

Ministry of Defence

Driving successful delivery of major defence projects: drawing on wider practice in tracking the progress of major projects

A BRIEFING AND CONSULTATION DOCUMENT BY THE NATIONAL AUDIT OFFICE
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EXECUTIVE SUMMARY

- 1 This briefing and consultation document is part of a programme of work by the National Audit Office (NAO) to bring better understanding to what drives the performance of major defence projects, and learn lessons from outside practice to feed into successful management of the drivers by the Ministry of Defence (MoD). The work builds on the annual Major Projects Report, published by the NAO and analysing the performance of major defence projects, by exploring the complex cultural and systemic drivers which the MoD and its industry partners need to manage. We are taking this work forwards in partnership with the MoD but the interim conclusions in this report are our own.
- 2 In early 2003, we began by commissioning PA Consulting to undertake some systems dynamics based analysis of the MoD's acquisition system to identify the key drivers of the performance of major defence projects. This analysis was unique in looking from the outside at the broader drivers bearing on the success of the MoD's internal processes, rather than at the processes themselves. Because of the new perspective this work brings, we have decided to publish the drivers that it identified now, without prejudice to further investigation by ourselves and the MoD of their effect on major defence project performance and how this is managed. We hope that providing this early sight of the identified drivers will be useful in raising awareness both within the MoD and more widely of the complexities surrounding the management of major defence projects. The analysis is not indicative of the strengths or weaknesses of management of the drivers by the MoD.

Battlefield Light Utility Helicopter

- 3 A list of the key drivers identified through working with PA Consulting, the MoD and industry is presented in Part 1. Taking a through-life approach, budgeting and funding, and staffing emerged as the drivers having the biggest impact on performance. In a series of future reports and other outputs, we plan to examine some of these drivers in further detail to understand how well they are managed by the MoD and explore the scope for bringing improvements to MoD practice.
- 4 Our first examination, which is underway, is investigating how the progress of major projects is tracked. Tracking the progress of major projects emerged as a critical linking factor between a number of the key drivers, and informs effective decision-making. Tracking progress is the link through from management information to governance and assurance, risk and cost estimating, and ultimately budgeting and funding.
- 5 Part 2 explains the focus of our examination into tracking progress, which will cover how information is gathered, analysed and used to inform decision-making. We plan to publish our findings in late 2004 and would welcome you contributing to our work by giving us the benefit of your knowledge and experience of how your organisation tracks the progress of major projects. How you can do this is covered later. We are seeking views from practitioners with experience of the management of major projects covering a range of government and commercial sectors, as well as those within the defence sector.
- 6 Key aspects of our fieldwork on tracking progress are:
 - i A structured questionnaire, included for reference with this document, through which we welcome views from any individual or organisations who would like to contribute to our examination. The questionnaire can be completed and submitted offline or it is also accessible for completion and submission online through our website at www.naodefencevfm.org.
 - ii A series of case study visits to commercial organisations and overseas defence ministries to conduct more in depth analysis of practice in tracking progress. We have chosen the case study organisations jointly with the MoD using a range of criteria to assess their suitability and utility in drawing out good practice.
 - iii Interviews and evidence gathering within the MoD to understand in detail how the MoD tracks the progress of major projects and any relevant improvement initiatives that it has underway.
- 7 Alongside our report on tracking progress, we are exploring with the MoD and industry the potential for spreading good practice emerging from our work on the key drivers of project performance in other ways, for example through conferences, seminars and good practice guides. We published a report on Through-Life Management in May last year¹ and will be following up our recommendations with the MoD. Further into the future, depending on our wider work programme, we may examine budgeting and funding, and staffing of projects.

¹ C&AG's Report, Ministry of Defence: Through Life Management (HC 698, Session 2002-2003).

Why we are comparing the Ministry of Defence's practices

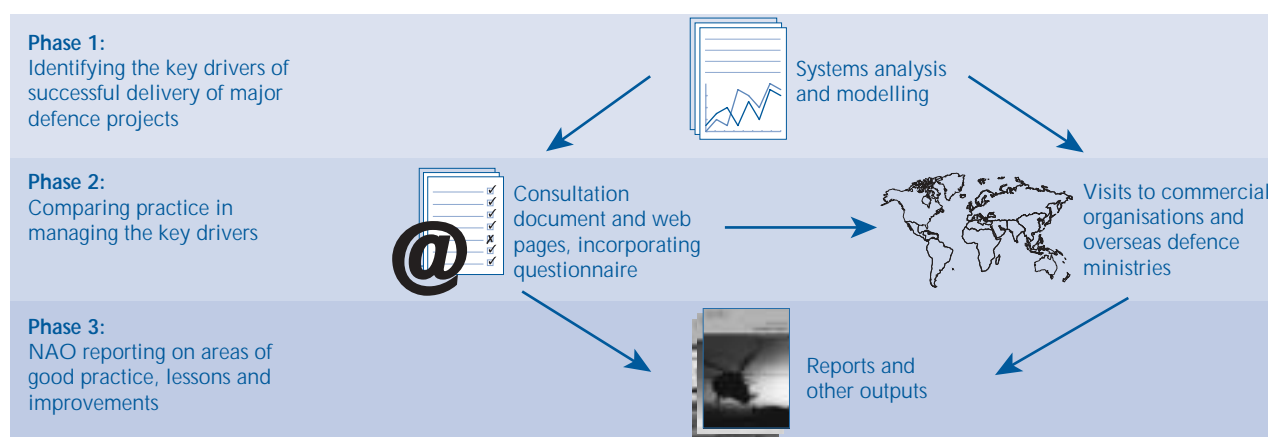
- 1.1 Towards the end of each calendar year the National Audit Office (NAO) publishes "The Major Projects Report". The Report summarises the progress of the Ministry of Defence's (MoD's) highest value defence equipment procurement projects. It compares current forecasts of cost, time and technical performance against the parameters set when the projects were given approval for procurement of the equipment to proceed. For many years, the Major Projects Report has highlighted the variable performance of projects with many suffering cost overruns and delays. This variable performance has been an ongoing matter of concern for both the MoD and Parliament, and the MoD has introduced a large number of reforms designed to improve project performance and achieve faster, cheaper and better delivery of military capability.
- 1.2 The most recent Major Projects Report² published in January 2004 concluded that, "progress has been made but more needs to be done" to improve project performance in the longer term. To achieve sustained improvement the MoD needs to have a thorough understanding of what influences the time, cost and technical performance of its projects, and what more can be done to manage these influences to bring more certainty to the successful delivery of projects.
- 1.3 Much of the analyses undertaken to date and most of the MoD's initiatives have been focused on improving the internal acquisition processes of the MoD. Relatively little work has been done to understand the broader influences on the success of those processes and how they can best be managed (see Annex D). In early 2003, in part reflecting suggestions from MoD and Parliament, the NAO embarked on a programme of work in partnership with the MoD, designed to improve understanding of these broader influences and help improve the delivery of defence equipment capability. Our programme, shown in [Figure 1](#), is split into three phases - identifying the key drivers of successful delivery of major defence projects, comparing MoD's practices in managing some of the key drivers and reporting the outcomes.

The key drivers of successful delivery of major defence projects

- 1.4 Our starting point in Phase I was to identify what drives successful delivery of major defence projects. It was clear that in order to do this we would need to take a systems analysis approach, to model and understand the complex dynamics surrounding project performance. Early in 2003, we commissioned PA Consulting to undertake this work. Our specification was for PA Consulting to identify the key drivers of the performance of MoD's major equipment projects, understand how and what impact they have on performance and how their impact can be managed.

² C&AG's Report, Ministry of Defence: *The Major Projects Report 2003* (HC 195, Session 2003 -2004).

1 Outline of the NAO's programme of work

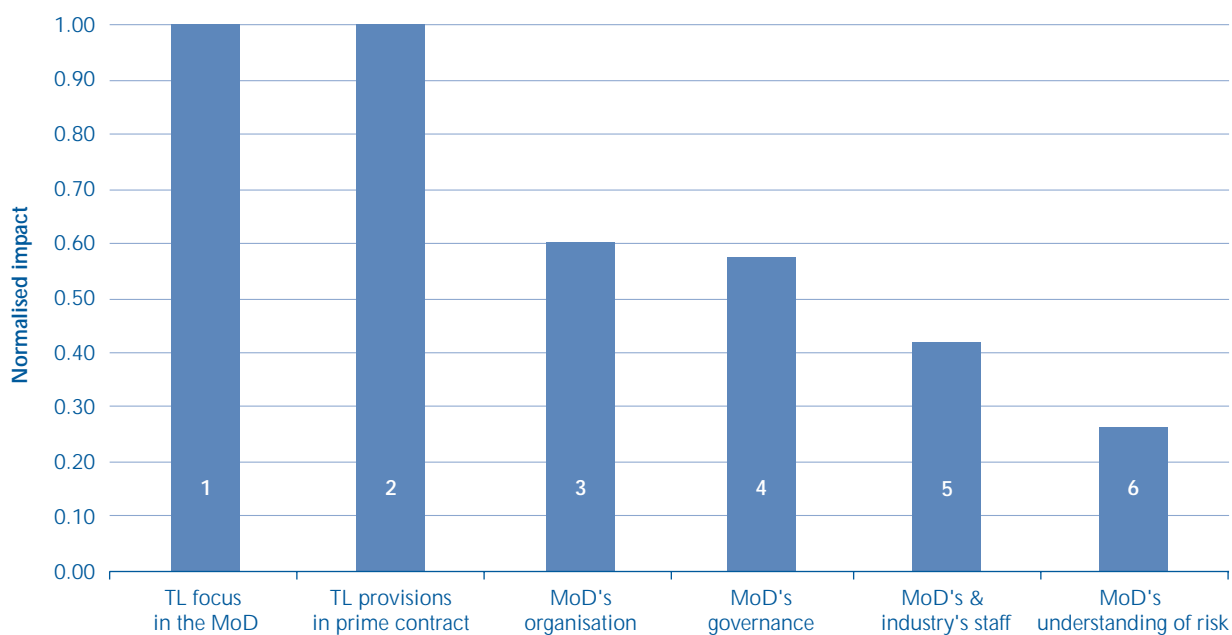


Source: National Audit Office

- 1.5 Under our guidance, and with close involvement by MoD throughout, PA Consulting completed this work in September 2003. Our interim conclusions on the key drivers of successful delivery of major defence projects identified through this work are shown in **Figures 2 and 3**. These are split into key drivers of acquisition performance (Figure 2) - defined as performance in both delivering equipment and supporting it in use, and the key drivers of procurement performance (Figure 3) - defined as performance in delivering equipment up to the point of use. In each case the drivers are ranked according to their relative impact on project performance, with the biggest impact driver set to unity. Cost³ was used as a good and representative proxy of procurement and acquisition performance in ranking the drivers.
- 1.6 Drivers of procurement performance have been analysed separately because procurement performance determines when capability becomes available. Decisions taken during the early procurement phases also heavily influence supportability and hence acquisition performance. Comprehensive data was available on the procurement phases of projects to inform separate analysis. A basic understanding of MoD's process for acquiring defence equipment is important as context to the drivers. Annex C gives an overview of this process known as the 'Acquisition Cycle'.
- 1.7 A summary of how the drivers were identified is given in Annex D and Annex E gives additional detail on the models used. PA Consulting produced a series of causal maps to aid understanding of the dynamics surrounding and feeding into each of the key drivers and the relationships between them. Some of these maps are discussed later in this document and the full series can also be found through our website, www.naodefencevfm.org, together with this consultation document and further explanatory information.

³ Full acquisition costs were not assessed. In view of the shortage of hard support data, acquisition performance was derived from a consideration of supportability costs assessed on the basis of a simple "bathtub" curve (see Annex E, Figure 5). The calculated supportability costs included those costs closely associated with the equipment (manning, fuel, spares etc.) but neither depreciation nor the cost of capital.

