National Audit Office

Ministry of Defence

Managing the defence inventory

Methodology

JUNE 2012

Methodology

1 This document accompanies *Ministry of Defence: Managing the defence inventory,* a report published by the Comptroller and Auditor General in June 2012. It adds further details to the description of the methodology included in the main report in Appendix One.

2 The report examines the Ministry of Defence's (the Department's) approach to managing the defence inventory. Our examination included looking at the armed forces and Defence Equipment and Support, the body which procures equipment and inventory for the armed forces. Our report considers the current position, how the Department is managing the inventory and what it is doing to improve inventory management. The scope of the report covers both non-explosive and explosive items. It does not include items managed on IT systems for the nuclear weapons inventory or loan items and war reserve.[1] Our fieldwork took place between July 2011 and November 2011.

3 We used well understood principles of inventory management practices[2] within the business community to manage stock to help us form our value-for-money conclusion. The objective of inventory management is to minimise the risk of having insufficient stock while also minimising the costs of holding stocks, and reducing the amount of money tied up in stock holdings. At its simplest, any inventory management system consists of six stages:

- **Plan** Identify the right type and level of inventory that meets customers' requirements (ongoing and future) most economically.
- **Purchase** Purchase the right items to meet planned inventory levels at an optimum price.
- **Store** Receive, store, maintain and issue inventory.
- **Use** Make requests in a timely manner and use the right types and levels of inventory.
- **Return/Repair** Identify and promptly return inventory that is not needed to stores or if in need of repair, out to the repair facilities (which may be external) and back again.
- **Dispose** Identify promptly any surplus or damaged inventory and then dispose of it, by selling or destroying it.

4 Professional industry management practice supports these stages by employing staff with the appropriate skills and experience and by having timely, coherent performance and financial management information.

1 The war reserve has been built up to meet the increase in military demands following the outbreak of a war.
2 Council of Supply Chain Management Professionals, 2010. *Suggested Minimum Supply Chain Benchmarking Standards,*

5 The main elements of the methodology used during the course of this study were:

- Inventory management good practice comparators
- Semi-structured interviews
- Document Review
- Inventory Data Analysis
- Financial Analysis
- Case Study Analysis
- Site Visits

6 We also used a best practice panel of expert partners to assist us with quality assurance when formulating our findings and conclusions for the report.

Inventory management good practice comparators

Good Practice from Literature Review

7 We carried out a literature review to identify professional standards for inventory management. We mapped these against the Department's policy on inventory management to assess whether the Department's policy reflected those professional standards. The publications we reviewed included:

- Council of Supply Chain Management Professionals (2010) *Suggested Minimum Supply Chain Benchmarking Standards.* Web publication at http://cscmp.org/resources/standards.asp
- Tony Wild (2002) *Best Practice in Inventory Management (second edition).*
- Harrison, A. and van Hoek, R. (2011) *Logistics Management & Strategy* (fourth edition).

Good practice examples within industry

8 We commissioned Deloitte to find examples of good practice used within organisations with supply chains in difficult environments or volatile demand. We used the findings to identify whether there were other areas that the Department could improve in. Deloitte examined 9 organisations including:

- disaster relief agencies such as the World Food Programme, Salvation Army (UK and International units) and Tearfund;
- European providers of health services, logistics and automotives; and
- global provider of medical equipment.

9 We also directly interviewed Toyota Motor Europe and BAE Systems to identify further examples of good practice.

Semi-structured interviews

Interview with Department's staff in inventory management roles

10 We conducted over 50 semi-structured interviews with staff who have roles in managing inventory in the Department, armed forces and in Defence Equipment and Support, the body within the Department responsible for procurement and support. We used the interviews to gain an in-depth understanding of:

- The planning of inventory requirements and inventory purchases;
- The storage and maintenance of inventory;
- The disposal of inventory;
- The information used by the Department and reported for managing inventory;
- The Department's policy on inventory and inventory management; and
- The Department's projects to improve its management.

Our interview questions were tailored according to role and seniority but would cover some or all of these topics. We used the evidence from the interviews to identify both key issues and good working practices and signpost our team to supporting data and documents.

Document review

11 We reviewed a range of documents provided by the Department and from our financial audit teams who audit the Department's annual accounts. The evidence from the documents was used to support the key findings from the interviews. We also used the documents on the improvement projects to assess whether they were addressing areas of weaknesses and whether there were significant risks to success. Key documents included:

- the Department's annual accounts for 2008-9, 2009-10 and 2010-11;
- strategy documents and business plans for the Department and teams within Defence Equipment and Support;
- Defence Equipment and Support management reports on inventory;
- inventory management plans at the working level;
- the Department's policy on inventory; and
- improvement project documentation on scope and progress.

We also reviewed previous National Audit Office and Committee of Public Accounts reports that reported on specific aspects of inventory management to further inform our findings.

