

# The Defence Evaluation and Research Agency Review of Performance



# Contents

<b>Executive summary</b>	<b>1</b>
<hr/>	
<b>Part 1: Introduction</b>	<b>6</b>
<hr/>	
<b>Part 2: Customer satisfaction, quality and capability</b>	<b>14</b>
<hr/>	
<b>Part 3: Technology transfer and the Agency's relationships with industry</b>	<b>51</b>
<hr/>	
<b>Part 4: Strategic management and performance measurement</b>	<b>67</b>
<b>Appendices</b>	
1. The Defence Evaluation and Research Agency's aims, objectives and functions	83
2. Methodology	85
3. National Audit Office case studies and summary findings	93
4. The Defence Evaluation and Research Agency's performance against their key targets for the years 1993-94 to 1996-97	96

## Executive summary

**1** The Defence Evaluation and Research Agency (the Agency) exist to maximise defence capability through the provision of advice on the use of science and technology in defence systems, and the exploitation of advanced technology solutions in the defence industry. The Agency, as a Trading Fund, remain part of the Ministry of Defence (the Department), and are subject to direction from relevant ministers on matters such as the Agency's key performance targets. In 1996-97 their turnover exceeded £1 billion, of which £955 million was derived from scientific research and technical services provided to customers from within the Department.

### The Agency's relations with Departmental customers

**2** The Department and Agency have developed arrangements for identifying the services needed, and then costing, pricing and supplying them. Customers must place research contracts with the Agency, but have the option to compete work in support of specific procurement projects. Most contracts require the Agency to be paid for costs incurred up to an estimated cost plus profit ceiling known as a limit of liability, estimated in advance using annually fixed charge-out rates. The charge-out rates applied reflect Agency achievements in reducing running costs since 1992. Other measures of economy and efficiency, such as staff utilisation and timely delivery of milestones, show similar improvements, although the rate of improvement has now slowed as performance has risen and the potential for further improvement becomes exhausted.

**3** Once underway, jobs are monitored against both milestones and against the financial limits of liability. However, customers are not always in a position to judge the technical challenge of the milestones. And the effectiveness of the limits of liability as an instrument of cost control is reduced where, as in 1995-96 in some parts of the Agency then recently absorbed into the trading fund, cost estimating is poor, and because the limits are not fixed but are subject to variations in response to changes in the scope of the work by the Agency or the customer. Customers also believed there were insufficient financial sanctions in the event of non-delivery to time or specification, notwithstanding their ability to withhold payment under standard Departmental contractual conditions.

## Recommendations

In order to maximise the value of separating customers from suppliers the Department should:

- a) ensure that, given the limited scope for employing direct competition, the mechanisms for exerting competitive pressure on the Agency are adequate in design and sufficiently independent from the Agency in operation to demonstrate value for money from customer funding.
- b) disseminate information on the Agency's performance and competitiveness to customers within the Department, so that they are best placed to challenge Agency proposals and progress.
- c) look for appropriate opportunities to transfer risk to the Agency through greater use of firm price agreements or other forms of incentivisation - much as the Agency do for the bulk of the work they sub-contract to industry; and
- d) raise customers' awareness of existing financial sanctions and other remedies in the event of non-delivery to time or specifications.

**4** The Agency have put in place systems to assess, with the aid of survey consultants and peer reviewers, customer satisfaction and the technical capabilities of their staff. The results are good, indicating that the Agency have been successful in meeting Departmental customers' needs while remaining highly capable.

## Recommendations

To improve the operation of their assessment mechanisms the Agency should:

- e) amend the customer survey arrangement to bring rating scales for different but related questions on to a common basis; ensure all types of customer are asked questions on quality; and broaden the analysis to review the performance of the Agency by the customers' main categories of work;
- f) change elements of the technical capability assessment process, to transfer the selection of the teams to be assessed and of the assessment auditors from the operating sectors to central Agency staff. The impact of audit on self-assessment results should also be reported;

- g) feed scientific quality peer review results into the technical assessment process; and
- h) together with the Department, investigate ways to track use of the Agency's work, building on current initiatives, and integrate the results into planning and review systems.

## **The Agency's relations with Industry and technology transfer**

**5** Industry and other external bodies feature in the Agency's work in two main ways: as customers and exploiters of Agency research - from which the Agency obtain around 10 per cent of their income; and as suppliers to the Agency as sub-contractors - some 30 per cent of the Agency's Departmental research funding goes to industry in this way. This sub-contracting also represents a major contribution to technology transfer, together with other schemes designed to use the Agency's research for broader wealth creation purposes.

## **Recommendations**

The Agency should build on their achievements in this area and:

- i) refine and progress the recent initiatives designed to secure the joint exploitation with United Kingdom industry of overseas markets;
- j) evaluate and revise as necessary the Strategic Alignment and Pathfinder initiatives which are designed to exploit industry capability and ideas in a way that complements Agency work;
- k) monitor the quality of work offered to industry and of work done by industry for the Agency; and
- l) continue the development of the system for measuring technology transfer, and ensure that this accommodates the volume of refereed articles published.

## **Performance targets and reporting**

**6** The Agency's targets are set by the Department based on the Agency's business plans. The targets for 1997-98 cover their objectives and activities well, if not fully, and of the 37 targets set for the years 1993-94 to 1996-97, the Agency met 22 in full and subsidiary parts in a further nine cases. The Agency's reporting of their targets and associated performance in these years has been complete and accurate in all but six cases. In two instances, targets were incorrectly reported;

and in four cases performance was overstated because of presentational errors or an imprecise interpretation of target requirements. The Agency considered that these discrepancies made very little difference to their overall reported achievement.

## Recommendations

The Department and the Agency together should:

- m)** review the target regime for coverage of Agency objectives, and for the coherence of significance of targets in relation to each other; and
- n)** ensure that there is a clear understanding of the definition of terms such as “customer satisfaction”, “mean group” and “capability”.

The Department should:

- o)** review their arrangements for analysing Agency draft plans and targets, to ensure that those taking decisions on performance targets are appropriately briefed.

The Agency should:

- p)** ensure that performance is monitored and reported accurately and consistently across the Agency, and that best use is made of existing management information systems;
- q)** ensure that there is a clear audit trail from internal management information to externally reported performance; and
- r)** have reported performance independently validated, when it is not covered specifically by the audit opinion on the financial statements.

## Overall conclusions

**7** The Agency have reduced costs, maintained and enhanced their capabilities, and satisfied their customers by increasing the relevance and improving the presentation of their work. The relative contributions of the pressures of reduced overall funding, the customer-supplier arrangements, and a variety of Agency management projects and initiatives cannot readily be distinguished. But the overall result is a coherent management approach that identifies problems and opportunities and then acts to secure improvements.

**8** There are two emerging issues which also have wider significance across Government. The first is the operation of the owner/customer/supplier arrangements. If these arrangements are to act as a proper discipline on the Agency, the owner and customer roles have to be active, adequately resourced and have real remedies available to counter any unsatisfactory Agency proposals or weak performance. In this instance, the Agency, through agreements with the Department on allocation of work to them, their dominant position in terms of scientific and technical expertise, and the legitimate respect accorded good recent performance, are in a powerful position. The Department need to preserve their capacity to challenge the Agency, improve their efficiency and drive down prices.

**9** Secondly, the operation of performance targeting, reporting and appraisal raises a number of questions. The targets set have been reasonably comprehensive and coherent with Agency management plans, such that they were useful in focussing Agency staff on the need for improvements in specific areas. But there have been weaknesses and errors in identifying and reporting performance - which were not picked up by the Department - which devalue the targets as instruments of accountability and control. Moreover, as the Agency become mature and the scale of annual performance improvement reduces, the inherent uncertainties of some of the measurement processes need to be addressed in the light of the performance improvement required: the measurement process must be sufficiently precise to give reliable assessments of performance. These factors militate in favour of further attention to target setting, performance measurement and independent validation of reported results.

# Part 1: Introduction

## Background

**1.1** The Ministry of Defence (the Department) commit expenditure to research and development to exploit and advance science and technology. They do this in order to maximise defence capability through the use of advanced technology in defence systems and in particular, to promote cost effective procurement of defence equipment. They also aim to contribute to United Kingdom wealth creation, where this is consistent with defence priorities.

**1.2** The Department's expenditure on defence research has been falling over recent years at a greater rate than defence spending more generally. Nevertheless, in 1996-97 their expenditure still exceeded £2.0 billion on the following research and development activities:

- **corporate research** - primarily innovative, underpinning, research that might provide the foundation for developments in the defence field in the 21st century. Key components are collaboration and an emphasis on technology push and pull through to the applied research projects (some £160 million);
- **applied research** - to support the formulation of operational requirements for equipment having a planned in-service date within the next 20 years. The research focuses on current issues arising with existing technologies (some £450 million);
- **project support and other non-research work** - independent advice, evaluation, demonstrations and testing in support of the Department's equipment procurement programmes (some £400 million); and
- **product development** - the development of an equipment to meet a military requirement, to the stage at which production can begin (£1.2 billion).

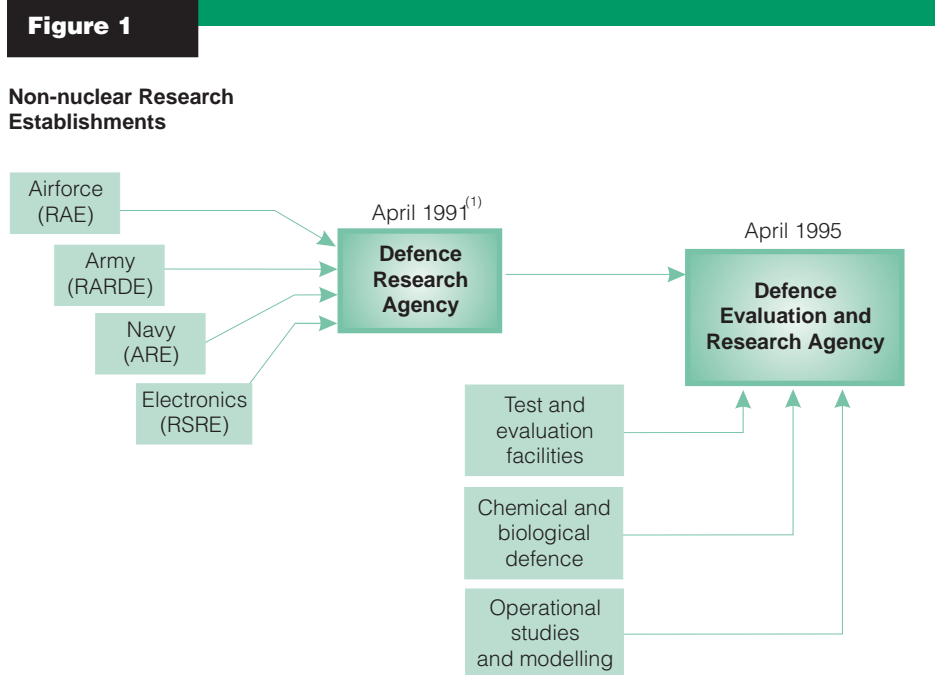
**1.3** Defence **research** and **project support** is largely carried out through the **Defence Evaluation and Research Agency (the Agency)**. About one third of the Agency's research work is sub-contracted to industry and academia through extramural contracts. Most of the **product development** work is placed directly with industry.



## The Defence Evaluation and Research Agency

**1.4** The Agency are the Department's primary source of technical and scientific advice. They are a next steps Agency within Government established in two main stages and which operate as a trading fund. First, in April 1991, the Department's largest non-nuclear research establishments were brought together to form the Defence Research Agency. And then in April 1995, the Defence Research Agency were amalgamated with the Department's remaining non-nuclear research establishments and equipment testing and evaluation facilities (Figure 1).

### Formation of the Agency April 1991 and April 1995

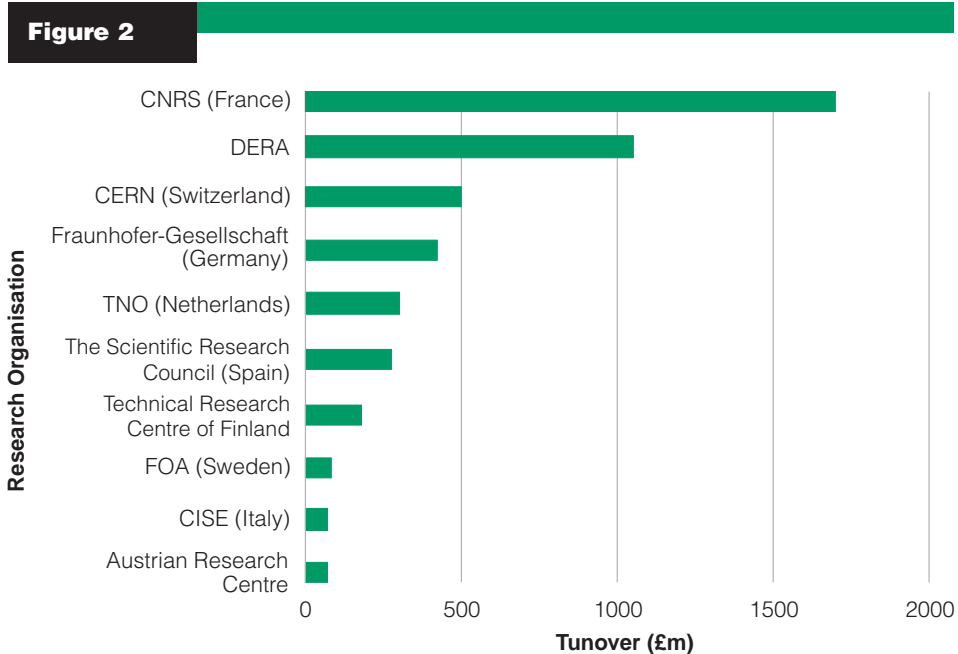


Note: 1. The Defence Research Agency became a trading fund on 1 April 1993

Source: The Agency  
Figure 1 shows that Agency were formed in two main stages - first in 1991, with the formation of the Defence Research Agency, and secondly with their expansion in April 1995

**1.5** The Agency are one of the largest science and technology organisations in Europe employing in excess of 12,500 permanent staff, including more than 8700 scientists and other specialists, and having a turnover of some £1 billion (Figure 2). They are a diverse organisation with a wide range of technical and scientific capabilities spread over some 250 specialist teams. At the time of our examination they were organised into four key operating divisions (Figure 3), reflecting their expansion in 1995.

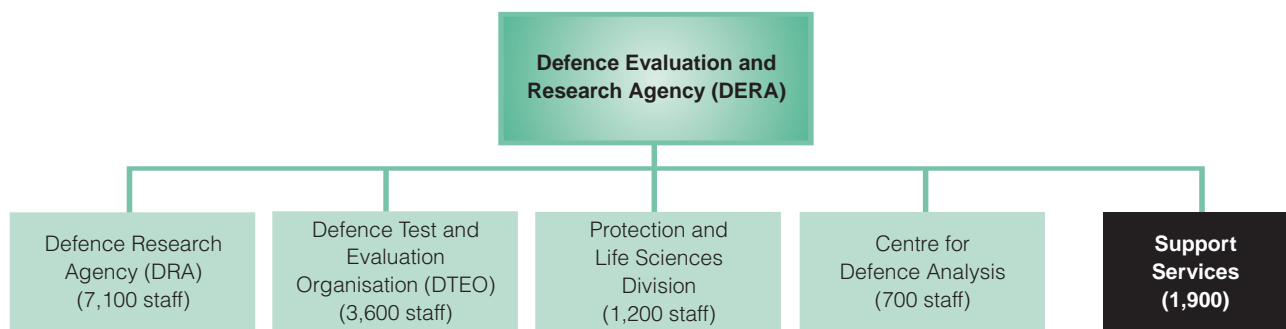
**Comparison of the Agency's turnover with other European research organisations**



Source: The Agency  
Figure 2 shows that the Agency are the second largest research organisation in Europe based on turnover.

**Figure 3**

**The Agency's overall organisational structure from April 1995 to March 1997<sup>(1)</sup>**



Note: 1. In April 1997, the Agency restructured their high level organisation to focus the role of the Divisional Directors on pan-DERA functional responsibilities rather than the mixture of operational and functional roles associated with the above structure. They also privatised the major part of their support services. The staff numbers include contract staff and the 1,300 support staff which make up the privatised services.

Figure 3 shows that at the time of the National Audit Office examination the Agency are organised around four key operating divisions, reflecting their expansion in 1995 (see Figure 1), and a number of support services. In particular, it shows that the DRA and DTEO are the two largest divisions.

Source: The Agency

**1.6** The Agency's relationship with the Department is governed by a Framework Document which defines their functions, responsibilities and accountability. They are required to operate in a commercial manner with predetermined performance targets and be financed from income earned from their customers. They are owned by the Secretary of State for Defence, who is also their principal customer - the Department are responsible for over 90 per cent of the Agency's income. The remainder of the Agency's income is sourced from services provided to customers from industry, academia and other government departments and from royalties earned from the sale of intellectual property. The nature and scale of these various relationships are illustrated in Figure 4.

