similar work (the less the better, i.e. the less crowding-out will occur).
- The volume of Government business relocated to the area (the less the better, i.e. the less crowding-out will occur). Large relocations, perhaps of several Departments, will be more likely to tighten the local labour market, drive up wages and price people out of private sector jobs. There is a tension between this factor and the beneficial multiplier impact of creating clusters of public sector activity. As such, there is a limit to the amount of clustering which can be supported by local economies, before they 'overheat' and cause significant amounts of crowding-out. OGC map the location of Government business and can help identify managed opportunities.

4.3.25 However, many MOD business cases will involve consideration of the effects of job losses arising from restructuring/relocation, rather than job creation. At the national level the impact of such changes is likely to be broadly neutral; studies have shown that redundant defence workers who remain in the labour market tend rapidly to find alternative employment. This does not mean that such effects should be ignored, as Ministers are likely to want to be informed of the regional employment implications of any decision they make. The appropriate vehicle for this information is not the investment appraisal, but the regional impact assessment included in the project's Regional Socio-Economic Report (RSER). Refer to DASA DESA and Defence Estates for guidance.

**Skills**

4.3.26 The second area where Government relocations are most likely to benefit receiving locations is the enhancement of skills in the local economy. There are three key drivers of this effect:

- Where the Government relocation involves more highly skilled or educated staff (e.g. managers or professionals) being 'moved with the job' from a previous location, this has a direct impact on the aggregate skills base in the receiving area. However, one may need to consider what would have happened in the area anyway, particularly if a Government relocation crowds out, for example, major private sector technological investment.

- Government as an employer tends to offer more generous training provision to its staff than some private sector organisations, given the economies of scale in provision which Government enjoys. The benefits of this training can pervade the private sector, therefore into the wider economy, as staff move from Government employment to that in local private sector firms. The magnitude of this effect will depend on the age and grade of Government staff (with high levels of training and moves between public and private sectors most likely for younger staff and those in junior professional or administrative grades). It will also depend on the extent to which there is similar junior and professional work available in the private sector in the area – or whether there is a strong likelihood of this developing or moving into the area as a 'multiplier' response to the Government relocation.

- Clusters of Government activity, strengthened by individual relocations to an area, can 'draw in' professional private sector activity such as consulting firms and academic research centres. In turn this has knock-on effects on skills levels in the local economy. The magnitude of this effect will depend on the nature of the Government work being relocated.

4.3.27 These drivers can help boost aggregate skills' levels in the receiving location. This can then drive important secondary effects, such as highly-trained or educated parents taking more of an interest in local schools and in the educational attainment of their children. Departments should also be mindful of the implications for race equality when reviewing skills within the context of the relocation exercise. Further detail to support Departments can be found within the CRE's Lyons Review technical note.

**Investment**

4.3.28 Re-use of existing public sector accommodation may clearly have strong cost-effectiveness benefits, from the perspective of the business case. OGC keeps track of the space becoming available, and should be the first port-of-call when considering the estate which may be available at a suitable time which meets an organisation's needs. At the same time, where relocations of Government business involve the building of new accommodation, there may be scope to lever-in private sector investment to the receiving location. An example would be a PFI deal to build new accommodation where the PFI partner used the opportunity to build housing, retail or other office accommodation on the site. It is important to be creative and wide-ranging in consideration of physical locations.

4.3.29 More generally, the multiplier impacts of Government relocation will also tend to draw in private sector investment to an area. This kind of effect has already been considered under the employment heading above however, and need not be considered further. Again, the CRE Lyons Review technical note provides further details on the race equality issues pertaining to investment.

**Other drivers**

4.3.30 The remaining elements of the six key drivers approach are innovation, enterprise and competition. In real terms, Government relocations are likely to have relatively small direct impacts in these areas. However, any indirect impact of the relocation of central public sector bodies on skills' levels in particular could have further knock-on impacts on innovation and enterprise.

4.3.31 Although significant direct positive impacts are unlikely, there is a risk of a negative impact of Government relocation on these remaining drivers if significant crowding-out occurs in the receiving economy. This adds further impetus to ensuring that these have been worked through in any assessment.

4.3.32 The impacts of the relocation of Government business on innovation, enterprise and competition can be assumed to be correlated with other impacts. As such, explicit consideration of these three drivers will not generally be a requirement – they are not included on the following economic impacts questionnaire – but it is likely that Departments would want to have regard to the potential positive or negative effects.

## ***Economic Impacts Questionnaire***

4.3.33 Economic effects should be assessed using the simple economic impacts questionnaire. This provides a method of comparing alternative locations and to rank them according to the economic impact of the proposed location. The Department for Communities and Local Government (DCLG) is available to assist with this assessment.

4.3.34 The questionnaire is intended to be a basic tool to help frame considerations and its results should be treated thoughtfully. Clearly, the more care, background research and intelligent consideration which is put into populating the questionnaire, the more robust will be its conclusions. The results should be open to objective testing – perhaps outside challenge – from others to establish its coherence and to what extent it can be demonstrated that it is a sensible underpinning to the outcomes.

4.3.35 Clearly, there will still be an element of judgment in this consideration and, in the interests of transparency, the process which produced these judgments should be documented.

4.3.36 The questionnaire aims to differentiate between the location options which have been generated for a given area of business or activity. It does not attempt to measure the overall economic impact of relocating that area of business in any absolute sense.

4.3.37 The questionnaire employs the assumption that the central public sector body is able to set wages and salaries on a local basis, so that they are not too out of line with private sector rewards for similar work. This is a critical assumption, and without the ability to adjust pay levels by locality, the danger of dislocating local economies by crowding-out private sector work is somewhat heightened.

4.3.38 A worked example of the questionnaire is provided at paragraph 4.3.51. Overall, it prompts either 'yes' or 'no' answers or simple rankings. From these answers, an overall ranking is facilitated, though this should always be sense-checked.

4.3.39 There will be instances where the answers to a number of the questions conflict, which makes an unambiguous overall ranking of options difficult. In these cases, the questionnaire suggests that more weight should be given to the employment impact, since this is likely to represent the most significant effect.

## ***Wider policy impacts***

4.3.40 In addition to the pure economic effects, the wider policy impacts of options should also be considered. For example, a key factor in location is the scope of an option to contribute to the dispersal and devolution of decision-making and good governance across the UK. There is scope to modify a ranking of options taking this into account in addition to the simple economic considerations.

4.3.41 The economic impact is at the core of any consideration of the wider impacts' case for particular options. However, there is a range of other policy areas which it is legitimate to consider when building an assessment of wider impacts. For our purposes here, we will assume that the most important of these is the need for decision-making and governance to be dispersed across all of the UK and not just concentrated in part of it (i.e. the GSE). Other potential policy impacts would include:

- The relative contribution of options to the Government's social inclusion agenda, neighbourhood renewal and sustainable communities;
- The relative impacts on transport, the environment and wider sustainable development in local areas.

4.3.42 Central public sector bodies should consider their ranking of options, having considered the economic impacts, and test where there is scope to modify in order to achieve other key policy imperatives. Essentially, these would be developed from the economic impacts' base case. Clearly, the relevant policy areas will vary from location to location – there can be no one-size-fits-all approach. However, there are a range of organizations and experts which are available to advise on key and persuasive priorities.

## ***Conclusions: a wider impact assessment checklist***

- **Consider wider economic impacts** of location options for each area of business with reference to the material contained in this guidance and making full use of a range of information sources.

- **Use the economic impacts questionnaire** to assess location options for individual activities/areas of business, as a base case. Test the conclusions.

- **Consider any wider policy implications** and the effect this may have on the ranking of options. Develop alternatives to the base case. Challenge the conclusions.

- **Document the wider impact assessment process** to ensure transparency.

## ***Example: using the economic impacts questionnaire***

4.3.43 A Department has five options for the location of one of its business units. This unit is responsible for policy advice to Ministers. It has assessed the business case of each of the five options, but now needs to assess the wider impacts of the different potential locations.

4.3.44 A completed economic impacts questionnaire is presented below. The Department's assessment of the issues raised in the questionnaire is as follows:

**Employment**

4.3.45 Whilst all location options for the unit involve the same direct employment impact (600 staff)[57], the judgment of the Department is that there is some variation in the size of the likely 'cluster' benefits associated with each of its five options A-E. Furthermore, there is also some variance in the degree of spare capacity in each location to support its relocation without some unhelpful crowding out effects on the labour market, transport and housing.

4.3.46 Option A is the most promising in terms of size of public sector cluster (first question), but the area already has a large number of civil

[57] This will generally be the case for a given activity unless there are different levels of scope for either introducing new ways of working or making efficiency savings at different locations.

servants and the relocation of many more in the area could cause the economy to start to overheat. As such, the Department answers ‘No’ to the second and third questions.

Similar assessments for the other options produce only two viable options: C and D, with C preferred.

**Skills**

4.3.47 Based on an analysis of available labour market data, the Department considers that Option C has the most scope for skills benefits arising from the relocation to pervade private sector activity (Question F). This is because a fairly large proportion of the local workforce is reasonably young and currently concentrated in low and medium-grade office activity.

4.3.48 Option E on the other hand is ranked 5th out of 5 because local employment is concentrated in specialised manufacturing. Meanwhile, the ranking of location options according to the likely level of ‘draw-in’ of highly-skilled private sector activity (Question G) is slightly different, with Option E having most scope. This is because the manufacturing base of the area is serviced by large consultancy firms which are likely (based on their behaviour elsewhere) to expand their operations into public-sector work. Overall on skill impacts, however, Option C appears best of the five since it also has a high rank on private sector ‘draw in’, and has best rank on skills transfer.

**Investment**

4.3.49 Answers to the investment questions (K and L) are based on advice on local property availability, including whether new builds are likely to be required. Locations A, C and E require new builds, with the Department’s judgment being that location A would be most likely to provoke private sector interest in a PFI deal. Hence that option is preferred overall on investment grounds.

**Overall impact**

4.3.50 The preferred options from the analysis of employment, skills and investment impacts are C, C and A respectively (repeated in lines M to P on the questionnaire). Option C also has a high rank on investment impact and so is preferred overall. Of the others, Option D emerges as next-most preferred as it is the only one judged to have a net beneficial employment impact, with this issue being given higher weight than the other two impacts in the final analysis.

4.3.51 This assessment is written up in the Department's appraisal of future location plans and the results taken forward to the next stage: making a decision on relocation given other aspects such as the business case.

