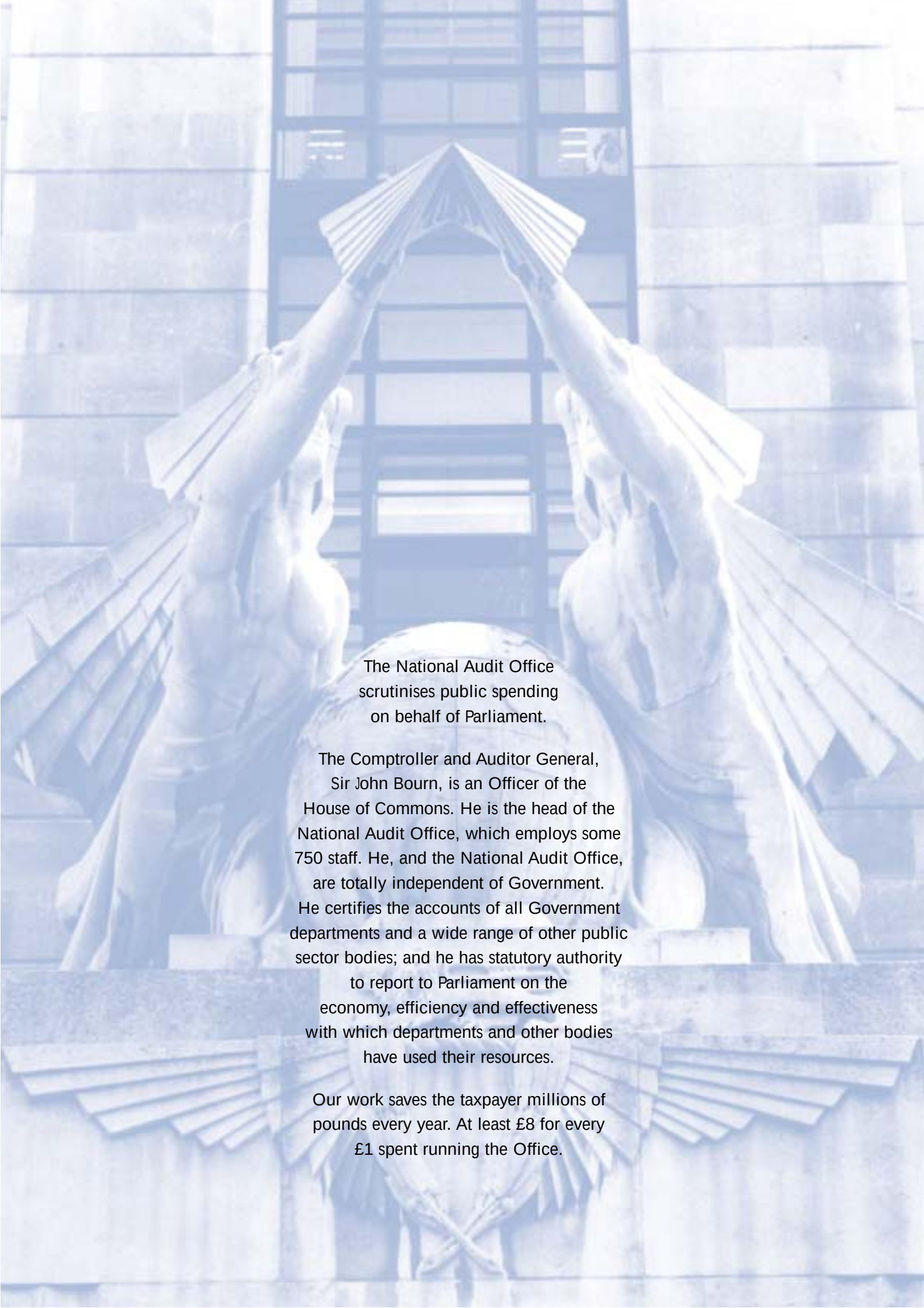
NATIONAL AUDIT OFFICE

Ministry of Defence

Helicopter Logistics

REPORT BY THE COMPTROLLER AND AUDITOR GENERAL
HC 840 Session 2001-2002: 23 May 2002



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John Bourn
Comptroller and Auditor General

National Audit Office
9 May 2002

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executive summary

1 The Ministry of Defence's (the Department's) 1998 Strategic Defence Review emphasised the need for flexibility, adaptability and responsiveness in undertaking military tasks, including expeditionary operations. Helicopters are a key component of defence capability as they make a unique contribution to a wide range of operations. Keeping them available to fly is therefore critical to the success of future defence capability.

2 This study focuses on the Department's six main established helicopter fleets, comprising 470 helicopters at the front line, whose logistics support costs some £260 million a year. Seventy per cent of these helicopters are operated by the Joint Helicopter Command which was established to facilitate the deployment of all battlefield helicopters on joint operations and which draws on helicopters owned by the Royal Navy, the Army and the Royal Air Force. In addition the Royal Navy (Commodore Naval Aviation) and Royal Air Force (Strike Command) operate smaller numbers of ship-borne and search and rescue helicopters which are not part of the Joint Helicopter Command.

3 Many of the current helicopter fleets will reach the end of their operational lives in the next ten to fifteen years, but are likely to be required to perform at a high operational tempo until then. They will therefore need careful management if they are to contribute to the expected military tasks. The formation of the Defence Logistics Organisation in April 2000 has provided the Department with the means of addressing logistics support issues coherently on a tri-service basis and the Defence Logistics Organisation is working hard to converge the various single service systems and practices.

4 This report examines the Department's performance in providing logistics support to its helicopters and the initiatives being taken to improve logistics management. It follows up the Committee of Public Accounts' past work on helicopters (Appendix 1). The methodology we adopted is set out in Appendix 2.

5 We found that the Defence Logistics Organisation has not yet been able to deliver fully the levels of logistics support that it had agreed to supply. This is partly due to unforeseen one-off events that have had wide impacts on helicopter fleet maintenance. The Defence Logistics Organisation has also had to manage its business utilising the legacy systems from the three predecessor Service areas and resource constraints have also played a part. The Defence

Logistics Organisation has a comprehensive programme designed to improve the quality of the logistics support it provides. This includes the development of modern, integrated IT systems and processes, adopting innovative support arrangements with industry using Smart Acquisition principles, and the identification of best practice and its application across the organisation. But there remains scope to improve performance and so increase helicopter numbers. Our recommendations complement the Defence Logistics Organisation's various initiatives, highlighting areas for management action that should result in increased availability of helicopters at the front line.

In this difficult area the Defence Logistics Organisation has not yet been able to deliver all the required logistics support (Part 1)

6 Providing helicopter logistics support is a complicated task and has proved a major challenge. The Defence Logistics Organisation has had to address a number of 'legacy' issues including the different procedures and ways of operating in the three Services and disparate information systems. And it has had to do this against the background of severe pressure on resources. Military helicopter logistics is also intrinsically complicated. For example a number of organisations combine to produce a helicopter that is ready to fly:

- The Defence Logistics Organisation is responsible for ensuring that helicopters are 'available' - that is the provision of airworthy helicopters that can be readily maintained by front line units.
- Maintenance at the front line is carried out by the units themselves with the Defence Logistics Organisation setting maintenance policy and providing spares and expertise. 'Serviceability', having a helicopter ready to fly a mission, is therefore the product of both the Defence Logistics Organisation and the front line units, together with the Service personnel organisations responsible for recruitment and training.
- The performance of the Defence Logistics Organisation and the front line units is also critically dependent on industry for the provision of replacement spares and in helping to investigate problems and identify solutions.

7 Against this background, the Defence Logistics Organisation is striving to meet the required level of service. Service levels are set out in Customer Supplier Agreements with its three helicopter customers - the Joint Helicopter Command, Commodore Naval Aviation and Strike Command. The Defence

Logistics Organisation has not yet been able to deliver all the required logistics support. As regards making helicopters available, performance has been patchy. For example, for Joint Helicopter Command the Defence Logistics Organisation achieved its targets more often than not. Where targets have been missed, performance has generally been marginally below target.

8 Many logistics problems have arisen because of one-off events. For example following the major failure of a Dutch Lynx main rotor head, many United Kingdom Lynx helicopters were grounded. The Defence Logistics Organisation responded promptly, consulting its front line customers, Commodore Naval Aviation and the Joint Helicopter Command, and agreeing revised targets for Lynx availability, typically involving a 20 per cent reduction. The Lynx main rotor head is highly complex and has a total lead time of more than two years. The Department and Westland Helicopters worked closely together to resolve the problem, with Westland Helicopters delivering the first replacement main rotor heads within a few months of the Department placing a contract. A robust fleet wide recovery programme is on target for completion in June 2002, when Lynx availability is to be restored to previous levels, and replenishment of all spares is scheduled for March 2003. This case illustrates the importance of developing innovative logistics solutions in partnership with industry.

9 Front line units are fundamentally concerned with the number of helicopters that are serviceable, that is having a helicopter ready to fly a mission. Analysis of the numbers of serviceable helicopters shows shortcomings in performance, with Joint Helicopter Command serviceability targets achieved on average for two of the six helicopter fleets in the twelve months to September 2001. Customer Supplier Agreements between front line commands and the Defence Logistics Organisation are still evolving and there are differences in terminology and content. For example, the Agreement for Commodore Naval Aviation includes serviceability targets whilst these are not incorporated in Agreements with other customers. Analysis of D states, where helicopters are grounded as a result of a lack of spares, and 'robberies', where a spare is taken from one helicopter to put on another, can highlight logistics weaknesses. However, the reasons for any shortcomings in logistics outputs need careful examination and the Defence Logistics Organisation is not yet able easily to interpret information regarding the level of D states and robberies, or to identify clear trends in performance. Greater consistency in definition and collection of data on performance aspects such as D states would facilitate comparison between the helicopter fleets and the development of a performance management regime that focuses on logistics outputs.

10 Weaknesses in logistics support can have severe operational impacts. Recent operations and exercises have highlighted shortcomings in helicopter logistics. The main rotor head problem reduced the number of available Lynx aircraft and the Royal Navy protected front line operations and the flying training programme, resulting in some ships going to sea without an embarked Lynx helicopter. The same problem contributed to the Joint Helicopter Command having to review its helicopter deployments. Thus the Lynx helicopters in the rapid reaction forces not currently deployed on operations are at lower levels of readiness. During an exercise in Oman in Autumn 2001 numbers of serviceable helicopters averaged 55 per cent. For European exercises the target is 75 per cent although the Department considered that this was ambitious for environmental conditions in Oman.

The Defence Logistics Organisation is tackling helicopter logistics problems but there is scope to improve performance and so increase helicopter outputs (Part 2)

11 The Defence Logistics Organisation has many initiatives in place to improve performance. It has identified key areas for change by which it might transform logistics support and is introducing the European Foundation for Quality Management Excellence model. It is driving forward Resource Accounting and Budgeting and the Smart Acquisition initiative. Many of these changes have direct implications for the current and future success of helicopter logistics.

