The National Audit Office scrutinises public spending on behalf of Parliament.

The Comptroller and Auditor General, Sir John Bourn, is an Officer of the House of Commons. He is the head of the National Audit Office, which employs some 800 staff. He, and the National Audit Office, are totally independent of Government. He certifies the accounts of all Government departments and a wide range of other public sector bodies; and he has statutory authority to report to Parliament on the economy, efficiency and effectiveness with which departments and other bodies have used their resources.

Our work saves the taxpayer millions of pounds every year. At least £8 for every £1 spent running the Office.
Contents

Executive summary 1

Part 1

The Department is changing its strategic management approach to Research and Technology 7

- There have been significant changes in the Research and Technology environment 7
- The Department is adopting an output-management approach to Research and Technology 9
- The Department recognises the need for advice as well as technology as a research output to support its needs 10
- A strategic framework for Research and Technology is developing but there is more to do to align levels of strategy and to reflect the output approach 10
- Measuring research outcomes is difficult: The Department is making progress but it will take time to see the benefits of the new focus 12

Part 2

Structural and process changes should improve business focus but changing culture will be the key to success 15

- Structural changes should increase programme visibility and support better decision-making 15
- Better corporate visibility of the Research and Technology programme should enable more informed decision-making 17
- The Department is developing a single funding stream to better facilitate a coherent balance among investment decisions 17
- Prioritisation mechanisms within customer areas vary but a framework for corporate comparison is not fully developed 17
- Output owners must behave in a collegial fashion in co-ordinating research activities to ensure a coherent programme 18
Part 3

The Department is seeking access to a wider Research and Technology Base

The increasing programme of competition should help broaden the research supplier base

The Department intends to work more closely with industry and academia to encourage innovation

The Department aspires to increase International Research Collaboration to improve access to wider Research and Technology

Part 4

The Department is taking action to manage technology exploitation more effectively

Intellectual Property Rights arrangements for research have been redesigned to enable broader exploitation

The Department has a number of initiatives to encourage industry to become more engaged in exploitation but more can be done

The part-privatisation of QinetiQ should encourage exploitation

A more appropriate programme of Technology Demonstration could reduce the level of risk being carried into the Equipment Programme

Capability Management requires a broader understanding of technology to inform the equipment decision which may not be achievable under current funding arrangements

Appendices

1. Methodology 35
2. Chronology of Key Events 36
3. Glossary of Terms 37
4. Measures 39
5. Latest Position on Part-Privatisation of QinetiQ 40

**Cover Picture**: Detection and processing techniques, originally developed to find submarines, were key in QinetiQ’s development of the Foetal Electrocardiogram - a non-invasive, passive monitoring system used to analyse the heart function of unborn babies.

Photographs courtesy of QinetiQ and the Ministry of Defence, Crown Copyright.
1 The Ministry of Defence (the Department) spends approximately £450 million a year on non-nuclear Research and Technology. The Department’s main objective in funding Research and Technology is “to ensure the continuing availability of sound technical advice and of advanced and affordable technology to support mission-successful Defence capabilities”.

2 The Department has historically provided direct funding to a major programme of Defence technology-related research, primarily within its own research facilities. Recently there have been important developments in the Department’s approach to Research and Technology. In part, these developments reflect changes in the research and technology environment, the increased threat of international terrorism and the lead being taken by the civil sector in areas such as communications and information technology. Other significant changes include the part-privatisation (as QinetiQ) of its main research supplier, the Defence Evaluation and Research Agency.

3 In response to the wide-ranging environmental changes, the Department’s strategy is increasingly changing from one of creating the Technology Base to one of accessing and exploiting it. It is focusing its expenditure on maintaining a knowledge base that covers a wide range of technologies relevant to Defence. The Department is re-organising how it manages the Research and Technology programme and is widening its supplier base through the introduction of competition. It also has a number of initiatives under way to improve exploitation of the Research and Technology that it funds.

4 This report examines the Department’s new approach to Research and Technology investment and Appendix 1 provides details of our methodology. We found that the Department has made much progress in developing new approaches to the management of Research and Technology that hold the prospect of delivering better outcomes both for Defence and more widely, but that there is more to do to embed the changes. The following paragraphs summarise the main conclusions from our analysis. Figure 1 shows how the issues are analysed in detail in the main body of the report.

---

The Management of Defence Research and Technology

The Department is changing its strategic management approach to Research and Technology

There have been significant changes in the Research and Technology environment

The Department is adopting an output-management approach to Research and Technology

The Department recognises the need for advice as well as technology as a research output to support its needs

A strategic framework for Research and Technology is developing but there is more to do to align levels of strategy and to reflect the output approach

Measuring research outcomes is difficult. The Department is making progress but it will take time to see the benefits of the new focus

Structural and process changes should improve business focus but changing culture will be the key to success

Structural changes should increase programme visibility and support better decision-making

Better corporate visibility of the Research and Technology programme should enable more informed decision-making

The Department is developing a single funding stream to better facilitate a coherent balance among investment decisions

Prioritisation mechanisms within customer areas vary but a framework for corporate comparison is not fully developed

Output owners must behave in a collegial fashion in co-ordinating research activities to ensure a coherent programme

The Department is seeking access to a wider Research and Technology base

The increasing programme of competition should help broaden the research supplier base

The Department intends to work more closely with industry and academia to encourage innovation

The Department aspires to increase International Research Collaboration to improve access to wider Research and Technology

The Department is taking action to manage technology exploitation more effectively

Intellectual Property Rights arrangements for research have been redesigned to enable broader exploitation

The Department has a number of initiatives to encourage industry to become more engaged in exploitation but more can be done

The part-privatisation of QinetiQ should encourage exploitation

A more appropriate programme of technology demonstration could reduce the level of risk being carried into the Equipment Programme

Capability Management requires a broader understanding of technology to inform the equipment decision which may not be achievable under current funding arrangements
5 The Department’s strategic management of Research and Technology is developing. In particular, its adoption of an output-management approach to managing research has the potential to deliver a range of benefits, although the full impact of the changes will not be known for several years. The Department’s strategic framework for determining funding priorities and planning the research programme is still developing, and there is further work to do in revising and aligning the various levels of strategy. Measures are being introduced to gauge the success of Research and Technology but these can be further developed.

6 The structural and process changes that the Department is introducing, notably creating the Research Acquisition Organisation and the Defence Science and Technology Board, have the potential to deliver a better focused and more responsive programme. There are risks associated with the changes, particularly influencing the culture of all those involved in the delivery of Research and Technology in the Department and its partners and encouraging corporate decision-taking. The Department will need to manage these risks carefully.

7 The Department is making good progress on introducing competition for the Research and Technology programme. Competition is having a positive impact on bid quality but the Department can do more to tailor pricing and contracting mechanisms to meet the particular challenges of research procurement. As far as encouraging joint working is concerned, the Department is making progress on establishing Defence Technology Centres and Towers of Excellence, but it is too early to evaluate their benefits. Although progress has been limited, the Department has aspirations to increase research procured through international collaboration and benefit from the associated favourable return.2

8 Improving the pull-through of technology from the Research and Technology programme to the delivery of Defence equipment is important and part of the Department’s new approach is to improve performance in this area. The Department has recognised many of the key exploitation issues and has developed new commercial conditions and processes to enable the exploitation of the technology development it funds both for Defence and for wider civil uses. There is more the Department can do to manage its expenditure on technology demonstration coherently and to bridge the gap between work funded from the research and equipment programme budgets.

---

2 Paragraph 2.3 of the National Audit Office’s report “Ministry of Defence: Maximising the Benefits of Defence Equipment Cooperation” HC 300, 2000-01, suggests that there is a 5:1 return on international collaborative research.
Recommendations

The following recommendations are intended to support and further develop the Department’s new approaches to the management and procurement of Research and Technology, to help ensure that they deliver better outcomes both for Defence and more widely. Our recommendations are grouped under three main headings: strategic management, improving business focus and managing technology exploitation.

Strategic Management

To ensure that all stakeholders are aware of the Department’s strategic priorities and its role in the development and application of technology, the Department needs to:

- update the existing strategy to clearly articulate technology priorities;
- ensure that the various levels of strategy are consistent across the framework; and
- communicate the strategy to stakeholders (including industry).

As the realisation of research outcomes can take a long time, the Department needs interim measures to determine the impact of the output approach. We recommend a number of process and outcome measures at Appendix 4.

Building on its Knowledge Network initiative, we recommend that the Department collects appropriate data that will enable programme performance to be distinguished according to a variety of factors, such as technology area, capability area, supplier and method of procurement, all of which should inform future decision-making.
Improving Business Focus
To ensure that the Department has the right expertise to deliver the research programme and meet the research competition targets, it should clarify the role of the Defence Science and Technology Laboratory in supporting the Research Acquisition Organisation. This should inform the Department’s recruitment and retention strategy, particularly for commercial staff. This should enable the Department to develop more appropriate contracting and pricing mechanisms for research competition.

In order to ensure that a balanced programme is achieved and all aspects of capability are recognised, the Defence Science and Technology Board should put in place higher-level prioritisation criteria to guide output owners’ strategies and decisions.

Managing Technology Exploitation
To maximise the proven benefits of technology demonstration in driving down programme risk, the Department should:

- rebalance the formal Technology Demonstrator Programme to increase funding availability;
- review its arrangements for funding and monitoring technology demonstration;
- consider ways of ensuring an even stream of funding for technology demonstration during the transition between research and equipment budgets;
- investigate ways to capitalise on industry’s willingness to jointly fund more of the demonstration work.