**Figure 4**

**The nature and approximate scale of the Agency's relationships with the Department and Industry**

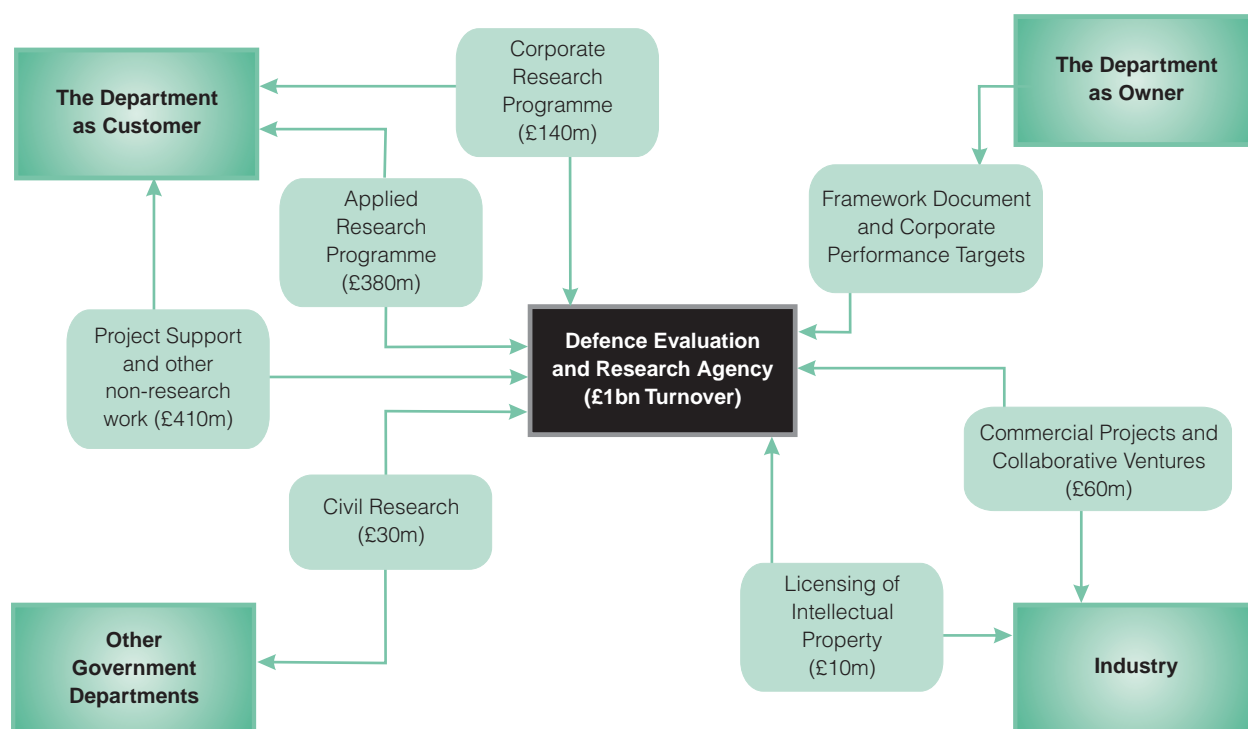


Figure 4 shows the Agency's wide range of customers by type and approximate value. It also shows the dual role of the Department as both the Agency's main customer (responsible for 90% of their income) and their owner.

Source: National Audit Office and the Agency

**1.7** The Agency's overall aim as set out in their framework document is:

“to provide independent, high quality, efficient and cost effective scientific and technical services to their customers. They exist primarily to serve their Departmental customers, but the exploitation of the wealth creation potential of programmes of work for defence purposes is a legitimate parallel objective”

**1.8** Supporting this overall aim are a set of specific objectives and related performance targets covering a number of issues, including efficiency, quality, income generation and technology transfer. The Agency's specific objectives are detailed in Appendix 1 and Figure 5 sets out their key performance targets for 1997-98.

#### The Agency's key targets for 1997-98

#### Figure 5

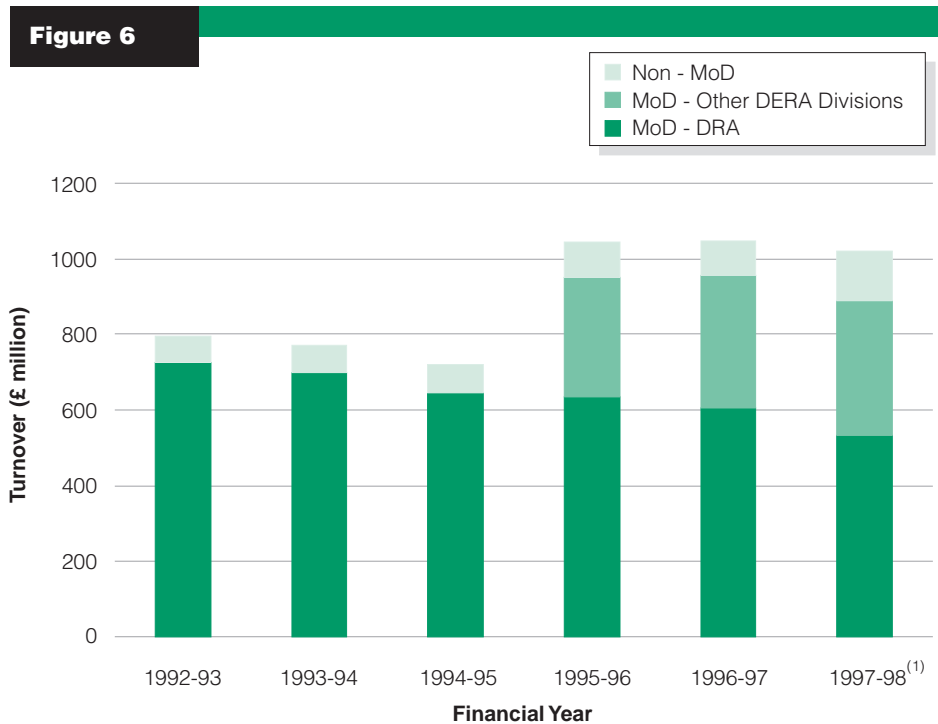
- Consistent with achieving an average of at least 6 per cent return on capital employed over a period of three years, the target for 1997/98 is 4.2 per cent.
- To achieve at least a 3 percentile point increase in customer satisfaction as measure by the external survey, and to develop with customers a methodology for measuring overall value for money.
- To achieve at least a 5 percentile point increase in the average score for technical capability as measured by the technical assessment scheme, and for all teams to have an improvement plan.
- To achieve a non-MOD income of at least £113 million.
- To measure the number of key capabilities that are dependent on a single programme for more than 50 per cent of their income, and set improvement targets for 1998-99.
- To achieve an overall improvement [in staff satisfaction] of at least 2 percentile points in the mean group as measured by the internal survey, with at least a 10 per cent improvement in the score for management style.
- To improve technology transfer practices by at least 10 percentile points as measured by the technology transfer measurement scheme.
- To measure business excellence in all DERA sectors using the United Kingdom Quality Award (UKQA), and improve by at least 15 per cent the average score across the 7 sectors that will have completed the UKQA assessment in Spring 1997.

**1.9** The Defence Research Agency (Figure 1) were formed to facilitate cost savings (through rationalisation of facilities), to achieve greater coherence in the delivery of scientific and technical services, and to provide a more disciplined

customer-supplier relationship through formal contracts between the Departmental customers and their primary supplier. The Agency were established to extend these benefits to the Department's other non-nuclear establishments.

**1.10** The Agency are also a key part of the Department's strategies to ensure the maintenance of an accessible defence research and development base, from which their needs for research and development advice, especially concerning the equipment programme, can be met. The central issue faced by the Agency is how to sustain the necessary capabilities required to support these needs in the face of reducing Departmental funds (Figure 6) whilst also meeting the wider requirements for wealth creation.

**Trends in the Agency's turnover in the period 1992-93 to 1997-98**



Note: 1. Estimate

Figure 6 shows that the Agency' Departmental income has been falling steadily since 1992-93. Although total turnover increased in 1995-96, following the expansion of the Agency (see Figure 1), the fall in Departmental income is forecast to continue over the five years to 2001-02.

Source: The Agency's Annual Reports and Accounts

## The National Audit Office examination

**1.11** Against this background we have addressed the following issues:

- the extent to which the Agency have met their primary remit to provide high quality, efficient and cost effective scientific and technical services to their Departmental customers;
- the Agency's relationship with industry and arrangements for securing the exchange of technology and scientific knowledge with industry and academia; and
- the roles of the Department and the Agency in the setting, maintaining and reporting of performance targets and the results to date.

**1.12** Our underpinning methodology was an analysis of performance achieved since 1993-94 (when the then Defence Research Agency was established as a trading fund - see Figure 1). The main features of the examination are detailed in Appendix 2 and summarised in Figure 7. Most of the fieldwork was conducted in 1996-97.

### Main Features of the National Audit Office Examination

#### Figure 7

##### 1. Customers' Views

In the absence of other comprehensive measures, customers' views are a proxy for effectiveness since the true worth of some of the research projects may not be apparent for many years. The National Audit Office drew on the findings of the Agency's annual customer satisfaction surveys since 1992 and on their one-off survey of their relationship with industry carried out in 1996.

To supplement the Agency's surveys the National Audit Office carried out a series of seven customer focus groups in which 45 Departmental corporate and applied research and project support customers participated. The focus groups discussed the customer-supplier relationship and trends in the Agency's performance under the key criteria of quality, time, cost, capabilities and overall satisfaction. The National Audit Office also asked participants to rate the Agency's performance on a random sample of 87 reports, presentations, tests, and demonstrations completed in the period February to August 1996. The Report summarises the balance of views on key issues or highlights important issues relevant to particular customer groupings.

The National Audit Office also discussed the industry issues addressed by this Report with representatives from the Society of British Aerospace Companies and the Defence Manufacturers Association.

continued ...

**Figure 7**

*continued*

**2. Case Studies**

To provide a more detailed insight into the management of research and technical work the National Audit Office examined 10 projects consisting of:

- two corporate research projects
- four applied research projects
- four project support projects

A summary of each project and the results of the examination are provided in Appendix 3. The projects were restricted to the Agency's two largest operating divisions - the Defence Research Agency and the Defence Test and Evaluation Organisation (see Figure 3).

**3. Review of Performance Measurement Regime**

The National Audit Office reviewed the Agency's performance measurement regime against their previous findings on performance measurement and against best practice criteria issued by both the Treasury and the Office of Public Service. The criteria are set out in Appendix 2. The National Audit Office also sought to validate the Agency's performance against their corporate targets for the years 1993-94 to 1995-96, as reported in their annual reports and accounts. And they assisted the Agency in reporting their performance in 1996-97. The results of this analysis are detailed in Appendix 4.

**4. Bibliometric Analysis**

To assess the Agency's success in the exchange of scientific knowledge with the wider scientific and industrial community, the National Audit Office analysed available data on the Agency's published output in scientific journals.

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## Part 2: Customer satisfaction, quality and capability

**2.1** The Agency aim to provide independent, high quality scientific and technical services to their customers. This part of the Report examines the following issues for Departmental customers:

- the customer-supplier relationship;
- changes to customers' and Agency efficiency;
- the extent of customers' satisfaction with the Agency's services; and
- the influence of quality, capabilities and timeliness on customer satisfaction.

### The customer-supplier relationship

**2.2** In 1992, a key element of the Agency's relationship with the Department was the introduction of a sharply defined customer-supplier relationship under which the Department place work under quasi contracts with the Agency. The contractual relationship is governed by a Terms of Business Agreement which seeks to provide a firm and binding agreement on both sides as to the work that should be done and the price that is to be paid. Because the Department and the Agency are not distinct legal entities under English law, the contracts do not contain conditions of the type that would normally be used to govern contractual relationships. Nevertheless, they are otherwise similar to those that the Department would apply to a commercial company. And the Department intend that the contracts with the Agency should be interpreted as though a contract existed.

**2.3** In principle, these arrangements should improve the efficiency of both the supplier and the customer by providing greater awareness of costs and by enforcing greater responsiveness, tighter objectives and a more vigorous dialogue on requirements and priorities. We assessed whether the customer-supplier relationship was working in practice by drawing on the views of customers and the case study examinations on the basis described in Appendices 2 and 3 respectively, and by examining in particular:



- the existing arrangements for customers' choice of supplier;
- the customers' ability to define their requirements and gauge the effectiveness of the Agency's work proposals;
- the customers' ability to assess the reasonableness of the Agency's costs and the quality of the Agency's cost estimating;
- the customers' control of costs; and
- the customers' ability to assess the overall competitiveness of the Agency.

## Choice of supplier

**2.4** A key aspect of an effective customer-supplier relationship is the extent to which the Departmental customer has freedom in the choice of their supplier. With the exception of the Defence Test and Evaluation Organisation customers in 1995-96, project support customers have the option to use other suppliers. By contrast, research customers are required to use the Agency as primary contractor.

**2.5** We asked participants in their focus groups whether they were content with the existing arrangements. Most of the research customers were satisfied with the Agency as primary contractor because for much of the work they provide a unique expertise or facility or they have familiarity with the programme. Most of the project support customers had not exercised their option to seek other suppliers for similar reasons. However, for those research customers operating in areas where there is greater availability of commercial facilities, some felt that they did not have the degree of freedom they would like in their choice of supplier. And some project support customers noted that they did not have sufficient resources to exploit fully the option of direct competition.

## Setting the specification

**2.6** The different tasking processes for the three main categories of work carried out by the Agency on behalf of their Departmental customers are summarised in Figure 8. The formal customer-supplier relationship places the burden on the customer to define their military needs as precisely as possible, particularly for research work. Because customers do not always have the necessary technical expertise, Agency staff have been made available to the

customers to provide the necessary intelligent interface between the customer and supplier. For the Applied Research Programme, the interface consists of package managers, who are part of the military customer team, on the one hand and the Agency’s project managers on the other. By contrast, the equivalent interface for the Corporate Research Programme is provided by managers within the Agency.

**Figure 8**

**Commissioning procedures for corporate and applied research and project support**

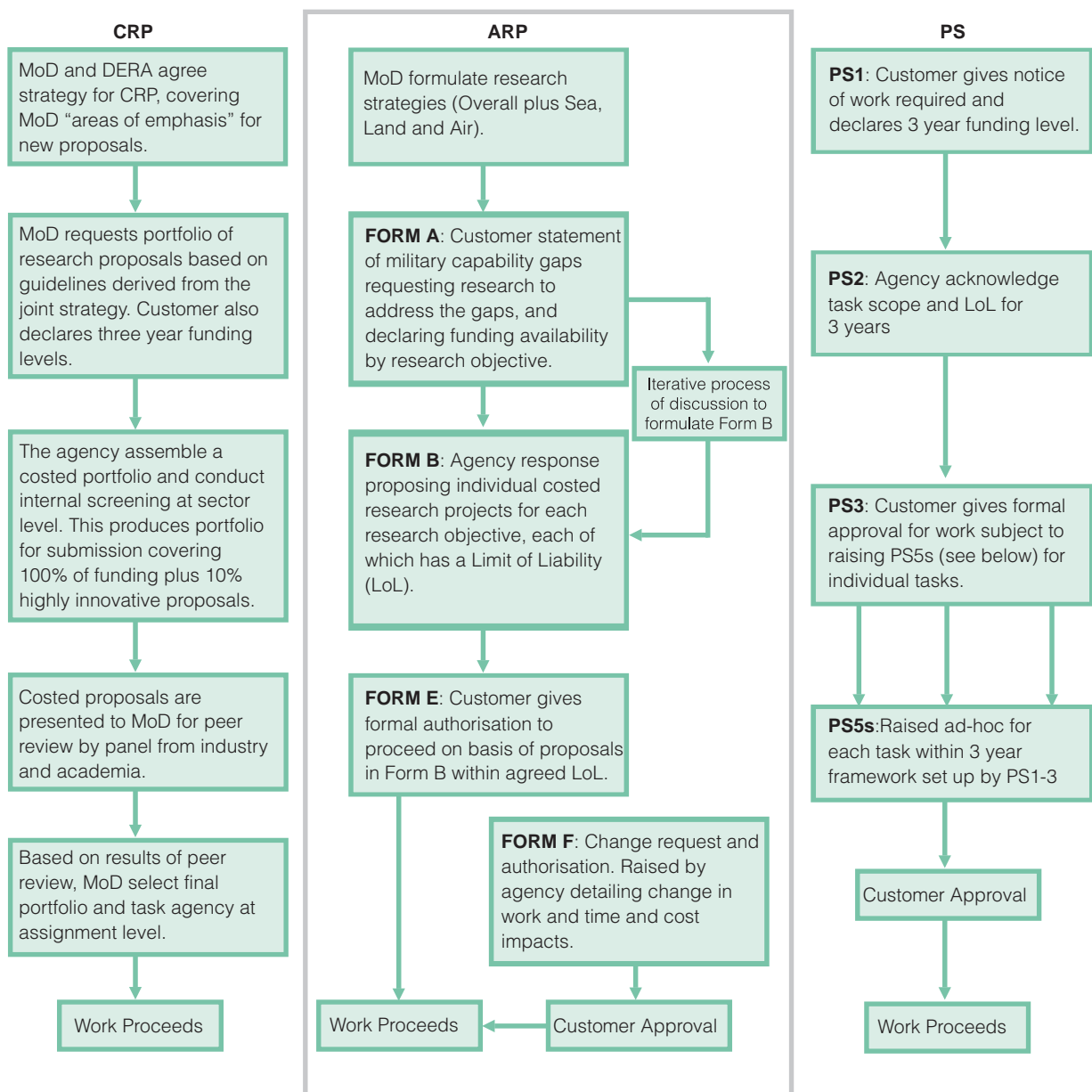


Figure 8 shows the commissioning procedures for the Applied and Corporate Research Programmes and for Project Support  
Source: National Audit Office

**2.7** Project specifications are formulated based on customers' research and project support tasking requirements, and on dialogue between the Agency's project managers and the customers. Although the definition of tasking requirements had improved over time, some applied research customers who participated in the National Audit Office focus groups noted that they were often reliant on the Agency for input to the specification because customers did not always have the necessary technical knowledge. They also noted that although they approved the milestone profiles, the profiles were invariably proposed by the Agency and the customer was not always in a position to judge whether the milestones were technically challenging.

