Ministry of Defence

JSP 886
DEFENCE LOGISTIC SUPPORT CHAIN MANUAL

VOLUME 2
INVENTORY MANAGEMENT

PART 1
POLICY AND PROCESS FOR INVENTORY MANAGEMENT

THE MASTER VERSION OF JSP 886 IS PUBLISHED ON THE DEFENCE INTRANET.

FOR TECHNICAL REASONS, EXTERNAL LINKS ON THIS INTERNET VERSION HAVE BEEN REMOVED.

VERSION RECORD		
Version Number	**Version Date**	**Version Description**
2.3	09/12/09	Changes to Ownership and Points of Contact.
2.4	02/08/10	Addition of Chapter 11.
2.5	17/08/10	Chapter 11 Para 6b reference to MOD Form 2249.
2.6	02/02/12	Chapter 4 Para 6f. Signing Powers.
2.7	18 Jul 12	Chapter 2, Paras 21 and 22 and new Annex B: PT Arrangements for Silent / Out of Hours Release of Inventory Items.
2.8	15 Oct 12	Transfer old Chapter 8 to JSP886 Volume 3 Part 404 and addition of Chapter 11: Stock Segregation Policy

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CHAPTER 1: INTRODUCTION TO INVENTORY MANAGEMENT

1. This Chapter describes the end to end Inventory Management (IM) procedures necessary for Project Teams (PTs) to follow from the initial stages of planning and sourcing of requirements to the in-service support and management of inventory, culminating in eventual disposal of surplus materiel no longer required for MOD use. Recognising the stakeholder benefit of applying the 'one stop shop' approach, JSP 886 Volume 2: Inventory Management has been designed to provide ready access and authoritative reference to all aspects of policy and procedures governing the effective and efficient management of inventory across Defence.

2. One of the key recommendations from the Inventory Management Diagnostic Study, which was undertaken in 2007, is to implement clear IM policy and process ownership, together with the review and regeneration of authoritative IM policy. Clearer policy direction and corporate governance is particularly crucial in respect of innovative Contractor Logistic Support (CLS) solutions to ensure that wider Joint Supply Chain (JSC) coherence is factored into the design of support solutions from the earliest (Concept) stage through life.

3. Deputy Head Supply Chain Management - Supply Chain Optimisation (Dep Hd SCM-SCO) is responsible for IM policy and process and for ensuring the coherence of other policy and processes that affect the IM role. This document provides a fully integrated set of policy that fits seamlessly with the other processes that form part of the overall Acquisition Operating Framework (AOF), including the Logistics Coherence Information Architecture (LCIA).

DEFINITION

4. The IM Diagnostic Study, endorsed by the Joint Supply Chain Board (JSCB) and DE&S Board, defined IM as follows:

> ''IM comprises the management and control of the full range of processes involved in defining, maintaining and disposing of the totality of the Defence inventory at stockholding points and throughout the life of all equipment and projects in order to provide the required level of operational capability with the minimum necessary level of resources''.

INVENTORY MANAGEMENT POLICY AND PROCESS GUIDE

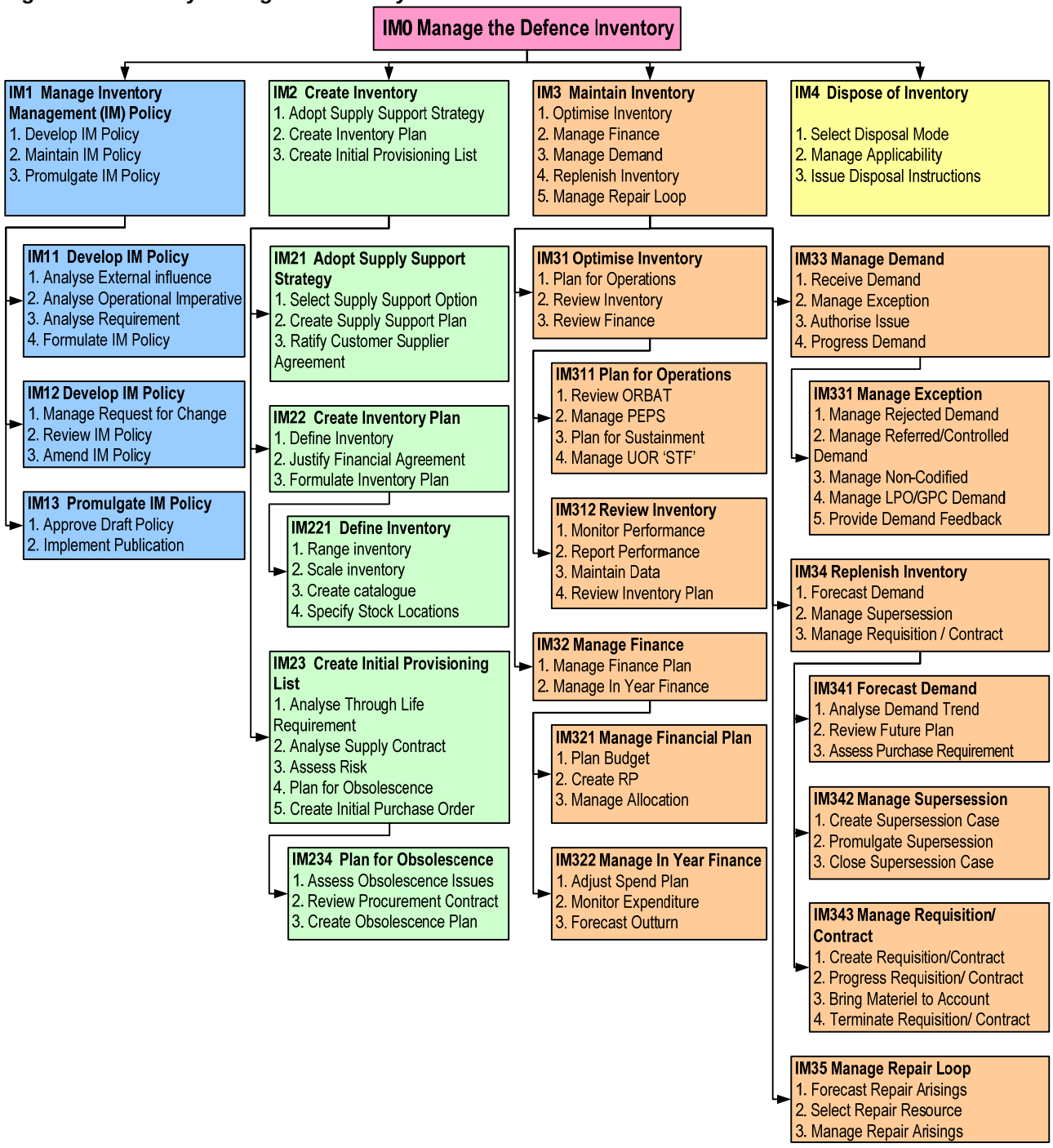
5. The policy and process guide at Figure 1 provides a top-level illustration of the constituent functions within the overall end to end IM process. It is supported by lower level work flow processes covering the inputs, value-added activities and outputs. The overarching principle is that the complete set of IM policy and processes will cover every IM function described in the guide. The guide is a living document which will be reviewed and updated regularly to maintain its currency and value.

APPLICATION

6. IM forms an essential part of all through-life platform, equipment and commodity support solutions delivered by PTs and other authorities, including Industry where the management of certain IM functions may be covered by CLS arrangements. To ensure effective, fit for purpose governance and overall JSC cohesion, compliance with JSP 886

IM policy and procedures is a mandatory requirement to be met by all PTs and other stakeholders, including suppliers within Industry.

Figure 1: Inventory Management Policy and Process Guide



OWNERSHIP AND POINTS OF CONTACT

7. The policy processes and procedures described in the Defence Logistics Support Chain Manual (JSP 886) are jointly owned by Director Joint Support Chain (D JSC). Head of Supply Chain Management (Hd SCM) is responsible for the management of JSC policy on behalf of D JSC. The sponsor for this policy is Dep Hd DES JSC SCM-SCPol.

a. Enquiries concerning the content should be made to the policy sponsor:

DES JSC SCM-SCPol-Convergence
Tel: Mil: 9679 81381, Civ: 030679 81381

b. Enquiries concerning the accessibility of this instruction should be addressed to:

DES JSC SCM-SCPol-Editorial Team
Tel: Mil: 9679 80954. Civ: 030679 80954

LINKED PUBLICATIONS

8. Further IM guidance is contained within the following publications:

a. JSP 462: Financial Management Policy Manual.

b. JSP 472: MOD Resource Accounting Policy Manual.

c. JSP 886 Volume 1 Part 2: Introduction to the Joint Supply Chain Blueprint.

d. JSP 886 Volume 2 Part 4: NATO Codification in the UK.

e. JSP 886 Volume 3 Part 2: Contractor Logistic Support.

f. JSP 886 Volume 3 Part 8: Reverse Supply Chain.

g. JSP 886 Volume 4: Materiel Accounting.

h. JSP 886 Volume 9: Disposal of Materiel.

i. Support Solutions Envelope (SSE).

j. Acquisition Operating Framework (AOF).

k. DEFSTAN 00-600: Integrated Logistics Support.

CHAPTER 2: KEY PRINCIPLES AND KEY ELEMENTS OF INVENTORY MANAGEMENT

PURPOSE

1. This Chapter provides a summary of the key aspects of IM policy and process as described in the Policy and Process Guide for IM by Project Teams (PTs) at Figure 1. The intent is to draw attention to the key stages and elements of IM, from the initial stages of planning and sourcing of requirements, through the in-service management phase, to eventual disposal of surplus materiel no longer required for MOD use.

SCOPE

2. This general policy guidance applies to all IM arrangements that are covered either directly by the MOD (PT) or by its suppliers in Industry under Contractor Logistic Support (CLS) arrangements. Policy for inventory aspects of CLS solutions is contained in Chapter 3, this is in addition to the Supply Chain aspects contained in JSP 886 Volume 3 Part 2: Contractor Logistic Support.

KEY PRINCIPLES OF DEFENCE INVENTORY MANAGEMENT

3. In order to manage the full range of Defence Inventory successfully IMs are required to adopt and apply the following four Key Principles as an essential contributor to effective and efficient Through Life Capability Management of platform, equipment and commodity support solutions:

a. **Plan for Success.** Effective and efficient inventory planning, which involves close engagement with the customer and other key stakeholders within the supply chain network(s) is a critical success factor. Demand forecasting must take into account not only current and previous demand rates but be capable of predicting future trends. The use of Sales and Operational Planning (S&OP)[1] or similar methodology (e.g Operational Support Planning) is vital to enable customer expectations and inventory affordability to be balanced with realism. Each PT is responsible through their Head of Inventory[2] for ensuring that a comprehensive Inventory Plan is developed and maintained through life in accordance with JSP 886 Volume 2, Part 2: PT Inventory Planning.

b. **Source for Success.** Effective and efficient sourcing and supplier management is a critical success factor for optimisation of inventory acquisition and it is vital to get this right from the very beginning of the CADMID process. Negotiation of **S**pecific; **M**easurable; **A**chievable; **R**ealistic; **T**ime (**SMART**) based objectives, key targets and performance measures covering inventory cost, availability and supply performance is an essential element of every platform, equipment and commodity support solution. It is the IM's direct responsibility to ensure that robust inventory

[1] S&OP is the set of business processes and technologies that enable an enterprise to respond effectively to demand and supply variability with insight into the optimal market deployment and most profitable supply chain mix. S&OP strategies help companies make "right timed" planning decisions for the best combination of products, customers, and markets to serve. *Source: Muzumdar and Fontanella, Supply Chain Management Review 4 September 2006.*

[2] The Head of Inventory for this purpose is the senior individual within the PT with responsibility for IM. Arrangements will vary between PTs and Clusters, but typically will be at about C1 or equivalent Service Rank. In cases of doubt the PTL is to give appropriate direction.

performance metrics are included in the Statement of Requirements (or 'requisition') for all contracts with suppliers[3].

c. **Manage for Success.** Effective and efficient through life management of inventory is a critical success factor for ensuring that the range and scale of inventory items is sufficiently lean and agile to meet the minimum military requirement specified within the platform, equipment and commodity support solution. It is the IM's direct responsibility to ensure that range[4], scale, value and availability of inventory is optimised through life in accordance with JSP 886 Volume 2, Part 2, Section 4.

d. **Deliver for Success.** Effective and efficient delivery of end to end inventory outputs and performance is a critical success factor for through life platform, equipment and commodity support solutions. In this respect delivery spans 'factory to foxhole and vice versa', and it is the direct responsibility of the IM to monitor and measure inventory cost and performance, rectifying shortfalls against target in conjunction with key stakeholders. It is the IM's direct responsibility to ensure that the through life performance of inventory is measured and managed in accordance with Chapter 6 of this document. The detailed policy and authoritative guidance contained elsewhere in JSP 886, Volume 2 underpins these four Key Principles.

KEY ELEMENTS OF DEFENCE INVENTORY MANAGEMENT POLICY

4. The **Inventory Management Policy and Process Guide** (Figure 1) provides an illustration of the end to end inventory functions that must be performed in order to achieve desired outcomes, objectives and performance targets. Each box in the process guide covers one of the many actions that need to be taken by IMs, either directly or in association with stakeholders. IM is a key component of the JSC, and in order to perform the role to the highest standards the IM must have the knowledge, skills and experience to balance financial, commercial, project management and operational factors, to ensure that the right item is in the right place at the right time (and at the right price and right quality).

5. Therefore this policy direction has been structured in four separate Sections, to deal with what can be complex subject areas as simply and clearly as possible, for the benefit of IMs and their suppliers and other stakeholders. All are required to understand and comply with this Defence policy without exception. A brief synopsis of the scope and contents of each is provided below.

Section 1: Managing Inventory Management Policy (IM1)

6. The need for inventory stems from the selected Support Solution to meet the capability / operational requirement as developed through the Integrated Logistics Support (ILS) methodology described in JSP 886 Volume 7: Integrated Logistic Support. Inventory is expensive in terms of both initial and through life costs, and Project approvals at all stages (Initial Gate (IG), Main Gate (MG) and Investment Approval Board (IAB)) must justify the need for this investment. The Inventory Plan, described in JSP 886 Volume 2 Part 2: PT Inventory Planning, is a key document in the approvals process to ensure that the (proposed) inventory is optimised through life to maximise availability and equipment sustainability within available financial resources. It is a living document and directly supports the financial Planning Round (PR), as it communicates the PT's justification for its inventory-financing requirement.

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[3] It is of course the Commercial Branch that takes the lead in negotiating the contract at tender stage.

[4] Ranging is a joint process involving the appropriate Technical / Engineering authority, Industry and SCS Inventory Optimisation staffs.

7. The selected Support Solution must adhere to the Governing Policies (GP) contained in the Support Solutions Envelope (SSE). The SSE mandates GPs and constraints that PTs must adhere to when developing a support solution. In the JSC's Key Support Area (KSA3) of the SSE these include IM and other supply chain requirements to ensure coherence and effectiveness of support to Operations. Conformance to the GPs (or an approved excursion) must be demonstrated as part of the Project approvals and assurance process.

8. Recognising that inventory availability (right item, right place, right time) is one of the critical success factors for a lean, agile and responsive JSC, inventory performance management is an integral element of the overall JSC Performance Management Board (JSC PMB) regime. The JSC PMB covers end to end JSC performance review, reporting up within DE&S to the 2* JSC Board, the 3* Chief Operating Officer (COO) Board and the 4* ECMB (Executive Committee of the DE&S Management Board) as part of the Directorate Corporate Approvals Performance & Risk (DCAPR) reporting process.

9. Management of IM policy must reflect related functional policy guidance owned by other specialism's, particularly commercial and finance in relation to acquisition and resource management of inventory.

Section 2: Create Inventory (IM2)

10. IM aspects of the overall ILS process are summarised in JSP 886 Volume 7, Part 5: Supply Support Procedures, and reflected in the Project's Through Life Management Plan (TLMP). An essential element of the TLMP is the Inventory Plan, which provides clear guidance on the factors to be considered in the creation of inventory. A crucial aspect is the range and scale of Initial Provisioning (IP). Faults made here, either procurement of too much or too little stock of the wrong items, cannot easily be corrected, and can seriously hinder the project for many years. The inventory scope is defined by Ranging, and the level of inventory quantified through Scaling. It is crucial that these are determined through an appropriate level of Inventory Analysis including Logistics Modelling, against credible and approved Operational scenarios and assumptions. The Sponsor and Customer must both be closely involved with this exercise. Particular attention must be given to the management of 'Repairables' and the Reverse Supply Chain, including the use of realistic Reverse Supply Chain Pipeline Times, JSP 886 Volume 3 Part 1: Standard Priority System refers. It is reiterated that the Inventory Plan is a living document and must be maintained through the life of the equipment.

11. It is MOD policy that all items managed in the JSC are codified; detailed policy and procedures are given at JSP 886 Volume 2 Part 4: NATO Codification in the United Kingdom.

12. The PT Inventory Plan must cover obsolescence from the very outset at the design stage and follow this through life. Managing obsolescence is primarily an engineering process but IMs must be closely involved, both to avoid procurement of obsolescent items and where unavoidable to consider life-of-type buys to cover to the out of service date of the platform or equipment concerned.

Section 3: Maintain Inventory (IM3)

13. The need to optimise inventory continues through life and PTs must keep this under constant review. Planning for Operations remains paramount and a close dialogue must be maintained with both Sponsor and Customer, the former particularly to keep the funded

availability under review. Inventory performance against the approved Performance Management for IM (PM4IM) objectives and key targets must be continually monitored as mandated in JSP 886 Volume 2 Part 2, Section 5. Since the introduction of DE&S Stock Accounting Collation System (DSACS) described at JSP 886 Volume 2 Part 6: Financial Accounting for Inventory, PTs have a single stock accounting management information system and can monitor and control the financial aspects of their inventory enabling reporting and adjustment in year. Proper financial management in this respect is not an 'overhead' but should be regarded as an enabler to effective management of the inventory.

14. In the ideal situation, demands from authorised customers are dealt with automatically without the intervention of PT inventory staff. However there is an unavoidable need for some demands to be referred to PT staff for action / authorisation, for example Controlled Items (previously known as Provision Bans or Referrals). The need to set such items is to be kept under continuous review, and in particular items so designated must be lifted as soon as the need has passed. To avoid artificially depressing immediate off the shelf availability demands referred to PTs must be dealt with expeditiously within 24 hours of receipt. Local monitoring must be undertaken to ensure that this target is achieved (or bettered).

15. The key task of the IM is to ensure proper stock management, particularly the Reprovisioning / procurement of Consumable items and the management of Repairable items. This task is covered in Chapter 4. The following points are emphasised:

a. It is ineffective to try to provide the same degree of attention to all items in the inventory, from complex assembly to simple nut, bolt or washer. PTs must therefore segment their inventory range to ensure that resources are focussed and prioritised accordingly. Advice and guidance on Inventory Segmentation is given in Chapter 9 Annex A.

b. Key to effective IM is the proper maintenance of data management and avoidance of erroneous or corrupt data. This task has hitherto attracted insufficient attention; much poor inventory performance in the past, leading to sub-optimal support to Operations, has been traced back to poor provisioning based upon corrupt or inaccurate basic data. PTs must carry out appropriate checks to ensure that this task is not neglected.

16. The PT IM has final responsibility for providing Supply Response, Demand Progression and where appropriate EQUIPSENT[5] information; this responsibility can not be delegated to contractors. The majority of responses can be either automated or provided by other agencies on behalf of the PT. This includes information on items provided against a CLS contract. Additional details on Supply Response, Demand Progression and EQUIPSENT requirements are contained in JSP 886 Volume 3, Part 1: Standard Priority System

17. **No Item Record Items.** The management of Not Item Record (NIR) demands (IM331) is at Annex A.

Section 4: Disposal of Inventory (IM4)

18. Disposal of surplus MOD owned spares and equipment is the responsibility of the Disposal Services Authority (DSA), whether in the form of open sales or part of

[5] Units making issues to RN and RAF units are to provide EQUIPSENT messages.

Government to Government sales (principally the support of ex RN warships and auxiliaries). Disposal must comply with legislation covering Health and Safety, Hazardous Waste and similar topics. Advice on disposals is contained in JSP 886 Volume 2 Part 404: Disposals of Inventory. Responsibility for deciding what is disposed, obtaining appropriate approval and initiating disposal action lies wholly with the IM, thereafter DSA is responsible for actual physical disposal by the most appropriate and cost effective means.

19. From the IM perspective, disposal is straightforward in respect of single-applicability items where the "last of class" equipment or platform is going out of service, but care must be taken to ensure that the financial aspects of disposal are properly addressed. Where either multi-applicability items are involved or equipment / platform populations are reducing over a period of time, a more complex calculation of disposal quantities is required, but as a matter of principle excessive stock should be disposed as soon as it is identified. The retention level of stock in these circumstances needs to be assessed taking account of both Out of Service Dates and the charge on capital for stock and likely storage overheads.

20. Even where equipment or platform populations are static, a regular (at least annually) surplus review is to be undertaken to ensure that excessive quantities of stock and / or assets are not building up, perhaps due to change of usage or other factors that the PT is unaware. Unexpected changes of usage identified by inventory staff should be brought to the attention of PT Technical staff, as it may be evidence of a departure from prescribed maintenance routines. Wherever excess stock is detected it should be subject to full investigation and, if appropriate, disposal action initiated.

PT ARRANGEMENTS FOR SILENT / OUT OF HOURS RELEASE OF INVENTORY ITEMS

21. The introduction of Single Item Ownership (SIO) policy at JSP 886, Volume 2, Part 3 has resulted in items previously managed on differing Base Inventory Systems (BIS) now being managed on a single system. Consequently, PT Inventory Managers (IM) may have transferred the management of items of their concern to alternative PTs. This may result in them being unfamiliar with the procedures for dealing with controlled item demands in the silent hours on the alternative BIS and how to make suitable arrangements for their processing.

22. Arrangements for the differing environments and BIS for out of hours support for inventory are therefore detailed at Annex B.

ANNEX A TO CHAPTER 2: MANAGEMENT OF NO ITEM RECORD (NIR) ITEMS

(Introduced at Paragraph 17)

Introduction

1. This annex deals with the procedures to be followed by PTs for managing demands for No Item Record (NIR) items. NIR is shorthand to indicate those items that are not managed on JSC LogIS and therefore the unit has to place demands 'manually' to a Customer Services location. NIR items can be:

a. Codified[6] but not mounted on the JSC LogIS.

b. Not codified but identifiable from Technical Documentation.

No Item Record Demands

2. Units that require an item where the NSN is not known or where the item has not been codified are to place a NIR demand in accordance with their local Supply Chain instructions. The demand will be routed through the JSC to the appropriate PT, initially the PT managing the equipment stated in the NIR demand, for action. The demand must contain the following information, as a minimum, for the PT to identify the item:

a. The Equipment designation and sub system details.

b. The Technical Documentation details, page, item number and item references.

c. Any details from the unfit item; Manufacturer's Part Number, etc.

d. Why the item is required. This is needed by the PT to assess the future support for the item.

Action by Inventory Manager

3. **NIR Demand Satisfaction.** The PT is to maintain a register of NIR demands, the action taken and the responses to the demanding unit. The Inventory Manager (IM) is to use the following procedures to determine the action required. The process is illustrated at Figure 2.

a. Has there been a demand for this NIR item before? If there has, then the reply to the previous request is to be reviewed and the same action, if still considered appropriate, should be taken.

b. The NIR item is to be identified and a technical investigation carried out by the IM and other relevant PT staff to determine if the NIR demand can be satisfied by:

(1) An existing item in the Defence Inventory. The PT is to inform the unit of the NSN of the item and demand procedures.

(2) If the NIR item is part of an equipment hierarchy, the PT is to determine whether the requirement can be met by higher or lower assemblies within the

[6] The MOD codification policy is that all Items of Supply procured by the MOD, which are to be demanded, managed or tracked, using JSC LogIS, are to be codified. Further detail is contained in JSP886 Volume 2 Part 4: NATO Codification in the United Kingdom.

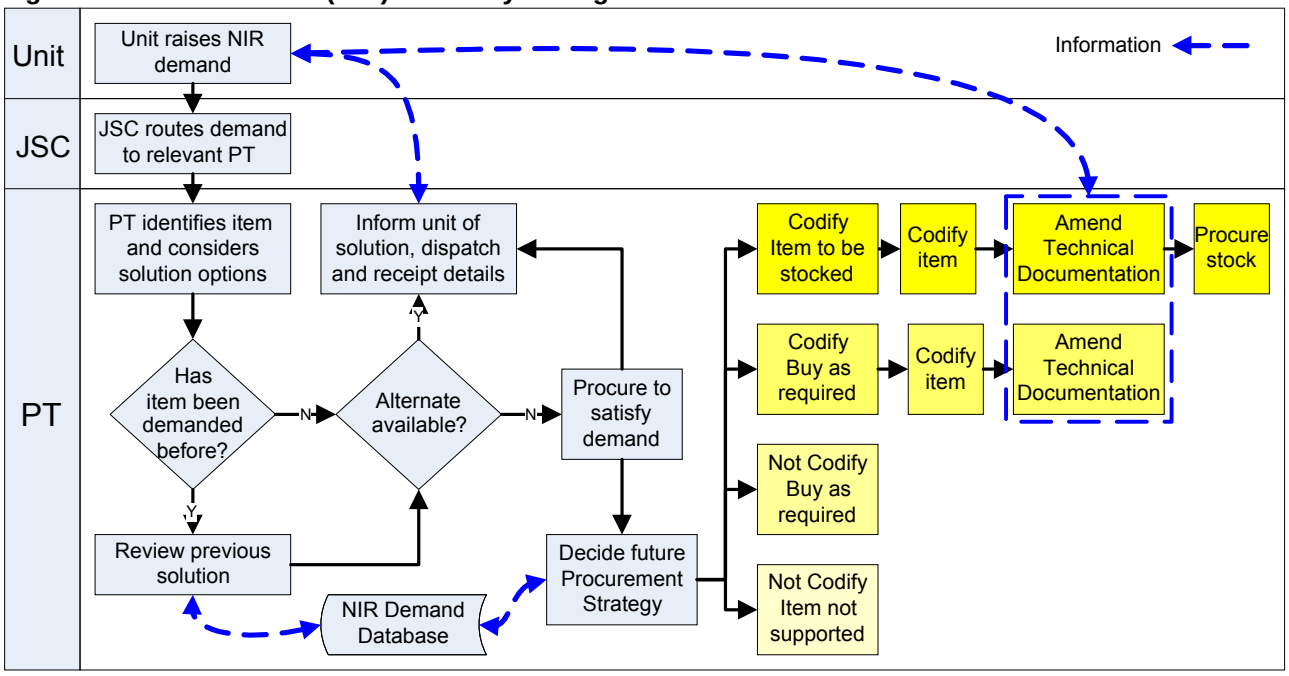
Defence Inventory. The unit is to be advised what item(s) to demand. The original demand is to be recorded in the NIR register.

(3) Availability from other equipments (see relevant cannibalisation policy), prototypes and other military sources; is to be determined. If the item is available then the IM is to initiate the acquisition, suitable packaging and dispatch of the item to the unit. If cannibalisation has taken place the procurement of a replacement item should be considered.

(4) Availability of the NIR item from industry. The priority is to satisfy the demand, if the item is not codified; its codification is to be considered after the demand has been satisfied.

4. **Demand Feedback.** The IM is responsible for providing demand feedback to the unit and where appropriate, the Chain of Command. The initial response is to match or be better than the Supply Chain Pipeline Time (SCPT) corresponding to the Standard Priority System (SPS) code of the demand. The demand feedback is to be updated regularly to give progress on satisfying the demand and is to include dispatch details. The PT is to advise the unit of the receipt action that the unit is to take.

Figure 2: No Item Record (NIR) Inventory Management Flowchart



Review of the NIR Demand

5. **Procurement Strategy.** After the resolution of the NIR demand, the IM is to conduct a review to determine the Procurement Strategy for the item, options are:

a. **Codify, item to be stocked.** A record for the NSN is created on the JSC LogIS. An initial buy of the item is initiated based on predicted usage and economic buy guidance.

b. **Codify, buy as required.** A record for the NSN is created on the JSC LogIS. No stock held.

c. **Not codify, buy as required.** This option should only be selected for irregular and infrequent requirements or when a parent equipment(s) are approaching its Out of Service Date (OSD) where the time and expense of amending the Technical Documentation and mounting the NSN on the JSC LogIS may be nugatory. The criteria used by an PT to justify the adoption of this option are to recorded in the NIR Register to allow the Inventory Management Continuous Improvement Team (IM CIT) scrutinise the decision.

d. **Not codify, item not supported.** Requirements to be met from higher or lower assemblies, cannibalisation, uneconomic repair or other alternative solutions.

6. **Codification.** The item is to be codified in accordance with JSP886 Volume 2 Part 4: Codification in the United Kingdom. All items supplied to resolve an NIR demand that are Hazardous, Classified RESTRICTED or above, are Accounting Class P or L, or may need to be backloaded in the future using the JSC LogIS are to be codified regardless of the Procurement Strategy for the item. PTs must be aware that all non-codified items returned by units, including Ships and RFAs, are likely to be disposed without reference to the PT regardless of hazard, classification, apparent utility, repairability, scarcity or value of the item.

7. **Technical Documentation.** The user has to be able to identify the NSNs of the items they require. This is only possible if the PT routinely amends the Technical Documentation to show the relevant repair task(s) and the relevant NSNs in the Illustrated Parts Catalogue (IPC). If the item is not equipment based then the IM should ensure that the PT has a method of 'advertising' the item so that users are made aware of the codified item. If the user is unable to identify the correct NSN they will have no alternative than to submit a NIR demand.

ANNEX B TO CHAPTER 2: OUT OF HOURS SUPPORT FOR INVENTORY

(Introduced at Paragraph 22)

Base Inventory System	**SCCS (Primarily Air Fixed Wing Items)**	**SCCS (Primarily Air Rotary Wing Items)**	**CRISP (Primarily Maritime Items)**	**SS3 (Primarily Land Items)**
Co-ord POC	DE&S, CST(Air) Enablers 1 SO2, Abbey Wood x71291	DES Hels-SCMST1, Yeovilton x 2345	FLEET-CAP LOG OPS FSCC PO, Northwood x 56171	Logistic Services Helpdesk – Team Leader – Bicester 94240 2052
Role Title	Abbey Wood Supply Duty Officer (AWSDO)	Yeovilton Supply Duty Officer (YSDO)	MOD Logistics Duty Officer (MLDO)	SS3 Duty Clerk
Depth of Cover	Processing only D or C states for Management Controlled items, deferring all other demands, plus inabilities and signals until the next working day.		Processing all IMMEDIATE or PRIORITY SPC requirements.	Priority 01, 02 and 05 demands received by signal or FAX
Method of Operating	The Duty Officer will complete duties using a designated mobile phone and can verbally release items through the LCS Helpdesk. They will work from Release Instructions provided by the PTs	This duty is combined with the Yeovilton Duty Officer, so it is carried out by service personnel with mobile phone and PT Release instructions. Items are authorised for release from LS depot and units.	Conducts CRISP issues out of hours as authorised by FOMO Needs to be called out to conduct issues on the CRISP Inventory System	Duty NCO actions above. If item has to be 'referred to provisioner', will contact Duty Provisioner. Also liaise with Reject Help Desk (RHD) and Rejected Demands Section (RDS) where appropriate
Overall out of hours period covered	1700 to 0800 weekdays. 1700 Fri to 0800 Mon weekends, and to 0800 the next working day for Bank Holidays		Mon to Thu: 1630 to 0730 1545 Fri to Mon 0730 All public and privilege holidays.	SPC 01 and 05 Weekends, holidays and the night hours SPC 02 Weekends and holidays
Role Contact Numbers	07881 518819	07768 007383	Portsmouth NB Mil: 23054 Civ: (023) 9272 3054 Mob: 07990 530508 Devonport NB Mil: 66061 Civ: 01752 286061 Mob 07899 067378 Clyde NB Mil: 6364 Civ: 01436 674321 6364 Mob: 07714 227531	Civ: 01869 256052 Mil: 94240 2052 Fax: 94240 2269 E-mail: DESDSDA-Bic-DOCShelpdesk@mod.uk
Process for managing PT Release Instructions update	POC coordinates 6-monthly update with PTs, but PTs can ask for items to be added, deleted or amended at any time		No PT Release Instruction as such. For urgent OPDEF demands, Duty Officer may release depending on reason for control, or seek advice from FOMO	
General Comments	Access to Log IS not required. Staffed by military and civilian volunteers	Access to Log IS not required. Staffed by service personnel		Documented at SSBP 17/06 Customer Services – Duty Clerk located on DSG website under Trove Documentation Web, Stores System Basic Procedures

CHAPTER 3: INVENTORY MANAGEMENT AS PART OF CONTRACTOR LOGISTIC SUPPORT

PURPOSE AND SCOPE

1. This Chapter focuses on the policy and associated process for effective IM within Contractor Logistic Support (CLS)[7] solutions. It should be read in conjunction with JSP 886 Volume 3 Part 2: Contractor Logistic Support which details the wider supply chain policy, processes and procedures within the overall context of CLS.

2. As part of the Defence Industrial Strategy (DIS) and the Defence Acquisition Change Programme (DACP), CLS type arrangements are becoming the preferred Through Life Management (TLM) support solution from the range of options illustrated within the Support Options Matrix (SOM)[8]. Under CLS the IM role transforms primarily from "Provider" to "Intelligent Decider" as the responsibility passes from the MOD to Industry to undertake traditional in-house functions.

3. This policy applies to all IMs who, in the Intelligent Decider role, are responsible for ensuring the effective through life management of inventory by suppliers contracted to manage CLS support solutions.

4. Further detailed guidance on CLS-related stock and materiel accounting matters, and in particular the key "on or off balance sheet" issue, is published in the Partnering Handbook by the MOD Partnering Support Group (PSG).

KEY PRINCIPLES IN RELATION TO CLS TYPE ARRANGEMENTS

5. CLS arrangements incentivise industry to deliver specified levels of equipment and system availability. On behalf of the Logistics Policy Working Group (LPWG), D Def Log Pol conducted a review of CLS[9] that highlighted the need to halt the adverse, cumulative effect of CLS support solutions failing to comply with support policy mandated within the Support Solutions Envelope (SSE), which includes elements of JSP 886. Whilst the entire CLS issue is much broader in scope than IM the review findings included a number of generic principles that are directly relevant.

6. In order to implement and maintain effective and efficient IM within all CLS solutions the following Key Principles are to be adopted:

a. **Inventory Requirements.** The Inventory Requirements expressed in terms of performance, time and cost, must be clearly specified within initial project / contract documentation, including the Master Data and Assumptions List (MDAL) and Statement of Requirement (SOR). This documentation must be reviewed regularly to reflect changes in operational tempo and consequent changes in support requirements.

b. **Roles and Responsibilities.** Respective Project Team (PT) and supplier roles and responsibilities for IM must be clearly stated to ensure that all of the functions

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[7] CLS is defined as "The methodology by which responsibility for provision of an agreed level of support is transferred to an industry provider. CLS can cover a wide spectrum of industry involvement ranging from minimal transferral under traditional product based support solutions to maximum transfer of responsibility to a Contractor"

[8] The location and ownership of the SOM is in flux. Ownership is currently vested in ESCIT but there is an intention to pass responsibility to DES SETLS-PC in the future.