2 The Key Drivers of Acquisition Performance

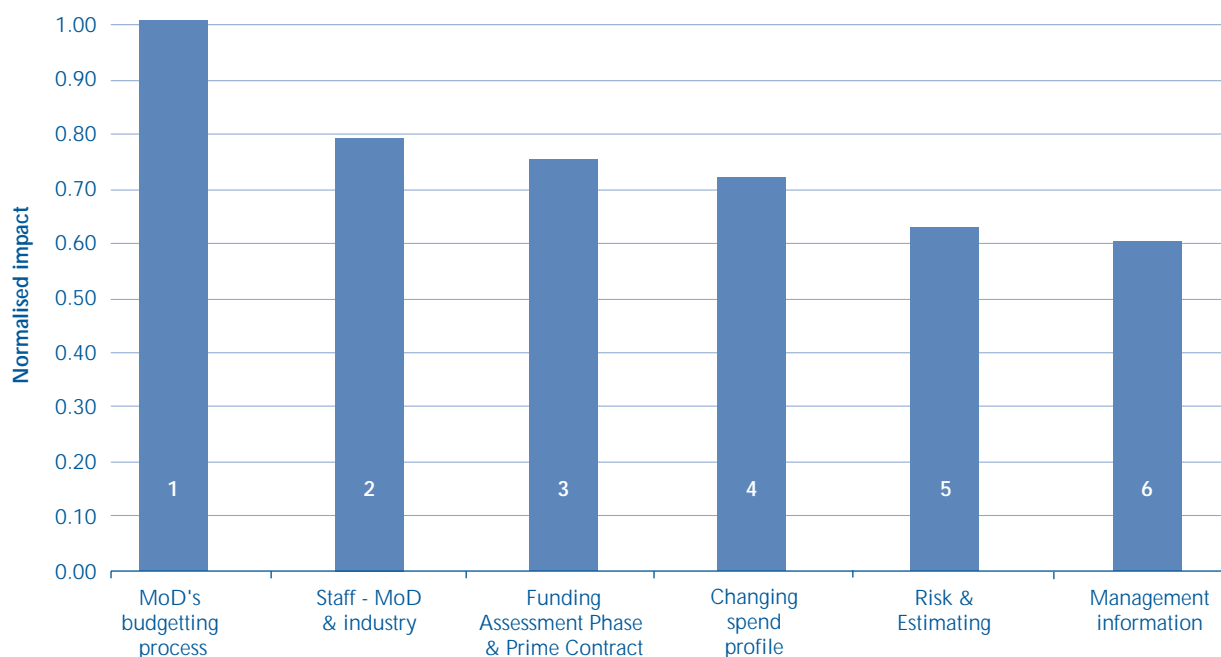


Rank Drivers of Acquisition Performance

- 1 The adequacy of through-life (TL) focus within the MoD, encompassing how well the MoD manages capability delivery through-life - integrating management of all aspects of capability delivery from identification of the need for the capability to its disposal.
- 2 The adequacy of through-life and supportability provisions within the prime contracts awarded to industry.
- 3 The coherence of the MoD's organisation between its constituent parts (e.g. the Equipment Capability Customer, the Defence Procurement Agency, the Defence Logistics Organisation and Front Line Commands).
- 4 The effectiveness, with which the MoD's governance and assurance processes assure that issues of supportability are fully comprehended and that risks to the project are identified, bounded and placed under management.
- 5 The availability of suitably qualified and experienced staff to both the MoD and industry.
- 6 The MoD's capabilities to identify, understand, bound and place a project's major risks under management.

Source: PA Consulting/National Audit Office

3 The Key Drivers of Procurement Performance



Rank Drivers of Procurement Performance

- 1 MoD's budgeting process has the biggest impact on procurement performance and impacts on every procurement phase.
- 2 The availability of suitably qualified and experienced staff to both the MoD and industry.
- 3 The Main Investment decisions (Initial and Main Gates) approvals which determine the funding and schedule for the risk identification and reduction activities performed in the Assessment Phase as well as, crucially, those for the prime contract.
- 4 Varying procurement spend profile resulting in funding constraints on the early phases of projects and existing commitments.
- 5 The ability of the MoD and industry to estimate the likely cost and time necessary to undertake the post-Initial Gate activities and the accompanying level of risk.
- 6 The availability of accurate, current and relevant management information in support of effective and timely decision-making.

Source: PA Consulting/National Audit Office

Consulting on management of the key drivers

- 1.8 Phase II of our programme of work is to consult on wider practice in managing some of the key drivers of successful delivery of major defence projects to assess how MoD might better manage these drivers to improve the delivery of defence equipment capability. This will involve a broad consultation exercise and visits to selected comparator organisations to conduct more in-depth comparative analysis of practice in managing the relevant drivers. The broad consultation exercises will be facilitated by briefing and consultation documents, of which this is the first, incorporating questionnaires, and accompanied by explanatory web pages.

The drivers we have selected for comparison

- 1.9 This document is the first consultation exercise exploring the drivers of successful delivery of major defence projects and best practice in managing them. It seeks views on best practice in 'Tracking the progress of Major Projects'. Depending on our wider future work programme, we may conduct further rounds of consultation covering two of the other key drivers of successful project delivery - Budgeting and Funding Major Projects, and Staffing Major Projects.
- 1.10 We selected these drivers for comparison jointly with the MoD from those shown in Figures 2 and 3. Selection of the drivers was guided by criteria covering their impact across procurement and acquisition performance, the extent to which we have previously examined and reported on them, and the extent to which the MoD is already pursuing change initiatives aimed at improving performance through better management of the drivers. We also considered the practicality of making comparisons and the likelihood of being able to learn lessons from outside practice.
- 1.11 Tracking progress was selected as first for comparison because of its importance as a critical linking factor between some other key drivers. It is the link through from management information to governance and assurance, risk and cost estimating, and ultimately budgeting and funding. Part 2 of this document explores tracking progress in more detail. Taking a through-life approach to managing major defence projects is clearly at the heart of the two biggest drivers of acquisition performance. We are not examining this here as we published a report in May this year on Through-Life Management⁴ and the MoD is currently taking forward our recommended improvements.

Those we are seeking views from

- 1.12 To ensure that we obtain the broadest appreciation of how others tackle the challenges facing the MoD, we are making our briefing and consultation documents accessible to a wide audience. We seek views from practitioners with experience of management of major projects covering a range of government and commercial sectors, as well as those within the defence sector. A list of the industrial sectors we believe are likely to offer particularly useful insights is given at Annex A, although we are interested in receiving views from anyone who has relevant experience. Part 2 explains the different ways in which views can be submitted to us.

⁴ C&AG's Report, Ministry of Defence: Through Life Management (HC 698, Session 2002-2003).

1.13 Alongside seeking broader views, we are undertaking a programme of individual visits to a targeted sample of commercial organisations outside the MoD and overseas defence ministries to conduct more in-depth comparative analysis of practice. We have selected the comparators jointly with the MoD using a range of criteria to assess their suitability and utility. The organisations and overseas ministries chosen are also listed in Annex A, together with the selection criteria.

1.14 An essential part of our work will be to understand in more detail how the MoD manages the key drivers and any relevant improvement initiatives that it has underway. In parallel with our external consultations, we will be interviewing relevant officials from across the MoD and examining documents and data, at project and corporate level, to gain this understanding.

Disseminating the results of our work

1.15 Based on the findings from the consultation exercises, we plan to publish a series of outputs assessing how well the MoD manages the key drivers and identifying how the MoD can make improvements using lessons from outside practice. Our first report on tracking the progress of major projects is likely to be published in autumn 2004. Alongside this, we will be exploring with the MoD and industry the potential for spreading good practice emerging from this work in other ways, for example through conferences, seminars and good practice guides.



Why tracking the progress of major projects is important

2.1 MoD and industry's ability to track the progress of major projects in a timely, relevant and accurate way and, to draw on this tracking for well-informed decision-making, is a common link across many of the key drivers of successful project delivery (see Figure 4). Tracking progress is dependent on having appropriate management information (the sixth most important driver of procurement performance) and, in turn, underpins critical decisions affecting the success of projects through the following drivers:

- governance and assurance;
(fourth most important driver of acquisition performance).

Tracking progress informs governance whereby the interests of major stakeholders are recognised (including their roles, responsibilities and authority levels), and stakeholders are engaged in the oversight of the project and its performance (including setting strategic direction and objectives, tracking progress and decision-making). Assurance is gained from tracking progress that the project is moving as intended towards its objectives and, if not, that rectification action can be taken through informed decision-making.⁵

- risk and cost estimating; and
(fifth most important driver of procurement performance)

Effective tracking of progress depends on MoD and industry's ability to robustly estimate the likely cost and time necessary to undertake remaining activities and the accompanying levels of residual risk associated with them. In turn, review of such estimates, and any assumptions they are based on, as part of tracking progress should give added confidence in their robustness.

- budgeting and funding.
(most important driver of procurement performance)

Through the above drivers, tracking progress ultimately feeds into budgeting and funding as the perceived amount of progress made and the amount of activity and residual risk remaining before objectives are expected to be met informs future funding decisions.

5 PA Consulting: *The key drivers of MoD's acquisition performance. Summary Report.* 20 October 2003. p. 3-3.

4 Figure showing how tracking progress is a link across many of the key drivers of successful project delivery

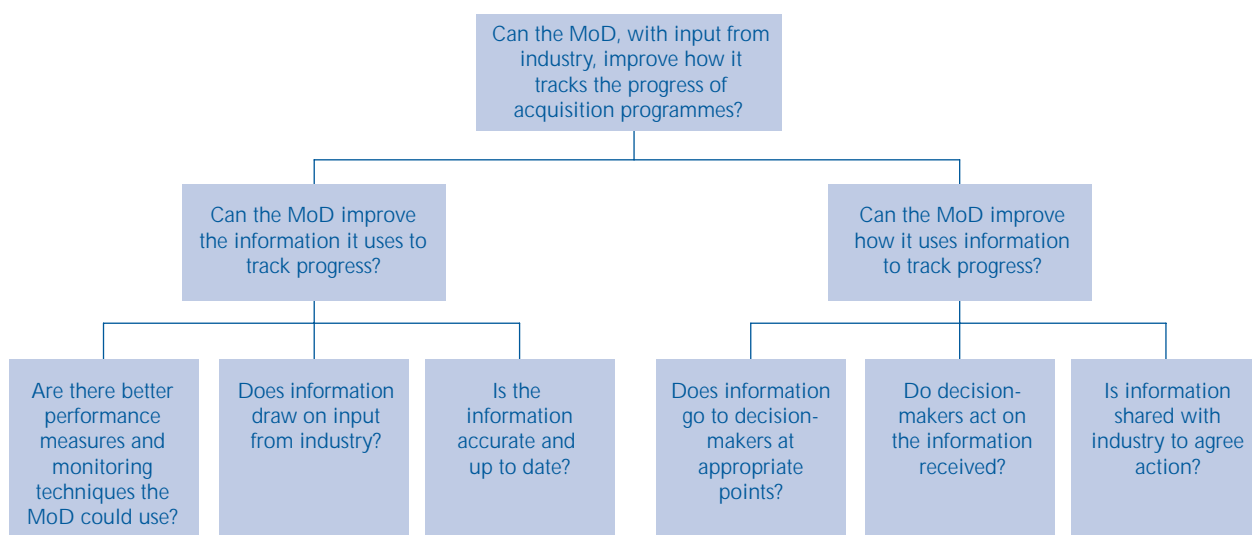


Source: National Audit Office

The aspects of tracking progress we would like views on

- 2.2 Tracking progress is essentially about gathering, analysing and using information. Information that is relevant, accurate and timely, and goes to decision-makers with the authority to act upon it and who use it to take action. For the purposes of comparing MoD practice, we have captured these different aspects of tracking progress in a set of logically structured issues shown in **Figure 5** (with more detail on these issues available on our website at www.naodefencevfm.org). The aim of these issues is to determine how the MoD might improve the way it tracks progress, by improving the information it uses and how it uses the information.
- 2.3 To help us examine these issues, we are seeking views from a wide range of practitioners across industrial sectors on good practice in tracking the progress of major projects in terms of:
- the *methods* used (i.e. what information is gathered, and how it is analysed and reviewed) to track the progress of major projects;
 - the *sources* of tracking progress information (i.e. - who/where the information is sourced from - internally, externally or both, and how widely tracking progress information is shared with customers/clients - do customers/clients and suppliers have shared data environments - do they track progress in the same way, using the same information or differently, and does this help or hinder);
 - *reporting* tracking progress information (i.e. - what and how frequently information is reported, and who it goes to e.g. project directors, portfolio directors, board members, etc.); and
 - *using* tracking progress information in decision-making (i.e. - how it is used by decision-makers at project and strategic levels to manage existing projects and plan for future projects).