## **Reasonableness and visibility of costs**

**2.8** For customers to make sound judgements on the value for money of the work they intend to commission they also need to have sufficient visibility of the Agency's costs and access to information about the performance of comparator organisations.

**2.9** Customers participating in our focus groups were asked to rate the reasonableness of the Agency's costs on a sample of 87 recent deliverables (Table 6). There were no significant differences in the ratings for each category of Departmental customer with the Agency's cost performance rated as adequate to good. However, most applied research customers noted that they had found this a difficult judgement to make because they lacked the necessary benchmark information from comparator organisations.

**2.10** The accuracy of cost estimates is an important factor underlying the rational allocation of research and development resources and evaluation of proposals. Our review of projects identified significant variations in the quality of cost estimates both between types of work and between the Defence Research Agency and the Defence Test and Evaluation Organisation, which only became part of the Agency in 1995. These variations are illustrated by the examples set out in Box 1.

**2.11** We concluded that the Agency should ensure that cost estimating practice across the Agency, particularly the Defence Test and Evaluation Organisation, is raised to the standards of the more highly specified projects found in parts of the Defence Research Agency. The Agency noted that the deficiencies in the Defence Test and Evaluation Organisation's cost estimating practice were due to their recent absorption into the trading fund and their consequent lack of familiarity

### Box 1

The quality of cost estimating was high for the Applied Research project involving research into Surface Ship and Submarine Sensors. The assignment covers research into the development of more effective low frequency active sonars, which are required to combat the progressive and continuing advances made in the quietening of submarines.

During the tasking process DRA drew up detailed zero-based cost estimates embracing all the cost drivers such as manpower, facilities and materials, extra mural contracts, and overheads (such as travel and subsistence) for individual tasks making up the assignment. This allowed an accurate overall Limit of Liability to be established, which in turn contributed to ensuring that the outturn for 1995-96 was within 3.5 per cent of the original estimate.



In contrast, the cost estimates were poor for a DTEO project support assignment covering the trialling of parachutes for use by airborne forces, and issuing airworthiness clearance for operational use of the equipment. This, in part, reflected the DTEO's lack of experience within the trading fund environment (see para 2.11).

The major cost drivers for this, and other similar assignments, are the use of aircraft, paratroops and aircrew for trials, technical manpower for evaluation of trials

results and support services for trials provided by DTEO.

However, the cost estimate for 1995-96 was based on the same proportion of the DTEO budget that the work had consumed in 1994-95, rather than a detailed estimate of the likely requirements in 1995-96 for each of the major cost drivers. As a result the original estimate for 1995-96 was £12 million, which was £8 million (53 per cent), above the actual outturn for the year. Although cost estimates should include a contingency for unsuspected changes in customer's requirements - a common feature of project support - inaccuracy of the magnitude of £8 million was, to a great extent, due to poor estimates rather than changes in customer tasking.

with Trading Fund requirements. They have not, however, carried out a review of cost estimating practice since our examination to determine whether cost estimating has improved.

**2.12** Furthermore, we noted that for all categories of work placed by Departmental customers, the Agency is advised in advance of the customer's budget. This reflects the close relationship between the Agency and the Department and avoids the possibility of nugatory work. But it also provides little incentive for the Agency to look for new ways to cut assignment costs, or to ensure that cost estimates relate solely to activities necessary to meet customer

requirements. Customers should not automatically pass funding details to the Agency: they should normally ensure that the discipline of producing a lean, requirement-driven proposal is placed firmly on the Agency.

## Control of costs

**2.13** Most of the contracts between the Department and the Agency require the Agency to be paid for costs incurred, up to an agreed cost plus profit ceiling known as a Limit of Liability, estimated in advance using annually fixed charge-out rates. A range of pricing regimes are permitted, however, including firm pricing - as used for a proportion of the project support work. The contracts also provide conditions for stopping the contracts under specified circumstances and facilities for customers to withhold payment in the event of non-delivery to time or specification - although progress payments for research work are made automatically in the absence of express intervention by the customer.

**2.14** Customers told us that their contractual relationship with the Agency provided a valuable level of flexibility that they perceived they would not obtain with other suppliers. Nevertheless, they also believed that their ability to control costs to an acceptable extent under these contracts was limited in practice. And whilst the Agency monitor costs in relation to the Limits of Liability, their effectiveness as an instrument of cost control is reduced both by the poor quality of cost estimates in some parts of the Agency (para 2.10) and because they can be changed, with customer approval, to cover internal cost growth. Although cost uplift is not granted automatically, these factors suggest there is insufficient transfer of risk to the Agency, as illustrated by the case study examples set out in Box 2.

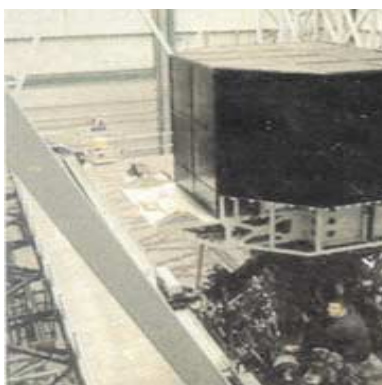
**2.15** Project support customers who participated in our focus groups preferred to use fixed price contracts in some instances although research customers were less certain of their benefits due to the uncertainty inherent in the research process. The Agency told us they are seeking wider application of fixed and firm price contracts to put pressure on their assignment managers to pay closer attention to delivery to price - just as the Agency use firm and fixed price contracts for much of the work they sub-contract to industry.

**Box 2**

Cost control on the case study assignments was variable. In some areas, notably DRA Applied Research and Project Support (PS) assignments, it was good with close monitoring, and outturn close to original estimates. Cost control appears to be best where there is a high level of customer visibility and involvement. The PS system can provide this by giving each task within an assignment an individual Limit of Liability (LoL) and by reporting financial information by task, rather than just for the assignment overall. For instance one of the case study assignments involves the provision of technical support to the Department's procurement of a combat net radio system. Technical support involves a range of tasks including: evaluation of system performance; provision of technical advice to support the design and conduct of trials; advice on the production of the invitation to tender and the evaluation of contractor's responses; and modelling of system performance and interfaces using DRA facilities. The support task also requires DRA to provide staff full time to work within both the Department's project office and on-site at the contractors. These broad requirements form the basis for the specific taskings placed ad hoc by the customer. The assignment was set up under the forms PS1-3 system (see Figure 8), which establishes a three year tasking framework. Each task within the assignment was specified, as and when required, and each was given its own LoL. Financial reporting was also conducted by individual task. This allowed the customer a high level of visibility and ensured that both DRA management and the customer were constantly aware of how spend on the assignment was progressing relative to the overall LoL. Control by task helps to ensure that the overall LoL is not breached by providing a regular update of the headroom left within the overall LoL which bears on the specification of future taskings. The visibility also reduces the risk of cost escalation by providing a clear picture of where, within the assignment, problems are occurring and corrective action is required.



This visibility and control contrasts with other assignments where reporting at an aggregated level for the whole assignment makes it difficult for the customer to identify which areas of work are causing problems and what action would be appropriate to deal with them, and control costs. Cost control problems lead to the need for repeated uplifts to assignments' LoLs. It is very difficult for the customer to deny requests for uplifts in LoL because if he does so, work will stop before it is complete.



For example, one of our case studies was an assignment exploring and modelling the handling characteristics of helicopters. This involves conducting flight trials to acquire data about aircraft handling which is then used to construct high fidelity models for use in piloted simulators. Flight trials are also required to validate the fidelity of the models.

Due to an underspend in other areas of the Corporate Research Programme, an opportunity arose mid-way through 1995-96 to conduct a major series of flight trials. The assignment's LoL had been uplifted early in the year to accommodate an increase in DTEO charge-out rates for aircrew and flight trials. The decision was taken to conduct the trials mid year, and the assignment team booked the aircraft and planned the trials. However, before these trials were

complete notice was received, from Air Fleet Department (AFD) in DRA, of a significant increase

in the costs of the aircraft used for the trials. This increase could have been anticipated by AFD and the assignment team notified before substantial work on the trials began. However, notice was not given and the assignment management had to request a significant increase to the assignment LoL to cover this unanticipated cost growth. The customer was faced with the choice of either granting the uplift or the trials being stopped before the required data had been collected, rendering previous expenditure on the trials nugatory. The uplift was granted.

Neither on the above assignment, nor on any of the other case study assignments does it appear to have been an option that the Agency would fund any cost growth and complete the work, effectively at a loss. On the basis of the case study evidence there is very little transfer of commercial risk to the Agency under the current customer-supplier relationship.

## Mechanisms to gauge the Agency's overall competitiveness

**2.16** To make the customer-supplier arrangements work most effectively, the customer must be able to gauge the cost-effectiveness of the Agency's proposals, and monitor performance. On specific assignments, the customer needs to be able to judge:

- the relevance of the proposals to customer requirements;
- the intrinsic quality of the scientific proposals;
- the timeliness and speed of delivery; and
- the cost, deriving from staff and facility charge rates and the packaging of the project.

While the system employed makes information on all of these points available to the customer, there are few benchmarks or options available to provide insight into the most cost-effective solutions, as opposed to one that is simply satisfactory.

**2.17** This circumstance reflects the inherent difficulty of judging the worth of research proposals; the limited dissemination of information possible on matters affecting national security; and the lack of possible alternative suppliers to the Agency for much of the research portfolio. The Department wish, nevertheless, to ensure that the Agency are subject to competitive pressures - a requirement reflected in the Agency's framework document. The principal mechanisms for meeting this requirement, which operate at increasing distance from the customer, are as follows:

- **direct competition**, under which the customer has complete freedom and control in the choice of supplier;
- **direct benchmarking**, under which the Agency is exposed to other suppliers' performance through sub-contracting, collaboration or other similar mechanism;
- **indirect benchmarking**, under which the Agency applies industry standards to their systems or exposes them to external assessment.



**2.18** The benefits and drawbacks of the above mechanisms for the customer are summarised in Figure 9. The table shows that a wide range of mechanisms have been put in place, capable of supplying information on competitiveness across the range of the Agency's work. The main points emerging are:

- at an assignment level, only direct competition can provide a full set of benchmarks to judge cost-effectiveness;
- competition is only possible and practicable for a small proportion of Agency work;
- the Agency themselves run most of the benchmarking activities;
- the degree of assurance on competitiveness on any given assignment will depend on the type of work in question and the precise relevance of the various benchmarking and assessment mechanisms; and
- the available information on competitiveness is not summarised and disseminated in a way which would help customer staff and research managers deal with specific requirements.

**Figure 9**

**Mechanisms for gauging the Agency's competitiveness**

Mechanism	Benefits	Potential Drawbacks
<b>Direct Competition:</b>		
<input type="checkbox"/> Optional for project support customers but used in only a limited number of cases (less than 10% of programme); and	<input type="checkbox"/> only mechanism which provides customers with simultaneous first hand access to cost, timeliness and quality information on other suppliers;	<input type="checkbox"/> number of potential suppliers may be small;
<input type="checkbox"/> Research customers cannot compete their requirements, and are required to use the Agency as primary contractor.	<input type="checkbox"/> sharpens definitions of requirements;	<input type="checkbox"/> competition in research could affect the attitudes and behaviour of staff within both the Agency and their potential competitors in industry and therefore limit the scope for the transfer of the Agency's technology into industry for incorporation into equipment production;
	<input type="checkbox"/> allows customer to draw on industry for particular capability attributes; and	<input type="checkbox"/> it may be difficult to define a requirement for the competition; and
	<input type="checkbox"/> may remove the need for technology transfer to industry.	<input type="checkbox"/> administration costs could exceed potential benefits.

continued...



**Figure 9**

**Mechanisms for gauging the Agency's competitiveness *continued***

Mechanism	Benefits	Potential Drawbacks
<b>Direct Benchmarking:</b>		
Exposing the Agency to other suppliers primarily through the following mechanisms:		
<input type="checkbox"/> around one third of the Departments research work is sub-contracted by the Agency to industry and academia under the Extramural Research Programme;	<input type="checkbox"/> provides a datum against which the Agency's work can be benchmarked internally;	<input type="checkbox"/> customers may have limited involvement in the process of selecting the supplier;
<input type="checkbox"/> national and international collaboration; and	<input type="checkbox"/> allows the Agency to draw on industry for particular capability attributes; and	<input type="checkbox"/> customers may have limited access to information about the cost and performance of the other suppliers; and
<input type="checkbox"/> comparisons of cost per hour with industry equivalents for the Agency's smallest division.	<input type="checkbox"/> facilitates technology transfer between the Agency and industry.	<input type="checkbox"/> customers may have limited involvement in those elements of the work that are to be carried out by other suppliers.
<b>Indirect Benchmarking Initiatives:</b>		
<input type="checkbox"/> Technical assessment - provides self-assessment of the scientific and technical quality of most of the Agency's teams, backed up by external audit;	<input type="checkbox"/> assessment systems provide a measure of the relative performance of the Agency's teams and therefore incentives for staff to improve their performance; and	<input type="checkbox"/> assessment information on team level performance not disseminated to customers;
<input type="checkbox"/> UKQA - provides self-assessment of business excellence for a number of the Agency's sectors, backed up by external audit;	<input type="checkbox"/> facilitates the introduction of best practice systems and assessment models.	<input type="checkbox"/> individual initiatives usually address only part of the value for money equation, such as quality or capability; and
<input type="checkbox"/> ISO 9001 - quality assurance systems for most of the Agency are now at an international standard.		<input type="checkbox"/> quality assurance systems provide no guarantee of output quality.

**2.19** At the time of our examination, the Department and Agency were reviewing the balance of advantage in introducing direct competition into the research programmes: interim findings suggested that a possible detriment to technology transfer would outweigh any cost-effectiveness benefits. In any case, it is clear that competition could not practicably apply to the entire range of research or project support activities, and that other mechanisms must remain in place. In order to exert proper pressure on the supplier, the customer must retain control of mechanisms adopted to measure or test value for money - regardless of who undertakes the data collection and analysis work supporting these mechanisms. Furthermore, information on competitiveness must reach those customers and

Agency staff who take decisions on the framing and conduct of assignments. And finally, the quality of the mechanisms themselves must be evaluated from time to time, to ensure they achieve the desired result.

## Key points and recommendations:

**2.20** Improvements in customer satisfaction and efficiency (see paras 2.21 to 2.37) testify to the benefits of a customer-supplier relationship, but the relationship still has some way to go before it is fully mature. In particular:

- a significant proportion of Departmental customers have no choice but to use the Agency, and little ability to gauge the competitiveness of individual projects;
- the Department needs to ensure that their role in defining research and project support requirements, appraising proposals and specifications and monitoring progress, is carried out to uniformly high standards, to ensure that the Agency are stretched on individual projects;
- the Agency need to improve cost estimating, particularly in the Defence Test and Evaluation Organisation, by building on the experience of their more tightly specified projects;
- customers believe that the contractual relationship between the Department and the Agency does not provide the degree of cost control that they would wish. The Department should explore the scope for greater use of firm price or incentivised contracts and raise customers' awareness of existing provisions for withholding payment in the event of non-delivery to time or specification;
- the Department should take the lead in defining and reviewing a set of mechanisms to provide information on Agency competitiveness, to ensure these mechanisms are adequate for their purposes;
- competitiveness information should be summarised and disseminated to staff commissioning and evaluating proposals; and
- without the scope to conduct even strictly limited and targeted competition within the research programmes, it may difficult in practice to obtain useful project cost and performance benchmarks.

## Charges and Agency efficiency

**2.21** The main impact on customers of the Agency's efforts to increase efficiency has been felt through charge-out rates for staff and facilities. Figure 10 below shows that average staff rates have reduced, in real terms, by just over 9 per cent over four years.

### Average Staff Charge Out Rates at 1996-97 prices

**Figure 10**

1993-94 (£/Hr)	1994-95 (£/Hr)	1995-96 (£/Hr)	1996-97 (£/Hr)	Percentage Reduction from 1993-94 to 96-97
41.9	39.5	39.0	38.0	9.3%

Source: The National Audit Office, based on Agency records

Figure 10 shows that the Agency reduced their charge-out rates by 9.3 per cent in real terms over the four years to March 1997

**2.22** Although the Agency's overall staff rate dropped in real terms between 1995-96 and 1996-97, we noted that the improvement fell unevenly across the Agency with considerable variation in rates between key operational elements. In particular:

- the average staff rates increased in 1996-97 for four of the seven sectors in the Defence Research Agency, the largest single part of the Agency, mainly as a result of planned reductions in staff utilisation in these sectors due to the diversion of staff into management and other initiatives; and
- the Defence Test and Evaluation Organisation have the widest range of staff rates, although rates decreased in 1996-97 primarily through improvements in staff utilisation and reductions in costs.