The Department needs to recognise explicitly the challenges associated with developing and exploiting a broader range of technologies. Exploration of a broader range of technologies is an essential element of effective Capability Management.
The Department is changing its strategic management approach to Research and Technology

There have been significant changes in the Research and Technology environment

Page 7

The Department is adopting an output-management approach to Research and Technology

Page 9

The Department recognises the need for advice as well as technology as a research output to support its needs

Page 10

A strategic framework for Research and Technology is developing but there is more to do to align levels of strategy and to reflect the output approach

Page 10

Measuring research outcomes is difficult. The Department is making progress but it will take time to see the benefits of the new focus

Page 12
1.1 This part of the report focuses on how the environment within which the Department undertakes Research and Technology is changing and how the Department’s strategic management is developing in response. In particular, we examine the Department’s adoption of an output-management approach to Research and Technology; the Department’s developing strategic framework to reflect the changing environment; and the Department’s progress in measuring the success of its research programme.

1.2 Our analysis shows that the Department’s new approach to managing research outputs has the potential to deliver a range of benefits, although the full impact of the changes will not be known for several years. The Department’s strategic framework for determining funding priorities and planning the research programme is still developing, and there is further work to be done on revising and aligning the various levels of strategy and on measuring success.

There have been significant changes in the Research and Technology environment

1.3 The Department’s management of Defence Research and Technology has had to respond to a number of key changes. These can be categorised under four headings: government; the threat environment; industry; and technology. The defence research conceptual framework at Figure 2 shows how the wider environment is translated through strategy to shape the internal processes of programme prioritisation; acquisition; exploitation; and output measurement.

1.4 The external influences are described in more detail in Figure 3.

1.5 The Department has historically provided direct funding to a major programme of Defence technology-related research, primarily within its own research facilities, and has been an important custodian of the national Technology Base. The Technology Base is essentially a set of capabilities, each representing a technology area, such as structural materials or sensor systems. Each capability comprises people (scientists, engineers and technical support staff), facilities (laboratories, experimental facilities and test ranges), knowledge and recorded information.

1.6 In response to the wide-ranging environmental changes, the Department’s strategy is increasingly changing from one of creating the Technology Base to one of accessing and exploiting it. It is focusing its expenditure on maintaining a knowledge base that covers a wide range of technologies relevant to Defence. Where the Department directly funds Defence specific technology, funding priorities are a direct reflection of the strategic and Defence value of the technology and its availability from other sources. Figure 4 (on page 9) shows the recent trend in the Department’s expenditure.
The Environment

There have been major changes in the environment for Research and Technology.

<table>
<thead>
<tr>
<th>Environment</th>
<th>Key Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government</td>
<td>Spending</td>
</tr>
<tr>
<td></td>
<td>- The Department's funding of Research and Technology has fallen faster than the general decline in Defence spending (Figure 4);</td>
</tr>
<tr>
<td></td>
<td>- Departmental Research and Technology funding is significantly greater than that of UK Defence industries.</td>
</tr>
<tr>
<td></td>
<td>Value for money</td>
</tr>
<tr>
<td></td>
<td>- The Department has set targets for exposing the Research and Technology programme to competition over the next few years (Figure 10).</td>
</tr>
<tr>
<td>Defence Industrial Policy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- The Department is committed by policy to co-ordinating resources with industry and academia, maximising exploitation of civil technology and targeting investment into areas where the United Kingdom can be global leaders;</td>
</tr>
<tr>
<td></td>
<td>- Pull-through of technology into early de-risking of specific technologies is important;</td>
</tr>
<tr>
<td></td>
<td>- The National Defence and Aerospace Systems Panel (NDASP) will advise on research strategy and identify industry priorities for Research and Technology support;</td>
</tr>
<tr>
<td></td>
<td>- Two major initiatives for developing partnerships with industry and encouraging pull-through of technology are Defence Technology Centres and Towers of Excellence (Parts 3 and 4 of the report).</td>
</tr>
<tr>
<td>International agenda</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- The aim is to avoid duplication of research effort with allies; improve access by industry to foreign technology; and increase the proportion of research that is carried out collaboratively (Part 3 of the report);</td>
</tr>
<tr>
<td></td>
<td>- International partnering will become increasingly important, for example, wider international collaboration in building Towers of Excellence.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Threat</th>
<th>Proliferation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- The trend towards proliferation of conventional weapons and weapons of mass destruction continues to be a threat to security.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Terrorism</th>
</tr>
</thead>
<tbody>
<tr>
<td>- The Department’s response to the evolving international terrorist threat is provided in the Strategic Defence Review New Chapter;</td>
</tr>
<tr>
<td>- The New Chapter recognises the need for new technology to counter asymmetric tactics and evolving threats.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Disruptive application of civil technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Civil technology is being adapted to provide military capability that is available to potential opponents;</td>
</tr>
<tr>
<td>- Wholly civil technology and commercial systems can be used for disruptive purposes, as evidenced by the events of September 11th.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>- The evolving nature of the Department's operations is a key influence, for example the requirement for greater speed and agility and the introduction of Network Enabled Capability.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Industry</th>
<th>Globalisation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- The increasing globalisation and rationalisation of the Defence industry has implications for research procurement.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technology</th>
<th>Commercial availability and leadership</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- The civil sector is now leading technology investment in many areas (e.g. electronics and communications);</td>
</tr>
<tr>
<td></td>
<td>- &quot;Dual-use&quot; technologies (e.g. information technology and biotechnology) are becoming increasingly important to Defence.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The accelerating pace of change</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Faster change means more rapid obsolescence of components in Defence systems;</td>
</tr>
<tr>
<td>- More frequent technology insertion and upgrade;</td>
</tr>
<tr>
<td>- It is necessary to rapidly identify and exploit the civil technologies that improve military advantage.</td>
</tr>
</tbody>
</table>

Source: National Audit Office
The Department is adopting an output-management approach to Research and Technology

1.7 The Department is in the process of introducing an output-based funding and delivery framework for Research and Technology. Under the new approach, Research and Technology management will be focused around seven specific outputs, as illustrated in Figure 5. This new approach aims to improve Research and Technology performance in a range of areas, including:

- the level of exploitation and pull-through of technology;
- the provision of specialist advice to Ministers and policy-makers;
- providing greater visibility and clearer understanding if possible of the outputs of research expenditure and their costs; and
- providing a more responsive system for allocating resources to Defence priorities.

The “Seven Outputs”

Five of the seven outputs consist of advice to key decision-makers.

<table>
<thead>
<tr>
<th>Category</th>
<th>Output</th>
<th>Description</th>
<th>Output owner</th>
<th>Approximate % of Spend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advice</td>
<td>1 Hot Topics</td>
<td>Specialist scientific advice for Ministers and key decision-makers on</td>
<td>Chief Scientific Advisor</td>
<td>3%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>strategic and politically sensitive issues.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 Policy and</td>
<td>Scientific advice and analytical support to policy- and decision-makers.</td>
<td>Policy Director</td>
<td>0.5%</td>
</tr>
<tr>
<td></td>
<td>Planning</td>
<td>Safety advice on equipment capability planning and management such as</td>
<td>Deputy Chief Defence Staff (Equipment Capability)</td>
<td>51%</td>
</tr>
<tr>
<td></td>
<td>3 Capability</td>
<td>Scientific advice across the Department and Armed Forces in support of wider</td>
<td>Science and Technology Director</td>
<td>9%</td>
</tr>
<tr>
<td></td>
<td>Management</td>
<td>activities such as procurement.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4 Availability</td>
<td>Technology-watch activities to ensure access to the global technology base</td>
<td>Science and Technology Director</td>
<td>13%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>and to interpret and communicate the consequences for Defence.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5 Technology</td>
<td>To ensure the availability of appropriate technology work in the UK Defence</td>
<td>Deputy Chief Executive (Defence Procurement</td>
<td>14%</td>
</tr>
<tr>
<td></td>
<td>Awareness</td>
<td>supplier base to meet UK Defence needs.</td>
<td>Agency)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Encouraging the exploration of innovative solutions to create new or better</td>
<td>Deputy Chief Defence Staff (Equipment Capability)</td>
<td>6%</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>military capabilities.</td>
<td></td>
<td>3.5%</td>
</tr>
</tbody>
</table>

NOTE

The intended outcome of “technology” outputs is the generation of technology, systems or solutions. The intended outcome of “advice” outputs is to inform a decision-making process.

Source: Ministry of Defence
The Department recognises the need for advice as well as technology as a research output to support its needs

1.8 Historically, new knowledge of technology, generated through research, provided the basis of advice. However, it was not clear how much of the research output was technology and how much advice. The Defence Evaluation and Research Agency (the forerunner to the Defence Science and Technology Laboratory (Dstl) and QinetiQ) was the primary repository of the Department's knowledge and a main source of impartial advice. Following the part-privatisation of the Defence Evaluation and Research Agency the Department has revisited its approach to ensure continuing access to, and maintenance of, an independent advice capability. Dstl, an Executive Agency of the Department, will continue to provide in-house expertise in sensitive research areas (such as biomedical sciences and sensor research), and a broader range of technical advice, often drawing on external knowledge. The agreement between the Department and QinetiQ ensures continued access to expert, impartial advice but other advice may be provided by Dstl, procured through competition, adopted from commercial activities or from user feedback.

1.9 The Department's new approach explicitly recognises advice\(^3\) as an output from the Research and Technology programme. It also recognises that advice is exploited for a variety of reasons and by different clients. The advice function is expressed in five of the seven outputs. Attributing the current programmes across the outputs should enable the Department to see more clearly the relative spends on advice and technology. Initial attribution has identified that around 75 per cent of current research expenditure is allocated to advice-related outputs. Recognising advice as a critical element of Research and Technology output is thus essential in supporting planning and procurement decisions and in helping to ensure that the Department retains its status as an intelligent customer. The Science and Technology Board has recently re-balanced the research programme. It has reduced resources for advice to capability management and advice availability and increased resources for technology in the supplier base, innovative solutions, advice on hot topics and advice for policy and planning.