12 Following a structure implemented across the Department's acquisition organisations, the Defence Logistics Organisation has established Integrated Project Teams to manage helicopter logistics. Feedback from front line customer organisations suggests that they broadly welcome the new structure. The establishment of a single focus for helicopter logistics support within the Defence Logistics Organisation has been highlighted by the Joint Helicopter Command as having a particularly positive effect on the way in which support is managed. The numbers of teams all contracting with a small number of industry players can, however, lead to some confusion between the Department and industry. Many teams are dealing with the same industrial suppliers and potentially there are competing demands between the teams working unilaterally to drive better performance from industry and an overarching industrial strategy. Aware of this, the Defence Logistics Organisation has developed a strategy to provide a set of resilient guidelines to enable coherent and integrated support across the logistics and acquisition community. For example, the Defence Logistics Organisation brings together Integrated Project Team leaders and industry directors to ensure that business is jointly taken forward and requirements prioritised. However, not all project teams yet have fully developed or effective business plans to achieve this. There are also complaints of initiative overload as teams are faced with implementing their own improvement programmes whilst preparing for Defence Logistics Organisation initiatives.

13 Our previous work on helicopter logistics pointed to weaknesses in management information and the Department gave assurances to the Committee of Public Accounts in 1992 that progress was being made. However, it will take some years before the Defence Logistics Organisation has established a fully converged management information system bringing together data from the Sea, Land and Air environments. Meanwhile legacy single Service information systems and practices remain. Integrated Project Teams are developing cost data in line with Resource Accounting and Budgeting and establishing cost of ownership models but these are immature. Project teams also have to develop new approaches to forecasting demand for spares. Traditionally forecast demand has been based very much on historic consumption but there is a need to look at future demands and the implications of reliability. On both these aspects there is a need for better quality data.

14 There are many examples of good practice, particularly as regards contracting and business planning, which have wider application across the Defence Logistics Organisation. Several Integrated Project Teams have developed innovative partnering or contractual arrangements, either on their own initiative or with the help of support and advice from the Defence Logistics Organisation Centre. Others, such as the Helicopter Engines Integrated Project Team, have increased their management grip of their assets and resources, enabling them to dispose of unnecessary assets and deliver better outputs to their front line customers. The Defence Logistics Organisation is also taking steps to improve its relationship with industry and ensure that industry is better able to deliver its part in logistics support. For example project teams are contracting for the guaranteed delivery of spares.

15 While recognising the Department's particular operational circumstances, international comparators and private sector organisations are using practices which are of direct relevance. Improved analysis of stock holding and forecast demand has led to higher levels of equipment availability for the United States Army. British Airways has comprehensive asset tracking and performance indicator data for its aircraft fleets and is able to make informed management decisions and achieve high availability percentages. Bristow Helicopters Limited achieves similarly high availability rates and both companies have a range of contracts which allow them to minimise their asset holdings and maximise performance. Whilst there are clear differences between the commercial sector and military logistics, the quality of management information and the lessons of innovative contracting are recognised by the Defence Logistics Organisation and are being addressed.

Recommendations

16 The Defence Logistics Organisation is making progress in tackling helicopter logistics and has many initiatives in train to improve logistics management and efficiency in the use of logistics assets. By building on these initiatives, our recommendations should help improve support to helicopters at the front line, directly contributing to military outputs. The possible effects on logistics outputs are summarised in **Figure 1**. Such is the importance of helicopters in the Department's defence tasks that even a small percentage increase in the numbers of helicopters will have a noticeable impact on exercises and operations. Our recommendations are applicable to both existing helicopter fleets and to the new Merlin and Apache fleets being brought into service over the next few years. The new fleets present major technical challenges with much of the procurement pre-dating Smart Acquisition. The existing fleets will continue to provide an essential component of defence capability during the next decade.

1 The Defence Logistics Organisation and its front line customers should aim to develop a consistent regime for measuring outputs and performance, and this should include mechanisms for analysing and addressing the reasons for any shortfalls in serviceability and trends in the numbers of D states and robberies.

2 For more effective business management the Defence Logistics Organisation needs to obtain better data, covering assets (the numbers of stocks, their condition and where they are located), financial data and reliability of equipments.

3 With more responsibilities being given to Integrated Project Teams, including negotiation of contractual arrangements, management of relations with industry needs to be better co-ordinated to drive better performance from contractors.

4 The Defence Logistics Organisation should look to benchmark the quality and timeliness of its management information and the robustness of its contractual arrangements with best practice in industry.

5 More needs to be done to disseminate the many good practices that are being implemented and the lessons that are available from external best practice.

6 There is a need to prioritise the various management initiatives, focusing on those that most directly contribute to improving logistics performance and increasing helicopter availability.

1 Summary of the Department's initiatives to improve helicopter logistics

Logistics Initiative	Effect on Outputs
1 Establishment of Integrated Project Teams (para 2.3)	■ Project teams have improved communication, allowing greater focus on customers' concerns
■ Guidelines for Integrated Project Teams (para 2.7)	■ Guidelines aim to balance a project team's autonomy with a strategic approach designed to maximise industry and internal resources
■ Business plans (para 2.22)	■ Better planning should result in improved business performance as demonstrated by the Helicopter Engines Team
■ Working with other operators (para 2.23)	■ Cooperative working with others and exchange of ideas can drive down costs with suppliers as achieved by the Chinook Team in its relations with the United States Army
2 Improving performance measurement (Part 1 and para 2.14 - 2.17)	■ Consistent measures of performance will highlight problems more effectively to all stakeholders and promote more efficient use of resources
■ Customer Supplier Agreements (para 1.8 - 1.11)	■ Agreements are evolving and there is a need for greater consistency and focus on logistics outputs
■ Improving analysis of reliability and forecast demand (para 2.20)	■ Reliability work carried out by the Support Chain Integrated Business Team and project teams should provide better demand forecasts
3 E-commerce and management information projects (para 2.10)	■ New management, IT and asset tracking packages should provide a clear picture of the condition and location of assets, and promote better use of existing assets
4 Full application of Resource Accounting and Budgeting, Whole Life Costing (para 2.8-2.9)	■ Better information on the full cost of activities should help project teams deliver their business aims and promote wider efficiency
5 Innovative contracting (para 2.24 - 2.25)	■ New arrangements should allow the Department to contract more efficiently for spares and repairs and help reduce stock holdings
6 Best practice dissemination (para 2.13)	■ Targeted benchmarking and further best practice dissemination should help the Department make better use of its resources and expertise by enabling and equipping project teams
■ Heads of Specialisation (para 2.9)	■ More effective sweating of assets should increase outputs
■ Drawing on best practice from industry and other countries' defence departments (para 2.28-2.37)	

Source: National Audit Office

Part 1

In this difficult area the Defence Logistics Organisation has not yet been able to deliver all the required logistics support

1.1 Logistics support for helicopters is a complicated task with responsibility for aspects of performance being shared between the Defence Logistics Organisation and front line commands. The Defence Logistics Organisation is also crucially dependent on industry to provide spares. The Defence Logistics Organisation is striving to meet its performance targets and weaknesses in helicopter logistics can have severe operational impacts.

Logistics support for helicopters is a complicated task

1.2 The Department's 1998 Strategic Defence Review emphasised the need for flexibility, adaptability and responsiveness in undertaking military tasks, including expeditionary operations. Helicopters are a key component of defence capability as they make a unique contribution to operations. The quality, timeliness and reliability of their support are therefore critical to the success of future defence missions.

1.3 This study focuses on the Department's six main established helicopter fleets supported by the Defence Logistics Organisation, comprising 470 helicopters at the front line, whose logistics support costs some £260 million a year **(Figure 2)**. Many of the current helicopter fleets are reaching the end of their operational lives and need careful management if they are to contribute to the expected military tasks. New fleets of Merlin and Apache helicopters are being brought into service by the Defence Procurement Agency, but have not been operated for sufficient time to demonstrate significant trends in logistics performance. The good practices identified in this report within the Defence Logistics Organisation, the Defence Procurement Agency and industry, however, will be of significant value to the new and current fleets in the future.

1.4 Seventy per cent of the Department's helicopters are operated by the Joint Helicopter Command, a new organisation that was formed in October 1999. It was designed to bring together all battlefield helicopters in order to facilitate their deployment on joint operations and draws on helicopters owned by the Royal Navy, the Army and the Royal Air Force. In addition Commodore Naval Aviation and Strike Command operate smaller numbers of helicopters which are not included in the Joint Helicopter Command. This is because they are either considered integral parts of a ship's weapons system or because they undertake non-battlefield tasks, such as domestic search and rescue work.

2 Main helicopter types

The main helicopter types have been in service for more than 20 years with the United Kingdom armed forces.

Helicopter	Number	Role	Operators
Wessex	11	Light Support	Joint Helicopter Command / Strike Command
Puma	33	Tactical Transport	Joint Helicopter Command
Gazelle	122	Reconnaissance	Joint Helicopter Command
Sea King	100	Numerous roles	Joint Helicopter Command / Strike Command / Commodore Naval Aviation
Chinook	31	Medium Support	Joint Helicopter Command
Lynx	169	Light Utility	Joint Helicopter Command / Commodore Naval Aviation

Source: Ministry of Defence Performance Report 2000/2001

1.5 Providing helicopter logistics support has proved a major challenge for the Department. The main responsibility rests with the Defence Logistics Organisation. Prior to the Defence Logistics Organisation's establishment in April 1999, each Service was responsible for logistics support for its own helicopters and operated its own systems, although some progress had been made in rationalising support and logistics systems with the formation of the Defence Helicopter Support Authority in 1994. In addition, the Royal Navy and the Royal Air Force have co-operated closely for over thirty years in the provision of air stores and other logistics matters.

1.6 The Defence Logistics Organisation is not alone in providing logistics support to helicopters. The maintenance policy for the aircraft is set by the Defence Logistics Organisation in discussion with the customer and front line units are responsible for many maintenance activities. Their performance is not the direct responsibility of the Defence Logistics Organisation, although the Defence Logistics Organisation provides spares and technical advice **(Figure 3)**. The Defence Logistics Organisation is also crucially dependent on industry for the supply of spares. In addition Service personnel organisations are responsible for providing the trained people needed.

1.7 The complexities of helicopter logistics support are illustrated by the Defence Logistics Organisation's response to the management of the Lynx fleet following a crash of a Dutch Lynx in 1998:

3 Logistics support for helicopters

Other bodies, in addition to the Defence Logistics Organisation, are involved in the provision of logistics support for helicopters.

The Defence Logistics Organisation is responsible for:

- 4th Line maintenance. The deep repair or overhaul of helicopters by industry.
- 3rd Line maintenance. Major repair carried out by Department bodies such as the Defence Aviation Repair Agency.

When helicopters are not subject to such maintenance, then they are technically available to front line units.

A technically available aircraft will still not necessarily be capable of flying. To do so it must first be serviceable. Helicopters are serviceable when they are technically available, are not subject to 1st or 2nd Line maintenance, and have been equipped with the necessary weapon systems to undertake their designated mission.

The Defence Logistics Organisation is not directly responsible for:

- 2nd Line maintenance. Minor repairs and parts replacement. Some major repairs.
- 1st Line maintenance. Daily servicing and maintenance, and routine defects investigations.

This maintenance is performed by front line units. The Defence Logistics Organisation acts as an enabler, providing spares, technical support and advice, and liaison with industry.

For a serviceable helicopter to be ready to fly, air crew have to be available and the helicopter has to be armed, fuelled, have the correct role equipment and be supported by sufficient numbers of adequately trained ground crew.