**Worked Example of Economic Impacts Questionnaire**:

| | Location Options | | | | |
|---|---|---|---|---|---|
| **EMPLOYMENT IMPACTS** | A | B | C | D | E |
| **A.** Rank (with 1=best) the options for direct impact and (for 'joined-up' activity), the size/breadth of cluster they fit into at the receiving location. | 1 | 3 | 2 | 4 | 5 |
| **B.** Is there sufficient spare capacity in the receiving labour market for your relocation, taking other possible public sector relocations as given, to avoid significant wage inflation? (Answer yes or no). | N | N | Y | Y | N |
| **C.** Would a relocation to the area by your organisation be likely to cause overheating of transport or housing markets, to the detriment of the private sector (taking other public sector activity and possible relocations as a given)? (Answer yes or no). | N | Y | N | N | N |
| **D.** For options answering 'Y' to **B AND** 'N' to **C**, copy answers to **A** here: | – | – | 2 | 4 | – |
| **E.** TOTAL EMPLOYMENT IMPACTS RANK (rank answers to **D**). | – | – | 1 | 2 | – |
| **SKILLS IMPACTS** | | | | | |
| **F.** Rank (with 1=best) the locations for the scope they offer for government training to pervade the private sector (dependent on type of work available in private sector) | 3 | 2 | 1 | 4 | 5 |
| **G.** Rank (with 1=best) the options for the likelihood that the cluster they will fit into will 'draw in' highly-skilled private sector activity. | 5 | 4 | 2 | 3 | 1 |
| **H.** Add numbers from lines **F** and **G** and give total here: | 8 | 6 | 3 | 7 | 6 |
| **J.** TOTAL SKILLS IMPACTS RANK (rank answers to **H**). | 4 | 2 | 1 | 3 | 2 |
| **INVESTMENT IMPACTS** | | | | | |
| **K.** Will the relocation involve new build accommodation (yes or no)? | Y | N | Y | N | Y |
| **L.** Rank (with 1=best) options for scope to lever in private sector investment (e.g. through a PFI deal). Give those answering Y to previous question highest rank. | 1 | 4 | 2 | 5 | 3 |
| **OVERALL IMPACT** | | | | | |
| **M.** Copy answers from line **E** (employment impact ranking). | – | – | 1 | 2 | – |
| **N.** Copy answers from line **J** (skills impact ranking). | 4 | 2 | 1 | 3 | 2 |
| **P.** Copy answers from line **L** (investment impact ranking). | 1 | 4 | 2 | 5 | 3 |
| **Q. OVERALL RANKING** of above three lines (where above rankings conflict, take employment impacts as most important, skills impacts next most important and investment impacts as least important and document reasoning for choice in box below). | – | – | 1 | 2 | – |

## Identifying the best option

4.3.52 Identifying the best location for each area of business involves weighing the business case alongside the wider case for each option. Where these match up and clearly indicate the most effective solution, a strong case will be produced. However, there will be circumstances when the option with the best business case may not offer the best wider impacts. In such cases, to reach a final decision, the scale of the wider economic impacts should be scored (as part of a scoring table) or quantified. Quantification should generally be possible for the job creation aspect of relocations. Direct and indirect employment impacts can be forecast using estimates of local multipliers.

4.3.53 Department for Communities and Local Government can assist in such cases and can also help in estimating the sums of money that Government would usually be prepared to spend to create given numbers of jobs in a regeneration area. Such estimates can then be used to assess if 'trading' business case benefits for wider impacts is sensible.

4.3.54 If the business case and wider impacts rankings suggest the same preferred option, then making a recommendation is straightforward (see the left-hand arm of the flow chart above). The table below illustrates an example of such a situation:

| Location Option: | A | B | C (preferred option) | D |
|---|---|---|---|---|
| Business case ranking (e.g. based on overall long-term operating cost) | 3 | 4 | 1 | 2 |
| Wider Impacts ranking | 4 | 2 | 1 | 3 |

4.3.55 However, where the rankings of the business cases and wider impacts of options do not point unambiguously at a preferred location more analysis will be required to support a decision (see right-hand arm of flow chart above). This is discussed in the next section.

## Further analysis of wider impacts

4.3.56 Clearly, the first stage is to consider if the comparison of rankings identified that some options can be excluded from further analysis. For example, in the table below options A and B can legitimately be excluded from further analysis, as these are unambiguously inferior to options C and D. The focus of attention can then be placed on a relative assessment of the latter two options to determine the best course of action.

| Option: | A | B | C | D |
|---|---|---|---|---|
| Business case reanking | 3 | 4 | 1 | 2 |
| Wider Impacts ranking | 4 | 2 | 1 | 3 |

4.3.57 To aid an objective consideration there may be areas in which there are obvious trade-offs evident between the business cases for different options and the initial, qualitative, assessment of wider impacts. In such cases, you would need to revisit wider impacts assessment to quantify at least some of those impacts where, up until now, it has been a qualitative consideration.

4.3.58 The key area where quantification of the wider impacts of Government relocations is possible is job creation. The requirement is to put numerical estimates on:

- Direct employment creation arising from the relocation;
- Indirect and induced employment arising from multiplier effects, net of displacement/crowding out.

4.3.59 Estimation of direct employment creation should be straightforward. Estimates may also tend to be constant across location options for the same activity, and to this extent will not enable any differentiation between those options. Estimates of net multipliers (i.e. those which take account of indirect and induced effects net of displacement/crowding out) are typically between 1 and 1.5,[58] and will vary between locations. Therefore, the key to understanding the relative job creation implications of different locations is to understand the associated differences in multipliers. The task of estimating multipliers can be discussed with DESA economists, and/or suitable consultants (In the case of the latter, this should be discussed with DESA).

[58] Source: Experian Business Strategies: Lyons Civil Service Relocation Review: A regional economic perspective on public sector relocations. The number, when multiplied by the number of direct jobs created, gives the total employment impact taking into account direct, indirect and induced jobs and any displacement (‘crowding-out’).

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# 4.4 REAL OPTIONS

**4.4.1 Defence procurement decisions typically involve the MoD incurring substantial upfront costs, which cannot be recovered in the event that a project is cancelled or is deemed to have failed. This can create problems in an environment characterised by significant technological challenges and a continually evolving user requirement in response to the changing threat. In such an environment, decision makers understandably place a premium on maintaining as much flexibility as possible.**

## ***Introduction***

4.4.2 The standard 'Investment Appraisal' approach involves capturing all of the costs and benefits associated with a project and then discounting them to obtain its overall Net Present Value (NPV). Implicit in this approach is a static one-time decision making process, which means that although the costs and benefits associated with a particular decision may be subject to uncertainty; once a decision has been made it is taken as given.

4.4.3 Although this method is more than adequate for evaluating a wide range of investment decisions, it has been demonstrated that it systematically undervalues approaches which allow for decisions to be altered or reversed in response to changing conditions in an uncertain environment. In these circumstances, Real Options Analysis can add value because it provides a framework for quantifying whether the cost of additional flexibility in a project represents value for money (by capturing it explicitly within the project's NPV).

4.4.4 Real Options Analysis theory applies the concept of Financial Options to real or physical assets. Financial Options essentially allow a trader to enter into an agreement in which they have the *right but not the obligation* to buy or sell financial assets at a future date at a pre-determined price known as the *Strike Price*. The trader pays a fee (the *Option Cost*) to be able to have this option guaranteed at or up to a certain point in the future. The option acts as a form of insurance against the uncertain conditions prevailing in the financial asset market.

4.4.5 An example of Real Options Analysis in practice is the Carrier Variant of the Future (CVF), which has an adaptable design allowing it to be converted from its default Short Take Off and Vertical Landing (STOVL) configuration to one which uses catapult launch relatively easily. This gives the MoD the option to switch to non-STOVL jets for use on the carrier should the STOVL variant turn out to be too expensive or otherwise unsuitable.

## ***Financial Options***

4.4.6 To better understand Real Options Analysis it is helpful to first look at Financial Options theory. A financial option represents the *right but not the obligation* to buy/sell a specific financial asset on (or before) a certain date for a pre-determined price. Where an option involves buying stocks it is known as a 'call' option and an option to sell is a 'put' option. Financial options are split into two categories: European style options which can only be exercised on a specific date and American style options which can be exercised at any point up to a specific date[59].

4.4.7 The price at which the option can be exercised is known as the *Strike Price* and the option need only be exercised if it is profitable for the trader to do so. For example, in the case of a call option this would be if the market price for the asset rose above the strike price allowing the option holder to purchase it more cheaply than the going rate. Conversely for a put option if the market price fell below the strike price, it would be profitable to exercise the option and receive a price for the asset which exceeds the market price.

4.4.8 When analysing financial options it is important to distinguish between their value ex post (when all information is known) and their value ex ante (which is based upon the expectation of future values).

4.4.9 The ex post value of an option is commonly known as the *Realised Option Value.* At the expiry date the option holder compares the current price of the asset in the market to the value they would receive by exercising their option, and acts to maximise the value. In a put option, where the option holder would be selling stocks, the option will be exercised if the Strike Price exceeds the going market price. If the option is not profitable the option holder's losses are bounded by the Option Cost, which is sunk.

[59] European options are considerably simpler to analyse than American options, however fundamentally the approach taken is the same. In practical terms the value of a European option represents the lower bound for an otherwise identical American option.

4.4.10 Although the strike price, option cost and duration of the financial option are all known with certainty ex-ante, the value of the option if and when it is finally exercised is not. Consequently the ex-ante value of an option is based upon its expected value, given one's best guess about the range of possible future market movements. This leads to the formation of expectations over how and when the option will be exercised and what the value of doing so would be.

4.4.11 The main determinant of the ex-ante value of an option is the estimated variability of the underlying asset's market price. The more volatile the asset price and the longer the term of the option, the more valuable the option will be since this means that there will be a greater range of possibilities under which exercising such an option will be profitable.

4.4.12 The *Gross Option Value* is the expected value of holding the option (not including the cost of purchasing the option). The *Net Option Value* is therefore the Gross Option Value less the current expected value of the asset at market prices, that is, what the buyer would expect to receive if they simply chose to hold the asset itself (the opportunity cost of the option). If the Net Option Value exceeds the option cost it is worthwhile purchasing the option.

4.4.13 It is possible to trade some financial options, which makes the value of the option easier to identify. As more information reveals itself, the value of the option changes. In this case the cost of the option in the secondary market is a function of the option value which can change over time. This, however, is not the case with Real Option Analysis as the options are generally not transferable. Thus the best available proxy for the value of a Real Option is the estimate of its expected market value.

## ***Models of Evaluation***

4.4.14 Several models have been developed to value the expected benefit offered by Real Options Analysis. They range from simple qualitative descriptions of the underlying intuition behind Real Options to highly complex closed form mathematical solutions. A simple exposition of the four main models is outlined below.

## Qualitative Approach

4.4.15 The value of an option essentially depends on two factors: the size of the project considered for the option and the degree of volatility in the market for the underlying asset. The larger the NPV of a project is, the greater the potential losses from making an irreversible investment decision and therefore the greater the potential option value. Equally, the greater the volatility and the longer the period of delay given by the option, the more the option is potentially worth, because the range of possible outcomes under which it will be profitable to exercise will be increased as a result.

4.4.16 Real Options Analysis can be seen as a form of insurance and since a certain outcome is generally preferred to an uncertain outcome[60], the MoD would be willing to pay more to maintain flexibility as the risk increases. Thus as the present value of the option increases or the volatility increases, the value of the option increases and so the MoD would be willing to pay a higher option cost.

4.4.17 Whilst this model is useful in outlining the basic criteria for comparing options, it cannot provide a value for money recommendation or a quantitative measure of the option value. There exist three main models which can provide an objective estimate of an option value but which also have a much higher informational requirement. The three main models are the formula based solutions (an example of which is the Black & Scholes formula), the Lattice model and the Monte Carlo approach.

## Black & Scholes

4.4.18 The Black & Scholes formula is a mathematical solution to a narrowly defined set of European Financial options problems. Whilst it is relatively simple to use, it is also the model with the strictest assumptions. The most restrictive of these is the assumption that there is a fixed date on which the option can be exercised and that the Strike Price and volatility are both known and constant over time. However there are some general observations arising from the Black & Scholes paradigm which apply to all Real Options Analysis:

[60] Assuming the MoD is risk averse, which, given the framing of government accounting rules and current government policy, is arguably a reasonable assumption.