5 Framework of issues for examining how the MoD might improve the way it tracks the progress of major projects



- 2.4 Our interest is in drawing out best practice in tracking progress at both project and corporate levels. There are a range of different methods that can be used to track the progress of individual major projects. Some of the recognised methods, drawn from the Association of Project Management, are shown in [Figure 6](#). We are interested to learn practitioner's views on how useful and effective these and any other methods prove in practice. Which method, or combination of methods, works best and why, and are there ways of using the methods which are more likely to make them successful in tracking progress. In addition, how tracking progress information is aggregated and used at a strategic level to exercise governance and assurance over a portfolio of projects or an area of business.

How to give your views

- 2.5 We have designed a questionnaire as a vehicle for gathering views which is included for reference at Annex B to this document. The questionnaire can be completed and submitted offline or, it is also accessible for completion and submission online through our website at www.naodefencevm.org. We hope to receive a wide range of views and encourage you to complete the questionnaire with any relevant information. A helpline will be available for any queries concerned with using the questionnaire up to last submission date of 7th May 2004. All replies will be held in the strictest confidence, according to any relevant provisions of the Data Protection Act 1998.
- 2.6 Alternatively we would be happy to receive views separately either by post, fax or e-mail. Please contact the study team at the address below who can e-mail, fax or post a hard copy version out to you (please mark all responses 'Tracking Progress').

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6 Some recognised methods for tracking the progress of major projects

Key Performance Indicators	Project success criteria. Determined at the beginning of a project.
Value management	Identifying key issues and setting targets in terms of success criteria; identifying teams and processes necessary for achievement; reviewing throughout the project.
Time scheduling/Phasing	Ordering of the processes required to ensure timely completion of the project.
Budgeting/Cost management	Process of estimating the proper cost expected to be incurred against a clear baseline.
Quality management	Quality planning, control and assurance.
Earned Value Management	Process of representing physical progress achieved in terms of a cost based measure.

Source: Association for Project Management - Project Management Body of Knowledge, Fourth Edition, 2000.

- 3.1 This part of the document highlights other major insights emerging from the key drivers. In particular, it explores budgeting and funding of major projects, and staffing of major projects which may form the basis for separate consultation exercises in the future. It also explains why competition does not feature as one of the key drivers of successful delivery of typical major defence projects. Industry and, to a lesser extent MoD, had intuitively believed that competition would be a key driver.

Budgeting and funding major defence projects

- 3.2 The MoD's budgeting process has emerged as the key driver having the biggest impact on procurement performance. An understanding of how this complex process impacts on procurement performance can be gained from a discussion of the causal map that describes it (see Figure 7). The MoD's equipment budget is split into two main parts; one relating to procurement of the equipment and one relating to support of the equipment in service. The two parts are managed over different timescales by different budget holders. The causal map for the budgeting process shows that there are three spirals affecting the budget available for funding procurement. These relate to:

- financial management of existing commitments

The procurement budget can be subject to pressure from the support budget when the former is used to absorb potentially large and unforeseen demands placed on the support budget by operations. In order to respond to these pressures, the procurement budget needs to be flexible and its flexibility is directly proportional to the unallocated headroom that it possesses. Existing large, long duration projects mean that the majority of the procurement budget is committed for some years ahead and its flexibility to respond to unforeseen pressures is reduced. These pressures may, therefore, result in constraints on the funding of existing contracts, which can lead to escalation of costs, adding to the pressure on the procurement budget.

There is also potential pressure on the procurement budget from other sources. Seeking to ensure the best use of available funds, normal MoD practice is to budget and manage projects against cost and time at 50 per cent confidence figures, whilst approving projects against 90 per cent confidence figures.⁶ However, there is a potential risk of overspend and delay should projects be managed and delivered against 90 per cent approved figures rather than the 50 per cent budgeted figures.

- Making new commitments

The pressures on the procurement budget can impact on new commitments as well as constraining spending on existing commitments, and can result in reduced funding for the early, risk identification and reduction (Assessment) phases of new projects. Consequently, unscoped and unquantified residual risk can be passed into prime contracts resulting in a lack of realism in some

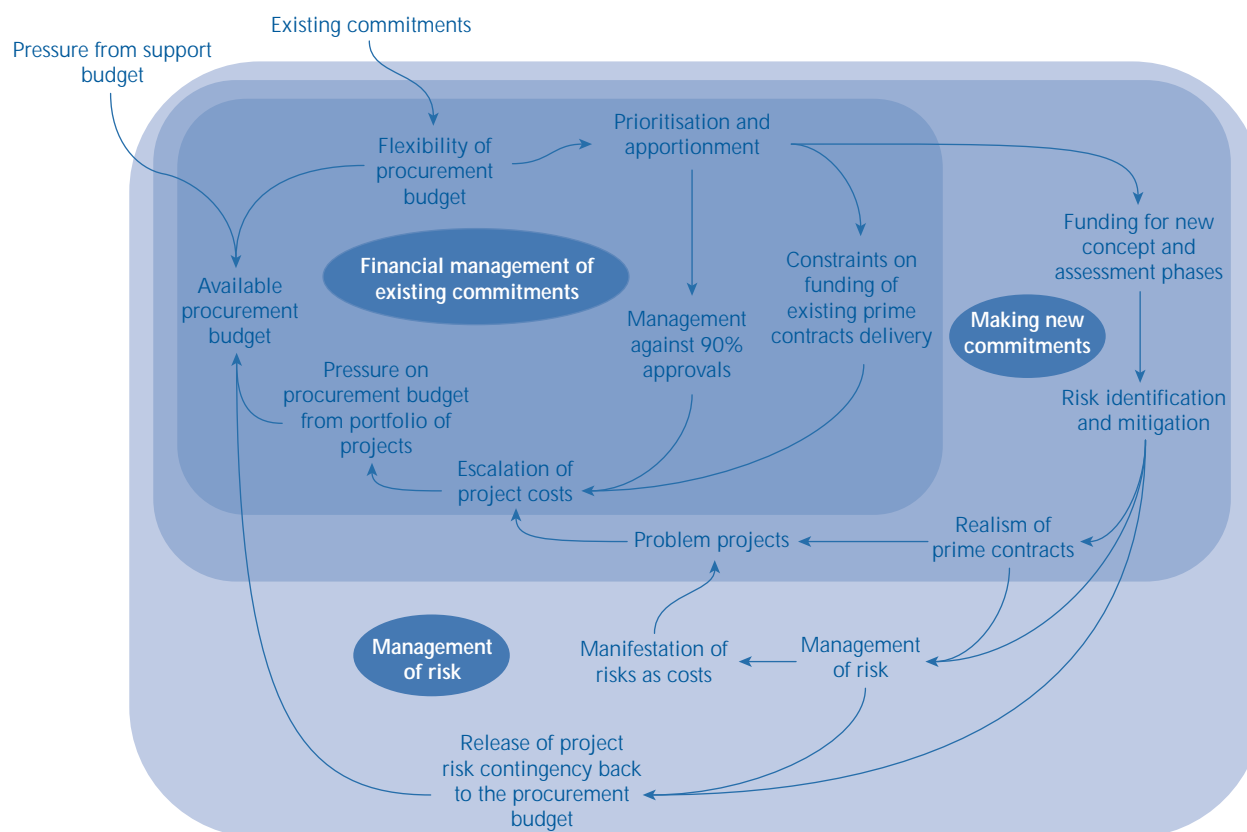
⁶ 50 per cent confidence figures are the MoD's forecast values for the most likely cost and delivery date of equipment and are the basis on which the MoD plans and apports its procurement budget. 90 per cent confidence figures are the MoD's highest acceptable, not to be exceeded, values for the cost and delivery date of equipment and broadly represent the manifestation of all identified risks to a project.

of the contracts awarded. Unrealistic contracts are more likely to run into cost, schedule and quality problems because the funding and time provided are not consistent with delivery of the contracted requirement at the contracted level of risk. Problem procurement projects result in unforeseen requirements for additional funds in the short and medium terms, adding to the pressures on the procurement budget.

■ Management of risk

Effective ongoing management of a project and the interface with the prime contractor on the basis of a sound understanding of the remaining risk and the effectiveness of outstanding mitigation actions is fundamental to successful procurement performance. Where there is poor understanding and mitigation of risks, cost and time contingencies can quickly be eroded by cost escalation and delays, adding to the pressures on the procurement budget. Conversely, where there is good understanding and mitigation of risks, it may be possible to release some cost contingency, relieving pressure elsewhere on the procurement budget.

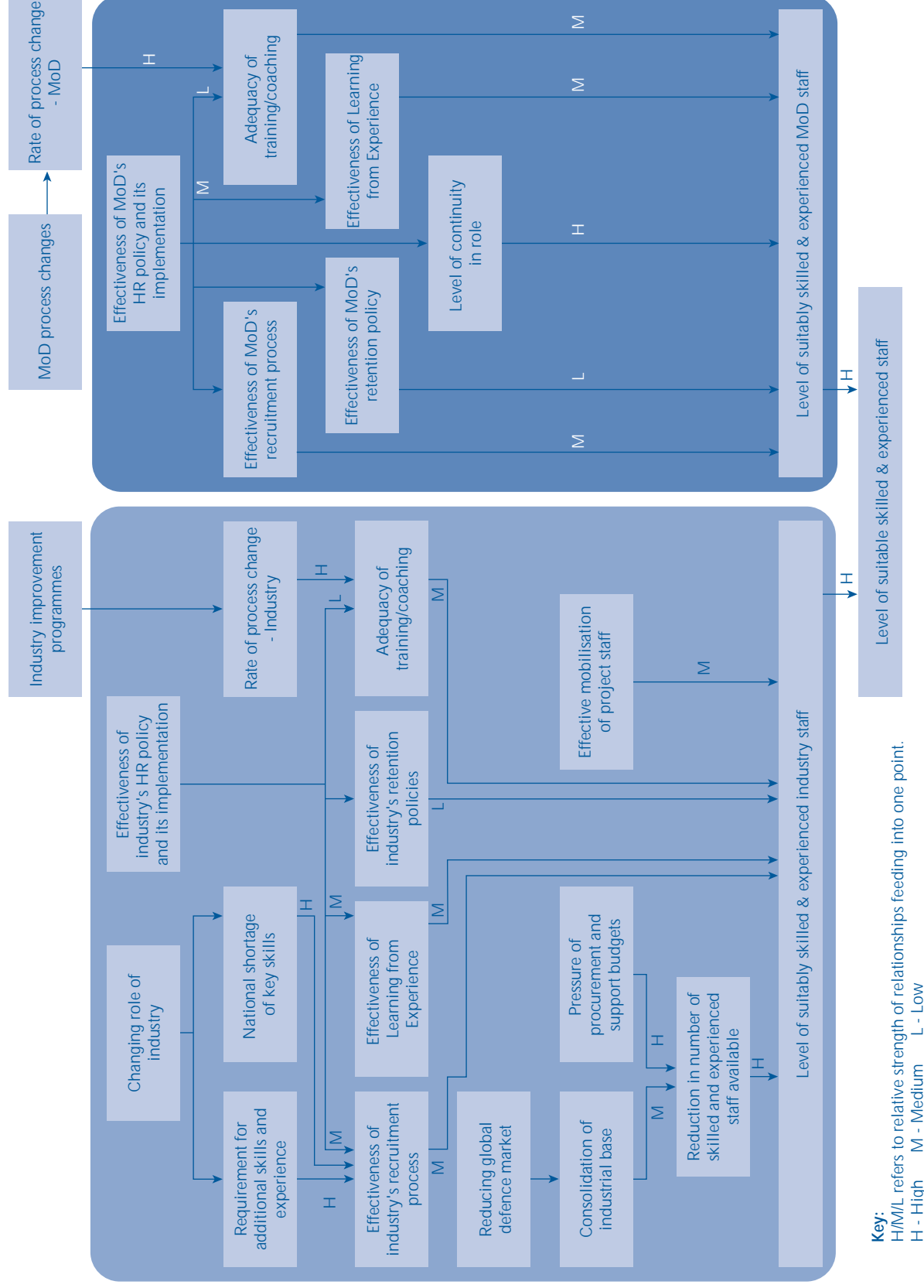
7 Causal Map for the MoD's budgeting process