**2.23** Thus customers for the Defence Research Agency are likely to have seen an entirely different effect to those for other parts of the Agency.

**2.24** In contrast to staff rates, overall facility rates are more difficult to compare because there is no common unit of charge. At the level of individual facilities, however, our case studies noted increases in the rates for some unique and under-utilised facilities.

**2.25** Reductions in charge-out rates reflect the following main factors: staff utilisation; facility utilisation; and overheads.

### Staff utilisation

**2.26** The Agency attach considerable importance to staff utilisation and employed this metric as a corporate key target until March 1997. Utilisation is the percentage of total staff time which is devoted to activities chargeable to customers. Figure 11 compares outturn performance with target, which shows that the Agency have made substantial improvements in their chargeable utilisation with a 57 per cent improvement overall in the five years to March 1997.

Staff Utilisation compared with corporate target

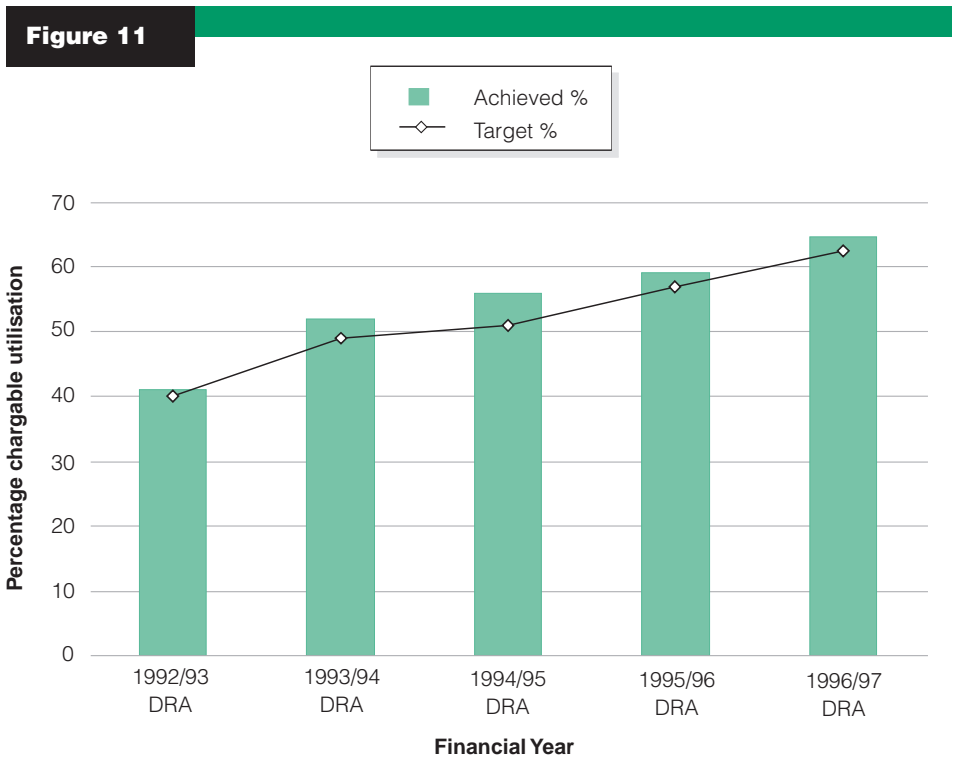


Figure 11 shows that the Agency secured a 57% improvement in their manpower utilisation over the five years to March 1997. However, overall manpower utilisation is budgeted to rise by only 1% in 1997/98.

Source: The Agency

**2.27** However, we noted that parts of the Agency may have reached the point where efficiency improvements will be difficult to sustain. In particular, chargeable utilisation for the Defence Research Agency fell below the level they achieved in 1995-96, reflecting both the impact of implementing ISO 9001 quality assurance systems and other corporate investments (see para 2.51) and an over-achievement in 1994-95. Thus the majority of the improvement in utilisation in 1996-97 came

from the Defence Test and Evaluation Organisation, which had a significantly lower level of utilisation than other parts of the Agency in 1995-96. And the Agency's overall utilisation is expected to rise by only 1 per cent in 1997-98.

**2.28** We further noted that the measurement of staff utilisation reflects both internal charging policy and individual time booking judgements. And therefore an increase in chargeable hours does not necessarily signal greater efficiency. The Agency accept that staff utilisation is a fairly crude measure of efficiency and needs management interpretation to be fully effective, but it is now firmly embedded as a means of measurement and control. They also noted that a high level of utilisation is not necessarily virtuous.

### **Facility utilisation**

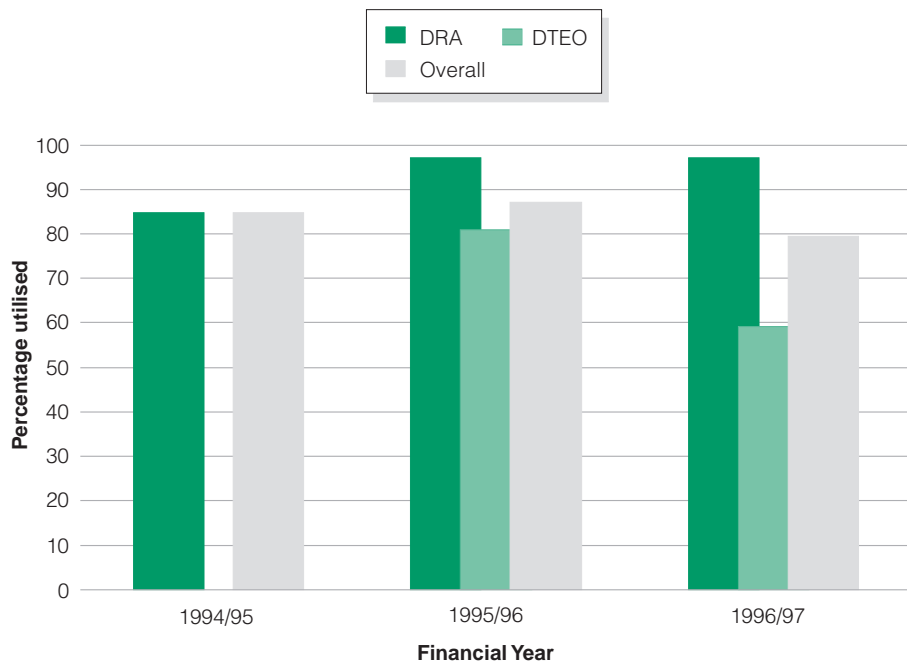
**2.29** In addition to staff utilisation, the Agency monitor the utilisation of their facilities. Facility utilisation - the percentage of total capacity that is charged to customers - can vary considerably between operational elements of the Agency, reflecting the varied and specialised nature of their facilities and the related definitions of capacity. Figure 12 compares overall facility utilisation for the Defence Research Agency and the Defence Test and Evaluation Organisation.

**2.30** Figure 12 also shows that overall utilisation of Defence Test and Evaluation Organisation facilities fell considerably in 1996-97 and their plans for the five year period to 2002 indicate a continued fall in utilisation. These trends are due, in part, to lower demand for physical testing arising from an increased use of simulation and from competition from other suppliers. This is a significant challenge for the Agency because some facilities may soon become uneconomic to run.

**2.31** Accordingly, to maintain the economic viability of the Defence Test and Evaluation Organisation facilities and prevent rates increasing to those customers who continue to use the facilities, the Agency aim to reduce fixed costs by reducing capacity by the equivalent of one range by 1999-2000. However, these plans are very sensitive to demand for Defence Test and Evaluation Organisation facilities and the Agency have recognised that more extensive action will be necessary if income projections fall by as little as 5 per cent per year.

**Estimated facility utilisation of the Defence Research Agency and the Defence Test and Evaluation Organisation**

**Figure 12**



Source: The Agency

Figure 12 shows that the overall utilisation of DTEO facilities is lower than that of the DRA.

**Initiatives to reduce costs**

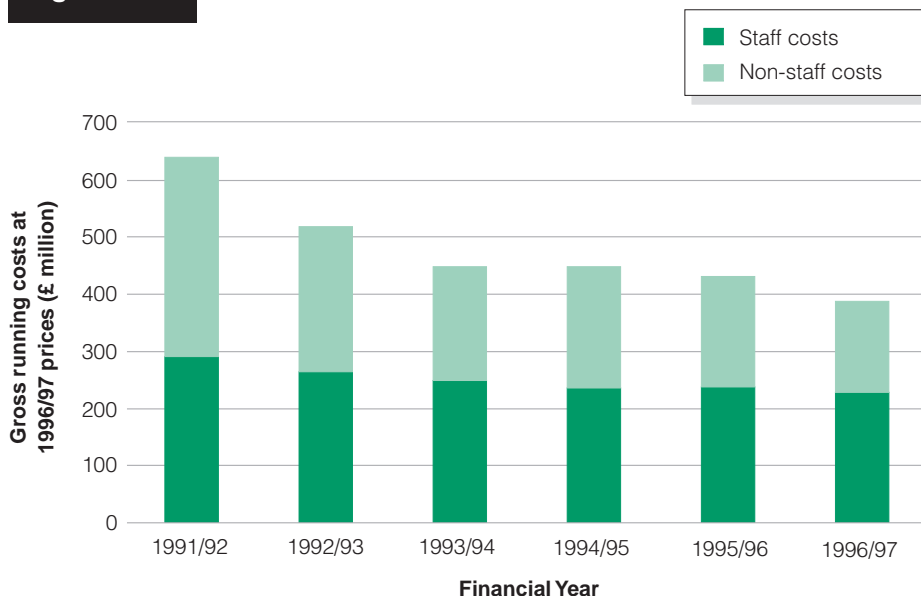
**2.32** Cost reductions have formed a major component of the Agency’s drive to improve efficiency since 1992-93. Figure 13 shows that the Agency secured a substantial reduction in their running costs of £71 million per annum in real terms (13.6 per cent) between 1992-93 and 1994-95. It also shows that the downward trend has continued for the Defence Research Agency element.

**2.33** Figure 14 shows that the Agency also achieved significant reductions in the number and proportion of support staff in the four year period prior to their expansion in April 1995. However, support staff numbers increased in 1995-96 as a percentage of total staff numbers following the Agency’s expansion. This was due to the additional support staff of the Defence Test and Evaluation Organisation, which were brought to the Agency without prior rationalisation.

**2.34** The cost and staff reductions set out in Figures 13 and 14 were achieved primarily through a combination of outsourcing or abolition of support services, site and facility rationalisation and market testing.

**The Defence Research Agency's gross running costs<sup>(1)</sup> 1991-92 to 1996-97**

**Figure 13**



Note: 1. Running costs covers variable costs such as staff, materials and accommodation, but excludes extramural contract costs.

Figure 13 shows the substantial reduction in the Defence Research Agency's (DRA) running costs. In particular, they secured a reduction in their gross running costs of £71 million (at 1996/97 prices) in the three years prior to their expansion in April 1995. The costs of the DRA element fell by a further £60 million (at 1996/97 prices) by March 1997.

Source: The Agency

**Staff numbers over the period 1991-92 to 1996-97**

**Figure 14**

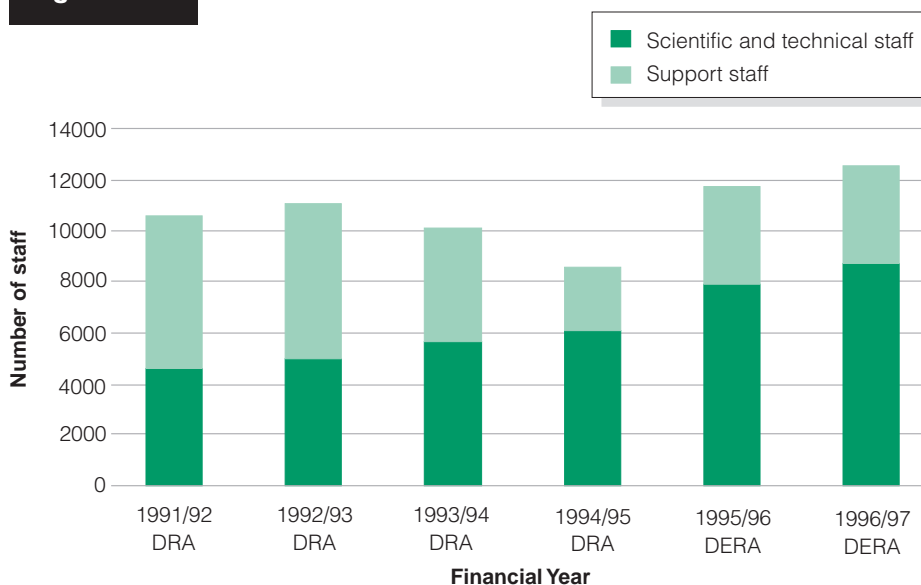


Figure 14 shows that the Agency's overall staff numbers fell prior to their expansion in April 1995. Although the proportion of support staff increased in 1995/96 with the expansion of the Agency, the number of scientific staff has continued to rise steadily over time.

Source: The Agency's Annual Reports

## Key points and recommendations

**2.35** The Agency have made considerable progress in improving efficiency, the main points being:

- manpower charge-out rates have reduced by around 9 per cent in real terms over the four years to March 1997. The improvements in 1996-97, however, fell unevenly across the Agency;
- staff utilisation rates have risen consistently over the last four years, and have now plateaued at around 65 to 75 per cent in many sectors;
- facility utilisation is a crucial issue for the Defence Test and Evaluation Organisation in particular. The Department should consider including an appropriate measure of the efficient use of facilities in the Agency's key targets; and
- overhead costs have been reduced considerably over the past four years, by a combination of site rationalisation and reduction in support staff.

## Customer satisfaction

**2.36** Since 1991 the Agency have commissioned consultants to conduct an annual customer satisfaction survey. For the three customer surveys completed covering 1993-94 to 1995-96 all respondents were asked to rate the Agency's performance under eight attributes, covering issues of timeliness, capabilities, quality assurance and value for money. As a result of changes the Agency made to the Departmental customers questionnaire for 1996-97, a strict comparison with earlier years and the other customer categories is no longer possible. However, the way in which the questions are grouped under the attribute headings enables an indicative comparison to be made. Further details on the attributes and the changes made by the Agency in 1996-97 are provided in Appendix 2.

### Trends in overall customer satisfaction

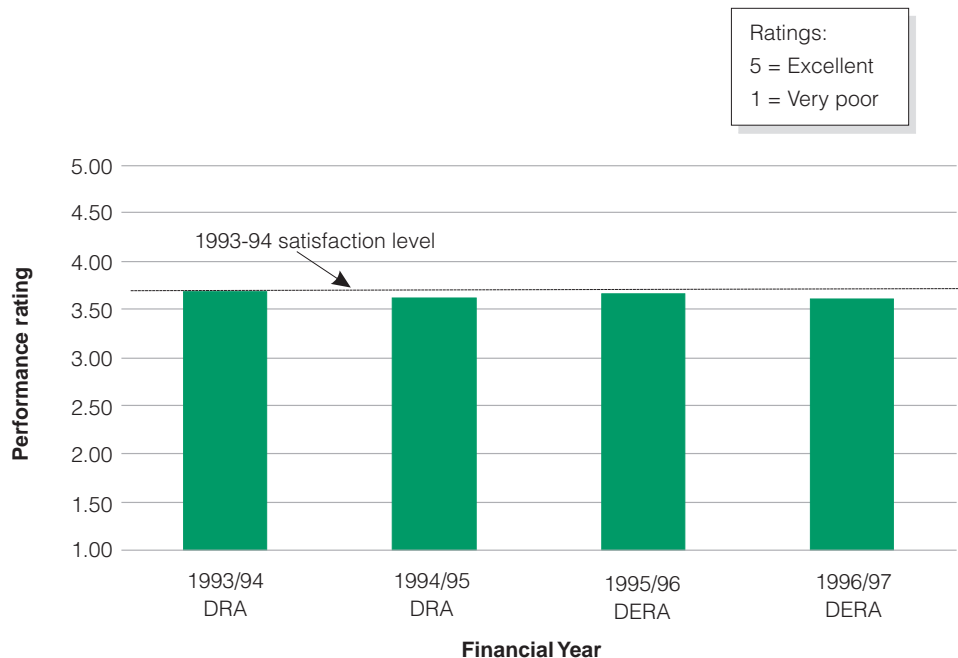
**2.37** The results of our analysis of Departmental customers overall satisfaction over the four years to March 1997 are shown in Figure 15. Departmental customers' overall satisfaction is at a good level, although there has been no significant change in the absolute rating over the four year period according to the Agency's survey. At the time of our focus groups in 1996, however, most of the participants considered that their overall satisfaction had improved, which



suggested that customers' perceptions of acceptable standards had risen over time. The Agency's last customer survey, conducted in the aftermath of our focus groups, shows a slight downturn in customer satisfaction. This may suggest a further hardening of customer expectations or that the Agency's efficiency improvements are beginning to compromise their effectiveness. The Agency are currently reviewing the position.

**Trends in Departmental customers' overall satisfaction with the Agency over the period 1993-94 to 1996-97**

**Figure 15**



Note: 1. The 1996-97 data is calculated on a different basis due to changes in Agency has made to the satisfaction survey questionnaire. However, an indicative comparison can be made.