A strategic framework for Research and Technology is developing but there is more to do to align levels of strategy and to reflect the output approach

1.10 The Department's strategy for Research and Technology is expressed through a variety of documents. At the top level is the Technology Strategy, which is informed by the Defence Strategic Guidance paper. The Intermediate Technology Strategy interprets the high level Technology Strategy, and links to the output owner strategies and lowest level “domain” strategies for individual technology areas. We found much of the existing strategy, across all levels, is yet to be reviewed to bring it into line with important developments, for example, the Department's industrial policy\(^4\), the New Chapter of the Strategic Defence Review and the new output approach. Work is continuing, and Figure 6 illustrates how the new strategic framework should appear when completed.

Funding has not always reflected the Department's strategic priorities

1.11 A weakness of the previous management process was that Department-funded research activity was not well aligned to the funding prioritisation recommendations of the Technology Strategy. For example, the Department's 2001 review found that of the 27 technologies recommended for increased funding in a previous version of the Strategy, 12 had received reduced funding, and of the 16 technologies recommended for reduced funding, six had received increased funding.\(^5\) Following the part-privatisation of the Defence Evaluation and Research Agency, the Department has reorganised itself, and now has a much stronger role in specifying its research programme and determining procurement strategies. This provides the Department with a direct opportunity to reflect strategic priorities in the research programme.

---

3 Advice is work that is mainly intended to inform, but it should be noted that such work is underpinned by a large amount of analysis and research which will ultimately benefit other advice and technology outputs.

4 Defence Industrial Policy, October 2002.

Further work is required to develop and update the various strategy documents and links with industry investment decisions.

1.12 We reviewed the strategic framework for completeness, coherence and consistency. The Department's Technology Strategy is a key document. Its purpose is to direct funding to those technology areas most likely to enhance Defence capability over a 30-year time horizon and to guide the planning of the research programme, and is therefore critical to the prioritisation process. Specific priorities for funding are identified in the Strategy. The Strategy was last updated in 2000, and identified 21 technologies for increased funding, and 12 technologies for reduced funding. The Strategy is still in force, but requires updating in light of the wider developments within the Department and technology. It is important that work to finalise and publish the Strategy is completed soon, as this document provides guidance for the selection of future tranches of Defence Technology Centres\(^6\) and Towers of Excellence.\(^7\)

1.13 We found that further work is needed to complete the lower levels of strategic guidance. A draft Programme Strategy was produced in 2002 to provide a strategic context for individual technology domain strategies. The draft strategy was, however, mainly directed towards guiding funding decisions relating to Corporate Research (controlled by scientific staff centrally with a bias towards inventive research) rather than the larger Applied Research Programme, which was driven more by specific military needs, for future capability identified in the 30 year Capability Plans, maintained by the Equipment Capability Customer and captured in the Applied Research Programme Strategy. The finalisation of the Programme Strategy was put on hold due to the introduction of the output approach. The Department is now developing an Intermediate Technology Strategy to replace the draft Programme Strategy and to provide a link between the top level strategy and detailed operational strategies at the technology domain level. At the lowest level of strategy, a full set of individual technology domain strategies are in place but they will need to be revised when the Intermediate Strategy and the revision to the Technology Strategy are completed.

---

\(^6\) Defence Technology Centres are collaborative partnerships between the Department, industry and academia focused on basic technology research.

\(^7\) Towers of Excellence are also collaborative arrangements but aimed at developing excellence within the Department and the equipment supplier base in specific high priority systems.
1.14 The Department has recognised that the focus of its own investment needs to be considered in the light of technology investment by industry. In 1995 the Foresight Defence, Aerospace and Systems Panel recommended a national strategy for defence and aerospace technologies. In March 2000, a National Defence Industry Technology Strategy (NDITS) was produced with industry participation. This presents industry views on the importance of defence technologies, and its expectations for future investment. The Industry Strategy, together with the Department’s Technology Strategy, guided the selection of the first tranches of Towers of Excellence and Defence Technology Centres. The National Defence Industry Technology Strategy is now being updated to identify priorities for the second tranche in 2003-04. An initial list of industry’s priorities was identified in August 2003, but this needs to be compared against the Department’s own views of current priorities.

Measuring research outcomes is difficult. The Department is making progress but it will take time to see the benefits of the new focus

The absolute value of research is difficult to measure

1.15 Research outputs are difficult to measure. Performance measurement is complicated by the long lead-times in realising outcomes, and the variety of research inputs and outputs. Input parameters (such as manpower and facilities) and shorter-term results are useful and easier to quantify. Historically, the Department has not had a coherent mechanism for identifying and quantifying the benefits of research programmes. This is currently being addressed and output owners are developing metrics to measure their performance with respect to their output. However, developing comprehensive, robust and complementary research-performance metrics to be applied across output owners is likely to take time.

The impact of the current changes will take several years to become embedded

1.16 The impact of changes in the conduct of Research and Technology will not be known for several years, and measurement of improvements is complicated by the lack of a clear baseline for comparison. It could take up to three years to implement the output-based framework across the programme, as many of the current research programmes are contracted for a three year period.

Process and outcome measures will aid decision-making

1.17 Robust measures of research outputs would be useful to the Department in prioritising research proposals. In the absence of established predictive indicators linking research to military capability, we found priority tends to be assigned by a combination of peer review (including review by independent advisors recommended by the members of the Defence Scientific Advisory Council) and the track record of specific suppliers. The Department is taking steps to collect long-term data on research performance. Research use and its benefits will be clearer as a result of the Department’s recent “Knowledge Network” initiative, which aims to build a comprehensive database of Research and Technology activities, and link these activities to capability achievements. Appendix 4 examines the scope for developing process and outcome measures.

As the realisation of research outcomes can take a long time, the Department needs interim measures to determine the impact of the output approach. We recommend a number of process and outcome measures at Appendix 4.

Building on its Knowledge Network initiative, we recommend that the Department collects appropriate data that will enable programme performance to be distinguished according to a variety of factors, such as technology area, capability area, supplier and method of procurement, all of which should inform future decision-making.
Structural and process changes should improve business focus but changing culture will be the key to success.

- Structural changes should increase programme visibility and support better decision-making
- Better corporate visibility of the Research and Technology programme should enable more informed decision-making
- The Department is developing a single funding stream to better facilitate a coherent balance among investment decisions
- Prioritisation mechanisms within customer areas vary but a framework for corporate comparison is not fully developed
- Output owners must behave in a collegial fashion in co-ordinating research activities to ensure a coherent programme
2.1 This part of the report examines the main structural and process changes that the Department is introducing to improve the delivery of Defence Research and Technology. We found that the structural and process changes have the potential to deliver a better focused and more responsive programme, but the Department will need to manage the associated risks carefully, particularly changing the culture of those involved in the delivery of Research and Technology in the Department and its partners.

Structural changes should increase programme visibility and support better decision-making

2.2 The Department is introducing a number of structural changes including the appointment of senior output owners, the creation of a new Defence Science and Technology Board and the establishment of the Research Acquisition Organisation. Figure 7 illustrates how the new structures relate. As the following paragraphs highlight, the changes should give the Department a better overview of the Research and Technology programme enabling more effective decision-making, although there are risks if the changes are not properly implemented.
Organisational changes should support the focus on the seven research outputs

2.3 Each output owner together with their stakeholders is required to draw up a strategy laying out their needs and critical success factors. Output owners then produce bids for resources for their outputs. These bids are screened by a stakeholder group of Director level representatives of Board members, called the ‘engine room’. They consider the balance of resources across outputs to best meet output owners’ needs and high level defence criteria. The engine room produce Balance of Investment options which are reviewed by the Science and Technology Board. The Science and Technology Board decides on the balance between outputs and direction for future investment. Output owners then work with the Research Acquisition Organisation to develop programmes for their outputs in line with the resources earmarked for each output by the Science and Technology Board, and place them with the right suppliers. The Research Acquisition Organisation advises output owners on the development of the programme and ensures the coherence of the programme. In most cases the programme will then be placed with appropriate suppliers by the Research Acquisition Organisation on output owners’ behalf.

2.4 Each output owner, who will represent a range of customers, has discretion over whether to delegate objectives to the 1-star level, for example, the Directors of Equipment Capability. Each output owner will be supported by a small support group of key stakeholders, who will help with the definition of requirements and priorities and work with the Research Acquisition Organisation. In addition, the engine room will fulfil the role of addressing cross-cutting issues and ensure there is cooperation between output owners.

2.5 The Research Acquisition Organisation was initially established in 2002 under the control of the Director of Technology Development in the Central Scientific Staff. Its roles and responsibilities continue to evolve. The Research Acquisition Organisation will work with the seven output owners and customers to translate customer needs in each of the output strategies and to plan and manage a Research and Technology programme that is consistent with the Department’s strategy and high-level Defence needs.

2.6 The Research Acquisition Organisation is planned to have a complement of 80 staff. Around 50 are currently in post, with specific staff shortages in the contractual and commercial areas. The Organisation is currently re-locating to Shrivenham, due to complete by March 2004. There is a risk that re-location will exacerbate existing staffing shortfalls. The Department has to date relied on staff from the much larger Dstl, particularly its Programme Co-ordination Office, to assist with definition of research requirements, management of research and assessment of research results. Some Dstl staff have also been embedded within the Equipment Capability customer areas. In the longer-term, the Department will need to take a view on whether this expertise should be brought into the Research Acquisition Organisation, with the possible staffing implications that may have, or whether it should continue to source this expertise from Dstl. Under either option, the Department should ensure that it has the necessary technical expertise to act as an intelligent research customer, to respond to the challenges posed by the increasing level of competition and to develop more appropriate contracting and pricing mechanisms.