Source: PA Consulting

Staffing major projects with suitably skilled and experienced staff

- 3.3 Staffing major projects emerged as the second most important driver of procurement performance and the fifth most important driver of acquisition performance. This driver encompasses whether there are sufficient people, across both MoD and industry, with appropriate experience in the core competencies required for projects. For example, people with expertise and experience in the Concept of Operations for particular types of major equipment platforms and how the individual functions and systems of the platforms contribute to their operational capability.
- 3.4 There are slightly different dynamics involved for MoD and industry, although the effectiveness of human resource policies covering recruitment and retention, and adequacy of training of staff are dynamics common to both, as is learning from experience. The dynamics are shown in [Figure 8](#).
- 3.5 For MoD, the introduction of new processes and technology, such as Whole Life Costing, adds to training requirements. Also, regular movement of staff affects levels of continuity in some roles, which impacts on skill and experience levels. The availability of suitably skilled and experienced staff in MoD impacts particularly on the early stages of projects when MoD is leading on decisions affecting the scope and direction of projects, which have resonance for downstream acquisition performance. For example, the availability of MoD staff with suitable skills and experience in risk management affects the quality of early risk reduction activity.
- 3.6 Process and technological change also adds to training requirements for industry. In addition, for industry, changing roles and taking on functions such as acting as Design Authority requires additional skills and experience to be brought in through recruitment, which can be affected by national shortages of skills in some cases. Within industry, consolidation has also impacted on the availability of skilled and experienced staff, and the mobility of staff can also affect this.

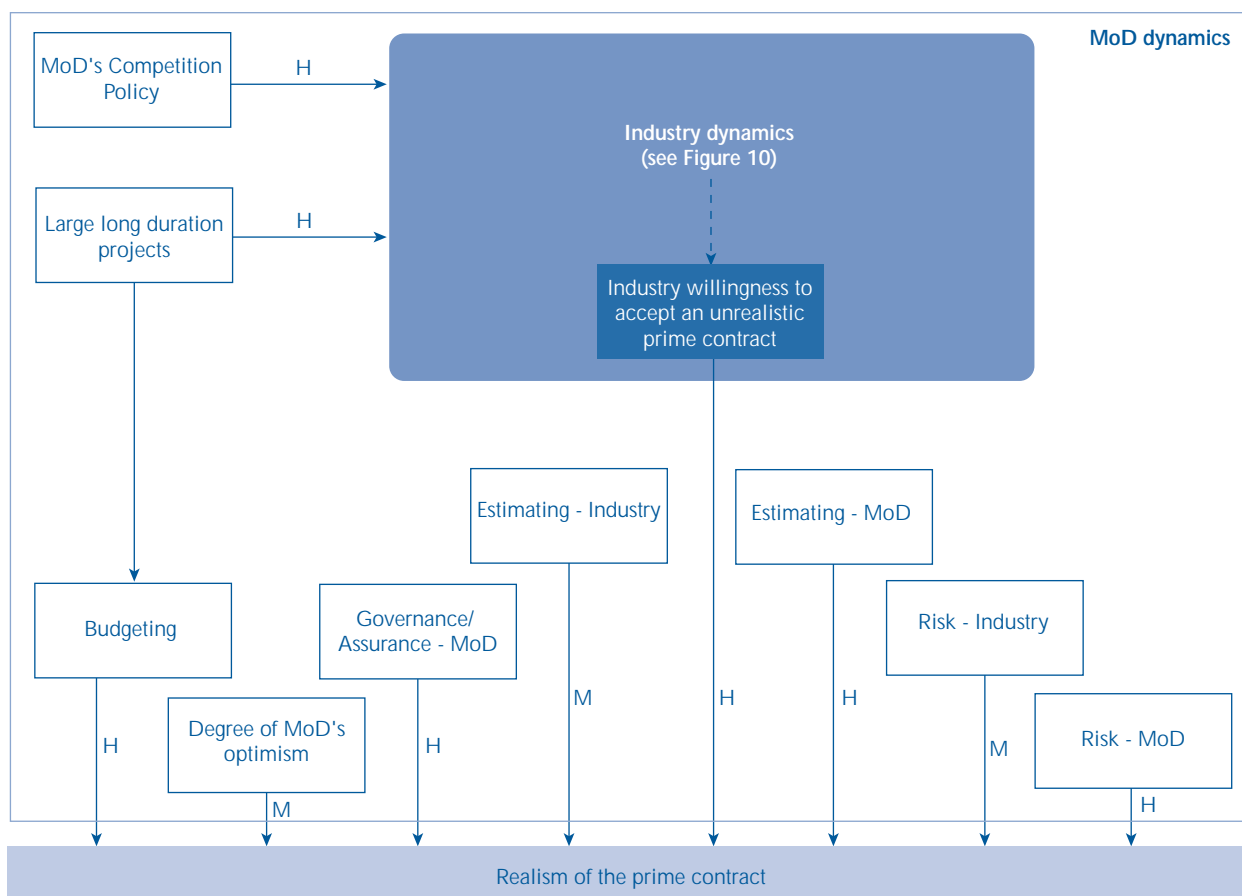


Why competition is not amongst the key drivers

- 3.7 **Figures 9 and 10** describe the dynamics surrounding the impact of competition on the successful delivery of defence projects. Competition impacts through the realism of the prime contract awarded to industry, which is defined as the degree to which the funding and schedule contracted for, are consistent with delivery of the contracted requirement. The MoD and industry both contribute to the realism of the prime contract. The drivers associated with the MoD are shown in the outer unshaded block of Figure 9 and those associated with industry (the inner shaded block of Figure 9) are expanded in Figure 10.
- 3.8 The possible dynamics for industry (see Figure 10) are that the need for corporate survival can drive a 'must win' attitude in the face of competition for a large contract. This can be added to by the need to create value for shareholders. Returns expected from internal improvement programmes can also drive a degree of optimism in pricing contracts. All of these drivers together contribute to the degree that industry is willing to accept an unrealistic prime contract. Key counterbalances to this are industry's ability to understand risk and put accurate cost and timescales estimates on activities, and the extent to which its governance and assurance processes pick up potential optimism or lack of reality in contracts.
- 3.9 The dynamics for MoD (see Figure 9) are associated with budgeting, and the governance, risk management and cost estimating that goes into preparing and reviewing the case for award of the contract. These drivers feed directly into the realism of the prime contract together with industry's willingness to accept an unrealistic prime contract. The connection of such a large number of competing drivers into one point results in a wide distribution of their effects. Essentially, from this model of the dynamics for typical major defence projects, the key message is that competition alone is not a key driver of successful delivery. Only if the other checks and balances are absent or their counterbalancing impact is reduced due to poor management of them does it emerge as a key driver.



9 Causal Map showing how competition impacts on the successful delivery of defence projects through the realism of the prime contract awarded to industry

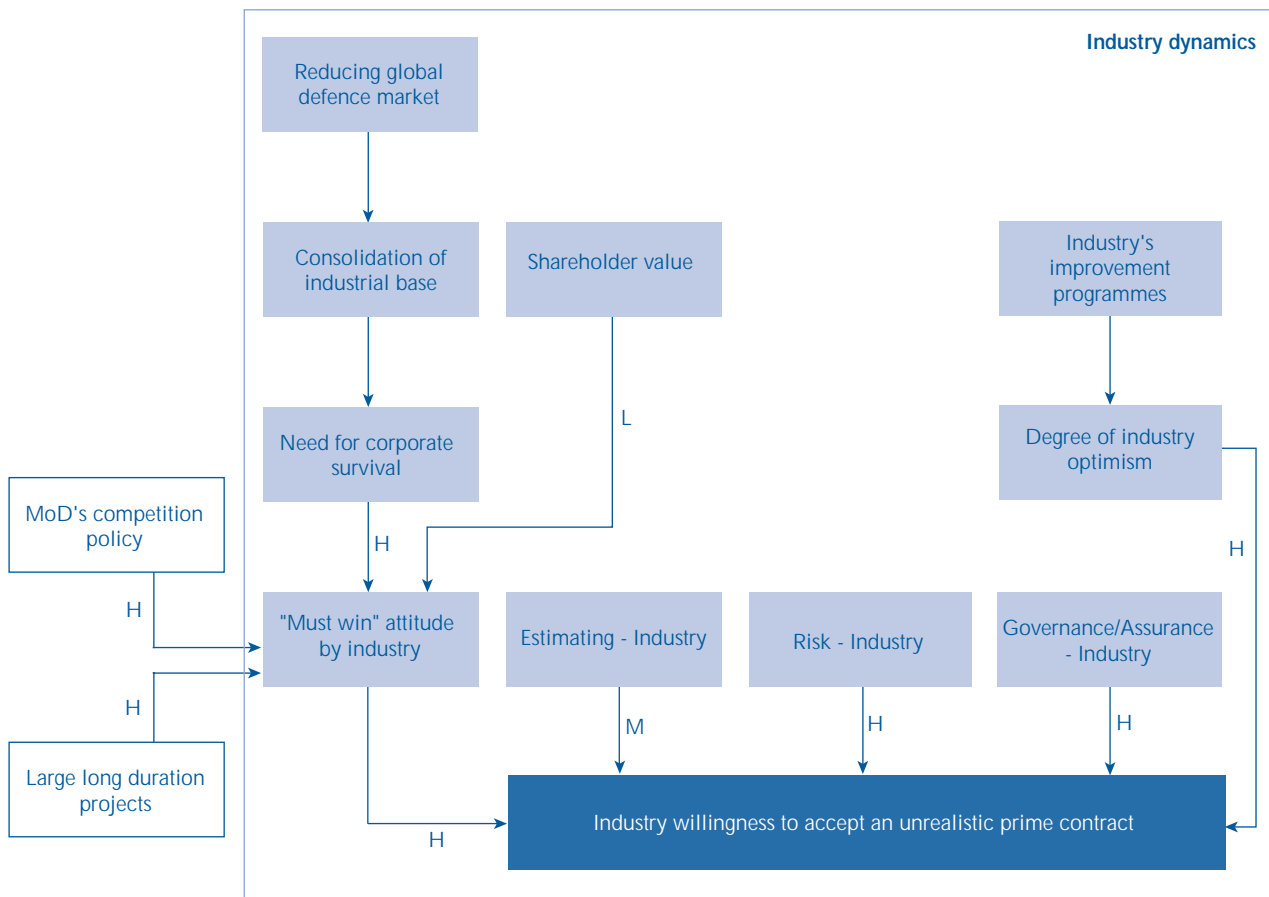


Key:
H/M/L refers to relative strength of relationships feeding into one point.
H - High M - Medium L - Low

Source: PA Consulting/National Audit Office



10 Causal Map showing drivers that contribute to the degree that industry is willing to accept an unrealistic prime contract in a competitive environment



Source: PA Consulting/National Audit Office

THE SECTORS AND ORGANISATIONS WE ARE SEEKING VIEWS FROM

- 1 Using this briefing and consultation document and the associated website (www.naodefencevm.org), we are canvassing views on tracking the progress of major projects via the questionnaire at Annex B. We are seeking views from practitioners with experience in the management of major projects across all public and commercial sectors, defence and other. Our target audience encompasses individual companies and government departments, Trade Associations, Professional Associations and experts from academia.
- 2 In addition to this broad consultation, we are seeking detailed views and comparisons on tracking the progress of major projects through individual visits to a targeted sample of commercial organisations outside the MoD and overseas defence ministries. These are detailed below.