- The value of a call option increases (decreases) as the current stock price increases (decreases);
- As a call option Strike Price increases (decreases) the option value decreases (increases);
- As the length of time until maturity of the option increases, the value of the option increases;
- As the risk free interest rate increases the value of the option increases. (This is because an increase in the interest rate represents an increase in the amount that could be earned by delaying an investment decision and holding onto capital until the investment environment is more certain)
- The greater the volatility of the underlying stock price, the greater the possibility that the stock price will exceed the Strike Price and therefore the greater the value of the option[61]

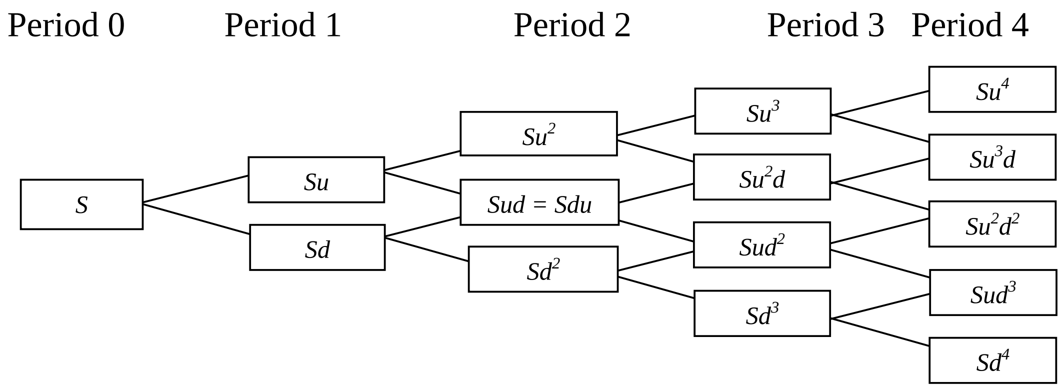
4.4.19 Similar solutions have also been derived for a range of other narrowly defined options problems. However like Black & Scholes they all suffer from having limited applicability to option problems which stray outside of their basic assumptions. The formula and its specific assumptions can be found in Annex B.

**Lattice Approach**

4.4.20 The Lattice approach considers the option problem as a 'cone of uncertainty'. It maps out the potential paths of the underlying asset based on the assumption that between any 2 points in time the asset value can either rise with probability, $p$, or fall with probability, $1-p$. The magnitudes of the up factor, $u$, and the down factor, $d$, are determined mathematically from the estimated volatility of the asset[62].

4.4.21 So, starting with the value (or Net Present Value) of the asset, $S$, one can multiply it by u and d to create the asset value lattice as seen below:

[61] In this case volatility is calculated as the annualised standard deviation in the natural logarithm of relative returns.
[62] This is commonly referred to as a 'risk neutral' probability because it explicitly takes into account the effect of the risk free rate on an individual's investment decision.




4.4.22 The lattice shown above traces the potential path of the asset price within its cone of uncertainty. If there were no uncertainty the lattice would in fact be a straight line as the asset path would be known with certainty. The higher the volatility, the wider the cone of uncertainty becomes, thus increasing the potential value of the option.

4.4.23 To accompany the asset value lattice there is an option valuation lattice which, for each potential asset value, calculates the value of the option. A process called backwards induction can then be applied to this second lattice to reveal the present value of the option.

4.4.24 Backwards induction involves taking each potential asset value in the final period (4) and looks at whether cancelling, continuing or exercising the option would be the value maximising decision. Once this has been done for all possible points in period 4 one moves back to period 3 and calculates the value maximising option for each node (decision point). This is done by taking the discounted expected value of the potential future option values calculated at period 4 (which represents the most likely outcome of continuing the option), compared with the value of exercising the option. This process is continued for the whole lattice to result in the Net Present Value for the option. The difference between the NPV of the option and the NPV of the asset is the additional value offered by the flexibility of the option.

4.4.25 Unlike the Black and Scholes formula, the lattice model uses discrete rather than continuous time. However, at the limit, as the number of steps in the lattice approaches infinity and the time between each step goes to zero, the solution produced by the lattice model converges on that of the B&S formula[63]. The Lattice model can be used more widely than

[63] For the narrow class of problems which can be solved by the B&S formula.

Black & Scholes due to its less restrictive assumptions and yet it is still relatively easy to understand and explain.

An example using the Lattice model can be found in Annex C.

## Monte Carlo Simulation

4.4.26 The Monte Carlo approach is similar to the Lattice Approach in that it builds upon the cone of uncertainty concept, but is the least restrictive model in terms of the assumptions needed. It is based on the same underlying principles as those used in producing three point cost estimates.

4.4.27 It is known that the asset will follow one of the many potential paths detailed in the lattice approach but it is not known which one. The Monte Carlo approach simply takes a random path and calculates the option value for this path. This calculation is then repeated for many different paths to produce a range of possible option values. The greater the number of paths simulated the more accurate the average Net Present Value (NPV) of the option will be.

4.4.28 An example of where Monte Carlo simulation would have to be used is in a switch option. When considering switching from option A to option B where both options have cones of uncertainty associated with their estimated NPV's, it is impossible to create a lattice because there exists a vast number of potential destinations to switch to in B's cone of uncertainty. Whilst the starting point in cone A would be known, option B could lie anywhere within its cone of uncertainty. Monte Carlo simulation could forecast an option value under these conditions by running numerous simulations matching random points within both cones.

4.4.29 The disadvantage of the Monte Carlo approach is that it is more technically challenging to apply and can be more intensive in terms of its time and computational requirements compared to the other two approaches.

## Application to the MoD

4.4.30 There are two main areas in which these techniques may have significant utility within the MoD. First, they may allow for the value of retaining flexibility in a particular defence procurement decision to be explicitly recognised in the estimated NPV for the project. Second, if this

proves feasible, their use could be extended to evaluating strategic defence industrial policy decisions, such as trading off the long run value for money benefits generated by sustaining domestic competition against the short term costs of the industrial support required to do so.
Given that the MoD already compiles much of the necessary information when producing its three-point estimates of project costs, the application of Real Options Analysis to Investment Appraisals should in many cases be straight forward. However in the case of strategic options, where estimates will inevitably be based on some degree of subjective judgement, it may only be possible to apply in a qualitative sense.

## *Investment Appraisal Options*

4.4.31 There are five broad types of Real Options Analysis problems which are likely to be applicable in the context of MoD Investment Appraisals:

- Option to Abandon
- Option to Switch
- Option to Expand/Contract
- Option to Upgrade
- Option to Acquire Incrementally

### Option to Abandon

4.4.32 There are many instances where the ability to defer a decision over whether to proceed with, or abandon a particular course of action, has value. This is because such a delay will allow time for new, potentially pertinent information to be collected, leading to a more informed final judgement.

4.4.33 It is important to note that an ‘Option to Abandon’ is only feasible if cancellation is a credible course of action, with there being no alternative fallback option available. Where a fallback option is available this is in fact an ‘Option to Switch’, which is discussed below.

### Option to Switch

4.4.34 Many IAs offer more than one viable option, of which one is judged to deliver best value for money. There may be no guarantee, however, that it will remain the best value for money solution, in which case maintaining the flexibility to switch to a different option may have value. It could then be that where we have say two options, where one has the option to switch but a higher NPV, it could still be the value for money solution when the value of flexibility is considered.

**Option to Expand / Contract**

4.4.35 This option is similar to the option to abandon but provides greater flexibility as to 'how many' are involved in the contract. When purchasing expensive equipment the option to increase/decrease mitigates against the risk of, for example, the price increasing, by allowing fewer quantities to be purchased to stay within budget while providing as much capability as possible. Equally, if the price dropped it would be possible to take advantage of this and increase the quantities bought. In practice this option would only tend to be useful when dealing with large numbers of similar units.

**Option to Upgrade**

4.4.36 Current acquisition thinking places an emphasis on the 'future proofing' of platforms or to build 'for but not with' a certain equipment or capability. Such options allow the flexibility to upgrade in the future, which is particularly valuable when considering large projects with a long project life and where it is likely the capability requirement of the project will change over time. A recent example of this is the Carrier Variant of the Future (CVF). The CVF has been future proofed by building it with a ski ramp for STOVL jets and 'for but not with' the space for steam catapults should the STOVL jets not prove to be viable. Previously there was no method to objectively evaluate the costs and benefits of this decision but Real Options Analysis helps to shed light on this.

**Acquire Incrementally**

4.4.37 There is an increasing drive for more incremental acquisition within defence. Whilst it often exposes the MoD to higher acquisition costs (through foregoing the advantages of Economies of Scale), it also reduces the risk of acquiring a large stock of equipment which ultimately proves itself unable meet the capability requirement. Real Options Analysis enables a clearer analysis of the trade-off between the potential higher costs and the reduced risk as the reality of future conditions reveals itself over time. An obvious requirement for this to be an option is the ability to split the purchase into smaller increments.

## ***Sequential Options***

4.4.38 All of the above options could be combined into a sequential option. For example there might be the option to switch from the build of new tanks to the purchase of foreign tanks. However, this contract in turn might allow for a further decision to abandon buying the tanks altogether and running old tanks on further. This would be a sequential switch and abandon option. Whilst the fundamental techniques used to evaluate these types of options are the same, they are both more complicated and challenging in terms of their data requirements.

4.4.39 An example using a previous decision taken by the MoD is detailed in Appendix 1. The example is regarding the potential re-location of RAF bases High Wycombe and Innsworth. It shows that whilst the best value for money decision at the time was to re-locate immediately to High Wycombe, had the relevant cost savings or volatility surrounding these savings been different, there may have been significant value in entering an option to switch to Innsworth at a later date. See Annex D for further details.

## Practical Issues Associated with Real Options Analysis

4.4.40 Although Real Options Analysis has a number of potentially useful applications to certain classes of MoD Investment Appraisals, there are still several significant practical issues which must be overcome.

### The Strike Price

4.4.41 An important factor in any Real Options Analysis model is the determination of the Strike Price. In some cases this will be explicit, such as a value specified in a contract, however in others it will need to be derived from other information. For example if an option to abandon, when exercised, results in the disposal of certain assets, the strike price would be calculated from the value expected to be generated by these disposals. Alternatively, in the case of an option to switch, the strike price would be the estimated NPV for the alternative solution at the point when the decision to exercise is made[64]. The accurate determination of the Strike Price is an absolute pre-condition for making Real Options Analysis a viable approach.

[64] Given that this NPV will have its own 'cone of uncertainty' the value of the option must be estimated using Monte-Carlo simulation.

## Volatility

4.4.42 Volatility must either be known or estimated from available data or a suitable proxy variable. In the case of Financial Options, it is common to use market replicating portfolios which are designed to replicate the performance of the underlying asset. In Real Options Analysis, however, this is unlikely to be appropriate unless there exist data from a similar project.

4.4.43 An alternative would be to use the three-point cost estimates calculated by the MoD in all major Investment Appraisals. Three-point cost estimates are produced from an estimate of the range of foreseeable cost outcomes for the project and thus this process can be used to provide an estimate of the degree of uncertainty about the central cost estimate. Critically, however, for the approach to be viable, the three point estimates need to be as robust as possible.

## Enforceability

4.4.44 Real Options contracts only have value if the option can be practically enforced. For example, over time cost fluctuations may drive an option to be so profitable that the seller is unwilling to honour it which would lead to default. This risk should be borne in mind when considering the negotiation of options.[65]

## Risk

4.4.45 Related to the point above, a third problem may be the existence of a catastrophic risk. Such extreme risks are rarely taken into consideration in the estimation of volatility and so the value of an option able to avoid such a risk may be under valued due to the failure to capture the risk in the first place. Conversely, risk averse organisations aware of such risks would require substantial compensation if they were to bear the potential consequences of such a catastrophic event.

## Time frame

4.4.46 The time frame available before exercising the option affects the value of the option. As the time frame for the project increases, the

[65] An example where this occurred was the dispute in early 2006 between General Motors and Fiat. The latter had an option to sell General Motors a further stake in the company. When it came to the expiry date of the option, General Motors refused to honour the contract as the Fiat unit had become so unprofitable. Fiat resorted to legal action and the case was settled in court.

greater the opportunity for the value of the option to vary since there is more time for useful information to become available.

4.4.47 All of the above pose potential problems in valuing options and fixing the value of the relevant Strike Price and Option Costs.

4.4.48 By way of example, DESA suggested applying Real Options Analysis to a MoD IT project for which the issue of incremental acquisition was critical. However, in practice it was found that the inter-dependence of the various sub options meant that it was not possible to disentangle the project costs to extract the necessary information for Real Options Analysis. In such cases Real Options Analysis can still add value to the decision making process by qualitatively highlighting that delay in conditions of uncertainty provides value. However, unless the value of delay can be quantified, a purely qualitative argument will have limited effect on the resulting option choice at the point of approval.