RECOMMENDATION

To ensure that the Department has the right expertise to deliver the research programme and meet the research competition targets, it should clarify the role of the Defence Science and Technology Laboratory in supporting the Research Acquisition Organisation and this should inform the Department’s recruitment and retention strategy, particularly for commercial staff. This should enable the Department to develop more appropriate contracting and pricing mechanisms for research competition.
Better corporate visibility of the Research and Technology programme should enable more informed decision-making

2.7 Under its previous arrangements, the Department did not have a comprehensive corporate overview of the overall pattern of Research and Technology activities and the funding allocated to individual technologies. The Research Acquisition Organisation will work with the Defence Science and Technology Board to:

- identify and manage synergies between the requirements of different customers;
- promote a more coherent programme and avoid duplication;
- check the consistency of the research programme with centrally-determined strategic priorities;
- identify and manage the progression of Science and Technology across outputs as appropriate;
- ensure that an efficient and balanced programme is achieved; and
- become more responsive to changing priorities in making funding decisions.

2.8 As such, the Research Acquisition Organisation will perform the vital function of removing duplication and increasing coherence between output owners’ requirements. Risks remain, however, in balancing the tensions inherent in any prioritisation process. Customers may potentially seek other procurement routes if their research requirements are not appropriately catered for.

The Department is developing a single funding stream to better facilitate a coherent balance among investment decisions

2.9 Two key judgments exist in any research programme with regard to the balance of investment: the spread of investment between advice and technology, and between inventive and equipment specific research. In the past, the Department funded and prioritised research through three main Programmes - the Corporate Research Programme, the Applied Research Programme, and the Technology Demonstrator Programme. The latter two Programmes were principally orientated to capabilities and linked to equipment to meet specific military needs. The Applied Research Programme received approximately three times the funding of the Corporate Research Programme. The Corporate Research Programme was generally aimed at meeting a multiplicity of military needs. The different focus of the Programmes and the fact that they each had a number of separate customers meant that links between related research carried out under each Programme were not clear. Research funding was largely assigned according to historical spending allocations and the annual Balance of Investment exercise focused on savings and enhancements rather than a review of the wider programme. Existing commitments and the lack of an accepted common prioritisation methodology limited the extent to which the budget could be reallocated.

2.10 In light of the new output system involving a single funding stream, we examined, first, whether there are effective systems for prioritising requirements within customer communities and, second, whether there are suitable criteria in place to assist the Board in making balance-of-investment decisions between outputs.

Prioritisation mechanisms within customer areas vary but a framework for corporate comparison is not fully developed

2.11 There are a number of potential customers for Defence research, the most prominent of which is the Equipment Capability Customer. Our analysis showed that within each Equipment Capability area, there are well-founded and effective prioritisation processes. Capability Plans are produced by each Equipment Capability area and include prioritised Research Programmes that capture the research requirements needed to address technology gaps. Figure 8 illustrates how this process works and who the stakeholders are.

2.12 Prioritising across different types of research is difficult, as the outputs differ considerably. Research to meet Equipment Capability requirements will typically be focused on gaining knowledge or exploring technology for a specific acquisition programme in a relatively short timescale. Inventive research programmes will generally involve developing technology with Defence potential but not necessarily a specific application, and usually with longer timescales to product realisation.

2.13 Our analysis found that there has been no clear method to reconcile priorities between inventive and equipment specific programmes, the division being determined by historical budget precedent. As a result, the balance between inventive and equipment specific programmes may not have been optimal. Assigning sufficiently high priority to inventive research is a difficult matter. This partially reflects a budget-orientated cultural mindset that drives the system towards incentives that emphasise near-term and quantifiable results, thus reinforcing risk aversion and short-termism.
Output owners must behave in a collegial fashion in co-ordinating research activities to ensure a coherent programme.

2.14 Under the Department’s new approach, the Defence Science and Technology Board, supported by the Research Acquisition Organisation, will prioritise resources between the outputs based on the agreed programme of research. Prioritisation is based on a single stream of funding, with research requirements considered in the context of wider corporate requirements and priorities.

2.15 The Department’s new processes have the potential to highlight synergies or overlaps between the requirements of different customers but there remain some areas of uncertainty. For example, where a proposed research programme is attributed across several output owners there is no clear mechanism to ensure it has the same priority within each output. This makes it important that there are higher-level prioritisation criteria in place to guide the decisions of individual output owners; the Defence Science and Technology Board functions effectively; and the potential for research to contribute to the development of all aspects of capability is fully recognised.
2.16 Figure 9 illustrates how the outputs relate to the dominant characteristics of the research - technology, advice, equipment-specific and inventive research. The final profile of the overall research programme at any point in time will depend upon the priority accorded to each need. The profile is not fixed and can change each year as evolving priorities are reflected in the programme. If the tensions are managed effectively, the result should support one of the outcomes the Department hopes to achieve: greater agility in determining and adjusting balance of investment between outputs.

**RECOMMENDATION**

In order to ensure that a balanced programme is achieved and all aspects of capability are recognised, the Defence Science and Technology Board should put in place higher-level prioritisation criteria to guide output owners’ strategies and decisions.

---

**Quadrant Analysis of the new System, showing Tensions**

The outputs can be positioned according to the dominant characteristics of the research.

Source: National Audit Office
The Department is seeking access to a wider Research and Technology Base

The increasing programme of competition should help broaden the research supplier base

The Department intends to work more closely with industry and academia to encourage innovation

The Department aspires to increase International Research Collaboration to improve access to wider Research and Technology
3.1 This part of the report examines the Department’s progress in increasing its Science and Technology base. The key Departmental initiatives to achieve this are the introduction of competition for the Research and Technology programme and encouraging collaboration with industry and academia through a range of measures, including the Defence Technology Centres initiative and international partnerships. Our analysis identifies that the Department is making good progress with introducing competition, which is having a positive impact on bid quality. For the future, the Department needs to tailor pricing and contracting mechanisms to meet the particular challenges of research procurement. The Department is also making good progress with establishing Defence Technology Centres, although it is too early to evaluate their benefits. The Department recognises the potential benefits of international collaborative research and aspires to increase research procured in this way.

The increasing programme of competition should help broaden the research supplier base

3.2 In Part 1 we explained that the Department’s aims are better access to the best military and civil Research and Technology, and improved value for money. Currently, 90 per cent of research work is awarded non-competitively, primarily to QinetiQ and Dstl. The Department has set targets for increasing competition and 10 per cent of the Research Building Block will be competed in 2003-04.

3.3 Competition is capped in the short term by assurances given to QinetiQ under the Public Private Partnership and the need to build expertise in the Research Acquisition Organisation to run competitions. A certain line of funding of specialist defence needs will always be placed with Dstl (approximately 36 per cent). The Department plans to compete the vast majority of the remaining research work, as shown in Figure 10, although single tender may remain the only option for some facilities or expertise where the entry costs are prohibitive.

3.4 Our analysis showed that competition was achieved on all but one occasion where it was embarked on and QinetiQ (or a consortium involving QinetiQ) has won approximately half the competed contracts (70 per cent by value). Incumbent advantage is therefore not overwhelming, and the evidence suggests that competition is encouraging networking in the supplier base. UK and overseas industry together with academia have been involved in the initiative. Our analysis shows that the average time for the Department to run a competition and award a contract has reduced across the first three batches of the competition initiative. Academia has been less well represented than was initially hoped, and concluding contracts has consistently taken longest with academia (Figure 11).
The Department has implemented new contracting arrangements to support competition but there is more to do

3.5 In the past, the Defence Evaluation and Research Agency was closely involved in specifying research. However, the Department’s decision to introduce competition has made it essential to develop a more formal relationship with its suppliers. The Department has successfully transferred the existing programme from rolling three-year programmes of research, based on “cost-plus” payment arrangements and without clearly-defined targets, to formal fixed or firm-price contracts. Requirements are now customer-defined, with stated deliverables and timescales. There are an increasing number of fixed or firm-price research contracts rather than the more traditional cost-plus style. In 2002-03, 60 per cent of the Applied Research Programme was delivered under firm-price terms. This form of contracting is most appropriate where the output can be clearly defined and measured, so may be less suitable for inventive-type research. However, in 2002-03, 86 per cent of the new Corporate Research Programme research contracts were let under firm-price conditions.

3.6 Industry told us that it was concerned that it would not be able to compete with QinetiQ for research work on a level playing-field. We found that the Department has taken steps to ensure that research competition is fair, by developing competition terms and conditions and Intellectual Property Rights clauses (see Part 4) that will be common to any supplier, whether industry, academia or QinetiQ.

3.7 We found that QinetiQ is producing better-quality bids than it did previously, and is more actively considering exploitation issues. There has also been a positive impact on the non-competed programme, where many of the same disciplines have been adopted for programmes that will be competed in the future. Ultimately, better-quality bids do not imply better products and the Department’s ability to evaluate research products at the bid and delivery stages will be critical in determining the success of competition.

The Department’s performance in letting programmes competitively

The Department has shown improvement in the timely letting of contracts across the first three batches of competitive programmes. On average, it takes longest to conclude a successful contract with academia.

The Department’s performance in letting programmes competitively

<table>
<thead>
<tr>
<th>Competition Batch</th>
<th>Batch 1</th>
<th>Batch 2</th>
<th>Batch 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Months</td>
<td>7</td>
<td>6</td>
<td>5</td>
</tr>
</tbody>
</table>

Average time from advert in contract bulletin to contract award

Average time for Department to assess bids and award contract

Source: National Audit Office

Average time for Department to assess bids and award contract

Industry | QinetiQ | Academia

Time taken to conclude a successful contract (months)

Research Supplier

0 | 1 | 2 | 3 | 4 | 5

Industry | QinetiQ | Academia

3.6 Industry told us that it was concerned that it would not be able to compete with QinetiQ for research work on a level playing-field. We found that the Department has taken steps to ensure that research competition is fair, by developing competition terms and conditions and Intellectual Property Rights clauses (see Part 4) that will be common to any supplier, whether industry, academia or QinetiQ.