Target organisations for in-depth comparison	
Overseas Defence Ministries	Commercial Organisations
Selected sample: <ul style="list-style-type: none"> ■ France ■ Sweden ■ Israel ■ USA ■ Australia 	Selected sample (to be completed from): <ul style="list-style-type: none"> ■ Oil and Gas (exploration) ■ Utilities ■ Distribution/Logistics ■ Nuclear ■ Information Technology ■ Construction ■ Telecoms ■ Transport ■ Pharmaceutical ■ Shipbuilding (tankers/cargo)
Selection criteria: Qualitative knowledge <ul style="list-style-type: none"> ■ Similar nature of acquisition (e.g. use of competition, balance between domestic and overseas business) ■ similar nature of capability requirements ■ similar level of engagement in active operations ■ perceived as at the leading edge of practice in any of the areas chosen for comparison ■ previous contacts and accessibility Informed by: <ul style="list-style-type: none"> ■ level of defence expenditure ■ total number of acquisition projects ■ average cost and duration of projects ■ number of complex, high technology projects ■ data on project performance 	Selection criteria: Qualitative knowledge <ul style="list-style-type: none"> ■ similarity of business/operations (i.e. organisation concerned with project management) ■ perceived as at the leading edge of practice in any of the areas chosen for comparison ■ previous contacts and accessibility Informed by: <ul style="list-style-type: none"> ■ size of operations, for example: <ul style="list-style-type: none"> ■ level of expenditure ■ number of projects/service contracts ■ average cost/duration of projects/service contracts ■ data on financial and project performance

Both of our consultation questionnaires are supplied here for reference. We encourage interested practitioners to visit the study website www.naodefencevfm.org in order to submit views and responses.

The questionnaire Terminology Guide can be found at Appendix B1.

Who should complete the questionnaires?

Questionnaire 1 - Tracking progress at project level

This is aimed at Project Directors primarily (i.e. those that have management authority over a single project or programme).

Questionnaire 2 - Tracking progress at a strategic level

This is aimed at all those who have a perspective across a number of projects or programmes. These may include Portfolio Directors, Technical Directors and Board Members.

We greatly appreciate any time spent giving us your views and anticipate each questionnaire taking approximately 30 minutes to complete. We would also welcome any feedback you may have on any aspect of the questionnaires.

The deadline for responses is **7th May 2004**.

Major Projects

A major project in the MoD is one valued at £400 million or more. These projects deliver equipment (or infrastructure) and are often characterised by complex technology, significant technical or other risk and long duration. The MoD is a client organisation, engaging outside companies to develop and produce equipment (or infrastructure).

Whilst we want to gain a robust comparison across projects in different sectors valued at £400 million or more, we recognise that a relatively small proportion of projects are valued at this level. We therefore welcome views from across the spectrum of projects to gain the widest possible insight into tracking project progress.

Helpline

If you require further assistance with any aspect of this questionnaire please do not hesitate to contact Ffiona Kyte (0207 798 7791, Ffiona.Kyte@nao.gsi.gov.uk) or Mike Scott (0207 798 7029, Michael.Scott@nao.gsi.gov.uk).

Details of your organisation and project

This section will appear at the start of both questionnaires.

The following questions will enable the study team to effectively analyse and collate the data. All replies will be held in strict confidence.

- 1 What is your name?
- 2 What is the name of your organisation?
- 3 Please describe your role by checking the box that applies:

		Comments
Project Director	<input type="checkbox"/>	<input type="text"/>
Organisation expert on project management	<input type="checkbox"/>	<input type="text"/>
Portfolio Director	<input type="checkbox"/>	<input type="text"/>
Technical Director	<input type="checkbox"/>	<input type="text"/>
Senior Executive	<input type="checkbox"/>	<input type="text"/>
Board Member	<input type="checkbox"/>	<input type="text"/>
Other (please describe)	<input type="checkbox"/>	<input type="text"/>
- 4 Please give your telephone and email address details to enable us to follow-up and/or clarify your questionnaire answers, if necessary.
Telephone: Email:
- 5 How long is a Project Director typically in post (on any one project) in your organisation?
Please specify in years and months:
- 6 Is/Are your project(s) in the defence sector?
If **yes**, please complete questions 6 - 11. ☐
If **no**, please complete questions 12 - 16. ☐
- 7 Are you primarily a client organisation or a contractor organisation? Please check the box that applies:
Client organisation (*tracking projects being undertaken by others*) ☐
Contractor organisation (*undertaking projects for clients*) ☐
- 8 What kind of defence project(s) are you engaged in? Please describe:
- 9 Was the project competed ☐ or single sourced ☐ ? Please select
- 10 Is your project supplying directly to the Ministry of Defence (MoD) ☐ or within a supply chain ☐ (if relevant)?
Please select

11 What is the value (or typical value) of your project(s)? Please check one box:

- > £400 million ☐
- > £100 million ☐
- > £20 million ☐
- < £20 million ☐

12 In which industrial sector is/are your project(s)?

13 Are you primarily a client organisation or a contractor organisation? Please check the box that applies:

Client organisation (*tracking projects being undertaken by others*) ☐

Contractor organisation (*undertaking projects for clients*) ☐

14 What kind of project(s) are you engaged in? Please describe:

15 Is your project supplying directly to a client ☐ or within a supply chain ☐ (if relevant)? Please select

16 What is the value (or typical value) of your project(s)? Please check one box:

- > £400 million ☐
- > £100 million ☐
- > £20 million ☐
- < £20 million ☐

REFERENCE ONLY

QUESTIONNAIRE 1 - TRACKING PROGRESS AT PROJECT LEVEL

to be completed by Project Directors



Methods of Tracking Progress

- 1 When do you use the following methods to track project progress (or have used them in the past)? A definition of each method can be found below. Please check the boxes that apply:

	Design	Manufacture	Other (please describe)
Project scheduling tool	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Contractual milestones	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Earned Value Management	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Risk Register	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
External cost incurred	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Forecasts to completion	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Metrics relating to critical path activities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (please describe)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Comments	<input type="text"/>		

Methods of Tracking Progress - Definitions

These are intended to be recognisable across different industrial sectors.

Project scheduling tool	Use of a software package to plan out project activities. This may involve creating work packages that correspond to those being undertaken by a contractor/client.
Contractual milestones	Targets linked to payments schedule in the contract or are stipulated in the contract (for example, a certain level of achievement by a certain date at a certain cost) and could have an incentive or penalty attached.
Earned Value Management	Process of representing physical progress achieved in terms of a cost based measure.
Risk Register	Use of the project risk register alongside the schedule, cost and quality checks. Risk identification and mitigation as an ongoing process and linked explicitly to progress made on the project.
External cost incurred	Reference to project balance sheet or ledgers - monitoring on the basis of money spent.
Forecasts to completion	Measuring progress in terms of what remains to be done, rather than work already done, and forecasting how long this may take, at what cost and at what level of quality.
Metrics relating to critical path activities	The use of metrics to measure high risk activities, an example being metrics for software development.

Source: Association for Project Management "Project Management Body of Knowledge" 2000, National Audit Office

- 2 What are the advantages of using these methods? Please check all the boxes that apply on the basis of your experience:

Advantages in terms of:

	Practical/ easy to use	Low/ straightforward training requirements	Commonality of use by a client or contractor	High accuracy	Low cost
Project scheduling tool	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Contractual milestones	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Earned Value Management	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Risk Register	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
External cost incurred	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Forecasts to completion	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Metrics relating to critical path activities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (please describe)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Comments

- 3 What are the disadvantages of using these methods? Please check all the boxes that apply on the basis of your experience:

Disadvantages in terms of:

	Impractical/ difficult to use	High training requirements	Limited commonality of use by a client or contractor	Low accuracy	High cost
Project scheduling tool	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Contractual milestones	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Earned Value Management	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Risk Register	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
External cost incurred	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Forecasts to completion	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Metrics relating to critical path activities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (please describe)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Comments

- 4 What methods do you use to track support projects, (which may typically be based on a logistics support contract that comes into force when manufacture is completed) if relevant?

Please check the boxes that apply:

	Support phase	Comments
Project scheduling tool	<input type="checkbox"/>	
Contractual milestones	<input type="checkbox"/>	
Earned Value Management	<input type="checkbox"/>	
Risk register	<input type="checkbox"/>	
External cost incurred	<input type="checkbox"/>	
Forecasts to completion	<input type="checkbox"/>	
Logistics performance metrics	<input type="checkbox"/>	
Other (please describe)	<input type="checkbox"/>	

- 5 Are project managers in your organisation empowered to choose tracking methods that suit their particular project and take appropriate decisions (without necessarily making reference to a more senior manager)?

	Please select	Comments
Yes	<input type="checkbox"/>	
No	<input type="checkbox"/>	

- 6 Have you made any improvements to the method(s) of tracking your project's progress since January 2003?

	Please select	Comments
Yes	<input type="checkbox"/>	
No	<input type="checkbox"/>	

If **yes**, please also check the boxes that apply:

Improvement		Comments
Linked project management and reporting systems	<input type="checkbox"/>	
Started to operate lifecycle management	<input type="checkbox"/>	
Started to analyse trends in time, cost or progress	<input type="checkbox"/>	
Adopted another method (please describe)	<input type="checkbox"/>	
Other (please describe)	<input type="checkbox"/>	

Sources of tracking information

The purpose of the following questions is to understand how you gain access to information from outside your project team that may be relevant to tracking your project's progress.

- 7 Please describe how you gain access to information from your prime contractor by checking the boxes that apply.

Comments

Weekly meetings	<input type="checkbox"/>	
Monthly review meetings	<input type="checkbox"/>	
Shared work breakdown structure	<input type="checkbox"/>	
Joint metrics	<input type="checkbox"/>	
Joint risk register	<input type="checkbox"/>	
Co-location of staff	<input type="checkbox"/>	
Other (please describe)	<input type="checkbox"/>	

- 8 Can data be shared easily between your project and its prime contractor?

Please select

Yes ☐ No ☐

If **yes**, is there a shared management information system?

Please select

Yes ☐
No ☐

Comments

- 9 Please describe how you verify prime contractor's data by checking the boxes that apply.

Comments

Data sample checking	<input type="checkbox"/>	
Real-time electronic data system	<input type="checkbox"/>	
System checking	<input type="checkbox"/>	
Dedicated staff	<input type="checkbox"/>	
Other (please describe)	<input type="checkbox"/>	

- 10 How often do you have to report upwards on project progress? Please check the box that applies:

Comments

Weekly	<input type="checkbox"/>	
Monthly	<input type="checkbox"/>	
Quarterly	<input type="checkbox"/>	
Every six months	<input type="checkbox"/>	
Other (please specify)	<input type="checkbox"/>	

11 Do you have an independent review process for your project? Please check all the boxes that apply:

	Monthly	Frequency Quarterly	Other (please specify)	Comments
Peer Review	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Governance Panel	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Senior Management Review	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Other (please specify)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Reporting project progress

12 What standard data do you have to regularly report upwards in your own organisation? Please check the boxes that apply:

		Comments
Actual spend	<input type="checkbox"/>	
Cost estimates/forecasts	<input type="checkbox"/>	
Schedule estimates/forecasts	<input type="checkbox"/>	
Build progress/performance achievement against plan	<input type="checkbox"/>	
Trade offs	<input type="checkbox"/>	
Staffing profile	<input type="checkbox"/>	
Project office costs	<input type="checkbox"/>	
Other (please describe)	<input type="checkbox"/>	

13 In your experience, what are the features of an effective reporting system? Please check the boxes that apply:

		Comments
Clear purpose for reporting	<input type="checkbox"/>	
Clear data requirements	<input type="checkbox"/>	
Common metrics across all projects	<input type="checkbox"/>	
Common information system	<input type="checkbox"/>	
Requirements for reporting balanced with the utility of reports generated	<input type="checkbox"/>	
Other (please describe)	<input type="checkbox"/>	

- 14 In your experience, what are the obstacles to effective reporting of project progress? Please check the boxes that apply:

Comments

Too many layers of management/levels of hierarchy

☐

Reliance on aggregated data across all projects

☐

Wrong types of project data required

☐

Mismatch between data used on the project and data required for reporting

☐

Poor timing of reporting

☐

No feedback mechanism

☐

Lack of definition of data required

☐

Poor availability of data

☐

Incompatible information systems

☐

Other (please describe)

☐

- 15 How frequently do you have contact with your client/prime contractor to discuss tracking information and agree action? Please check the boxes that apply:

Comments

Informal day-to-day contact

☐

Weekly informal contact

☐

Weekly formal meeting

☐

Monthly informal contact

☐

Monthly formal meeting

☐

Other (please describe)

☐

Taking action

- 16 What sorts of action do you agree with your client/prime contractor on the basis of tracking information? Please check the boxes that describe the actions you take:

Comments

Re-allocate resources

☐

Re-prioritise work

☐

Identify risks

☐

Mitigate risks

☐

Identify training needs

☐

Recruit more staff

☐

Identify re-work

☐

Apply lessons learned

☐

Other (please describe)

☐

If possible, please visit our website at www.naodefencevfm.org which gives further details of the key drivers of acquisition performance in the Ministry of Defence. We are interested to find out if these drivers apply in other industrial sectors.