Source: National Audit Office

The Joint Helicopter Command and Commodore Naval Aviation operate Lynx helicopters in a variety of different roles.

In November 1998 a Dutch Lynx suffered an unforeseen critical failure of its main rotor head. As a result of this incident, the service life between maintenance of rotor heads fitted to the Department's own helicopters was reduced. The Defence Logistics Organisation did not have accurate data on the consumed lives of rotor heads, particularly those being operated by the Army. In the absence of good data, the Defence Logistics Organisation had to adopt a conservative position when undertaking repairs and a number of rotor heads may have been taken out of service prematurely.

The effect was an overall shortage of rotor heads and many helicopters were grounded. The Defence Logistics Organisation responded promptly, consulting its front line customers, Commodore Naval Aviation and the Joint Helicopter Command and agreeing revised targets for Lynx availability, typically involving a 20 per cent reduction. The Lynx main rotor head is a complex and high performance component which is constructed from a special material, processed through a number of specialist suppliers and has a total lead time of more than two years. The rate at which rotor heads could be manufactured and delivered was insufficient to avoid the overall fleet shortage. The Lynx Integrated Project Team reacted quickly given the long lead times and the manufacturer, Westland Helicopters initiated recovery action well in advance of new contractual arrangements.

The Defence Logistics Organisation has worked closely with Westland Helicopters to deliver additional rotor heads and has put in place a robust fleet wide recovery programme that is on target for completion in June 2002, when Lynx availability is to be restored to previous levels and replenishment of all spares is scheduled for March 2003. Progress against the recovery programme has been carefully monitored by the Defence Logistics Organisation and included in the monthly performance reports provided to senior management.

The Defence Logistics Organisation is striving to meet its helicopter related Customer Supplier Agreements

1.8 Performance against Customer Supplier Agreements is mixed and the agreements do not provide a comprehensive measure of helicopter logistics performance.

Performance against Customer Supplier Agreements is mixed

1.9 The Defence Logistics Organisation has established Customer Supplier Agreements with its three customers of helicopter logistics: the Joint Helicopter Command, Commodore Naval Aviation and Strike Command. These Agreements are negotiated annually and cover the totality of the logistics support provided by the Defence Logistics Organisation. **Figure 4** illustrates the key outputs and performance indicators in these agreements.

1.10 During 2000 and 2001 the Defence Logistics Organisation reported its performance against these Agreements as unsatisfactory, although in recent months its performance has started to improve. It identified a lack of spares, including vital repairable items, as the main reason for its performance weaknesses. Where there is a requirement for replacement spares the Defence Logistics Organisation is very much dependent on capacity in industry.

4 Key outputs in Customer Supplier Agreements

The Customer Supplier Agreements detail the agreed key outputs and performance indicators.

Output	Example of Performance Indicator
Sufficient aircraft	■ Number of aircraft technically available
	■ Flying hours achieved against agreed target
Airworthy aircraft	■ Number of urgent maintenance instructions
Capable aircraft	■ Percentage of aircraft not fitted with required equipment
Reliable aircraft	■ Mean time between replacement for technical failure of major rotables
Maintainable aircraft	■ Unscheduled maintenance manhours per flying hour
Sustainable aircraft	■ Numbers of robberies
	■ Numbers of D states

Source: Defence Logistics Organisation

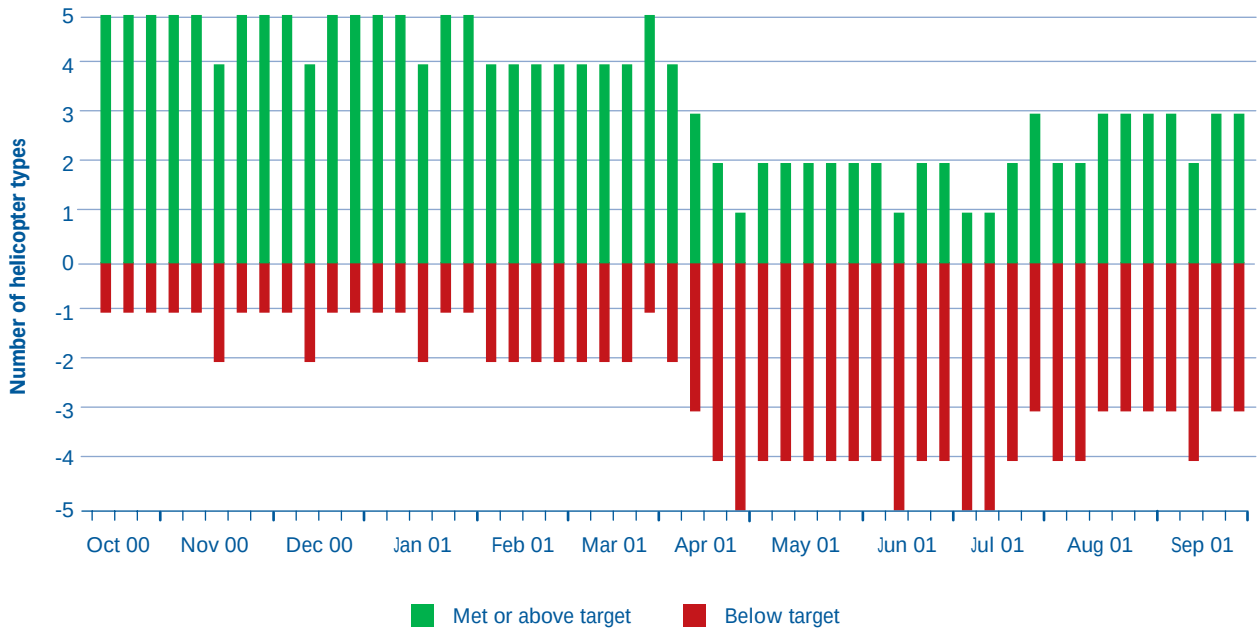
1.11 Our examination of the Defence Logistics Organisation's detailed performance under the Customer Supplier Agreements revealed some variability between customers in the performance information collected to monitor service delivery, limiting the comparisons that could be made in the standards of service provided to these customers. Standardisation of performance monitoring would facilitate comparison.

1.12 For each type of helicopter the Defence Logistics Organisation agrees the number of aircraft that it will make technically available to its customers during the year. Its performance in meeting these targets has been patchy:

- For Commodore Naval Aviation Sea King and Lynx helicopters, in 2000 the Defence Logistics Organisation succeeded in making all of the agreed helicopters available for use half the time.
- For the Joint Helicopter Command, in the 12 months to September 2001 the Defence Logistics Organisation achieved its targets more often than not **(Figure 5)**. It succeeded in making all agreed helicopters for five of the six helicopter types available for use 30 per cent of the time. Where targets were missed performance was marginally below target, with availability at more than 80 per cent **(Figure 6)**. For Lynx, the sixth helicopter, as a result of the main rotor head problem (Box page 8), the Defence Logistics Organisation never succeeded in meeting its availability targets. Availability targets for Chinook, Gazelle and Puma helicopters for 2001-02 were generally made more demanding and the Defence Logistics Organisation has experienced difficulties in achieving these higher standards - hence from April 2001 Figure 5 shows more red than green.

5 Helicopter availability - Joint Helicopter Command

During 2001 performance deteriorated with the Defence Logistics Organisation not meeting its availability targets for one or more of the Joint Helicopter Command's helicopter types.



Source: Joint Helicopter Command

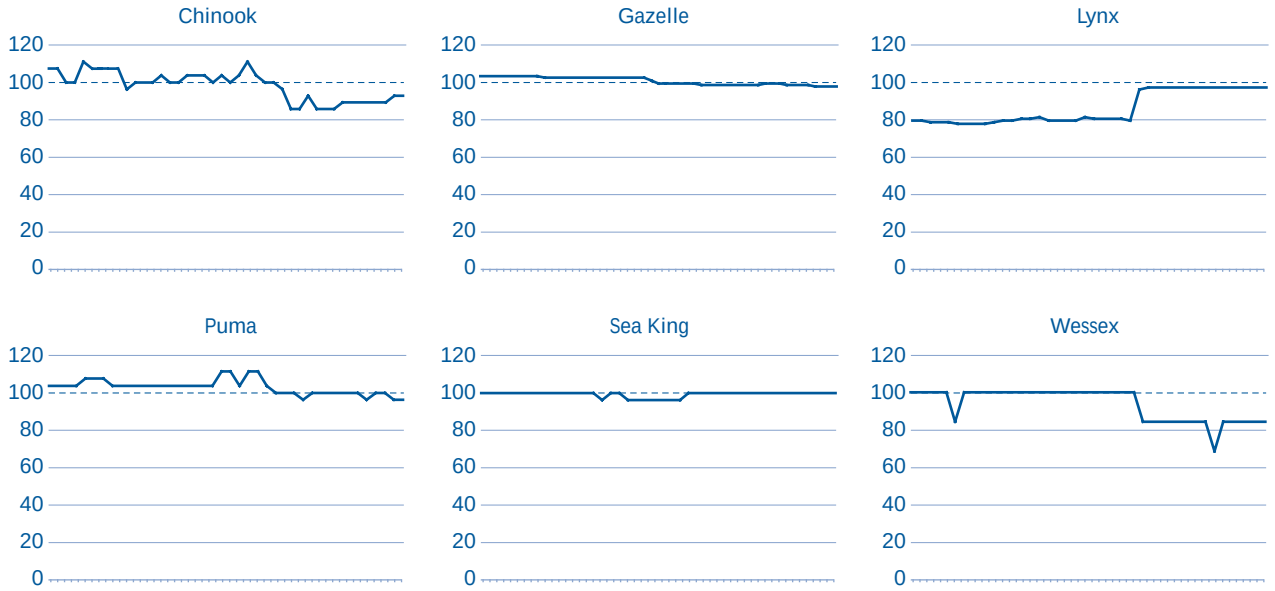
- For Strike Command's main search and rescue helicopter, the Sea King, the Defence Logistics Organisation succeeded in making all agreed helicopters available 40 per cent of the time. For the remaining time it did not meet this target, but the number of helicopters made available never fell below 94 per cent of the agreed levels.

The numbers of D states and robberies indicate logistics weaknesses

1.13 The Customer Supplier Agreements contain targets which cover the Defence Logistics Organisation's provision of logistics support to front line units to assist in making helicopters serviceable. Thus targets are set for the number of helicopters which are grounded as a result of a lack of spares to enable front line units to carry out maintenance (D states), and the number of times units have to take equipments, such as gear boxes or rotor heads, and spares from one helicopter to place in another (robberies). In these cases, the Defence Logistics Organisation's target is to ensure that the number of D states and robberies is as low as reasonably practical. A zero D state target would not be practicable or cost-effective as this would require disproportionate increases in spares holdings. Nevertheless, robberies are hugely time-consuming for ground crew, since it multiplies their workload and delays other scheduled maintenance. There are also knock-on effects from continual robbing, with increasing risk of damage to components and fixings.

6 Availability of the Joint Helicopter Command's six helicopter types

The figure shows performance in meeting the 100 per cent availability target for the Joint Helicopter Command's six helicopter types for the 12 months to September 2001. In the light of the major problems with the Lynx main rotor head the availability target was eased in April 2001 but was still not achieved (Box page 8). Performance dipped in the last 6 months for Chinook helicopters as the availability target was made more demanding. There are 8 Wessex helicopters and unavailability of one helicopter has a marked effect on overall performance.