## ***Choice of Models***

4.4.48 Given its ease of use and modest computational requirements, the Black & Scholes formula and related mathematical solutions have clear advantages in those situations where their restrictive assumptions are valid, and so should be considered as the first choice.

4.4.49 If the underlying assumptions for the B&S model are not valid, it is recommended that the Lattice model should be applied. Whilst it is the most complicated model of the three, it has the key advantages of being flexible whilst still providing a single point estimate to be used to compare values in the business case. The Lattice is contingent on the underlying asset following a stochastic process, meaning that the asset path is determined by a random variable.

4.4.50 If this assumption is considered to be overly restrictive then the Monte Carlo approach should be used. Monte Carlo derives an estimate for the value of the option by running several simulations of the path the asset value may take. Each time the simulation is run, different paths will be taken resulting in a different answer. Monte Carlo produces a range of estimates for the option value but a single point can be calculated by taking the mean. Whilst this result will vary every time the simulation is run, the answers will converge on the true value as the number of trials is increased. This approach, whilst having the least restrictive criteria, is not favoured because it has a high computational requirement. It is for this reason that it is recommended that the Monte Carlo approach be used only if both other models are considered invalid.

4.4.51 It is possible that the requirements of Real Options Analysis may mean that the additional cost and time involved outweighs the potential benefit of the additional information provided by the process. Particularly with smaller projects it may be that it is not worth using Real Options Analysis even if the project is suited to its application. In such projects, however, the use of qualitative analysis may add to the analysis of the project by considering the value provided by flexibility.

## ***Conclusion***

4.4.52 Traditional Investment Appraisal technique gives a static analysis of options represented as Net Present Values. This technique does not capture the value of flexibility of changing strategy in projects where decisions can be adjusted or reversed in the light of new information. It is this that Real Options Analysis seeks to redress.

4.4.53 In cases where information is uncertain and may be revealed over time, there is potentially considerable benefit to be drawn from the ability to delay a decision. Real Options Analysis shows that often it is worth paying a short-term penalty of a higher cost in order to reap the benefits from future flows of information. It also serves to approximate the point when the cost of delaying begins to outweigh the benefit of future knowledge and could thus advise on the optimal decision making point.

4.4.54 Whilst the theoretical benefits of Real Options Analysis to the MoD are clear, there are several practical issues which limit its scope for use in Investment Appraisals; in particular the informational requirements to carry out the analysis, the complexity of Real Options Analysis and the presentation of results in the Business Case.

4.4.55 There exists a more technical Real Options Analysis paper which is available from DASA DESA for those who wish to have a more detailed understanding of the subject.

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## ***Annex A: Real Options Analysis Project Checklist***

Below is a summary of conditions necessary in order to apply Real Options Analysis:

The project is subject to uncertainties which are expected to diminish over time as new information becomes available.
The MoD is able to delay making a decision in order to be able to benefit from the revelation of information in the future.
The project requires substantial upfront investment

Information on the following is available:
Strike Price
Volatility
Time frame
Enforceable option set

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## ***Annex B: The Black and Scholes Model***

The B&S is the simplest of the formal models to use as it can be expressed in a single equation and does not require long computer runs to provide an answer. The mathematics underpinning this equation is extremely complex and therefore no attempt will be made to derive the formula here.

The B&S does however require a number of assumptions for it to be valid. Through the use of these assumptions it is then possible to form a single equation to provide a real option value. These assumptions are:

a. That a short term risk free interest rate is known[66]
b. That the option can only be exercised at a fixed and known date and not before – i.e. there is no flexibility in when the option can be used.
c. That the strike price is known with certainty and fixed.
d. The volatility is also known and constant.
e. That the asset price follows a Brownian Motion Process.
f. There are also a large number of other financial assumptions underpinning the model[67]. However these are not so relevant to MoD analysis and are unlikely to be invalid. They can therefore be safely ignored.

Using the assumptions above B&S derived the following mathematical equation:

$$Value = S_t \phi(d_1) - Xe^{-rT}\phi(d_2)$$

where

$$d_1 = \frac{\ln\left(\frac{S_0}{X}\right) + \left(r + 0.5\sigma^2\right)T}{\sigma\sqrt{T}}$$

$$d_2 = d_1 - \sigma\sqrt{T}$$

**Equation 1**

[66] This can be taken to be the same as the discount rate used in NPV calculations since the risk free rate is used to calculate the NPV figures in the B&S model – i.e. it can be taken to be 3.5%.
[67] For more information see Real Option Analysis – J Mun

In this equation the following variables are needed:

g. $S_t$ = NPV of project in year t
h. X = The Strike Price
i. r = The risk free or discount rate.
j. T = The time to maturity – i.e. the time left until the decision has to be made.
k. σ = A measure of the volatility of the returns of the project
l. $\phi$= The Cumulative Standard Normal Distribution.

**e = exponential function**[68]

[68] The Exponential function and Standard Normal Distribution are mathematical tools which are used in a wide range of applications and can be calculated by Excel.

## ***Annex C: Hypothetical Option to Switch to Illustrate Lattice Approach***

The MoD is considering developing new radar technology for use on ships to help counter a new type of missile threat. The MoD estimates the NPV cost of developing the technology domestically to be £100m, however the US have already developed an equivalent system which could be adopted in the UK subject to several adaptations at an estimated total cost (including the necessary adaptations to meet UK specific requirements) of £115m.

Due to the uncertain nature of researching and developing a new custom-made technology, one of the procurement options under consideration includes a 'real option' allowing the MoD to terminate the domestic programme before completion at a cost of £10m and switch to the US design if the former becomes too expensive.

In order to calculate the value of the option it is necessary to have various pieces of data. From the three point estimates used to derive the net present value of the domestic option (£100m), the underlying volatility of this solution is calculated to be 30%. The interest rate on a risk-free asset over the time frame of the option is taken to be 5% and the project is assumed to have a lifespan of five years. For simplicity the number of steps in the lattice is also set to five[69]. The Strike Price is the cost of switching to the US provider, inclusive of any costs incurred at the time of cancelling the domestic contract[70]; which is estimated to be £115m + £10m = £125 million.

With this information it is possible to calculate the value of the option. The up and down factors are calculated using the set formulae[71]:

$$u = e^{\sigma\sqrt{\partial t}} \quad \text{and} \quad d = e^{-\sigma\sqrt{\partial t}}$$

The (risk neutral) probability of moving up (p) and down (1-p) is calculated using the formula:

$$p = e^{r(\partial t)} - \frac{d}{u-d}$$

[69] In practice it would be set much higher and the computation of the various values left to a software package.

[70] This is different from the Option Cost which is the upfront cost of retaining the flexibility to make such a decision (i.e. the amount charged by the UK contractors to permit the possibility of future cancellation.)

[71] For simplicity we will set $\partial t$ equal to one in the following exposition.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Present Value of Asset** | **S** | = | 100 | **Years to Expiry** | T | = | 5 |
| **Salvage (Strike) Price** | **X** | = | 125 | **Number of steps** | n | = | 5 |
| **Volatility** | **v** | = | 0.3 | **Time delta** | t | = | 1 |
| **Risk Free Rate** | **r** | = | 0.05 | | | | |
| **Upfactor** | **u** | = | exp(v(t)^0.5) | = 1.349859 | | | |
| **Downfactor** | **d** | = | exp(-v(t)^0.5) | = 0.740818 | | | |
| **risk neutral probability** | **p** | = | (exp(rt)-d)/(u-d) | = 0.509741 | | | |

There are two steps to creating the option valuation lattice. Starting with the underlying value of £100m this is multiplied by the up and down factors to create the lattice of the underlying asset value. The second step is to calculate the option valuation lattice using the values from the underlying asset lattice. This is done through the process of backwards induction.

The first lattice is constructed by multiplying the NPV by the up and down factors progressing from left to right. The second lattice, the option valuation lattice, reverses this process and starts calculating from the end points back to the beginning.

To demonstrate, the node in the top right hand corner of the option valuation lattice has a value of £125m. This is arrived at by taking the minimum of £441m (the cost of the domestic solution) and £125m (the cost of the US option); hence in this case it is optimal to switch. At all stages the MoD will wish to minimise the cost of its investment and so will continue research and development if domestic procurement is cheaper than exercising the US option. Conversely the node in the bottom right hand corner is calculated by taking the minimum of £22m (the cost of continuing with domestic contractors) and £125m (the cost of switching). Here it is optimal to continue UK production and so the value shown is £22m.

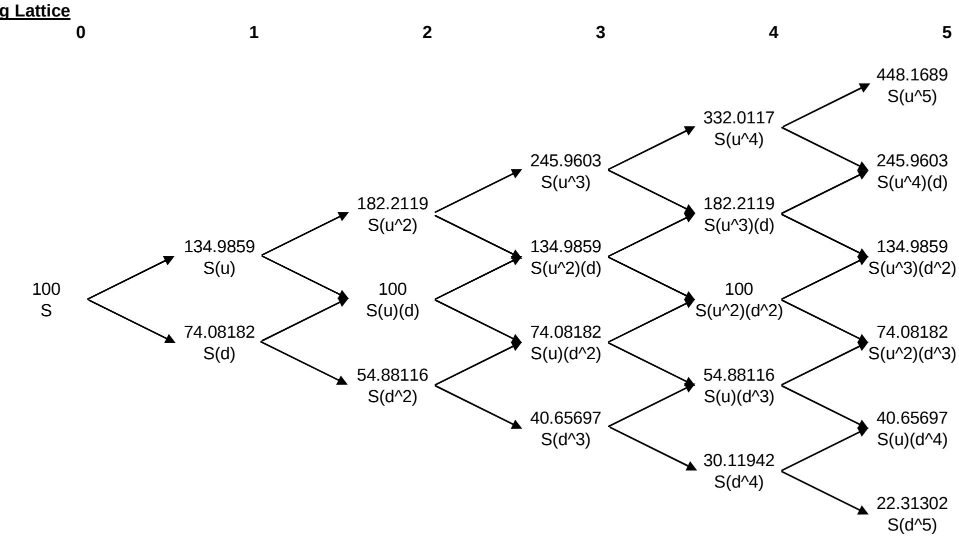
Continuing back to the intermediate nodes, the first node in time period 4 is valued at £118.9m. The decision at this stage is whether to abandon the project and switch to the US option or whether to continue and keep the option open in the anticipation that the project continues to be ‘profitable’. The value of switching is the salvage value of £125 million (this is the Strike Price). The value of continuing is the weighted average of potential future option values discounted using the risk-free rate. This can be calculated using the probability given by the formula above and taking the probability weighted average of the optimistic and the pessimistic outcomes of the next period i.e.:

$$\left[(p)(£125)+(1-p)(£125)\right]e^{[-r(\partial t)]} = £118.9\,million$$

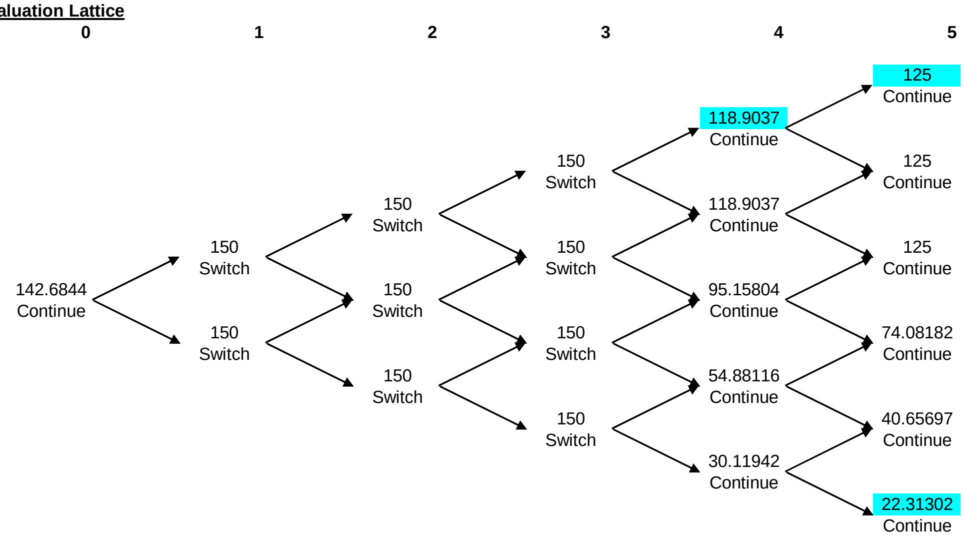
Since this is cheaper than abandoning the project, the option will be kept open.