[9] CLS Sub Working Group Report dated Jan 08.

within the end to end process are covered from both an intelligent decider (PT) and service provider (Industry) perspective.

c. **Governance.** The PT intelligent decider role covers not only a governance function but also close involvement in the co-ordination of output delivery, including a robust contractor monitoring and supplier performance management regime.

d. **Flexibility.** All CLS arrangements must seek to promote flexibility and make change easy and cost effective. It is not always easy to avoid being tied into fixed arrangements but gain share mechanisms can be built in to promote behaviour that will allow the contract to adapt to changing requirements.

e. **Visibility.** CLS arrangements must promote our ability to retain full visibility of the Supply Chain so that all parties can exercise a level of intelligence in a spirit of open partnership. The concept of "hole in the wall", where the MOD may have no interest in what happens on the Industry side of the wall constrains our ability to perform the role of intelligent customer.

f. **Joint Supply Chain Synchronisation.** CLS must promote rather than undermine the synchronisation of the JSC and be able to adapt to evolving technical and support arrangements. Arrangements must address the wider needs of the whole JSC rather than be exclusively tailored to single system solutions.

g. **Management Information.** CLS contracts must include a clear statement of the Management Information (MI) required for effective IM, including demarcation of roles and responsibilities for maintaining / updating and providing MI. Closely allied to this is the need to specify the requirement for a seamless interface between Information Systems (IS) used by Industry and MOD to ensure compatibility and coherence, to facilitate two-way exchange of data and MI throughout the E2E JSC.

h. **Standard Priority System.** CLS contracts must reflect a full and clear understanding of the Forward and Reverse Supply Chain processes to ensure that demands for inventory reflect the timelines covered within the Standard Priority System (SPS) for world-wide, operational and non-operational demands. In order to achieve effective and efficient management of the end to end repair loop stretching from the Front Line Command (FLC) holding unit back to Industry, it is imperative that inventory demands are subject to best practice Sales and Operational Planning (S&OP)[1] techniques, to optimise the Supply Chain through time compression, forecasting and accurate assessment of realistic repair and return lead times for all unserviceable equipment.

i. **Stock Accounting.** The respective PT and Industry roles and responsibilities for stock accounting must be clearly specified from the outset to satisfy Government (National Audit Office (NAO)) audit requirements. The degree of PT involvement will vary significantly, depending upon whether the overall CLS solution is to be managed on or off the DE&S Balance Sheet.

KEY POLICY OBJECTIVES

7. The above key principles must be reflected in the IM objectives, plans and performance management requirements enshrined within the overall CLS contract. The scope and coverage of each objective, which represents the minimum military requirement

and is therefore not intended to be prescriptive, is covered in detail below, for use by IMs to optimise the through life management of inventory within CLS solutions.

STATEMENT OF REQUIREMENT / PLANNING ASSUMPTIONS

8. IMs must ensure that the MDAL, SOR and associated contract documentation fully covers all IM functions, performance objectives and targets to reflect JSP 886 policy and ensure SSE compliance as part of overall end to end JSC coherence. A detailed reference and checklist of examples of the key elements for inclusion is at Annex A. It is crucial that those setting the requirement have a sound understanding of the Operational Requirement of the platform / equipment / commodity to be able to articulate properly the risks associated with provisioning, as reflected in the performance metrics.

THE INVENTORY PLAN

9. The IM must ensure that the CLS arrangement covers the policy requirement to develop and maintain effective and efficient inventory planning throughout the life of the support solution. Full details of the Inventory Plan policy are at JSP 886 Volume 2 Part 2: PT Inventory Planning. The CLS contractor must demonstrate the capability to meet the policy standards set out in JSP 886.

MATERIEL ACCOUNTING

10. Materiel Accounting policy and procedural requirements are detailed in JSP 886 Volume 4: Materiel Accounting. These must be followed or the lack of a disciplined and well informed joint approach by the PT and its CLS contractor will potentially affect operational capability and attract adverse comment and criticism from the NAO.

DATA STANDARDS / QUALITY

11. The IM must ensure that the CLS arrangement clarifies and specifies the data standards to be maintained in accordance with those being developed by DES SCS-Progs[10]. This aspect of IM business represents a significant risk if data standards are not monitored regularly. PTs must have data cleansing and updating processes in place to prevent sub optimisation of the quality of provisioning, demand forecasting and supply management arrangements due to inaccurate data and management information.

SUPPLIER PERFORMANCE MANAGEMENT

12. The IM must ensure that the CLS contract specifies the performance management arrangements in terms of performance metrics that reflect Specific Measurable Achievable Realistic Timely (SMART) objectives as detailed in Chapter 5: Supplier Management. Based upon lessons identified from earlier CLS contracts a template / framework of CLS performance metrics is included at Annex B for information and reference purposes. This template reflects the minimum recommended requirement in all cases.

[10] DES SCS-Progs-Data-Management-Team, in conjunction with ACDS (Log Ops) Log Info Data Management, is developing guidance for inclusion in JSP 886 on Data Management and Data Quality.

ANNEX A TO CHAPTER 3: STATEMENT OF INVENTORY RELATED REQUIREMENTS

(Introduced at Paragraph 8)

Maintenance of an Inventory Plan

1. The requirement for the Contractor to maintain an Inventory Plan (JSP 886 Volume 2 Part 2, Section 5, Paragraph 12) must itself be included in the Statement of Requirement (SOR). The requirement exists even for 'Off Balance Sheet' solutions both as a matter of prudence and good governance and to demonstrate to the satisfaction of the PT that the contractor does indeed have a viable and deliverable inventory strategy.

Supply Chain Assurance

2. The SOR needs to be compliant with support policy mandated within the SSE, which includes elements of JSP 886, particularly Key Support Area (KSA) 3 Joint Supply Chain (JSC), to maintain and develop JSC coherence. Additionally, there needs to be a mechanism to ensure that any variations developed during the life of the contract remain compliant. Particular emphasis needs to be given to adherence to the 'Contractor Time' element of the Supply Chain Pipeline Time tables contained in JSP 886 Volume 3 Part 1: Standard Priority System (SPS) including the Reverse Supply Chain (RSC) and end to end repair loop.

Ranging & Scaling (R&S)

3. The need for the contractor to agree the range and scale of spares to be held forward, including how changes during the duration of the contract will be managed to reflect both experience of actual usage and changes in the operational requirement, equipment fit etc. R&S data for stock held forward has to be included in standard MOD systems and documentation, to ensure transparency to the operational user.

Inventory Optimisation

4. The Optimised Support Planning ('OSP') Output Management role to deliver agreed performance using the optimum mix of technical solution, Front Line Command (FLC) manpower, maintainer / operator training, R&S of spares and inventory spend. This task has to be performed by MOD as it includes the balancing of inventory spend (whether at MOD or Contractor expense) against other solutions at MOD expense, including FLC manpower.

Supply Systems AND Procedures

5. Agreement to the mechanism to manage changes and developments to the supply system and procedures to ensure arrangements work effectively from both the MOD and the contractor's perspective. The reality is that there are always evolving developments in the supply system and other initiatives that will impact on the CLS contract, including those as a result of changes to operational requirements.

Data Management

6. Need to specify the Contractor's responsibility, covering not only requirements directly in support of the CLS task but any others required by MOD and that the CLS contractor is to provide. In essence, if the particular task is not to be retained in house it must be specified in the SOR in sufficient detail as a Contractor responsibility.

Interface with the Joint Supply Chain / Purple Gate

7. Need to specify the arrangements for the interface between the Contractor and the (physical) JSC described in JSP 886 Volume 3 Part 3: Purple Gate. As well as procedures for routine supplies this includes liaison for priority / critical supplies and otherwise on an exception basis; out of hours responsibilities of both parties need to be defined. Arrangements must include the need for the Contractor to forewarn of late delivery to either the JSC and / or to the end customer if (exceptionally) using a bespoke arrangement.

Stock Accounting (On Balance Sheet Only)

8. Arrangements need to be specified for stock accounting adherence and reporting, and for authorising of equipment loans / task issues. The PT needs an assurance that MOD owned assets are properly managed and reported and there is audit assurance. The Statement of Requirement (SOR) also needs to address provision of appropriate instruction and training for the Contractor.

Supplier Performance Management

9. Supplier Performance Management is defined in detail in Annex B.

ANNEX B TO CHAPTER 3: CLS PERFORMANCE METRICS RELATED TO INVENTORY

(Introduced at Paragraph 12)

Introduction

1. Inventory performance metrics form part of the overall CLS performance management approach to ensure that the ultimate output – platform, equipment or commodity availability / capability provided by Industry to Defence – is measured in terms of performance, time and cost. Lessons identified from previous CLS contracts indicate that during the process of transformation from traditional to CLS arrangements there is a risk that inventory ("spares") is deemed to be a subordinate or intermediate output that will no longer concern the PT now looking at the bigger picture of output-based availability / capability.

2. There is thus a danger that the detailed business requirements and implications of IM are considered to be more a matter for the CLS contractor than the PT. This is a dangerous fallacy, bearing in mind that while it may be feasible to transfer elements or all aspects of financial risk this is not the case for operational risk – the responsibility remains with the PT and ultimately the FLC, dependent upon equipment support to maintain operational capability.

Inventory Performance – An Integral Part to Play

3. Comprehensive performance management of inventory is equally if not more important for CLS solutions than traditional support arrangements. Performance management for IM (PM4IM) metrics must form an integral part of the overall CLS performance management regime. There is a danger however in being over prescriptive, and room must be left for manoeuvre at PT / Cluster / Industry sector level. Key Performance Indicators (KPI) for CLS contracts typically measure equipment or platform availability, flying hours, track miles or similar, and unless the contract is to specifically manage logistics functions it is not usually appropriate to include inventory measures as KPIs.

4. However it is essential to establish lower level Performance Indicators (PIs) to measure inventory performance, noting that this can be an advance indicator of impending drop in platform or equipment availability – or of promised improvement. The different stakeholders (PT, Corporate DE&S and PJHQ / FLC) each have a different view of the inventory related management information (MI) required of CLS arrangements, and for clarity these are summarised in Figure 3. These requirements inform the needs for MI specified in Figure 4, although tempered by the need to avoid an over complex reporting regime. It is important to strive for a single version of the truth, with common MI shared by the Contractor and MOD and accessible to all including the FLC / user.

5. In order to achieve the output target the CLS contractor will typically be required to co-ordinate the provision of skilled people (the maintenance / repair agent), available infrastructure (maintenance / repair facilities) and available spares or replacement equipments. In principle it is as simple as that, in practice it becomes more complex due to the chain of dependencies, interfaces and networks required to bring all of this together in an effective, efficient and value for money (VFM) support solutions package.

Figure 3: Management Information for CLS

	PT VIEW		DE&S VIEW
ON PT	**ON FLC**	**ON INDUSTRY**	**ON PT**
Does the Inventory meet the needs of current operations and FE@R?	Does the FLC correctly place demands and manage Inventory held forward?	Does Industry properly manage their supply chain?	Does the investment in the Inventory deliver value for money?
Responsiveness of Inventory to demands for Stock from Ops Op Days lost for spares Off Shelf Satisfaction Rate (deployed stock) Immediate Satisfaction Rate Customer Wait Time (CWT) Responsiveness to RDDs Responsiveness of Inventory to demands for Stock from FE@R Op days lost for spares Off Shelf Satisfaction Rate Immediate Satisfaction Rate Customer Wait Time (CWT) Responsiveness to RDDs Readiness for future Ops DSP / PEP fill rates (non-deployed) Validity of current scaling Cost to FLC of shortfalls Cannibalisation costs Backlog of Demands Dues Out	Demands Cancelled demand rate RDD profile Stock Held Value of Damaged or Written off Stock Returns Unserviceable Asset Return Times	Adequacy of Industry Inventory Plan Sub-contractor performance monitoring Supply chain risk management	Does Inventory planning match Defence Planning Assumptions (DPAs)? Value of Inventory Stock Turn Ratio for major segments Runners Repeaters Strangers IP Stock Repairables Working Asset Level (WAL) (months) Ratio of Repair Loop to In Use.

6. The third component (available spares and / or replacement equipment) of the support solution is IM business that must be integrated with the other two components to achieve success. Great care needs to be taken to ensure that both KPIs and lower level PIs are well chosen to ensure that they do not drive perverse behaviour by either party that might distort this balance of resources. PM4IM metrics for CLS must form an integral part of the DE&S Performance Management strategy and process.

7. Under the terms of the DE&S Service Delivery Agreement, Chief of Defence Materiel (CDM) is required to manage the performance of the TLB. A number of KPIs and Business Performance Indicators (BPIs) have been developed to satisfy CDM's management of performance remit against which performance is reported to the DE&S Management Board (which considers performance and risk). The DE&S Main Board sets the levels of performance required and therefore receives the outcome of Management Board deliberations, including any issues escalated for consideration. In addition, DE&S provides discrete performance and risk data to a number of external stakeholders (e.g Defence Management Board (DMB), HM Treasury for Public Service Agreement targets).

8. Therefore the PM4IM policy covering CLS solutions has been written to dovetail with the requirements specified in the DE&S Performance Management Handbook sponsored by Director Corporate Approvals, Performance & Risk (DCAPR) and within DE&S Standing Instruction No 2 (Performance & Risk Management), whilst recognising the need not to be over prescriptive. The PM4IM metrics for CLS solutions are a sub-set of those defined for "in house" managed support solutions defined in the Inventory Plan, (see JSP 886 Volume 2 Part 2, Annex B).

PM4IM Metrics Required for CLS Solutions

9. The PM4IM metrics that must be specified within CLS solutions to ensure that the DE&S fully discharges its intelligent decider role and responsibilities within the contractual relationship with Industry are listed at Figure 4. This is designed to ensure provision of the required levels of platform, equipment or commodity availability / capability measured in terms of performance, time and cost within the CLS contract.

Figure 4: Performance Indicators

Serial	Performance Indicator
1	Platform / equipment available days lost due to lack of spares (days).
2	First demand availability of spares – off-the-shelf fill rate broken down between repairable inventory and consumable items (See Note 1).
3	Spares delivered to customer by Required Delivery Date (RDD) .
4	Number of Dues-Out / Back Orders (cumulative).
5	Repair Pools – proportion of equipment serviceable.
6	Stock Turnover Performance (stock / issue ratios for Repairables and consumables.
7	MOD manpower hours used on cannibalisation for spares (See Note 2).
Notes: 1. PTs may wish to break this down further between Depth (UK Base) and Forward. 2. This is not a true measure of output but a critical balancing measure; to expose and / or manage the extent that cannibalisation may be hiding poor spares performance.	

10. The metrics feature a conventional approach to the assessment of the state / status of performance based upon a DE&S approved standard of four colours; Red, Amber, Yellow, Green. The PM4IM metric specifies the colour rating according to levels of performance achieved against target. Note that Blue (over achievement) is not to be used to ensure that the DE&S approach remains consistent with the DMB assessment regime. An illustration of the PM4IM metric and associated colour codes is provided at Figure 5.

Figure 5: PM4IM Metric

GREEN	> 98% of Outputs achieving Green and remainder all Yellow
YELLOW	96% – 97.9% of Outputs achieving Green or Yellow and remainder all Amber.
AMBER	92% – 95.9% of Outputs achieving Green, Yellow or Amber.
RED	< 92% of Outputs achieving Green, Yellow or Amber.
Degree of accuracy: 0.1%	

Figure 6: Summary of Performance

Year	08 / 09	09 / 10	10 / 11	11 / 12
Target	>98%	TBD	TBD	TBD
Performance	-	-	-	-

CHAPTER 4: REPROVISIONING POLICY

PURPOSE

1. This chapter covers all aspects of Reprovisioning policy for effective and efficient through life IM as a key element of platform, equipment and commodity support solutions. Reprovisioning is the process of using data on spares usage and notified fleet activity to predict the range and quantity of items to be procured to meet equipment availability targets.

SCOPE

2. This Reprovisioning policy applies to all IM arrangements covered either directly by the MOD Project Team (PT) or by its suppliers in Industry under Contractor Logistic Support (CLS) arrangements.

GOVERNANCE

3. Overall authority for governance of inventory reprovisioning methodology, including computer-based algorithms, parameters and off-line Reprovisioning tools, is vested in DG Joint Supply Chain (DG JSC) in the role of end to end JSC policy / process owner. AD SCS (IM) is the policy and process owner for IM, including Reprovisioning, across Defence. Periodic performance reports on inventory Reprovisioning are submitted via the JSC Performance Management Board (JSCPMB) and the 2* Joint Supply Chain Board (JSCB) up to 3* and 4* Board level within DE&S.

4. The policy covering the requirement for the governance of LogIS inventory algorithms and guidance on the use of analytical techniques for inventory management is at Chapter 10.

KEY PRINCIPLES OF REPROVISIONING OF DEFENCE INVENTORY

5. In order to carry out effective and efficient Reprovisioning of Defence Inventory, IMs are to adopt and apply the following five Key Principles to contribute cost effective and efficient spares support to all platform, equipment and commodity support solutions:

a. **Inventory Reprovisioning is a Through Life Process.** It is essential that IMs understand and influence the range, scale and cost of inventory at every stage in the through-life management cycle. Decisions made at the Initial Provisioning (IP) stage of procurement are likely to have a significant and enduring impact upon off-the-shelf availability and stockholding levels of inventory. It is therefore imperative that IMs are fully involved in the decision-making process and understand the implications. Equally importantly IMs are directly responsible for ensuring that all Reprovisioning-related actions are undertaken as accurately and expeditiously as possible throughout the life cycle of inventory items, otherwise there is a significant risk of stock-outs and back orders in the case of under-provisioning and excess stock levels in the event of over-provisioning.

b. **Inventory Segmentation is a Critical Success Factor.** The Defence Inventory covers a large catalogue of items ranging from consumable spare parts (eg nuts, bolts and washers) to capital equipment (e.g gearboxes, engines and other propulsion systems). Segmentation of the inventory by type, characteristic and

behaviour is essential to avoid a 'one size fits all' approach to Reprovisioning that is not tailored to take account of criticality, cost and transaction rates.

c. **Forecasting is primarily based on Future Customer Demand.** Forecasts based upon computer generated Base Inventory System (BIS)[11] calculations must take into account not only current and previous demand rates but also reflect future consumption trends to enable Reprovisioning and procurement decisions to be based on future, rather than previous, consumption trends.

d. **Off-line Reprovisioning Tools / Techniques are Important.** IMs must make best use of the range of off-line tools that are designed to provide extra assistance, including data analysis and 'what if' functionality, to determine the most accurate Reprovisioning outcome.

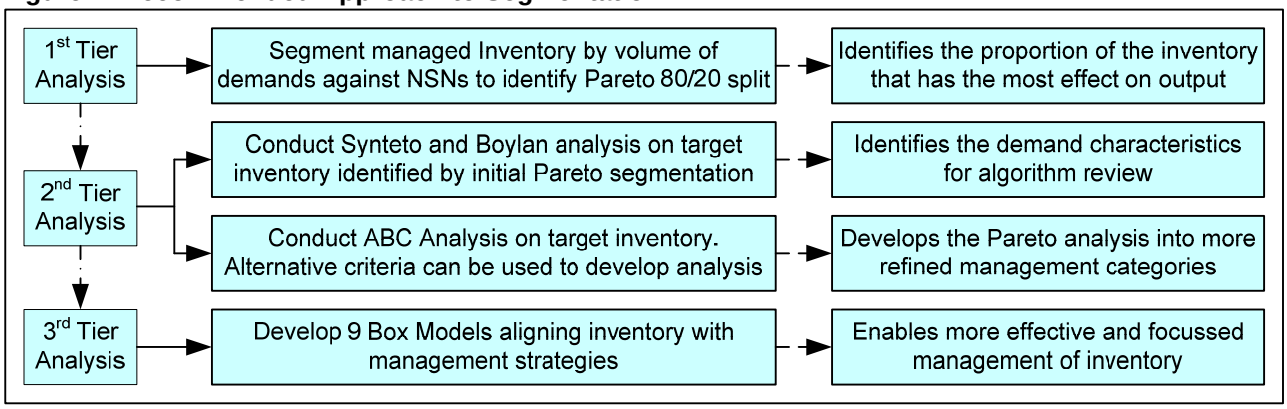
e. **The Benefits and Risks of Over / Under Provisioning Must Be Managed.** IMs must operate within a proactive benefits and risk management regime. Benefits and risk registers, supported by clear mitigation action plans, must be maintained at all times (these will need to be complementary rather than duplicate related risk registers, e.g those maintained by Vendor Category Teams).

KEY REPROVISIONING OBJECTIVES

6. The following six key Reprovisioning objectives are to be achieved without exception:

a. **Segmentation.** Defence Inventory is to be segmented by type, characteristic and behaviour for the purposes of demand forecasting, Reprovisioning and through-life management. Segmentation analysis is to be undertaken annually, to determine any changing trends and other influencing factors that affect the criticality, cost and activity rates upon which inventory segmentation and Reprovisioning is tailored. Figure 7 is the recommended approach for PTs to take when segmenting their inventory. Advice on the techniques used can be sought from the SCM Algorithm Cell introduced in Chapter 10. In particular this will be required to conduct Syntetos and Boylan segmentation until a tool can be developed that automatically performs this function. This method is introduced at Chapter 10 Annex A.

Figure 7: Recommended Approach to Segmentation



b. **Process.** IMs are to adopt the appropriate Reprovisioning process. Schematic diagrams that illustrate the formal Reprovisioning process related to each BIS are included at Annex A.

[11] The main BIS are the Comprehensive RNSTS Inventory System Project (CRISP), Stores System 3 (SS3) and the Supply Central Computer System (SCCS).

c. **Review.** Defence Inventory reprovisioning algorithms and associated parameters embedded within BIS are to be reviewed annually to test fitness for purpose in relation to any changing trends. Further guidance is included and tests for algorithm fitness are at Chapter 10.

d. **Off-Line Tools.** Appropriate off-line Reprovisioning tools are to be used without exception by IMs to provide extra forecasting data and management information to optimise Reprovisioning decisions. Further guidance is at Annex B.

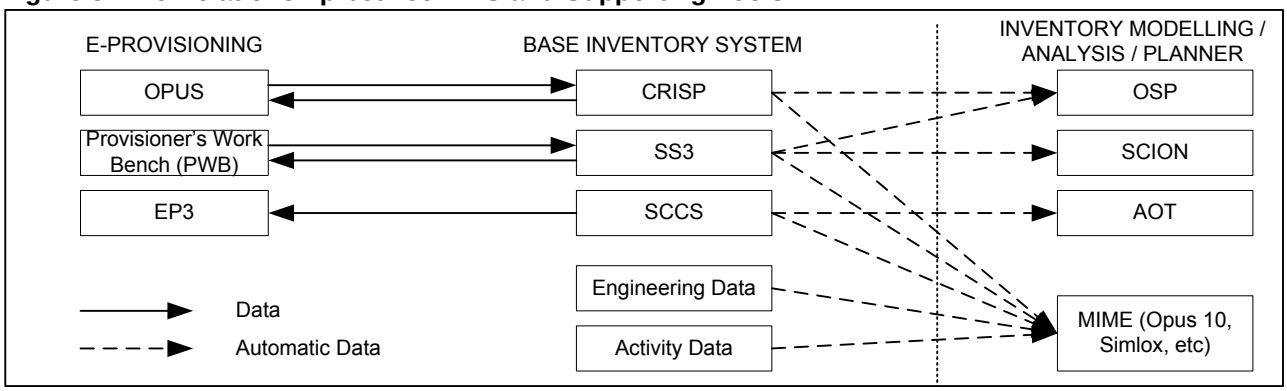
e. **Modelling.** Reprovisioning of more complex (system / equipment related) inventory must be supported by appropriate modelling techniques that take into account through life repair loop management and other key factors. The principle is Multi Indenture Multi Echelon (MIME) modelling described in JSP 886 Volume 2 Part 2: PT Inventory Planning.

7. **Signing Powers.** Requirement and financial approval of inventory reprovisioning decisions is to be undertaken only by IMs and their senior line managers, at the level appropriate to their delegated signing powers. Policy on delegated signing powers, letters and associated responsibilities of budget holders and managers can be found at JSP 462: Financial Management and Policy Manual, Chapter 5.

POLICY REGARDING THE CURRENT BASE INVENTORY SYSTEMS (BIS)

8. IMs are dependent upon a range of Information systems for day to day business. Primarily, but not exclusively, this involves the three major legacy BIS (CRISP, SS3 and SCCS), plus separate systems for managing munitions, fuels and equipments. The BIS, which were originally designed for single-Service purposes, do not provide the optimum functionality required for the new era of end to end JSC convergence and coherence. BIS Reprovisioning capability is supplemented by associated (off-line) e-provisioning and modelling, analysis, and planning tools; a schematic of the relationship between BIS and supporting tools is at Figure 8.

Figure 8: The Relationship between BIS and Supporting Tools



9. The future strategy and plan is to replace the three separate BIS with the joint business capability encapsulated within the Modernisation of the Base Inventory Systems (MBIS) Single Statement of User Need (SSUN)[12]. MBIS will provide a joint set of logistics processes supported by an IS application that significantly improves the current functions of end to end IM, linking Base / Depth seamlessly with the business / IS solutions operated in the Forward / Deployed space. The form that MBIS will take has not yet been decided.

[12] MBIS URD Draft V1.8 dated 29 Feb 08.

10. In preparation for MBIS, DG JSC has declared the strategic intent [13] to rationalise and reduce dependency on three separate BIS by designating SS3 as the target Base IM System. SS3 is thereby the default system for all new platforms, equipment and commodity support solutions that need to interface with the JSC. It is recognised that more work is required to map out the processes that PTs will need to follow in order to achieve the end state of the Defence Inventory converged onto a single base system. It is also acknowledged that in some cases it will be necessary to provide additional functionality to SS3 before full convergence is possible. Therefore, SS3 will have priority over other BIS within the Request for Change (RFC) process. CRISP and SCCS will continue to be maintained (care and maintenance plus essential operational / audit requirements only) until SS3 and then MBIS delivers the requisite joint capability.

11. In order to improve the end to end information flow of supply and engineering data, enhance our knowledge management capability and also dispense with various offline data tools, DSCS has sponsored the SC Information Exploitation initiative. This involves the further development of end to end logistics information architecture, supported by the use of middleware and data mining tools that are transforming the availability of data. The Defence Stock Accounting Collation System (DSACS) will assist IMs and other Stakeholders by simplifying and streamlining inventory accounting processes, adopting a single approach to key issues such as consumption, depreciation and pricing.

[13] Agreed at the 2* JSCB meeting held on 23 Oct 07 – see policy statement SCS 97/47/14/1 dated 12 Nov 07 for full details.

ANNEX A TO CHAPTER 4: BASE INVENTORY SYSTEM OVERVIEW

(Introduced at Paragraph 5b)

COMPREHENSIVE RNSTS INVENTORY SYSTEM PROJECT (CRISP)

System Overview

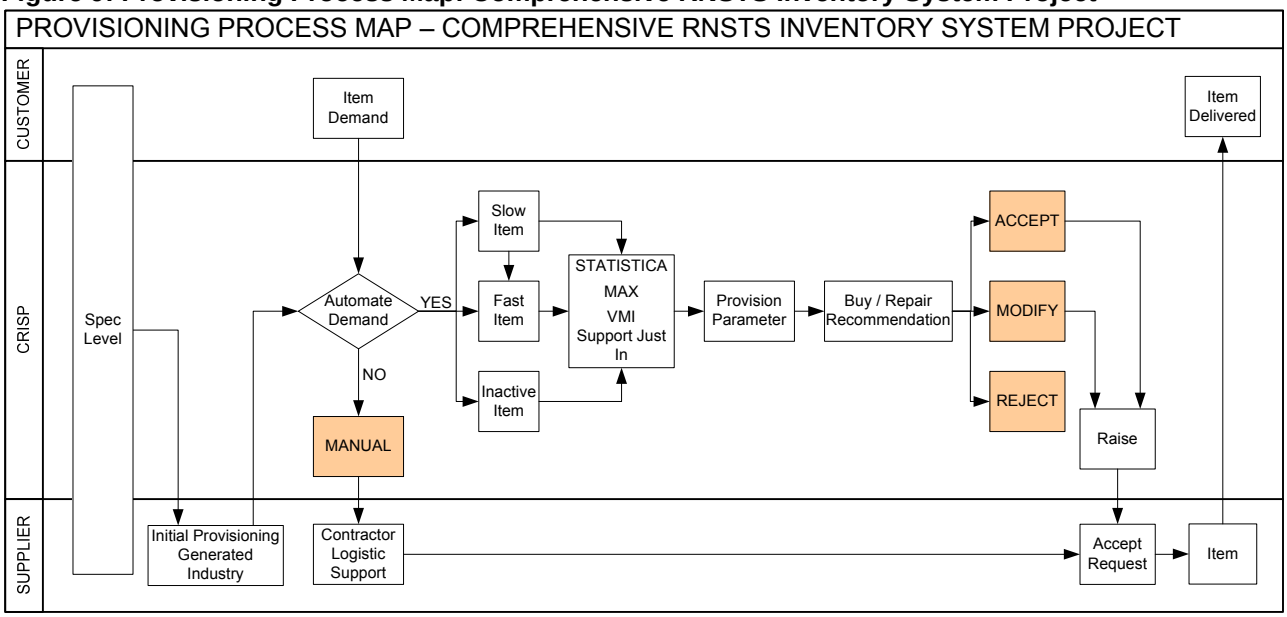
1. CRISP is the Base Inventory System (BIS) that historically provided support to the Maritime Environment. The functions provided by CRISP are item introduction and initial provisioning, demand management (issues, returns, receipts), provisioning, procurement, repair & returns management, stock review, liabilities and on-board documentation (OBD).

2. A Management Information System (MIS) provides interactive on-line enquiries and scheduled or one-off enquiries. CRISP maintains visibility of stocks up to the point of issue and allows IMs to monitor usage and to manage Reprovisioning.

3. CRISP is a distributed system and is predominantly used by Maritime PTs. Users gain access to the system through the Restricted LAN Interconnect (RLI). The maximum protective marking of the RLI is RESTRICTED. BR1029(14) is the CRISP user manual.

4. A Provisioning Process Map for CRISP is at Figure 9. CRISP users are provided with an automated on-line system called OPUS II that produces paperless Provisioning Review Statements (PRS), for details see Annex B.

Figure 9: Provisioning Process Map: Comprehensive RNSTS Inventory System Project



CRISP Provisioning Algorithms

5. The re-provisioning calculation is based on Dual Exponential Smoothing of the Monthly Demand Rate (MDR), of recurring demand quantities where positive, and the intervals between demands. The Forecast Monthly Demand Rate (FMDR) is calculated as follows:

$$FMDR = \frac{\alpha CurrentDMD + (1 - \alpha)(SmoothedDMD)}{\alpha CurrentInterval + (1 - \alpha)(SmoothedInterval)} * \frac{2 - \alpha}{(2 - \alpha)(CurrentInterval + (1 - \alpha)(SmoothedInterval))}$$

6. The value of α is hard-coded as 0.1 which heavily weights the calculation towards historic usage. If the current interval is unclosed, ie no demand since the last calculation, then it is only included in New Smoothed Interval if it is longer than the previous interval. In this case the value of Current Interval would be the Unclosed Interval + 1. Dual Exponential Smoothing calculations do not apply to Obsolescent or Obsolete items; these attract Single Exponential Smoothing based on demand quantities.

7. Each item can have up to 4 'Service Levels' defined. These are known as 'Superior', 'Higher', 'Common' or 'Lower'. The choice of service level depends on demand activity and / or turnover value with cut-off points defined in provisioning database records. Service Level can be defined either as numbers of demands (Activity) or value of demands (Turnover). Service Level is sourced from the Item Management Code (IMC) Provisioning parameter database record using the item IMC as the key field. If the IMC does not have Service Levels set then PT level Provisioning Parameters are used. This has entries for all IMCs, arranged in 26 groups.

8. The quantity proposed for re-provisioning is calculated as:

$$Quantity\,\mathrm{Pr}\,oposed = MaxAssetLvel - FreeAssets(StockOnHand + DuesIn - DuesOut)$$

9. The CRISP provisioning calculation is handled by a separate application known as the "CRISP Black Box". In addition to the Max Asset Level (MAXAL) for each line item this also calculates values of Re-Order Level (ROP), Economic Order Quantity (EOQ), Safety Stock (SS) and Forecast Availability (FA).

CRISP 'Black Box' - Overview

10. The CRISP 'Black Box' is an application which calculates the Reprovisioning quantities for the majority of items. There are 2 types of calculation; Periodic items are considered at fixed intervals at 3, 4, 6, 9 or 12 months, with the order quantity set accordingly. Continuous items are processed monthly and a re-provisioning recommendation is triggered if stock is down to the Re-Order Level (ROL). Any changes in provisioning parameters, such as price, will trigger a review of an item.

11. Once the Global Forecast Demand Rate (GFDR) has been calculated, it and other required parameters, such as the Required Service Level, are passed to the Black Box. The Forecast Requirement is based on:

a. The numbers of Recurring Demands; a Poisson distribution is assumed.

b. The Demand Quantities; a Geometric distribution is assumed.

c. The availability is taken to be the proportion of demands satisfied in the chosen interval.

d. The Lead Time is assumed to be constant in most cases.

e. The Lead Time-Demand is assumed to have a Normal distribution.

12. The Safety Stock (SS) requirement is calculated as the quantity of additional items to achieve the Required Service Level (RSL) through the Demand-Lead-Time based on a Normal Distribution.

13. **Required Input Values.** The following are required input values:

a. Global Forecast Monthly Demand Rate (GFMDR). This value is factorised by a Population Provisioning Factor (if set). Length of Demand Record in months.

b. Total Recorded Recurring Demand Quantity.

c. Total Recorded Number of Recurring Demands.

d. Average Demand Size.

e. Shortage Cost.

f. Holding Cost.

g. Order Cost.

h. K Factor (represents Order / Holding Cost ratio where explicit costs are not used).

i. Procurement Lead Time.

j. Procurement Price.

k. Percentage Availability Target (PAT).

l. Percentage Availability Minimum (PAM).

m. IPER (Interval between reviews of Periodic items – in months).

n. Safety Stock (SS) Constraint.

o. Price Breaks.

p. ISSNUM (Upper limit imposed on number of months' usage).

q. ISSVAL (Upper limit imposed on Purchase value of replenishments).

14. **Periodic Items.** Economic Order Quantity (EOQ) is then the product of the Forecast Monthly Demand Rate (FMDR) and the Interval between Periodic Reviews (IPER). In the case of repairable items the Global EOQ is reduced to represent the proportion of items Beyond Economic Repair.