Source: Joint Helicopter Command

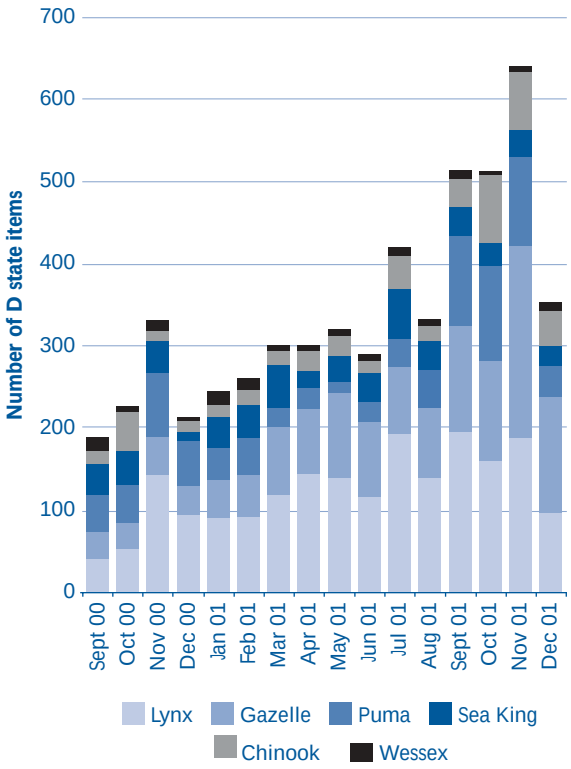
1.14 Analysis of performance for these two aspects illustrate weaknesses in the Defence Logistics Organisation's support for front line units. The raw statistics suggest that overall performance has been mixed with apparent increases in D states and little change in numbers of robberies for the Joint Helicopter Command **(Figures 7 and 8)**. However, care needs to be taken when interpreting results as there are concerns regarding the consistency of data. Definitions have changed over time and some units may adopt different approaches to data collection and reporting, making the identification of clear performance trends difficult. In addition the unit of measurement is broad, covering an entire engine to a minor component. Raw statistics on D states require careful interpretation as one helicopter may be affected by more than one D state. Indicators such as the number of days lost awaiting spares provide additional information but data are not collected consistently.

Performance on flying hours achieved has been poor

1.15 The Customer Supplier Agreements detail the number of flying hours to be achieved during the year. For most of the helicopters operated by the Joint Helicopter Command, these targets have not been met **(Figure 9)**. The flying hours targets for Strike Command Sea Kings have also not been met; in 2000 86 per cent of planned flying hours were achieved, falling to 79 per cent in 2001. Commodore Naval Aviation achieved 76 per cent of planned flying hours in 2000-01 and 89 per cent to January 2002 in 2001-02. The low level of flying hours in 2000-01 was partly the result of a deliberate reduction during the year in the number of hours flown as part of a cost savings exercise.

7 Level of D states - Joint Helicopter Command

During 2000-01 the number of D states for Joint Helicopter Command helicopters increased by over 160 per cent.



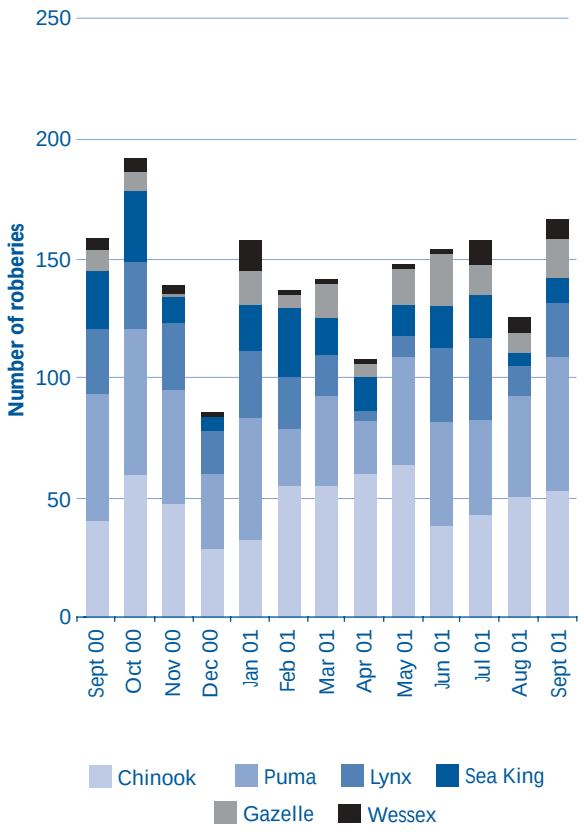
NOTE

The above data needs to be treated with caution as there were changes in the definition of D state.

Source: Joint Helicopter Command

8 Level of robberies - Joint Helicopter Command

During 2000 and 2001 there was no improvement in the total number of robberies on Joint Helicopter Command helicopters.



Source: Joint Helicopter Command

9 Flying hours achieved - Joint Helicopter Command

The Joint Helicopter Command has met three out of 12 targets for flying hours.

	2000-01		2001-02 First Quarter (1)	
Targets met	Puma Sea King		Gazelle	
Targets not met		Percentage of target achieved		Percentage of target achieved
	Wessex	93	Sea King	98
	Gazelle	84	Puma	96
	Chinook	78	Lynx	85
	Lynx	76	Wessex	82
			Chinook	73

NOTE

1. Figures for 2001-02 are the actual number of flying hours achieved in April to June 2001.

Source: Joint Helicopter Command

The Department needs to extend the scope of Customer Supplier Agreements to provide a more comprehensive measure of performance

1.16 One measure of output in the Customer Supplier Agreement is annual flying hours. Flying hours, however, are the product of a number of factors including spares provisioning, appropriate maintenance scheduling and both air and ground crew training and manning levels. Front line manning and training is the responsibility of service personnel organisations, whilst front line units are responsible for the performance of certain levels of maintenance and the Defence Logistics Organisation for making helicopters technically available and providing spares and technical support to the front line. Since the achievement of flying hours is dependent on so many parties, they are not a definitive measure of the Defence Logistics Organisation's performance. However, they are monitored as they are a key cost driver for the Defence Logistics Organisation. Flying hours are also an important measure for the Defence Logistics Organisation's customers as they are related to the achievement of outputs, such as training courses and aircrew currency, for which the customers are responsible.

1.17 In contrast, the Customer Supplier Agreements do not generally contain targets for the number of helicopters which are serviceable during the year - the Commodore Naval Aviation Agreement is the exception. As with flying hours, the numbers of serviceable helicopters is dependent on the performance of both the Defence Logistics Organisation and its customers. When determining whether helicopters are able to be used, the Defence Logistics Organisation's customers are fundamentally concerned with the number of serviceable helicopters which are ready to fly, rather than the number of those that the Defence Logistics Organisation has made available to them. The Customer Supplier Agreements should therefore include targets for the number of serviceable helicopters during the year, with supporting analysis to identify the causes of any shortcomings in performance and responsibilities for improvements.

1.18 The inclusion of targets for serviceable helicopters will avoid the situation which has occurred in the past where the Defence Logistics Organisation has reported its performance as satisfactory, as it has succeeded in meeting its targets for making helicopters available to the front line units. At the same time front line commanders have reported helicopter numbers to be unsatisfactory as they have focused on the number of serviceable helicopters for use. In 1992 the Committee of Public Accounts raised similar concerns on the need for greater consistency in the definition and measurement of availability between the Services (Appendix 1).

1.19 The Customer Supplier Agreements do contain targets for aspects of the Defence Logistics Organisation's support to front line units in making helicopters serviceable. For example, the targets for D states and robberies (paragraph 1.13) cover the Defence Logistics Organisation's performance in providing the front line

units with spares. However, the Agreements do not cover other aspects of the Defence Logistics Organisation's support, such as the provision of technical advice and publications. These Agreements should therefore be extended to include performance indicators covering the timeliness and quality of such support. As partnering arrangements evolve this may lead to closer co-operation between front line customers and industry, as is the case with Westland Helicopters and the Sea King, Merlin and Apache fleets.

1.20 The levels of service to be provided under the Customer Supplier Agreements agreed each year reflect the levels of funding available to the Defence Logistics Organisation. The Agreements can be renegotiated during the year to reflect funding pressures, changes in the outputs required by the customers in response to military operations, or technical problems.

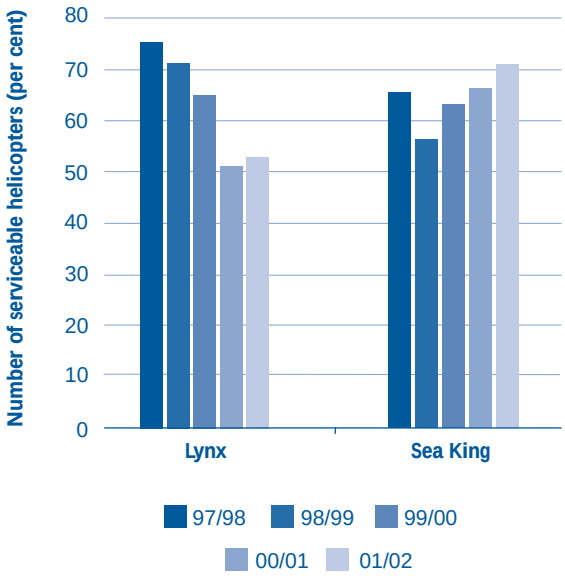
Analysis of serviceable helicopters shows shortfalls in logistics performance

1.21 The Defence Logistics Organisation and its front line customers share responsibility for aspects of helicopter logistics performance. The Defence Logistics Organisation is clearly responsible for the provision of set numbers of 'available' helicopters to the front line. It sets a maintenance policy for each helicopter type in discussion with the customer. Newer types such as Merlin and Apache have their maintenance policies jointly derived with the manufacturer. The advantages of this approach are being investigated for the current Sea King fleet. Through this maintenance policy, spares and expertise are provided to front line units. The front line units are themselves responsible for many maintenance activities, including daily servicing and maintenance, routine defect investigations, minor repairs and parts replacement. The deployment of helicopters which are serviceable rather than simply available is, therefore, a joint effort between the Defence Logistics Organisation and its customers.

1.22 Analysis of the number of serviceable helicopters reveals shortcomings in logistics performance, although the data for Lynx have been heavily influenced by the problems associated with the main rotor head (Box page 10):

10 Serviceable helicopters - Commodore Naval Aviation

Performance in making Commodore Naval Aviation helicopters serviceable has been mixed.