Source: The Agency's Annual Reports

Figure 15 shows that there has been no significant change in the Departmental customers' overall satisfaction in the four years to March 1997, according to the Agency's annual survey.

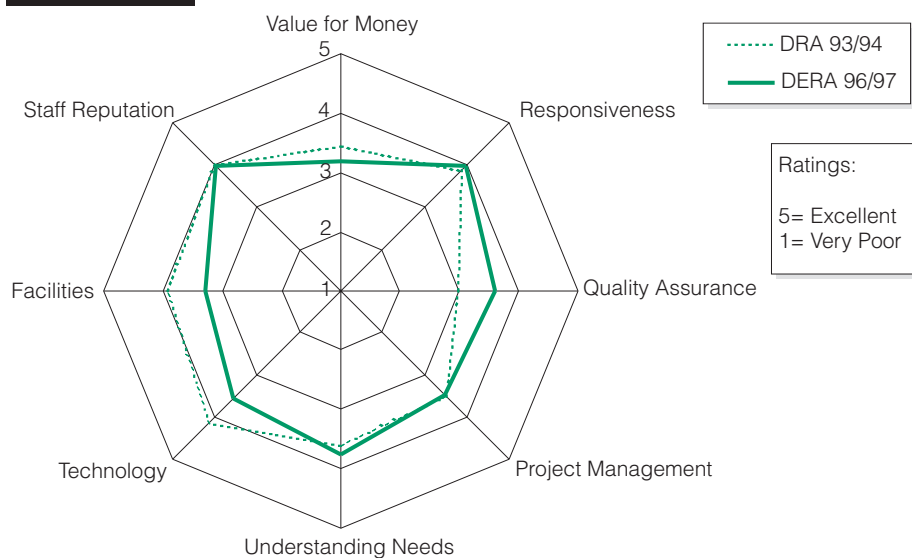
### Comparison between attributes

**2.38** Although overall customer satisfaction would appear to be at a higher level than in 1993-94, there are different trends evident when specific criteria are considered. Figure 16 illustrates how the Agency's performance has varied over the four years to March 1997 for Departmental customers, under the eight attributes which the Agency regard as key. The figure shows that historically the Agency has performed better under those criteria concerned with capabilities than

with management and the delivery of the product. However, the ratings for facilities, technology and value for money have fallen over the period whilst quality assurance registers the largest improvement.

**Trends in Departmental customers' view on the Agency's performance under key attributes<sup>(1),(2)</sup>**

**Figure 16**



Notes: 1. The attributes are defined in Appendix 2.

2. The ratings for 1996-97 are on a different basis to earlier years, as set out in Appendix 2.

Source: National Audit Office on the Agency's annual customer survey

Figure 16 shows that Departmental customers' satisfaction with the agency's quality assurance has improved over the four years to March 1997. In contrast, their views on facilities and technology have worsened over this period.

**Comparison between type and research activity**

**2.39** Figure 17 analyses customers' views on recent outputs examined as part of our focus groups (see Figure 7). It shows that there are relatively small differences in performance between the different categories of work with customers' overall satisfaction falling just below good on average. Similar ratings are achieved under the other criteria and are broadly consistent with the ratings shown in the Agency's survey, where similar factors are covered.

**The Agency's performance on Corporate and Applied Research and Project Support**

**Figure 17**



Source: National Audit Office  
Focus groups

Figure 17 shows that there are relatively small differences in Departmental customers' satisfaction between the three main categories of the Agency's work.

## Comparison between Divisions

**2.40** Whilst there are no substantial differences between the overall performance of the Agency's four Divisions, there are wider variations in performance under individual attributes (Figure 18). This suggests there is room to level up performance between Divisions, particularly in the areas of staff reputation, technology, value for money and quality assurance.

## Surveying customers

**2.41** Regular monitoring of customers' views provides management with important information about the Agency's performance. However, at the time of our fieldwork, there were a number of areas where there was scope to enhance the survey and analysis of results:

- industry, other government department and some departmental respondents were not asked questions about the quality of the Agency's work or how it compares with other suppliers. These factors limit the scope

**Departmental customers' views on the performance of different parts of the Agency under specific attributes**

**Figure 18**



Source: The Agency's customer satisfaction survey 1995/96

Figure 18 shows the significant variations in customers' views between the Agency's four main divisions under the criteria of staff reputation, technology, quality assurance and value for money.

for comparing the Agency's performance between customer groups and with other suppliers. All Departmental respondents now complete the same questionnaire;

- when the Agency wish to aggregate the scores from different sets of questions, they should ensure that the rating scales applied are the same - currently they are not;
- respondents are asked to rate the general performance of particular business sectors or the Agency overall and not in respect of individual items of work or "deliverables". The Agency are not confident that their systems could accommodate the latter approach;
- the survey is not routinely analysed according to the key Departmental customer groupings (corporate, applied and project support) - thus depriving management of important information about variations in performance between them. The Agency have now carried out this type of analysis for their most recent survey; and

- the Agency analyse their survey results at the level of each of their operational sectors. They then weight these results according to the headcount in each sector to provide a measure of their overall performance. This analysis can lead to difficulties, however, when the result for individual sectors are not statistically valid, as occurred for one of the Agency's Divisions in 1995-96.

## Key points and recommendations

- Overall Departmental customer satisfaction with the Agency is good, and has remained at the same level for the last four years;
- there are differences in ratings between attributes, and between types of activity and the Agency operating Divisions that merit further analysis; and
- the independently-conducted, Agency commissioned survey of customers is a valuable tool for management and accountability purposes, and the 1995-96 and 1996-97 results accord with the outcome of our focus groups with customers. There are, however, a number of detailed improvements to the survey instrument and the analysis of results that would improve its utility.

## Quality of the Agency's research

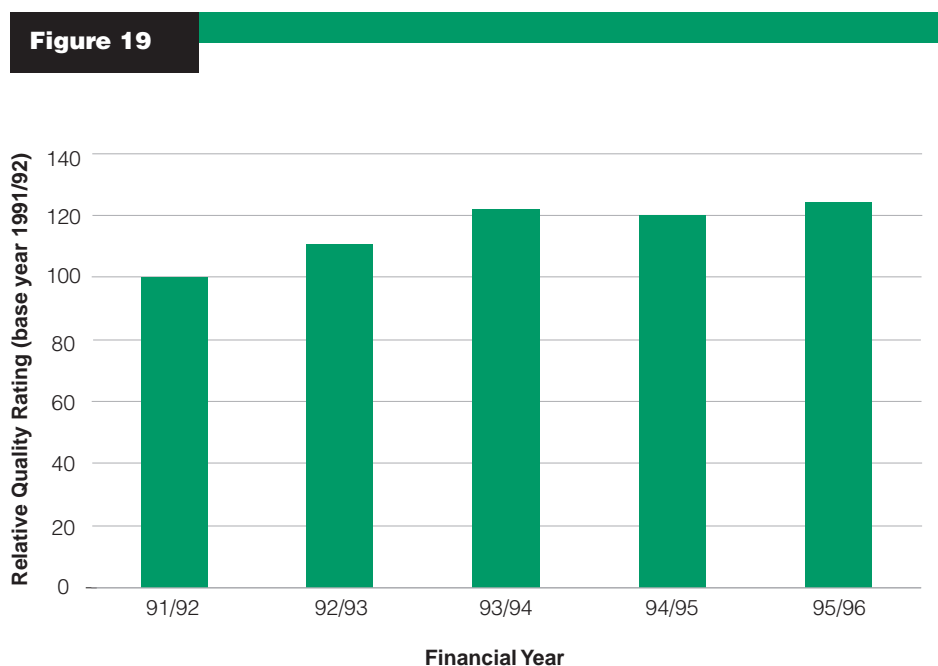
**2.42** Although the attributes used in the customer survey cover much useful ground, they do not address explicitly the intrinsic quality of the Agency's work nor the extent to which it is used by customers. The Agency are now seeking to establish a new measure to evaluate the value of their work to customers. The following paragraphs analyse the information available currently on these topics.

### Scientific quality

**2.43** The Agency have limited direct evidence of the scientific quality of their research. The only part of their scientific output that they have consistently assessed is the innovative element of the Corporate Research Programme (that part which was previously known as the Strategic Research Programme, equivalent to about one third of the Corporate Research Programme). The assessment is based upon the peer review scores awarded by independent academic assessors employed by the Department to appraise both the quality of the initial research proposals and subsequent progress. The reported results for

the 5 year period 1991-92 to 1995-96 are analysed in Figure 19, which shows that there has been just under a 25 per cent improvement in the scientific quality of innovative corporate research over this period using this measure.

**Reported trends in the scientific quality of the innovative element of the Corporate Research Programme 1991 to 1995**



Source: The Agency  
Figure 19 shows that the quality of the innovative element of the Corporate Research Programme has risen by about 25% in the five years to March 1996

**2.44**

The peer review process was extended to the whole of the Corporate Research Programme in 1996-97. The Agency have abandoned this measure as a corporate target, however, because the technical assessment measure (see paragraph 2.59), which they have substituted for the scientific quality target, covers a wider range of their activities. Nevertheless, in the absence of other measures of intrinsic scientific quality, peer review assessment represents an important element of the Agency’s performance information. Scientific quality could usefully be tracked alongside the results of technical assessment and be incorporated into it.

**Exploitation of the Agency’s output**

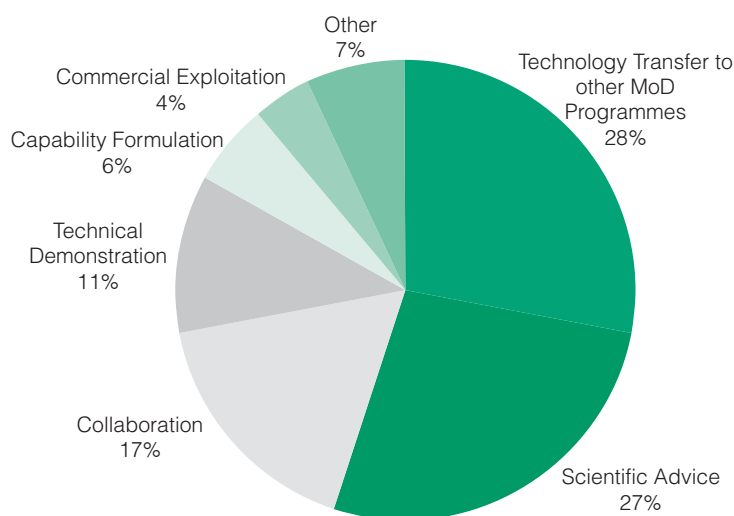
**2.45**

A key indicator of the quality of the Agency’s work is the extent to which it contributes to the achievement of military objectives; contributes to other programmes of work (“pull through”) or provides other downstream benefits such as technology transfer. Prior to 1996, the Department had limited information on

the utility of the Agency's output. However they have recently completed the construction of a database to track the exploitation of the Agency's corporate research. We analysed this database to determine the principal benefits of the Agency's output. Figures 20 and 21 show the results of the analysis.

**Analysis of the type of benefits generated by the Corporate Research Programme**

**Figure 20**



Source: National Audit Office, based on data supplied by the Department

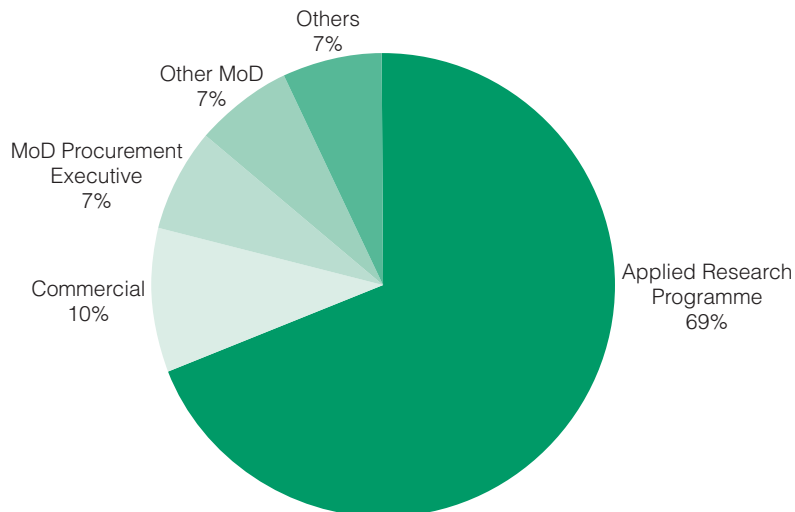
Figure 20 shows that the principal outputs from the corporate research programme are technology transfer and scientific advice to inform future or other Departmental work. Direct commercial exploitation, where the research establishes a technical capability in industry, represents a small percentage of the outputs.

**2.46** Figure 20 shows that the principal outputs from corporate research are scientific advice to inform future corporate research or other Departmental work and the transfer of the technology to other Departmental programmes. The main beneficiary is the Applied Research Programme (Figure 21), reflecting the pull through from the more general research to its application on specific technologies. However, just under one quarter of outputs from corporate research pass to other Departmental programmes and industry. In particular, 7 per cent of outputs pass to the Department's Procurement Executive which suggests that the linkages between corporate research and military application is much shorter in some instances.

**2.47** One of the main objectives of the Corporate Research Programme is to maintain and develop the Department's access to capabilities. Figure 21 also shows that capability formulation, where the research has developed a technical

## Recipients of Corporate Research

**Figure 21**



Source: National Audit Office, based on data supplied by the Department

Figure 21 shows that the Department's Applied Research Programme is the principal recipient of outputs from the corporate research carried out by the Agency. Other Departmental programmes and Industry make up the majority of the other recipients.

expertise or facility within the Agency, represents only a small proportion of the Programme's output. Similarly, direct commercial exploitation, such as the establishment of a technical capability in industry represented a relatively small part of the output. This is consistent with the nature of the Corporate Research Programme.

**2.48** Following our examination the Agency extended the range of information available on technology transfer out of both the Corporate and Applied Research Programmes. The results are discussed in Part 3 of this report.

## Key points and recommendations

**2.49** The Agency's direct measures of the intrinsic quality of its work are currently confined to annual assessments of the more innovative elements of the Corporate Research Programme, and it is for this Programme that the Department have started to track exploitation of research. Points to note are:

- peer group review of the innovative element of the Corporate Research Programme showed an improvement of around 25 per cent in ratings over five years;



- the results of the peer review process could usefully be tracked alongside, and incorporated into, the technical assessment process;
- Departmental tracking of corporate research exploitation shows that most outputs relate to technology transfer to other programmes and advice, with the Applied Research Programme the dominant beneficiary; and
- tracking the exploitation of research is potentially valuable, and could be refined and extended to the Applied Research Programme. The exercise needs to be able to distinguish between strong and weak influence on advice and other research.

## Capabilities

**2.50** The Agency's ability to meet customers' needs is dependent on the capabilities upon which it can draw. In particular:

- people - their experience, skills, knowledge and understanding of defence requirements; and
- appropriate technology and facilities.

### Staff capabilities

**2.51** Recognising the need to strengthen their scientific and technical staff capability, the Agency have:

- increased the ratio of scientific and technical staff to non-technical and support staff from 0.77 to 1 in April 1991 to just under 2.3 to 1 in March 1997;
- participated in staff interchanges with the Department to raise the Agency's awareness of the Department's military requirements. For instance, as at March 1996, 71 Agency staff were on secondment to the Department and 103 Departmental staff were seconded to the Agency;
- introduced a system of technical self assessment based on the United Kingdom Quality Award to measure the quality of their technical and scientific teams;

- created an internal knowledge database to improve Agency staff access to colleagues' capabilities; and
- provided staff training on business management.

In assessing the Agency's staff capabilities we concentrated on customers' views and the Agency's technical assessment system.

### Customers views on staff capabilities

**2.52** The Agency's annual survey asks customers to rate staff reputation and understanding of requirements - both measures of staff capability. Figure 22 shows that the Agency achieve consistently good ratings on these measures for Departmental customers. Staff reputation is rated more highly than understanding of needs, although the difference between them has reduced in the four years to March 1997.

#### Trends in Departmental customers' views of the Agency's staff capabilities



Note 1. The 1996-97 data is calculated on a different basis due to changes the Agency has made to the questionnaire. However, an indicative comparison can be made.

Source: National Audit Office based on the Agency's annual customer survey

Figure 22 shows that Departmental customers rate staff reputation consistently higher than their understanding of needs, although the difference in ratings has varied over time.

**2.53** Our focus groups revealed mixed views underlying the Departmental customer results shown in Figure 22 above. Participants were split evenly on whether staff capabilities had improved, remained the same or worsened, but the majority considered that these capabilities were in danger of being adversely affected by the following factors:

- a lack of co-ordination and communication within the Agency. Such concerns have also arisen in the Agency's customer surveys. In 1996-97 only a fifth of respondents agreed that departments within the Agency communicated and worked effectively with each other. Although this was a significant improvement over the previous year, poor communication had resulted in duplication of effort according to the Agency's recent survey of their extramural research managers. And in 1996-97 only 15 per cent of Departmental respondents considered that the Agency had removed unnecessary duplication;
- the loss of experienced senior scientists: the average age of scientists has fallen as a result of the loss of older scientists and recruitment of junior staff. The Agency plan to continue this trend over the next five years. Until the junior staff gain the necessary experience, customers will not have access to the range and breadth of scientific and technical expertise available previously; and
- increased business management: scientists in senior grades were spending too much of their time on resource management and implementing ISO 9001 and not enough on the science, leaving the younger, less experienced staff to do much of the research. Similar concerns about business management were expressed both by the Agency's own staff in a recent survey of extramural research managers and by managers interviewed as part of the National Audit Office case studies.