This backward induction technique continues back to the starting point of the lattice and reveals it to be £73.3 million. Since the NPV for the asset value itself is £100 million, the difference of £26.7 million is the additional value given by the option to switch. If the option is expected to give £26.7 million in value, as long as the cost of the option is less than this amount, it would be worthwhile to purchase the option.

**Underlying Lattice**




**Option Valuation Lattice**



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## ***Annex D: RAF Organisational Review Example***

The MoD recently faced a decision regarding the possible co-location of RAF bases High Wycombe and Innsworth. It was considered that there was the potential for savings and an increase in operational effectiveness if it was possible to collocate the TLBs for Personnel and Strike Command which resided separately at Innsworth and High Wycombe respectively. The options were to move to High Wycombe immediately, which represented best value for money at the time (as shown in the Investment Appraisal), or to delay the decision and decide whether to move to Innsworth or High Wycombe at some point in the future when more information about the relevant costs was known. The option to switch would therefore act as insurance against the possibility that the High Wycombe option would later be found to be poor value for money.

As will often be the case with MoD estate rationalisations, the figures by which the projects were compared actually represent *cost savings* rather than costs. Accordingly the solution with the highest number represents the greatest savings and value for money. At the time of presenting the case, the cost savings of immediately going to High Wycombe and not taking the option were estimated to be £417 million. The cost savings offered by relocating at some point in the future were £401 million for High Wycombe and £353 million for Innsworth. The value of the option lies within the fact that there is uncertainty over the extent of the cost savings that may result in the future. By taking the option the MoD is insured against the possibility that High Wycombe, whilst the value for money decision at the time, may not remain so.

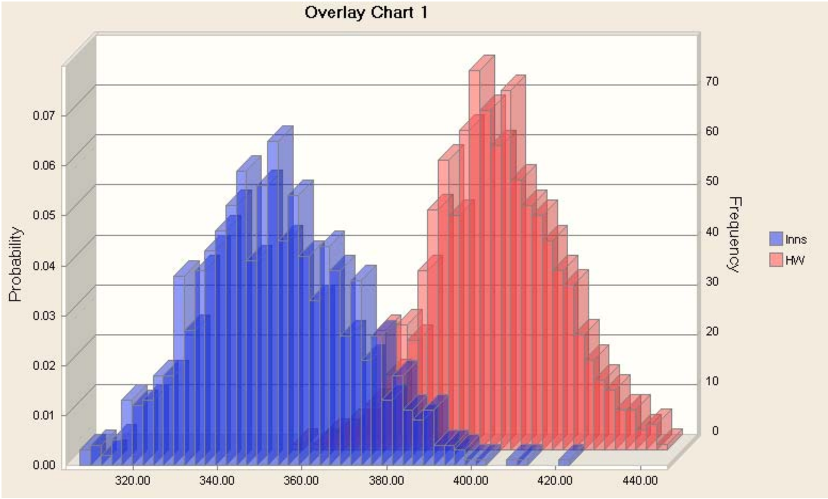
As the option is an option to switch, the model used to carry out the Real Options Analysis must be Monte Carlo analysis because the value of the option will depend on ***two*** cones of uncertainty and thus there are a vast number of combinations of values for High Wycombe and Innsworth, which are can only be evaluated by multiple trials run through Monte Carlo simulation.

The information necessary to evaluate the option is the project length, the years until a decision must be made (assumed to be 15 years in this example), the estimated costs savings for each alternative and the degree of uncertainty associated with them. Using this information, specialist software packages (such as Crystal Ball) can be used to set a number of simulations showing the possible distribution of cost savings offered by both options, calculated using the expected project volatility around the expected cost savings.

The results produced show the distribution of the expected cost savings from the decision to co-locate to both High Wycombe and Innsworth and then calculate the net benefit of taking the option. The value of the option can be shown graphically by the area of overlap between the two options. This area shows the probability that the cost savings of the two projects may overlap, illustrating that there would be a value to keeping the option open to change the RAF basing location.

**Forecast: Switch Option Value**

| Statistic | Forecast values |
|---|---|
| Trials | 1,000 |
| **Mean** | **0.14** |
| Median | 0 |
| Mode | 0 |
| Standard Deviation | 1.16 |
| Variance | 1.35 |
| Skewness | 10.11 |
| Kurtosis | 116.52 |
| Coeff. of Variability | 8.52 |
| Minimum | 0 |
| Maximum | 17.97 |
| Mean Std. Error | 0.04 |

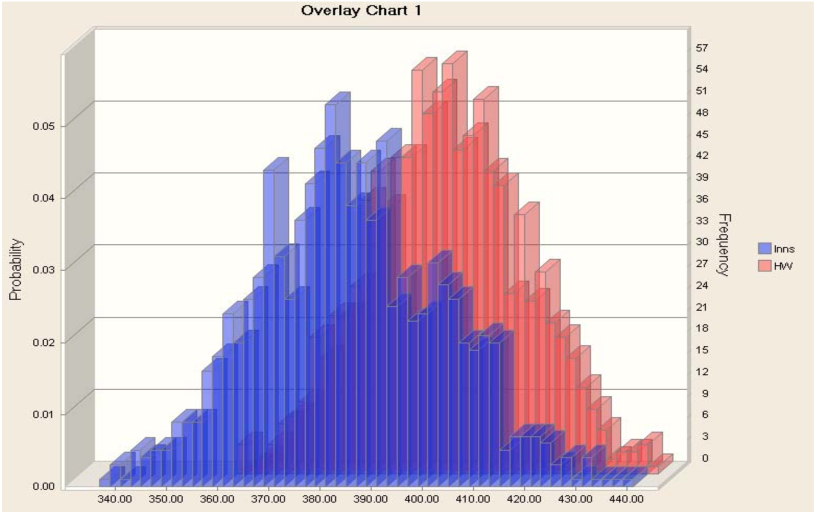



As can be seen from the results, the area of overlap of the alternatives is quite small and the value of the option to switch is £0.14 million, an insignificant value compared to the value of the project as a whole. Therefore, given these results, the MoD's decision to make an irreversible move to co-locate at High Wycombe is confirmed as the most likely best value for money solution. However, we can also change the assumptions to get an understanding of the conditions under which the option would have more significant value.

The reason there is little value in the option to switch is due to the wide gap between the estimated cost savings of the two options in the Investment Appraisal and also the low volatility associated with these estimates. However, if one alters the expected cost saving from Innsworth such that it is closer to that offered by High Wycombe, (in this example to £385 million), the overlay chart changes significantly showing a much higher value captured by the option to switch. This is because using the same volatility, there is a higher probability that with the expected cost savings being closer for the alternatives, it is more likely that the value for money solution may switch to being Innsworth. Under these conditions the option to switch has a mean expected value of £3.84 million.

*Forecast: Switch Option Value*

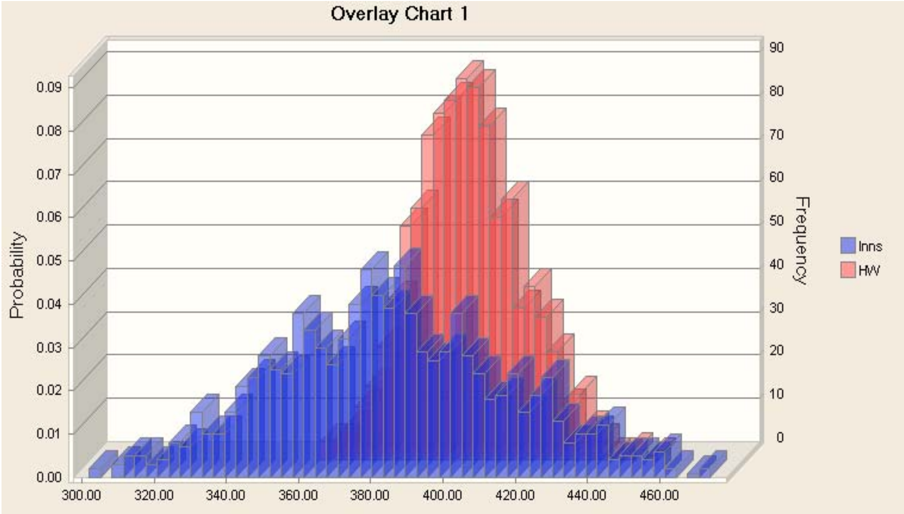
| Statistic | Forecast values |
|---|---|
| Trials | 1,000 |
| **Mean** | **3.84** |
| Median | 0 |
| Mode | 0 |
| Standard Deviation | 8.87 |
| Variance | 78.65 |
| Skewness | 2.83 |
| Kurtosis | 11.78 |
| Coeff. of Variability | 2.31 |
| Minimum | 0 |
| Maximum | 58.84 |
| Mean Std. Error | 0.28 |




A similar effect is generated if we increase the uncertainty associated with the estimated cost savings for the Innsworth option. With the expected volatility increased to 0.1 (in addition to the expected cost saving increase to £385 million), the results from the Monte Carlo simulation yields an option value of £7.57 million. Although this may still not be large enough to justify taking up the switch option, it is significantly larger than the estimated value under the original assumptions.

*Forecast: Switch Option Value*

| Statistic | Forecast values |
|---|---|
| Trials | 1,000 |
| **Mean** | **7.57** |
| Median | 0 |
| Mode | 0 |
| Standard Deviation | 15.46 |
| Variance | 239.07 |
| Skewness | 2.45 |
| Kurtosis | 9.32 |
| Coeff. of Variability | 2.04 |
| Minimum | 0 |
| Maximum | 100.41 |
| Mean Std. Error | 0.49 |



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# PART 5 – APPENDICES

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## ***Appendix 1: Risk analysis for investment appraisal: Monte Carlo simulation using Crystal Ball®***

### Background

1. Inadequate analysis of risk is one of the most common complaints levelled at investment appraisal practitioners throughout the MOD. Outside the DPA, current practice generally involves simple sensitivity tests of key assumptions, although often at a fairly rudimentary level. In some (few) cases the analysis is extended to the consideration of various ‘scenarios’, where more than one key variable is allowed to vary. Full blown risk analysis, using Monte Carlo simulation, is very rare, if not completely unused. This paper sets out the case for more comprehensive risk analysis, by way of presenting a simple users guide to the software package “Crystal Ball”, which uses Monte Carlo simulation techniques. The ultimate aim is to show that Monte Carlo simulation, although complex in theory, is actually rather simple to apply in practice, and hence that it should be used routinely to improve the way risk is analysed in investment appraisal.

2. It should be stressed at the outset that we are not formally endorsing the Crystal Ball software in any way, since there are other risk analysis packages on the market, notably @RISK and PREDICT. All we would say is that our experience of using Crystal Ball has shown it to be an excellent, user-friendly package. Much of the following will be applicable, whatever your software choice.

### Monte Carlo Simulation

3. Monte Carlo simulation can be thought of as a system which uses random numbers to measure the effect of uncertainty in a spreadsheet model. In other words, during a simulation, random numbers that conform to real life possibilities are generated for the assumptions contained within a model. Each set of random numbers effectively simulates a single “what-if” scenario for the spreadsheet model. As the simulation runs, the model is recalculated for each scenario and, with Crystal Ball, the results are dynamically displayed in simple, clear, forecast charts.