15. **Continuous Items.** CRISP holds 2 EOQ constraints defined in months, MAX and MIN. Maximum and minimum limits on EOQ quantities are calculated as:

a. MAXEOQ = Min Months * FMDR.

b. MINEOQ = Max Months * FMDR.

16. **Items sourced from USA and K Factor Items.** The Global EOQ is constrained to MINEOQ and MAXEOQ.

a. USA Items have annual reviews where EOQ is: Global EOQ = FMDR * 12.

b. Items with a positive K Factor then: Global EOQ = K * √ (12 * FMDR / PRICE)

17. **Items with Order and Holding Costs.** The EOQ is calculated as the quantity between MIN and MAX EOQ having the lowest total cost of buying, ordering and holding the item. The calculation takes safety stock into account.

a. **Calculation.** The EOQ calculation is implemented as an iterative loop which tests the order costs at the upper and lower bounds (initially MIN and MAX EOQ) and 2 equally spaced values between, creating 4 segments. The next iteration does the same with the segment which has its lower boundary value below the optimum EOQ, and its upper boundary value above the optimum EOQ. The process stops when the difference between the upper and lower values of the chosen segment is less than 1.

b. **Processes.**

(1) **Safety Stock.** Set the MAX value to MAXEOQ, MIN value to MINEOQ. Calculate two intermediate segment boundary values, making four boundary values in all. The calculations is stopped if (MAX value – MIN value) < 1.

(a) Calculation of the Cost associated with the Order Quantity represented by each segment boundary.

(b) Calculation of Safety Stock (SS), Asset Availability and SS Truncation Indicator.

(c) Lead Time variance (LTVAR) is calculated, or set to 1% of LT if 1 or less LTs recorded.

(d) Maximum Allowed Safety Stock =

$$Usage\,\mathrm{Re}\,striction(in\_months) * GFMDR + \frac{Value\,\mathrm{Re}\,striction}{\mathrm{Pr}\,ocurement\,\mathrm{Pr}\,icePerItem}$$

(e) If the item has a shelf life then safety stock is constrained to half the shelf life if necessary.

(2) **Variables.**

(a) SdDpO = SD of LT-Dem + Overshoot.

(b) Ratio of EOQ and Std Dev of LT Demand plus overshoot:

$$E = \frac{EOQ}{SdDpO}$$

$$R1 = \frac{SDofLTDem}{SdDpO}$$

$$GSize = \frac{Total\,\mathrm{Re}\,cordedDemandQty}{TotalNumberof\,\mathrm{Re}\,cordedDemands}$$

(c) Forecast number of Demands = GFMDR / GSize

(d) Variance of Lead-Time Demand (DLTVAR)

$$DLTVAR = GFMDR * LT * (2 * GSIZE - 1) + GFMDR2 * LTVAR.$$
$$SD\ of\ DLT = \alpha\ DLTVAR$$

(e) Demand Overshoot is noted as W where W = 0.5 * Forecast number of Demands

(f) (VarDpO) is Var LTDmd plus overshoot (VarDpO).

(g) (Overshoot looks like 1.5 times forecast demand number).

$$VarDpO = DLTVar + GSize * (GSize * (1 + W * (2 + \frac{W}{3})) - W - 1)$$

SdDpO = α VarDpO
E = OrdQty / SdDpO
R1 = SD of DLT / SdDpO

(h) Ratios E and R1 are used in the calculation of the Max Constrained SS (TMAXSS).

(i) Max Constrained SS is calculated to meet the probability of a shortage based on back-orders using the Unit Normal Loss Function. The number of Backorders resulting from a shortage is assumed to be normally distributed, based on the SD of Lead Time Demand. A copy of the SS quantity is incremented, and the back-order probability re-calculated, until the probability of a shortage has fallen to, or below, the target availability.

(j) If the item is not lifed then TMAXSS is adjusted upwards to meet Target Availability if necessary (to value of SS copy).

(k) If the TMAXSS already gives Target Availability then it is reduced to minimise cost.

(l) If necessary TMAXSS is adjusted for Trident and Fixed Reserves stock, and Forecast Availability is calculated.

(m) Annual cost of meeting GFMDR + SS is calculated.

(n) From the 4 boundary values find the one with the cheapest Total Cost.

(o) Set the MIN value of the range to the one with the cheapest Total Cost, and the MAX value of the range to the next boundary value above it.

(p) Exit if the new MIN value is the cheapest of all possible EOQs. MIN Value is the Order Quantity.

(q) If a price break is available for the item, and it is not repairable, then recalculate EOQ to find optimum EOQ in the best price band.

(r) Re-run the SS calculation again using the Order Quantity.

18. **Calculation of Max Asset Level (MAXAL).** If the item is repairable then calculate the expected Proportion Lost (PLOST) as:

a. PLOST = BER + (1 – BER) * (1 – RRR) where BER = Beyond Economic Repair and RRR = Repair Recoverability Rate.

b. Calculate REPAIRED as the number of items expected to return from repair during new manufacture LT.

c. Re-calculate average demand size (GSize).

d. Calculate overshoot as 0.5 * GFMDR + GSize – 1.

e. If overshoot > GEOQ – 1 the overshoot = GEOQ – 1, otherwise overshoot = 0.

f. MAXAL = GFMDR * LT + Order Quantity + SS – REPAIRED + Specified Reserves.

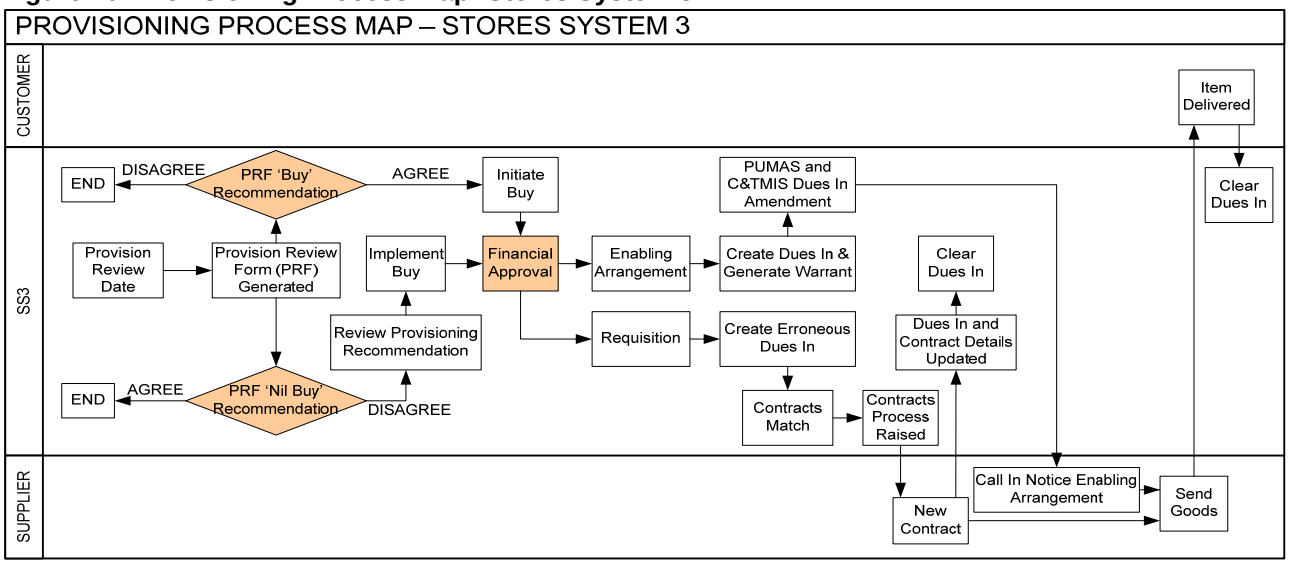
STORES SYSTEM 3 (SS3)

System Overview

19. SS3 is the BIS which historically managed Land materiel. It has been identified as the Target Base Inventory System (TBIS) that will provide the principle BIS in the future. Principally SS3 provides supports to reprovision and repair management. Buy recommendations are generated on Provision Review Forms (PRF) based upon historical demand modified by Simple Exponential Smoothing. The supporting systems, PUMAS and PWB are described in Annex B. A Provisioning Process map for SS3 is at

20. Figure 10.

Figure 10: Provisioning Process Map: Stores System 3



SS3 Provisioning Calculation

21. The SS3 re-provisioning calculation is carried out quarterly. In addition a check for shortfalls is made after each stock movement, e.g after issues. Investigations are in hand to examine the feasibility of changing the SS3 re-provisioning calculation to monthly. Action following transactions which result in a change of stock level:

a. The stock level is re-calculated:

(1) Assets = Total current Stock + Dues In – Dues Out.

b. The Re-order Level is re-calculated:

(1) ROL = SafetyStock+OperationalStocks+EarMarks+(Lead Time * AQF/3).

(2) AQF = Actual Quarterly Forecast.

Phased Review

22. Most items are subject to phased review; however exceptions, which can be defined using identifiers such as DMC, can be excluded from the process. The review compares current assets with demand rate. The demands included in the calculations are recurring demands, non-recurring demands with a control over-ride (Control Code 2 – Non-Recurring Demands Referred to range manager, or 3 – All unit demands to be considered recurring). No demands issued from Secondary Depots to units are considered.

23. Actions:

a. If there have been less than 2 recurring or replenishment demands in any of the last 4 quarters then the item is flagged as “Slow Moving” and an alpha constant of 0.2 will be used in Exponential Smoothing, otherwise the item is classed as “Fast Moving” and a constant of 0.1 will be used.

b. A new smoothed value of the Forecast Quarterly Usage (FOS) is calculated.

c. Forecast Quarterly Demand (FQD) is calculated from current quarter’s demand (D) and previous FQD as:

NewFQD = (σ * D) + (1 - σ)(oldFQD)

d. Quarterly Maintenance Forecasts (QMFs) for Computer Controlled Items (CCI) are held for the last 4 quarters. Each value is moved back one quarter and a new QMF calculated for the most recent. The SQD (ISR) is the sum of the 4 QMFs.

e. For CCIs an Actual Quarterly Forecast (AQF) is calculated as:

AQF = FQD + Scaled Quarterly Forecast. It must be zero or greater.

Economic Order Quantity (EOQ), calculated as $\sqrt{\frac{8*Co*AQF}{Ch*\mathrm{Pr}\,ice}}$

Where Co is Cost to Order, Ch is Cost to hold as % of Price and P is the Price.

f. Constraints on EOQ. For most items the default constraints are a lower Economic Order Period (EOP) of 3 months demand, and an upper EOP of 12 months. Some types of item also attract other constraints, e.g Shelf Life, Cyclic Buy items, NAMSA items and lifed items. The EOQ cannot be lower than 1.

g. Forecast Error (E) = old FQD – (Current quarterly demands).

h. Mean Absolute Deviation (MAD), used in the safety stock calculation:

New MAD = beta*|E| + (1 – beta) * oldMAD. Beta is normally set to 0.1

i. Safety Stock is calculated as:

(1) Standard Deviation of Demand within Lead-time (TSD) is calculated using a standard approximation as: MAD * $\sqrt{(\pi * LT/6)}$ [14]

(2) The product of the TSD and EOQ (C) is used with the Required Service Level (RSL) P to create a factor, k. This factor is input to a function which calculates Safety Stock. P is represented by a value between 0 and 1, e.g. P = 0.8 for a RSL of 80%.

(a) k = (1 – P) * EOQ (C) / TSD.

(b) K = f (k). There is a table in the SS3 User Guide, Section 15, giving the output values of K for input values of k. If k is large, up to a maximum of 4, then K is small, down to a minimum of –4. Their relationship is inversely proportional until k is down to a value of 0.4, after which k flattens out, reaching zero as K hits 4.

(3) From this it appears that a high EOQ (C) and / or a low TSD (predictable demand) yields a high value of k, and hence a low value of K.

(4) Safety Stock = K * TSD. Safety Stock will be comparatively high where there is a small EOQ (C), high RSL and high TSD.

(5) Re-order quantity = Shortfall + Safety Stock + EOQ (C).

Improvements to the Calculation of Safety Stock

24. It may be difficult to make changes to calculations in SS3. An alternative could be to calculate offline and feed the results back into SS3. Therefore, SS3 provisioning is ignored or calculations need to be done "offline" and the results fed back to SS3. SS3 allows for management set Reorder Level by setting the forecast demand rate and / or lead time.

25. How the safety stock is calculated depends largely upon what data is available about the pattern of demands. There appear to be three main options:

a. Use the safety stock (and EOQ) calculations from the Maritime CRISP "Black Box", which requires no factual information about demand variability.

b. Use the 12 quarterly counts of demands and demanded quantity shown on the SS3 Provisioning Review Form to derive an actual standard deviation of demand in lead time; and use the other applicable calculations from the CRISP "Black Box".

[14] This calculation must be based on the assumption of Normal distribution, which means that $\sigma = \sqrt{(\pi/2)}$ x True MAD. Secondly using the Law of Large Numbers means converting from a MAD linked quarterly Lead Time to a monthly requires division by $\sqrt{3}$. Dr Rutherford's Thesis indicates that the assumption of a Normal Distribution is questionable for MOD used items. This approximation for σ also breaks down for the distribution of low volume items.

c. Use the records of individual demands for each item to give a direct conversion of service level and safety stock for each item; and use the other relevant calculations from the Maritime CRISP "Black Box".

(1) (Option 1 is the "quick fix" that solves three of the identified problems and requires the least data.

(2) Option 2 uses what should be readily available data to solve one problem.

(3) Option 3 uses the available data to give the best answer. In particular, it will give notably better answers for items with low demand.

SUPPLY CENTRAL COMPUTER SYSTEM (SCCS)

System Overview

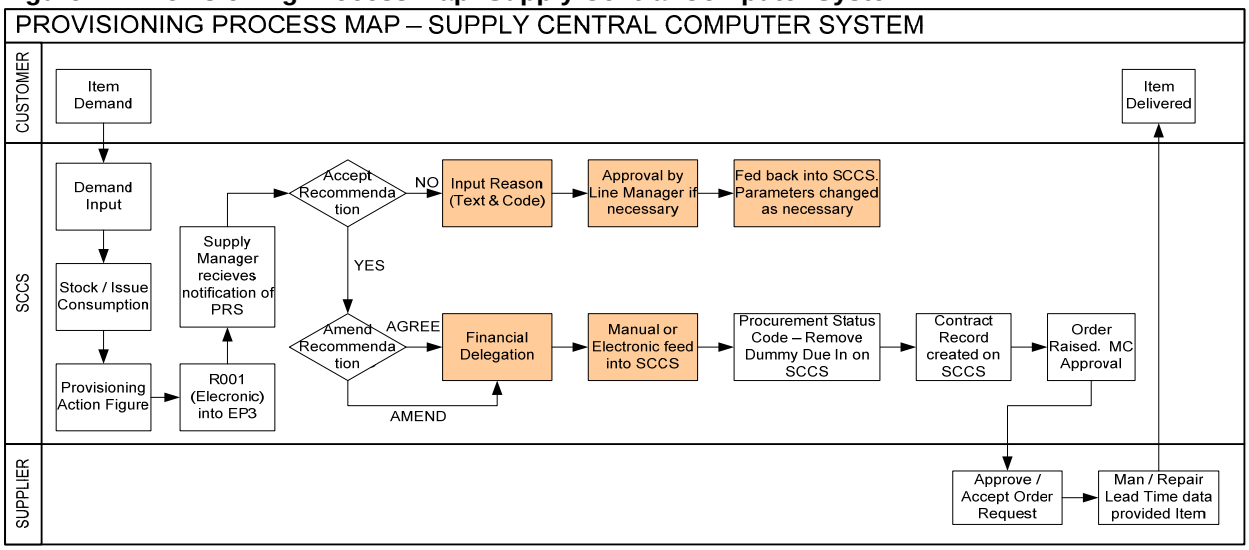
26. SCCS provides the Air environment with a 'real time' picture of global stock at units, in DSDA storage, a provisioning and contract management tool, stock accounting and demand satisfaction functionality. A Provisioning Process Map for SCCS is at

27. Figure 11.

SCCS Provisioning Calculation

28. SCCS runs a monthly calculation for consumable items to determine if, and how much, stock should be ordered to provide cover for expected demands. If the item is classed as inactive because no demands have been placed for it, then the calculation is carried out at 6 monthly intervals, in case there has been a change in any of its parameters since the last calculation. The calculation is of the Re Order Period (ROP) / Economic Order Quantity (EOQ) type, where ROP represents sufficient stock for the duration of the re-order period, and EOQ is an economic order quantity, defined as the quantity which represents the best balance between order costs and holding costs.

Figure 11: Provisioning Process Map: Supply Central Computer System[15]



29. The SCCS calculation does not use a ratio of Order Costs to Holding Costs as such. Instead it substitutes a literal value, currently set at 43. This effectively represents:

[15] SCS Inv Opt Task 1169 Report dated 30 Jun 06: MBIS Segmentation Final Report.

$\sqrt{\frac{2*Co}{Ch}}$ where Co = Cost to Order. Ch = Cost to Hold as a proportion of price.

30. The "Demand Rate" is used as the basis of the provisioning calculation. It is based on the product of the Recurring Demands for the previous month and a forecast factor. The forecast factor, called the Global Forecast Factor (GFF), represents known changes in future requirement, such as a change in fleet size, calculated as follows:

GFF = Average Fleet-size over Re-Order Lead-Time
Weighted Average of Previous Fleet-size (10% smoothing)

31. A Global Forecast Demand Rate is created by exponentially smoothing the current month's recurring demands and GFF with the previous Global Forecast Demand Rate (GFDR) value as below. Replenishment demands should never be recorded as recurring demands, as this would cause double-counting when a demand is placed at a unit.

GFDR = 90% old GFDR + 10% current Recurring Demands * GFF

32. A number of checks are carried out before the calculation to see if the item requires special processing. Examples are:

a. The item is 'High Value', 'P' class or has a 'Type of Value' code which precludes it from normal re-provisioning.

b. It is in a precluded DMC group.

c. Under management control or Initial Provisioning.

d. Classed as obsolete.

e. A check is also made of suffix (quarantined) stock and whether it is to be included in the assets.

33. A recommended order for stock is generated when the balance of 'Stock on Hand' (available stock, dues-in and dues-out) falls below the quantity needed to cover the period before the arrival of the next order. This quantity is termed the 'Provisioning Action Figure' (PAF), and is defined as:

a. 'Provisioning Action Figure' = "Demand Rate" * (Re-order Period + DWSL) + UHR

(1) Where:

(a) DWSL = "Depot Working Stock Level". Normally 2 months of stock representing safety stock.

(b) UHR = "Unit Holding Requirement". Calculated from each unit's requirement, depending on location and the type of item. Normally based on the unit's consumption rate for the item.

(c) "Stock on Hand" = Assets – Dues Out + Dues In

34. If the "Provisioning Action Figure" is greater than zero and greater than the 'Stock on Hand' then the shortfall is calculated as:

a. "Shortfall" = "Provisioning Action Figure" - "Stock on Hand"

(1) An upper and lower constraint on the order quantity is calculated as:

(2) "Lower constraint" = ("Demand Rate" * "Interval between orders") + "Shortfall"

(3) "Interval between orders" is currently 3 months for most consumables, but varies for other items.

(4) "Upper Constraint" = Absolute ("Demand Rate" * 24 - "Stock on Hand"). (No negative values allowed)

(5) If (12 * "Demand Rate" / Price) is greater than zero then:

"Economic Order Quantity" = 43*√(12*GFDR / Price)

(6) Else "Economic Order Quantity" = zero.

35. If the EOQ falls outside one of the constraints the order quantity is set to that constraint, otherwise the order quantity is set to the EOQ. Therefore for most items the order quantity will be sufficient for 6 months, but no more than 24 months, at the current demand rate.

36. The logic of the buy quantity decision is as follows:

a. If the Lower constraint is less than the EOQ then.

b. If the EOQ is greater than the Upper constraint then.

c. If the Upper constraint is less than the Lower constraint.

d. Final Buy = Lower Constraint.

e. Else: Final Buy = Upper Constraint.

f. Else: Final Buy = EOQ.

g. Else: Final Buy = Lower Constraint.

37. The final buy is compared with the Primary Packed Quantity and Contractor's Minimum Batch Quantity for the item, and rounded up if necessary.

38. For some items the PAF is fixed rather than calculated. In such cases the GDR is calculated as:

a. GDR = 10% * Current Month's Recurring Consumption + 90% old GDR

b. In all cases GFDR is set to zero if it falls below 0.05.

39. **Repairable Items**. Order quantities of repairable items first take into account the number which could be repaired, the Forward Repair Potential, calculated as:

$$FRP = \frac{(MRP - (Global\ RD\ Stock * Recovery\ Factor)) * Interval\ between\ orders}{Lead\ Time + DWSL - RP}$$

a. Where MRP = Estimate of number of items which can be repaired during the Re-Order Period, RD = Repairable at Depot, IBO = IBO and RP = Recovery Potential.

b. FRP represents the number of items expected to be returned from repair during the IBO. The Recovery Factor is the proportion of RD stock expected not to be beyond economic repair.

c. The provisional order quantity (POQ) of the repairable item is then calculated as: POQ = (IBO * GFDR) – FRP.

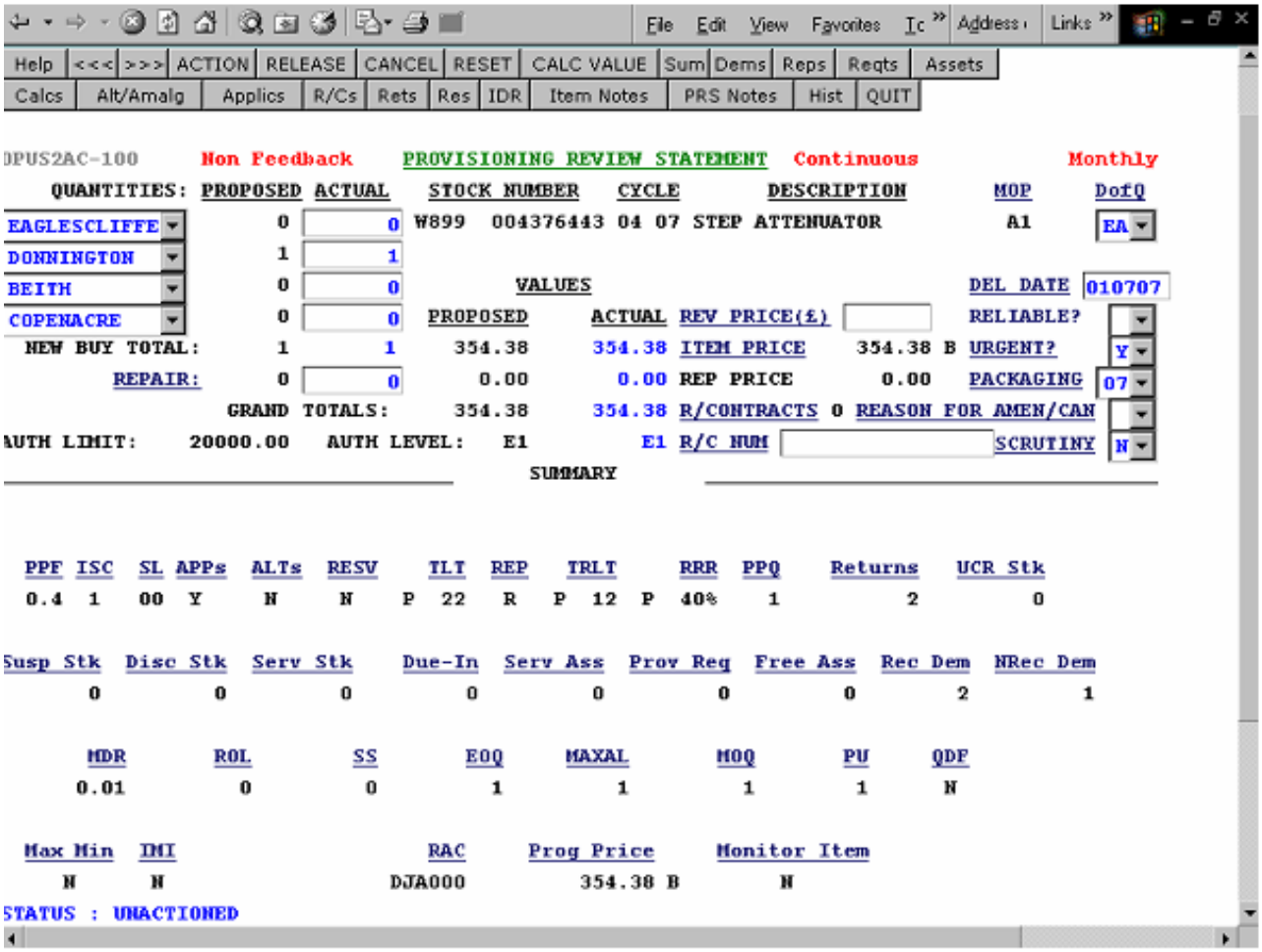
ANNEX B TO CHAPTER 4: OFF-LINE PROVISIONING TOOLS

(Introduced at Paragraph 5d)

On-Line Provisioning Update System (OPUS II)

1. OPUS II[16] is a web based on-line paperless system producing Provisioning Review Statements (PRS) as illustrated below, and offers improved 'front-end' operation for CRISP users. OPUSII is used by Commodity Managers in Maritime PTs located at Abbey Wood and Foxhill. CRISP data is updated to OPUS II monthly to produce the PRS. This tells the Commodity Managers when they need to consider re-provision of stocks and the resulting proposed buys are transmitted to the CRISP procurement system daily. The data is mainly "read only" although certain fields can be updated, such as the recommended purchasing quantities, by Commodity Managers with the appropriate authorisation.

Figure 12: OPUS Provisioning Review Statement



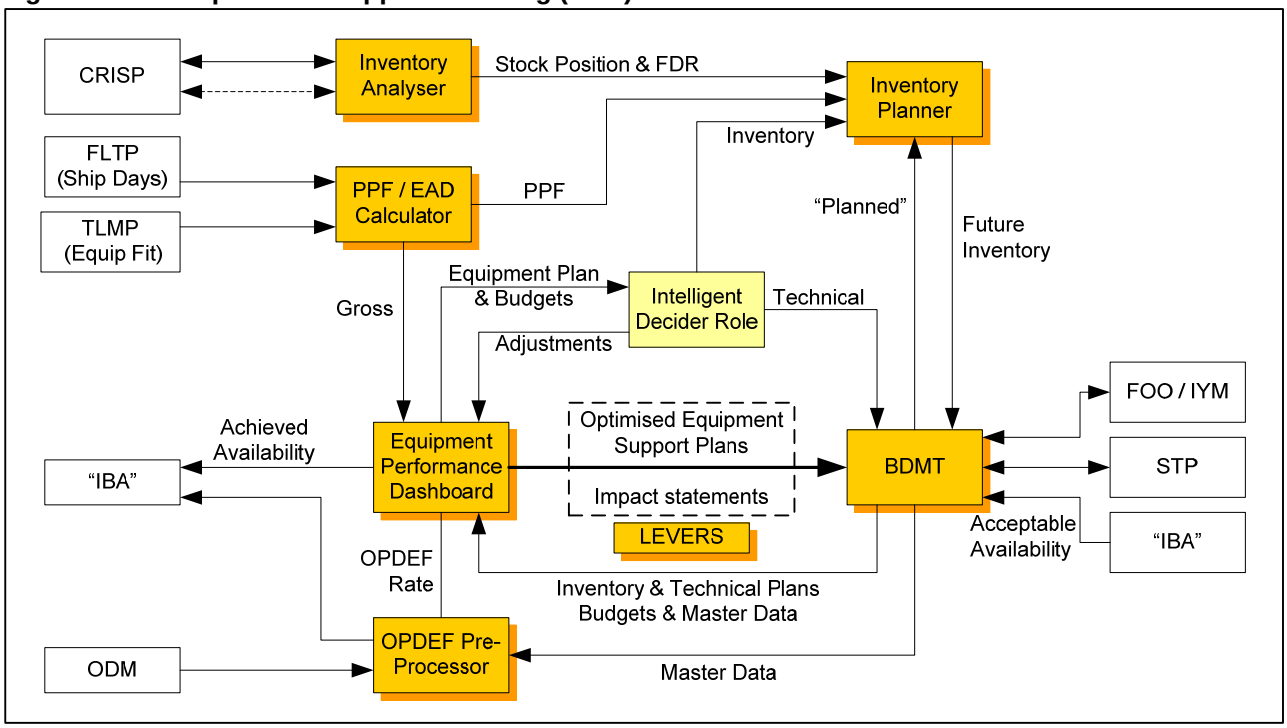
Optimised Support Planning (OSP)

2. **Overview**. Optimised Support Planning is a planning process that provides Equipment PTs with the ability to make best use of their resources by providing the appropriate level of support for each equipment. The process relies on a simple priority framework that, when populated, indicates where the Customer is willing to accept risk against individual equipment support plans.

[16] Note OPUS II should not be confused with the OPUS modelling tool; they are completely different tools.

3. Within OSP there are a series of tools built in Excel to compliment the underlying IM systems. Regardless of which system is being used the look and feel of the tool is similar, as is the functionality. It was designed to assist IMs to ensure that the underlying inventory system functionality is exploited and enables inventory optimisation. An example [17] of the system is shown at Figure 13.

Figure 13: The Optimised Support Planning (OSP) Process



4. The system is also able to identify 'D' and 'R' errors.[18] A 'D' error arises when the demand is outstripping supply and where a stock out is likely that will impact directly upon the customer. Such errors can be identified and eliminated with continued focus but they are a symptom of not having the correct inventory profile and settings within the respective Log IS. 'D' errors should be addressed in conjunction with 'R' errors, as by reducing 'R' errors 'D' errors will be virtually eliminated. The mathematical formula for 'D' Errors is:

'D' Error = Dues Out > A1 stock + Dues In.

5. An 'R' error occurs when the Re-Order Level (ROL) is greater than the sum of the A1 stock and Dues In. Thus the level of stock held will never rise above the ROL and no purchase orders (PRF / PRS) will be raised by the Log IS. A snapshot of the inventory will contain 'R' errors; however by monitoring them continuously they can be significantly reduced. The mathematical formula for 'R' errors is:

'R' Error = ROL > A1 stock + Dues In

6. **Algorithms within OSP.** OSP replicates the algorithms within the BIS that it supports but enables the IM staff to run 'what if' scenarios without corrupting raw data.

7. **Significant Upgrades.** This system is not yet fully rolled out across all PTs; a pilot study has been successfully conducted. A project has been initiated to replace the current ad-hoc and work-around tools with a Permanent Tools Set.

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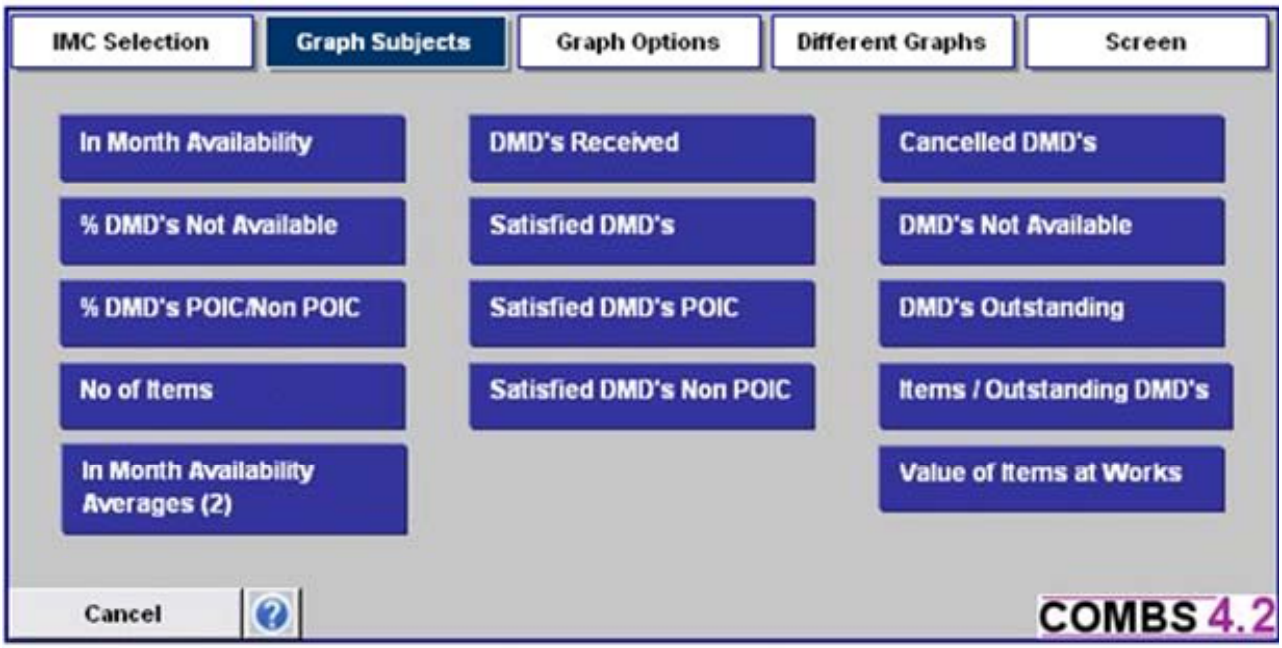
[17] Source: OSP Training Presentation Version 2.0 dated 28 Nov 06.
[18] Source: IM Diagnostic Report dated 31 May 07, Annex S, Appendix 1.

Commodity Management Business System (COMBS)

8. This is a data management tool that enables Maritime PTs to analyse 3 years of rolling data by Domestic Management Code (DMC)[19]. COMBS is fed from CRISP on a monthly basis via Defence Technical Information Centre (DTIC) reports. The range of analysis that can be conducted and an example of in month availability are shown at Figure 14 and Figure 15.

Figure 14: Examples of a Range of Analysis (COMBS)



System for Consumable Inventory Optimisation (SCION)

9. **System Overview.** SCION has been developed to provide PTs with an integrated software tool for managing and planning their Consumable Inventory. It contains functionality to enable supply and provision management teams to:

a. Carry out the 'Inventory Review'.

b. Provide a planning capability to support 'In Year Management'.

c. Provide a planning capability to support the 'Short Term Plan' process.

d. Update fundamental assumptions using the 'Maintenance Menu'.