**2.54** The Agency believe that increased business management has led to a better service to the customer. We noted from our case studies, however, that some departments had introduced local measures to alleviate the administrative demands on their assignment managers. For instance, in one department eight assignments have been consolidated into a single "assignment" managed by a dedicated assignment administrator. And more generally, the Agency are seeking to streamline their bureaucracy and complete their implementation of ISO 9001 systems for most parts of the Agency in 1997.

## Technical assessment

**2.55** In late 1995, recognising the need to provide a more comprehensive system for assessing the quality of their scientific and technical capabilities, the Agency piloted a new system of technical self assessment based on the United Kingdom Quality Award approach. A total of some 2,600 staff were involved from the Agency's Defence Research Agency and Protection and Life Sciences Divisions. The system's specific objectives are:

- to check the technical quality of teams and to help them see where they need to improve;
- to combat insularity and challenge teams by focussing on world class capabilities; and
- to satisfy the Agency's customers that they provide good value in their technical capabilities.

**2.56** The self assessment is undertaken at the level of teams of 20 to 30 scientists who assess themselves against a range of key criteria such as their distinctive capabilities and the quality of their technical processes. About one quarter of the assessments are then audited by teams of independent assessors.

**2.57** The assessment in 1995 rated 90 per cent of the 213 participating scientific teams as "amongst the best in the United Kingdom". Figure 23 analyses the audited results for 1995 and 1996 under the six capability attributes covered by the assessment process. This shows that the participating teams have scored well on average under most of the attributes, particularly on business feedback and future development, which covered helping customers to understand and articulate their needs. The assessments have also found teams to be strong in the alignment of their strategies with those of their customers. However, teams scored less well in the area of risk and project management and on the use of intellectual property. The Agency's performance in 1996 improved on most criteria with their overall rating showing a 5.5 per cent increase on that for 1995. These results are broadly consistent with the findings set out in other parts of this Report.

**2.58** We reviewed the operation of the technical assessment system. They considered that it provided a good basis for measuring scientific and technical capability and noted that it had been well operated in its pilot year. They also recommended the following enhancements if the Agency are to gain maximum value from the process and provide the necessary auditability:

**The quality of the Agency's scientific and technical teams under key capability attributes**

**Figure 23**

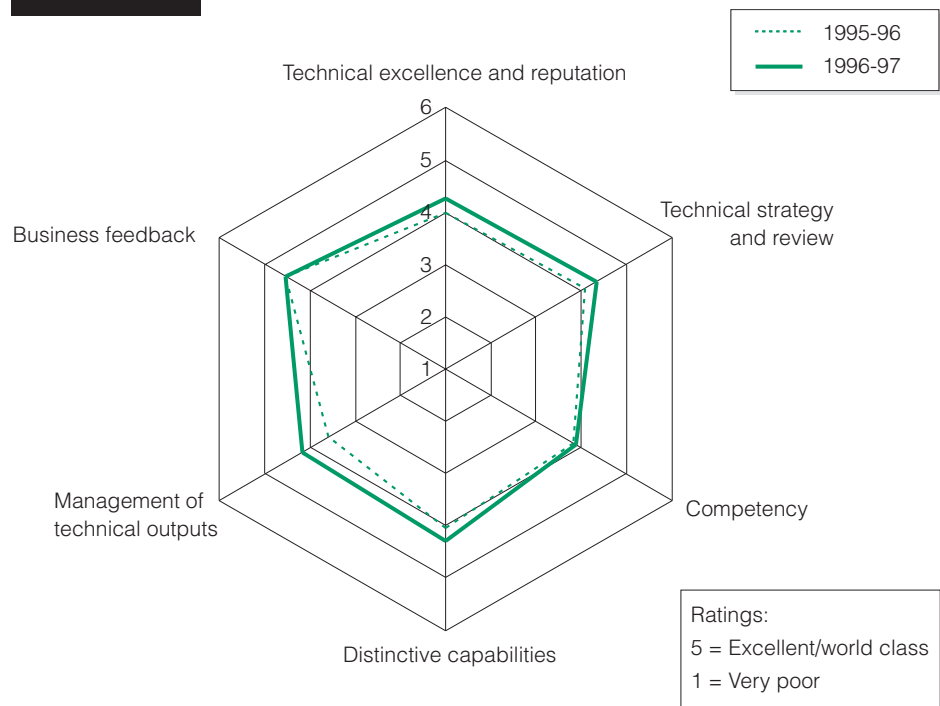


Figure 23 shows that the Agency's scientific and technical teams scored very well on average under most attributes, particularly business feedback and development. The management of technical outputs involving project and intellectual property management showed the largest improvement in 1996-97.

Source: The Agency

- the assessment focussed on inputs and processes and took no direct account of the quality of the output. The Agency have now modified their assessment to incorporate output quality assessment;
- the sectors should have minimal input to the selection of the teams to be audited. These should be selected centrally so as to be representative of sectors ratings generally and the external auditors should have the freedom to select at least some of the teams to be audited if they wish to do so. In future, the Agency propose to ensure that the selection of the teams for audit will be more rigorous; and
- where practical, the sectors should have minimal or no input to the selection of the auditors and auditors should be required to sign a statement confirming they have no conflict of interest. The Agency propose that sectors will have less control of the auditors and the independence and quality of the auditors will be scrutinised by the centre.

**2.59** The Agency intend to use the results of Technical Assessment to assess their performance against their staff capability key target (see Figure 5). Although this system will enable the Agency to track changes in their technical capability, it does not readily permit the benchmarking of performance against other research organisations. The Agency proposes to include additional benchmarking questions in the assessment process.

### **Technology and facilities**

**2.60** By reference to customers' comments we reviewed the extent to which the Agency's rationalisation programme had reduced their ability to meet customers' expectations in respect of the level of technology development and innovation, and the exploitation and relevance of technical and experimental facilities.

**2.61** Customers rate the Agency's performance as good to very good under the technology and facility capability attributes according to the annual customer surveys. There has, however, been a drop in ratings over the four years to March 1997, particularly in respect of facilities.

**2.62** The National Audit Office focus groups revealed a range of views underlying these overall results. In particular, project support customers who rely on adequate test and experimental facilities considered that the Agency's facilities have worsened in these areas. They considered that this could be attributed to the pressure on the Agency to close down expensive under-utilised facilities rather than "mothball" them (see paragraphs 2.30 and 2.31). They argued that facilities should be better marketed to increase their utilisation. The Agency recognise the need to market under-utilised facilities although they believe there is no guarantee that they can attract external customers. Customers are also consulted before facilities are closed or rationalised. In recognition of the importance of this issue, however, one of the Agency's new key targets for 1997-98 measures the number of key capabilities which are excessively vulnerable to short term changes in customer demand.

## **Key points and recommendations**

**2.63** The Agency have faced a considerable challenge in maintaining their capabilities during times of declining budgets and rationalisation. The main points are:

- customers continue to rate the Agency's staff highly;
- customers were, however, concerned that pressures on staff and on the maintenance of specialised sites could lead to lower capability in the future;

- poor internal communications and co-ordination had resulted in duplication of effort between the Agency's sectors;
- the Agency are developing a technical assessment procedure based on a British Quality foundation model: early results show encouragingly high ratings in all attributes bar technology management;
- there is scope, however, to improve the detail of the technical assessment process to improve the rigour and value of the results; and
- project support customers are concerned about a lowering of the Agency's facilities capabilities.

## Timeliness of output

**2.64** The Agency have sought to improve their performance in meeting customer deadlines through staff training to improve project management skills and through the setting of customer milestone targets at both corporate and lower levels of the organisation. Most customer milestones are technical reports although technology demonstrations are becoming more common, as illustrated by the applied research case study set out in Box 3.

**2.65** We reviewed the Agency's performance against customer milestones and sought customers' views on timeliness.

### The Agency's performance against milestones

**2.66** Performance against customer milestones was one of the Agency's corporate targets up until March 1997. They consider it to be one of their most important indicators of customer satisfaction. In particular, business sector directors are incentivised according to milestone performance. The Defence Research Agency's reported performance against their target is shown in Figure 24.

**2.67** Figure 24 shows that there has been a significant improvement in the Defence Research Agency's performance in meeting customer milestones since 1991-92, taking the six year period as a whole. However, the rate of improvement has slowed over the last three years as the Defence Research Agency have reached higher performance levels.

### Box 3

The Applied Research Programme assignment on Information Security covers research into the vulnerability of the Department's Information Technology (IT) systems to deliberate attack and degradation, and into the potential within the Department's IT systems for inadvertent disclosure of classified and sensitive information. Once vulnerabilities and threats have been established the assignment also researches ways of improving system defences and minimising the scope for accidental leaks. There were 15 customer milestones, 4 of which were related to assignment strategy and 11 of which were technical reports, covering, for instance :

- hostile forces' intentions and capabilities (updated annually);
- the vulnerabilities of Windows NT systems;
- the implications of the use of distributed systems in a military context;
- support for projects in defining and describing their required security markings.



The report on security markings was linked to work on minimising the risk of uncontrolled disclosure of information. The work was investigating systems of labelling for data and documents which prevents the importing of classified

information into a document of a lesser classification, and which prevents disclosure of information to those not cleared to receive it.

Writing the milestone report effectively requires the design and testing of a labelling system. Designing and producing such a system is a complex task, and the software behind such a system is very difficult for anyone other than an expert to understand. However, the threat posed by inadvertent disclosure, how easily it can happen, and how an effective system of labelling can reduce the risks, are easy to understand if conveyed, not just through a written report, but also by demonstrations of working hardware and software. The security markings report was therefore supplemented by demonstrations of a potential labelling system.

On this particular assignment demonstrations were much more effective than large, complex technical reports in showing the customer that outputs meet his requirements and can be exploited. They also aided the customer's decisions concerning the direction of future work.

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**2.68** Figure 25 compares the reported milestone performance of the Defence Research Agency with the Agency's three other operating divisions in 1995-96 and 1996-97. This shows that the milestone performance of all three of the new divisions exceeds that of the Defence Research Agency, with the Defence Test and Evaluation Organisation having the highest reported performance. In the Agency's view, this reflects the uncertainty inherent in research when compared with the testing carried out by the Defence Test and Evaluation Organisation.



**The Defence Research Agency's reported milestone performance 1991-92 to 1996-97**

**Figure 24**

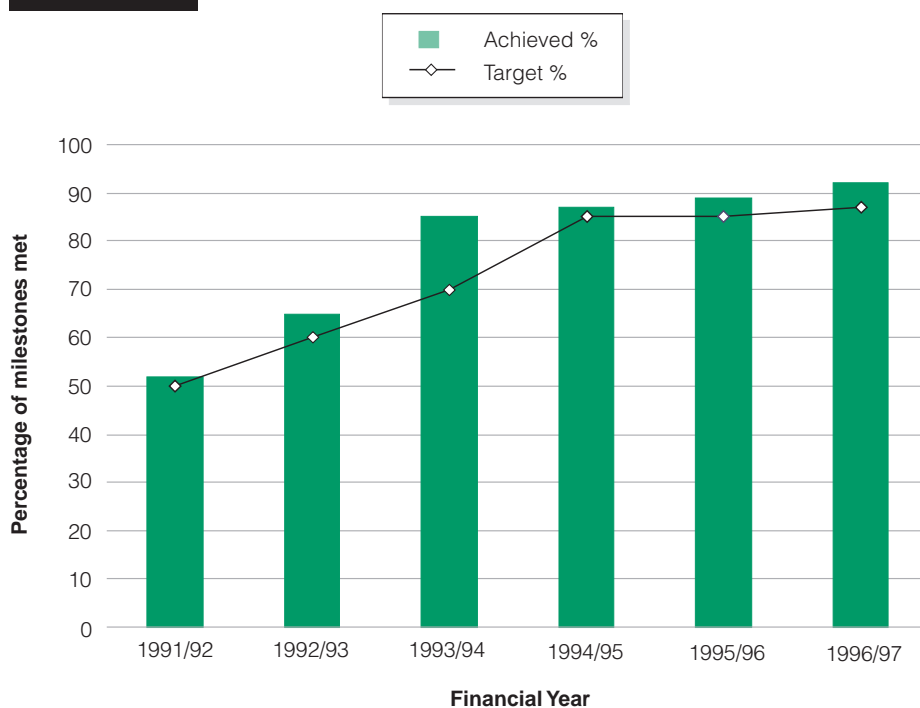


Figure 24 shows that the Defence Research Agency have achieved a significant improvement in their performance against milestones since 1991-92, although the majority of the improvement occurred in the first three years.

Source: The Agency

**Comparison of the reported customer milestone performance of the Agency's four operating divisions in 1995-96 and 1996-97**

**Figure 25**

	1995-96 %	1996-97 %
DRA	89	92
CDA	90	98
PLSD	91	93
DTEO	97	98

Figure 25 shows that the milestone performance of all three of the new divisions exceeds that of the Defence Research Agency, with the Defence Test and Evaluation Organisations having the highest reported performance.

Source: The Agency

**2.69** The high milestone performance reported in Figure 25 suggests there is little scope for further improvement overall. However, the underlying performance can vary significantly from project to project, as illustrated by the case study examples set out in Box 4 below:

#### Box 4

An Applied Research Programme assignment in the Land Systems area covering research into armour for fighting vehicles, delivered 20 of the 21 milestones set in 1995-96 on time. The aim of this assignment is to provide technical solutions to meet capability gaps in fighting vehicle protection against ballistic threats such as projectiles and mines. The research encompasses the development, trialling and modelling of different types of armour (such as conventional and novel armours including explosive reactive armour and other advanced materials) and the design of engineered applications for specific systems like the Army's new main battle tank, Challenger 2.



This research project had a range of milestones in 1995-96, the majority of which were based on the delivery of technical reports and/or engineering drawings. The milestones covered such tasks as:

- a strategy report on armour modelling;
- a review of fighting vehicle designs capabilities versus mine attack;
- mine blast trials on composite armours;
- an updating report on electric armour technology;
- reporting the results of modelling the impact of high-explosives and explosive reactive armour on base armour;
- a report finalising the turret appliqué design for Challenger 2.

This effective assignment was enhanced by the high degree of emphasis placed on timely delivery by DRA management, both during planning and execution, to meet the customer's needs. The assignment management were highly aware of critical path activities and were willing to adjust resource allocations to ensure customer delivery dates were met.

In contrast performance was poor on a project support assignment covering the trialling of a mid-life update of a combat aircraft, which had three major milestones over six months late. The assignment involves trialling and testing work to establish the airworthiness of new physical and avionic configurations for the Sea Harrier aircraft and then the issuing of guidance, reports and certificates to the Department and the service user on how the aircraft may, and may not, be used. The tasking for 1995-96 covered evaluating areas such as weapons and fuel tank carriage, undercarriage loadings and new avionic software following extensive modifications to the Sea Harrier's radar and weapons suite. The work involves three key phases:



- flight trials;
- issue of interim results to allow flying within certain boundaries; and
- the issue of the final report and airworthiness certificate.

Milestones are based on the delivery of the final report, which have a specific technical content and structure in order to act as certificates of airworthiness. The reports are a key customer requirement as they allow full operation of the aircraft. They can take 3 months to write after the completion of trials. However, as noted above, in 1995-96 three of these reports were over 6 months late. The management within DTEO appear to have afforded delivery of the final report a very low priority relative to the conduct of the actual trials, resulting in a lack of resources for the completion of the deliverables. The Agency noted that this was with the agreement of the customer and that all the reports have been delivered since the National Audit Office carried out their examination.

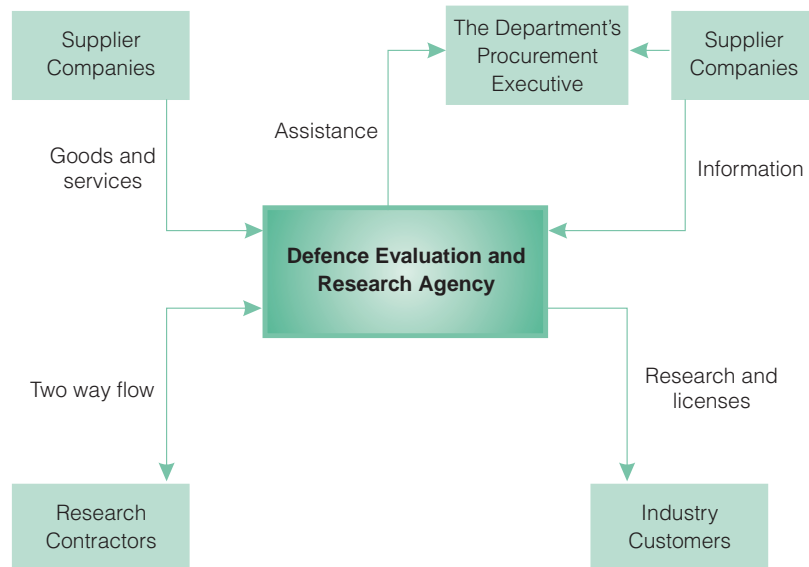
- there is little scope for further improvement, and customers noted the possibility of an adverse effect on quality if concentration on milestones becomes dominant. The Agency have now abandoned the corporate milestone target.