NOTE

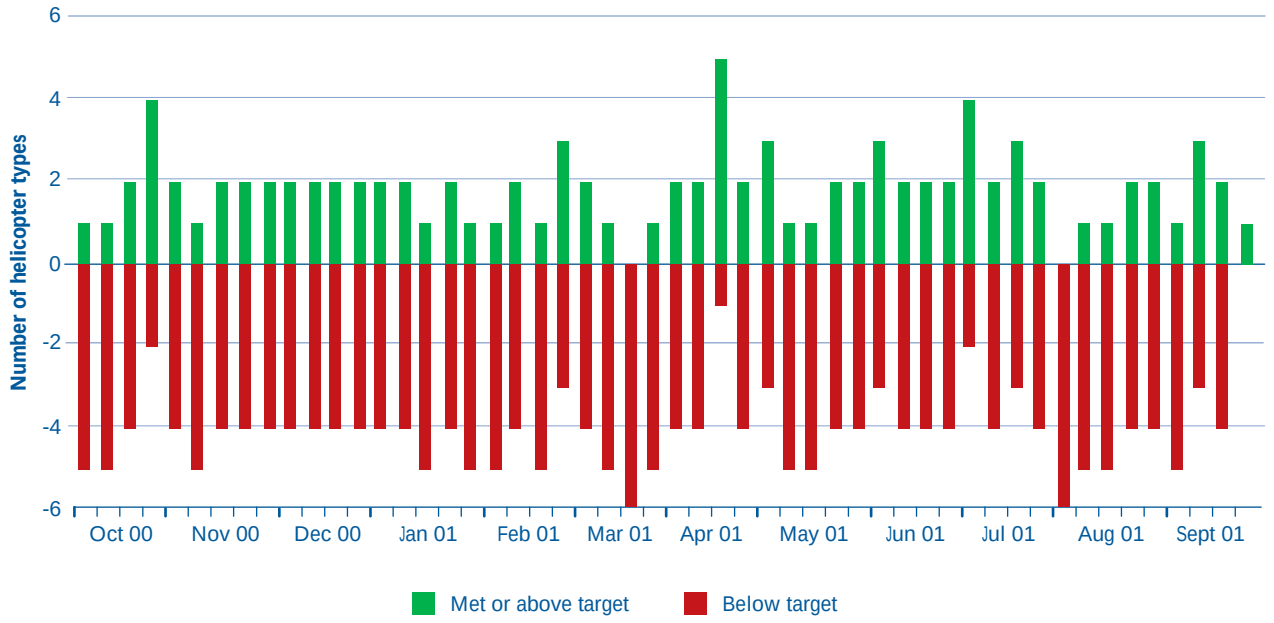
The Defence Logistics Organisation was established in April 2000.

Source: Royal Navy

- For Commodore Naval Aviation helicopters performance has been mixed. Over the past five years the number of serviceable Sea King helicopters has increased to over 70 per cent. In contrast the number of serviceable Lynx helicopters has decreased significantly to just over 50 per cent **(Figure 10)**.
- For the Joint Helicopter Command the target is for two thirds of its available helicopters to be serviceable. Serviceability targets were achieved on average for two of the six helicopter fleets in the twelve months to September 2001 **(Figure 11)**. As for availability, where targets were missed, performance was marginally below target.
- Strike Command's target for its main search and rescue helicopter, the Sea King, is for 60 per cent of these to be serviceable. In the 18 months to September 2001 this target was only met in three months **(Figure 12)**. Search and rescue units are required to have two helicopters at very high levels of readiness and serviceability for the first standby helicopter was 98 per cent.

11 Serviceable helicopters - Joint Helicopter Command

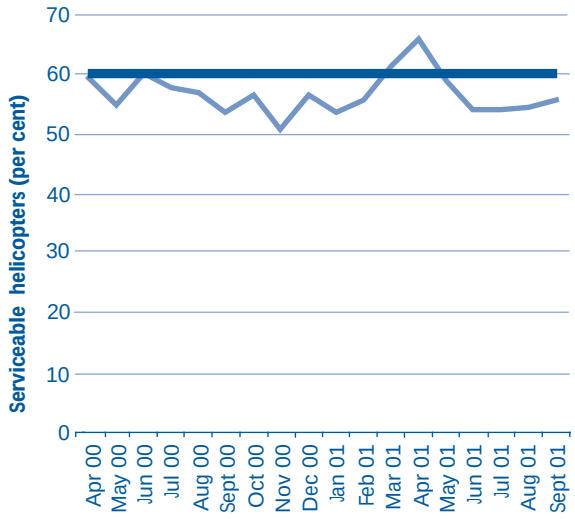
In the 12 months to September 2001 Joint Helicopter Command serviceability targets were achieved on average for two of the six helicopter fleets.



Source: Joint Helicopter Command

12 Serviceability of Strike Command's Sea King helicopters

In the 18 months to September 2001 the serviceability target for Strike Command's Sea King helicopters was only met in three months.



Source: Royal Air Force

Weaknesses in logistics support can have severe operational impacts

1.23 Weaknesses in logistics support can have severe impacts on operations and exercises but the Department has managed its limited resources in such a way to protect critical operations and the training programme.

Operations

1.24 The recent operational performance of several aircraft has been diminished by logistics shortcomings. While some shortcomings can be attributed to heavy use or the extension of a platform's out of service date, logistics difficulties remain. Shortages of spares have affected a number of types of helicopter in particular.

1.25 Lynx outputs have been severely affected by problems with the main rotor head (Box page 10). This issue reduced the number of available aircraft and the Royal Navy protected front-line operations and the flying training programme, resulting in some ships going to sea without an embarked Lynx helicopter. This means that the ship as a whole lacks anti-submarine and air-to-surface warfare components as well as the other utility roles provided by the Lynx. This represents a significant downgrading of operational capability. Furthermore, the

longer a ship operates without its helicopters, the harder it becomes for the crew to maintain their aviation-related skills and experience. The same rotor head problem contributed to the Joint Helicopter Command having to review its helicopter deployments. As a result, the Lynx helicopters in the rapid reaction forces not currently deployed on operations are at a lower level of readiness than targeted.

1.26 There have also been problems with the rotor heads and rotor gear boxes of Sea Kings. Again action is being taken to address these problems. Despite this, there have been operational difficulties. When amphibious assault Sea Kings were deployed to Sierra Leone, all spare Sea King engines were sent with them. This impacted on search and rescue Sea Kings in the United Kingdom as there was a consequent increase in the number of D states and an increase on the workload on ground crews, although helicopter availability was maintained.

1.27 Problems have also emerged with the Gazelle helicopters. A recent accident highlighted faulty torsion bars dating from before 1997. The Design Authority introduced a new monitoring requirement and the Defence Logistics Organisation had to use manual tracking systems to identify which Gazelles contained torsion bars from this period. The Defence Logistics Organisation reacted swiftly to identify the affected components and briefly grounded three quarters of the Gazelle fleet to enable inspections to be carried out to identify faulty parts. Learning valuable lessons for the future, the Puma/Gazelle Integrated Project Team worked closely with the Joint Helicopter Command and the Design Authority to manage the recovery plan and minimise operational impacts.

1.28 Front line units have experienced difficulty in meeting their sustainability requirements. For example, although the Royal Air Force's requirement is for five priming equipment packs for its Chinook fleets, only one of these has been funded. These packs are sets of key spares which are crucial for expeditionary operations.

Exercises

1.29 From our discussions with front line units, aircraft unavailability is contributing to poor staff retention. Some aircrew cannot achieve their stipulated flying hours ('currency') since aircraft are grounded. Other aircrew are unhappy that they are only achieving their stipulated flying hours through equipment testing flights rather than through more technically demanding training and exercises. Training opportunities are limited as training units' requests for scarce spares for their helicopters take a lower priority than requests from units on operations.

1.30 During the recent exercise in Oman, Saif Sareea II, experience gained from the Gulf War suggested that the harsh conditions would have an effect on helicopter performance and logistics planning was changed accordingly. However, the extreme environmental conditions caused some components, such as the Lynx rotor blades, to break down at a faster rate than expected. The necessary spares had to be sent from the United Kingdom and there were delays as available space on freight flights to Oman was limited. Consequently helicopter serviceability during the exercise averaged below 55 per cent. For European exercises the target serviceability rate is 75 per cent, although the Department considered that this was ambitious for conditions in Oman.

Part 2

The Defence Logistics Organisation is tackling helicopter logistics problems but there is scope to improve performance and so increase helicopter outputs

2.1 The Defence Logistics Organisation has many initiatives in train to improve performance but management information is not yet sufficiently robust. There are examples of good practice within the Defence Logistics Organisation which should be disseminated. In addition lessons can be learned from outside organisations.

The Defence Logistics Organisation has many initiatives in place to improve performance but management information is not yet sufficiently robust

2.2 The Defence Logistics Organisation has established Integrated Project Teams and introduced a number of initiatives to improve performance but it needs to ensure that project teams have the data to manage their businesses effectively.

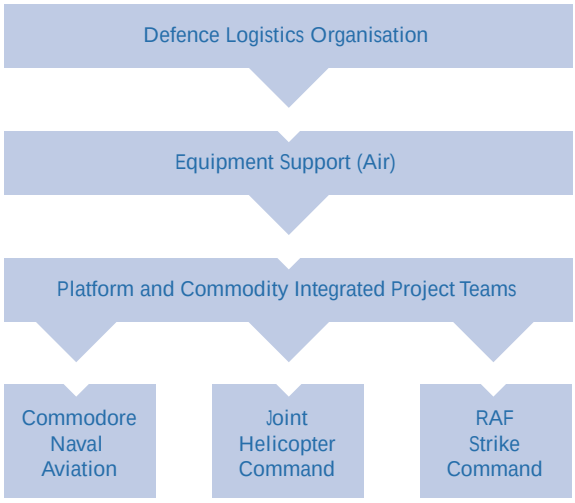
Integrated Project Teams manage helicopter logistics

2.3 There has been considerable change in the management of helicopter logistics in the last decade. Before the establishment of the Defence Logistics Organisation there was very much a silo mentality. Despite the formation of the Defence Helicopter Support Authority, the three Services continued to operate their own systems and budgetary structures, limiting progress on convergence. Following a structure implemented across the Department's acquisition organisations, the Defence Logistics Organisation has established Integrated Project Teams to manage helicopter logistics. Direct responsibility for those Integrated Project Teams responsible for helicopter support falls to the Equipment Support (Air) pillar, which is also responsible for logistics support for fixed wing aircraft **(Figure 13)**.

2.4 Equipment Support (Air) operates five main helicopter platform Integrated Project Teams (Sea King, Chinook, Puma/Gazelle, Lynx, Helicopter/Islander) and four commodity teams (Helicopter Engines, Avionics, Aircraft Support and Air Launched Munitions). A further two platform teams for new helicopters (Apache and Merlin) will remain predominantly within the Defence Procurement Agency until the aircraft are fully brought into service, at which point they will migrate to the Defence Logistics Organisation.

13 Support arrangements for the Department's three helicopter customers

Support for helicopter customers is channelled through Equipment Support (Air) Integrated Project Teams.



Source: National Audit Office

2.5 Feedback from front line customer organisations suggests that they broadly welcome the Integrated Project Team structure. They are particularly keen on using the team leader as a single point of contact through which to channel their technical, replenishment and budgetary concerns. As part of its development of performance measurement, the Defence Logistics Organisation is to establish customer satisfaction indicators, and so monitor customer opinion more formally, but other priorities have resulted in the project slipping.

2.6 There are competing demands between helicopter platform and commodity teams and it is important to ensure that there are clear lines of accountability between the customer via the platform teams. The Defence Logistics Organisation is reviewing its arrangements in the light of experience across the Air and other Service pillars.