Provisioner's Workbench (PWB)

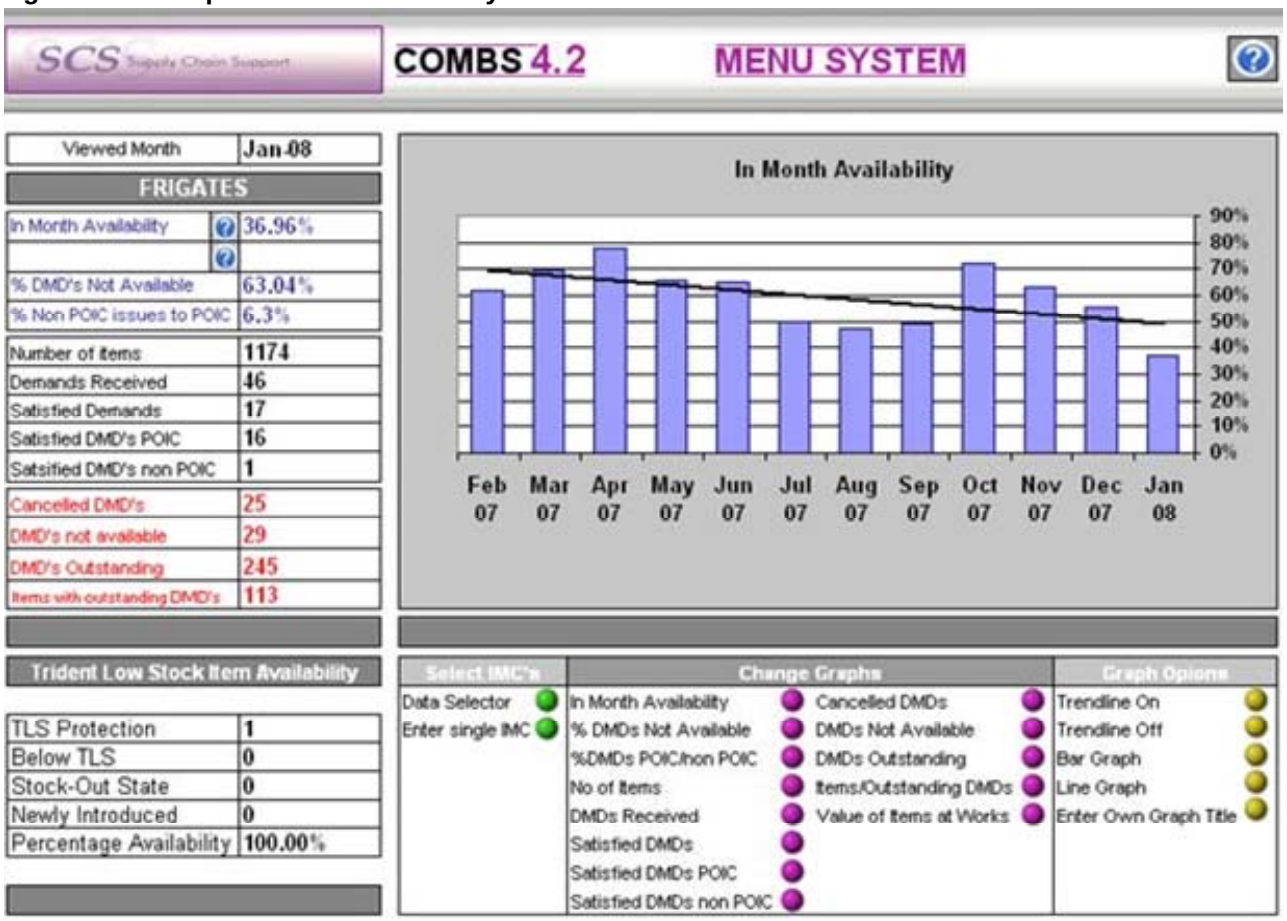
10. **System Overview.** Document Workflow management to support decisions related to Provision Review Forms (PRF), Equipment Review Forms (ERF), Disposal Review Forms (DRF) and to maintain an accurate record of such decisions.

11. PWB has replaced paper based provisioning, incorporating additional fields. The automatic provisioning has allowed for manpower reductions, has provided visibility of current and historical provisioning data. PWB has reduced the administrative lead times

[19] Also known as Inventory Management Code (IMC)

for spares procurement resulting in lower stock holding. An example of the PRF screen is at Figure 16.

Figure 15: Example of COMBS Menu System



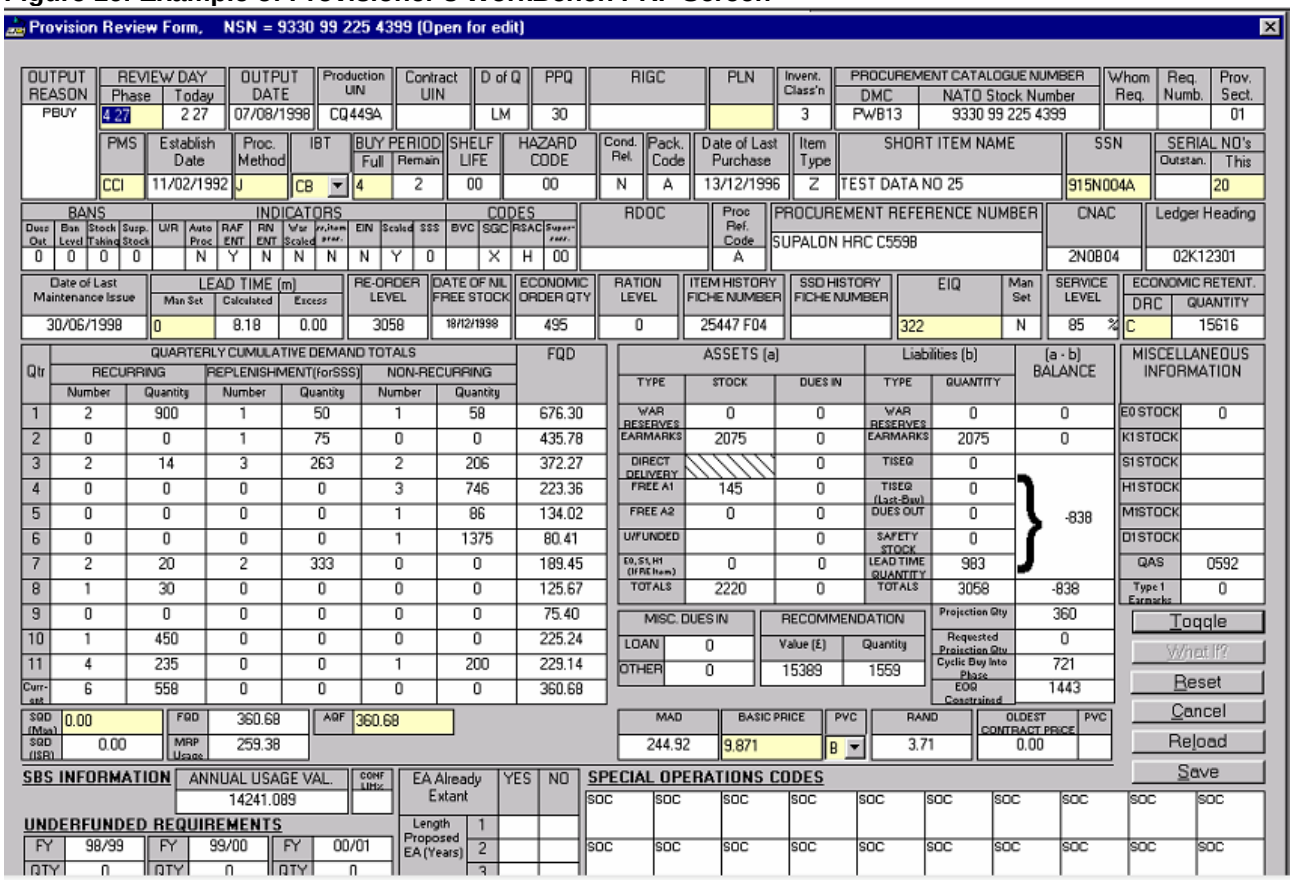
PURCHASE MANAGEMENT SYSTEM (PUMAS)

12. **System Overview.** PUMAS is a Workflow Management system for the purchase of spares and Repairables and for the stockholding requirements for Land PTs and contract management purchasing and progress.

ASSET OPTIMISATION TOOL (AOT)

13. **System Overview.** Asset Optimisation Tool (AOT) was developed internally within the former LARO specifically to aid provisioning staff, and incorporates engineering, financial and supply information. It takes data feeds from SCCS on a monthly basis, but has its own in-built algorithms to enable various queries and 'what-if' scenarios. It facilitates the management of both repairable and consumable spares, incorporating the concept of recurring and non-recurring demands by providing a Single Item Modelling (SIM) capability based on out of service dates; the algorithms are still based on simple exponential smoothing. Another major advantage of AOT is that the system also has the capability to deal with both NSN and contractor part numbers, allowing for non-codified items to be dealt with.

Figure 16: Example of Provisioner's WorkBench PRF Screen



14. AOT has three pillars:

a. Manage Availability - uses the forward plans of aircraft numbers and flying hours and generates a forecast factor to Out of Service Date (OSD).

b. Manage Assets - uses a number of Engineering and Supply levers to generate a requirement for the level of inventory needed to support platform both currently and through to OSD. Identifies deficiencies and surpluses generated by the planned support requirements and has a 'what-if' capability.

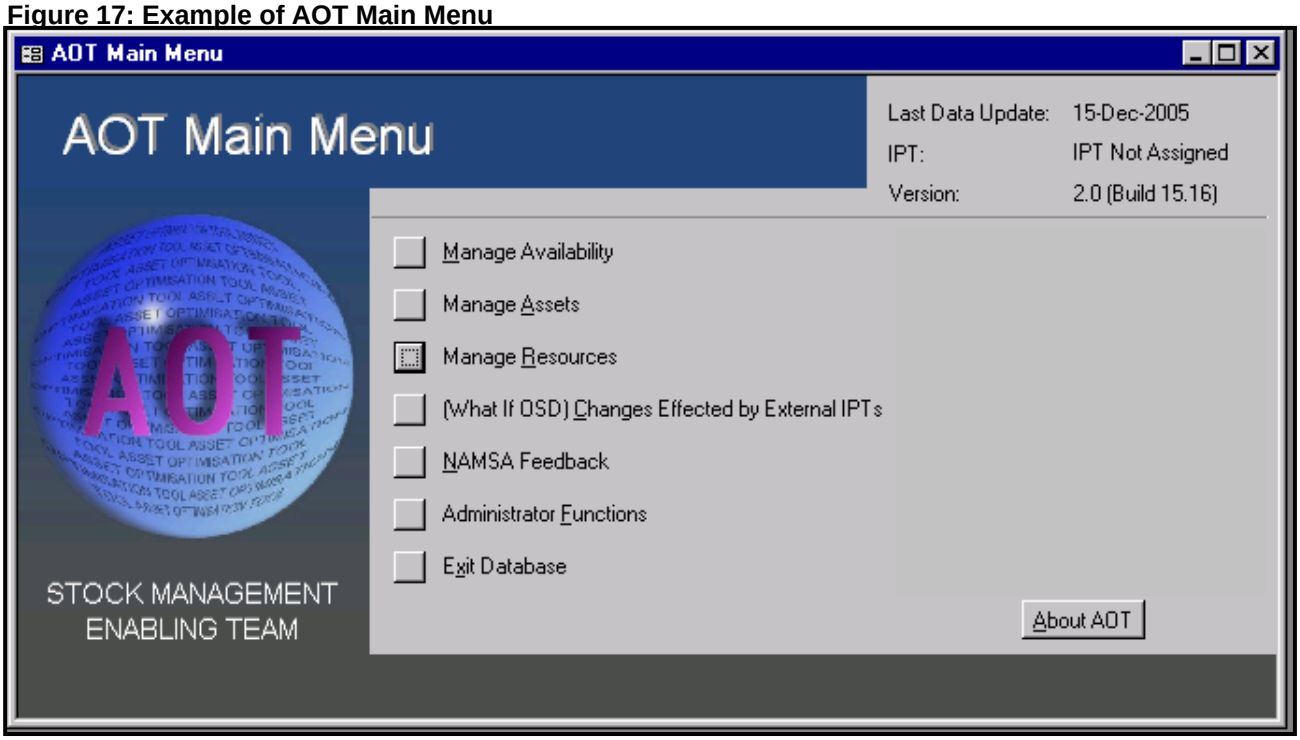
c. Manage Resources - outputs to a 10 year Equipment Plan at item level through management levels to PT. Can accommodate both Gross Book Value (GBV) and Net Book Value (NBV).

15. Asset Optimisation Tool (AOT) is designed to draw key information relating to an item of supply and then to calculate:

a. Predicted optimum number of assets.

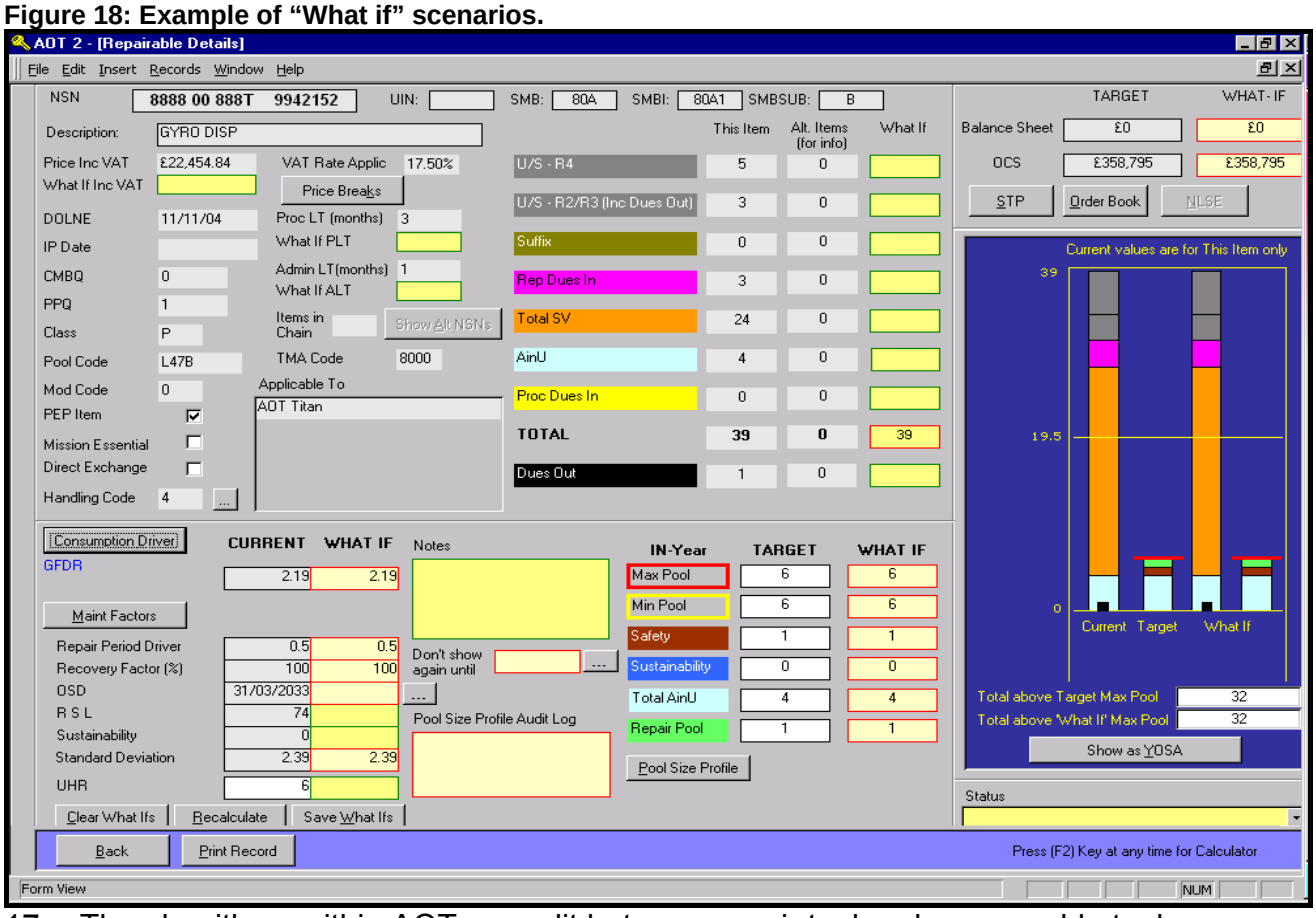
b. Satisfaction Level of a perceived need.

Figure 17: Example of AOT Main Menu



16. It is possible to calculate the number of assets that need to be held to maintain a chosen level of availability whilst capturing the full cost implications. 'What if' scenarios can also be run in any of the yellow boxes as shown at Figure 18. AOT is currently a SQL back end and Access front end. The system is being converted to a web-based front end.

Figure 18: Example of "What if" scenarios.



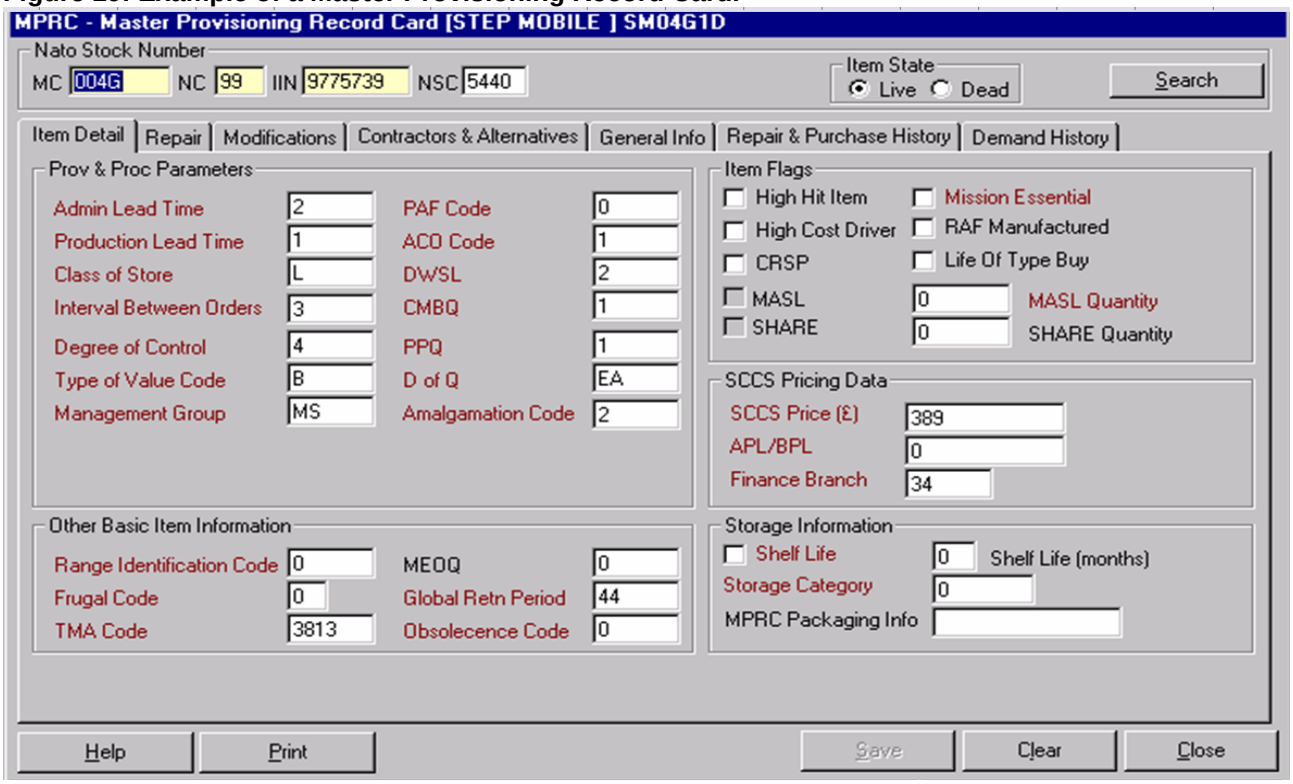
17. The algorithms within AOT are split between repair tool and consumable tool algorithms. Essentially AOT continues to use Simple Exponential Smoothing but allows

the user to choose between using the Global Forecast Demand Rate (GFDR) default or selecting their own forecast error.

EXPERT PROVISIONER 3 (EP3)

18. **System Overview.** The system is designed to download master provisioning recommendation (R001) documents electronically primarily from SCCS. Each R001 can be accessed on line by the Supply Manager, and must be run against a rule base to check that all the factors are correct prior to determining the appropriate buy quantity. Any provisioning actions or parameter changes are updated electronically to the Master Provisioning Record Card, an example of which is at Figure 19.

Figure 19: Example of a Master Provisioning Record Card.



CHAPTER 5: SUPPLIER MANAGEMENT

PURPOSE

1. This chapter describes the policy and associated process covering the requirement for effective supplier management by IMs.

SCOPE

2. This policy applies particularly to all IMs who are directly responsible for ensuring that the sourcing and procurement of inventory from suppliers is effective and efficient in terms of performance, time and cost. Further guidance can be found on the AOF Commercial Toolkit.

GOVERNANCE

3. Overall authority for governance of supplier performance is vested in Director General Commercial, supported by project and supplier engagement teams that are responsible for managing the supplier interface at corporate / Industry level. Below that, at Cluster / PT level DG Commercial exercises functional authority over all commercial staff embedded within each business area. It is imperative that IMs, who have delegated requirement and financial powers, work very closely with DG Commercial staff to maximise supplier engagement and influence Industry performance at all times.

KEY PRINCIPLES OF SUPPLIER MANAGEMENT

4. In order to implement and maintain highly effective supplier management within the Defence Inventory the following five Key Principles are to be adopted:

a. **Understand the Supplier Base.** It is imperative that IMs have sufficient understanding and awareness of their supplier base to enable them to leverage contractor performance, timeliness and cost throughout the life of platform, equipment and commodity support solutions. They must also understand and actively manage risk within the supply chain. Understanding the market, particularly to determine whether or not there is scope for competition, is vital. Data should be gathered on suppliers to create the knowledge to be able to exert influence where necessary.

b. **Work Closely with Suppliers.** IMs are, together with Commercial staff, to work closely with suppliers to achieve performance, time and cost targets in accordance with contract terms and conditions. Every opportunity must be taken to achieve further improvement in output effectiveness and cost reductions through joint, mutual working. Front Line Commands (FLC) must be closely involved to ensure that the totality of every cost reduction is understood throughout the life of the platform or project.

c. **Regularly Assess Supplier Performance.** IMs must ensure that outstanding contract Dues In is regularly reviewed to ensure that delivery dates agreed with the supplier are met without delay. Failure on the part of the supplier to deliver to promise will increase the risk of stock-outs, back orders and ultimately failure to meet customer demand for inventory. Spurious dues in data will also increase the risk of stock-outs and back orders, hence the importance of regular checking of inventory overdue for delivery. Regular analysis of supplier performance data is essential to

determine trends, draw conclusions and present recommendations for corrective / recovery action and / or improvements.

d. **Regularly Review Total Lead Time Data.** IM staff must ensure that the total lead-time data recorded in Base Inventory Systems (BIS), principally CRISP, SS3 and SCCS is accurate and up to date. Accurate lead-time data is a critical component of effective forecasting and safety stock calculations. The overarching principle is to achieve compression of the length of total lead-time based upon reliable sources of information at all times.

e. **Work Closely with Commercial / Contracts Authorities.** IMs must liaise closely and often with PT Commercial staff and other stakeholders, including category management teams, to ensure that every opportunity is taken to leverage supplier performance, rationalise the supplier base and encourage competition.

KEY OBJECTIVES OF SUPPLIER MANAGEMENT

5. IMs are to achieve the following key objectives in respect of supplier management:

a. **Supplier Management Database.** Develop a supplier management database to provide key elements of management information covering details (by IMC / DMC) of range and scale of inventory, value and delivery performance of suppliers against performance, time and cost measures of effectiveness and efficiency. In cases where there are too many suppliers to maintain a full database then the Pareto principle (80% of inventory value / transaction volume generated by 20% of the supplier base) must be applied to enable appropriate prioritisation of resource effort. This database must be available for periodic inspection and use by line managers.

b. **Identify Poor Performance.** Maintain a shortlist of poor supplier performance to support further pro-active supplier engagement and energise improvement in performance, time and cost as appropriate. This short-list must be available for use by line managers to intercede in conjunction with DG Commercial staff where appropriate.

c. **Supplier Reviews.** Undertake face-to-face supplier performance reviews with contractors at quarterly intervals, or more frequently if specified in the contract. The purpose of the reviews is to assess supplier performance against that required by the contract, identify shortfalls and initiate and monitor recovery action as appropriate. A formal record of supplier performance reviews must be maintained for audit purposes.

d. **Lead Time Data.** Carry out the systematic review of total lead-time data maintained on the BIS to ensure that it is completely accurate and up to date. This systematic review should be undertaken on a continual basis with particular emphasis on active inventory items. In cases of very large scale inventory Pareto principles must be applied to achieve focus and priority of treatment according to the value / volume of inventory.

e. **Dues in Reconciliation.** Undertake the systematic reviews of outstanding 'Dues In' that are overdue for delivery. Expediting action must be taken with suppliers on every occasion of their failure to meet promised delivery profiles. In addition the overall situation at IMC / DMC level must be reviewed periodically

(quarterly or more often if possible) to detect downward trends in levels of service and initiate remedial action with suppliers.

f. **Supplier issues.** Liaise regularly with the Defence Storage Distribution Agency (DSDA) and other JSC stakeholders to resolve any outstanding issues and problem areas related to supplier performance, and the knock-on effect upon off-the-shelf availability of inventory. Common problems, such as mismatch of quantity or quality of deliveries, inadequate documentation, packaging and condition of material upon receipt, must be dealt with expeditiously, otherwise there is risk of stock-outs and back orders because receipts of inventory have not been brought to account, and are therefore not visible on BIS to meet customer demand.

6. In all cases the IM must maintain up to date records, in the form of an Outstanding Issues Log (OIL) or similar, to enable regular review and action in conjunction with stakeholders to remove barriers to inventory availability.

CHAPTER 6: PERFORMANCE MANAGEMENT OF DEFENCE INVENTORY

PURPOSE

1. This Chapter describes the policy and associated process covering the periodic review and reporting of inventory performance against **S**pecific, **M**easurable, **A**chievable, **R**ealistic, **T**ime (**SMART)** based objectives and key targets.

2. Recognising that inventory availability (right item, right place, right time) is a critical success factor for a lean, agile and responsive JSC. Inventory performance management is an integral element of the overall JSC Performance Management Board (JSC PMB) regime. The JSC PMB covers end to end JSC performance review, reporting up within DE&S to the 2* JSCB, the 3* Chief Operating Officer (COO) Board and the 4* Executive Committee of the DE&S Management Board (ECMB) as part of the Directorate Corporate Approvals Performance & Risk (DCAPR) reporting process. For ease of reference at JSC PMB and higher level the term PM4IM (Performance Management for Inventory Management) has been adopted to cover all IM metrics.

SCOPE

3. This policy sets out the minimum PM4IM requirements and actions required by the MOD (PTs and other JSC stakeholders) to satisfy DE&S policy standards. The corporate level PM4IM metrics may be supported by more detailed performance measures and indicators at PT (platform, equipment, commodity) level and as part of any Contractor Logistic Support (CLS) arrangement to meet more detailed (operational level) business needs. Further guidance on performance management requirements of inventory aspects of CLS solutions is in Chapter 3.

KEY PM4IM PRINCIPLES

4. In order to implement and maintain an effective PM4IM governance regime across the full range of Defence Inventory, the following five Key Principles are to be adopted by all IMs, as an essential contributor to effective and efficient through life capability management of platform, equipment and commodity support solutions:

a. **IMs Cannot Manage What Is Not Measured.** While the extraction of reliable and accurate data and supporting analysis is often a challenge every reasonable effort must be made to achieve the optimum balance of PM4IM to enable MOD stakeholders to understand what good looks like and highlight the need for pro-active recovery action where appropriate.

b. **IMs Must Use a Single Set of Numbers.** DE&S policy states, logistic performance management is based on the principle of 'one set' of questions asked, one accepted source of data, collected once"[20].

c. **IMs Must Provide a Single Version of the Truth.** The PM4IM process is integrated within the JSC PMB and higher level reporting regime have been established to prevent duplication of effort that would otherwise occur were individual

[20] Legacy Customer Service Agreements (CSAs) and disparate CLS arrangements have generated a plethora of different service levels and performance targets. Furthermore legacy Base Inventory Systems (BIS) designed for single rather than joint Service purposes do not provide a complete and common data set for PM4IM. These constraints will be removed as new Log IS capability is delivered as part of the Defence Logistics Programme (DLP).

Clusters, PTs and other JSC stakeholders to set up parallel review and reporting arrangements; this must be avoided at all cost in the interest of lean and 'smarter not harder' ways of working.

d. **PM4IM - Part of Defence Logistics Performance Management.** PM4IM metrics will complement (not replicate) the higher level performance metrics prescribed by Defence Logistic Performance Management (DLPM) for END TO END performance review and reporting of Force Elements (FE).

e. **PM4IM – Based upon SCOR Methodology.** The Supply Chain Operations Reference (SCOR) Model, originated by the Supply Chain Council, is widely regarded as a "best of breed" approach to SC design, process improvement and PM4IM. SCOR is based upon a simple but highly effective grouping of individual activities and / or functions under the broad categories of Plan, Source, Make, Deliver. PM4IM is designed in principle to follow the SCOR model to achieve full coherence, including E2E back into Industry, as part of best practice.

5. PTs are required to adhere to the above principles in relation to all forms of support solutions including CLS arrangements, to ensure that PM4IM metrics form a part of the overall performance management of support solutions managed on their behalf by contractors and their suppliers. Best practice Sales and Operational Planning (S&OP)[1] techniques are to optimise the Supply Chain through time compression, forecasting and accurate assessment of realistic repair and return lead times for all unserviceable equipment.

GOVERNANCE

6. Overall authority for governance of end to end inventory performance is vested in the Chief Operating Officer (COO) at 3* level within DE&S. In the role of in-service manager, DG JSC attends monthly COO Performance Board meetings to advise on JSC business, including PM4IM.

7. Under the auspices of the JSC PMB, AD SCS (IM), as the policy and process owner for Inventory across Defence, is the lead authority for all PM4IM business. As a full member of the JSC PMB, AD SCS (IM) is required to provide an overview of inventory performance at each quarterly meeting, together with input to the monthly PM4IM reporting packs for the JSC PMB and higher-level boards.

KEY PM4IM PERFORMANCE MEASURES

8. All of the PM4IM metrics are encapsulated within the Inventory Plan; see JSP 886 Volume 2 Part 2: Inventory Planning, Chapters 3 and 5 for full details. The full table of PM4IM metrics, standard reporting procedures and periodicity of reports is covered in Annex B of the Inventory Plan[21].

9. To emphasise the business benefit of regular reporting of inventory performance up through the chain of command within DE&S, a set of three Key PM4IM metrics are reported to, and reviewed by, JSC PMB stakeholders and up to 3* and 4* Board level on a monthly basis. The key PM4IM metrics (from Annex B of the Inventory Plan) are illustrated in Figure 20.

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[21] The Defence Inventory Effectiveness Transformation (DIET) project is continuing to develop PM4IM strategy, implementing the best practice within legacy IS and other constraints. The set of PM4IM metrics covered by the Inventory Plan and this policy are categorised as "interim but in place forthwith" and therefore extant until further update.

Figure 20: Three Key PM4IM Metrics – Monthly Report to JSC PMB, 3* and 4* Level

PM4IM METRIC	MARITIME	LAND	AIR	COMMODITIES
EFFECTIVENESS:				
S1a Overall Immediate Availability	GREEN XX%	YELLOW XX%	AMBER XX%	RED XX%
S1e Due Out Backlog	YELLOW XX%	AMBER XX%	RED XX%	GREEN XX%
EFFICIENCY:				
S2a Raw Materials and Consumables Stock Turn Ratio	GREEN XX%	YELLOW XX%	AMBER XX%	RED XX%
Note: Specific targets are published separately to JSC PMB and higher stakeholders.				

CHAPTER 7: CONTINUOUS IMPROVEMENT

PURPOSE

1. This Chapter describes the policy and associated process for adoption of continuous improvement (CI) methodology to enhance the effectiveness and efficiency of inventory performance, availability and cost / value.

SCOPE

2. This policy applies to all IM staffs that are directly responsible for Performance of Defence Inventory. This includes inventory managed by suppliers under Contractor Logistic Support (CLS) arrangements but which remains on the MOD Balance Sheet, to ensure that Industry is applying the same or better approach to achieve best value for money for Defence.

3. This instruction should be read in conjunction with related parts of JSP 886 Volume 2 Part 2: PT Inventory Planning covering the Inventory Plan (Section 2) and Performance Management (Section 5).

KEY PRINCIPLES OF CONTINUOUS IMPROVEMENT

4. In order to energise and maintain a pro-active CI culture across the vast range of Defence Inventory the following five Key Principles are to be adopted:

a. **Through Life.** IMs must adopt a pro-active approach to CI, otherwise waste will not be minimised and the risk of over / under provisioning and supply of spares will not be negated or mitigated.

b. **Systematic.** In order to apply continuous improvement successfully a systematic approach is essential. Based upon 'total quality' principles, this is a four step process to baseline current performance, analyse and scope improvement opportunities, implement change improvements and finally review results – which then represent the baseline for the next phase of CI activity.

c. **Target Based.** Effective CI requires a formal process to establish objectives and targets monitor and review performance against targets, and intervene and / or escalate action where necessary.

d. **Integrated.** CI must be implemented within an overall process of benefit and risk management to provide a balanced and controlled approach.

e. **Pro-Active.** CI is a pro-active (self starting) aspect of successful enterprise leadership and management, supported by internal ensurance[22] or external assurance of results as a part of good governance.

GOVERNANCE

5. Overall governance of CI of inventory performance is vested in the Chief Operating Officer (COO), supported by Director General Joint Supply Chain (DG JSC) in the roles of in-service adviser and IM policy / process owner.

[22] Ensurance is the MOD term used to describe assurance carried out internally by the PT.

CONTINUOUS IMPROVEMENT POLICY OBJECTIVES

6. IMs are to achieve the following key objectives in respect of CI:

a. Participate in CI initiatives at Cluster, Project Team (PT) and Domestic Management Code (DMC) level as appropriate. As part of the Defence Inventory Effectiveness Transformation (DIET) project this should be as part of a CI Team (CIT) formed at PT / Cluster level.

b. Participate in DIET Health Check assessments and follow up management action to baseline inventory performance, identify shortfalls and improvement opportunities, implement CIs and deliver benefits.

c. Maintain a Benefits Tracking system to log, monitor and report results from CI initiatives.

d. Maintain a Risk / Issues Management system to log, manage and mitigate risks and issues that otherwise would hinder or prevent the achievement of CI. The details of the risks, their proposed mitigation are to be recorded in accordance with the Risk and Opportunity Management Plan associated with the Through Life Management Plan (TLMP).

e. Contribute best practice knowledge of successful CIT results, together with lessons learned from experience (LFE), to the DIET inventory knowledge base, to spread situational awareness and build corporate knowledge across the IM functional specialisation. The mechanism for disseminating best practice is through their inclusion in IM course content, IM Cluster forums and IM communication.

THE DIET HEALTH CHECK ASSESSMENT POLICY AND PROCESS

7. The DIET Health Check assessment of inventory performance is to be undertaken annually by AD SCS-IM and his team in conjunction with DE&S Cluster / PTs. The health check provides an independent, evidence-based assessment of IM performance to provide a baseline for further CI.