## Part 3: Technology transfer and the Agency's relationships with industry

**3.1** The Agency's traditional and most important role is to act as prime technical and scientific adviser to the Department and to prepare the way for successful defence procurement. But for the Department to gain the maximum value from the Agency's work they need to ensure that the Agency's knowledge of defence systems is transferred to industry, whose role it is to develop, build and support the necessary equipment for the Department. This in turn is dependent upon sound and effective relationships with industry. The Agency's different links with industry are illustrated in Figure 26.

### The Agency's links with Industry

**Figure 26**



Source: The Agency

Figure 26 shows the key links and flow of services between the Agency and industry and how the Agency fit into the Department's procurement process.

**3.2** The Agency's framework document specifies that the Agency will:

- provide technical and scientific services to non-Departmental customers where this will result in an overall benefit to the Department and does not conflict with the Agency's primary responsibilities; and

- co-operate with industry to ensure that their output is exploited to the full, consistent with defence requirements.

**3.3** The main thrust of the 1993 White Paper on Science and Technology was the need to increase the benefit to United Kingdom wealth creation from all Government funded research, including defence research. The Department gave a commitment to make increased efforts to enhance spin-off from defence research, to exploit the commercial potential of this research and to encourage collaboration with the civil sector in order to enhance the contributions of their research programmes to the economy as a whole.

**3.4** Against this background we examined:

- the Agency's performance in selling its services and intellectual property to non-Departmental customers;
- industry as a supplier to the Agency;
- the Agency's arrangements for promoting and measuring technology transfer.

## **Measures to increase income from non-Departmental customers**

**3.5** The Agency earns revenue from industry and other non-Departmental sources primarily to broaden the base of funding to help maintain necessary defence research capabilities that the Department may not otherwise be able to afford. But the provision of scientific and technical services to these customers also provides a mechanism for the spin-off of defence research into both the defence and the civil sectors. The Agency derive this income from the following sources which are analysed in Figure 27 for the period 1992 to 1997:

- exploitation of intellectual property rights; and
- the sale of scientific and technical services to non-Departmental customers.

### **Exploitation of intellectual property rights**

**3.6** The Agency's exploitation of intellectual property through licensing agreements provides a formal mechanism for technology and knowledge transfer. Although the Agency have in excess of 500 active licences, the majority of their intellectual property income shown in Figure 27 is derived from licences

**The Agency's non-Departmental income 1992-93 to 1996-97**

**Figure 27**

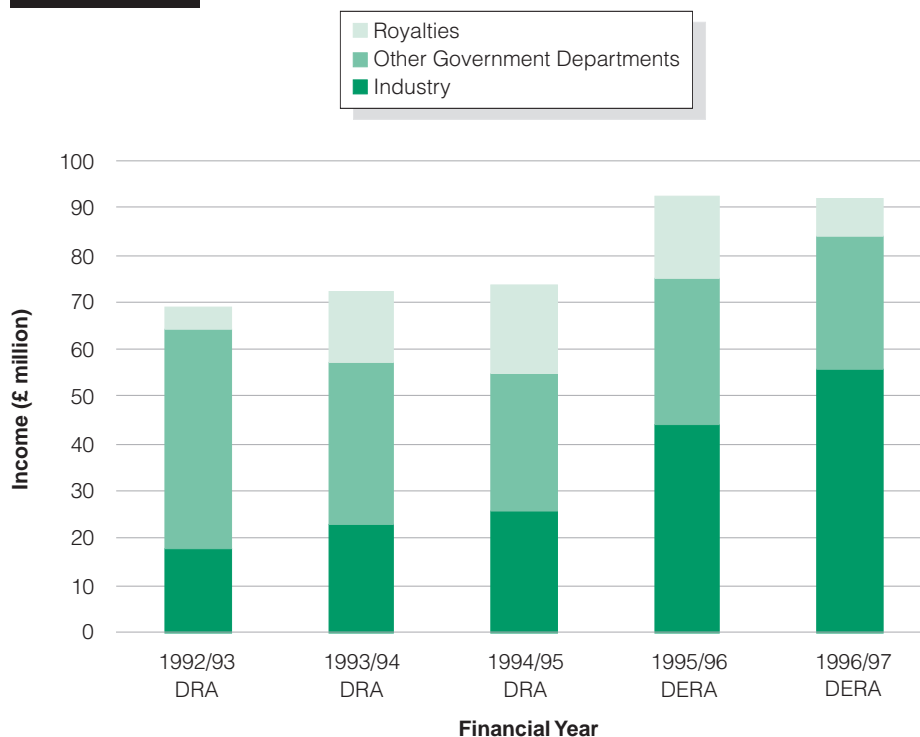


Figure 27 shows the Agency's income from the sale of services to industry is the fastest growing component of non-Departmental income. In the three years to March 1996, annual income from the sale of licences remained broadly constant at around £15 million, but has since fallen due principally to the expiry of certain Liquid Crystal patents.

Source: The Agency's Annual Report and Accounts

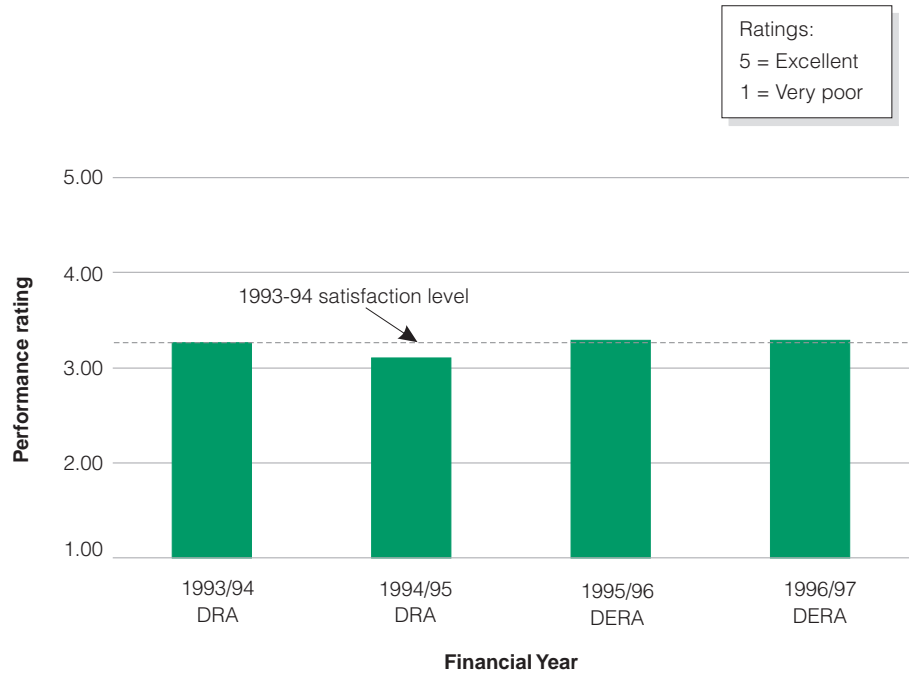
connected with Liquid Crystal devices and materials patents, which the Agency began to licence more aggressively in 1993. Nevertheless, the fall in licence income in 1996-97 is expected to continue over the next five years because some of the more valuable Liquid Crystal patents expired in 1995. There are also a number of active licences which the Agency are seeking to terminate because they are generating no income. The Agency expect to minimise the fall in licence income by exploiting new patents connected with surface acoustic wave technology.

### Provision of scientific and technical services

**3.7** The most important, and fastest growing, component of non-Departmental income is the sale of services to industry. The Agency have, since 1992, included industry customers in their overall survey of customer satisfaction. Figure 28 below summarises levels of overall satisfaction in the years 1993-94 to 1996-97.

**Industry customers' satisfaction with the Agency's work**

**Figure 28**



Source: The National Audit Office based on the Agency's annual customer survey

Figure 28 shows that customers' overall satisfaction has remained at broadly the same level, taking the four year period as a whole.

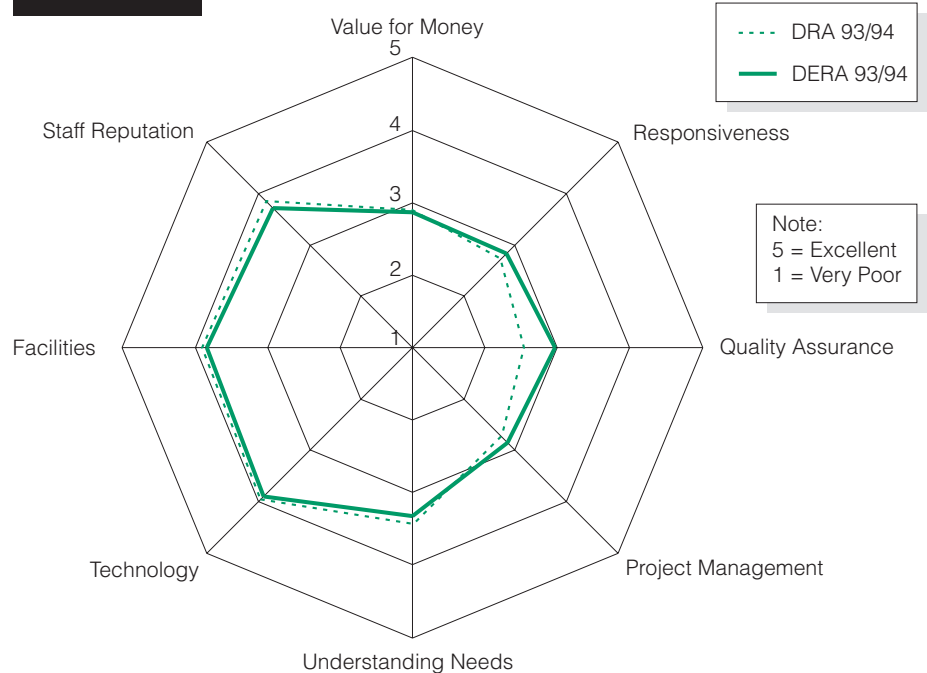
The results in Figure 28 show no net change. In comparison with similar assessments by Departmental customers, industry customers are some 9 per cent less satisfied, although the overall rating is still good.

**3.8** Viewing the average scores by industry customers under each of the key attributes yields the results set out in Figure 29.

**3.9** The detailed results show that while “intrinsic quality” factors are highly rated, much as for Departmental customers (para 2.38), industry are noticeably harder in judgements on value for money (Figure 30) and on project management.

**Trends in Industry customers' views on the Agency's performance under key attributes<sup>(1)</sup>**

**Figure 29**



Source: The National Audit Office based on the Agency's annual customer surveys

Figure 29 shows that industry customers rate the Agency highly on capability factors such as staff reputation and facilities. The Agency is rated much lower on delivery aspects, however, such as project management and responsiveness. Quality assurance shows the largest improvement in ratings over the four year period.

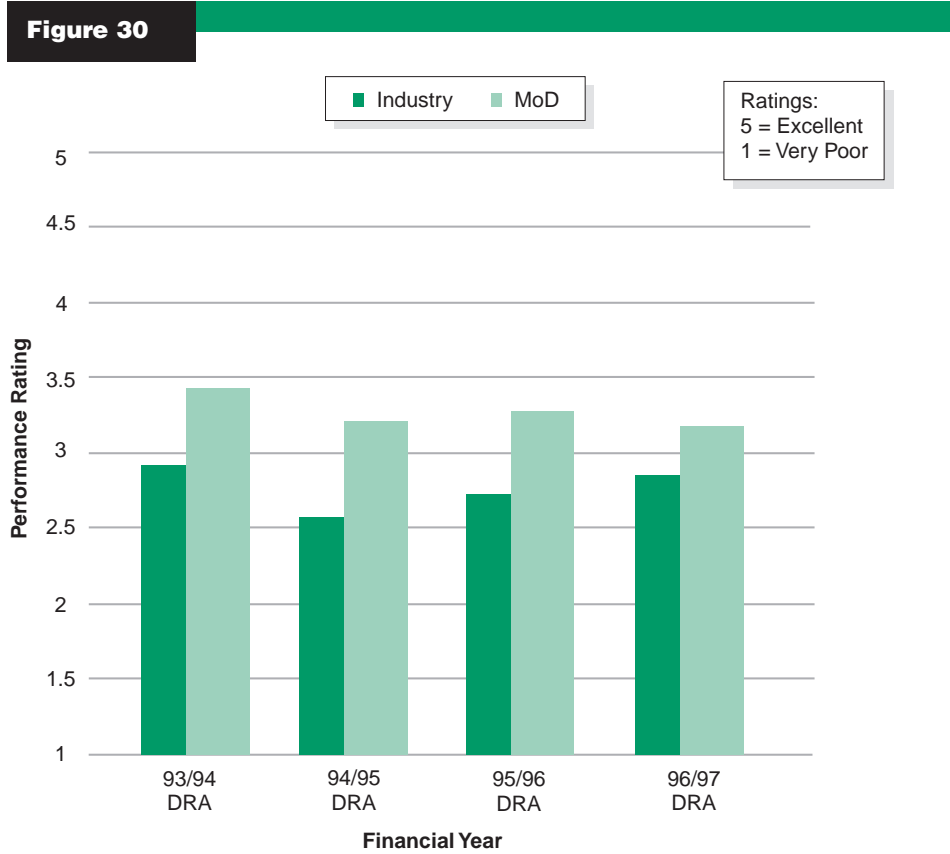
**Impact of the Agency's income generation strategies on their relationship with Industry**

**3.10** Successive customer surveys between 1993 and 1995 also identified industry concerns about the Agency's commercial approach and industry's distrust of an Agency seen increasingly as a competitor. This was perceived to be restricting the flow of technology to industry.

**3.11** Given the continuing concerns about relationships and technology transfer, the Department asked the Agency early in 1996 to review the position. Accordingly, the Agency commissioned a stakeholder analysis of technology transfer, which involved interviews with industry and a further specific survey of their relationship with industry, both carried out with the aid of consultants. The latter survey was completed towards the end of 1996. It sought the views of 79 industry respondents and was designed to determine the basis for industry's concerns and identify the options for responding to them.



**Comparison of  
Departmental and  
Industry customers'  
views on the Agency's  
value for money**



Source: The National Audit Office based on the Agency's customer surveys

Figure 30 shows that industry customers rate the Agency's value for money performance consistently lower than Departmental customers.

**3.12** The survey found that relationships with industry had recently improved but that a number of important issues remained to be addressed. In particular, we noted that:

- exploitation of intellectual property and competition policy of both the Agency and Department were seen as the most significant problem. The Agency needed to provide better visibility of their intentions;
- the Agency's multiple roles (to be profitable whilst acting both as the Department's technical adviser and for the benefit of United Kingdom industry) were causing confusion in industry;
- 65 per cent of respondents considered that the Agency's pursuit of non-Departmental income interfered with relations with industry. They also considered that this policy could create conflicts of interest for the Agency on those occasions when they advise the Department on competitive bids put forward by companies with whom they also do business; and

- about a fifth of industry respondents considered that relations with the Agency had been severely damaged by the introduction of competition between the Agency and industry, particularly in the applied research, technology demonstration and project support areas.

**3.13** The survey also sought the views of 88 of the Agency's extramural research managers. Over 80 per cent considered that relations with industry would not be improved if the Agency competed with industry for work. In comparison, less than half considered that the Agency's commercial activities had worsened relationships at working level with some noting an improvement more recently. The consultants reported that the following comment was typical of Agency staff:

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"Our unique position of trust and impartiality has been damaged. Industry is no longer totally candid with DERA. When the Defence Research Agency was set up we were suddenly seen as competitors. Since then industry has realised that we can be trusted and that we aren't a privatised organisation. Existing relationships/trust took a dip but they have come back up. There's a little bit of a barrier left."

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**3.14** The consultants recommended that better dialogue between the Agency and industry was required to clarify the rules for technology transfer. And the most recent survey of stakeholders from industry and the Department identified poor communication by the Agency on competition and intellectual property policy as the main barriers to technology transfer - echoing the earlier survey findings (para 3.12).

**3.15** To secure a further improvement in their relationships with industry the Agency intend to move towards a closer partnership with the defence industry with a declared policy of seeking mutual benefit from exploitation of the Department's research programme and from joint pursuit of overseas sales opportunities. One consequence of this is that income from prospective overseas sales will fall by half.

## Key points and recommendations

**3.16** Set against falling Departmental funding for the Agency, the fullest appropriate exploitation of other potential income is an important element in the Agency's plans to maintain the breadth and quality of its services. Main points are:

- non-Departmental income rose by some 34 per cent over the period 1992-93 to 1996-97, to £92 million, some 9 per cent of total income;

- the bulk of sales are to industry customers, who, while satisfied with the services provided, rate the Agency less highly than Departmental customers;
- industry view the commercial objective and behaviour of the Agency with suspicion, to the detriment of co-ordinated research programmes and technology transfer;
- the Agency and the Department should clarify their policy on intellectual property. The Agency consider that no further clarification is necessary; and
- the Agency have responded by surveying industry to establish the precise parameters of the problem, and have started to remedy it - by inter alia, restricting overseas industry sales to those provided in partnership with United Kingdom industry.