3.7 We found that QinetiQ is producing better-quality bids than it did previously, and is more actively considering exploitation issues. There has also been a positive impact on the non-competed programme, where many of the same disciplines have been adopted for programmes that will be competed in the future. Ultimately, better-quality bids do not imply better products and the Department’s ability to evaluate research products at the bid and delivery stages will be critical in determining the success of competition.
The Department intends to work more closely with industry and academia to encourage innovation

3.8 One way in which the Department is trying to ensure best value for money and access to technology is to increase research collaboration through partnerships with industry and other governments. We examined what mechanisms the Department has developed to meet these intentions and how successful they have been.

The Defence Technology Centre initiative helps to focus the Department and industry on specific technology areas

3.9 The establishment of Defence Technology Centres is a key initiative to achieve collaboration with industry and academia in the development of priority basic technology areas. Technology areas have been determined on the basis of the Department’s Technology Strategy and industry’s National Defence Industry Technology Strategy exercise. Consortia are selected according to their proposed approach to the task and its subsequent exploitation, including civilian use where appropriate. Centres are jointly funded by the participants and the Department has earmarked £100 million from the Research Building Block to fund the Centres over a five-year period. Cost-sharing results in the Department having more limited rights over the output of the programme (Figure 12).

The Department aspires to increase International Research Collaboration to improve access to wider Research and Technology

3.10 The Department’s policy is to pursue international research collaboration actively when it adds value. Such collaboration can give Government access to information to support decision-making, and industry access to technology to produce equipment, as shown in the Electronic Armour Case Study. Our report on Equipment Cooperation and the Department’s recent internal policy paper on international collaboration suggest that research collaboration produces a return of three to five times its direct expenditure. Other countries spend significant sums on Defence research: the United States spends 12 times as much on Defence research as the United Kingdom and four times as much as Europe as a whole. However, research collaboration with the United States is usually confined to information exchange. European collaborative research arrangements are governed by the EUROPA agreement, a flexible arrangement developed between the Governments which can include industry.

### The Department’s programme of Defence Technology Centres

<table>
<thead>
<tr>
<th>Defence Technology Centre</th>
<th>Contract Awarded</th>
<th>Winning Consortium</th>
<th>Departmental Funding</th>
<th>Consortium Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tranche 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data and Information Fusion</td>
<td>Feb 2003</td>
<td>General Dynamics U.K</td>
<td>30 (over 6 years)</td>
<td>30 (over 6 years)</td>
</tr>
<tr>
<td>Human Factors Integration</td>
<td>Apr 2003</td>
<td>Aerosystems International</td>
<td>7.6 (over 3 years)</td>
<td>5.1 (over 3 years)</td>
</tr>
<tr>
<td>Electromagnetic Remote Sensing</td>
<td>Apr 2003</td>
<td>BAE Systems</td>
<td>15 (over 3 years)</td>
<td>30 (over 3 years)</td>
</tr>
<tr>
<td>Tranche 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systems Engineering: autonomous and semi-autonomous vehicles</td>
<td>Not yet awarded</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Source: National Audit Office/Ministry of Defence

---

3.11 Expenditure on international collaboration is currently low — about five per cent of the Research and Technology budget. We examined what action the Department is taking to increase the level of collaboration. We found that the majority of the Department’s international research is undertaken with the United States, Europe and Australia, funded under existing treaties. The Department’s internal policy paper on international collaboration proposes greater coherence and rationalisation of existing arrangements, and setting priorities for future research collaboration. We found few concrete signs of success, which is perhaps not surprising, given the long timescales to secure change in the international environment.

3.12 The Department is also attempting to extend collaboration with the United States to joint development of technology, accessible to both the United Kingdom and the United States industry, and has identified specific technologies to take forward under this initiative.

Electronic Armour was begun in 1998 as a joint US-UK collaborative research programme.

**Case Study - Electronic Armour**

Electronic armour is a means of making military vehicles less vulnerable to attack from widely available weapons such as rocket-propelled grenades, which can penetrate up to 600 mm of solid armour and can destroy a tank. It involves fitting metal plates to the exterior of the vehicle, which are connected to a capacitor that can be run off the vehicle’s standard power supply. The electronic armour will vaporise grenades or shells on impact. In trials of vehicles fitted with electronic armour, only cosmetic damage has been caused from the firing of grenades at point-blank range.

The technology that underpins electronic armour has been developed under a collaborative research programme with the United States, which began in 1998 and allowed for the exchange of detailed information and hard data. The United Kingdom element initially received funding under the Corporate Research Programme and then from the Applied Research Programme to carry out a six-month trial of the armour fitted to a vehicle. The research was led by Dstl, working with Loughborough University.

The development of electronic armour technology demonstrates that it is feasible to identify promising research carried out under the Corporate Research Programme and achieve rapid maturation of the technology with industry. It also demonstrates the value of collaborative working. The United States has developed a lighter-weight variant of the electronic armour solution and both solutions will be available to bidders for the Future Rapid Effects System contract.
The Department is taking action to manage technology exploitation more effectively

- Intellectual Property Rights arrangements for research have been redesigned to enable broader exploitation  
  Page 27

- The Department has a number of initiatives to encourage industry to become more engaged in exploitation but more can be done  
  Page 28

- The part-privatisation of QinetiQ should encourage exploitation  
  Page 29

- A more appropriate programme of Technology Demonstration could reduce the level of risk being carried into the Equipment Programme  
  Page 30

- Capability Management requires a broader understanding of technology to inform the equipment decision which may not be achievable under current funding arrangements  
  Page 33
4.1 This part of the report examines what steps the Department is taking to ensure that technology is exploited effectively and efficiently. It considers the Department's commercial conditions to enable the exploitation of technology development it funds, the Department's organisation and processes to support its exploitation aspirations, and the Department's initiatives to improve exploitation.

4.2 We found that the pull-through of technology from the Research and Technology programme to the Equipment Programme has not been well documented. There was a common view that pull-through into the Equipment Programme has historically been low and there was scope to improve it. One aim of the Department's new approach is to improve performance in this area. The Department has recognised the key exploitation issues and taken action to review and improve many aspects of its exploitation activity. The recognition of the transfer of technological know-how generated in the research domain into industry (and ultimately military capability) as a specific output should encourage technology pull-through.

Intellectual Property Rights arrangements for research have been redesigned to enable broader exploitation

4.3 Intellectual Property Rights are key to successfully exploiting research that the Department commissions. The Department has developed a new research intellectual property condition, Defence Condition 705, which clarifies information rights and deliverables and facilitates the wider passing and sharing of information. Condition 705 was developed in response to three major issues. First, the Department recognised that it needed to formalise the relationship between itself and the Defence Evaluation and Research Agency (now QinetiQ and Dstl). Second, the Department needed to ensure that competition conditions were fair, so there was a requirement to develop a common clause that applied equally to all suppliers. Finally, Condition 705 is part of the Department's response to the Baker Report, which recommended that Government Departments should leave ownership of Intellectual Property Rights with industry or academia for exploitation.

4.4 A key feature of Condition 705 is the segregation of foreground and background information. Foreground information is the technical information that is generated in the performance of work under the research contract. Foreground information is appropriate for wider dissemination, whereas background information is restricted. Background information is contractor-owned technical information that has been generated outside the contract. The contractor in industry or academia retains ownership of the Intellectual Property Rights and is responsible for exploitation, although the Department can take ownership when the contractor does not wish to exploit it. Figure 13 summarises the situation regarding access to background and foreground information by different organisations.

4.5 We analysed the new intellectual property condition to determine how it met the Department's intellectual property aspirations, how applicable it was to the variety of research work and how acceptable it was to various stakeholders. Our analysis showed that Condition 705 reflects the Department's business needs, but only applies where the Department fully funds the research programme. Where the cost of the research is shared between the Department and another organisation, as, for example, in Defence Technology Centres, Condition 705 does not apply and the Department has more limited rights over the output. Currently, discrete arrangements are negotiated where research funding is shared, but this can take time to conclude. The Department's retention of appropriate intellectual property is important to prevent premature supplier "lock-in" for subsequent competitive equipment programmes.

Dissemination of foreground and background information

Defence Condition 705 allows for a wider dissemination of foreground information.

<table>
<thead>
<tr>
<th></th>
<th>Ministry of Defence</th>
<th>Other UK Government Departments</th>
<th>UK Defence Industry</th>
<th>Other Governments</th>
<th>Overseas Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreground Dissemination</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes conditional on confidentiality agreement and use for UK Defence</td>
<td>Yes but within the confines of any existing Memorandums</td>
<td>Yes with a reciprocal agreement</td>
</tr>
<tr>
<td>Background Dissemination</td>
<td>Yes</td>
<td>Yes</td>
<td>No (unless named upfront)</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

Source: National Audit Office

4.6 In relation to fully funded contracts, QinetiQ has accepted application of Condition 705 in full, while industry more generally is currently considering its application on a case-by-case basis. Industry is concerned that it will lose competitive advantage if the Department shares its specialist knowledge with competitors. In most situations, however, the Department reserves the right to exploit intellectual property generated under government-funded research contracts for official purposes.

The Department has a number of initiatives to encourage industry to become more engaged in exploitation but more can be done

4.7 We examined what the Department is doing to incentivise industry to increase pull-through of technology and incorporate innovative technology into new equipment. Our analysis showed that much progress has been made with the new output framework, which explicitly recognises the need to achieve exploitation, designating "Technology in the Supplier Base" as a discrete output.