### Using Crystal Ball to Analyse Risk

4. The first step with Crystal Ball is to define the spreadsheet cells which contain assumptions, i.e. values which might be subject to variation, and forecasts, i.e. the formulae into which the assumptions are fed. With a simple investment appraisal, assumption cells might contain works costs, staff numbers, pay rates, etc., while the forecast would probably be just the overall Net Present Value (NPV) calculation. To maximise the benefit of using Monte Carlo simulation, as many assumption cells as possible should be specified. As a rule, any cost or benefit which is uncertain should be defined as an assumption.

**Defining Assumptions**

5. Crystal Ball requires a 'probability distribution' for each assumption, and for those not well versed in statistical methods, this is the area likely to cause most initial difficulty. See Annex for a guide. Essentially the probability distribution is a description of how a particular value is likely to vary, and Crystal Ball offers a menu of 17 different standard distribution types[72]. If historical data is available, a 'distribution fitting' function can be invoked to automatically select the most appropriate distribution type; but in most cases a choice will have to be made based on judgement and advice from experts.

6. The most commonly used distributions are as follows:

- The *Uniform* Distribution; where there is a fixed minimum and maximum value, and all values in-between are equally likely. Such a distribution could, for instance, be appropriate to the relative price effect (RPE) applied to pay costs in appraisals. We might believe, for example, that the RPE is likely to lie in the range 0 - 2%, with each outcome in the range equally likely.

- The *Triangular* Distribution; where again there are fixed minimum and maximum values, but we also know (or can reasonably estimate) the most likely value - the 'mode' - (which may in some cases be identical to the minimum or maximum). Such a distribution might be appropriate for, say, staff savings expected in an option, or new build costs.

- The *Normal* Distribution; where we can specify the most likely value, and we know that the actual value is likely to be close to

[72] Since customisation is also possible, the number of potential distributions is very large indeed.

this, but is as likely to be above as below it. The normal distribution is essentially a more complex version of the triangular distribution, but with no fixed minimum or maximum value. The difficulty in working with such a distribution is the need to have some measure of variability around the mean (the 'standard deviation'). Unless historical data is available, estimating this variability would be problematic.

7. There are many other, more complex, distributions, but it will usually be sufficient to simplify and use one of the distributions described above. Where the data clearly does not fit any one of these, however, advice can be sought from DESA.

8. Once distributions have been chosen for the assumptions, all the details can be entered through Crystal Ball's simple menu system. Essentially this involves selecting the cells containing assumptions, and filling in a dialogue box with the distribution type, minimum, maximum and, where appropriate, most likely value. It should be noted though that existing appraisal spreadsheets which were not designed with risk analysis in mind may need some small degree of customisation to interface easily with Crystal Ball. For example, if one of the assumptions to be tested was a relative price effect for pay, the RPE factor would need to be specified in a separate cell, which is then referenced by formulae in the actual pay line. It is good practice to set out spreadsheets like this in any case, since NPVs can then be recalculated by changing a single cell value.

Example:

A pay line in an IA which assumes a 2% annual RPE would typically be entered as (with pay cost in year zero = 100):

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | Year | 0 | 1 | 2 | 3 |
| 2 | Pay | 100 | 102 | 104 | 106.1 |

For simulation purposes, the following structure would be required:

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | Year | 0 | 1 | 2 | 3 |
| 2 | Pay | 100 | =B2*(1+B3)^ | =B2*(1+B3)^ | =B2*(1+ |

| | | | | | |
|---|---|---|---|---|---|
| | | | C1 | D1 | B3)^E1 |
| 3 | RPE | 0.02 | | | |

where the RPE factor is made explicit. Cell B3 can now be defined in Crystal Ball as an assumption, and during a simulation its value will be changed according to its distribution. The pay line will be recalculated automatically.

**Correlated Assumptions**

9. By default, Crystal Ball assumes that the defined assumptions vary independently. The program generates random numbers for each assumption without regard to how random numbers are generated for other assumptions. For most investment appraisal situations, this will be a valid approach. The RPE for pay, for example, is unlikely to be related to the variability of works costs.

10. However, dependencies often do exist between variables in a system being modelled. The correlation feature allows the user to specify correlation coefficients to define assumption dependencies. Crystal Ball then uses the correlation coefficients to rearrange the generated random numbers to produce the desired correlation.

11. Correlation coefficients can either be entered directly, as a value between -1 and +1, where -1 indicates perfect negative and +1 perfect positive correlation. If it were known, for example, that one variable moved exactly one-for-one with another variable, its correlation coefficient would be +1. Alternatively, in the more common situation where the exact correlation is unknown, Crystal Ball can estimate the value from historic data.

***Example.*** *In a recent investment appraisal of relocation options, costs were included for pay, works and IT (amongst other things), and a risk analysis was conducted to examine the impact of differential inflation rates. For pay, the relative price effect (RPE) is simply the difference between earnings growth and the GDP deflator*[73]*. Merely specifying ranges of values for earnings and GDP will not properly capture the interrelation between the variables: we would expect, intuitively, higher rates of earnings growth to go hand-in-hand with higher rates of inflation (regardless of the direction of causality), so a simulation which allowed very low values of earnings growth to combine with high inflation rates - and vice versa - would be unrealistic and end up overstating the likely RPE. Indeed, using Crystal Ball to calculate a correlation coefficient using data for the past 20 years or so gives a value of 0.61 for MOD civilian pay against the GDP deflator - so we have fairly strong, though not complete, positive correlation.*

*A similar analysis of tender price inflation (for works) and IT prices revealed correlation with the GDP deflator to be weak, at 0.08 and 0.16 respectively.*

## Define Forecasts

12. Once assumptions have been entered, the next step is to define those cells which will ultimately contain the forecast(s). In most appraisal situations, this will simply be the cell containing the NPV. During a simulation, this cell will be recalculated for all possible assumption values.

13. As with assumption cells, forecast cells are defined through a dialogue box. Optional names and units, which may be useful in the final report, can be applied if required.

## Running the Simulation

14. After defining the assumption and forecast cells, the simulation can be run. During a simulation, Crystal Ball will forecast the entire range of results most likely to occur in the situation as defined by the spreadsheet model, and display those results in a forecast chart that shows the range of possible outcomes. Crystal Ball implements Monte Carlo simulation in a repetitive 3-stage process:

[73] The true RPE formula is actually a little more complex, but a straightforward subtraction gives a good approximation when both rates of inflation are low.

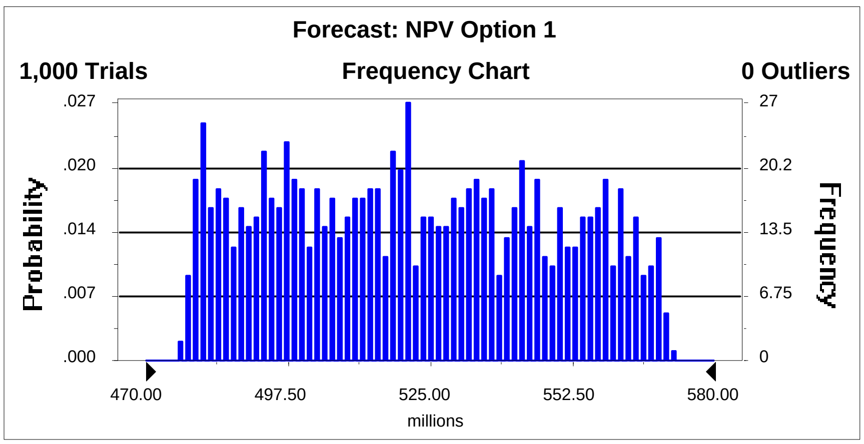
- for every assumption cell, a value is generated according to the defined probability distribution and placed into the spreadsheet;

- the spreadsheet is recalculated;

- the value in the forecast cell is retrieved and added to the results chart.

**Interpreting the Results**

15. While a simulation is running, Crystal Ball creates a forecast chart for each forecast cell. The final chart which is presented at the end of the simulation will show, graphically, the number of values occurring in a given interval (the ‘frequency’). A sample forecast chart is shown below:



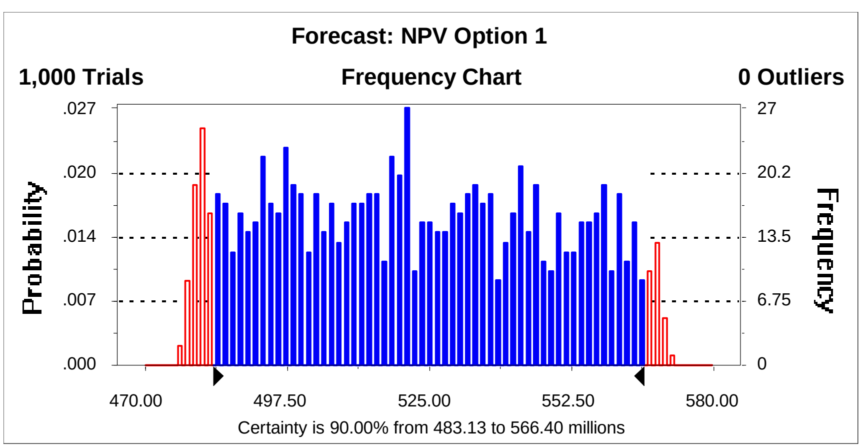

16. In the top left hand corner of the chart, the number of trials is reported. This is one of the variables chosen when running a simulation, and represents the number of times the 3-stage repetitive process described in paragraph 11 is carried out. The greater the number of trials, the more accurate will be the results, but the longer the calculations will take, so a balance needs to be struck. The default value is 500, and this should in most cases give an acceptable result, without severe time penalty. The maximum value is 5,000.

17. By default, the entire range of forecast values may be slightly truncated for display purposes in the forecast chart, and the number in the top right hand corner reports the number of ‘outliers’ (in the example

there are none). So long as this value is small relative to the number of trials, it will in most cases not be worth investigating these extreme values.

18. The frequency chart itself consists of bars of varying height, showing the probability of obtaining values within a given interval - left hand vertical axis, and the actual number of times that the forecast fell within a given interval (the 'frequency') - right hand vertical axis. In the example, we see that the forecast NPV for our Option 1 will lie somewhere between around £477m and £573m.

19. The 'certainty level' is one of Crystal Ball's key statistics because it shows the certainty of achieving a value within a specific range. There are two ways of using this feature. We can either directly specify a probability level at which we want to be certain - for example, we might want to determine the range of forecast values which will occur 95% of the time; or alternatively, we can directly specify a pre-determined range which we want to determine the probability of achieving. This feature is particularly useful for determining the robustness of option rankings to changes in assumptions. If a range is specified for the preferred option which just fails to overlap with the next best option, then the certainty of option rankings can be clearly demonstrated. In the chart below, for example, we specified a certainty level of 90%, which cut the range of NPV values to £483.1m - £566.4m. If the next best option had an NPV range whose upper limit was just under £483.1m, then we could say that we were 90% certain that Option 1 has the higher NPV.



20. Where NPV ranges for different options overlap, we can combine certainty values to calculate the probability that our 'best' option genuinely offers best value for money. With the lowest possible NPV for Option 1 at £477m, if we had a second option with an NPV range peaking at £490m, then the probability of Option 1 being 'best' is equal to 1 minus the probability of the NPV ranges overlapping. To calculate this, we would first set £477m as the upper limit on the frequency chart of our alternative option and derive the probability of the NPV falling below it. If, for example, this probability was 80%, then there would be a 20% chance of our alternative option's NPV falling within the overlap range. We now need to combine this with the probability that Option 1's NPV also lies within the overlap: if the probability of Option 1's NPV being less than £490m was 15%, then the probability of overlap would be equal to 0.15 * 0.20 = 0.03, or 3%. We can now say that the probability of Option 1 being the 'best' option is equal to 97%.