- 17 According to the circumstances in your organisation, how would you rate the importance of tracking progress and the other key factors listed below to the success of major projects?

Scale: 1 = very important 2 = moderately important 3 = not noticeably important

	Rating	Comments
Tracking progress (Management information linked to governance and assurance)	<input type="checkbox"/>	
Early risk mitigation	<input type="checkbox"/>	
Staffing	<input type="checkbox"/>	
Budgeting process	<input type="checkbox"/>	
Lifecycle approach	<input type="checkbox"/>	

- 16 Would you be interested in receiving feedback of the results of this questionnaire?

Please select

- Yes ☐
- No ☐

- 17 Would you be interested in attending a later seminar in 2004 to focus on these issues further?

Please select

- Yes ☐
- No ☐

Additional comments:

Thank You

Please return completed questionnaires by **7th April 2004**.

Trackingprogress.questionnaire1@nao.gsi.gov.uk

or in hard copy to:

Ffiona Kyte
Defence Value for Money Team
National Audit Office
Room C510
157-197 Buckingham Palace Road
Victoria
London SW1W 9SP

Fax: 0207 7987588
Tel: 0207 798 7791

Types of data to track a number of projects

- 1 Why do you track the progress of your projects? Please check the boxes that apply:

Comments

To highlight progress against corporate targets/objectives

☐

To gain assurance that the business is progressing satisfactorily

☐

For future planning

☐

To allocate resources

☐

Other (please describe)

☐

- 2 Please rate how useful the following types of data are to you in overseeing projects:

Scale: 1 = very useful 2 = moderately useful 3 = not noticeably useful

Rating

Comments

Actual spend

☐

Cost estimates/forecasts

☐

Schedule estimates/forecasts

☐

Build progress/performance achievement against plan

☐

Trade offs

☐

Staffing profile

☐

Project office costs

☐

Other (please describe)

☐

- 3 Is a consistent set of metrics kept for all projects?

Please select

Comments

Yes

☐

No

☐

If **yes**, please outline what they measure

- 4 In your experience, what are the features of an effective reporting system? Please check the boxes that apply:

		Comments
Clear purpose for reporting	<input type="checkbox"/>	
Clear data requirements	<input type="checkbox"/>	
Common metrics across all projects	<input type="checkbox"/>	
Common information system	<input type="checkbox"/>	
Requirements for reporting balanced with the utility of reports generated	<input type="checkbox"/>	
Other (please describe)	<input type="checkbox"/>	

- 5 In your experience, what are the obstacles to effective reporting of project progress? Please check the boxes that apply:

		Comments
Too many layers of management/levels of hierarchy	<input type="checkbox"/>	
Reliance on aggregated data across all projects	<input type="checkbox"/>	
Wrong types of project data required	<input type="checkbox"/>	
Mismatch between data used on the project and data required for reporting	<input type="checkbox"/>	
Poor timing of reporting	<input type="checkbox"/>	
No feedback mechanism	<input type="checkbox"/>	
Lack of definition of data required	<input type="checkbox"/>	
Poor availability of data	<input type="checkbox"/>	
Incompatible information systems	<input type="checkbox"/>	
Other (please describe)	<input type="checkbox"/>	

Reviewing project progress and taking action

- 6 How often do you routinely review project progress? Please check the box that applies:

		Comments
Weekly	<input type="checkbox"/>	
Monthly	<input type="checkbox"/>	
Quarterly	<input type="checkbox"/>	
Every six months	<input type="checkbox"/>	
Other (please specify)	<input type="checkbox"/>	

- 7 Are there specific points during the project life-cycle when you review project progress and/or take decisions (for example on approval of funding)? If **yes**, please describe:

- 8 Is there an independent review process for your projects? Please check all the boxes that apply:

	Monthly	Frequency Quarterly	Other (please specify)	Comments
Peer Review	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Governance Panel	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Senior Management Review	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Other (please specify)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

- 9 If you do have an independent review process for your projects (as in question 8 above), do you find it useful?

Please select

Yes ☐

No ☐

Please explain:

- 10 What sorts of action do you take on projects? Please check the boxes that apply:

		Comments
Re-allocate resources	<input type="checkbox"/>	
Re-prioritise work	<input type="checkbox"/>	
Identify risks	<input type="checkbox"/>	
Mitigate risks	<input type="checkbox"/>	
Identify training needs	<input type="checkbox"/>	
Recruit more staff	<input type="checkbox"/>	
Identify re-work	<input type="checkbox"/>	
Apply lessons learned	<input type="checkbox"/>	
Other (please describe)	<input type="checkbox"/>	

- 11 Do you share tracking information with your opposite numbers in your contractor or client organisations to agree action:

	Yes	No	Comments/Actions
On individual projects?	<input type="checkbox"/>	<input type="checkbox"/>	
Across the portfolio?	<input type="checkbox"/>	<input type="checkbox"/>	

- 12 Are you reviewing the process by which you track the progress of a number of projects?

If **yes**, please describe in the table below:

Method/Process under review e.g. tracking metrics	Reason for review	Likely improvement	Comments

If possible, please visit our website at www.naodefencevfm.org which gives further details of the key drivers of acquisition performance in the Ministry of Defence. We are interested to find out if these drivers apply in other industrial sectors.

- 13 According to the circumstances in your organisation, how would you rate the importance of tracking progress and the other key factors listed below to the success of major projects?

Scale: 1 = very important 2 = moderately important 3 = not noticeably important

	Rating	Comments
Tracking progress (Management information linked to governance and assurance)	<input type="checkbox"/>	
Early risk mitigation	<input type="checkbox"/>	
Staffing	<input type="checkbox"/>	
Budgeting process	<input type="checkbox"/>	
Lifecycle approach	<input type="checkbox"/>	

- 16 Would you be interested in receiving feedback of the results of this questionnaire?

Please select

Yes ☐

No ☐

17 Would you be interested in attending a later seminar in 2004 to focus on these issues further?

Please select

Yes

☐

No

☐

Additional comments:

Thank You

Please return completed questionnaires by **7th April 2004**.

Trackingprogress.questionnaire2@nao.gsi.gov.uk

or in hard copy to:

Ffiona Kyte

DefenceValue for Money Team

National Audit Office

Room C510

157-197 Buckingham Palace Road

Victoria

London SW1W 9SP

Fax: 0207 7987588

Tel: 0207 798 7791

FOR REFERENCE ONLY

Questionnaire Terminology Guide

This questionnaire is aimed at major projects practitioners in a variety of industries. Standard terminology has been used as far as possible and the following is a list of terms with a definition to provide some useful context and clarification.

Acquisition¹

In the Ministry of Defence (MoD), this term refers to acquiring new capability using a through-life approach embodied in a single Integrated Project Team with clearly identified customers. The acquisition cycle is represented in Annex C.

Capability

Comprised of six elements: People, Force Structure and Estates, Sustainability, Training, Concepts and Doctrine, and Equipment. These combine to enable the armed forces to fulfil their military objectives. Each element is described in more detail below:

People	It is essential to have the right people trained and in place. Effects on manpower must be considered, particularly if there will be an increase or decrease in required manning and the costs incurred and savings made. Linked to Force Structure and Estates.
Force Structure & Estates	The introduction of a new equipment may require changes to current force and unit - structures. These are likely to have corresponding cost adjustments. Examples of Estates issues: Is specialist accommodation/storage required? Are there sufficient maintenance facilities? Do barracks/infrastructure need strengthening?
Sustainability	Ongoing and emerges from a rigorous assessment of the requirement. Resource consumption during peacetime and operations must be quantified. The Support Strategy is approved at Main Gate.
Training	A Training Needs Analysis must be carried out which will also identify Whole-Life Costs.
Concepts & Doctrine	Underpins all other capability elements. An agreed concept of how the military capability will be used needs to be in place at an early stage. The associated tactics, techniques and procedures require careful consideration from an early stage.
Equipment	Equipment is delivered according to performance, time and cost parameters that are in place by Main Gate. The Integrated Project Team can purchase existing products or contract for entirely new equipment. The equipment choice is underpinned by a set of Key User Requirements.

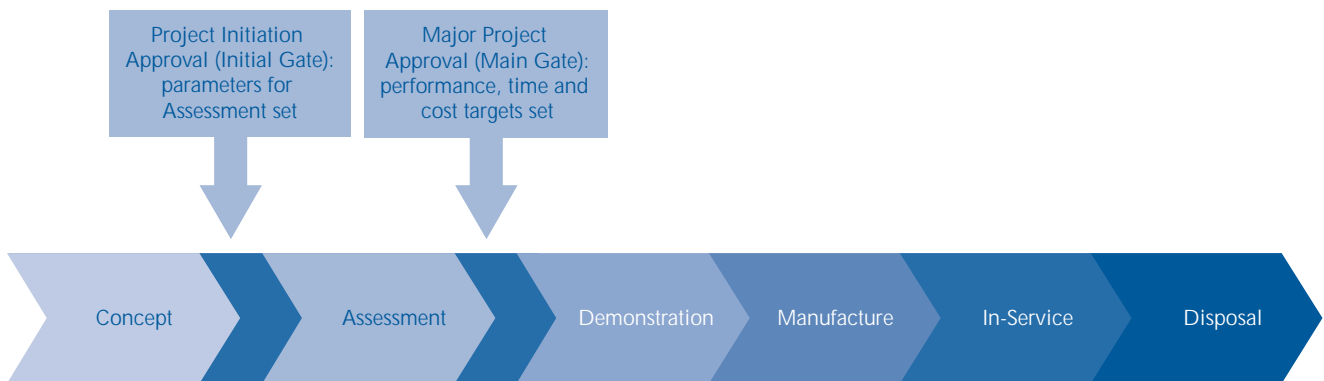
¹ More information about all aspects of Ministry of Defence acquisition practices can be found via the Acquisition Management System website www.ams.mod.uk.