- The helicopter area of the Defence Logistics Organisation maintains a separate Helicopter Engines Integrated Project Team, which gives substantial advantages in dealing with industry and getting efficiencies when managing similar engines. In contrast, in the fixed wing area, platform teams have been responsible for their own engines since their inception, with the advantage that one team is responsible for the integrated performance of each platform. For helicopters, platform teams have primacy and have established internal business agreements with the commodity teams. Platform team leaders take the lead in dealing with customers but there are varying interpretations as to when the leaders of commodity teams should be involved.
- The Avionics Integrated Project Team manages avionics equipment only when it is used by more than one platform team, although there are exceptions to this rule, decided on a case-by-case basis. The result is a degree of confusion as to who should take the lead on new avionics equipment support.

2.7 The numbers of teams all contracting with a small number of industry players can lead to confusion between the Department and industry. Many teams are dealing with the same industrial suppliers and potentially there are competing demands between the teams working unilaterally to drive better performance from industry and an overarching industrial strategy that is generally implemented at senior levels. This is difficult to achieve with a set of 'empowered' teams, but is necessary if better performance is to be achieved. Aware of this, the Defence Logistics Organisation has developed a strategy to provide a set of resilient guidelines to enable coherent and integrated support across the logistics and acquisition community. For example, the Defence Logistics Organisation brings together Integrated Project Team leaders and industry directors to ensure that business is jointly taken forward and requirements prioritised. The principal manufacturer, Westland Helicopters, welcomes this initiative in contributing to convergence in helicopter support. The management of dealings with commercial suppliers and manufacturers should be more closely co-ordinated in order to drive better performance from industry.

The Defence Logistics Organisation has introduced many concurrent initiatives

2.8 In its 2000 Corporate Plan, the Defence Logistics Organisation identified seven key areas for change by which it might transform logistics support, namely people, inventory, industry, capital asset management, engineering support, e-business and convergence. Many of these changes have direct implications for the current and future success of helicopter logistics. The Defence Logistics Organisation has also developed business planning and performance monitoring through balanced scorecards, which are cascaded down through its business units. Other projects include the introduction of the European Foundation for Quality Management Excellence model, adopting a Whole Life Cost Approach and driving forward Smart Acquisition initiatives.

2.9 Work continues on the full application of Resource Accounting and Budgeting, and there are targets for reducing stock and generating efficiency savings. The Chief of Defence Logistics has set a target of a 20 per cent reduction in output costs by 2005, whilst continuing to deliver or improve the quality of outputs. The Defence Logistics Organisation is introducing a number of Heads of Specialism for various areas of expertise. These Heads would be the focal point for Integrated Project Teams seeking advice and also for the dissemination of best practice across the three environments.

2.10 The Defence Logistics Organisation is working to transform its business, people and processes and converge information systems across the three environments but much still remains to be done. A range of electronic solutions to current business needs forms part of this work.

- Asset tracking and inventory management should be improved by the introduction of new systems, although implementation of these will take time. While new systems may be comprehensive, they may lack the sophistication of some systems which are already in place.
- An e-commerce framework should speed up interactions between the Defence Logistics Organisation, the Defence Procurement Agency, the Defence Bills Agency and industry.
- In addition, work is underway to ensure that all the data used to populate these new systems is as accurate as possible.

2.11 Whilst these projects are pan-logistics applications, their successful introduction should result in increased serviceability of helicopters, as a result of optimising inventories, converging business and engineering practices, reducing the repair cycle and giving better control of assets. However, the timescales for these projects are medium term (three or four years), their full funding is not yet guaranteed and there is therefore a need for interim solutions which Integrated Project Teams are developing. These interim solutions are not interoperable with the major systems currently being developed.

2.12 Integrated Project Teams are keen to implement the various Defence Logistics Organisation initiatives but their uptake is more advanced in some areas than others. Much depends on the maturity of the bedding in of Smart Acquisition changes. There are also widespread complaints of initiative overload, with teams stating that they are not always given the time or resources to train and be able to implement new working practices successfully.

2.13 In addition to the business change programme mentioned above, the Air environment headquarters is pursuing a number of business process improvement initiatives, although some of these are directly cascaded from the Defence Logistics Organisation centre. The Air environment business plan sets out a number of these initiatives, including: developing a Whole Life Cost approach, Smart Acquisition initiatives and improving efficiency through Resource Accounting and Budgeting. A Change Programme Management Group has been formed to prioritise extant initiatives. The Air environment has added Best Practice web pages to its intranet site and instituted a Best Practice newsletter in order to spread innovation throughout the Integrated Project Teams, and peer group meetings are regularly held. The staff at the Air site in Yeovilton have instituted a series of lunchtime seminars with similar aims in mind.

The Defence Logistics Organisation needs to ensure that teams have the data needed to manage their business effectively

2.14 For the successful provision of logistics support, management information should be timely, accurate and reliable, and requires data on key areas such as end user demands, the location and condition of assets, accurate costs, the reliability of equipments, and the supply base. The Department's management information has historically been poor, as shown in the Committee of Public Accounts 1992 report when the Department gave assurances that progress was being made (Appendix 1).

2.15 Whilst the Department has systems to record costs, asset tracking and other data, the Defence Logistics Organisation has not yet completed the convergence of these systems. Legacy single Service information systems and practices remain, denying Integrated Project Teams and the Defence Logistics Organisation the management information they need. The problem of connectivity remains an ongoing concern. In this context the Air environment mirrors the Defence Logistics Organisation because it has inherited a number of legacy systems which are gradually being brought together. The new Apache and Merlin helicopter fleets, which are being brought into service by Defence Procurement Agency Integrated Project Teams, present even greater technical and engineering challenges for the Defence Logistics Organisation than the current fleets. It is crucial, therefore, that effective systems are put in place in order to operate these fleets efficiently.

2.16 By way of example, poor asset tracking exacerbated problems on Lynx and Gazelle where the Department did not have the data readily available on the age, condition and location of key components (Box page 10 and paragraph 1.27). Particular difficulties arise when spares are transferred across fleets, for example from a Commodore Naval Aviation Lynx to a Joint Helicopter Command Lynx and therefore across asset tracking systems. The Royal Navy and the Royal Air Force both use automated asset tracking systems, whereas the Army uses a manual tracking system. There is therefore limited interoperability between the three systems.

2.17 The Sea King Integrated Project Team has a particular challenge in terms of information convergence since it supports helicopters from Commodore Naval Aviation, Strike Command and the Joint Helicopter Command. It therefore has to use data from a range of legacy systems when conducting its activities. In conjunction with Equipment Support (Air) IT staff, the Sea King Integrated Project Team is developing a data warehousing project, designed to bring together all extant information systems into one package. Besides allowing the team to manage its assets in an efficient way, the project should provide an early sample of the benefits that are expected from improvements in IT systems.

2.18 The Defence Logistics Organisation is currently looking at options for achieving information systems convergence across the helicopter community, both to aid interoperability and to improve data consistency and accuracy. This is being done in conjunction with Westland Helicopters in order that data and information can be shared and collaborative working facilitated. Key to this is the exploitation of new technological systems being introduced in support of the Merlin and Apache helicopters. Westland Helicopters has produced a helicopter management information convergence strategy for the Defence Logistics Organisation based on the Merlin Enhanced Health and Usage Diagnostics (EHUDS) which the company is developing for the Merlin Integrated Project Team. EHUDS is being assessed by the Department who considers that the system has potential to be used across other helicopter types.

2.19 The introduction of Resource Accounting and Budgeting has engendered a much closer focus amongst all staff on the real costs of their business. Integrated Project Teams are developing cost data in line with Resource Accounting and Budgeting and establishing cost of ownership models but these are immature. Progress is patchy and there is a need for more training in some areas.

2.20 Previous National Audit Office work on the Department's logistics operations suggests that reliability data across the maintenance area have been poor and that this has contributed to poor forecast demand data. Our analysis of the data available to Integrated Project Teams suggests that this is also true in many cases for helicopter support. Traditionally forecast demand has been based very much on historic consumption but there is a need to look at future demands and the implications of reliability. On both these aspects there is a need for better quality data. In order to improve repairable stock optimisation level calculations, much better data are required on reliability, and a proper reliability monitoring system needs to be put in place. At present reliability is measured in terms of constant failure rates, such as Mean Time Between Failure, and often the cause of failures within equipments is not properly analysed. There is a clear need for a generic, understandable methodology for carrying out reliability analysis to assist equipment managers in minimising the life cycle costs for legacy systems.

There are many examples of good practice within the Defence Logistics Organisation which should be disseminated

2.21 Within the Defence Logistics Organisation there are examples where Integrated Project Teams have implemented robust business plans and pursued innovative contracting.

Robust business plans

2.22 Some Integrated Project Teams have developed robust business plans. Helicopter Engines Integrated Project Team as a 'Beacon' Integrated Project Team has used consultancy support to develop a strong business plan. The plan incorporates a 25 per cent hard target reduction in costs of ownership by 2005 and a stretch target of 50 per cent. Key aspects of the business strategy are: reviewing current stock holdings to develop improved provisioning models; improving asset management and generating better information systems; and developing new support arrangements.

2.23 Some Integrated Project Teams have delivered efficiency savings. The Helicopter Engines and Chinook teams have already made savings with further savings forecast.

- The Chinook Integrated Project Team has developed a close working relationship with the United States Army - the world's major Chinook operator. One benefit of this relationship is an innovative joint programme to develop a low maintenance rotor head, which, if successful, has a projected whole life cost saving of £49 million.
- The Helicopter Engines Integrated Project Team used consultants to conduct a physical audit of all their engines. This has given the team a reliable baseline upon which to plan future work. As a result of this audit, the team was able to identify a number of defunct engines still on its books and strike them off. This had the added benefit of reducing Resource Accounting and Budgeting charges. In addition, the audit gave the team better visibility of its inventory and allowed it to identify efficiencies in the repair and supply loop. Front line customers report that this action has led to a reduction in D states attributable to engine unavailability.
- Finance staff on the Avionics Integrated Project Team have recently produced work on reclaiming VAT payments for Contracted Out Services which, if applied across the Air environment, could produce savings of £21 million.

Innovative contracting

2.24 The Defence Logistics Organisation is committed at senior levels to transforming relations with industry and incentivising key suppliers to perform better. Much of this high level aim is being implemented by Integrated Project Team leaders, who are seeking to replace excessive numbers of contracts either with single contracts or reduced numbers. These new contracts are being designed as much broader packages that will reward effective performance. In the past manufacturers have not been incentivised to build in reliability in equipments.

- The Chinook Integrated Project Team has let a Direct Vendor Delivery contract for the provision of spares. This is a contract for the provision of a small, selected range of spares directly to the user. Results to date have been promising, prompting the possible extension of the range of application to other components. This enables the team to hold few stocks itself and thus cut its operating costs. It is also working actively towards a total support contract with Boeing, which would include data sharing arrangements. This arrangement is seen as the cutting edge of Equipment Support (Air)'s contractual work and its successful implementation will be a boon for those proposing the wider use of innovative industry relations.

- Another innovation in spares supply is the Spares Catalogue System introduced jointly with Westland Helicopters. This system, which is available on-line to the Defence Logistics Organisation at its Yeovilton site, provides an electronic catalogue of parts which are displayed with firm prices, lead-times and delivery options. Defence Logistics Organisation staff are able to place electronic orders which are transmitted automatically to Westland Helicopters' suppliers. The parts are delivered directly from the suppliers to the Department's packing and distribution agent. In this arrangement, Westland Helicopters' role as Design Authority is to manage the capability (capacity, stability and quality) of its supply base rather than process individual orders.