8. The DIET health check assessment is a 4 step process that comprises:

a. **Step 1.** Initial customer engagement between the SCS-IM team and the Cluster / PT stakeholder, to establish a common understanding of the process and the overall IM situation within the business area.

b. **Step 2.** Undertake the DIET health check in conjunction with the Cluster / PT stakeholder. The health check is an evidence-based bi-lateral assessment that involves the use of the DIET maturity matrix tool.

c. **Step 3.** SCS-IM team prepares the draft health check assessment for agreement and sign off by the Cluster / PT stakeholder.

d. **Step 4.** SCS-IM and Cluster / PT stakeholder jointly convene to address CI opportunities and deliver benefits.

DEFENCE INVENTORY EFFECTIVENESS TRANSFORMATION (DIET) HEALTH CHECK

9. The DIET Health Check is an assessment of the IM condition of a PT. It is conducted as a check of the PT's preparedness against a variety of headings. The headings and related questions are below. The results are recorded on the Assessment and Assessment tool (maturity matrix), an Excel based tool which allows the answers to be weighted and analysed in a consistent manner. The annual programme of DIET health check assessments is promulgated on the DIET Intranet web page.

PLANNING

10. The aim is to see what IM related plans the PT has in place and jointly constructed with stakeholders including industry. Typical areas are:

a. Has an Inventory Plan (IP) been produced and included in the relevant project Through Life Management Plan (TLMP)? Is the IP integrated with the other segments of the TLMP? How mature is the IP and has it been reviewed to reflect project changes? Has the IP been endorsed by the FLC(s) with an interest in the project?

b. Where CLS support solutions are in place, who controls and monitors stock levels and what steps are in place to reduce inventory levels?

c. Has Inventory analysis been conducted using a Verified and Validated methodology for the appropriate stages of CADMID? Are existing projects being modelled to review stockholdings and placement?

d. Has a Disposal Plant been produced and included in the TLMP? Does the Disposal Plan cover IM aspects? What targets been established for stock management, particularly the disposal of surplus inventory? When was the disposal plan last updated?

SEGREGATION STRATEGIES

11. Does the PT understand the segregation of the project inventory and integrate the segmentation into the management of their inventory? Is an Inventory Segmentation strategy in place?

a. How many items have Management bans / controls in place? As a total of the inventory and by segmentation areas? Why are the items on Management bans?

b. What Stock Segmentation reviews take place and what tools are used (ABC-contract type, Pareto, criticality, movement, etc)? Is the segmentation only by IMC / DMC / Weapon code etc?

PROVISIONING

12. This examines how the PT manages the physical provisioning process.

a. What percentages of items are on Auto provisioning / with no interventions? Has the assignment of Auto-provisioning / auto acceptance of recommendations been reviewed?

b. What percentage of procurement recommendation (PRS / PRF / R001) recommendations are accepted without amendment by the PT / Project? As a percentage of all recommendations and also by IMC / DMC / SMBI[23]? This includes passing data direct to contractor IS without manual "Swivel Chair".

c. What is the availability of these items? As a percentage of all recommendations and also by IMC / DMC / SMBI?

d. What is the lead time of these items? As a percentage of all recommendations and also by IMC / DMC / SMBI?

LEAD TIME CALCULATIONS

13. The accuracy of the lead times used in provisioning are a significant factor in maintaining availability and avoiding surplus stock.

a. Are lead times used in provisioning calculations updated regularly and efforts made to drive improvements? Have Admin lead times used / assumed in provisioning calculations been reviewed?

b. What is the assumed time between output of the procurement recommendation (PRS / PRF / R001) and the item going to contract? Have Contract lead times used in provisioning calculations been reviewed?

c. Has the assignment of Management / calculated Lead Times been reviewed?

d. Have excessive lead times recorded on the provisioning system been reviewed?

e. Have aged Lead times been reviewed / amended?

f. Where items have not been procured for years, are the lead times amended in line with current "acceptable" thinking?

g. Have manufacturing and supply lead times been reduced in the last three years? On average is there a reduction in lead times that can be demonstrated?

CONTRACTING PERFORMANCE AND DUES-IN PERFORMANCE

14. Does Contracting and Dues-in performance follow parameters and forecasts held on system and the guidance promulgated by DG Commercial?

a. How many demanded dues-in (previous provisioning system recommendations) are extant beyond Administrative Lead Time (ALT) (outstanding PRFs / S / R001)? Are all provisioning recommendations being acted upon within target schedule?

b. How many requisitions are outside of Administrative Lead Time (ALT) months? (Qty & % outstanding requisitions)? How many requisitions have not gone to contract yet after; 3 / 6 / 9 / 12 months?

c. How many Trade Dues-in are overdue?

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[23] IMC - Inventory Management Code used on CRISP, DMC - Domestic Management Code used on SS3 and SCCS, and SMBI - Supply Management Branch Indicator also used on SCCS for segmentation.

(1) What is the number of late deliveries?

(2) What is the effect on outstanding demands?

(3) What patterns exist? Particular vendor?

(4) What types of contracts are involved?

d. Are there regular reviews of contractual arrangements / incentives with suppliers to achieve targets for CLS in Inventory? Is this part of the formal condition of the contract? Is this a two way process? Are there Gain shares involved?

e. Are communications with suppliers fit for purpose, routine; both electronic and face to face?

DATA CLEANSING

15. Data Cleansing is a regular and essential task performed by IMs.

a. How often is data cleansing carried out? Is this part of a continuing process or done as adhoc exercises? Who prompts these actions?

b. What levels of data conflict exist? e.g unserviceable consumables (recorded on the systems as E0 etc), Obsolete stock, Obsolete dues-in, Accounting class C but greater than value thresholds? Number of items involved? % of items in range?

INVENTORY LEVELS

16. Stock Turn Ratios (STRs) and total value conforms to targets agreed in Inventory Plan and are reviewed regularly.

a. What analysis has been done on STRs? Does the IM know what their achieved STR is? Do they report on it, and if so, to whom?

b. What is the current stock turn ratio performance against Inventory Plan targets?

c. Do they have SMART targets to improve it?

d. What is the total Gross Book Value of the Inventory against the target inventory levels as published in the Inventory Plan and agreed with the FLC? Or with Contractor(s)? By Consumable. By Rotable. By Repairable (EO) stock.

e. Has the inventory been reduced in the last 3 years? / in the process of reduction? By how much (Value / % overall)? Who prompted the reduction?

f. What Disposals have been achieved against the disposals plan target?

g. What % of active items within the PT is non-codified against the target agreed in the Inventory Plan and agreed with the FLCs / Industry? What is the value of non codified purchases against targets agreed in Inventory plan with FLCs? / contract agreements? How significant is this in terms of business? What processes are used to bring them into contract cover for future buys?

h. Non-conformance? What delay does this cause? What is the significance in terms of availability?

i. Value of Suspect / Suffix stock? Number of items with Suspect / Suffix stock?

j. Number of obsolescent (Fitted but can't buy) items as a percentage of total inventory? This needs to be managed in accordance with the Obsolescence Plan which is included in the Through Life Management Plan (TLMP).

k. What percentage of total Inventory is made up of Safety Stock and reserves (buffer stock / war stock etc)?

l. What is the current consumable performance ratio against target?

DELIVER - AVAILABILITY PERFORMANCE

17. Achieved performance of the Inventory reflects target laid out in the Inventory Plan especially in terms of off the shelf availability.

a. What is the current achieved 'overall immediate availability' performance of the PT against the target? At PT level? At IMC / DMC / SMBI level?

b. What is the immediate availability of the top 10 items by movement? Are these the same items each month? Are there any outstanding demands? What contract cover is involved?

c. What is the immediate availability of the known top 10 "critical items"? Are these the same items each month? Who assigns the criticality? What contract cover is in place?

d. What is the number of Dues out by demands? How does this compare with the Inv Plan Targets? As a total? By IMC / DMC / SMBI?

e. What is the number of dues out by number of items? How does this compare with the IM Plan Targets? As a total? By IMC / DMC / SMBI?

f. What is the value of Dues Out? How significant is this in terms of total turnover?

g. Number of items with demands outstanding which are over 12 months old? As a total? By IMC / DMC / SM? What contract provision is involved?

h. What % of items under management ban / control fail to meet their demand processing time target? As a total? By IMC / DMC / SMBI?

GOVERNANCE

18. Controls, checks, reporting systems with appropriate measures and appropriate tools are being used for governance.

a. Are there controls in place to ensure consistency across common processes across the team? What management checks exist to comply with current regulations?

b. What tools does the PT use to assist and report effectiveness of output?

c. Are performance measures weighted towards short lead times and quick response with minimal inventory levels? Is this working and driving the right behaviours? Is the balance between Lean and Agile being achieved?

d. What Inventory accounting arrangements exist for items under CLS including Contracting for Availability (CfA) and Contracting for Capability (CfC) arrangements? Is Inventory held on or off Balance-sheet? How often are figures reported? Is this a contractual condition? Is it verified?

e. What approaches are evident in the IM function to addressing problems?

RESOURCES

19. Is the IM team appropriately resourced for both manpower and finance?

a. What measures are in place to assess In-year funding availability against the inventory plan? What financial management controls exist? What FOOs are done? What contracting mechanisms are in place to cope with surge? What tradeoffs occur to stay within budget?

b. How much time is spent on expediting? (% of effort within team)? Is this because requirements have changed or poor delivery performance? What tradeoffs occur to bring some forward but delay others? What capacity is made available by contractors to cope with surges?

c. What barriers are there to increasing customer service and reducing costs of inventory? (Resource constraints et al).

TRAINING & DEVELOPMENT

20. Staff to be fully trained and take advantage of Continuing Professional Development (CPD) opportunities.

a. What is the size of the IM team? By number. By rank. By Job title. How does this compare to MCTs?

b. What methods exist to share best practice across the teams? Internally, across the Cluster and across DE&S.

c. When was the training requirement and Professional Posts last assessed? What level of training and CPD is required?

CHAPTER 8: MANAGEMENT OF SAFETY RELATED ITEMS OF SUPPLY

INTRODUCTION

1. In recognition of the safety and operational implications of component failure, system integrity has traditionally been protected by establishing a close working relationship between provisioning and engineering staff within PTs to ensure that purchasing decisions are managed down to Manufacturer Part Number (MPN) level, not just NATO Stock Number (NSN). The move to a Single Defence Inventory alongside the growing complexity of the defence inventory and associated range of purchasing and support arrangements now in place, require a clear and auditable process for the management of safety related Items of Supply.

PURPOSE

2. The purpose of this instruction is to provide a framework to ensure that the purchase and subsequent in-service management and upkeep of safety related Items of Supply is undertaken to a standard that maintains the integrity of the associated equipment / weapon system / platform safety case, protecting all relevant attributes and ensuring that all stakeholders' interests are identified and protected. This instruction does not replace existing Configuration Management (CM) procedures; it ensures that these principles of configuration management are applied at every stage in the supply chain.

SCOPE

3. This Chapter applies specifically to the situation where an item of supply is procured by a single authority and fitted to more than one platform or equipment irrespective of the environment.

OWNERSHIP AND POINTS OF CONTACT

4. The sponsor of this chapter is DES JSC SCM-SCO who should be contacted if clarification of the policy or procedures is required.

LINKED PUBLICATIONS

5. The following publications are linked to this instruction:

a. JSP 886 Volume 2, Part 3: Single Ownership of Items of Supply in the Defence Inventory.

b. JSP 886 Volume 2, Part 4: NATO Codification in the United Kingdom.

c. DEFSTAN 05-57: Configuration Management of Defence Materiel.

d. DEFSTAN 05-123: Technical Procedures for Procurement of Aircraft, Weapons and Electronic Systems.

e. DEFSTAN 05-130: Maintenance Approved Organisation Scheme.

f. JSP 553: Military Airworthiness Regulations.

g. MAP-01: Military Aviation Engineering Policy and Regulation.

h. SCMI 2.6: Submarine First Level Quality Assured Material.

i. Sea System Publication No 25 (SSP 25) - Policy for the Management of Safety Related Items of Supply - Quality Assurance for Safety in Submarines.

NOMINATION OF SAFETY RELATED ITEMS OF SUPPLY

6. **Safety Related Items.** The term 'Safety Related' is here used to denote an item considered by a customer PT to be related to the safe operation of that PT's equipment. Examples include (but are not restricted to) items deemed safety related for airworthiness and hull integrity considerations. Responsibility for defining Safety Related rests with the Safety & Engineering organisations within each environment, whilst responsibility for nominating an item as Safety Related rests with the Engineering & Safety organisations within each PT; Definitions of Safety Related for each environment can be found:

a. **Air**: JSP553 Military Airworthiness Regulations.

b. **Land**: JSP 454: MOD System Safety and Environmental Assurance for Land Systems.

c. **Sea**: JSP 430: MOD Ship Safety Management.

PROCESS APPLICABILITY

7. **General Applicability.** The procedures detailed in this instruction are applicable to any item of supply within the defence inventory nominated as Safety Related; regardless of ownership, application and the use of in-house or commercial support arrangements. Additionally, for items of supply sourced through or provided in support of multi-national and collaborative programmes, the managing PT must also comply with agreed multi-national and programme specific procedures.

8. **Multiple Users.** This instruction has been specifically developed and introduced to support the case where, in accordance with the principles of the Single Defence Inventory, an Item of Supply is managed by a single PT on behalf of the wider defence community.

9. **Item Ownership.** The policy for determining ownership of an Item of Supply where there is a shared interest is detailed in JSP 886 Volume 2 Part 3: Single Ownership of Items of Supply in the Defence Inventory.

COMMUNITY OF INTEREST

10. **Community of Interest**. For the purposes of this document the community of interest for an item of supply is defined as being represented by the Procurement Authority, all PTs on whose platform/equipment the item is fitted and, where nominated, the designated item engineering authority. The Item of Supply Information System (ISIS) database identifies the Procurement Authority[24] of the item of supply and the base inventory systems the item is managed on. ISIS does not enable the wider community of interest to be identified against the item record therefore the Procurement Authority is to maintain a list of those Project Teams which constitute the Community of Interest.

[24] Regardless of the contractual arrangements under which the item is procured, for the purpose of this document the Procurement Authority is defined as the MOD authority responsible for the contract.

SPECIFICATION OF THE ITEM OF SUPPLY

11. The accurate and comprehensive identification of an Item of Supply is an essential element in the management of safety related items particularly where an item is used on more than one platform or equipment.

12. Policy for the codification of Items of Supply is detailed in JSP 886 Volume 2, Part 4, NATO Codification in the UK. The master database of item attributes is ISIS. The quality and integrity of ISIS data is dependent on data feed from PT and industry sources.

13. It is the enduring responsibility of PTs to ensure that all relevant attributes of an item of Supply are correctly identified and communicated. Not all characteristics required for effective pan-defence management of safety related items are contained within ISIS. Therefore, the managing PT is to maintain additional management controls and records as appropriate to ensure that all essential characteristics are identified and managed. Figure 21 gives the minimum data required by the provisioning PT to support the management of the integrity of the Item of Supply:

Figure 21: Minimum Data Requirements

Requirement	ISIS Y / N	Comment
All relevant Manufacturer/Part Number combinations for a given NSN.	Y	
Full Item of Supply specification, Design Authority / Design Organisation and original Equipment Manufacturer (OEM) (where known) details25.	Y	Enforces the responsibility of the PT to provide totality of data iaw JSP 886 Vol 2, Pt 4, Ch 3 Para 4c. Need to identify for Record Purposes, all other PNs that have been used under this NSN but are no longer valid for purchase.
All current users by Equipment Applicability Code (EAC)26.	N	To identify the platform(s) / equipment(s) using an item.
Nominated EAC Engineering Authority (EA) with delegated authority for decision making for each user PT.	N	This identifies the decision making community of interest.
Source Control Items of Supply.	Y	Should be reflected in the Item of Supply definition within the codification process.

14. Where a PT considers a specific characteristic that can not be included in the ISIS record to be essential to the management of an Item of Supply for its application, then it is the responsibility of the PT requiring the additional characteristic to document the requirement and agree suitable administrative procedures with the owning PT to manage the additional characteristic. Examples where this may be required include (but are not restricted to) items supplied under a multi-national agreement or otherwise non-UK codified).

IDENTIFICATION OF SAFETY RELATED ITEM ON ISIS

15. When nominating an item ‘safety related’, the nominating PT is to ensure that the part number is prefixed with “QCA” on the ISIS record, this annotation to be undertaken

[25] Need further reference to Maritime QCA procedure

[26] The Equipment Applicability Code (EAC) is used in the Air Environment to identify equipments using an item in a many to one relationship; it is analogous to the Inventory Management Code (IMC) and Domestic Management Code (DMC) that indicates the lead PT / equipment on a one to one relationship.

through UK NCB. The ISIS record may contain other part numbers which are retained for record purposes only.

MANAGEMENT OF SPECIFICATION

16. **Contract Requirements** The purchase contract must address at least the following:

a. Traceability requirements (e.g: Provenance and Traceability).

b. Contractor Applicable Quality Standards including, DEFSTAN 00-56, DEFSTAN 05 – 57, DEFSTAN 05-123, etc.

c. The requirement to specify that suppliers and repairers to be registered to specific Quality Assurance or other licensing schemes such as (for the Air Environment) the Design Approved Organizations Scheme (DAOS) and Maintenance Approved Organization Scheme (MAOS).

d. For Items of Supply procured under enabling arrangements the contract must reflect a 'no change / no substitution' policy.

e. For Items of Supply procured / managed under CLS see Paragraph 16.

f. Terms and Conditions imposed on the Prime contractor are cascaded to sub-contractors.

g. Only the QCA annotated part number is to be supplied.

CONTROL OF CHANGE

17. Configuration Management (CM) is a project function defined in DEFSTAN 05-57 which is the application of control over a products form, fit or function. It details responsibilities and procedures associated with changes to the Configuration Status Record (CSR) which maintains an audit trail of CM documentation, the status of proposed changes and the implementation status of authorised changes and holds primacy in managing changes to specifications to Items of Supply. Of particular relevance is the requirement to seek concurrence to proposed changes by all members of the stakeholder community regardless of procurement authority.

Design Organisation Part Number Changes

18. Where the supplier is also the Design Organisation (DO), the supplier may have the authority to amend item specifications and part numbers. While this is a logical situation within the DO's own equipment, items supplied through CLS arrangements for wider defence applications introduce the risk of contamination within another user's equipment. To control this, where an item is supplied under a CLS contract for general defence use (ie beyond the particular platform or equipment supported by that CLS contract) the authority to supply an alternative MPN without formal approval from the managing PT following extant CM processes is to be denied.

19. Where an PT is considering a modification to an Item of Supply, or where a supplier proposes a specification or Part Number change that will not, of itself, lead to the definition of a new Item of Supply (new NSN), it is essential that the managing PT staff the proposed change with all stakeholders (including NCB) before accepting the new item. All proposed specification changes or modifications must be formally accepted by all user PTs and the

UK NCB before the modified item can be accepted. Where all stakeholders can not agree that the post modification item is the same in fit, form and function then it will be necessary to create a new Item of Supply; normally against the new MPN.

Management of Proposed Changes

20. Responsibility for the staffing of any changes proposed within an NSN (e.g, changes to Manufacturer / MPN, addition of new MPN, changes to the MPN specification) rest with the PT proposing the change. The diagram of the indicative process is at Figure 22. Changes are to be staffed through the wider customer PT community of interest, including the UK NCB. The minimum information to be promulgated includes:

a. Existing MPN.

b. New MPN.

c. Nature of change.

d. Reason for change.

e. Revised specification.

21. Change of manufacturer (where applicable - MAOS & equivalent scheme requirement):

a. Change of supplier.

b. Timescales proposed for change.

c. Availability of alternative supplier(s).

d. Request for agreement / non-agreement to change.

22. If all domestic and international (through the UK NCB) users accept the proposed change then the following actions will be required:

a. ISIS record changed (ensuring QCA annotation(s) correctly applied).

b. New component procured.

c. Old MPN made direct alternative (conditional / unconditional as appropriate).

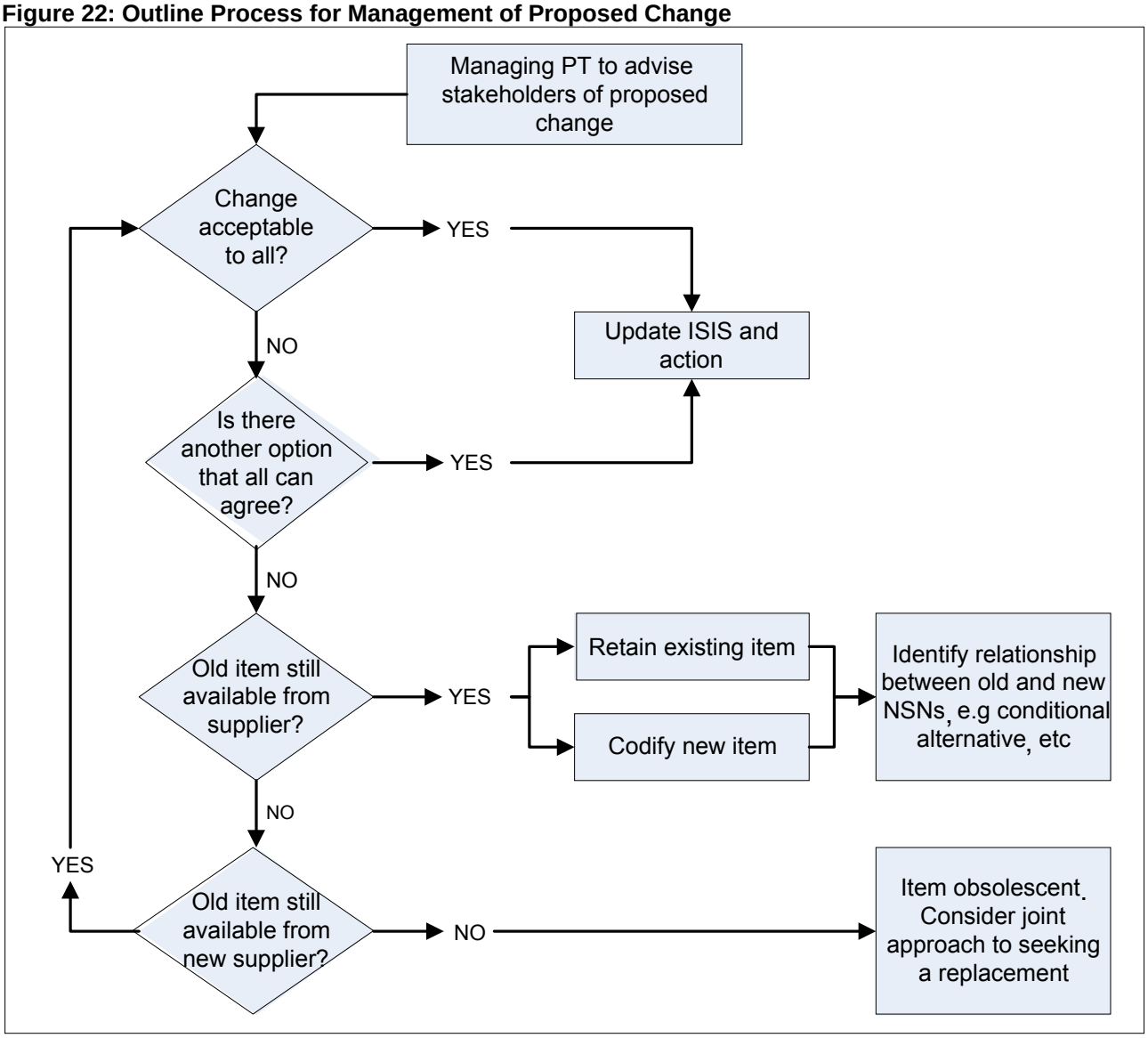
d. Notification to all PTs of MPN change and agreed timescales.

e. Inform the DO(s) of change (if required).

f. Retain all communication / correspondence for audit trail.

g. Update all relevant documentation including Illustrated Parts Catalogues (IPC), Illustrated Parts List (IPL), Technical Publications, Books of Reference (BRs), inventory management, asset tracking and maintenance recording databases, etc.

Figure 22: Outline Process for Management of Proposed Change



23. If not all PTs can accept the proposed change (ie the old and proposed new items are not identical in fit / form / function) then:

a. Is there another option that all can agree on?

b. Can old NSN still be procured from same supplier or same specification from new supplier?

c. If new supplier, seek approval for change as per above.

d. Codify the new item to ensure old and new specifications can be identified as separate Items of Supply.

e. If old NSN obsolescent; can replacement activity be coordinated to minimise costs?

f. Identification of relationship between 'new' and 'old' NSNs, conditional alternatives etc.

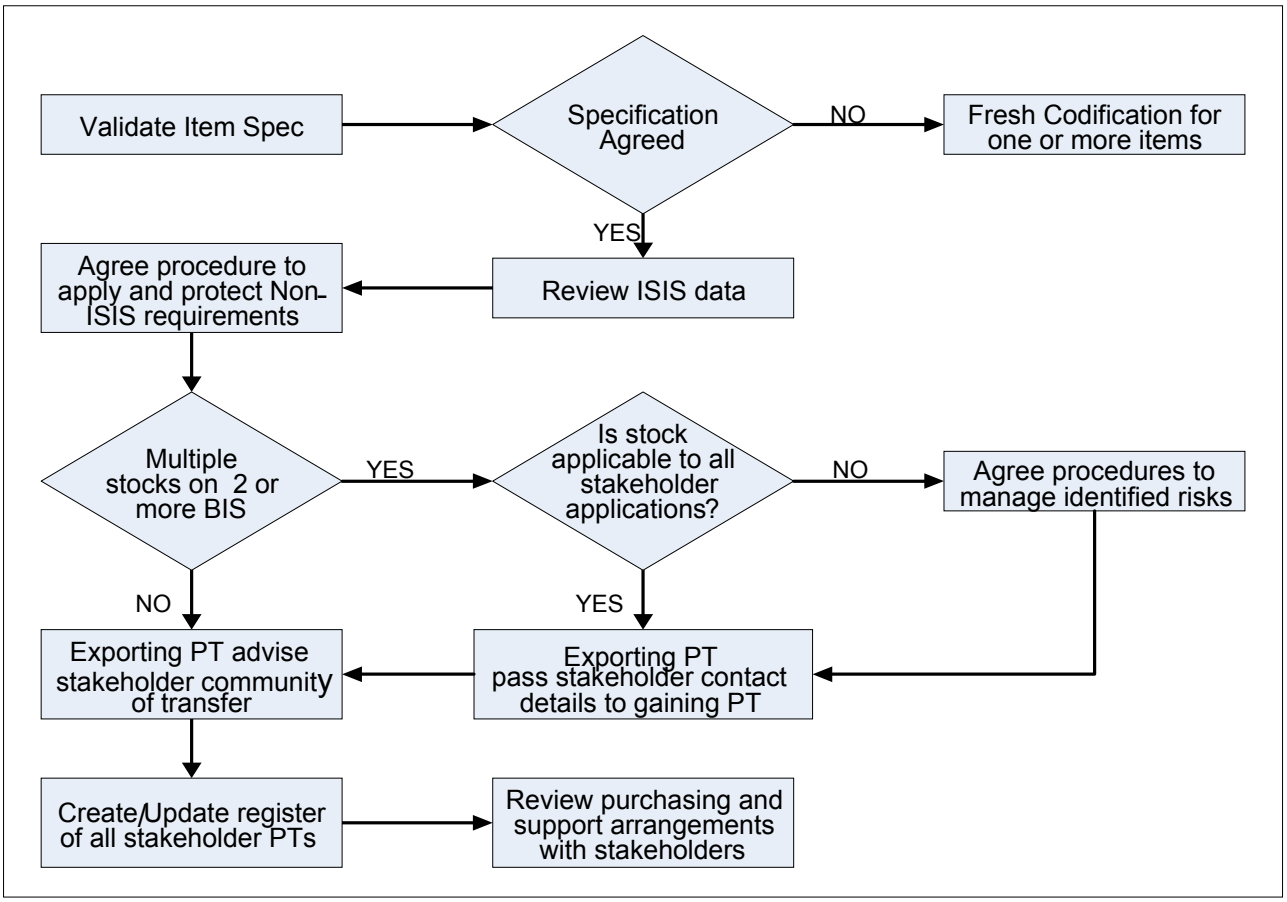
TRANSFER OF OWNERSHIP

24. The indicative process for the transfer of management of an Item of Supply between PTs is at Figure 23. This may occur either for:

a. **Multiple Interests.** Where 2 or more PTs currently manage an item on separate Base Inventory Systems and management is being rationalised on a single PT in accordance with the single defence inventory policy. In this instance both the gaining and losing PTs retain an interest in the subject Item of Supply.

b. **Transfer of Interest.** Where the managing PT no longer has a business interest in the Item of Supply and is transferring management either to a newly involved business area or to an existing stakeholder.

Figure 23: Outline Process for Transfer of Ownership



25. The following actions are to be undertaken by all stakeholders to affect the transfer of responsibility for procurement of an Item of Supply:

a. **Joint Preparation.** The following actions are to be undertaken jointly by all user PTs and the UK NCB.

(1) Validate and agree the item specification for the item being transferred.

(2) Where a common specification can not be agreed it will be necessary for one or more items to be freshly codified as new Items of Supply iaw JSP 886, Volume 2 Part 3, Single Ownership of Items of Supply in the Defence Inventory.

(3) Review ISIS Data in accordance with the requirements detailed in Paragraph 11. Particular interest should be placed on any specialist requirements (e.g: Source Control). Any difficulties or queries should be addressed in the first instance to the UK NCB.

(4) Establish and agree procedure with managing PT to ensure that non-ISIS requirements are applied and protected.

(5) Identify where multiple stocks exist[27] under the same NSN, identify and agree actions to validate the applicability of stocks to all stakeholder applications. Where safety concerns are identified, PTs are to agree and implement joint procedures to manage identified risks with due consideration of the level of risk together with the associated costs and practicalities of implementation

b. **Exporting PT.** Where the exporting PT has been managing the Item of Supply on behalf of the wider defence community.

(1) Advise the stakeholder community of the proposed transfer.

(2) Pass contact details for all stakeholder PTs to gaining PT.

c. **Importing PT.**

(1) Create or update as applicable, the register of all stakeholder PTs.

(2) In consultation with other stakeholder PTs, review current purchasing and support arrangements to ensure that all identified stakeholder PT requirements are met or deviations agreed.

[27] This situation can arise where an item is managed simultaneously on 2 or more Base Inventory Systems.

CHAPTER 9: ALGORITHM GOVERNANCE

PURPOSE

1. This Chapter describes the policy and processes covering the requirement for governance of algorithms used by LogIS and the use of analytical techniques for Inventory Management. At this stage, this governance policy is aimed at inventory and programme managers within DE&S.

SCOPE

2. This policy applies to project leaders and programme managers who are responsible for the development and integration of LogIS and management of the defence equipment inventory.

GOVERNANCE

3. The sponsor and regulator for algorithm governance is Hd SCM on behalf of D JSC. Executive responsibility is vested in Dep Hd SCM-SCO with the functional execution delivered through an Algorithm Cell.

KEY POLICY OBJECTIVES

4. LogIS inventory optimisation requires the identification and use of the best algorithm for an item given its data characteristics. As such JSC inventory policy and LogIS algorithms should be developed jointly to ensure supply chain coherence and that the algorithms employed are 'fit for purpose'. In addition, a greater understanding of inventory behaviour can be gained through the application of analytical techniques. These can range from simple segmentation analysis to more complex analysis; for example a test for the presence of seasonality in a time-series data set. Therefore, the key objectives of the policy are to:

a. Improve inventory forecasting through the employment and endorsement of specific and accurate algorithms within LogIS.

b. Ensure the use of "best of breed" algorithms, are selected and correctly aligned to inventory segments and for the appropriate purpose.

c. Enable more effective cost benefit analysis and risk assessments to be undertaken in order to focus on improving equipment availability and JSC capability.

d. Develop and maintain a coherent and authoritative understanding of the algorithms that are contained within LogIS.

TECHNICAL VISION

5. A technical vision and guide for algorithms and analytical techniques is at Annex A. This provides a basic understanding of techniques and forecasting methods applicable to the management of the defence equipment inventory. Some of the simple techniques can be quickly employed to great effect, whereas further advice will be required for the more complex methods. The ability to readily exploit all the techniques described does not yet exist and staff are not expected to implement the techniques locally. The vision is to utilise the functionality and data within the Enterprise Data Warehouse (EDW) and other future LogIS to provide PTs and other stakeholders with a suite of tools for inventory

segmentation and to review forecasting algorithms. This will permit PTs to adopt more effective inventory management strategies that are aligned to the demand characteristics exhibited by the inventory under their control.

ALGORITHM COHERENCE

6. Over and above the analytical techniques, Project Leaders and Programme Managers are to engage with the Algorithm Cell for advice on, and, recommendations for endorsement of the algorithms used within their LogIS. Advice is to be sought when:

a. Analysis is being undertaken on the efficacy of supply chain algorithms.

b. Recommending Improvements are being considered to LogIS.

c. A new LogIS is being designed and introduced.

ALGORITHM CELL

7. The SCM Algorithm Cell provides a fast, in-house one-stop service for PTs and programme managers who require mathematical and decision support analysis. It deals with the 'hard' quantitative science of inventory management and as well as offering guidance and critical comment, it can undertake complex simulation modelling. The sponsor's authority is exercised through the Algorithm Cell which has functional responsibility for:

a. Evaluating algorithms employed in LogIS.

b. Recommending changes to underlying LogIS algorithms or associated parameters. This may include simulation modelling to establish parameters or the effect of algorithm changes.

c. Maintaining regular contact and dialogue with relevant projects and will offer guidance to develop, with the project teams, "best of breed" supply chain solutions.

d. Establishing and controlling levels of user access for tools, both current and future, such that only personnel with an appropriate level of expertise are permitted to make changes to system parameters.

e. Ensure algorithm coherence throughout the JSC and issue policy on behalf of the sponsor.

f. Maintaining relationships with leading SCM academic institutions in order to incorporate leading academic thinking on forecasting algorithms and inventory management techniques into the JSC environment.

g. Advise on the functional competences and the training staff in SCM appointments on supply chain algorithm knowledge.

PROCESS FOR REQUESTING AND RECEIVING ADVICE

8. Requests for algorithm SME advice and guidance are to be directed to C1 Algorithms. Following initial discussion, a formal request is to be submitted which will be acknowledged. Submissions will be categorised as follows at the discretion of C1 Algorithms:

a. **Category 1.** Algorithm review in support of an existing LogIS change request or future LogIS requirements. This may include complex simulation modelling to inform the decision making process. A formal report will be produced specifying the algorithm requirement or submitting potential options with accompanying recommendations based on the analysis.

b. **Category 2.** Wider algorithm mathematical analysis. This could include advice on segmentation techniques, algorithm understanding or review of inventory analysis criteria for example. The output is to be agreed with the customer.