## **Industry and academia as suppliers to the Agency**

### **Extramural Research Programme**

**3.17** The Agency's principal mechanism for securing industry involvement in defence research is the Extramural Research Programme under which they place some £170 million of research work with companies and academic institutions each year. The Programme aims to provide the Department and the Agency with access to the widest possible knowledge base and secure a two way flow of technology and skills between the Agency and industry. Although the Agency's extramural research expenditure has fallen since 1992 it has remained at just over 30 per cent of the combined Departmental corporate and applied research funding (Figure 31).

**3.18** As part of their strategies to further improve their relationship with industry the Agency intend to increase steadily the proportion of the Department's research expenditure sub-contracted to industry and academia from just under 31 per cent in 1996-97 to over 35 per cent by 2002.

**3.19** The Agency's 1995-96 customer satisfaction survey indicated that their advertising of the Programme and their internal communications both needed to be improved. Accordingly, as part of the Agency's survey on their relationships with industry, respondents were asked whether they were satisfied with the

**Extramural Research  
over the period  
1992-3 to 1996-97**

**Figure 31**

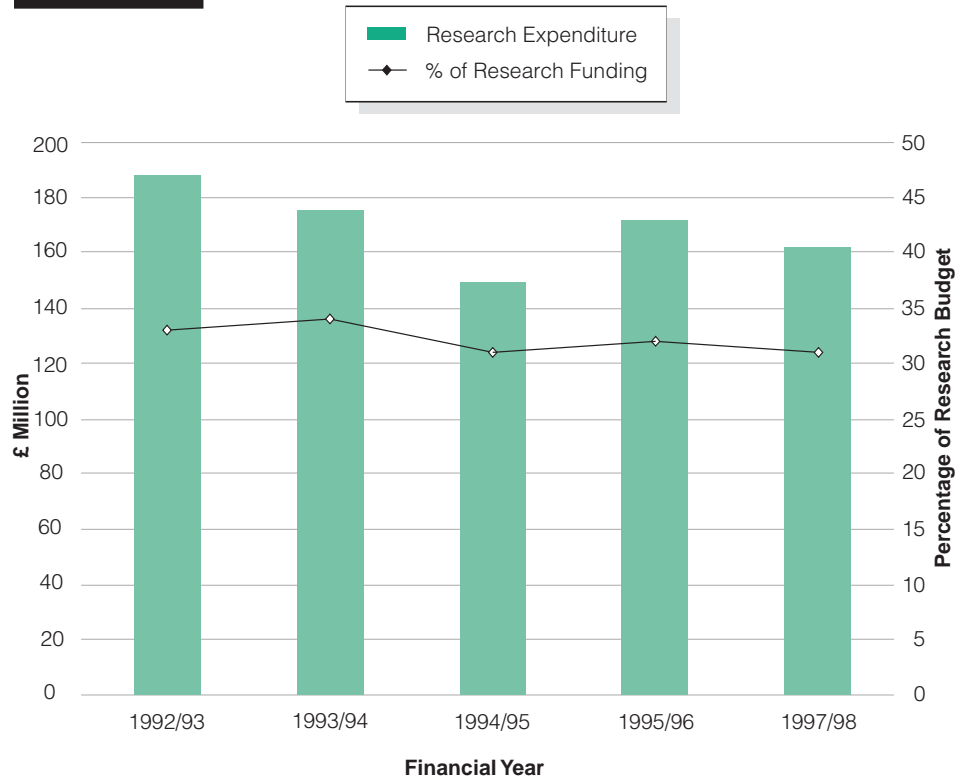


Figure 31 shows that expenditure on extramural research has fallen over time broadly in line with Departmental funding shown in Figure 1.6. Nevertheless, the Agency's extramural expenditure has remained roughly constant, at just over 30% of Departmental research expenditure over the five years to March 1996-97.

Source: The Agency

arrangements for securing involvement in the Programme. The survey found that several aspects of the Programme needed to be improved. In particular we noted that:

- 48 per cent of those surveyed believed that industry's opportunities under the Programme were biased towards the less innovative elements; and
- 82 per cent believed that the Agency was building up areas of expertise in-house rather than allocating business to companies. Although respondents considered that this could be justified in many instances they also noted that this was leading to duplication of capability which could also lead to a "not invented here attitude".

**3.20** Following the Agency's most recent customer survey for 1996-97 the consultants reported that there had been a modest improvement in industry's views on whether the Agency make sensible decisions on which work to outsource and which to provide from internal sources. The consultants also noted, however, that the result was still unsatisfactory.

**3.21** Of the Agency's 88 extramural research managers who also took part in the earlier relationship survey, just over 80 per cent considered that it was fair to criticise the Agency's internal communications and 43 per cent had experienced duplication of effort as a result of poor communications. A further 64 per cent said there had been no improvement in communications in the last year.

### **Pathfinder**

**3.22** The Agency launched the Pathfinder scheme in November 1992 as an extension to the Extramural Research Programme. The scheme is run on the basis of an annual competition under which industry are asked to put forward proposals for funding novel defence research in areas which align well with both the Agency's and companies' priorities. It aims to contribute to wealth creation by involving both civil and defence sectors. The scheme's objectives are:

- to improve value for money in defence research by avoiding duplication and improving industry take-up of promising ideas; and
- to provide companies with the earliest opportunity to develop their ideas and thereby to improve wealth creation.

**3.23** Figure 32 analyses the take-up of the scheme since it was established in 1992. This shows that there was a significant downward trend in both the number of proposals received and the number and value of contracts placed to March 1996. The results for 1996-97 suggests that take-up is levelling out and the reduction in the rejection rate suggests that the quality of proposals has improved over time, in line with the Agency's intention. The scheme has made a relatively small contribution to the Extramural Research Programme (see Figure 31), however, and the Agency have not yet evaluated the scheme's performance in light of its objectives.

**Pathfinder statistics  
1992-93 to 1996-97**

**Figure 32**

	1992-93	1993-94	1994-95	1995-96	1996-97
Number of proposals received	641	589	391	291	303
Number accepted for programme definition	122	200	171	151	167
Total value accepted for programme definition	-	£39.5m	£31.3m	£29.9m	£28.7m
Value of contracts placed to date	£11.0m	£9.7m	£7.4m	£7.6m	£0.8m

Figure 32 shows that industry's take-up of the Pathfinder scheme fell over the four years to March 1996. The results for 1996-97, however, suggests that take-up and the value of industry contracts accepted for programme definition is levelling out.

Source: The Agency

**3.24** The Agency's annual customer survey in 1995 found that only a quarter of respondents considered that the processes for obtaining a Pathfinder project were clear and efficient. The consultants noted that a typical comment was:

"The process is incredibly slow - even package managers and the budget holders get in a muddle over the rules"

The results from the Agency's 1996-97 customer survey are not encouraging, with no significant improvement in industry's satisfaction with the process for obtaining Pathfinder contracts. The Agency consider that the Pathfinder timetable is driven by the Departmental annual budgetary systems and not by their own processes - a provision must be made in the customer's programme for accepted proposals. They have, nevertheless, developed some fast track rules to inject projects into customers' programmes within the same financial year and introduced more recent refinements to improve the quality of industry's proposals. The Agency together with the Department should continue to monitor the impact of these measures and seek to reverse the fall in take-up shown in Figure 32.

### **Other initiatives to broaden industry involvement**

**3.25** In addition to the Pathfinder scheme, the Agency have introduced a number of initiatives since 1992 to counter the deterioration in their relationship with industry and to widen industry's direct involvement in defence research and enhance the Agency's links with the civil sector. Chief amongst these are:

- specific Strategic Alignments with companies, first initiated in 1992;
- the creation of Dual Use Technology Centres; and
- an increase in the number of collaborative technology demonstrators for taking forward output from the Applied Research Programme.

We concentrated our review on the first two of these measures.

### **Strategic Alignments and collaborative protocols**

**3.26** The Agency launched this initiative in 1992. Their aim in creating Strategic Alignments with individual companies is to ensure that the Agency's work contributes wherever possible to the core capabilities and competitiveness of United Kingdom companies. Strategic Alignments are corporate enabling discussions between the Agency and the company aimed at providing both parties with a better understanding of each others aims and objectives. These meetings can in turn lead to formal protocols which define a framework for future collaborative work between them. Whilst early Strategic Alignment meetings may have lead to useful high level exchanges, there has been less progress in terms of formal protocols - as at December 1996 the Agency had established collaborative agreements with only two defence companies, with a further three under negotiation. These results reflect the difficulty of negotiating general high level agreements of this type.

**3.27** We further noted that the precise status of Strategic Alignments as a distinct initiative was unclear. For instance, the Agency's business plan for 1996-97 made no substantial reference to this initiative. Because there is a risk that other companies will regard these arrangements as representing "most favoured customer" status and that they will be disadvantaged as a result, we considered that the Agency needs to communicate better the purpose of these Alignments. They should also evaluate the benefits that have so far arisen.

### **Dual Use Technology Centres**

**3.28** A number of the technologies developed by the Agency are generic in that they have both civil and military application. Dual Use Technology Centres are open laboratories which are designed to facilitate the exploitation for commercial purposes of the Agency's research. The Agency have established five Centres in those technologies which they consider to offer the best potential for civil spin-off. The first of these, the Structural Materials Centre, was established in April 1994.

This was followed during 1995 and 1996 by the Marine Technology, Software Engineering, Electronics and Supercomputing Centres. These Centres also provide the opportunity for the Agency to capitalise on emerging technology from within the civil sector and provide a further source of income.

**3.29** In late 1995 the Agency reviewed the performance of the Structural Materials Centre. They found that the Centre had exceeded its original targets for non-Departmental income and for the integration of staff from industry and academia. It had also established a number of commercial partnerships with industry, including 20 dual use technology development projects such as the example shown in the box below.

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The Structural Materials Centre is collaborating with a company, two hospitals and a university to develop a stable flesh simulant which has both the thermal and acoustic properties of human flesh with which to calibrate accurately medical equipment

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**3.30** The National Audit Office noted that it is too early to judge the success of these Centres. Nevertheless, although commercial confidentiality is likely to restrict the scope of these Centres, thereby limiting them to certain types of generic technologies, the results from the Structural Materials Centre look promising.

## Key points and recommendations

**3.31** The proportion of Agency research work put to suppliers has been maintained at around 30 per cent despite the decrease in Agency funding. Main points are:

- industry are concerned that they may have the opportunity to bid for only the less innovative areas of the Agency's work;
- some specific initiatives, such as Pathfinder and Strategic Alignment, show declining or slow rates of growth; and
- the Agency should now start to evaluate their various initiatives with industry, and to monitor the quality of work provided to and by industry more generally.



## The transfer of technology and knowledge

**3.32** Prior to 1997, the Agency had no system for assessing their transfer of technology and knowledge to the wider scientific and industrial community. As part of their measures to improve technology transfer (para 3.11), however, they have recently completed a baseline measurement of technology transfer out of the Corporate and Applied Research Programmes, developed with the assistance of stakeholders from both the Department and industry.

**3.33** The technology transfer measurement initiative has a number of key objectives. The Departmental customers' primary interest is the transfer of the Agency's research into military equipment, for which there was limited information at the time of our examination (see paragraphs 2.45 to 2.48). The measurement initiative found that:

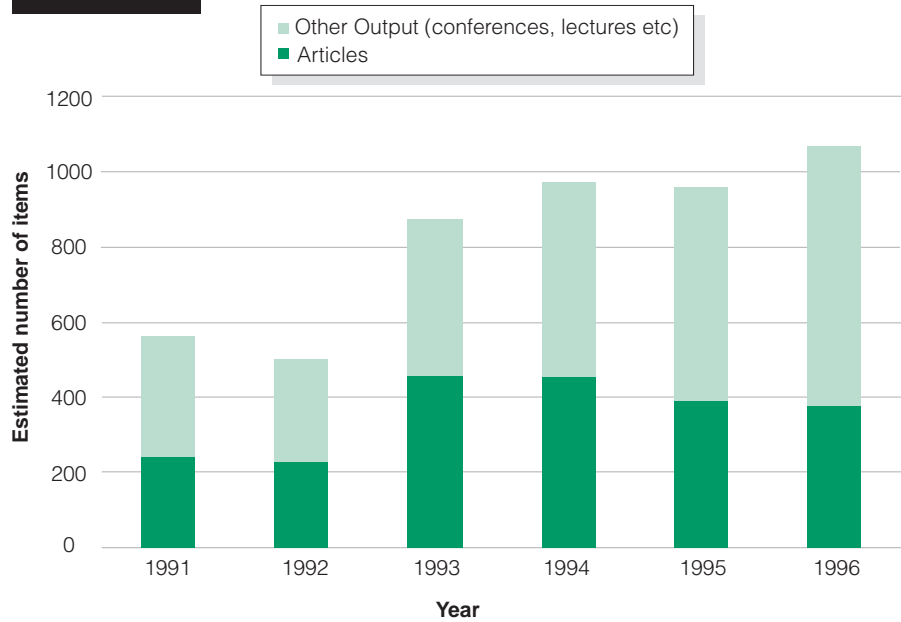
- the Agency's teams have reasonable technology transfer practices, but there is a wide variation in practice across the Agency and the effort expended in securing technology transfer is small;
- Departmental staff are less confident in the teams' ability to impact on military equipment procurement than with their scientific and technical capabilities; and
- the technology transfer benefits perceived by industry are moderate to good rather than good to excellent.

**3.34** Another key objective of the measurement initiative is to improve Agency staff attitudes to the exploitation of their research by industry. An important indicator in this respect is the extent to which the Agency contribute to the stock of scientific knowledge, particularly through articles published in peer reviewed scientific journals.

**3.35** Although the Agency maintain records of published and other similar scientific output they are of variable quality and at the time of our examination the Agency did not monitor their performance in this respect. We therefore analysed available data on the number of articles published in the scientific literature and on other outputs such as conference papers. Figures 33 and 34 show the results of this analysis for the five years to 1996.

**Volume of knowledge transferred through the medium of published articles, conferences, lectures and other transfer mechanisms- 1991 to 1996**

**Figure 33**

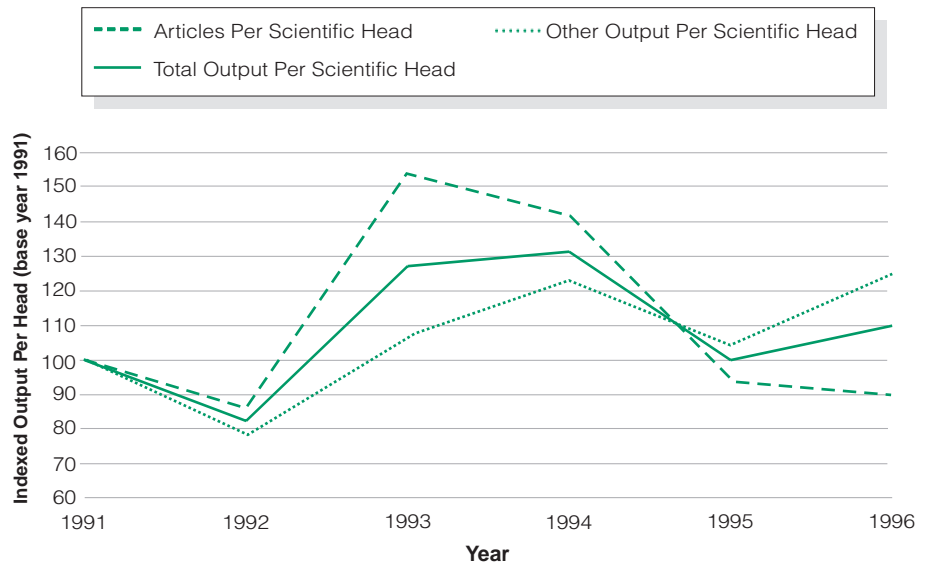


Source: National Audit Office, based on data supplied by the Agency

Figure 33 shows that total output has risen steadily since 1991. However, the number of articles published in peer reviewed scientific and technical journals has fallen since its peak in 1993.

**Transfer of Scientific and Technical Knowledge 1991 to 1996**

**Figure 34**



Source: National Audit Office, based on data supplied by the Agency

Figure 34 shows that total output per head of scientific and technical staff peaked in 1994 but has since fallen to levels similar to those achieved in 1991. In particular, whilst conference, lecture and miscellaneous output has risen steadily over the period, articles published in peer reviewed journals has fallen substantially since 1993.

**3.36** Figures 33 and 34 show that whilst total output has risen steadily since 1991, total output per head of scientific and technical staff is at levels similar to those in 1991, having peaked in 1994. In particular, although conference participation and lectures has risen steadily the number of articles per head in peer reviewed journals has fallen substantially since its peak in 1993. We considered that this could be attributed to the greater administrative demands placed on scientists (see para 2.53) and to customers' priorities. They further noted that the Agency was middle ranked when compared with the total articles output of other research organisations and companies over this period. These findings are disappointing given the status of the Agency.

**3.37** Following our examination the Agency now plan to monitor the number of articles published in the scientific literature as part of their proposals for measuring technology transfer (para 3.32) and the technical assessment system.

## Key points and recommendations

**3.38** The Agency's contribution to wealth creation through technology and knowledge transfer is a key feature of their performance. Main points are:

- the volume of knowledge transferred through the medium of journal papers, conferences and lectures has risen since 1991, but the number of articles per head of scientific staff has fallen since its peak in 1993;
- the Agency now plan to monitor journal output as part of the technical assessment system and their developmental system for measuring technology transfer.