- In December 2000 the Sea King and Lynx Integrated Project Teams placed new repair and delivery contracts with Westland Helicopters covering the 'blade to blade' components of the respective aircraft. These contracts have firm prices, guaranteed turn round times, component guarantees and incentives to improve reliability. It also enables the Defence Logistics Organisation to monitor supplier performance.

- The Sea King Integrated Project Team and Westland Helicopters as prime contractor are developing the Sea King Integrated Operational Support project (SKIOS). The object is to deliver a total support solution to the various Sea King fleets. Designed to be implemented in stages from the end of 2002, the project should deliver reliable and accurate support for the Sea King user community, as well as cutting down the lengthy repair and re-provisioning times.

- Two examples of support innovation come from helicopter Integrated Project Teams within the Defence Procurement Agency: the Apache Special Repair Activity and the Integrated Merlin Operational Support project.

  a) The Special Repair Activity facility allows fourth line repair and overhaul of significant number of Apache Weapons System components to occur at the front line by locating a comprehensive industry facility within the boundaries of the front line unit. This allows a fast, direct exchange of these key components, maintaining their availability to a high state of readiness.

  b) The Integrated Merlin Operational Support (IMOS) initial business case is being compiled quickly because good data exists within a structured database. Similar in approach to SKIOS, it builds on experience gained from the Enhanced Health and Usage Diagnostic System and electronic technical publication techniques already developed. It is expected to promote continuous improvement of life cycle costs throughout the operational life of the Merlin helicopter weapons system.

- The Sea King, Merlin and Apache projects would also benefit the other helicopter fleets supported by the Defence Logistics Organisation and provide good examples of the beneficial cross-pollination of helicopter support ideas between the Defence Procurement Agency and the Defence Logistics Organisation. Both the Merlin and Sea King initiatives also consider the linkages between the training of front line units and support outputs as a key innovative element.

2.25 Contracting for repair is a key area where improvements must be made. Some Integrated Project Teams have made crucial first steps in this area. Modelling its work on a United States Navy project, the Avionics Integrated Project Team has let a new contract with Smiths Industries for the repair or replacement of proprietary Horizontal Situation Indicators, a crucial piece of navigational equipment. This replaces three separate contracts across the fixed wing and helicopter communities and guarantees a single firm price and availability. Previous shortages of these components had led to D states across the Air environment and initial feedback is that the new contract has largely eradicated these D states, leading to more serviceable helicopters.

2.26 Strategic partnering is another area where much good work is taking place. The Helicopter and Islander Integrated Project Team has taken advantage of the fact that it has small helicopter fleets based in single locations to develop innovative partnering arrangements, mostly on the Contractor Owned Military Registered principle. Whilst these arrangements do not yet apply to the larger established fleets, they are changing perceptions within both industry and the logistics community and could have a positive effect on future support arrangements.

Lessons can be learned from outside organisations

2.27 The Defence Logistics Organisation can learn lessons from international comparators and from private sector organisations. There are examples of timely and comprehensive management information, better sweating of assets and tauter contracting arrangements.

International comparators

2.28 The challenge of providing effective helicopter logistics support is not unique to the Defence Logistics Organisation. A recent Australian National Audit Office performance audit of the Department of Defence's Naval

Aviation Force revealed similar difficulties[1]. The audit found significant shortfalls in helicopter availability, leading to difficulties in meeting operational and training requirements. These shortfalls were attributed in large part to logistics issues, specifically inefficient inventory management systems, inaccurate data and a lack of challenging performance targets. The audit also found that there was scope to review and improve relations with industry and maintenance policy. The Australian National Audit Office made the following recommendations:

- The introduction of a broader and more challenging performance regime, linked to flying hours and operationally available aircraft.
- Enhancing inventory management controls in order to increase connectivity between ship and shore, provide systems for tracking, controlling and recording stocks across repair and stores boundaries and facilitate obsolete stock disposals.
- Reviewing maintenance policy and practices with a view to controlling costs and increasing aircraft availability.
- Increasing co-operation on the management of common aircraft parts and repairable items across the Australian forces as a whole.

2.29 The Rand Corporation[2] analysed methods of forecasting demand for stock and concluded that the use of a new algorithm to calculate inventory levels has produced immediate and significant gains in performance at little or no additional inventory cost for the United States Army. The algorithm enabled the Army to calculate demand history and make adjustments for mobility requirements and costs. By reducing the customer wait time, especially for critical items, the algorithm reduces the risk of stock shortages and gives greater flexibility in setting desired levels of stock which are appropriate to both customer demand and replenishment patterns. Since the algorithm was introduced, equipment availability has risen from 79 per cent to 86 per cent. This algorithm represents the kind of innovative provisioning arrangements which could do much to sweat existing assets in the Defence Logistics Organisation's helicopter support inventory.

Private sector timely and comprehensive management information

2.30 Management information in the Defence Logistics Organisation has been poor, and it will take some years before there is a fully converged system (paragraph 2.15). In contrast the private sector places considerable emphasis on the need for comprehensive and timely management information in order to drive their businesses. For example both British Airways and Bristow Helicopters Limited highlighted the resources they allocate to forecasting demand for spares. The Defence Logistics Organisation is improving its management records. One example is placing Lynx and Gazelle data on one system, facilitating overall fleet management.

2.31 We visited British Airways at its headquarters in Heathrow to discuss best practice in aviation logistics. British Airways Engineering as a whole controls around 320 aircraft of eight types, £400 million of materials assets and 7,500 staff at over 160 locations world wide. It supports fleet operations 24 hours a day, 365 days a year. British Airways has to deploy large numbers of aircraft from different fleets to a considerable number of airports. The comparisons with the Department, therefore, are numerous. Whilst the outputs are based on making profits, while maintaining the highest safety standards, rather than supporting military operations, the price of failure is extremely serious in both cases. Logistics failures for British Airways have an immediate impact on customer satisfaction and profitability. In order to reduce the occurrence of logistics failures, British Airways has established taut supply and repair systems and constantly sets targets to improve those systems. British Airways' key performance measure is a Technical Despatch Reliability rate. This provides a picture of how many aircraft leave on time. The target is 96 per cent and performance met or bettered this for the last year.

2.32 In order to support this performance, British Airways has established a number of systems, practices and targets which relate to spares provisioning, repair and overhaul and management information. As regards management information, British Airways is facing a similar situation to the Defence Logistics Organisation, in that it has to converge legacy information systems to achieve better efficiency. British Airways has recently invested £60 million in a commercial off the shelf product which will make the vast majority of its information systems interoperable. Even without this, however, the range of management information available is impressive. An inventory management tool facilitates asset tracking around the repair loop, assesses their condition and flags up re-provisioning orders when necessary. This and other systems enable British Airways to meet two other key targets. The first is a 97 per cent availability target for those spares designated 'critical' and the second is a 100 per cent availability target for those spares required for planned maintenance. As a result, few robberies occur and the vast majority of maintenance can be carried out without delays.

1 *'Naval Aviation Force'. Audit Report No.44, Australian National Audit Office 1999 (www.anao.gov.au)*
2 *'Improved Inventory Policy Contributes to Equipment Readiness', RAND Arroyo Centre, Army Research Division, RB-3026-A, 2001 (www.rand.org/publications/RB/RB3026/)*

More effective sweating of assets

2.33 Private sector companies operate with lower levels of spares and achieve considerably higher levels of availability. The Defence Logistics Organisation should seek to learn from industry best practice and benchmark helicopter logistics activities accordingly. It is clearly more realistic to benchmark industry best practice against certain parts of helicopter operations than against others. The Army Air Corps' 7 Regiment, for example, operates its helicopters in ways that are more similar to civilian schedules than ship-borne Lynx. The role of the Regiment is primarily liaison flying for both the Regular and Territorial Army in the UK and in support of overseas exercises. It is not normally involved in operations. Nonetheless, the private sector uses practices that would be applicable across the Department's helicopter fleets.

2.34 Whilst being a civilian operator, Bristow Helicopters Limited operates a number of different helicopter types, some in austere conditions, such as those serving oil rig platforms in the North Sea. There are, therefore, some similarities between Bristow Helicopters Limited and the Department. Bristow Helicopters Limited operates its helicopter fleets with a maximum 30 per cent of critical spares (engines, gearboxes, and rotables) and achieves availability of more than 90 per cent. The Department's figures for holding spares are significantly greater (the Department holds 2,100 helicopter engines for some 800 engine placements) but many of these spares are unserviceable and helicopters are grounded because of a lack of spares, resulting in lower availability and serviceability rates.

2.35 The Defence Helicopter Flying School at RAF Shawbury provides a benchmark for helicopter performance. The contractor, FB Heli Services (a joint venture between FRA Serco and Bristow Helicopters Limited), owns and operates the fleet, provides all logistics support and achieves more than 97 per cent serviceability. The 32 helicopters required for training activities every day are made available from a total fleet of only 35 with a monthly lost sortie rate of around 2 per cent. Although these helicopters are used on reasonably predictable schedules and flying patterns, their high serviceability levels provide the Department with an in-house example of what can be achieved.

2.36 The British Airways case illustrates how better management information is required for achieving business efficiencies through better use of assets. A full awareness of asset costs and tracking has enabled British Airways to optimise stockholding. It has also transferred stock holding risks to a number of suppliers. British Airways has therefore achieved reductions in logistics costs whilst improving performance (paragraphs 2.31 and 2.32)

Contracts which guarantee service outputs for key components and repairs

2.37 Private sector organisations have established arrangements with their contractors for 'power by the hour' contracts which guarantee service outputs for key components and repairs such as engines. For example Bristow Helicopters Limited has contracted for engine, main rotor head and gear box repair, guaranteeing service outputs. British Airways also outsources the provision of engines on a 'power by the hour' basis. However, the adoption of such an approach for military helicopters would require careful consideration, as 'power by the hour' necessitates greater control of operator maintenance policies by the manufacturer.

Appendix 1 Previous PAC Recommendations

Treasury Minute on the Eighth Report from the Committee of Public Accounts 1992-93 - Ministry of Defence: Helicopter Maintenance

This appendix details some of the Public Accounts Committee's previous recommendations on helicopter maintenance and the Government's responses, as well as an assessment of progress made since those responses.