9. Contact details for C1 Algorithms are:

ALGO1
DES SCM SCO
W120, Swales Pavilion, RAF Wyton, PE28 2EA
Tel: Mil: 95371 Ext 5248. Civ: 01480 52451 Ext 5248
Email: DES SCM-SCO ALGO1

ANNEX A TO CHAPTER 9: JSC ALGORITHMS – TECHNICAL VISION

(Introduced at paragraph 5)

VISION

1. To facilitate the use of best practise supply chain algorithms for optimising Inventory Management in the defence supply chain.

INTRODUCTION

2. An algorithm is a precisely designed set of rules with the aim of solving a particular problem. It may take the form of a mathematical equation, a few lines of computer code to traverse a network or perhaps a cookery recipe. The point is that in each case, if the rules (or instructions) are followed precisely the problem will be resolved; i.e. the equation will be solved, the network path will be determined or the meal will be cooked. The 'rules', if applied rigorously will consistently and unambiguously provide the same output given a specific input.

3. The scope of the generic subject of algorithms covers a vast spectrum. Indeed, many textbooks have been written on the subject and a complete review is neither practical nor desirable. Therefore, this annex focuses on algorithms that have direct relevance to the JSC and have wide applicability to programmes and initiatives. For example, provisioning, placement and movement of inventory is critical for JSC capability. Within this, inventory segmentation techniques, forecasting methods, size of procurement methods and network optimisation must all be considered and for each aspect, the choice of algorithm(s) is fundamental to capability delivery and optimisation.

4. Whilst the techniques are universal within the context of supply chain management, local implementation is not expected. Incorporation and adoption within Log IS of any of the techniques would only occur following appropriate staffing, consultation, development of suitable tools and training.

AIM

5. To present an overview of the spectrum of mathematical techniques and algorithms that will enhance and optimise JSC programmes and initiatives.

BENEFIT STATEMENT

6. A coherent knowledge and understanding of algorithms applicable to supply chain management will facilitate the most cost-effective use of supply chain resources and move towards an optimised supply chain. Reducing the size of errors in the management of the supply chain will reduce waste by avoiding unnecessary purchases or stock movements.

ALGORITHM REVIEW

7. The following topics will be discussed:

   a. Segmentation.

   b. Forecasting.

   c. Inventory Management.

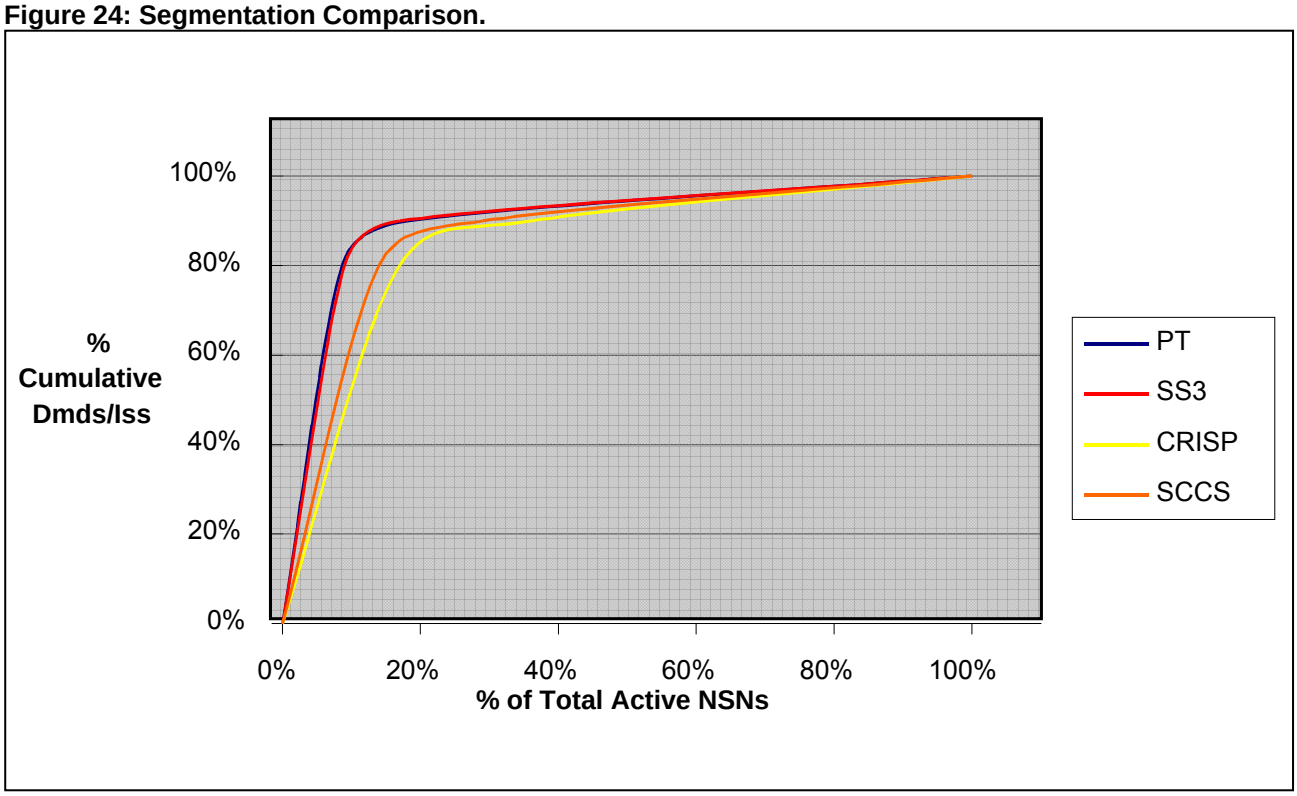
d. More sophisticated techniques.

SEGMENTATION

Pareto

8. A good starting point for solutions to supply chain problems is through the application of segmentation techniques. The aim of segmentation is to understand the real drivers that are contained within a data set. The simplest of these and most well known is Pareto Analysis where, 80% of the frequencies are associated with just 20% of the categories[28]. The 80/20 proportions are not absolute values. The point is that a minority of any population often accounts for a disproportionate majority of a given parameter. This is clearly demonstrated by a Pareto Analysis of the defence inventory where approximately 10% of the inventory accounts for 80% of the demands. This can be seen in Figure 24, which includes a Pareto Graph of one PT for comparison with SS3, SCCS and CRISP.

Figure 24: Segmentation Comparison.



9. ABC analysis is a logical progression from Pareto and applies categories in order to designate management attention. Typically, category 'A' items account for 80% of activity, category 'B' 15% and category 'C' the remaining 5%. This will often approximate to 20% of items in category 'A', 30% in category 'B' and the remaining 50% in category 'C'. The actual values are somewhat arbitrary, but it is based upon the original Pareto findings and a guide for defence is:

a. Category 'A' items - Top 80% of activity.

b. Category 'B' items - Next 10% of activity.

c. Category 'C' items - Remaining 10% of the activity.

[28] 19th century Italian economist Vilfredo Pareto made an observation that 80% of Italy's wealth was owned by 20% of the population. This 80/20 split has been observed in many different areas of life.

10. This information can be readily used to good effect. Identifying that 10% of demands accounts for 80% of active NSNs, immediately demonstrates where the primary inventory management effort should be placed. This provides the catalyst for optimisation and management techniques. There are three questions to answer when selecting a segmentation approach:

a. What are your objectives? Examples are;

(1) Reduce inventory investment.

(2) Reduce warehouse capacity utilisation.

(3) Identify spend categories.

(4) Increase availability of equipment with a minimum investment of inventory.

b. Select the criteria that supports or impacts upon the objective. Examples are;

(1) Cost.

(2) Demands placed.

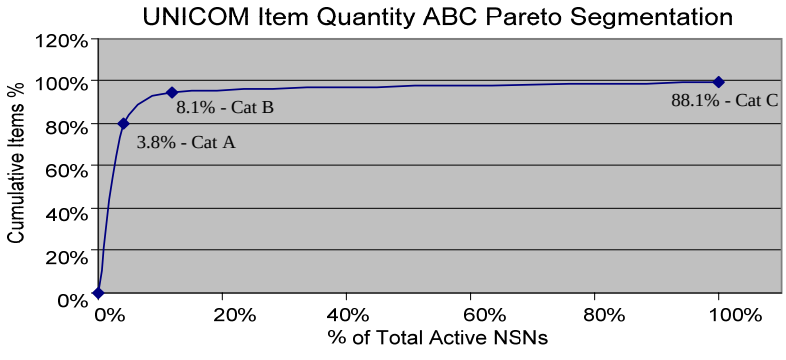
(3) Failures.

(4) Criticality.

c. Based on the criterion chosen, segment the data using ABC analysis.

11. An example of ABC analysis is at Figure 25. Note how small the 'A' and 'B' categories are. These ABC categories were selected because of the demand frequencies of the data examined; 80% of the demand activity was focused on only 3.8% of items.

Figure 25: Project ABC Analysis



Item Qty Category	Number of NSNs		
	Total	%	Cum %
A	287	3.8%	3.8%
B	626	8.1%	11.9%
C	6782	88.1%	100.0%
Totals	7695		

9 Box Model

12. The above examples provide the foundation for more technical analysis. Discussion will now focus upon more complex segmentation, which enables managers to direct specific management strategies supported by specific algorithms. The first of these is a 9 Box Model.

13. A 9 Box Model is a 2 dimensional Pareto style segmentation tool. Again segmentation categories are applied to the data and then these are aligned to management strategies. Figure 26 provides an example of management strategies for a

procurement model. A more complex model can be created using criticality as a metric aligned to safety stock for example, to create a service level driven statistical inventory model.

Figure 26: 9 Box Procurement Model

	Inventory Strategy			
Annual Demand	Fast	Stock with User (Vendor Managed Inventory)		Held Centrally
	Medium	Auto Procure		
	Slow	Life-time Buy	Held Centrally	Make to Order
		Low	Medium	High
	Unit Cost			

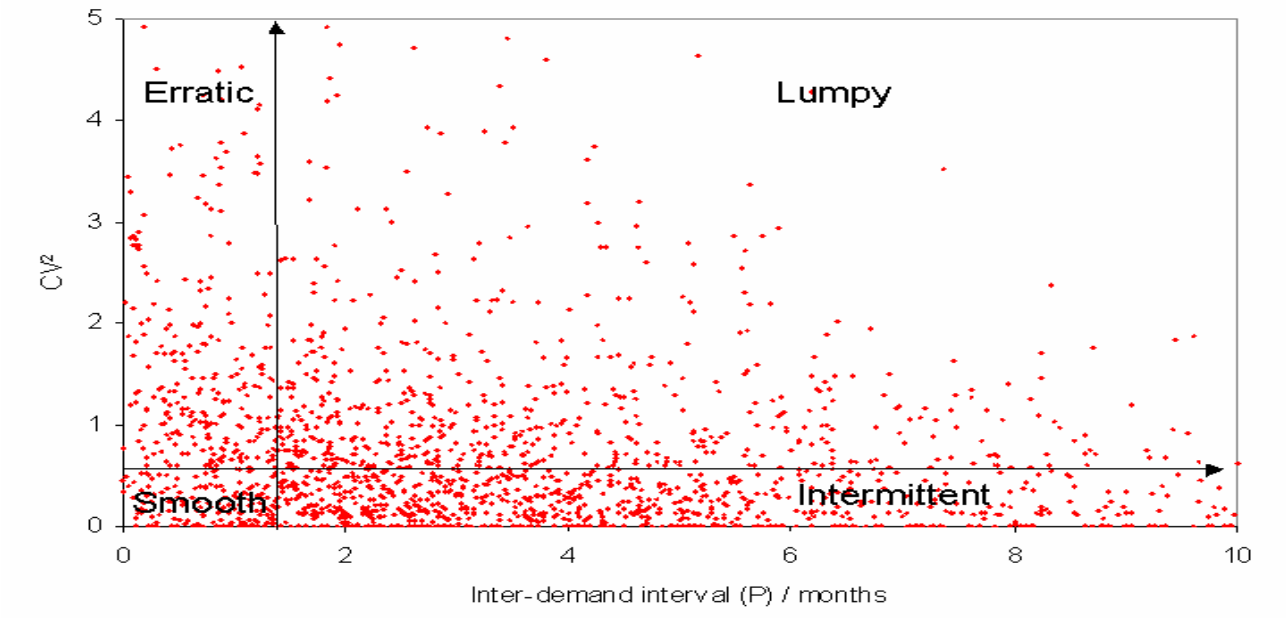
Segmentation for Demand Forecasting

14. Demand forecasting presents its' own unique problems and there are numerous forecasting techniques that can be employed. However, knowing which forecasting techniques to apply is not simple as each item (Stock Keeping Unit (SKU) or NSN) has its own demand pattern. It is therefore good practice to segment inventory according to demand characteristics and then apply forecasting algorithms on the basis of 'best fit' or the algorithm that produces the minimum forecasting error. This discussion will focus on inventory demand segmentation, leaving forecasting techniques to a later section.

15. Segmentation based on demand characteristics allows the analyst to apply forecasting techniques to manage inventory with different underlying characteristics. Syntetos and Boylan have developed one such method of segmentation based on demand characteristics. Logically, it is clear that demands for inventory are categorised by a quantity and an interval between demand events. Syntetos' and Boylan's (2005) approach to segmentation considers the interval between demand events (P) and the square of the coefficient of variation (CV^2) in the quantity demanded to derive 4 segments based upon the level of variation in demand quantities and the length of the interval between demand events. An example of this segmentation approach is shown in Figure 27, which demonstrates the differing demand characteristics of a random sample of SCCS NSNs.

16. This technique has been demonstrated in academic literature to provide a valid approach to identify items that would be suitable for different forecasting methods. This is fundamental to effective inventory management and an expectation that a single forecasting algorithm within any inventory management tool will be effective for forecasting demand for all inventory is unlikely to hold true.

Figure 27: Syntetos and Boylan Segmentation of Random SCCS NSNs



Smooth	=	Consistent Demand Size & Frequency.
Intermittent	=	Consistent Demand Size but Intermittent Frequency.
Lumpy	=	Variable Demand Size & Intermittent Frequency.
Erratic	=	Variable Demand Size but Consistent Frequency.

17. Recent work within SCO has used this technique to identify items that may be suitable for a hands-off (or auto) procurement approach. Items within the 'smooth' region represent items that are both frequently demanded with little fluctuation in quantity. These items can be forecasted with reasonable certainty and generally do not require close management. Allowing these items to be auto procured frees time that can be used managing the 'problem' items. Eaves (2002) and Williams (1984) have proposed similar schemes, both with merit. The Syntetos and Boylan model is a preferred approach as the JSC data requirements to support the model are readily available, making it its implementation straightforward.

Segmentation and Criticality

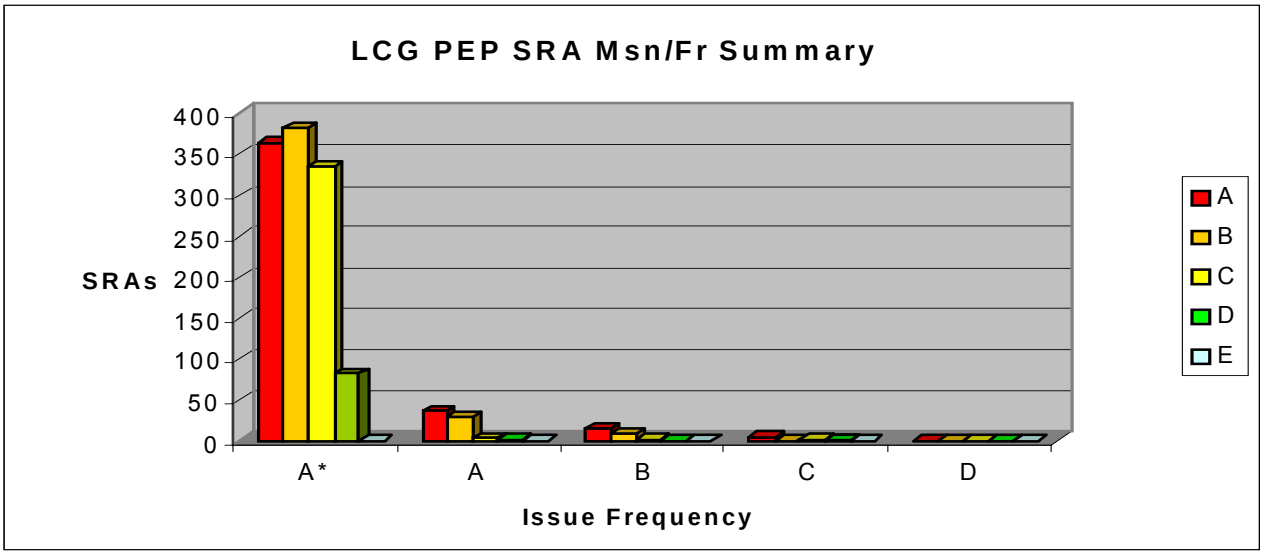
18. There are two widely held notions of criticality. An item or system may be critical in an engineering sense or in a supply chain sense. To explain further, the failure of an item (say a helicopter rotor) may be critical to the complete system; as if it fails in service then it is likely that the whole system is lost. No number of rotor spares on the shelf will make any difference to availability if the overall system is lost. A first line consumable item on the other hand might well make the difference between having a serviceable asset or not. It is clear that the rotor blade is critical in an engineering sense, while the consumable service item is critical in a supply chain sense. Both measures of criticality are valid, but their management policies will be markedly different. Hence it is important for criticality to be clearly defined and understood throughout the supply chain.

19. Currently within the JSC there are numerous measures of criticality. These generally are engineering centric. However, a means of identifying criticality is a line of work that is both relevant and vital to the defence supply chain. Work in this area has already been conducted (Rutherford and Woolford, 2005). This idea is predicated on the applicability of an item and where in the supply chain that item is used. In general terms, items applicable to a weapon system are more critical than those that are not, and those consumed at first line are more important than those consumed further back in the supply chain and those with a long replenishment lead-time are more important than those whose lead-time is

small. The relative criticality of items is determined using an analytic hierarchy process (Saaty, 1990) to determine a criticality factor based on the three variables. The relative criticality factor is then used to set an appropriate service level. This approach is logical, since items consumed at first line represent the difference between having a serviceable weapon system or not. Consequently, it is important to consider and include if possible, criticality as criteria when segmenting the defence inventory.

20. An example of employing criticality to supply chain analysis is the segmentation work conducted on behalf of Land Primary Equipment Packs (PEPs). This work brought together Pareto, 9 Box Model and criticality evaluation to provide a staff tool that allowed instantaneous identification of PEP items by criticality and demand profile. Figure 28 shows the demand frequency and mission criticality analysis conducted for a Lead Company Group PEP. The criticality was assigned to Standard Repair Activities (SRAs) using defined engineering categories (Classified A to E; mission critical to non-essential). The inventory demand was profiled and categories assigned for A* (NSNs with demand greater than once every month) to D (NSNs with demand less than one every 3 years).

Figure 28: PEP Segmentation by Criticality



21. This analysis provided the following benefits:

a. It demonstrated the 90% of the PEP contained NSNs that had a demand profile of more than one demand every three months.

b. It identified the PEP issued NSN quantities with SRAs and criticality. Thereby allowing commanders to draw confidence in the PEP.

c. It allowed the PEP to be intelligently interrogated.

Segmentation Benefits

22. Segmentation is an important tool for supply chain improvement. In the first instance it is simple to use. However, through the application of more complex procedures, it can provide the foundation for focused intervention and management strategies. An example of more complex analysis is at Appendix 1, this demonstrates another application of ABC analysis a 9 Box Model incorporating criticality criteria.

23. The following key points are made:

a. Segmentation can be used to great effect to focus on cost, time and resource issues.

b. Segmentation is very powerful in identifying themes, failures and choke points.

c. Ensure that the segmentation categories are relevant to the problem.

d. Segmentation can be performed using basic MS Excel software as well as being incorporated into enterprise systems.

e. Segmentation is not just for bosses.

FORECASTING ALGORITHMS

The Role of forecasting in a Supply Chain

24. Demand forecasts form the basis of all supply chain planning. Inaccurate estimates result in either too much or too little inventory in the system. Therefore, it is important to ensure that the forecasting method used is fit for purpose. In order to perform effective forecasting, a recommended approach is to adopt the following four-step sequence:

a. Understand the objective of the forecast.

b. Integrate demand planning and forecasting throughout the supply chain.

c. Determine the most appropriate forecast method(s).

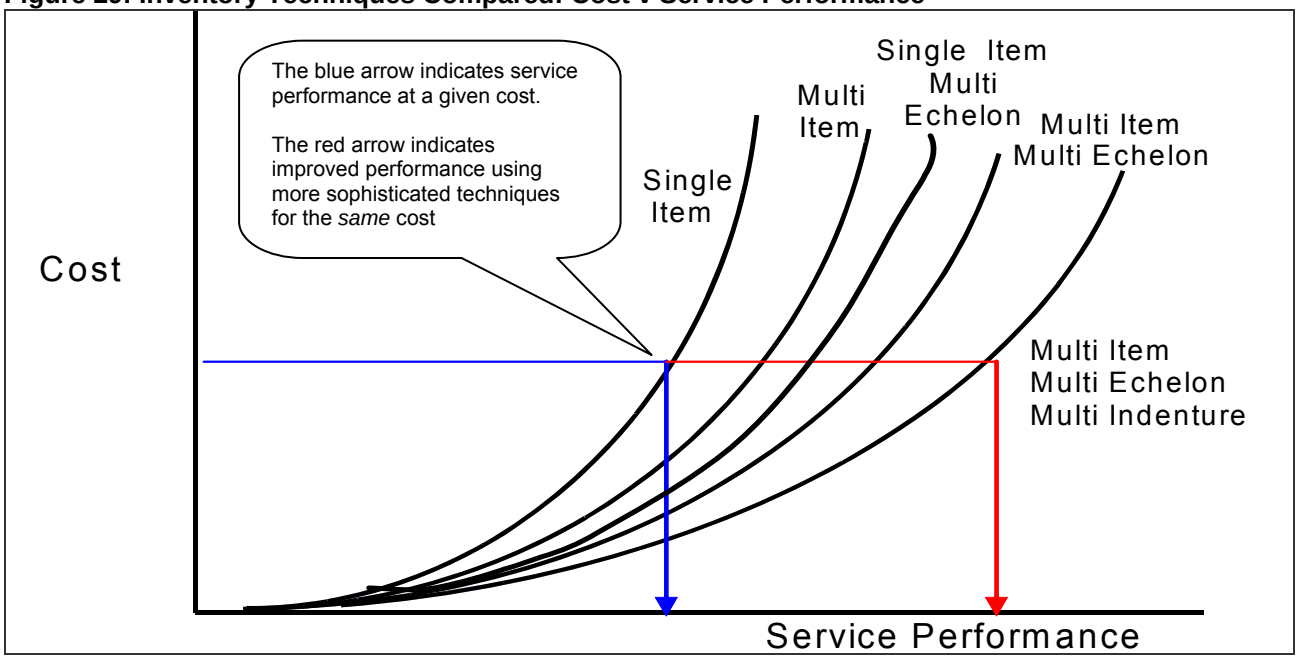
d. Stabilise performance and error measures for the forecast.

25. The goal of any forecasting method is to predict the systematic component of demand and estimate the random component. In its most general form the systematic component contains a level, a trend and a seasonal factor. There are many different types of forecasting methods. Some are qualitative and rely on management opinion and consensus. Others are quantitative and are computed using algorithms. This analysis will focus on the quantitative forecasting method which is the methodology employed in the JSC BIS.

26. Before proceeding in further detail, it is important to place the current Base Inventory Systems[29] (BIS) provisioning process and the simulation model in context. BIS provisions on a single node and item basis. However, it is supporting a complex, multi-echelon supply chain and it can be shown that a single item provisioning tool with a ‘one size fits all’ approach will not meet the inventory demands and service the supply chain at optimised levels. Industrial comparators, with similar circumstances, use tools that automatically segment the inventory and apply appropriate algorithms to optimise support and stock levels across multi-echelon supply chains. Figure 29 compares the different methodologies highlighting current BIS performance against requirement.

[29] SS3, SCCS and CRISP.

Figure 29: Inventory Techniques Compared: Cost v Service Performance[30]



Key	Description
Single Item.	Nodal forecasting & provisioning for each item separately without budget or other constraints. Current approach for in service BIS.
Multi Item.	Nodal forecasting & provisioning for each item separately with budget or other constraints.
Single Item Multi Echelon.	JSC forecasting & provisioning for each item separately with budget or other constraints.
Multi Item Multi Echelon.	JSC system forecasting & provisioning for each item separately with budget or other constraints.
Multi Item Multi Indenture Multi Echelon[31].	JSC system forecasting & provisioning for each item separately with budget or other constraints and without the assumption of independence of items' failure rates.

Quantitative Forecasting Algorithms

27. Quantitative forecasting methods are often based on time-series analysis and include moving average, exponential smoothing and more complex autoregressive (AR) models. These algorithms forecast a future requirement based on past behaviour. The simplest is a basic moving average algorithm; however, the algorithms progressively become more complex incorporating factors for trend and seasonality. The sequence of algorithms below provides a simple explanation of the most common time-series forecasting algorithms. The Defence inventory is characterised by a predominance of slow moving inventory. Simple averaging methods are unlikely to give accurate forecasts for these items. Averaging methods are most effective where demand intermittency is small and demand size is reasonably stable.

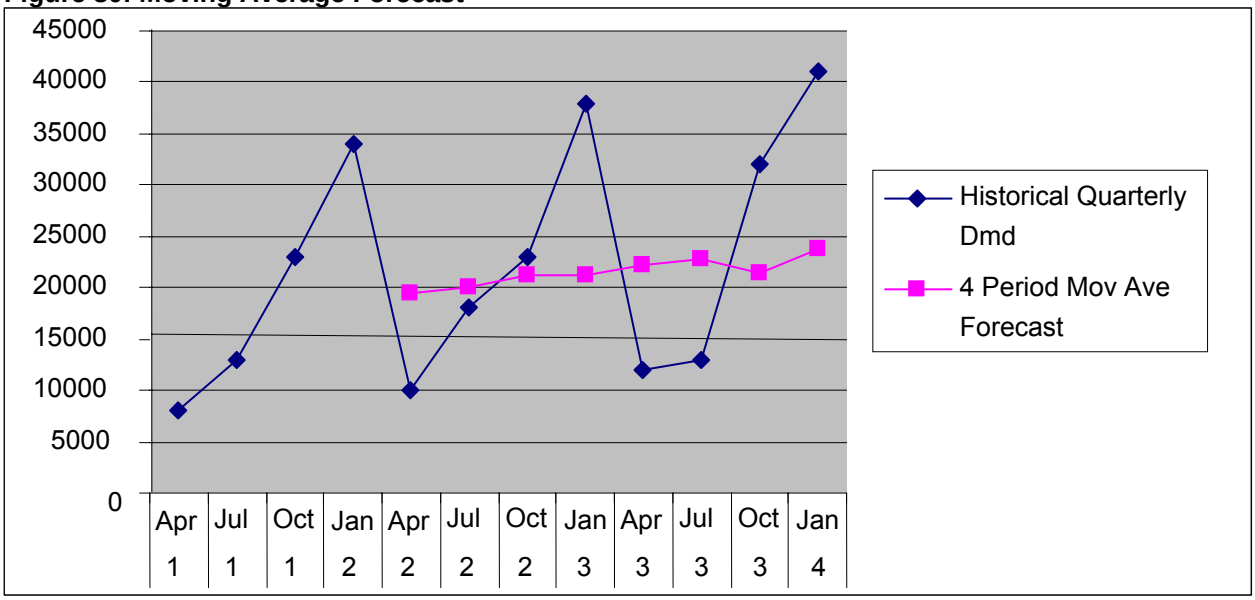
28. **Simple Average.** This is the most basic of forecasting algorithms and forecasts demand by summing the total recurring demand quantity, then dividing the sum by the number of days of the demanding period. This will provide an average rate of consumption per unit time. This algorithm operates effectively for Smooth items with low intermittency and unvarying demand size. However, its sensitivity is limited to the length

[30] Adapted from Click Commerce Comparison.
[31] Called MIME in DE&S

of period (in days) used to compute the average. For example, a daily average calculated over a 12 month period (365 days), will not identify cyclical behaviour occurring within the 12 month period. Therefore a high level of stock outs will occur resulting from the cyclical change of operational tempo within the 12 month period.

29. **Moving Average.** This method forecasts demand as an average estimate calculated from a given period of past months. The longer the past period of months used in the calculation, the less responsive the forecast becomes to the most recent demand. This technique is illustrated at Figure 30. It can be seen that a moving average forecast cannot respond to trend or seasonality and requires a minimum build equal to the period forecast. This method works well for Smooth items with very low intermittency and unvarying demand size, slightly better than simple average but always behind demand level changes. One clear benefit of a 12-month moving average is that seasonal variations will be wrapped up in the forecast, which is of considerable value over an annual planning horizon. However, as with any averaging approach, it works best with stable frequent demand. If trend in data is present, then a moving average will necessarily lag behind true demand.

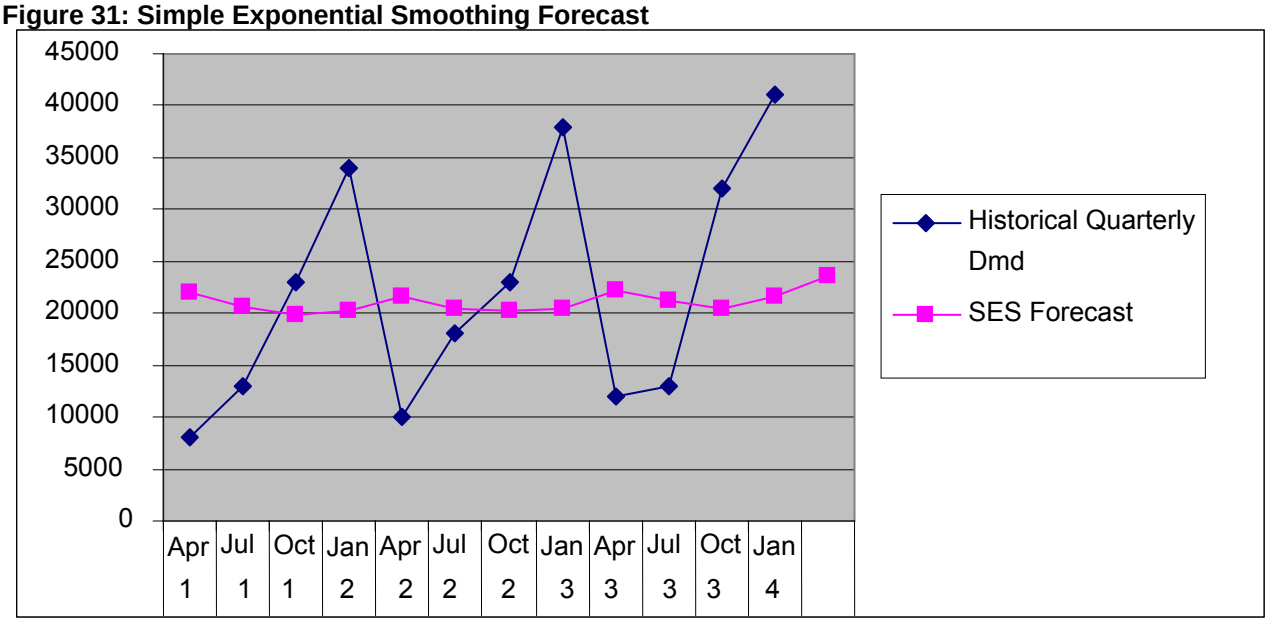
Figure 30: Moving Average Forecast



30. **Simple Exponential Smoothing.** This is a weighted moving average method and benefits from minimal record keeping of past data. The forecast for a period is equal to the forecast for the previous period, adjusted by a smoothing constant (fraction) of the forecast error in the previous period. By increasing the smoothing constant, more weight can be given to recent periods and by reducing the smoothing constant more weight can be given to past periods. This method is illustrated at Figure 31. The benefits of simple exponential smoothing (SES) are that it is easy to initialise, it is economical in terms of data storage and its sensitivity can be changed at any time by altering the value of the smoothing constant. However, this method is only appropriate when there is no observable trend or seasonality as it lags behind changes in demand. It is also only appropriate for inventory with a 'smooth' demand profile i.e with low intermittency and "Stationary[32]" demand size. It is better than the simple or moving average methods but always lags behind demand level changes. This algorithm is currently utilised in SS3 and SCCS.

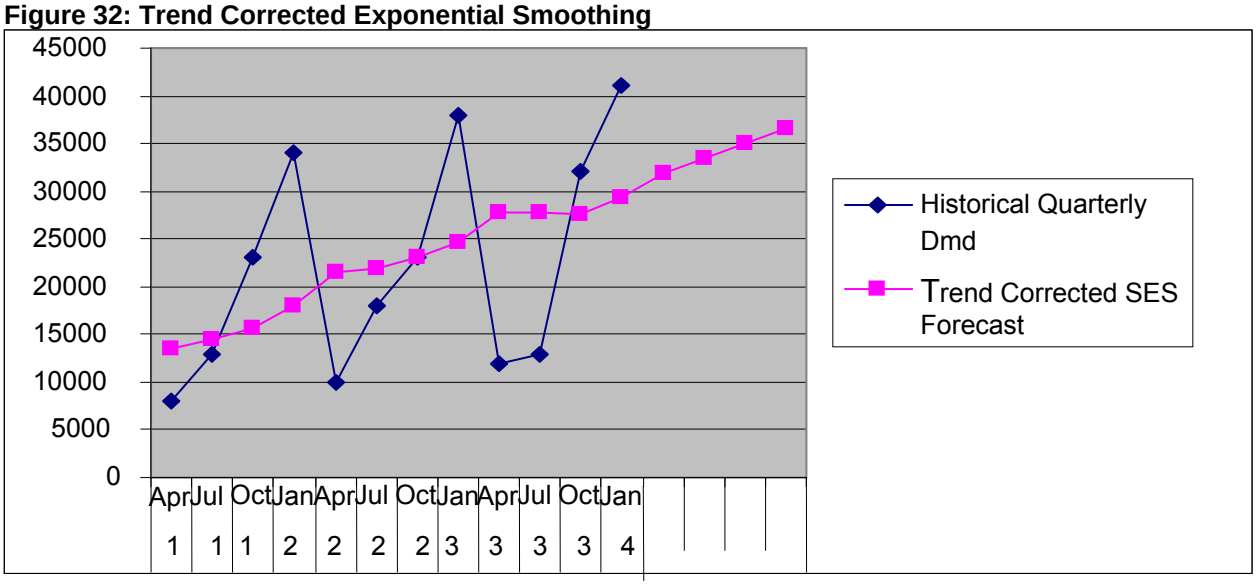
[32]Stationary demand refers to a profile where the underlying mean is constant. Random fluctuations occur, which may be considered as noise. There is no underlying trend present in the data.