- National Audit Office reports: *The use of information to manage the logistics supply chain*, HC 827, 2010-11, and *Progress in reducing stocks*, HC 898, 2001-02; and
- HC Committee of Public Account: *The use of information to manage the defence logistics supply chain*, Forty-third report of session 2010-12, HC 1202 and *Ministry of Defence: Progress in reducing stocks,* Thirteenth report of session 2002-03, HC 566.

Inventory data analysis

12 We analysed a range of inventory data that the Department holds on its inventory management systems. The purpose was to understand:

- trends in the inventory holdings by value, quantity, number of different types of inventory and volume and how this breaks down by category (explosive and non-explosive), by location (central depots and forward bases) and by condition;
- the reason for any particular changes in the trends identified;
- the time it would take for inventory to be used up based on past usage (stockturn);
- value of inventory with no usage recorded; and
- value of purchases made in 2010-11 for inventory items already in stock at the start of April 2010.

We also used the data to assist in selecting specific items for further analysis as part of our case studies.

13 With the exception of the total value, the Department does not bring together in any of its management information any summary information of the entire inventory that it holds. The Department provided data from over ten of its inventory systems. These systems included those used for managing inventory at central depots and by the army, navy and air force for inventory they hold in bases in the UK and across the world.

14 Our previous report in March 2011[3] found shortcomings in these systems including questionable data accuracy and information not being available. We have recognised in this report the constraints that it has placed on our analysis. For example, we have not been able to analyse:

- the volume of storage space occupied by its inventory because the Department has not fully populated its inventory systems with this data; or
- the trends from explosive inventory systems in central depots because the systems are real time and do not retain accessible data covering past periods; or
- data going back beyond March 2009, as information held on some of the systems used was not accurate or complete prior to this date.

15 We applied prices constant at March 2011 for the stockturn analysis and December 2011 for other trend analysis to remove the impact of inflation. Prices sourced from the inventory systems are exclusive of VAT. The VAT rates for individual types of inventory vary so that the relationship between VAT inclusive and exclusive figures not simply 20 per cent.

16 We also excluded the empty cartridges and shells that are the by-product of firing off ammunition. These items have no use and so are not considered as inventory but military units collect and record these empty cartridges and shells as they have potential scrap value.

17 The Department assigns a unique identifier to each different type of inventory. Our analysis on the number of different types counts the number of unique identifiers on the systems with stock held at the end of the month. We have excluded those types of items with no unique identifier for this analysis. These include items that have been bought locally at army bases but which are recorded on the Department's inventory management systems.

18 **Figure 1** sets out our analysis of the change in the value, quantity and number of types of item for inventory held by the armed forces and non-explosive inventory in central depots between the end of March 2009 and December 2011. This is graphically illustrated in Figure 2 of the Report.

19 We calculated the stockturn for each type of inventory by dividing the total number of items held at the end of March 2011 by the average annual number of items issued over the period between April 2009 and March 2011. We did not include items held at the end of March 2011, but not held at the start of April 2009, to avoid including new types of inventory items. New types of inventory will not have stable issue patterns and so the stockturn calculated would not be representative.

3 Comptroller and Auditor General, *Ministry of Defence: The use of information to manage the logistics supply chain,* Session 2010-11, HC 827, National Audit Office, March 2011.

Figure 1
Changes in the Department's inventory

	Value of inventory held (£ million)		Quantity of inventory held (million)		Types of inventory held (million)
	Central depot	Armed forces	Central depot	Armed forces	
March 09	8,899	8,318	117	105	0.88
June 09	8,980	8,480	118	99	0.88
September 09	9,012	8,539	114	107	0.88
December 09	9,174	8,589	117	106	0.87
March 10	9,261	8.820	118	117	0.93
June 10	9,479	8,969	120	121	0.93
September 10	9,599	9,107	115	124	0.92
December 10	9,800	9,374	113	120	0.92
March 11	9,642	9,525	108	123	0.91
June 11	9,590	9,932	107	126	0.92
September 11	9,657	9,981	105	124	0.92
December 11	9,679	9,759	103	120	0.91

NOTES
1 The analysis excludes data on explosives held by central depots.
2 All figures for values exclude VAT.

Source: National Audit Office analysis of data from Ministry of Defence inventory systems

20 We based our estimate of the value of inventory purchased in 2010-11, where stock was already held, on the value of items delivered to the central depots. This is because the Department does not centrally hold data on purchases for individual types of items. As items delivered to central depots includes items being returned, we used a number of indicators on the inventory management systems to identify those deliveries that were new purchases only. In the case of the navy central depot system, the key indicators were, through our analysis, found to be corrupted. We have therefore had to use secondary indicators to estimate which deliveries were new purchases.

Financial analysis

21 We investigated the cost to the Department of storing and managing inventory. As the Department cannot identify all relevant costs, we made an estimate from information we were able to obtain for costs incurred in 2010-11 for Defence Equipment and Support. We were not able to estimate the costs of storing and managing inventory by the armed forces for their stores as the financial systems do not hold the data in a way that would allow us to identify the costs of activities undertaken to manage inventory.