Customers	There are two customers in the MoD: the Equipment Capability Customer, which is the customer prior to the point when equipment becomes available to the user (and for upgrades to in-service equipment); and the Second Customer, responsible for user and in-service aspects (all the non-equipment elements of capability, as outlined above).
Estimating²	Estimating is the process, for example, of accurately assessing the amount of work required to complete each work package.
Initial Gate	A relatively low approval hurdle intended to encourage early and full exploration of a wide range of options for meeting a particular capability.
Integrated Project Team	The body responsible for managing a project through-life and is characterised by its "cradle to grave" responsibility, the inclusion of all the skills necessary to manage a project, and its effective and empowered leader.
In-Service Date	For equipment, the in-service date is defined at Main Gate and should relate to achievement of real operational capability.
Life-cycle management/ Through-Life Management	The term life-cycle refers to the different stages of a project, from initial idea through development, construction, delivery and, in some cases, maintenance, upgrade and final disposal. In the MoD, this is called through-life and Through-Life Management is described as "an integrated approach to all Smart Acquisition process, planning and costing activities across the whole system and whole life of a project".
Main Gate	An exacting approval hurdle - a business case should recommend a single technological and procurement option.
Major project	An equipment or infrastructure project that is characterised by complex technology, significant technical or other risk and high value. A major project in the MoD is valued at £400 million or more.
Procurement	In the MoD, this term refers to procuring new equipment for delivery to a user (specifically the Concept, Assessment, Demonstration and Manufacture phases of the acquisition cycle).
Risk estimates	Risk estimates are used in the MoD as a project management tool based on the process of Three-Point Estimating in relation to time and cost forecasts. 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
Tracking progress	This concept refers to the ways in which project directors (team leaders) monitor the progress of their projects and make decisions on the basis of tracking information. It is also the process by which this information is used to monitor progress and take decisions at a strategic level. The concept links the availability of good quality management information from individual projects to successful governance and assurance of a number of projects.

² Association for Project Management "Project Management: Body of Knowledge" 2000.

³ See Acquisition Management System website www.ams.mod.uk

THE MINISTRY OF DEFENCE'S PROCESS FOR ACQUIRING MAJOR DEFENCE EQUIPMENT - THE 'ACQUISITION CYCLE'



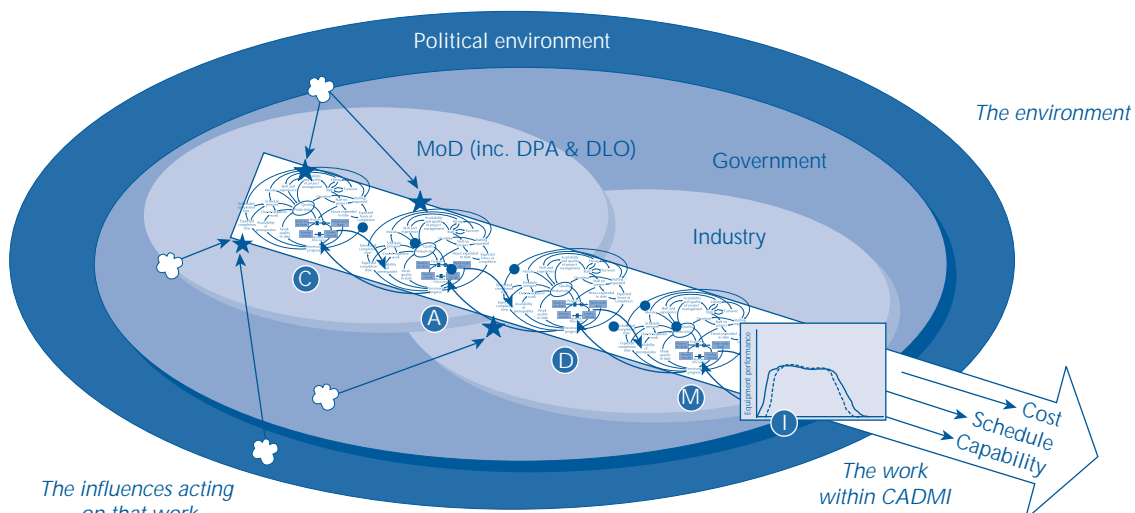
Source: National Audit Office

The objective of the MoD's Acquisition Cycle is to assist the reduction of risk during the Concept and Assessment stages so that, at Main Gate, there is a high level of confidence that project targets for time, cost and performance will be achieved. At the highest level, each of the six acquisition stages involves executing the plan agreed in the previous stage, reviewing the outcome, and planning for the remaining stages. The basic content of each stage is as follows:

- Concept:** Produce and baseline a statement of the outputs or results that users require from the system. Identify technology and procurement options for meeting the need that merit further investigation. Obtain funding and agree plan for the Assessment and subsequent stages, identifying performance, cost and time boundaries within which it is to be conducted.
- Assessment:** Define what the system must do to meet user needs. Identify the most cost-effective technological and procurement solution trading time, cost and performance. Reduce risk to a level consistent with delivering an acceptable level of system performance to tightly controlled time and cost parameters.
- Demonstration:** Progressively eliminate development risk in order to fix performance targets for manufacture. Demonstrate ability to produce integrated capability. In many cases, demonstration is the stage where a single contractor is selected.
- Manufacture:** Undertake production and deliver the solution to the military requirement within the time and cost limits appropriate at this stage. Conduct System Acceptance to confirm that the system satisfies user needs.
- In-Service:** Confirm that the military capability provided by the system is available for operational use, to the extent defined at Main Gate. This may happen in Manufacture instead. Provide effective support to the front line. Maintain levels of performance within agreed parameters. Carry out any agreed upgrades or improvements, refits or acquisition increments.
- Disposal:** Carry out plans for efficient, effective and safe disposal of the equipment.

- 1 As the first step, a framework model of the wider system of stakeholders and associated influences within which the Acquisition Cycle sits was developed and this is shown in **Figure 1**.
- 2 The framework model recognises that the progress of projects through the Acquisition Cycle does not stand alone. Rather, the ability of projects to deliver to time, cost and quality will be affected by a wide range of stakeholders and external drivers as illustrated by Figure 1. The arrow through the centre represents the Acquisition Cycle. The success of projects will be influenced by stakeholders across the MoD and in industry making decisions affecting the outcome of projects. For example, decisions affecting the availability of suitably qualified and experienced staff to work on the project. Beyond MoD and industry, there are wider government and political drivers. Here, drivers such as economic policy, international relations and the changing nature of the security threat impact on project outcome.
- 3 Quantifying the impact of the influences on project performance to rank them in order of effect was a key requirement of the task set PA Consulting by the NAO. To do this, inside the framework model, the project itself is represented by a model of the work to be done within the project team. As Figure 1 shows, the Concept, Assessment, Demonstration and Manufacturing phases of the Acquisition Cycle (referred to from now on as the procurement phases) are represented using PA Consulting's well established Programme Management Modelling System (PMMS), with a supportability model incorporated to represent the in-service phase. The Disposal phase was not considered because it does not generally impact on the previous phases and is not a strong and consistent influence on project outcome.
- 4 PMMS is a systems dynamics based modelling tool that has been used to simulate the complex dynamics of around one hundred and fifty of the world's most difficult programmes, including many major defence procurements. It can simulate changing influences on programmes and calculate the impact on cost,

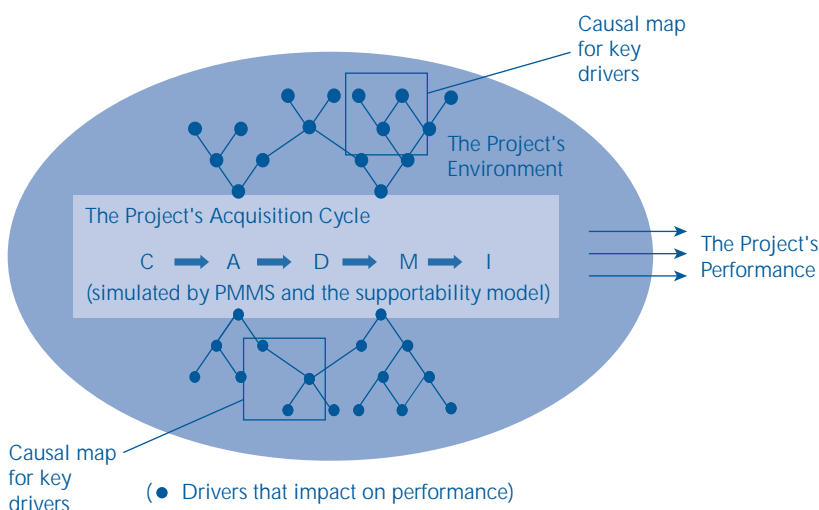
1 The system within which a project sits



schedule and quality, and has been used successfully to support over 30 major claims, withstanding adversarial scrutiny in the course of supporting litigation, arbitration and negotiation. The supportability model represents the pattern of support costs for a typical defence equipment across its life, and is one form of what is commonly known as "the bathtub curve" because of its shape. It is driven by the quality of equipment delivered from the procurement phases, including the extent to which equipment has been designed with a view to optimizing through-life support costs, as calculated by PMMS.

- 5 Together, PMMS and the supportability model have been used to simulate a project within the Acquisition Cycle. They were configured, using historic data on actual project performance drawn from the Major Projects Report and other MoD sources, to verify that they realistically simulated the performance of a generic defence equipment project. Annex D provides more of an overview of PMMS and the supportability model and further detail is available on our website at www.naodefencevmf.org.
- 6 PA Consulting conducted some sixty structured interviews at senior level (management board, project director and project leader level) across the MoD and industry, listed on our website, to understand the drivers of the performance of major defence equipment projects and the relationships which exist between them. Using this information, PA Consulting constructed a map showing the drivers of project performance, the relationships between them and where they impact directly on the Acquisition Cycle. This was broken down into smaller causal maps for key drivers as shown by the modelling concept illustrated in **Figure 2**.
- 7 Expert advice drawn from across the MoD and industry was used to verify the relationships between drivers and assess their relative strengths. From this knowledge and using the ability of the PMMS, PA Consulting calculated the impact that each individual driver has on project performance and identified the key individual and groups of related drivers influencing the performance of major defence equipment projects.

2 Mapping the drivers of project performance



Source: PA Consulting

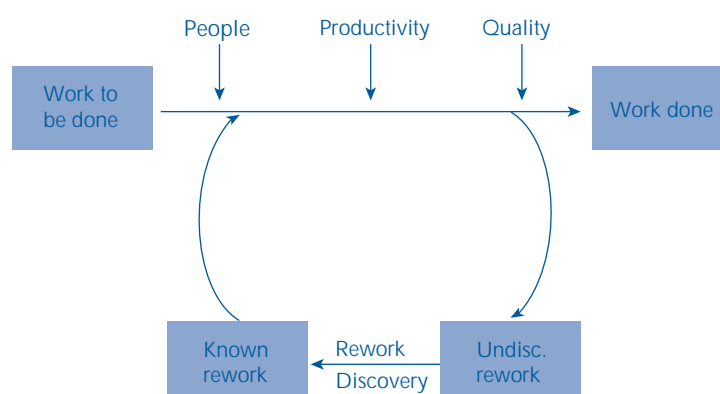
- 1 PA Consulting's Programme Management Modelling System (PMMS) is based on system dynamics programming, a modelling approach developed at the Massachusetts Institute of Technology in the 1950's. This is the established approach for solving complex problems with high degrees of causality, non-linearity and feedback. The use of this model enables a robust perspective on the complexities of the acquisition system to be gained including:
 - a view of project work at a level of abstraction that sets the project in its wider environment;
 - handling of soft factors (for example morale, schedule pressure, productivity, work quality);
 - analysis of the impacts on the availability and quality of downstream work products;
 - diagnosis of upstream impacts affecting subsequent phases; and
 - quantification of systemic influences, non-linear responses, time delays and feedback.
- 2 The baseline model is derived from a distillation of the common dynamics of approximately 150 complex programmes. As for all PMMS models, it is necessary to calibrate its behaviour to represent a known starting point; in this case the generic MoD acquisition project. The following section gives an overview of the basic theory behind the PMMS model, and how it was used to model the phases within the acquisition cycle.

The rework cycle

- 3 Based on experience of modelling dozens of complex development projects, PA has developed an approach for significantly enhancing the traditional view of the completion of work and of the quality of management on a project. Repeated applications of this approach has proven it to be logically correct and, when codified as a working simulation model, numerically accurate. Its use has brought significant financial benefits (£multi-million) to the businesses that have adopted it. The core of the model structure is "the rework cycle" (see Figure 1).

1 The "Rework Cycle"

The rework cycle incorporates 'work quality' into the project planning model, explicitly recognising rework, and delays in its discovery.