Figure 31: Simple Exponential Smoothing Forecast



31. **Trend Corrected Exponential Smoothing (Holt's Model).** This method is the same as SES but develops the algorithm to accommodate 'trend' in the demand data. The initial estimate of level and trend is obtained by running a linear regression between demand and the time period. The result of this provides another smoothing constant β, which is incorporated into the SES algorithm. The forecasting algorithm will now follow the trend in the demand data. Whilst the general shortcomings of the SES methodology still apply, clearly this method is more adaptive. This is illustrated in Figure 32. It is necessary to establish that there is a trend present in the data prior to applying this technique. It should be borne in mind that it may be difficult if not impossible to establish the presence of trend with any great confidence where demand is intermittent.

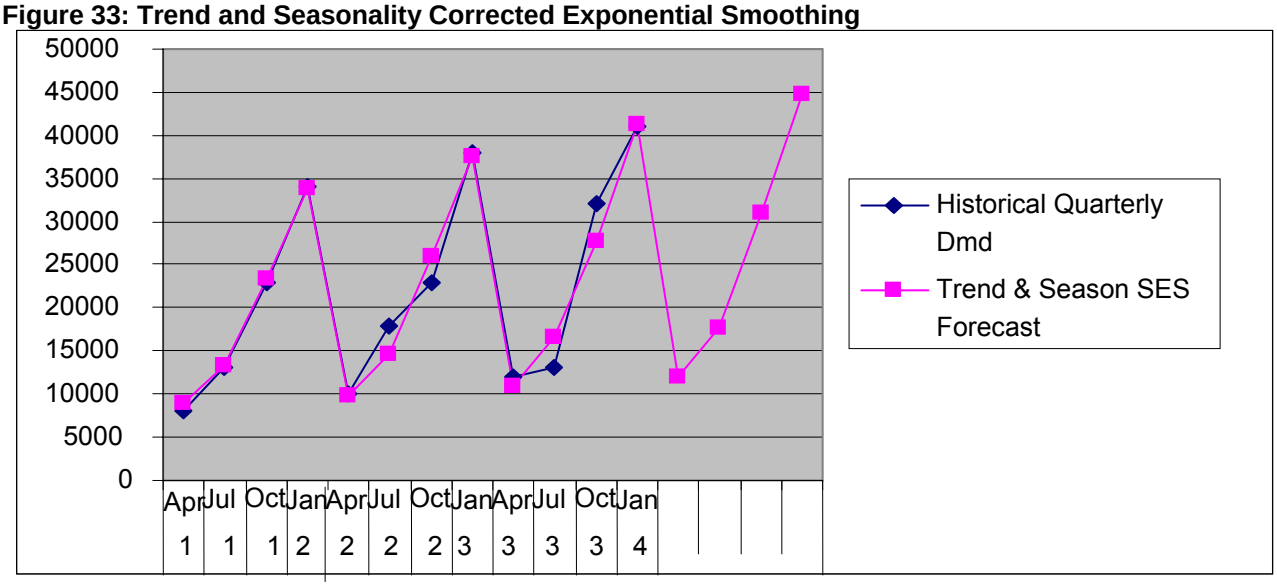
Figure 32: Trend Corrected Exponential Smoothing



32. **Trend and Seasonality Corrected Exponential Smoothing (Holt-Winters method).** This SES method is appropriate when the demand has a level of trend and seasonality. This is performed by calculating factors for trend and seasonality. Again the benefits and limitations of SES still apply but this works well for erratic items with low intermittency. However, utilisation of this must be preceded by tests for trend and seasonality. Similar to the case where trend in data is present, the presence of seasonality will be difficult, or impossible to detect where demand is intermittent. If there is

any doubt, assume the seasonality does not exist. This method utilises 3 smoothing constants, one for level, one for trend and one for cycle. The setting of appropriate smoothing constants is not straightforward. This method is illustrated at Figure 33.

Figure 33: Trend and Seasonality Corrected Exponential Smoothing



33. **Croston's Method.** Croston's method is a form of simple exponential smoothing whereby the non-zero demand quantities are smoothed and the inter-demand interval is smoothed. The two values are combined to give a forecast of demand per period. If demand occurs every period then Croston's method becomes identical to single exponential smoothing, which would suggest that Croston's method is equally suited to stationary demand with fast moving items as well. Croston's method has been adopted by the Royal Navy's base inventory system, CRISP, as its forecasting method. The forecast is only updated following a period of positive demand.

34. A clear problem with smoothing methods is that they react proportionally to recent events. Thus a spike in demand will trigger a spike in the forecast. In the current BIS applications, the forecast for the next period is then multiplied by the lead-time to give a forecast of lead-time demand. Any errors in the forecast are magnified by a factor of the lead-time. Since a decision to purchase is usually made following a demand event, large positive fluctuations in the lead-time forecast will generate large purchase orders. This is a particular problem with slow moving inventory where a demand spike may be followed by prolonged inactivity, where the long term demand mean may be low. In this case, Croston's algorithm is superior to single exponential smoothing since the inter demand interval is also considered when making the forecast. The reactions of lead-time forecast to demand are shown in Figure 34, shows a lumpy demand profile; and Figure 39 shows the corresponding lead-time demand forecasts.

Figure 34: A lumpy demand profile - 5975995670904, "Strap, ground", lead-time = 6 months

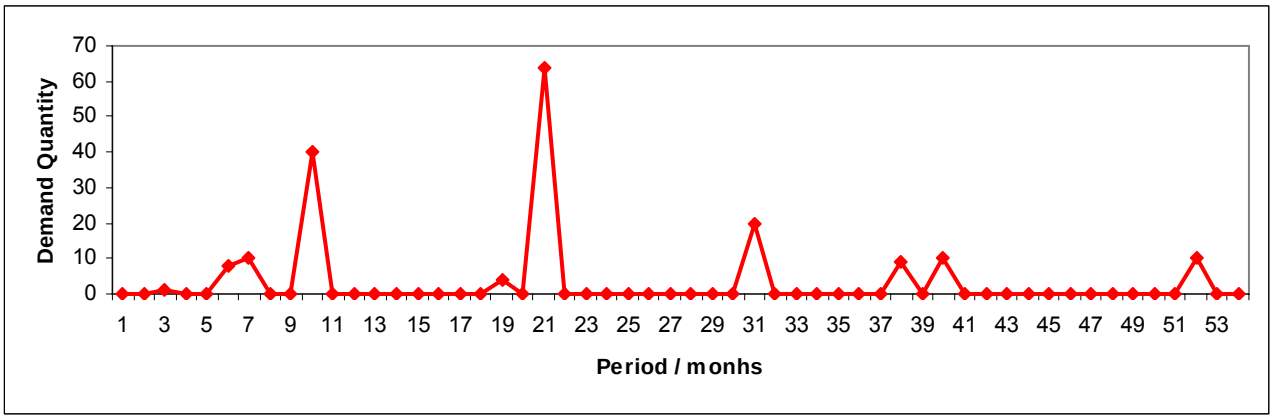
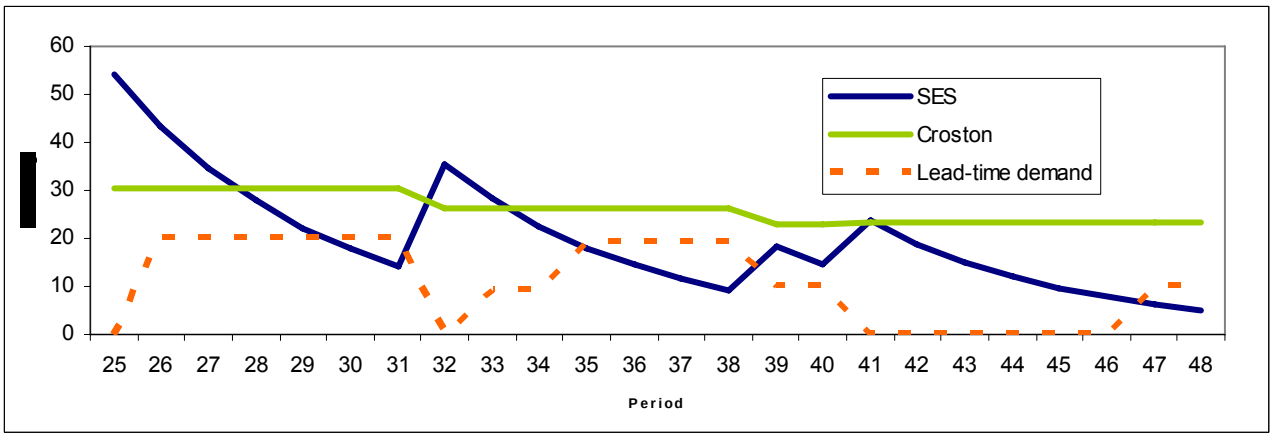


Figure 35: A lead-time forecasts and observed lead-time demand for the above demand profile.

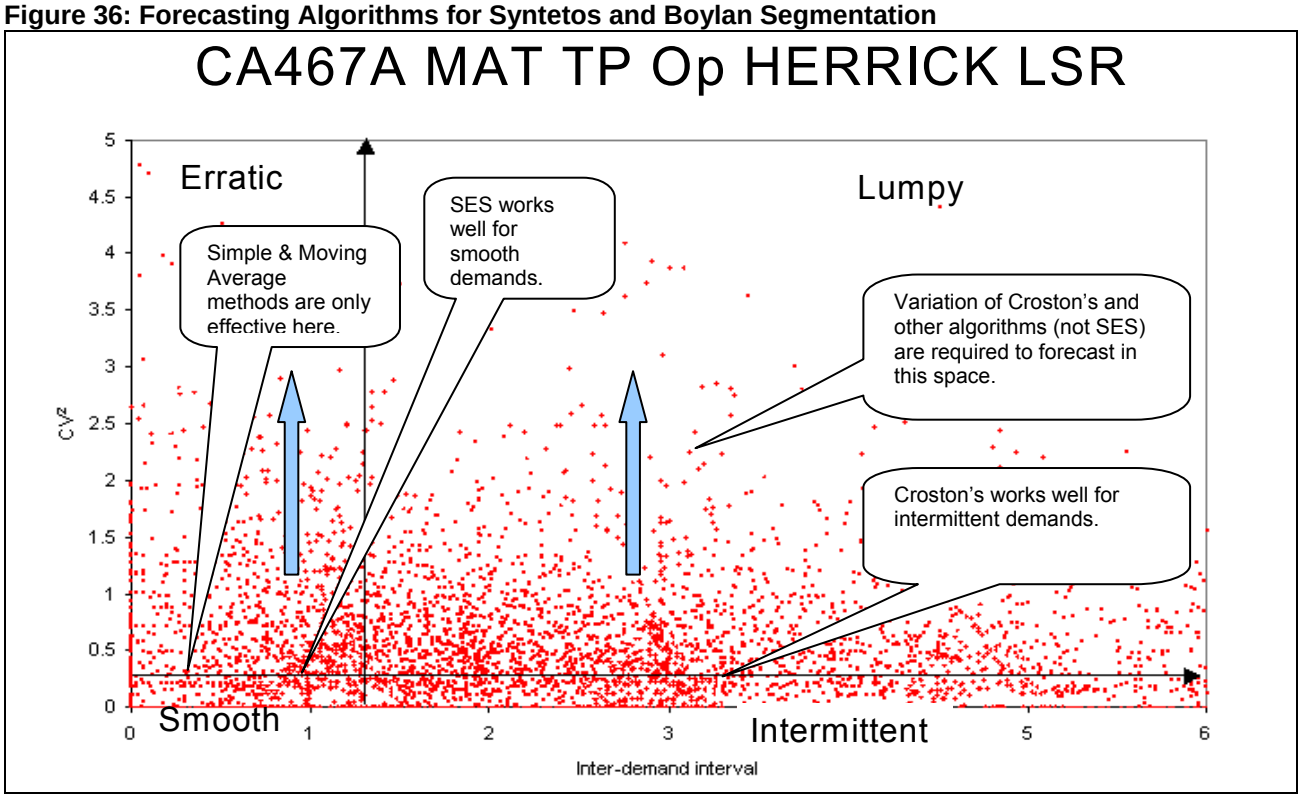


35. It is clear that the spike in demand during period 22 causes a huge surge in lead-time demand forecast when simple exponential smoothing is used. The forecast will progressively decay, but it is clear that purchasing decisions will be made based on the forecast following the spike. The result is likely to be excessive inventory costs. Croston's method, by considering the inter-demand interval results in a far less volatile forecast, but still suffers from the same trait to a lesser extent.

Single Algorithm versus Algorithm Suite

36. Figures 38 and 39 demonstrate that forecasting algorithms are not universally applicable and that careful consideration should be given to select the optimum forecast. Segmentation by demand characteristics is a good approach and as discussed at paragraph 15, Syntetos and Boylan segmentation identifies four categories of demand from which forecasting algorithms can be aligned. Consequently, a responsive forecasting tool should contain a suite of algorithms that can effectively deal with different demand profiles. For example, Croston's (1972) method (and several variations thereof) was developed to specifically deal with intermittent demand profiles. This is illustrated in Figure 36 where the demand activity of the Op HERRICK Log Sp Regiment Mat Tp has been segmented using the Syntetos and Boylan method. It is interesting to note the GLOBAL system that supports the Mat Tp uses a plain weighted average forecast. It can be seen that this is only effective for a minority of the items and that a suite of algorithms would be more appropriate to deliver more accurate forecasting. The generic formulae for SES and Croston's forecasting algorithms are at Appendix 2 plus a list of alternative algorithms.

Figure 36: Forecasting Algorithms for Syntetos and Boylan Segmentation



Seasonality and Forecast Error

37. **Seasonal Behaviour.** The identification of seasonality in demand data is an important factor when selecting algorithms for optimum forecasting performance. 'Seasonality' usually implies a 12-month cyclical pattern, but may also be applied to any cyclic repeating pattern. Therefore it is important to test for seasonality when examining demand data. Having reviewed a number of tests for seasonality, a recommended approach is at Appendix 3. A test for the presence (or not) of seasonality should be included alongside segmentation of demand profile. It can be undertaken on individual items, or, on the target inventory as a whole.

38. **Forecast Error.** Accepting that forecasting algorithms must be aligned to demand characteristics, it is necessary to have a test to establish which forecast is best in any particular situation. Examining the forecast error does this. Every demand has two components; the systematic component and a random component. A good forecasting method should capture the systematic component but not the random component. The random component manifests itself in the forecast error. There are a number of measures of forecast error and their use depends upon particular circumstances. A list of the most common forecast errors and their application is at Appendix 4.

39. **Fleet Size or Activity Level Changes.** Apparent Seasonal or Cyclic patterns may in fact be caused by changes to fleet sizes or activity levels linked to training patterns, which are customarily linked to the normal seasons and holiday periods. In the Land Environment, with the growing maturity of JAMES 1 and of BLENHEIM, probably using linear transformations initially, it should be possible to implement corrections to inventory demand forecasts based on forecasts of changes to fleet size or activity levels.

INVENTORY CONTROL ALGORITHMS

Importance of Inventory Control

40. Inventory is one of the most important and expensive assets of any organisation. Therefore good inventory control is crucial. Whether employing a nodal or system approach to forecasting, inventory control requires the use of additional algorithms, which will be discussed here.

41. There are two main decisions that have to be made when controlling inventory; how much to order and when to order. The purpose of inventory control algorithms is to satisfy these two issues. However, meeting target service levels and minimising the cost of maintaining and storing inventory is always a fine balance. A major objective in controlling inventory is to minimise total inventory costs. The most significant inventory costs are as follows:

a. Cost of Items.

b. Cost of Ordering.

c. Cost of carrying and holding inventory.

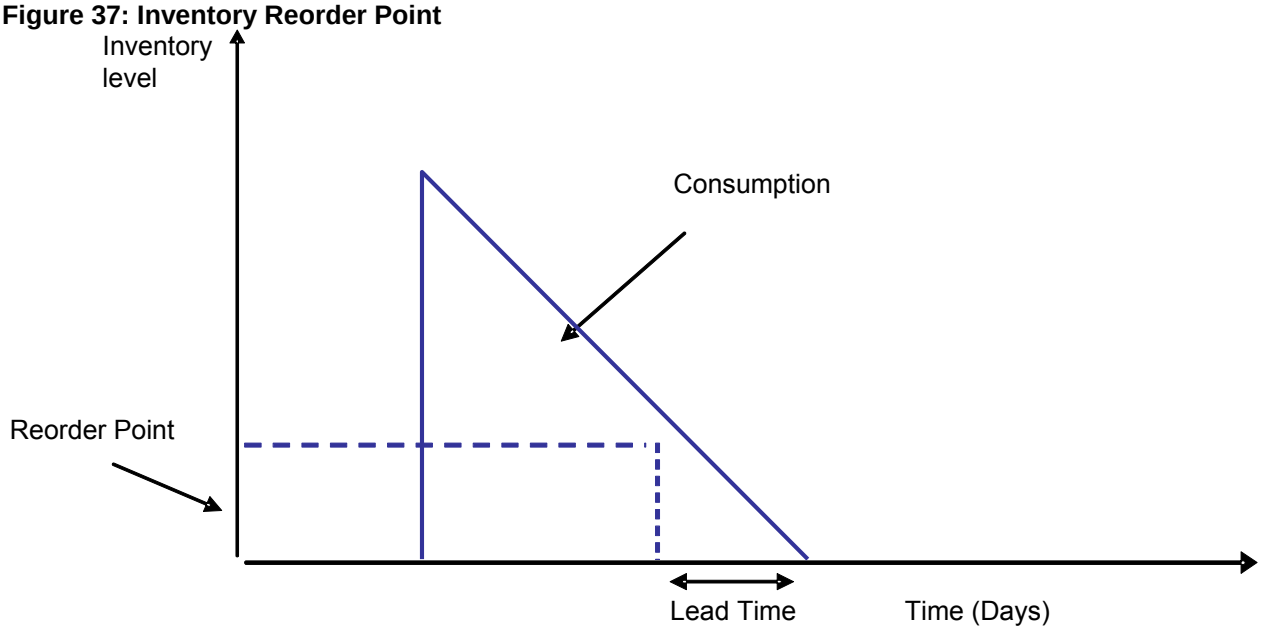
d. Cost of stock outs.

e. Cost of safety stock – the additional inventory that may be held as a buffer to cover the variability in demand.

Determining When to Order

42. A primary question faced by inventory mangers is determining when to place an order. In reality receipts of orders are not instantaneous and there is a time period between placing an order and receipt. This is known as the lead time. Therefore in order to prevent stockout, a reorder point is calculated so that new inventory arrives at the same instant the inventory is reaching the safety stock threshold. This is illustrated at Figure 37.

Figure 37: Inventory Reorder Point



Order Quantity

43. **Economic Order Quantity (EOQ)**. Having decided when to order, the next question has to be how much to order. The EOQ is one of the oldest and commonly known inventory control algorithms. It utilises a fixed order quantity with a variable interval between orders and uses a simple mathematical process to minimise the variable inventory costs. While a perfectly valid technique, it does not take into account that fact that an element of collaborative planning between supplier and consumer could be effective in reducing production costs. Steps to improve the current algorithms could include:

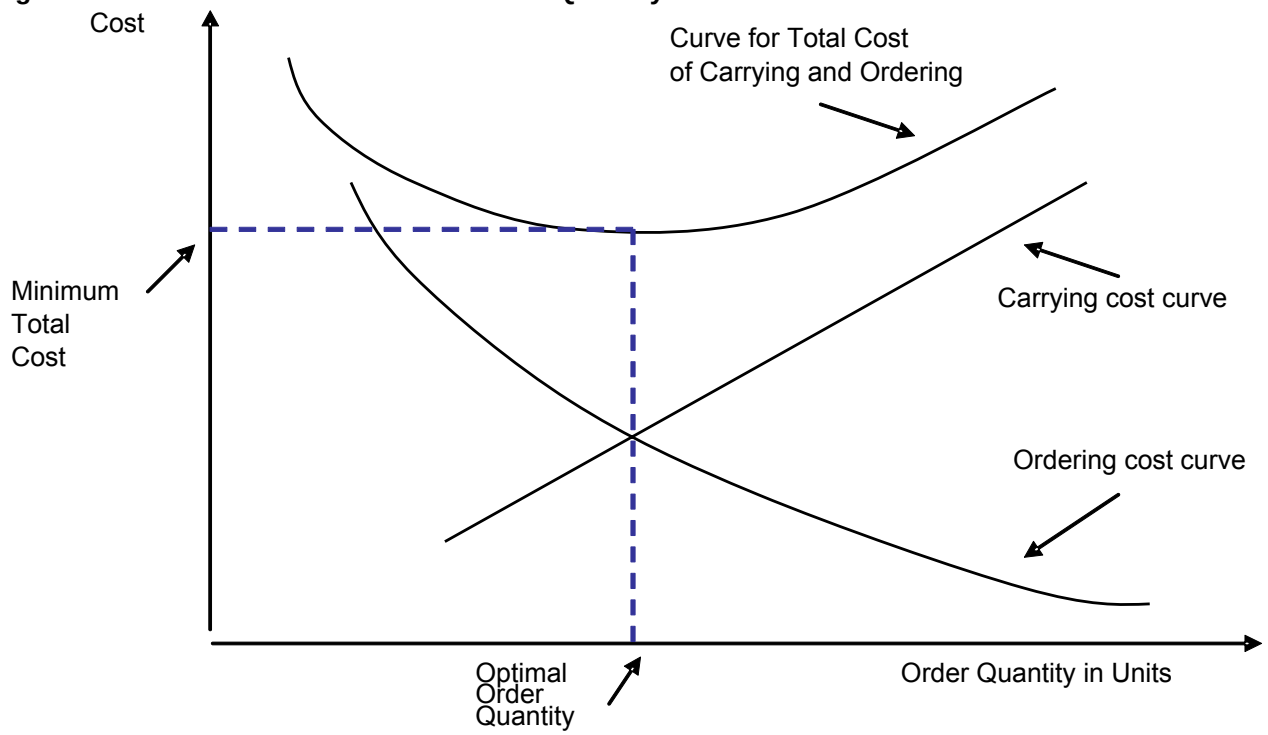
a. Allowing for price breaks.

b. Phased or split deliveries.

c. More sophisticated warehousing cost models.

44. The aim if the EOQ is to determine the value of order quantity that minimises the total variable inventory costs. Assuming that the only variable costs are cost to order and cost to hold, the EOQ algorithm calculates the optimum ordering quantity. This is illustrated at Figure 38. In general, the total cost curve is asymmetric and the costs of under-ordering are generally far greater than the costs associated with over-ordering.

Figure 38: Total Cost as a Function of Order Quantity



45. **Fixed Interval Variable Quantity**. An equally valid approach is to use a fixed interval ordering policy with a variable quantity. This has the advantage that the supplier will know that every x months an order for a certain part will be made. Although the final quantity required may not be known, the supplier will have the power to plan accurately their production scheduling. This approach frequently leads to lower production costs, some of which could be passed back to the consumer. Further, especially where either unit costs are low or usage is high (in which case an EOQ would recommend a large

purchase quantity), a fixed interval ordering approach would prevent the build up of excessive inventory levels.

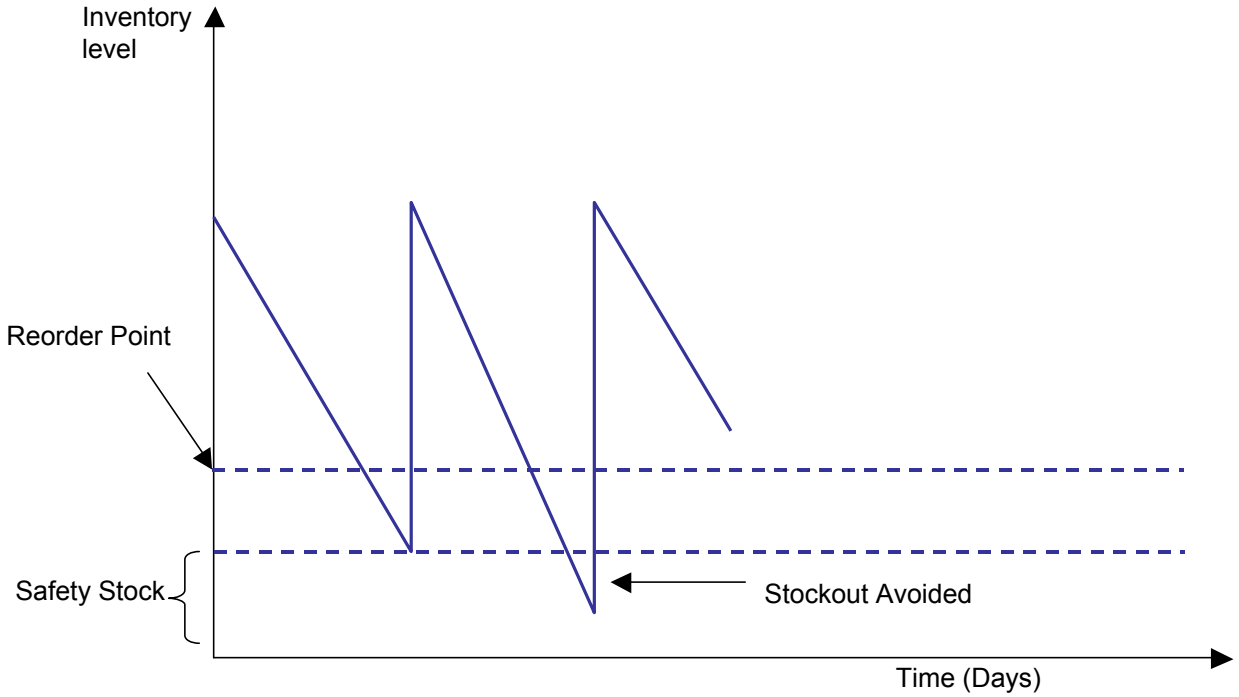
Safety Stock

46. If demand forecasting were an exact science, using the EOQ and ROP calculations, only the inventory required would have to be purchased and held. However, there will be occasions where demand is unusually high or other factors impact upon inventory (supplier delays for example). Therefore, safety stock is carried in order to maintain service levels in such circumstances; however, safety stock is no guarantee that stockouts will still not occur, it provides cover against a certain probability of variation in demand, and probability is just that, it is not certain. A representation of this is illustrated at Figure 39. The level of safety stock should be modified in light of the error present in the forecast. This should not be confused with the volatility of demand; if the variation of demand & other factors can be predicted with certainty then it should be appreciated that the safety stock requirement would be zero. Improvements may include:

a. Not always assuming that random changes to demand are Normally distributed.

b. Alternatively using sampling techniques (as opposed to Probability Distribution Function (PDF) best fit techniques) e.g. bootstrapping.

Figure 39: Safety Stock



MORE SOPHISTICATED TECHNIQUES

System Versus Nodal Forecasting

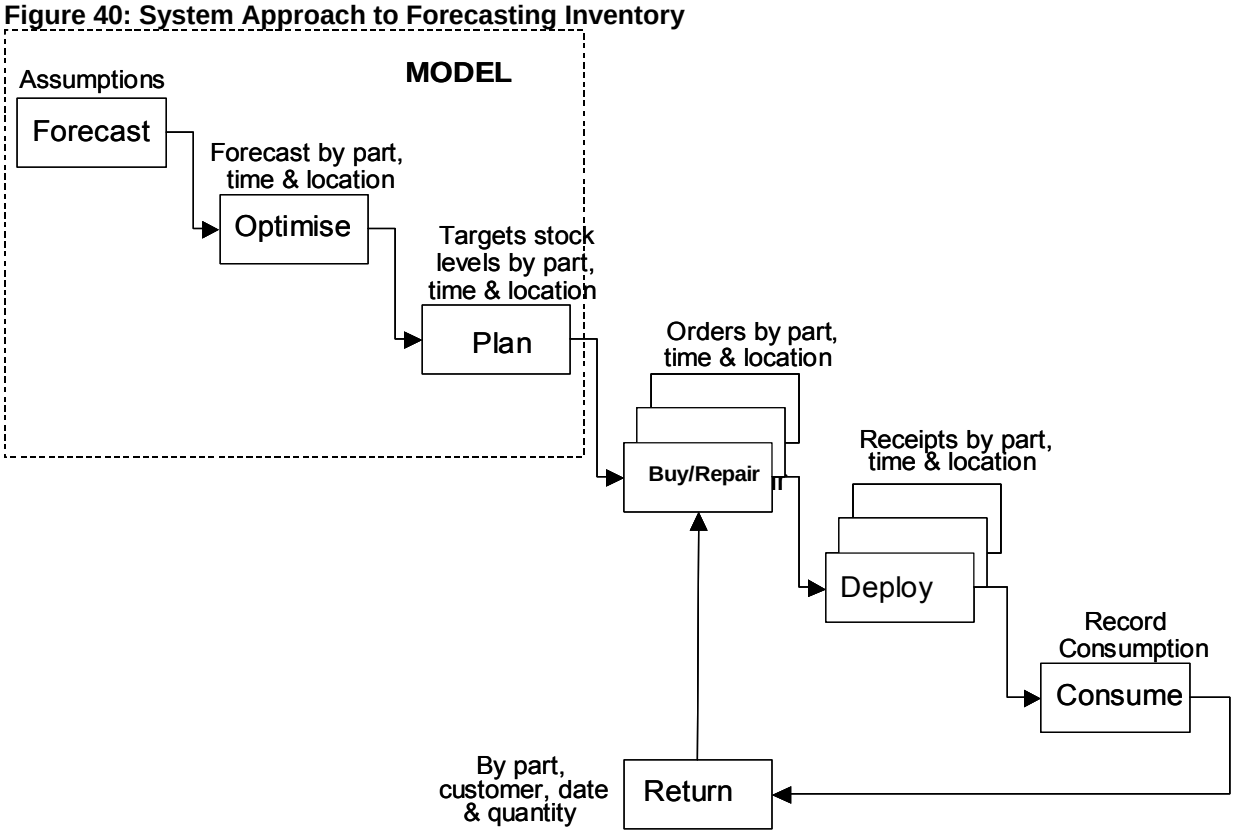
47. Military supply chains are a complex web of systems and processes. However, due to data, software and technological issues, forecasting in the defence environment has not progressed from a nodal approach. The limitations of nodal forecasting are that each information system that conducts a forecasting function does so in isolation of other information systems performing inventory forecasts. This leads to incoherence in

forecasting algorithms and consequently, optimisation initiatives (in particular cost and performance) will not be able to meet expectations.

48. Through investment and development in technology, one approach is to address the limitations of nodal forecasting through the introduction of Enterprise Resource Planning (ERP) systems. This facilitates the adoption of more rigorous forecasting techniques such as multi-item, multi-indenture, multi-echelon advanced inventory forecasting.

49. The benefits of transforming a service supply chain from nodal forecast to system forecast are substantial and Figure 40 demonstrated the increase in performance and cost benefits of the current BIS verses an incremental system forecasting approach. As the level of sophistication increases, the service performance improves for less cost as the impact of interrelationships between inventory, stocking echelons and product configuration are incorporated into the optimised solution. A template for a system forecasting approach is at Figure 40.

Figure 40: System Approach to Forecasting Inventory



50. In order to synchronise these processes, each must be driven by the same set of data and assumptions. A minimum data requirement is listed in Figure 41. This should be derived from the Enterprise Data Warehouse – 'single source of truth'.

Figure 41: System Approach to Forecasting Minimum Data Requirements

Product Data	Objectives Data	Derived Data
BOM Indenture Structure Redundancy Part Criticality Part Classification	Budgets Availability Targets Fill Rate Targets Wait Time Criteria Priority System Constraints	Availability Backorders Performance Metrics
Fleet Data	**Equipment Use Data**	**Inventory Data**

Equipment population by location & time period history	Failures Environmental Conditions Contingency Plans Operating Assumptions	Current Stock Levels Orders and Due Dates Part Condition Lead times Transportation methods / schedules & capacity
Reliability Data	**Repair Capability Data**	**Supplier Data**
Engineering Assumptions Engineering History Failure rates	Facility Locations Capacities Repair times	Manufacturers Repair providers Lead times Costs

Linear Programming

51. Linear programming (LP) is an elegant technique that will optimise (i.e. maximise or minimise) some given objective within a set of defined constraints. The technique was developed by American mathematician George Dantzig and presented to the world in 1947. Initially LP was employed to solve military logistic problems (Dantzig was a mathematician in the US Air Force) but quickly its wider industrial and business use became apparent.

52. It is not intended to provide a detailed mathematical description of LP as it is complex and the technique must be uniquely applied to the problem in hand. It is possible to conduct quite complex LP using MS Excel but without previous LP experience this will be difficult. The Algorithm Cell should be contacted for further advice and support.

Network Algorithms and Models

53. LP provides the basic mathematical framework to develop algorithms for multiple scenarios. Below are some examples of network algorithms that have particular use within supply chain management. If it is considered that such an approach might benefit a project then advice can be sought from the Algorithm Cell.

a. **Transportation Model.** This deals with the distribution of goods from several points of supply to a number of points of demand. The most common objective is to derive a schedule programme that minimises transportation costs.

b. **Transhipment Model.** This is an extension of the transportation model and optimises costs where shipments both arrive and leave. This approach is the basis for the hub and spoke system used by most airlines to optimise travel routes.

c. **Maximal-Flow Model.** This model finds the maximum flow that can occur from the origin to the destination through the network. For example, this model can determine the maximum number of vehicles that can pass through a road network.

d. **Shortest Path Model.** This algorithm finds the shortest path through the network from the origin to the destination.

e. **Minimal-Spanning Tree Model.** This determines the shortest path that connects all points on the network. For example of a visit had to be made to a number of distribution centres, then this algorithm could be used to determine the shortest route.

Queuing Algorithms

54. Queuing models are centred on identifying the ideal level of service that should be provided whilst optimising resources. For example, distribution centres must determine the optimum number of staff to ensure that inventory is distributed in accordance with its priority classification. Often the complexity of the problem means that it can only be solved through simulation modelling. Further advice and support can be obtained from the Algorithm Cell.

Search and Sorting Algorithms

55. It is not possible to list all potential algorithms that could be appropriate to the JSC. The final algorithms that could be considered applicable are those with a search or sort function; these are listed below. Again, advice can be sought from the Algorithm Cell.

a. Bin-packing Algorithms that used to optimise space.

b. Search Algorithms that used to identify and locate specific items.

c. Matching Algorithms that used to locate and match against specific criteria

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APPENDIX 1: SEGMENTATION OF THE DEFENCE INVENTORY

Segmentation

1. An SCM SCO report[33] recommended segmentation of the inventory to enable the alignment of Reprovisioning techniques, algorithms and processes to different inventory types and characteristics, thereby improving demand forecasting and Reprovisioning accuracy, effectiveness and efficiency. The Defence Inventory is already separated into different Domestic Management Codes[34] (DMC) for management purposes. However generic DMCs and associated NSNs do not signify inventory by type, nature or characteristic for the purposes of demand forecasting, Reprovisioning and other management functions. DMCs therefore cover a combination of capital (repairable) and consumable items that vary widely in terms of cost / value, size and demand frequency.