**Sensitivity Testing**

21. While Monte Carlo simulation produces a complete picture of the total risk embedded within an option, it may still be useful to determine the sensitivity of the forecast to each individual assumption. Crystal Ball provides the option of producing a sensitivity chart which depicts the influence each assumption has on the forecast. During the simulation, Crystal Ball ranks the assumptions according to their importance to the forecast, displaying the rankings as a bar chart.

**Creating Reports**

22. One of the most attractive features of Crystal Ball is its ability to generate, automatically, customised reports of the simulation, showing full details of all assumptions. All the user has to do is to specify the level of detail he wants in the report and leave the software to do the rest. The report should be routinely appended to the investment appraisal.

**Conclusion**

23. Monte Carlo simulation is a very powerful tool for risk analysis, and software like Crystal Ball makes its application very straightforward. Proper risk analysis is a key element of good appraisal, and while there will clearly be occasions where full Monte Carlo simulation is not warranted, whenever options contain a number of, possibly inter-linked, assumptions, it is an approach which is well worth pursuing.

# Annex: The Statistics of Risk Analysis

## Risk and Uncertainty

1. The presence of uncertainty makes decision-making more than the relatively trivial exercise it would otherwise be. If we define decision-making loosely as "the need to choose the *best* out of a number of possible courses of action", then uncertainty raises wider issues as to the meaning of *best*.

2. Simple examples can convey some important aspects of uncertainty, and the closely related concept of *risk*. Consider a gamble on the toss of a coin. If the coin is 'normal', then there is an equal chance of obtaining a Head or a Tail. Offered an 'even' bet on the outcome, you might well consider accepting it. But few situations permit the use of natural logic as does coin tossing (or, for another example, the rolling of dice). It is much more likely that outcomes, and the chances of those outcomes occurring, are uncertain, and recourse will be necessary to *data*, perhaps by reference to a stored database, by physically collecting new information, or even more subjectively by drawing upon experience. Analysing the data can give us information about the *probability* of various possible outcomes, which in the jargon, transforms a problem of *uncertainty* into one of *risk.*

3. Returning to the-coin tossing example, here we have only two possible outcomes. If you were to stake £10 on the outcome being Heads, and your payoff was to be an extra £10 if you won, with your stake lost if the outcome was Tails, since the respective probabilities are known to be 50%, we would intuitively expect to break even; i.e. after a long series of gambles we would expect to have neither gained nor lost financially. This is equivalent to calculating a formula that first multiplies each outcome by its probability, and then adds up the resulting quantities. The end result is the *mean* (also referred to as the *average* or *expected value*). Here we get:

$$\tfrac{1}{2} \times 10 + \tfrac{1}{2} \times (-10) = 0$$

as the mean return on the gamble. In this example the calculation is trivial, but the same procedure applies to more complex problems, such as we encounter in risk analysis.

## Probability Distributions

4. A proper understanding of risk analysis requires an understanding of *probability distributions.* To explain and illustrate the concept, we will use a data sampling example.

5. When statistical data are collected, they are usually in an unstructured form, for example, the run of observations:

4 4 4 4 3 4 5 1 3 4

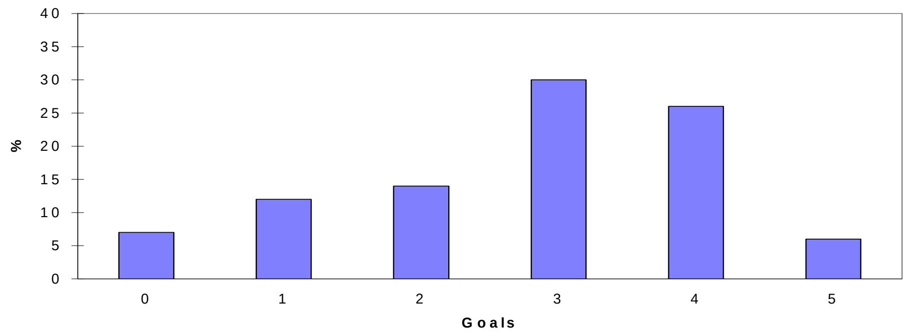
If we want to characterise these data, we might consider three different measures: the mean, the median, and the mode.

6. The *mean* is the sum of the data divided by the sample size. In this case it is 36/10 = 3.6. The *median* is the middle value (or the average of values either side when we have an even number of observations) when the data are placed in order (ascending or descending). In this case it would be 4. Finally, the *mode* is the value which occurs most frequently, in this case also 4.

7. But knowing just an average, or 'middle' value tells us nothing about *risk*. To get an idea of this we require at least one more value, i.e. something which measures the degree of 'spread' around the average. The most commonly used measure of 'spread' is the *standard deviation*. In words, the *standard deviation* is calculated by subtracting the *mean* from each observation, squaring the results, and then dividing the total by the sample size. The result is called the *variance*, of which the *standard deviation* is the square root.

8. The data presented above are in fact the total goals scored in each match of the premier league football matches played on a particular Saturday. Taking a larger sample - say, the whole of the football league for 2 successive Saturdays - we can represent the data in a *frequency distribution* chart (or *histogram*):

Fig A1: Histogram of Goals per Match




9. The *histogram* is simply an approximation to a *probability distribution*, and will often be referred to as a 'sample probability distribution'. It becomes an increasingly close approximation as the sample size (here 86 matches) increases. Eventually, for large samples, a smooth curve can typically be drawn or visualised around the tops of the frequency bars. It is this curve which, ideally, we require, since it conveys everything about the uncertainty of the outcome. Since the heights of the frequency bars indicate the percentage of matches with the corresponding number of goals, then the curve shows, by its height above the horizontal axis, how the 'true' probability varies with the number of goals.

10. In the larger sample of matches above, the mean number of goals scored per match is 2.8, while the median and mode are both 3. The shape of the distribution is 'lopsided' or *skewed*, i.e. outcomes are not symmetrically distributed around the *mean*. Probability distributions encountered on MOD projects also tend to be *skewed*, typically to the right, indicating that extreme project under-runs on time or cost are much less likely than over-runs. The degree and type of *skewness* are reflected in how much the mean falls below or above the median or the mode.

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# ***Appendix 2: Discount tables***

**Table 1 Discount Factors (where the discount rate is 3.5%)**

| Year | Discount Factor |
|---|---|
| 0 | 1.0000 |
| 1 | 0.9662 |
| 2 | 0.9335 |
| 3 | 0.9019 |
| 4 | 0.8714 |
| 5 | 0.8420 |
| 6 | 0.8135 |
| 7 | 0.7860 |
| 8 | 0.7594 |
| 9 | 0.7337 |
| 10 | 0.7089 |
| 11 | 0.6849 |
| 12 | 0.6618 |
| 13 | 0.6394 |
| 14 | 0.6178 |
| 15 | 0.5969 |
| 16 | 0.5767 |
| 17 | 0.5572 |
| 18 | 0.5384 |
| 19 | 0.5202 |
| 20 | 0.5026 |
| 21 | 0.4856 |
| 22 | 0.4692 |
| 23 | 0.4533 |
| 24 | 0.4380 |
| 25 | 0.4231 |
| 26 | 0.4088 |
| 27 | 0.3950 |
| 28 | 0.3817 |
| 29 | 0.3687 |
| 30 | 0.3563 |

**Table 2 - Long term discount rates**

| Year | Discount factor | Year | Discount factor |
|---|---|---|---|
| 31 | 0.3459 | 46 | 0.2220 |
| 32 | 0.3358 | 47 | 0.2156 |
| 33 | 0.3260 | 48 | 0.2093 |
| 34 | 0.3165 | 49 | 0.2032 |
| 35 | 0.3073 | 50 | 0.1973 |
| 36 | 0.2984 | 60 | 0.1468 |
| 37 | 0.2897 | 75 | 0.0942 |
| 38 | 0.2812 | 100 | 0.0508 |
| 39 | 0.2731 | 150 | 0.0167 |
| 40 | 0.2651 | 200 | 0.0062 |
| 41 | 0.2574 | 250 | 0.0029 |
| 42 | 0.2499 | 300 | 0.0014 |
| 43 | 0.2426 | 350 | 0.0009 |
| 44 | 0.2355 | 400 | 0.0005 |
| 45 | 0.2287 | 500 | 0.0002 |

**Table 3 Annuity factors (where the discount rate is 3.5%)**

| Year | Cumulative DCF | Annuity factor | Year | Cumulative DCF | Annuity factor |
|---|---|---|---|---|---|
| 1 | 0.9662 | 1.035 | 16 | 12.094 | 0.0827 |
| 2 | 1.8997 | 0.5264 | 17 | 12.6513 | 0.0790 |
| 3 | 2.8016 | 0.3569 | 18 | 13.1897 | 0.0758 |
| 4 | 3.6731 | 0.2723 | 19 | 13.7098 | 0.0729 |
| 5 | 4.5151 | 0.2215 | 20 | 14.2124 | 0.0704 |
| 6 | 5.3286 | 0.1877 | 21 | 14.6979 | 0.0680 |
| 7 | 6.1145 | 0.1635 | 22 | 15.1671 | 0.0659 |
| 8 | 6.8739 | 0.1455 | 23 | 15.6204 | 0.0640 |
| 9 | 7.6077 | 0.1314 | 24 | 16.0584 | 0.0623 |
| 10 | 8.3166 | 0.1202 | 25 | 16.4815 | 0.0607 |
| 11 | 9.0016 | 0.1111 | 26 | 16.8904 | 0.0592 |
| 12 | 9.6633 | 0.1035 | 27 | 17.2856 | 0.0579 |
| 13 | 10.303 | 0.0971 | 28 | 17.6670 | 0.0566 |
| 14 | 10.9205 | 0.0916 | 29 | 18.0358 | 0.0554 |
| 15 | 11.5174 | 0.0868 | 30 | 18.3921 | 0.0544 |

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## ***Appendix 3: Glossary of terms***

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| Additionality | A measure of how much of the change estimated or observed after a project or policy comes into effect is actually additional and attributable to that project or policy. Additionality is reduced by DEADWEIGHT, DISPLACEMENT and SUBSTITUTION. |
| Adverse Selection | When asymmetric information restricts the quality of the good traded. This typically happens because the person with more information is able to negotiate a favourable exchange. |
| Affordability/Affordability Test | Comparison of annual expenditure with budget allocation to assess whether project can be financed within existing budget or whether some reallocation of budget provision is necessary. |
| Appraisal | The process of defining objectives, examining options and weighing up the costs benefits, risks and uncertainties of those options before a decision is made. |
| Avoidability | When a cost is different for one or more options (see COMMON COSTS). |
| Capitalised value | The sum of the discounted values of a future stream of costs or receipts. |
| Choice modelling | This term encompasses a range of stated preference techniques and includes choice experiments (often preferred because of its firm base in welfare economics), contingent ranking, contingent rating and paired comparisons. |
| Common Costs | When a cost is the same in all options being considered. |
| Compound Interest | The process whereby interest is added to the total of the original capital and accumulated interest. |
| Constant Prices | Estimate of prices prevailing at a particular point in time to remove effect of inflation. See REAL PRICE. |