Source: PA Consulting

- 4 The rework cycle expands upon the traditional planning model by adding "work quality"; defined as the fraction of work done which does not require subsequent rework. By adding this "return valve" to the planning model, rework is recognised, though not immediately, leading to an amount of "undiscovered rework". Undiscovered rework consists of those tasks or work products that contain as-yet-undetected errors that are reported by all traditional planning models as being complete. Subsequent work phases, that assume completion of these work products, suffer.
- 5 The four procurement phases of the Acquisition Cycle (Concept, Assessment, Demonstration and Manufacture) can be thought of as having a rework cycle, in which work product/s (for example documents, technical solutions, equipment) flow around the cycle and are passed into subsequent phases.

Productivity and Quality

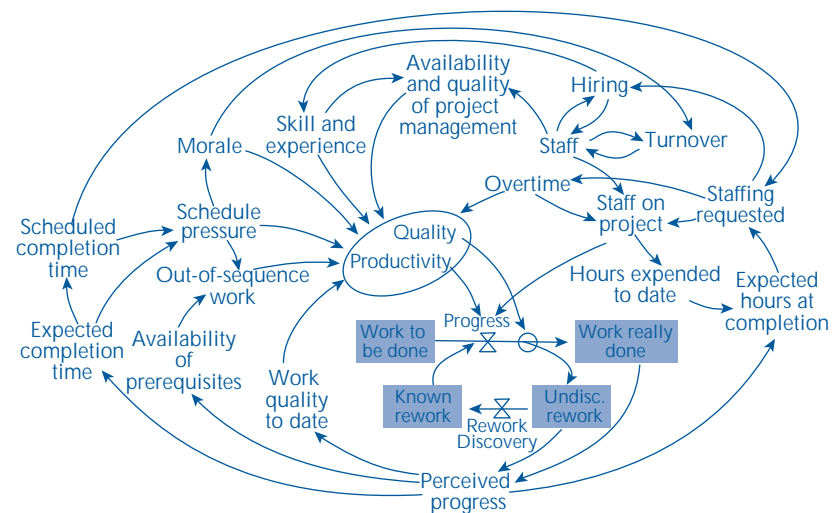
- 6 Productivity and quality do not stay constant throughout the completion of the work product/s in the Acquisition Cycle. The drivers of productivity and quality vary over time and are not always a result of poor workmanship; rather, there exist a number of systemic drivers that are, in turn, driven by other factors. The inter-relations and dependencies of the drivers of productivity and quality must be clearly understood to comprehend how the Acquisition Cycle is influenced by a variety of factors in this study.
- 7 The following is a list of factors that commonly affect both productivity and quality on large complex projects:
 - Overtime
 - Prior Quality
 - Schedule pressure
 - Congestion
 - Availability/quality of upstream work products
 - Morale
 - Staff experience
 - Resource constraints
 - Organisational size
 - Out-of-sequence work
 - Availability/quality of subcontractor products

The Project Management Modelling System (PMMS)

- 8 These concepts can be drawn together into an influence map with work flowing around the rework cycle, the drivers of productivity and quality and, in turn, their drivers included. **Figure 2** shows, at a high level, the sort of dynamics that exist for each phase within a PMMS model.

2 Structure of each rework cycle within a PMMS model

Combining the rework cycle with the factors affecting productivity and quality in a closed loop system.



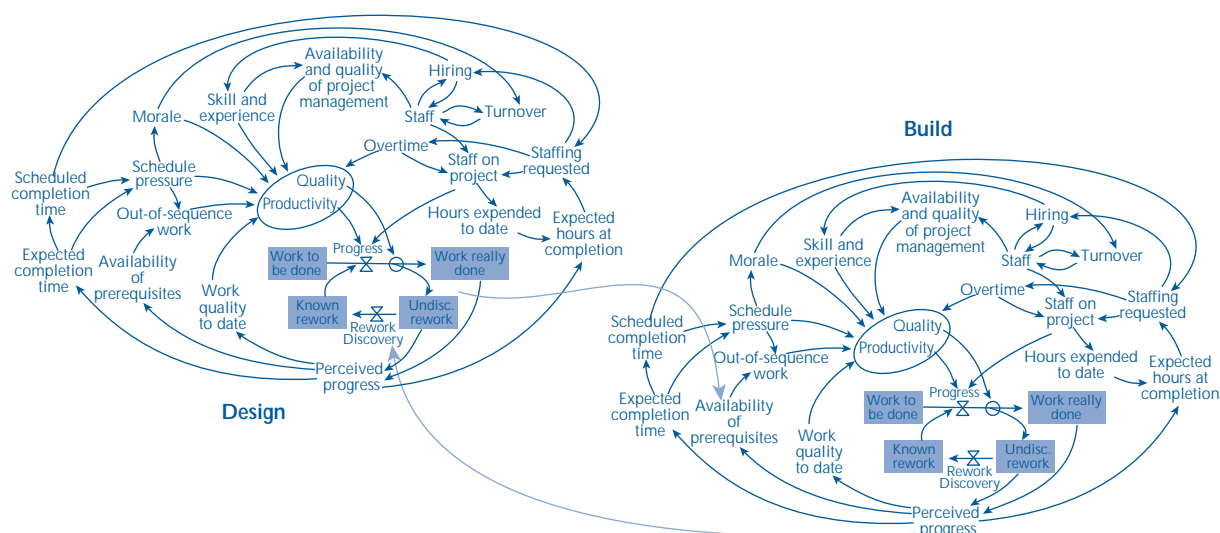
Source: PA Consulting

- 9 These rework cycles represent phases of a programme and are then linked together so that they represent a complete multi-phase equipment project. Thus, the project is made up of the relevant number of design phases and manufacture phases. The links between the phases represent the availability and quality of upstream work products as they flow into subsequent phases. Rework discovery is then built upon downstream, in later phases of a project.

- 10 It is when subsequent work phases assume completion of upstream products, where in fact there exists an amount of undiscovered rework, that impacts propagate and amplify through the entire project, from system definition to manufacture. PMMS explicitly recognises this and the links between phases / rework cycles, including feedbacks, are built into the model. This is represented in **Figure 3**. This is particularly so with the links between the final design phase and the build phase where activity tends to occur concurrently rather than sequentially.

3 A rework cycle in each major phase of work

The cycles are linked by the availability and quality of work products, and rework discovery.



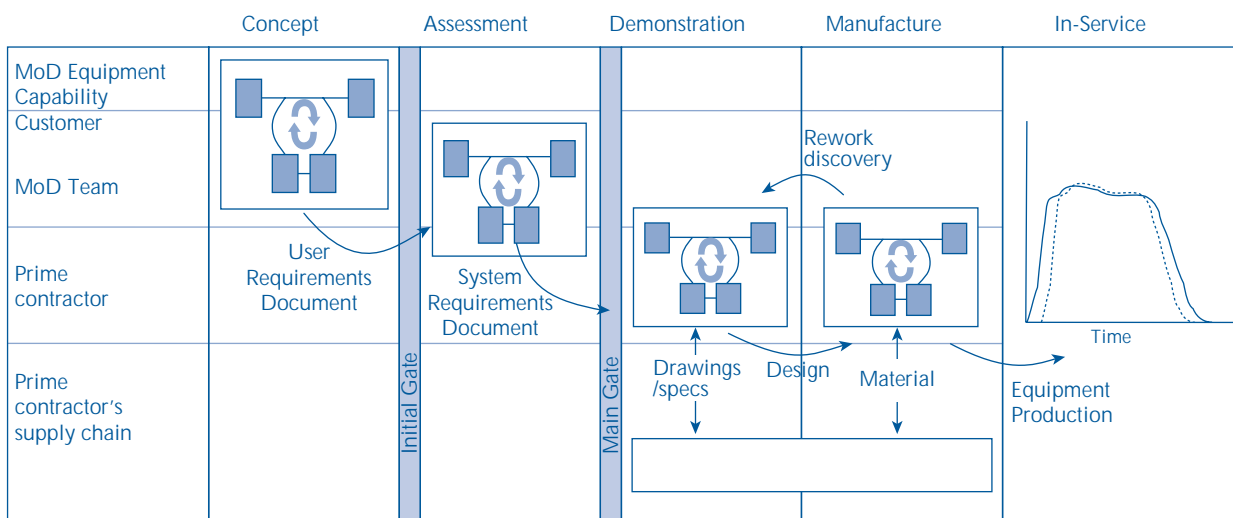
Source: PA Consulting

The Acquisition Cycle

- 11 The Acquisition Cycle is essentially a system of interdependent but semi-independent phases in which a product (for example design package, equipment) is developed during one phase and passed to the subsequent phase. PMMS has been used to represent the procurement phase of the Acquisition Cycle by idealising each of the Concept, Assessment, Demonstration and Manufacture phases as separate rework cycles. These rework cycles are then linked by recognised products and by the feedback links. Thus, each rework cycle simulates the iterative flow of work through a phase, and the factors affecting timeliness and quality of those work products being delivered.
- 12 PMMS also recognises that contributions to a phase or rework cycle can be from many sources and that the emphasis changes over the duration of a project. For example, the key contributors during Concept are within the MoD (the Equipment Capability Customer and the project team). By the time manufacture is reached this has migrated to industry (the prime contractor) and the MoD project team. Products from the lower tiers of the supply chain are treated as discrete inputs to the rework cycle rather than as components of it. This concept is drawn together in **Figure 4** where the rework cycles are shown overlaid on the Acquisition Cycle and against the key contributors for each phase.

4 PMMS and the Acquisition Cycle

Linking of the PMMS structure between the acquisition process phases and organisations involved to capture the major work efforts and dependencies in the process.



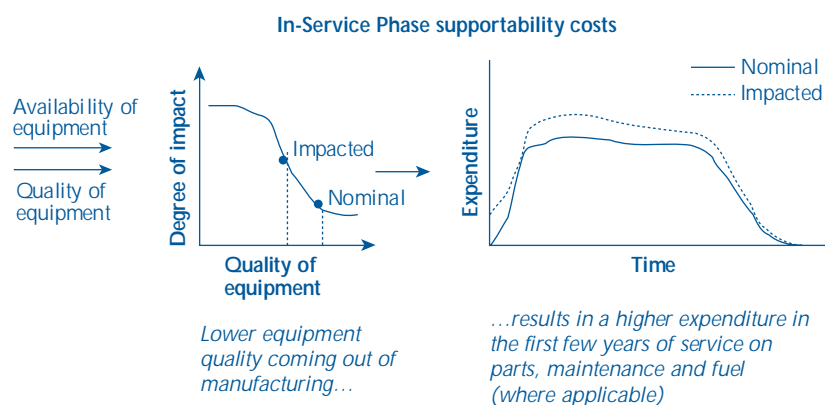
Source: PA Consulting

The In-Service Phase

- 13 A model that represents the acquisition, as opposed to procurement, lifecycle must include the in-service phase. There was insufficient data to construct a comprehensive support model. The NAO and MoD agreed that, in considering acquisition, the study should concentrate, instead, on the supportability of equipment. This does not require a rework cycle to emulate its dynamics. Instead, we have used a simpler structure that, like the rework cycle, takes as its inputs both the timeliness of the delivery of the equipment and the quality of the equipment but is linear in nature.
- 14 The basis for the simulation is the modelling of the supportability of an equipment. This is a function of two inputs from the procurement phases (which were calculated using PMMS):
- The degree to which the equipment design took through-life support issues into account;
 - The quality of the equipment on its introduction into service, based on its manufacturing quality and the maturity of the design.
- 15 **Figure 5** below illustrates the way in which these concepts have been modelled in this study. The cost of support is represented by one form of a bathtub curve where the area under the curve is the cost of support throughout the equipment's life. The size of this is determined by the degree to which the equipment is designed to minimise through-life costs. The front end, or start, of the bathtub is then raised, against the nominal or expected value, by the quality of the equipment on introduction into service. Additional cost is incurred in resolving the undiscovered rework that is carried in from the Manufacture phase and is frequently evidenced by a flurry of modifications in the early years of an equipment, sometimes carried out under warranty.

5 In-service phase dynamics

Showing the relationship between manufacturing availability and quality, and in-service supportability and the consequent expenditure.



Source: PA Consulting

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