2. Within each DMC, at the appropriate platform, equipment or commodity level, there is a need to apply segmentation methodology that will enable tailoring of the IM approach. The segmentation solution will be delivered by adopting the following approach:

a. Identify appropriate IM objectives:

(1) Increase immediate availability - improve availability of system critical components with a minimum investment in spare parts.

(2) Reduce inventory investment costs.

(3) Improve the efficiency and effectiveness of storage and distribution.

b. Select the drivers for segmentation criteria (item characteristics) e.g:

(1) Item transaction volume.

(2) Item price.

(3) Accounting category (Capital Repairable) or (Consumable).

(4) Item size (volume).

(5) Item criticality to system availability and 'cost usage'.

c. Segment the inventory using the ABC analysis technique, outlined below.

ABC Analysis

3. ABC[35] analysis enables the IM and JSC stakeholders to tailor demand forecasting, Reprovisioning and procurement methodology and to focus effort and resources in terms of business priorities, potential benefits and operational / financial / commercial risk. Typically 20% of the inventory will account for 80% of costs, activity and transaction rates.

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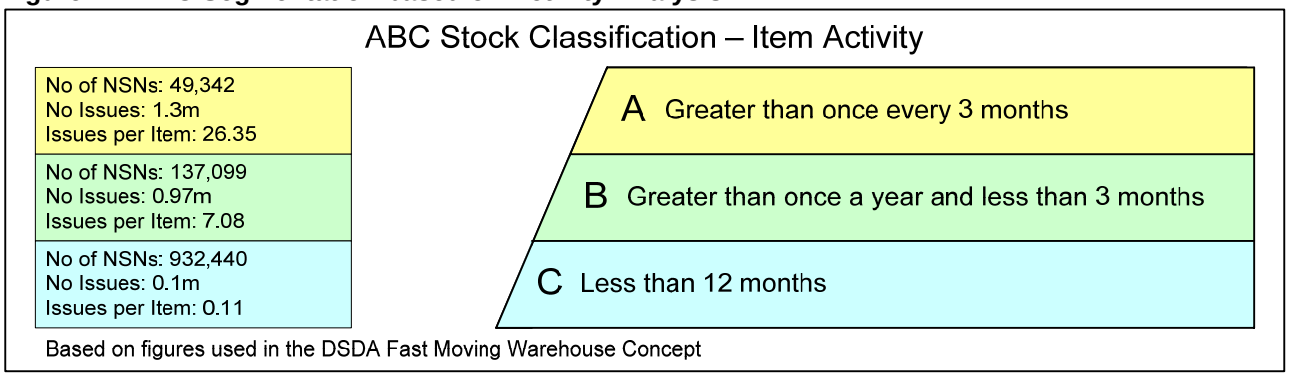
[33] SCS Inv Opt Task 1169 – report dated 30 Jun 06: MBIS Segmentation Final Report.

[34] Also known as Inventory Management Codes (IMC).

[35] ABC analysis identifies items which have a significant impact on inventory cost whilst also identifying categories of stock that require different management. When carrying out ABC analysis, items are valued with the results then being ranked and then grouped typically into three bands; called ABC codes. ["Purchasing and Supply Chain Management"; Kenneth Lysons and Brian Farrington].

4. Pending further research into the feasibility of applying more sophisticated methodology (applying criticality criteria) inventory segmentation is to be based upon simple ABC type analysis that typically uses cost / value and transaction frequency criteria. An example of the use of ABC type segmentation is the implementation of the DSDA Fast Moving Warehouse concept, to concentrate fast moving line items within a much DSDA reduced warehouse footprint; an illustration of the ABC analysis is shown at Figure 42.

Figure 42: ABC Segmentation based on Activity Analysis

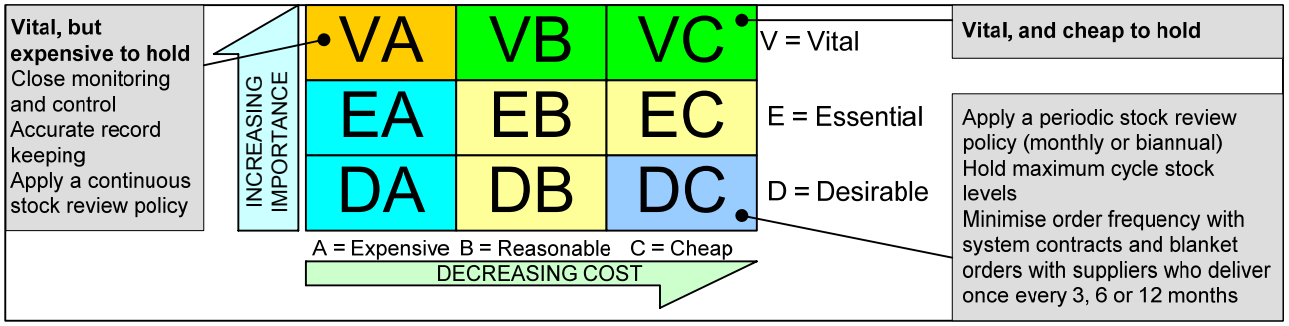


Segmentation by Item Criticality

5. Commonly used consumable items that are relatively low cost and easy to procure do not require any form of sophisticated segmentation. In such cases the Economic Order Quantity (EOQ) approach within generic demand forecasting methodology is the appropriate approach. In the case of technical inventory there is added complexity due to the need to range and scale requirements to take account of anticipated operation and maintenance of equipments. This is where the inventory criticality factors can be applied.

6. In this context criticality is defined as 'A measure of the potential of an item to impact on the availability of an end-system'[36]. One of the methods to identify item criticality recommended by Cranfield University is the Analytic Hierarchy Process (AHP)[37] whereby the otherwise subjective judgement of experts attracts a numerical rating or score. Using pre-determined limits inventory is then to be segmented into Vital, Essential and Desirable (VED) segments. A schematic model of VED segmentation[38] is provided at Figure 43. An example of the IM approach to be adopted for each VED segment is provided at Figure 44.

Figure 43: Vital, Essential and Desirable Segmentation



[36] SCS Inventory Optimisation Course Notes, Cranfield University, 2007. Note that this measure of criticality should not be confused with prioritisation of military criticality.
[37] Saaty's Concept quoted in The Criticality of Consumable Spare Parts: An Inventory Solution, Dr CE Rutherford and Robert E Woolford, Cranfield University 2006.
[38] SCS Inv Opt Task 1169 Report dated 30 Jun 06: MBIS Segmentation Final Report. The diagram originated from "Recognising the Role of Criticality in Spares Parts IM within Defence Sector", MSc Thesis, Cranfield University. Dr CE Rutherford December 2001.

Figure 44: Segmented Inventory - Business Model Example

Category Combination	Recommended Management Controls	Skill Level of Manager	Management Method	Algorithm Sophistication
VA - Vital & Expensive	Close monitoring and control Secure a reliable source of supply – long term contracts Implement procedures that gather and process spare specific data – share data with supplier Monitor supplier performance – including lead-time variability High level procurement and stocking decisions with input from user Accurate record keeping Apply a Continuous Stock Review Policy	High level / fully trained section head supervised by Project leader	Close control	Move to Multi-Indenture Multi-Echelon (MIME) simulation modelling
EA / DA - Expensive & Essential or Desirable	Hold in inventory at minimum levels Apply a Continuous Stock Review Policy	High level / fully trained section head supervised by Project leader	Close control	State Space Method model / Bootstrapping
VB / VC - Vital & Inexpensive	Stock at maximum possible levels Secure a reliable source of supply – long term contracts Implement procedures that gather and process spare specific data – share data with supplier Monitor supplier performance – including lead-time variability Apply a periodic stock review policy (weekly)	Medium level / fully trained section head supervised by Project leader	Medium control / repeated routine manual intervention	State Space Method model / Bootstrapping
EB / EC & DB - Common-usage spares	Apply a periodic stock review policy (monthly) Stock at medium acceptable levels Apply process to deal with out of control recommends	Low level / limited training with supervision	By exception - Apply process to deal with out of control recommends	Dual Exponential Smoothing with a monthly provisioning cycle. Common usage will mean the majority of demands are fast movers. Slow movers will generate management by exception. Thorough and strict guidance should be applied to slow movers to ensure consistency.
DC - Desirable & Cheap	Apply a periodic stock review policy (monthly or biannual) Hold maximum stock levels Minimise order frequency with system contracts and blanket orders with suppliers who deliver once every 3, 6, or 12 months Apply process to deal with out of control recommends.	Low level and / or limited training	By exception – Apply process to deal with out of control recommends	Dual Exponential Smoothing with a monthly provisioning cycle. This will meet the requirements of both fast movers and intermittent demand. Slow movers will generate management by exception. Thorough and strict guidance should be applied to slow movers to ensure consistency.

APPENDIX 2: QUANTITATIVE FORECASTING ALGORITHM FORMULAE

Simple Exponential Smoothing

$f_{t+1} = (1 - \alpha)f_{t-1} + \alpha(y_t)$

Where f_{t+1} = forecast for next period
ft-1 = forecast for previous period
yt = demand for previous period
= smoothing constant with a value between 0 and 1

Croston's Method

Let y_t = demand in period, t

pt = smoothed interval at time, t
zt = smoothed demand estimate at time, t
q = number of time intervals since last demand
= smoothing constant

If $y_t = 0$ (i.e. no demand)

pt = pt-1
zt = zt-1
q = q + 1

Else (y_t != 0, i.e. demand occurs)

pt = pt-1 + α(q - pt-1)
zt = zt-1 + α(yt - zt-1)
q = 1

The forecast demand per period equals

yt+1 = zt / pt

1. The forecast is only updated following a period of positive demand. If there are no periods of zero demand, then Croston's method provides a forecast identical to the simple exponential smoothing forecast.

List of Possible Algorithms

2. The under mentioned is a list of forecasting algorithms that could be used within JSC inventory management.

Zero	Croston's (SB)	MIME
Averages	Holt	EBO
Moving averages	Holt-Winters	Bootstrap
EWMA	ARMA	Neural Networks
SES	ARIMA	
Croston's	Box-Jenkins	

APPENDIX 3: TEST FOR SEASONALITY

1. To assess whether there is a seasonal component in data it will be necessary to determine the correlation coefficients at different lag periods, say from 1 through 12 (assuming that data are aggregated as monthly blocks). The correlation coefficient may be defined thus:

$$r_k = \frac{\sum_{t=k+1}^{n}(Y_t - \bar{Y})(Y_{t-k} - \bar{Y})}{\sum_{t=1}^{n}(Y_t - \bar{Y})^2}$$

Where:
- rk = correlation coefficient at a lag of k periods
- n = number of observations in series
- Yt = value of series at period t
- Yt-k = value of series at a lag of k periods
- Y = mean value of series

2. Interpretation of correlation coefficients is often undertaken with the aid of a correlogram. A correlogram presents the correlation coefficients in the form of a histogram for the different lag periods. The larger the bar on the histogram then the stronger the correlation. That said however, the size of the correlation required to be considered significant will depend on the amount of data available. Common sense would suggest that with limited data, 2 seasons for instance, it would be extremely difficult to prove a correlation with a high degree of certainty. In practise, upwards of 3 seasons' data are required. It should also be noted that a correlation does not necessarily mean that there is a causal link.

3. Figure 45 shows a time-series exhibiting strong seasonal behaviour and Figure 50 presents the associated correlogram.

Figure 45: Time Series Data with Strong Seasonal Behaviour.

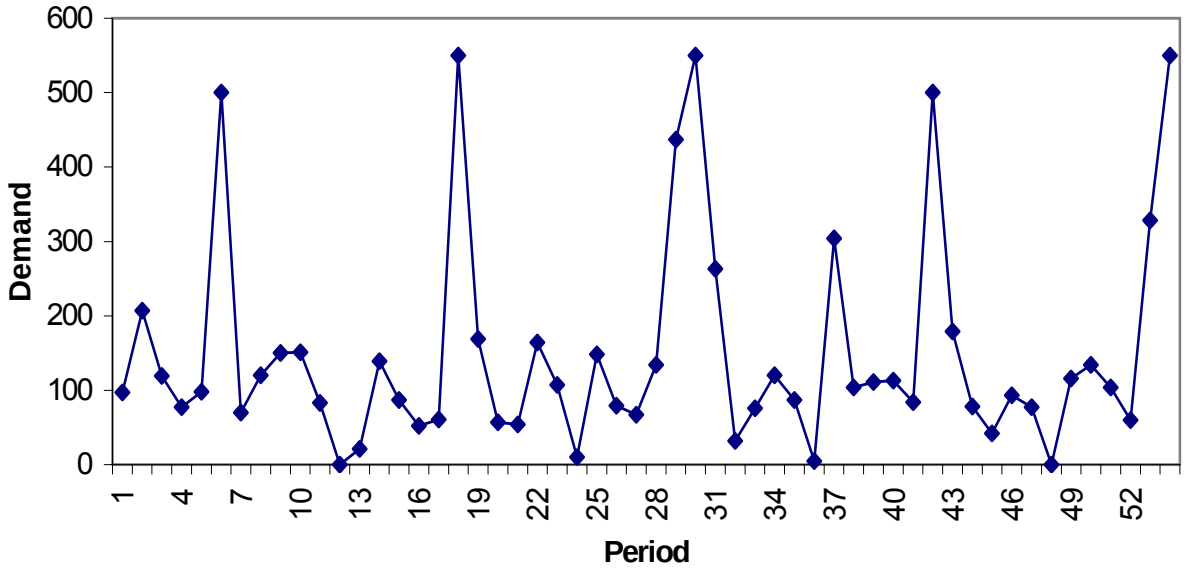
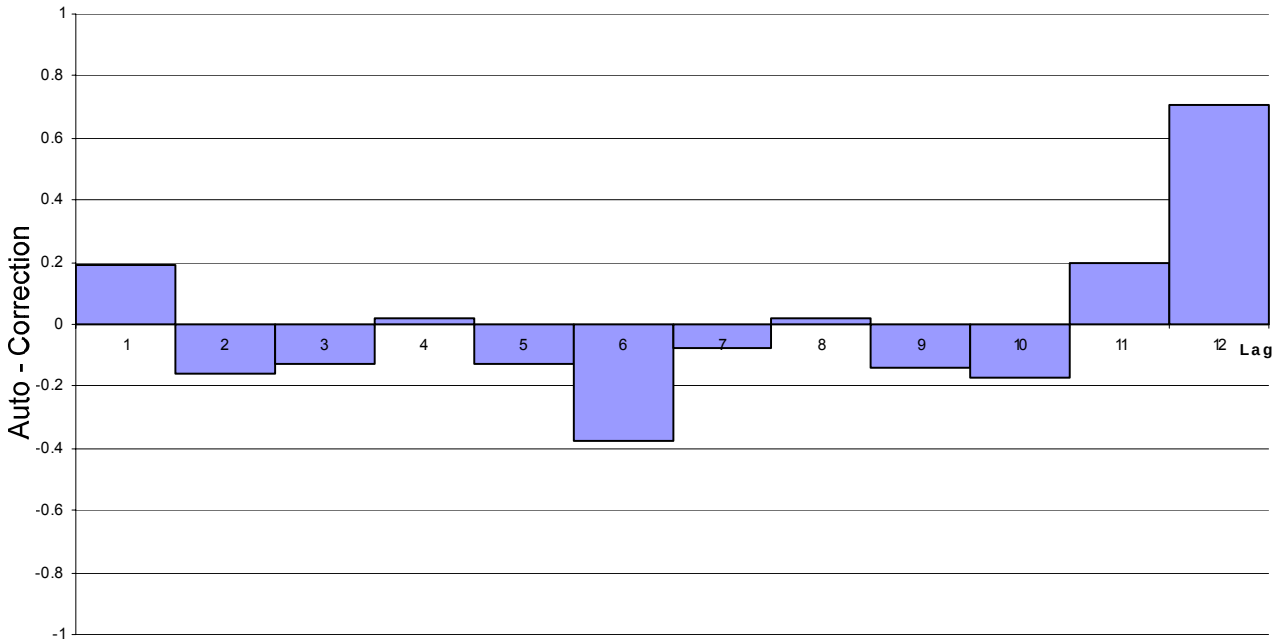


Figure 46: Correlogram Associated With Figure 45.



APPENDIX 4: FORECAST ERROR METRICS

1. Commonly used forecast error metrics include ME, MAE, MPE, MAPE, MSE and RGRMSE. Each measure will now be considered in turn.

2. **Mean Error (ME) / Mean Absolute Error (MAE).** If the signed error of a forecast is measured over a time series, then perhaps the simplest measure of error is the ME. However, since errors can be both positive and negative then there will be an element of cancelling out. It follows that an unbiased forecast over a sufficiently long series will give a zero forecast error. Makridakis et al. (1998) points out that the ME can be used to indicate if there is systematic under or over-forecasting; i.e. it will give an indication of forecast bias and does warrant consideration as a measure of bias. The MAE ignores the sign and just considers the absolute value. Therefore it can give no indication of bias, but does give an indication of dispersion.

3. **Mean Percentage Error (MPE) / Mean Absolute Percentage Error (MAPE).** MPE and MAPE are analogous to ME and MAE respectively but express the error as a percentage relative to the size of the demand. Whilst this may appear a desirable property in many circumstances, it is observed by Willemain et al. (2004) and Makridakis et al. (1998) that for intermittent time series the MPE and MAPE calculations require division by zero and as such are undefined. This makes them in the main inappropriate measures for most of the defence inventory at SKU level. However, although this clearly applies at SKU level time series, MPE / MAPE could be applied to an aggregated time series with sufficient SKUs to ensure that division by zero does not arise.

4. **Mean Squared Error (MSE).** MSE is a measure that has been widely used in the literature. Eaves and Kingsman (2004) and Syntetos and Boylan (2005) have both considered it an appropriate measure of forecast error. Since the error is squared, the significance of outliers is made more prominent and as such provides an effective measure of dispersion. Once again, it is an absolute measure and does not give any indication of bias present in the forecast.

5. **Relative Geometric Root Mean Square Error (RGRMSE).** Fildes (1992) proposed a measure of error that allowed a direct comparison of different techniques. Assuming that there are n items in a data sample, the statistic is represented by the nth root of the sum of errors squared of method A divided by the sum of errors squared of method B. A value of less than one indicates method A to be superior, a value of greater one implies method B is superior. Since the method considers the square of the errors then outliers will have greater significance in the statistic. Since this is a comparative metric, it may provide a valuable method for ranking the forecasting methods that are applied in this work. It has been suggested (Duncan, 2005) that when applied to intermittent demand, the results provide a similar evaluation to the MSE metric.

6. **Forecast Bias (and adjustment where it exists).** Mean Error (ME) and Mean Percentage Error (MPE) are both error measures that give information on the sign of the error. As such they provide effective indicators of forecast bias. The use of dual exponential smoothing combines a SES forecast with a smoothed measure of forecast error and combines the two to give an approximately unbiased forecast. This technique will, to an extent, also address trend in data. If a forecast is consistently under forecasting then it is highly likely that there is a positive trend in the data. Adjustment of the forecast using the bias will take this into account. It is however, still a lagging forecast and as such a technique that specifically deals with trend would be preferable.

CHAPTER 10: MANAGEMENT OF NON-CONFORMING TRADE RECEIPTS

CONTEXT

1. The MOD expects to receive satisfactory, fit for purpose and contractually conformant material from Industry. When this materiel is delivered to the MOD it is known as Trade Receipts. Trade Receipts that do not meet the required standards cannot be processed and are not available for use by the MOD. The lack of these items impacts on the MOD's ability to conduct operations. It is to the MOD's advantage that Non-Conforming Receipts (NCR) are identified and rectified promptly.

POLICY

2. It is MOD policy is that NCR are to be identified and rectified promptly to allow stock to be used to support MOD operations and activities.

PURPOSE AND SCOPE

3. This policy applies to all MOD units processing Trade Receipts and to the Project Teams (PTs) responsible for their procurement except for Munitions that have separate instructions in JSP 886 Volume 6 Part 1: Munitions.

4. The mandatory implementation of this policy is currently restricted to DSDA Depots although other MOD units processing Trade Receipts may use the same process.

5. A NCR is a deficiency with packaging, labelling or other shortcoming as indicated at Figure 47 below, which requires rectification before an item can be processed adequately through the supply chain and relates exclusively to items destined for shelf stock. It does not cover:

a. Items which are **non-compliant** with Consignment Tracking policy contained in JSP 886 Volume 3 Part 7: Consignment Tracking.

b. Item discrepancies, particularly where the quantity is deficient, are to be reported using MOD Form 445: Discrepancy Report (DR). DR procedures are contained in JSP 886: Volume 3 Part 15: Supply Chain Transactions.

Figure 47: Categories of Non-Conforming Receipts

Code	Category
CA	Incorrect DMC / NSN
CB	Incorrect Description
CC	Incorrect Part / Batch Numbers
CD	Incorrect Serial Number(s)
CF	Incorrect PPQ
CG	Incorrect D of Q or Unit of Issue
CH	Incorrect Packaging Level
CK	No Bar Code Labelling
CL	Insufficient or No Certificate of Conformity / Test Certificate
DA	Damaged in Transit
IL	Incorrectly Labelled

Code	Category
IM	Incorrect MATCON
LN	No Logo (ISPM 15) Fail
MN	Mixed NSN
NC	Non-Codified Item
NE	No Engineering Record Card
NL	No Labelling
NP	No Paperwork- MOD F640, 650 etc
NW	No Weight Label
SL	Inadequate Shelf Life
UB	No Safety Data Sheet
NS	Incorrect Quantity - Surplus

PROCESS

ACTION BY RECEIVING UNIT

6. **NCR Reporting.** The MOD receiving unit is to process all Trade Receipts within 5 working days. When an NCR is identified, regardless of operational imperative, the NCR is to be reported on either:

a. DSDA G 0013: Trade Receipt Non Conformance Notification, or

b. MOD Form 2249: Non Conforming Trade Receipt Proforma.

7. The NCR is to be registered with the local focal point where appropriate, and sent to the Inventory Management (IM) staff of the responsible Project Team (PT) and the responsible Operating Centre (OC) by email within the 5 working days. The responsible PT can be identified from the LogIS or the DMC / IMC the UKNCB database. Details of the NCR are to be recorded by the unit raising the NCR to allow for future reporting and analysis.

8. **NCR Recording.** The originator is to record:

a. Details of all NCRs raised and when sent to the PT. This will allow the determination of the percentage of all Trade Receipts that are NCRs and the percentage of NCRs not rectified within the 12-day window.

b. Details and timescale of the completion of the NCR.

9. **NCR Completion.** The NCR process is considered to be completed when the NCR item(s) is/are rectified, returned to stock and the PT informed accordingly.

ACTIONS BY PT

10. The PT is to log the receipt of the NCR immediately. The NCR is to be investigated and rectification implemented within 12 working days of receipt of the email. PTs are to ensure that primary causes of NCRs, and not just the symptoms, are addressed by reviewing the validity of contracts and supplier performance in order to prevent recurrence of the NCR in future deliveries.

11. Deliveries from Trade must conform to mandated delivery criteria, as set out in relevant Policy documents and Defence Standards. It is the responsibility of the PT to ensure that contracts include the mandated packaging and labelling requirements in addition to the technical specifications. Non-conformance with these standards can be due to either:

a. A failure by the procuring PT to define and articulate adequately to the Supplier the required delivery standards; or

b. A failure by the Supplier to adhere to the agreed standards articulated in the relevant contract.

12. If there are Dues Out or a known urgent operational need for the item then the PT is to initiate rectification as a priority in order to meet these Dues Out.

13. PTs are to annotate all NCR Proforma with details of how, by whom, and when the rectification will take place. The three options available to a PT for effecting rectification are:

a. **Option 1.** Arrange for collection by the supplier of the non-conforming item from the MOD to effect rectification elsewhere.

b. **Option 2.** Arrange in situ rectification by the supplier or their agent. The supplier is to provide all the required materials, tools and manpower. The supplier is to liaise with the MOD site to arrange security clearance, access and facilities.

c. **Option 3.** Arrange the rectification utilising MOD resources. The PT is to investigate the resources required, budgetary implications and provision of funding. Except to meet urgent operational requirements this option should be considered as the last resort because it can fail to address the root cause of the NCR and can also be seen as encouraging bad behaviour by Industry. DSDA are to respond to all requests for quotes including 'Nil bid' where appropriate.

14. Where the NCR is wholly or partially due to the supplier, the PT is to formally notify the supplier, copy to the NCR originator, of the transgression and, where appropriate, state the rectification actions required. Where the NCR is not due in whole or part to the supplier, PTs are to ensure that corrective action and education is taken where necessary.

15. The PT is to notify NCR completion to the originator and the OC. The physical achievement of any of the three options above within the 12-day window for rectification will constitute success in adhering to this policy. The originator is to annotate the NCR record as completed.

ACTION BY OPERATING CENTRE (OC)

16. The OC is responsible for monitoring the PTs' adherence to this timescale, and ensuring the transfer of the Proforma back to the originator detailing how the NCR will be rectified.

ACTION BY CONTINUOUS IMPROVEMENT TEAM (CIT)

17. The CIT is to examine the management of NCRs by PTs as part of the routine scrutiny of Inventory Management. PTs are to note that their Inventory Plan should contain details of their NCR process, JSP 886 Volume 2 Part 2: Inventory Planning refers.

CHAPTER 11: STOCK SEGREGATION POLICY

PURPOSE

1. The purpose of this instruction is to define the Defence Stock Segregation policy that will govern the segregation of all materiel within all defence storage facilities, including buildings and open storage areas, at depot facilities, static and deployed stock-holding units. This equally applies to all MOD stocks held by defence contractors under Contractor Logistics Support (CLS) arrangements and consequently, must be considered by Project Teams (PT) when entering into any such arrangements. This instruction is not intended for HM Ships, RFAs or Army units at first line.

2. In simple terms, this Pamphlet removes the financial ceilings imposed upon storage providers in the 1980s and in place introduces the duty for PTs and storage providers to agree and exercise appropriate business continuity and risk management plans to protect stock. In addition, PTs retain responsibility for requesting dual point holdings with necessary justification, for example, for items which are deemed to be of strategic importance or are in short supply or mission critical.

BACKGROUND

3. Following two significant storage site fires in the 1980s, a policy was developed that segregated stock on a financial basis. This policy was aimed at protecting vital assets and reducing the risk of stock losses by ensuring that stocks were held in a number of locations prior to issue.

4. The previous policy also introduced several types of segregation, most notably:

   a. **Depot Segregation.** A specific range of stock segregated between storage depots/ centres. This affords the highest degree of safeguarding stocks from all perceived threats.

   b. **Intra-Depot Segregation.** The depot stockholdings of a specific range segregated further between depot site, or dispersed buildings within a depot. This form of segregation is an effective means against all but the most widespread of major incidents.

   c. **Building Segregation.** Fire compartments within the same building segregate the stockholdings of a specific range.

   d. **Open Air Storage.** There are limited means of achieving segregation in open air storage but distance, shelter, and/ or barriers provide some protection against losses which may occur as a consequence to fire, contamination or exposure to weather conditions or natural disaster.

5. The previous policy categorised stock as being in either Category A or B, predicated on strategic importance and value. In addition, an annually assessed value was set on the maximum value of stock that could be held in a single building.

6. With the introduction of modern supply chain initiatives which includes the reduction of the storage footprint and reducing inventories, a value based principle of segregation has proven unsustainable and therefore a fresh approach is required.

AIM

7. The aim of this policy is to establish a sustainable means of Stock Segregation that is pertinent to modern processes, strategic initiatives and revised Joint Supply Chain (JSC) methodology across all defence storage facilities.

CONSIDERING FACTORS

8. In pursuance of the operational benefits and commercial efficiencies encompassed in the Future Defence Supply Chain Initiative (FDSCi), the JSC has:

a. Reduced the storage footprint through closure of 3 major storage sites thereby reducing opportunity for routine segregation.

b. Re-brigaded other sites in support of Whole Fleet Management and other procurement and support initiatives.

c. Due to the rising cost of the Defence Inventory, linked to inflation and technology costs, provided storage to a higher value inventory within a smaller storage footprint.

d. Reduced the overall cost of the storage footprint, through the reduction of the physical footprint and optimisation of the storage capacity.

e. Committed to continued improvement within the defence inventory, in conjunction with PT, through improved delivery of coherent JSC performance and process.

9. Consequently, it can be seen that whilst there is an absolute need to protect the defence inventory, this must be considered alongside the operational need to ensure flow of stock and optimised performance. This will ensure the delivery of capability to the front line.

POLICY AND APPLICATION

10. The stock segregation policy contained in this instruction is to be applied by all storage providers and places on them a duty to undertake appropriate business continuity, risk management and business planning to mitigate against risk or loss to their stock holding and facilities utilising appropriate advice. In support of this, equipment stock is to be classified as either:

a. **Category A.** Items of strategic importance and items that merit special storage arrangement.

b. **Category B.** Items that merit routine storage.

11. PTs are responsible for advising storage providers of all items for which Category A storage, Items of Strategic Importance, is justified. Items that are not deemed to be of strategic importance will default to routine storage, Category B, unless PTs direct otherwise.

12. The default stock-split for items identified as Category A is 70/30, however where less than 10 items exist within the Defence inventory a split of 50/50 may be requested by the stockowner.

13. Items designated as strategically important should be identified on the appropriate item management system, using a specific Item Data field for the purpose. This data should also be held on warehouse management systems, operated by storage and distribution centres, to manage the Stock Segregation process. PTs will be required to review the process periodically to re-assess items designated for Category A storage and to inform storage providers of any subsequent alterations of status.

14. Storage providers are defined as any custodian of MOD materiel whether at depot or unit level, including deployed units[39] and CLS contractors, and are responsible for ensuring:

a. Production of local Orders and procedures for implementation and maintenance of the Stock Segregation planning, execution and a safe storage environment.

b. Implementation and exercise of appropriate business continuity and risk management, predicated on appropriate professional advice from providers such as the MOD Business Continuity and Risk Management focal points and the Defence Fire Risk Management Organisation (DFRMO) utilising the Resource Allocation Risk Management (ReARM) methodology to ensure the safety of stock coherent with JSC operations.

c. Monitoring stored items to ensure customer requirements are met appropriately.

FUELS, LUBRICANTS AND INDUSTRIAL GASES

15. Detailed guidance on the Stock Segregation for Fuels and Lubricants is contained in JSP 317: Joint Service Safety Regulations for the Storage and Handling of Fuels and Lubricants. Detailed guidance on the Stock Segregation for Liquid Petroleum and Industrial Gases is contained in SP 319: Joint Service Safety Regulations for the Storage and Handling of Liquefied Petroleum Gas (LPG) and Industrial Gases (IG).

MUNITIONS

16. Detailed guidance on the Stock Segregation for Munitions is contained in JSP 482: MOD Explosives Regulations.

THREATS TO STOCK

17. This policy is intended to protect vital assets and to reduce the risk of stock losses. JSP 503: Risk Management and Business Continuity Plans, are to take into consideration the numerous potential threats to stocks. Whilst not an exhaustive list, these threats may include the following:

a. **Fire.** DFRMO advice is to be sought to determine appropriate levels of Fire Protection utilising the ReARM methodology**.** To inform this process fire risk management benchmarking guidance is below.

b. **Criminal and Terrorist Activity.** A threat exists from disaffected employees, criminals and terrorists ranging from theft and fraud to losses caused by Improvised Explosive Devices (IEDs), including incendiaries. The possibility of criminal or

[39] This does not include Army units at first line.

terrorist activity preventing the MOD from completing its functions is countered by security measures at all stock holding points

c. **Climatic Conditions.** The extent of damage as a result of extreme meteorological conditions such as flooding, heat and cold could be substantial. Therefore, the location of storage sites is an important factor in assessing the risk to stock.

FIRE RISK MANAGEMENT BENCHMARKING

General Description

18. **Fire Risk within Store Houses.** The National Audit Office published a report titled, 'Ministry of Defence: Management of Fire Risks' in 1996[40]. This report predates many of the advances made within the sphere of JSP 503: Business Continuity Management articulated in and as evidenced in academia[41], however significantly the National Audit Office report agreed the need for established maximum financial limits on stores within compartments. Whilst this policy no longer agrees with the misplaced sense of security engendered through financial rather than operational risk management, it is considered that a single maximum compartment total of £300m[42] is appropriate for benchmarking purposes providing that this is supported with an appropriate business continuity and fire risk management plan.

19. Under Building Regulations, a Fire Protected Compartment or Building is a 'building or part of a building, comprising one or more rooms, spaces or storeys, constructed to prevent the spread of fire to or from another part of the same building, or an adjoining building'. However, for the purpose of this instruction it is necessary to differentiate between compartment and buildings with racking and non-racking storage systems. Therefore, following criteria applies:

a. **Fire Protected Compartment and Building with Racking Storage Systems.** For the purpose of this instruction a Fire Protected Compartment or Building is a compartment or building which incorporates the following Fire Prevention Measures:

(1) Automatic mechanical roof ventilators which can be actuated by the automatic fire detection system, fusible link and manual override controls.

(2) Fire protected structural steel work.

(3) In-Rack Automatic 'Fast Response' Sprinklers in high-rise racking.

b. **Additional Measures.** In addition to the above Fire Protection Measures, at least one of the following measures to provide early warning of a fire or reduce the spread of smoke/ fire must also be incorporated noting that is preferable to incorporate all 3 measures where possible:

(1) Automatic Smoke detection and alarm systems (additional National Audit Office criteria).

(2) Storage in steel bins, sheet steel tops and bottoms to racks.

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[40] London, HMSOO, HC 129 Session 1995-6 published 24 January 1996.

[41] Pattinson, I. H. (1999) Stores Sustainability (Its Measurement and Maximisation). Cranfield University.

[42] This demonstrates a 10% increase on the maximum storage value of £270m established in 2006.

(3) Tiered storage where mezzanine floors are steel.

c. **Fire Protected Compartment and Building with Non-racking Storage Systems.** For the purpose of this instruction, in order for a compartment or building with a non-racking storage system to be considered Fire Protected, at least four of the following measures must be incorporated:

(1) Load bearing elements of the structure are protected with Fire Resistance to prevent building collapse.

(2) Sprinklers / automatic fire suppression fitted in accordance with Crown Fire Standards.

(3) High level low temperature melting plastic panels provided in accordance with Crown Fire Standards or automatic roof ventilators which can be actuated by the automatic fire detection system; fusible link and manual override controls.

(4) Automatic smoke detection and alarm systems (additional National Audit Office criteria).

Assessment of Risk and the Business Continuity Plan

20. Business Continuity plans should be cognisant of the higher security provided by military establishments, the alert military ethos and nature of the work force and the co-location of the Defence Fire Risk Management Organisation (DFRMO) support.

21. Each compartment or building, where the need applies, is to be individually assessed by the Local Fire Advisor to establish appropriate protection to assessed risk. JSP 426: MOD Fire Safety Manual also provides guidance.