22 The following costs were taken from the Department's accounting systems to construct our costing for Defence Equipment and Support:

- the cost of holding inventory in central depots for explosives and non-explosives;
- the costs of the central support team within the Joint Support Chain operating centre; and
- the cost of disposal (which includes other activities such as disposal of equipment such as ships or vehicles and not just inventory).

These costs include staff costs, running costs and for the storage depots, the distribution costs within the UK. Costs from the Department's accounting systems are inclusive of VAT where it applies.

23 We have excluded accounting charges such as depreciation and write-offs in addition to interest and foreign exchanges gains or losses. The costs for security and estates management for the central depots are based on a Departmental estimate.

24 The cost of inventory managers in project staff is based on the number of staff in each grade and the average salary for that grade. This information was sourced from the Department's HR system and published pay scales.

25 We have not included the cost of the land and buildings used by the central depots. We estimate from the Department's recording of land and buildings that the value of the freehold land currently occupied by the central depots in the UK is £59 million and that the buildings would cost £1.4 billion to replace.

26 We used the accounting information held by our financial teams to report on the split of the gross and net values of inventory at 31 March 2011 and 31 December 2011 into the three accounting categories; raw material and consumables, capital spares and guided weapons, missiles and bombs. We also used financial data from Defence Equipment and Support to report on the value of inventory purchased and consumed in 2009-10 and 2010-11.

27 We analysed the storage costs communicated to project teams by Defence Equipment and Support against their total expenditure for 2010-11. This was for the ten project teams with the highest storage costs. We used this to assess whether, if storage costs were charged, they would be a noticeable proportion of total expenditure by a project team and influence their purchasing behaviours.

Case study analysis

28 There are over 80 project teams in the Department who plan and purchase inventory and own it until it is used or designated for disposal. Using our analysis of the inventory data and our review of documents, we selected six project teams to reflect the wide variety of inventory that the Department holds and visited them to discuss with their staff how they managed inventory. In selecting the teams we considered: explosives and non-explosives, rates of turnover, value of the equipment, and the number of items held.

29 For each project team we also selected up to six individual items for further analysis. The purpose of this analysis was to illustrate the factors that need to be considered in managing each and the reasons for its level of holding. We used the data analysed to assist in selecting these items, as we looked to reflect how some items could be issued many times in a month but others could have no issues for years. We therefore selected items based on the stockturn and also the number of months with items issued in the period of data between March 2009 and March 2011.

30 The project teams and items selected were:

- **Defence Clothing** – responsible for clothing for all three services. Items selected included shirts, fire resistant coveralls and long johns.
- **Maritime Equipment Support** – responsible for spare parts covering propulsion and steering systems for ships in service. Items selected included propellers for the Type 42 destroyer and fire extinguishers.
- **Fast Air Support** – responsible for fast jet aircraft including Typhoon and Tornado. We focused on Tornado and items selected included wing sections and fuel pipes in the engines.
- **Light Weapons, Photographic and Batteries** – responsible for weapons such as rifles and machine guns, camera equipment and batteries. Items selected included AA non-rechargeable batteries, 0.50 calibre machine gun and the SA80 rifle currently used by all three services.
- **Defence General Munitions** – responsible for many different types of ammunition for use with range of weapons such as rifles and tanks. Items selected included tracer rounds, armour piercing rounds and detonators.
- **Surface Attack Medium** – responsible for a number of missiles used by aircraft. We focused on the Brimstone missiles, designed to be used against vehicles.

31 For each of the six project teams we visited as case studies, we conducted semi-structured interviews with members of the project team involved in inventory management. Our questions were tailored to the individual project team's area of responsibility and the items of inventory selected for further analysis but all focused on inventory management. We also discussed the reasons for holding the levels of stock for those selected items.

32 We obtained and reviewed documents supporting the interviews, which included contracts and inventory plans. We also analysed data on the level of stock holdings, the forecasted demand quantities and issues over time for items where the data was available. We used the evidence from these case studies to help inform our understanding of the Department's approach to inventory management and illustrate our findings with specific examples.

Site visits

33 We visited a number of locations as part of our interviews. Most were held at the Defence Equipment and Support headquarters in Bristol or the Department's main office in London. We also visited the central storage depots at Bicester and Donnington in the UK, and Dulmen, in Germany, to see how inventory is physically stored, maintained and managed on a day to day basis. For a similar purpose, we visited RAF Marham, Portsmouth Naval Base and army bases in Wiltshire.

Good practice panel and expert advisors

34 We engaged an expert panel to review the preliminary findings of the report in October 2011. We used the panel to challenge our findings and identify any further issues from the evidence we presented. The panellists included an academic, a private sector practitioner and a consultant with defence inventory expertise. Two senior staff from the Department with responsibility for inventory management also attended to provide balance.

Design and Production by NAO Communications
DP Ref: 009820-002