4.8 Establishment of Towers of Excellence is another important collaborative initiative to support the maintenance of a strong competitive UK Defence industry. Figure 14 explains the Towers of Excellence concept. Towers of Excellence are focused towards the system-level application of research. Priorities for establishing Towers come from the Department’s Technology Strategy and consultation with industry through the National Defence Industry Technology Strategy exercise.

4.9 The first three “Towers” have been launched as shown in Figure 15. Specific programmes within the various Towers will be funded either by the Department or by industry. Our work showed that industry felt that the concept was a more efficient way of carrying out research and offered a potential exploitation route, but that the competitive contracting to determine participation does not encourage the development of a partnering culture.

The Towers of Excellence Concept

The Department plans to develop world-class technology through the Towers of Excellence concept.
The establishment of Towers of Excellence

Three Towers of Excellence have been established and more are planned.

<table>
<thead>
<tr>
<th>Towers of Excellence</th>
<th>Contract Awarded</th>
<th>Tower Members</th>
</tr>
</thead>
<tbody>
<tr>
<td>Established Towers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guided Weapons</td>
<td>Jul 2002</td>
<td>Wide range of participants from Defence Aerospace industry; Government Departments and agencies; and academia</td>
</tr>
<tr>
<td>Radar</td>
<td>Dec 2002</td>
<td>Wide range of participants from Defence industry; Government Departments and academia</td>
</tr>
<tr>
<td>Underwater Sensors</td>
<td>Jun 2003</td>
<td>Industry, academia and the Department</td>
</tr>
<tr>
<td>Future Towers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electro-optical sensors</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Synthetic Environments</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Electronic Warfare</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Source: National Audit Office

The part-privatisation of QinetiQ should encourage exploitation

4.10 One of the main objectives of the Government in placing QinetiQ into the private sector was to make it easier for the technology and technical capability that is created through the Defence research programme to be exploited for the benefit of the wider economy. QinetiQ has restrictions on its involvement in Defence manufacturing, so successful transfer of its technology will primarily be achieved through partnership with other companies.

4.11 We found evidence that partnerships between QinetiQ, industry and other suppliers were developing (see the QinetiQ Case Study). There are, however, concerns within industry regarding the rigour of the exercise undertaken by the Department to identify what intellectual property QinetiQ should retain following privatisation. Our consultation with industry revealed only a small number of challenges had been made to date. However, elements of industry remain unconvinced by the process and believe that latent intellectual property issues from previous joint research could still emerge. We also note that measures are in place to prevent leakage of industry’s intellectual property into QinetiQ ‘s wider business.

QinetiQ is involved in a number of ventures to exploit Defence research

QinetiQ Case Study - Foetal Electrocardiogram

QinetiQ, working with Queen Charlotte’s Hospital and Guy’s and St Thomas’ Hospital, has developed a non-invasive system to monitor and analyse heart functions in unborn babies. The system uses detection and processing techniques, developed for Defence purposes, to distinguish the faint unborn baby’s heartbeat from the mother’s own heartbeat and other interference. The heart signals are detected entirely passively, using sensors applied to the mother’s skin.

Although only in prototype, the equipment has already detected a number of abnormalities that were not known beforehand and were subsequently confirmed by ultrasound. In one case, a Complete Heart Block was identified, which might otherwise have gone undetected. The technique can also be applied to twins and triplets, which is thought to be a world first.

This new technique could change both foetal science and clinical practice, through the application of the foetal electrocardiogram to screening for abnormalities and the monitoring of high-risk cases. It has already possibly saved one life and could save many more.
A more appropriate programme of Technology Demonstration could reduce the level of risk being carried into the Equipment Programme

4.12 Technology demonstration is vital to reducing the risk associated with new technology and therefore to its successful exploitation. Our previous work suggested that significant savings have been realised from demonstration work. We therefore analysed whether the Department has a coherent approach to managing and funding Technology Demonstration.

Different funding routes and organisational structures make visibility and coherence of Technology Demonstration difficult

4.13 The Department is currently planning to spend around £184 million on separately identified Technology Demonstrator Programmes, of which the Research Building Block commitments are approximately £74 million and the Equipment Programme currently about £110 million. This level of funding has declined in real terms in recent years although the Research Building Block element, as a proportion of research funding, has remained relatively stable. The Technology Demonstrator Programme is dominated by air platforms. The Department recognises that it needs to do more to make funding available for demonstration across the range of platforms and systems.

4.14 Our analysis showed that a significant element of technology demonstration is funded outside the formal Technology Demonstration Programme. Information we obtained identified that further technology demonstration commitments, using Applied Research funding, total £134 million. These activities cover a wider range of equipment capability areas. Figure 16 shows which Equipment Capability Customers received funding for technology demonstration, and the source of that funding. Decisions over whether the formal Technology Demonstration Programme work will be funded from the research budget or equipment budget have in the past been expedient.

Distribution of funding for technology demonstration across the Equipment Capability Customer areas.

<table>
<thead>
<tr>
<th>Equipment Customers</th>
<th>Technology Demonstration funded from the formal Technology Demonstrator Programme</th>
<th>Technology Demonstration outside the formal Technology Demonstrator Programme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under Water Battlespace</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intelligence Surveillance Targeting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acquisition Reconnaissance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Above Water Battlespace</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combat Support Services</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Theatre Airspace</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Command, Control and Information Infrastructure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deep Strike</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nuclear, Biological and Chemical</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tactical Mobility</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: National Audit Office
Industry has indicated a willingness to invest in research at a stage where the output is more directly linked to a procurement programme.

4.15 **Figure 17** compares the Department’s acquisition cycle with a generic industrial acquisition cycle. The acquisition concepts are broadly similar, each attempting to understand the technology risk before a major investment decision is made, although the Department is not always successful at driving out all risks between the phases. Industry and the Department agree on the critical role of technology demonstration in reducing risk, and that increased priority should be given to this specific element of the research programme. Our survey of industry has indicated a willingness to consider joint funding of demonstration work where there is a clear route to industrial exploitation for Defence and, where applicable, commercial application. Our analysis suggests that the greatest scope for securing industry funding is during what the Department calls the Assessment Phase, when the technology is clearly linked to possible equipment. Consequently, the Department is likely to have to continue to bear most of the burden of early research and concept work of specific Defence technology with no commercial application. Furthermore, there is a necessary tension between the Department’s competition policy to deliver best value for money and the desire to attract supplier investment ahead of the main investment decision point.

---

### RECOMMENDATION

To maximise the proven benefits of technology demonstration in driving down programme risk, the Department should:

- rebalance the formal Technology Demonstrator Programme to increase funding availability;
- review its arrangements for funding and monitoring technology demonstration;
- consider ways of ensuring an even stream of funding for technology demonstration during the transition between research and equipment budgets;
- investigate ways to capitalise on industry’s willingness to jointly fund more of the demonstration work.

---

**17 Research and the Acquisition Cycle**

Comparison of the Department’s acquisition cycle with a generic industrial acquisition cycle showing the Major Investment Decision Point relative to perceived programme risk.

---

*Source: National Audit Office*
4.16 Bearing in mind the critical role that the Department’s funding is likely to continue to play in the early stages of a programme, Figure 18 illustrates how the Research Building Block and the Equipment Programme budgets fit in with the overall cycle from research through to equipment. As technology moves towards application into equipment, there is a transition between the two budgets. This budget division reflects the structural division between research and acquisition activities within the Department. The Research Building Block funding tails off while the Equipment Programme budget ramps up. A similar funding transition is also common in the commercial sector and is often referred to as the "Valley of Death". Procurement risks are exacerbated within the Department by the relatively low spend prior to the main investment decision. As a guide, up to 15 per cent of the total procurement costs should be spent before reaching the main investment decision point, but data from the National Audit Office’s Major Projects Report shows the Department is currently achieving an average of around 5 per cent.
Capability Management requires a broader understanding of technology to inform the equipment decision which may not be achievable under current funding arrangements.

4.17 When it comes to research, Capability Management should encourage innovation and a recognition that not all research undertaken will be relevant to the equipment finally chosen. In the early stages of the Capability Management approach, there will potentially be a large number of technologies to explore compared to a more traditional approach, as shown in Figure 19.

4.18 Given that the research budget is limited, the outcome of Capability Management will be either that a broader range of technologies will be slower to develop or that funding will only be made available to explore fewer technology options in depth, requiring a very early choice of options based on limited information.

Investing in Technology to enable Capability Management

Capability Management requires a broader consideration of the available technologies.

Source: National Audit Office
4.19 **Figure 20** shows this relationship between technology, risk and resources. The first graph shows the relationship between technology and risk. Achieving higher levels of technology and hence capability is relatively more risky. The second graph shows how this relationship is influenced by resources. With fewer resources, achieving a given level of technology maturity will be more risky. Alternatively, for a fixed level of risk, the level of technology maturity achieved will be lower with fewer resources. If resources are used more efficiently i.e. more effective prioritisation, acquisition and exploitation of research, then the impact of reducing resources will not be as great.

## RECOMMENDATION

The Department needs to recognise explicitly the challenges associated with developing and exploiting a broader range of technologies. Exploration of a broader range of technologies is an essential element of effective Capability Management.

### The relationship between Technology, Risk and Resources

With a fixed research budget, exploring various technology options to meet a capability reduces the total spend on each technology.

Source: National Audit Office
The National Audit Office examined whether the Department’s new approach to Research and Technology investment is likely to deliver its needs in the changing world.

We used an issue-analysis approach to designing the scope and nature of the evidence required to complete the examination. This identified five main issues, namely:

- Does the Department have an effective strategy for the provision of Research and Technology?
- Does the organisation have an appropriate mechanism to prioritise the budget and programmes?
- Does the organisation deliver outputs in an appropriate way?
- Does the Department effectively exploit the outputs?
- Does the organisation have mechanisms for measuring the spectrum of research outputs?