PAC Conclusion	Treasury Minute	Progress
PAC conclusion (ii): ... each Service sets its own availability targets, using its own definitions of when an aircraft is "available" ... although some targets are achieved and others not, it is difficult to get a clear picture.	A single definition of availability for aircraft and equipments, based on Military Standard 1388, has been developed and is being considered for introduction across all three Services. Information Technology systems proposed for introduction will be capable of gathering data which will be transferable between the Services.	The establishment of the Defence Logistics Organisation and the Joint Helicopter Command has produced some progress in agreeing definitions of availability. Further development of Customer Supplier Agreements should aid this process. The Department's IT systems are not yet capable of gathering data which can be transferred across the services. (Para 1.11)
PAC conclusion (iii): ... greater consistency in the definition and measurement of availability within and between the Services would make comparisons of performance easier, and lead to a better assessment of the effectiveness of maintenance expenditure	The single definition of availability referred to above will provide consistent and accurate measurement of availability within and between the Services. However, there is a wide range of factors which must be taken into account when attempting to compare performance between the Services. For example, only one aircraft type (Gazelle) is common to all three Services but it is used in 10 different roles and comparison of performance between a united Kingdom training unit and an overseas operational unit cannot be based on availability alone.'	There is still a lack of consistency in the definitions and measurement of availability and comparison of performance therefore remains difficult. However, the establishment of Integrated Project Teams has promoted more effective maintenance expenditure, since all versions of each helicopter type are supported by the same Team. (Paras 1.16 - 1.20)

PAC Conclusion	Treasury Minute	Progress
PAC conclusion (xi): ... progress is being made in improving the cost and performance management information available ... But we remain concerned that despite significant investments in information technology, the Department still do not have sufficient reliable information to identify the full cost of helicopter maintenance.	The Department welcomes the Committee's acknowledgement of its progress to date. Reliable information relating to the full cost of aircraft and component repair and maintenance at the third line is now both available and in use. Additional information is also being gathered to assess the National Aircraft Repair Organisation's performance against the targets set for it as an Agency. At first and second lines, maintenance cost information will be provided in the Royal Navy by the Work Recording and Asset Management, the Logistics Support and Cost Management IT projects. Within the Royal Air Force, similar information will be provided through the introduction of systems within the Logistic Information Technology Strategy. The Statement of User Requirement, which is currently being drafted for the Army's future aircraft management IT system, will specify the need to collect first and second line maintenance cost information.	Single service IT systems are gradually being replaced by pan-logistics systems which should improve the performance management information. The implementation of Resource Accounting and Budgeting is helping the Department to identify the full cost of helicopter maintenance. (Paras 2.9 - 2.11)
PAC conclusion (xii): We recommend that the Department take steps to ensure greater consistency between the Services in the type and amount of data input to their information systems.	The Department fully accepts the need for consistency between the Services in terms of the type and amount of data input to their information systems. To this end, close liaison is being maintained between all three Services during the development of IT systems designed to meet both common and specific needs to ensure maximum consistency for relevant data. A study recently commissioned into the interface emphasis on interfacing and compatibility rather than integration and consolidation on the grounds that the latter is likely to be uneconomic and lead to delays. The formation of the Defence Helicopter Support Authority will offer scope for ensuring that there is greater consistency in the data input to the Services' IT systems.'	Since the formation of the Defence Helicopter Support Authority and, subsequently, the Defence Logistics Organisation, progress has been made in converging data. More remains to be done and the Defence Logistics Organisation is not yet able to interpret performance information or identify clear trends. Common IT systems are now being introduced for logistics management and these should have a beneficial effect on data consistency. (Para 1.14)

Appendix 2 Methodology

1 This appendix sets out the methodology for the study, covering our analysis of the delivery of logistics outputs and how these might be enhanced.

Analysis of helicopter availability

2 We analysed logistics performance in delivering available helicopters to customers. Our work illustrated a number of ways in which customers and logistics suppliers collect availability data. We therefore analysed what was meant by 'availability', and presented information on a consistent basis that would be recognised by customers and the Defence Logistics Organisation. We examined the causes of shortfalls in availability through analysis of the reasons for D states (helicopters grounded because of a lack of spares) and robberies (equipments and spares taken from one helicopter to ensure another helicopter is serviceable).

Scope for improvement in logistics

3 Turning to the scope for identifying further improvements in logistics performance, we undertook a programme of visits to the main Integrated Project Teams for helicopter logistics, concentrating on the well established fleets - Chinook, Lynx, Puma/Gazelle, Sea King and also visiting the Avionics and Helicopter Engine teams. We reviewed business plans, the performance regime (hard and stretch targets and performance achievements) and the quality of information available to the team leaders. We also examined the challenges facing the teams in implementing new information systems whilst delivering day to day logistics services to customers and engendering a business culture.

4 In order to ensure that we had a customer perspective, we visited the customer organisations' headquarters and front line units operating Chinook, Lynx, Sea King and Gazelle helicopters.

The Process Map

5 As part of our work, we developed an overview of the helicopter logistics cycle in the form of a process map **(Figure 14)**. This helped to structure our subsequent analyses, and provided assurance that no critical areas were omitted from our investigations. It also assisted us in ensuring that improving logistics support would have a direct impact on the number of helicopters available for the front line. The map can be used to explain the relationship between different parts of the helicopter logistics cycle. We employed HVR Consulting Services Ltd as consultants to develop the process map.

6 The process map broadly illustrates the dependencies between spares reprovisioning, demand forecasting, usage rates and the activities of the various suppliers of logistics. The map uses influence diagram notation to depict the cause and effect relationships between variables. Influence diagram notation consists of an arrow, to show the direction of the influence (the variable at the tail of the arrow exerts an influence upon the variable at the head), with + and - signs to depict the sense of the influence. Thus a positive (+) influence implies that if the tail variable increased in value, then the head variable would also be expected to increase. A negative (-) influence suggests that if the tail variable increased in value, then the head variable would be expected to reduce. Chains of cause and effect can then be established by tracing influence between several variables.

7 The overall cycle of logistics management is depicted in the flow that may be traced around the perimeter of the map. This shows that flying hours, the key output of logistics, may fall short of the performance targets set by the front line users. These shortfalls require corrective actions to be taken by the Integrated Project Teams, resulting in contracts placed upon suppliers and manufacturers. New equipment and services are delivered to improve the availability of assets for operational use, hence improving operational readiness and increasing the output.

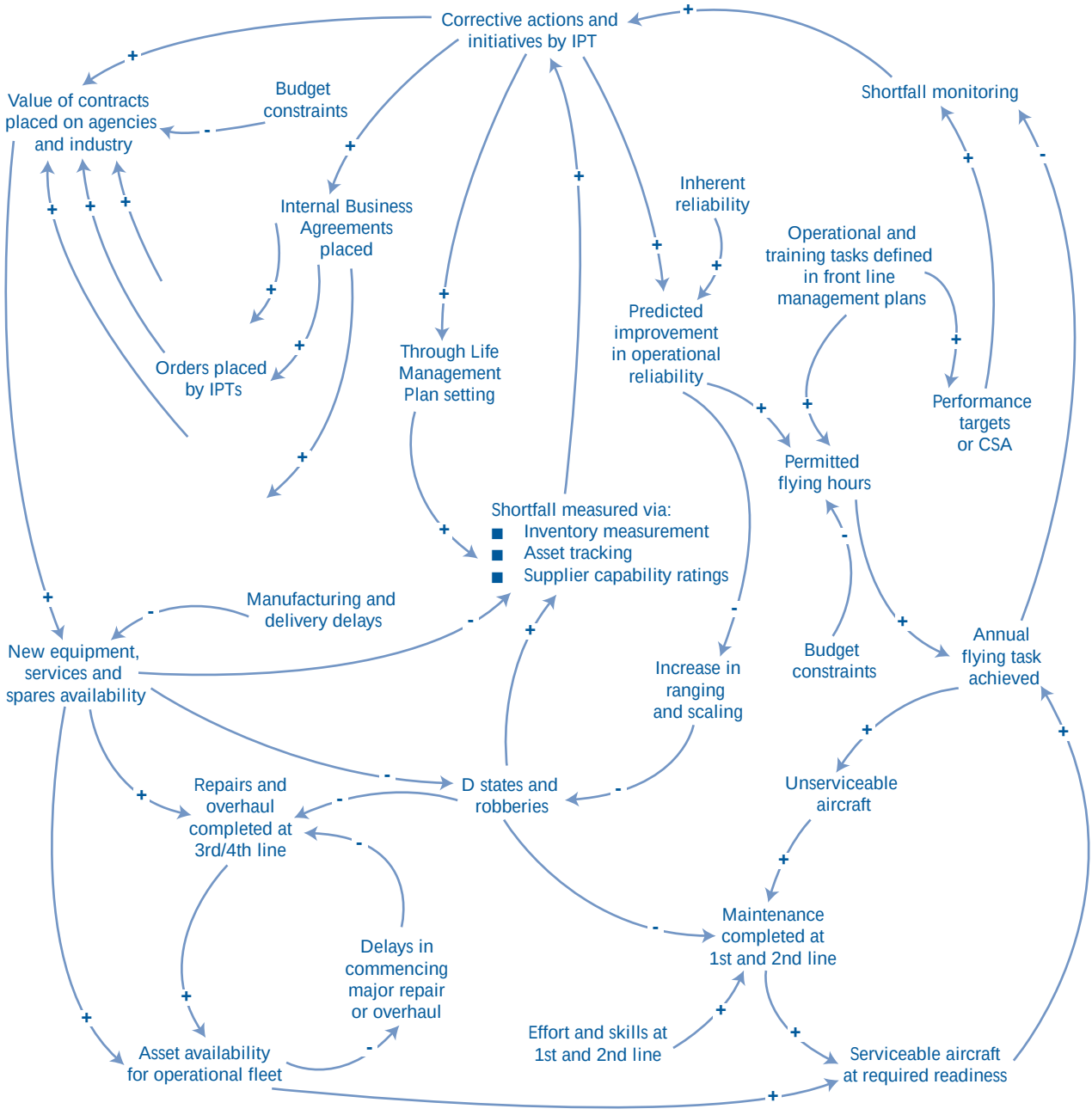
8 Within this outer loop a number of localised processes can be identified. Broadly, those associated with the user are to the right of the diagram. Across the top are the performance monitoring and supplier contract actions, with platform Integrated Project Teams as the focal point. To the left are the sources of supply. Delivery is across the bottom, with maintenance processes at 3rd/4th line and also 1st/2nd line, depicted in the lower half of the diagram.

9 Some broad messages are apparent from the diagram:

- Output is the result of a balance between four autonomous processes: major repair and overhaul processes at 3rd/4th line; 1st/2nd line maintenance; contracting arrangements and setting and monitoring of user targets.

14 Influence diagram for helicopter logistics management

The flow around the perimeter of the map links flying hours, the logistics output, to the performance regime, contractual arrangements and maintenance activities (see paragraphs 5 to 9 of this Appendix)



- Ranging and scaling of spares, spares supply and asset tracking to locate spares in the system are a key determinant of all these processes.
- A number of factors (inherent reliability of the equipment, manufacturing and delivery delays, effort and skill levels of 1st and 2nd line maintainers and overall budget constraints) are outside the direct control of the Integrated Project Team.
- Maintenance at 3rd/4th line can be increased directly by contract action with suppliers of these services and indirectly by contract actions to improve parts availability, reducing the spares robbing and D states.
- Maintenance at 1st/2nd line can be assisted indirectly by the spares provisioning process.

Comparators

10 We were keen to discover good practice examples of managing logistics in the private sector. In order to do so, we visited three companies: British Airways, Bristow Helicopters Limited and Fast Helicopters. We met management and engineering staff in all three companies and discussed their management information, spares provisioning practices and relations with suppliers. We also undertook a literature search of other countries' National Audit Offices and research bodies to provide an international perspective.

Expert panel

11 We established an expert panel to review our work. The panel included representatives from the Department and two consultants, Dr Jezdimir Knezevic of MIRCE Akademy (Management of Industrial Reliability, Cost and Effectiveness, Devon) and Keith Milk of HVR Consulting Services Ltd.