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| Contingent Liability | A cost incurred only in a particular set of circumstances. |
| Contingent valuation | This involves directly asking people how much they would be willing to pay for a good or service, or how much they are willing to accept to give it up. |
| Contingency | An allowance of cash or resources to cover unforeseen circumstances. |
| Cost Benefit Analysis (CBA) | Analysis which seeks to quantify and express in money terms as many of the costs and benefits of a proposal as possible, including items for which the market does not provide a satisfactory measure of economic value. |
| Cost Effectiveness Analysis | Analysis which seeks to compare the cost of alternative ways of producing the same or similar outputs which are not necessarily given a monetary value. |
| Combined Operational Effectiveness and Investment Appraisal (COEIA) | A specific type of COST EFFECTIVENESS ANALYSIS applied to defence equipment procurement decisions which combines analysis of the operational effectiveness of different options with appraisal of the costs of alternative options. |
| Cost of Capital | The cost of money raised for investment expressed as an annual percentage rate. |
| Cost of variability in outcomes | This is the most a person is willing to pay to have a benefit that is certain, rather than one that is uncertain. |
| Counterfactual | An alternative hypothetical state where everything is the same except for the absence of the project or policy intervention. |
| Crowding out | The extent to which an increase in demand occasioned by government policy is offset by a decrease in private sector demand. |
| Current Prices | Prices actually prevailing or expected to prevail in each time period. |

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| Deadweight | The element of an activity supported by government which would have taken place in any case without government assistance. |
| Depreciated Replacement Cost | The cost net of depreciation of a replacement asset of a current design broadly equivalent to the existing asset. |
| Depreciation | A proportion of the cost of an asset charged to the operating cost statement each financial period which also cumulatively reduces the value of the asset on the balance sheet. |
| Diminishing marginal utility | The tendency as extra units of any commodity or service are used up or ‘consumed’, for the satisfaction provided by those extra units to decline. |
| Discounting | The process of converting a stream of costs or benefits which occur over time to a PRESENT VALUE. |
| Discounted Cash Flow (DCF) Analysis | Analysis which involves discounting a stream of costs and benefits to derive a NET PRESENT VALUE (NPV). |
| Discount Rate | The annual percentage rate used in discounting and presumed to reflect the COST OF CAPITAL and/or the preference to consume today rather than later. |
| Displacement | The extent to which an activity supported by government displaces similar activities elsewhere in the economy. |
| Economic Cost or Benefit | The cost or benefit measured in terms of the OPPORTUNITY COST. |
| Economic Efficiency | This is achieved when nobody can be made better off without someone else being made worse off. |
| Economic Life | The actual or expected productive life of an asset. |
| Effectiveness | A measure of the extent to which a project, programme or policy achieves its objectives. |

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| Equivalent Annual Cost | The constant annual cost (annuitised value) which is equal to the NET PRESENT VALUE of the total project cost over its lifetime. It can be likened to the annual payments on a repayment mortgage. |
| Evaluation | Retrospective analysis of a project, policy or programme to assess how successful or otherwise it has been, what lessons can be learnt for the future, and to compare actual outcomes with predictions made in the APPRAISAL. |
| Existence value | The value placed by people on the continued existence of an asset for the benefit of present or future generations. The latter is sometimes referred to as bequest value. See also Use value. |
| Existing Use Value | An estimate of what it would cost to have the use of an asset similar to that being used. |
| Expected value | The weighted average of all possible values of a variable, where the weights are the probabilities. |
| Externality costs or benefits | The non-market impacts of an intervention or activity which are not borne by those who generate them. |
| Feedback | Communicating the results of EVALUATION to those concerned. |
| Firm Price | A price in a contract that is set in CURRENT PRICE terms with no adjustment for inflation, or exchange rates. |
| Fixed Cost | The cost of producing a good or service that does not vary in the short term with the volume of goods or services produced. |
| Fixed Price | A price in a contract that is set in CONSTANT PRICE terms with a formula for adjustment for inflation (variation of price - VOP) or exchange rates (exchange rate variation – ERV). |
| Forward Rate (of Exchange) | The rate today for foreign exchange to be delivered on a specified date in the future. |

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| GDP Deflator | An index of the general price level in the economy as a whole, measured by the ratio of Gross Domestic Product (GDP) in nominal (i.e. cash terms) to GDP in constant prices. |
| Hedonic pricing | Deriving values by decomposing market prices into their constituent characteristics. |
| Information asymmetry | Differences in information held by parties to a transaction where this information is relevant to determining an efficient contract or a fair price or for monitoring or rewarding performance. |
| Implementation | The activities required during the period after appraisal to put in place a policy, or complete a programme or project, at which point ‘normal’ service is achieved. |
| Internal rate of return (IRR) | The discount rate that would give a project a present value of zero. |
| Irreversibility | This applies when an option would rule out later investment opportunities, or would use resources now that might subsequently be preferred for a more important later use. |
| Market failure | An imperfection in the market mechanism that prevents the achievement of economic efficiency. |
| Market Value | The price at which a good or service could be bought or sold. |
| Marginal utility | The increase in satisfaction gained by a consumer from a small increase in the consumption of a good or service. |
| Monitoring | The process of continuous review of the project's or policy's operation. |
| Monte Carlo analysis | A technique that allows assessment of the consequences of simultaneous uncertainty about key inputs, taking account of correlations between these inputs. |

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| Moral Hazard | An example of information asymmetry where a contract or relationship places incentives upon one party to take (or not take) unobservable steps which are prejudicial to another party. |
| Multi Criteria Analysis | Otherwise known as Weighting and Scoring |
| Net Cash Flow | The subtotal of costs less benefits in a cash flow model used for an investment appraisal. |
| Net Present Value | The difference between the PRESENT VALUE of a stream of costs and a stream of benefits. |
| Nominal Rate | The actual, or money rate, of return on an investment, calculated from cash flows that have been inflated each year. |
| Objective | What the policy or project is intended to achieve. |
| Open Market Value (for property) | The best price at which a property can be sold or let, assuming a willing seller and purchaser, and a reasonable period for proper marketing. |
| Opportunity Cost | The value expressed in terms of the best alternative use of resources foregone. |
| Optimism bias | The demonstrated systematic tendency for appraisers to be over-optimistic about key project parameters, including capital costs, operating costs, works duration and benefits delivery. |
| Option appraisal | The appraisal of various options chosen to achieve specific objectives. |
| Option value | The value of the availability of the option of using an environmental or other asset (which in this context is usually non-marketed) at some future date. See also Use value. |
| Output Specification | A statement of the needs to be satisfied by the procurement of external resources. |
| Passing Rent | The actual rent payable at a particular point in time. |

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| Payback Period | Investment appraisal technique that identifies the time taken to recover the original sum invested. |
| PFI | Private Finance Initiative |
| Policy Evaluation | The EVALUATION of a policy, which may include a number of individual projects, intended to achieve some defined goal. |
| Project Evaluation | The evaluation of a specific project. |
| PPP | Public Private Partnership |
| Precautionary principle | The concept that precautionary action can be taken to mitigate a perceived risk. Action may be justified even if the probability of that risk occurring is small, because the outcome might be very adverse. |
| Present Value | The discounted value of a stream of future costs or benefits. |
| Price Index | A measure of the amount by which prices change over time. Commonly used general price indices are the GDP deflator, the Retail Prices Index and the Producer Prices Index. |
| Private Finance | Term used to describe the provision by the private sector of physical assets including their financing for the supply of public services. |
| Probability Factor | The likelihood of an event occurring, represented by a number ranging from 0 (never) to 1 (certain). |
| Proposal | An idea for a policy, programme or project that is under appraisal. |
| Pure time preference | Pure time preference is the preference for consumption now, rather than later. |
| Rationale | The need for the policy or project. |

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| Real option theory | This presumes that decision making is sequential and that decision makers may benefit from choosing options that may seem sub optimal today but which increase flexibility at later times, leading to better decision making when more is known about the project. |
| Real Price | The NOMINAL or CURRENT PRICE deflated by a price index relative to a specific base date. |
| Real Return | The rate of return earned on an investment over and above the rate of inflation. |
| Real Terms | Value of expenditure converted to REAL or CONSTANT PRICES. |
| Recurrent Costs | The continuing costs incurred each year of the life of the project. |
| Relative Price Effect | The movement of a specific price index (such as construction prices) relative to a general price index (such as GDP deflator). |
| Relevant cost/benefit | All costs and benefits that can be affected by decisions and that are therefore related to the objectives and scope of the proposal in hand. |
| Required rate of return | A target average rate of return for a public sector trading body, usually expressed, for central government bodies, as a return on the current cost value of total capital employed. |
| Residual Value | The expected value of a capital asset at some future date. |
| Resources/Resource Cost | Terms used in a variety of senses according to context. In Resource Accounting, "resource costs" are accruals accounting costs expressed in REAL TERMS. In APPRAISALS resource costs are payments made in exchange for provision of goods or services as opposed to TRANSFER PAYMENTS. |
| Revealed preference | The inference of willingness to pay for something which is non-marketed by examining consumer behaviour in a similar or related market. |

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| Risk | The probably of a cost or benefit turning out different to that predicted. |
| Risk Matrix | A table used as a management tool throughout the procurement process. It will usually constitute a listing of the various risks and uncertainties to which particular project options are exposed, together with an assessment of the likelihood of their occurring and the financial or other impact on the outcome of the project. |
| Risk register | A useful tool to identify, quantify and value the extent of risk and uncertainty relating to a proposal. |
| Risk Transfer | Transferring the responsibility for a risk. |
| Sensitivity Analysis | Analysis of the effect on an APPRAISAL of varying the projected value of important variables. |
| Shadow Price | An imputed value used in a cost benefit analysis for services which have no market price. |
| Social Benefit | The total increase in the welfare of society from an economic action - the sum of the benefit to the agent performing the action plus the benefit accruing to society as a result of the action. |
| Social Cost | The total cost to society of an economic activity - the sum of the opportunity costs of the resources used by the agent carrying out the activity, plus any additional costs imposed on society from the activity. |
| Special Purpose Vehicle (SPV) | The organisation, usually a limited company, set up to manage and operate a PFI programme. |
| Spot Rate (of Exchange) | The rate for foreign exchange delivered immediately. |
| Standardisations | Adjustments made either to the PSC or to the bids to ensure a standard approach is taken to costing the same or similar items. |
| Stated preference | Willingness to pay for something that is non-marketed, as derived from people's responses to questions about preferences for various combinations of situations and/ or controlled discussion groups. |

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| Substitution | The substitution within a firm of one activity by another similar activity to take advantage of government assistance. |
| Sunk cost | A cost that has already been incurred or to which one is irrevocably committed, which is now irrelevant to any new investment decision. |
| Switching point or switching value | The value of an uncertain cost or benefit at which the best way to proceed would switch, for example from approving to not approving a project, or from including or excluding some extra expenditure to preserve some environmental benefit. |
| Systematic risk | Risk which is correlated with movements in the economic cycle and cannot therefore be diversified away. |
| Time Preference Rate | The preference for taking a benefit sooner rather than later expressed as an annual percentage rate. |
| Total Economic Value | The sum of the use, option and existence value of a good: a term used primarily in environmental economics. |
| Transfer Payment | A payment for which no goods or services are provided and no OPPORTUNITY COST is incurred. |
| Uncertainty | The condition in which the number of possible outcomes is greater than the number of actual outcomes and it is impossible to attach probabilities to each possible outcome. |
| Upfront Costs | The one-off costs incurred in the early years of the project. |
| Use value | Value of something which is non-marketed provided by people’s actual use of it. See also Existence value and Option value. |
| Value for Money Benchmark | The Value for Money Benchmark (VfMB) is to test the value for money of commercial bids.  It can take a number of different forms and may incorporate in-house provision, bought-in services, or a mixture of the two. |

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| Volume Terms | A measure of the physical quantity of a resource obtained by dividing nominal (i.e. cash) expenditure by a price index specific to the particular resource (eg construction prices). |
| Weighting and Scoring | Aggregation of a number of unquantifiable costs and benefits into a single score. |
| Willingness to Accept | The amount that someone is willing to receive or accept to give up a good or service. |
| Willingness to Pay | The amount that someone is willing to give up or pay to acquire a good or service. |
| Welfare cost/benefit | Anything which subtracts or adds to human well-being or satisfaction. |
| Working Capital | Investment in stocks and debtors less the amount owing to short-term creditors. |