For each of these main issues we devised a set of sub-issues in order to direct our detailed work and analysis and to allow us to answer the main issues identified.

Our co-ordinator for the study was the Department’s Director General Research and Technology. The evidence came from a programme of interviews with a range of staff in the Department, including Central Science branches, the Defence Procurement Agency, including the Future Business Group, the Equipment Capability Customer and the Research Acquisition Organisation.

To obtain an industrial perspective on key issues we carried out a postal survey of a sample of firms who form part of the UK Defence industrial base. The firms approached were BAE Systems, Lockheed Martin and Thales. We also sought the views of the Defence Manufacturers Association. Where appropriate, we followed up the responses with interviews. We also interviewed representatives of QinetiQ and Dstl, and examined relevant papers produced by the Department.

We appointed a review panel, which contained experts from industry, academia and the Department of Trade and Industry. The panel provided advice on the issues we should address and comments on our draft report. External members of the review panel were:

- Ken MacIver, Chairman National Defence and Aerospace Systems Panel;
- Professor David L I Kirkpatrick, Professor of Defence Analysis, Department of Mechanical Engineering, University College London;
- David Way, Director Aerospace and Defence Technology at the Department of Trade and Industry.

To assist with examining the methods used by the Department to prioritise research, we employed Jonathan Cave, Silvia Anton and Steven Wooding of RAND Europe. The work had three main components: a review of general principles for research prioritisation; an examination of the current systems for prioritising research; and a consideration of the implications of the transition to the new system for prioritisation. The results of the work were made available to the Department to assist them in their development of prioritisation methods.
## Chronological List of Key Events

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Defence Technology Strategy Published</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Department undertakes Science and Technology Review</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QinetiQ established as a Government owned company</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dstl established as an Executive Agency of the Department</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chief Scientific Advisor’s Defence Science and Innovation Strategy published</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research Acquisition Organisation established</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contract for first Tower of Excellence awarded</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Defence Science and Technology Board created</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Defence Industrial Policy published</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Draft Programme Strategy produced</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Defence Science and Technology Board decides budget attribution across outputs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research Acquisition Organisation due to relocate to Shrivenham</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corporate Research and Technology budget, based on single funding stream, due to be fully operational</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
This Glossary provides definitions of terms used in this report that reflect the National Audit Office’s understanding.

**Applied Research Programme**
The Department’s Programme of research to identify technical options, at quantified cost and risk, for operational requirements that best meet the needs of the UK Armed Forces over the next 20 years.

**Asymmetric warfare**
The use of technology, doctrine and tactics that are designed to deter or defeat a superior enemy by using a different balance of forces and a dissimilar operational approach.

**CADMID cycle**
The whole-life acquisition cycle used by the Ministry of Defence. The cycle is divided into six phases - Concept, Assessment, Demonstration, Manufacture, In-service and Disposal.

**Capability Management**
The process by which the Equipment Capability Customer develops and manages a balanced Equipment Programme to meet the current and future needs of the Armed Forces. The process allows for innovation, and the exploration of broader options for meeting the requirements, rather than replacing one platform with another.

**Corporate Research Programme**
The Department’s Programme of research encompassing underpinning research to support the Technology Base; inventive research aimed at developing new approaches and techniques, and research applicable to more than one environment or military function.

**US/UK Declaration of Principles for Defence Equipment and Industrial Cooperation**
An agreement signed in February 2000 between the governments of the United States and United Kingdom governing cooperation over the production of Defence Equipment. It included an undertaking to simplify technology and equipment transfers between the two countries.

**Defence Evaluation and Research Agency**
The Department’s in-house research Agency, established on 1 April 1995 from several of the Department’s research and evaluation Agencies. In July 2001 it was split into QinetiQ, a government-owned company, and Dstl, an Executive Agency of the Department.

**Defence Procurement Agency**
An Executive Agency of the Department responsible for the procurement of equipment for the UK Armed Forces. It is responsible for capital expenditure of £4.6 billion in 2003-04.

**Defence Scientific Advisory Council**
A Non-Departmental Public Body that provides independent advice to the Secretary of State for Defence in the fields of science, engineering and technology.

**Dstl**
An Executive Agency of the Department, established in July 2001, that contains approximately 3,000 staff formerly in the Defence Evaluation and Research Agency. It provides core science and engineering expertise on Defence-related science and engineering.

**Dual use technology**
A technology that has both military utility and sufficient commercial potential to support a viable industrial base.

**Equipment Capability Customer**
The central customer in the Department for a specific Equipment Capability. The Equipment Capability Customer organisation is led by the Deputy Chief of the Defence Staff (Equipment Capability).
EUROPA Memorandum of Understanding

The European Understandings for Research Organisation, Programmes and Activities (EUROPA) agreement signed in May 2001 allows bilateral or multilateral collaboration by all members of the Western European Armaments Group on a wide variety of research and technology projects and programmes.

Integration risk

The uncertainty and challenges inherent in bringing together varying and complex sub-systems to meet system characteristics.

Intellectual Property

The concept of Intellectual Property allows people to own their creativity and innovation, and to control and be rewarded for its use, through the use of such methods as patents; trade marks; designs and copyright.

Interoperability

The ability of Alliance Forces and, when appropriate, Forces of partner and other nations to train, exercise and operate effectively together in the execution of assigned missions and tasks.

National Defence and Aerospace Systems Panel

The Panel was launched in February 2002, and is jointly sponsored by the Ministry of Defence and the Department of Trade and Industry. Its role includes contributing to the development of a National Defence Technology Strategy, and supporting key initiatives on Defence Technology Centres and Towers of Excellence.

Public Private Partnership

This term covers a range of arrangements:

- The introduction of private sector ownership into state-owned businesses through sales of a majority or minority stake;
- Under the Private Finance Initiative, the public sector contracts for the purchase of services on a long-term basis;
- Exploitation of the commercial potential of Government assets through sale into wider markets.

QinetiQ

QinetiQ was formed in July 2001, when three-quarters of the staff in the Defence Evaluation and Research Agency were transferred to this government-owned company. In February 2003 the Carlyle Group acquired a 33.8 per cent stake-holding in QinetiQ, and took over management control of the company.

Research Building Block

The Department's central budget for funding Research and Technology, which is controlled by the Chief Scientific Advisor. The annual budget is approximately £450 million.

Research Director

Capability and Technology Research Directors are responsible for the formulation of research programmes and will be located in the new Research Acquisition Organisation when it is fully established.

Research and Technology

Research and Technology is normally distinguished from Research and Development as a definition of expenditure. It involves investment in basic and applied research and technology demonstration before the production phase.

Strategic Defence Review New Chapter

The Strategic Defence Review New Chapter was published in July 2002. It involved a re-examination of Defence plans to meet new challenges.

Technology Demonstrator Programme

Technology Demonstrator Programmes are undertaken primarily as a means of reducing risk, to establish that new technology can (or cannot) be usefully applied to meet the Department's requirements. The Department had previously ring-fenced approximately £30 million funding from the Research Building Block for such work.

Technology pull-through

The incorporation of appropriate technology in the final product.

Technology Readiness Levels

A measure of the maturity of technology used by the Department. Technology maturity is measured on a scale of 1 to 9.

Valley of Death

The term used in industry to describe the funding gap between research investment (often with public funds) leading to the development of a new technology, and achieving its commercial application. In the private sector this funding gap is often bridged with funds from venture capitalists.

The Western European Armaments Group

A forum for armaments cooperation established in May 1993. There are currently 19 member countries. One of its objectives is cooperation in research and development.
Appendix 4

Measures

Short Term Measures (Primarily Process)
- Strategy updated and disseminated
- Coherent levels of strategy
- Coherence with industry strategy (NDITS)
- Coherence with Defence Technology Centre and Towers of Excellence programmes

Longer Term Measures (Primarily Outcome)
- Correlation between expenditure decisions and strategic priorities

Strategy

Prioritisation
- Development of high level prioritisation criteria
- Customer feedback

Acquisition
- Level of expertise in Research Acquisition Organisation
- Performance in letting contracts
- Level of responses to tenders
- Variety of contract mechanisms

Exploitation
- Level of advice and technology in outputs
- Whether budget mechanisms support progression
- Exploitation plans

- Achievement of prioritised criteria
- Customer feedback
- Responsiveness to changing Defence priorities
- Responsiveness of system based on changes in output budgets

- Time/cost and performance of research contracts
- Number and breakdown of suppliers

- Technology pull-through to Equipment Programme
- Spin off to civil use
- Exploitation plans achieved
- Measure of advice and technology
The House of Commons Defence Committee has reported on the future of the Defence Evaluation and Research Agency several times since July 1998. More recently, in January 2003, the Committee took oral evidence from the key players in the formation of QinetiQ. This Appendix summarises the latest response from the Department, QinetiQ and the Carlyle Group on the key Industrial, Collaborative and Organisational issues. Figure A1 below illustrates the genesis of QinetiQ and Dstl and summarises some key attributes.

### Figure A1: Illustration of the Genesis of QinetiQ

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td>Defence Research Establishments</td>
</tr>
<tr>
<td>1995</td>
<td>Defence Research Agency</td>
</tr>
<tr>
<td>1995</td>
<td>Defence Evaluation &amp; Research Agency</td>
</tr>
<tr>
<td>2001</td>
<td>QinetiQ</td>
</tr>
<tr>
<td>2001</td>
<td>Dstl Defence Science &amp; Technology Laboratory</td>
</tr>
</tbody>
</table>

### QinetiQ
- 9,000 staff
- £780 million income
- Growing commercial Company
  - Main business streams:
    - Technical Consultancy
    - Defence Services and Technology
    - Wealth creation through technology
- The Department will remain the most important customer, even as commercial business grows
- Partnerships, Spin-offs and Joint Ventures

### Dstl
- 3,000 staff
- £260 million income
- An Agency within Government
- Undertakes the most sensitive Defence programmes
- Undertakes Government-to-Government work (including international research collaboration)
- Conducts systems-level research

Source: National Audit Office

---

HCDC Oral Evidence “Developments with QinetiQ” - HC 322 I 9 April 2003.
Objectives

As described in the Annex to the 12th Special Report, the aim of the part-privatisation of the Defence Evaluation and Research Agency is to deliver two sustainable structures, in QinetiQ and Dstl, which will provide value for money and a range of benefits in defence research including:

- introduction of commercial disciplines, to achieve reduced contract prices for the Department and other customers as a result of increased competition, economies and productivity;
- enhanced flexibility to develop commercial business partnerships and engage in a greater range of joint ventures thereby positioning itself to anticipate, rather than merely react to, customer needs;
- access to private capital through either equity or debt in order to build capability and support future investment in technology;
- strengthening the links between civil and defence technology so the Department and the wider economy benefits from broader application of technological advances;
- effective and productive relationships between private and public sector reflecting the Department’s aims under the Smart Procurement Initiative;
- the ability to address skill shortages in critical technologies;
- a structure that provides international partners and other stakeholders with confidence that collaborative relationships will be maintained and protected.

### Key Issues

| Exploitation of IP generated between industry and DERA | When the Defence Evaluation and Research Agency was split into Dstl and QinetiQ, its Intellectual Property (IP) was essentially allocated between the two organisations in accordance with the division of the individual business streams and work programmes. The IP transferred from the Department to QinetiQ has been agreed between interested parties and is listed in three legal documents: the Patent Agreement, the Trademark Assignment and the Crown Copyright Assignment.

There are restrictions on QinetiQ’s rights to manufacture, so exploitation of its IP will generally be under a licensing or leasing arrangement. The Department has free user rights to all QinetiQ-owned IP created prior to vesting, and rights conferred under intellectual property conditions created through contracts with the Department after vesting.

Prior to the vesting of QinetiQ as a Government-owned company in July 2001, the Department carried out an extensive exercise to identify and remove any IP which could not be held by the company when it ceased to be part of the Department. During this exercise, known as the Records Audit and Segregation Process (RASP), over 160,000 Records were examined. In the 18 months since vesting the Department stated it has received three challenges where contractors have disputed Intellectual Property Rights and these are described below.

Smiths Group plc raised a concern which was of a general nature. The Department has corresponded with the Company over its general concerns.

Advanced System Architecture Ltd. After investigation of the company’s challenge, the Department stated that it did have the right to pass the IP to QinetiQ.

Rolls Royce has raised an issue about the fate of 500 "Grey Books". These were documents jointly authored by the Defence Evaluation and Research Agency and Rolls Royce relating to the Gas Turbine engine research programme. The IP was jointly owned by the Department and Rolls Royce but the contracts did not allow the Department to disclose the information contained in the document without the permission of Rolls Royce. There is currently no suggestion that QinetiQ has illegally exploited the IP contained in these documents or that Rolls Royce has suffered any form of loss.

QinetiQ’s limitation on manufacturing | The Department has stated that QinetiQ will not, without its express permission, be permitted to undertake the manufacture or supply of equipment, products or systems whose principal use is intended to be for a military, defence or security application, other than small numbers of prototypes or demonstrators. Unless there is a clear conflict of interest, QinetiQ will be permitted to act as a Systems Integration contractor in partnership with or as a sub-contractor to industry. This is seen as an important mechanism for ensuring that the results of work within QinetiQ can influence the design of new defence systems.

The Department stated that these controls are designed to ensure that a conflict of interest does not arise in QinetiQ’s ability to advise and support the Department in the delivery of military capability. Indeed, this reflects previous practice whereby the Defence Evaluation and Research Agency was prevented from engaging in defence manufacturing through its framework agreement.
The Department began to open both the Applied Research Programme (ARP) and the Corporate Research Programme (CRP) to competition two years ago. Work which is placed with Dstl, representing around 36 per cent of the Research Building Block (RBB), will not be subject to competition. By 2007 it is expected that 70 per cent of the non-Dstl part of the research programme will be let competitively.

When determining which elements of the research programme to compete, the Department (principally the Research Acquisition Organisation) makes the decision using its internal processes (which include the use of Dstl) and does not use QinetiQ in any form of consultative role about which programmes are competed and which are placed with QinetiQ.

Long-Term Partnering Agreement (LTPA) for Ranges and Aircraft Test and Evaluation. On 1 March 2002 the Department announced that it had selected QinetiQ as preferred bidder for the 25 year LTPA to run the Department's Test and Evaluation and Aircraft Test and Evaluation Ranges. This followed a detailed review by the Department's customers of their current and likely future requirements. The review concluded that placing a long term contract with QinetiQ for the provision of these services was the option most likely to deliver value for money and also to encourage the infrastructure investment necessary to ensure that the Department's future requirements would be met.

Ministers and senior officials from the Department have had a number of discussions with counterparts in the US Department of Defense and intelligence communities. During consultation a team from the Department visited a wide range of US laboratories to brief scientists and managers on the proposals and to discuss any issues that they wanted to raise. In the Department's view these exchanges have given a degree of confidence that existing collaborative agreements will be unaffected, and that it can continue to develop new areas of cooperation after the implementation of the Public Private Partnership.

The Carlyle Group have stated that salaries and bonuses paid to staff in QinetiQ are a matter for the company, although details are disclosed in QinetiQ's annual report. The salaries and bonuses of the most senior staff are subject to approval by the Remuneration Committee of the QinetiQ Board. The Department currently sends observers to meetings of this Committee, but does not have voting rights. Future salaries will be set in accordance with normal commercial criteria. Share options have been set in accordance with the Government's stated objectives for the Public Private Partnership, and a share scheme has been established which involves all staff within QinetiQ. There are a number of separate elements to this scheme:

a Free Share Options. The scheme will grant a small free share option worth £40 to all staff;

b A Co-investment Scheme. All staff (with the exception of the ten most senior executives) will be able to purchase shares at the same price, and on largely the same terms, as Carlyle. Staff will enjoy the same potential for return on their investment as Carlyle and the Department;

c Senior Management Incentive Scheme. There is a separate scheme for the top 230 managers who may purchase shares which have the potential to provide high returns if the company does well, but at the same time they are exposed to a higher degree of risk than other employees.

It is anticipated that the total fraction of shares held by employees will be around 4 per cent.

The Department has stated that Dstl exists to provide independent, high quality scientific and technological services to the UK Armed Forces and Government, principally in areas inappropriate for the private sector. Consequently, it will not directly compete with industry for the provision of advice to the Department.

On the issue of security, the Department stated QinetiQ and Dstl staff and accommodation have been physically separated to usual security accreditation standards prior to vesting in July 2001. The two organisations still share some sites, but there is complete separation of their respective areas by physical and electronic access control measures. The Defence Evaluation and Research Agency's Information Systems were physically separated in May 2001. The Department was fully involved in the drawing up of the system architecture and provides security accreditation for the systems. Data is physically separated on dedicated servers.
### Key Issues

**The future of QinetiQ under the Carlyle Group**

The Carlyle Group stated that:

- it is committed to maintaining and deepening QinetiQ’s reputation as a centre for excellence in science research and development and helping it to grow to become the global leader in this field. This can only be achieved by QinetiQ safeguarding its capabilities and leveraging them to generate services that customers demand. QinetiQ will remain a British company and its success will be Britain’s success;

- in recognition of the sensitivity of QinetiQ’s role in the national economy Carlyle has created a special purpose fund to ensure that the interests of investors are focused solely on QinetiQ’s success and QinetiQ is independent of any investments Carlyle has made through other funds. The dedicated fund is a British company subject to UK law and its investors are predominantly institutional investors from the UK, Europe and the US. Taken together with the Department’s majority interest and that of the staff, the beneficial ownership of QinetiQ will remain overwhelmingly British; and

- following the company’s investment in QinetiQ, UK national security remains protected by the same strict Departmental regulations and procedures that currently govern access to classified material. Only those individuals with a Department approved need-to-know and appropriate security clearances will have access to detailed information. No exceptions to the established procedure will be made for Carlyle representatives on the Board or Carlyle’s investors.

### Protection of the Department’s interests

The Department believes that the Compliance Regime established upon vesting protects its interests and those of the defence industry by providing a set of procedures to regulate the potential conflict of interest between QinetiQ’s defence and commercial activities. The company is legally bound to adhere to the Compliance Regime. The Regime stipulates the need for QinetiQ to:

- preserve the confidentiality of the Department’s information;

- ensure the provision of impartial advice to the Department; and

- comply with UK security interests.

On the issue of retained liabilities, the Department stated that decisions on whether to retain liabilities within Government were taken on value for money grounds and were based on advice and discussions with specialist external advisors. In general the Department’s approach has been to retain a contingent liability only in cases where this represents better overall value than the alternative, which would be to accept a significant, and disproportionate, reduction in the receipt from the Public Private Partnership. The Department has submitted three Departmental Minutes to Parliament dated 4 December 2001, 8 July 2002 and 17 December 2002 respectively covering the liabilities.

The actual costs of these liabilities are impossible to predict. The Department has however taken measures which it believes reduces the potential financial risks to a very low level. This includes an extensive disclosure exercise within the Department and QinetiQ. The results of this exercise have been made available to The Carlyle Group and in general they cannot raise claims in relation to such matters. In general, claims could only be made if the Department was aware of a potential concern and failed to disclose the relevant details to the purchaser.