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Research Report

Improving Inventory Management of Organizational Clothing and Individual Equipment at Central Issue Facilities

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RAND Arroyo Center

Prepared for the United States Army

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Preface

More than 90 Central Issue Facilities (CIFs) located at major installations around the world issue Organizational Clothing and Individual Equipment (OCIE) to Active Component soldiers and deploying National Guard and Army Reserve soldiers. The value of OCIE inventory held at CIFs in the continental United States (CONUS) increased by 33 percent between January 2007 and August 2010. The Army does not have a standard, data-driven approach for CIF inventory management. Likely as a result, there has been a perception that many CIFs have significantly more inventory than required to meet soldier needs. Army logistics leaders asked RAND to help the Army improve OCIE inventory management while maintaining high levels of soldier support.

This report addressed our twofold recommendations for improving the efficiency of inventory management at the CIFs: (1) use a data-driven approach to help CIF managers make replenishment decisions and (2) increase the use of existing inventory through lateral transfers. The report also includes appendixes designed specifically for readers with a detailed knowledge of and experience in CIF inventory management. The appendixes provide an in-depth description of the CIF inventory levels–setting process, including which items to order, when to order, and how much to order. They also describe the CIF retention levels–setting process and address how to identify materiel that is available for lateral transfer. CIF inventory management personnel will find this report useful for gaining more detailed knowledge of the input files and how the RAND-developed algorithms work, allowing those who participate in setting CIF inventory levels and coordinating lateral transfers to understand the underlying methods used to set inventory levels.

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Summary

More than 90 Central Issue Facilities (CIFs) located at major installations around the world issue Organizational Clothing and Individual Equipment (OCIE) to Active Component soldiers and deploying National Guard and Army Reserve soldiers. The value of OCIE inventory held at CIFs in the continental United States (CONUS) increased by 33 percent between January 2007 and August 2010. This growth was due primarily to two factors: (1) the transition to new OCIE, which necessitated supporting both old and new inventory over the transition period, and (2) an overall increase in the cost of individual OCIE items. Another factor contributing to this inventory growth is the CIF managers' focus on soldier satisfaction, emphasizing availability of OCIE for soldiers on their first visit to the CIF. Finally, the CIFs did not have a formal mechanism to signal when a CIF manager should review inventory levels, requisition items, or how much to requisition. Army logistics leaders viewed the establishment of a routinized inventory review process as a prerequisite to improving the inventory management practices at the CIFs. Therefore, RAND was asked to examine the current inventory management practices at the CIFs, develop an inventory management process, and help the Army implement it.

RAND recommended that (1) the CIFs adopt a standard, data-driven approach to help CIF managers make replenishment decisions and (2) the Army increase the use of lateral transfers across CIFs to use existing inventory rather than ordering from the wholesale system. These recommendations were adopted by the Army and are being included in the next update of Army Regulation 710-2. With the expected reductions in wholesale replenishments and increases in lateral transfers, the Army reduced its fiscal year (FY) 2011 centralized OCIE budget by $100 million and will reduce it further in future years.

A Standard, Data-Driven Approach to Help CIF Managers Make Replenishment Decisions

CIF managers operate their CIFs in support of soldiers. OCIE materiel is issued to soldiers when they arrive at their first duty station, before deployment, and when their OCIE becomes unserviceable and needs to be exchanged. OCIE materiel is turned in by soldiers when their OCIE becomes unserviceable and before the end of their time in service. When inventory runs low, CIF managers requisition replenishments through the Central Management Office (CMO)—the Army organization that oversees inventory at the CIFs. Replenishments may be filled by orders to the wholesale distribution system through the Defense Logistics Agency (DLA) or via lateral transfers of OCIE inventory from other CIFs.

The current replenishment process is based on managers' experience and expert judgment, which is not always empirically based. Local differences in experience and expertise mean that the replenishment process is executed unevenly and typically infrequently (monthly or quarterly) across the CIFs.[1] To help CIF managers make replenishment decisions, RAND developed a data-driven algorithm and process for setting and executing inventory levels.

The Peak Issue Methodology (PIM) Algorithm Determines When and How Much Inventory to Replenish

RAND developed the PIM algorithm to determine the point at which to replenish inventories and the quantity to replenish to achieve a high level of performance. The approach uses historical issue and turn-in data to determine the breadth and depth of items stocked, i.e., what and what quantity to order. RAND also recommended increasing the requisition frequency to reduce the risk of excess inventory. Under the recommended approach, inventory levels are calculated for a centrally managed item if it has positive net issues, i.e., more issues than serviceable turn-ins, in the past year. The point at which to replenish inventories is based on the "peak net issue," i.e., the largest net issue quantity over a replenishment lead time (RLT)-day period over the past year. The quantity to replenish is an economic order quantity that trades off holding and ordering costs.

The PIM can be adapted to different types of CIFs, including mobilization and training CIFs and main and annex CIFs. The PIM takes into account relationships between new and replaced or substitutable items that are necessary to maintain high performance goals.

Pilot Test of Inventory Levels at Ft. Stewart and Ft. Drum Was Successful

A pilot test of this approach began at Ft. Stewart in August 2009 and at Ft. Drum beginning in May 2010. The pilot was successful in improving performance at CIFs. In November 2010, the approach was expanded to include 18 additional CIFs.

Replenishment requisitions are being reviewed more frequently, closer to the goal of weekly review. RAND recommended that replenishment requisitions be reviewed weekly to reduce the risk of ordering too much inventory. Before implementation of the PIM inventory levels at the end of July 2009, Ft. Stewart typically executed requisitions every 2.7 weeks.[2] Since the start of 2011, Ft. Stewart has been executing requisitions every 0.9 weeks.[3] Note that if no replenishments are required during a given week, then it is possible to review but not execute replenishment requisitions during that week. Similarly, before implementation, Ft. Drum was

[1] The CIF manager determines monthly or quarterly whether items need to be replenished.
[2] Replenishment requisitions executed between December 31, 2008, and July 23, 2009.
[3] Replenishment requisitions executed between January 11, 2011, and April 26, 2011.

executing replenishment requisitions every 2.4 weeks and is now executing replenishment requisitions every 1.7 weeks.[4]

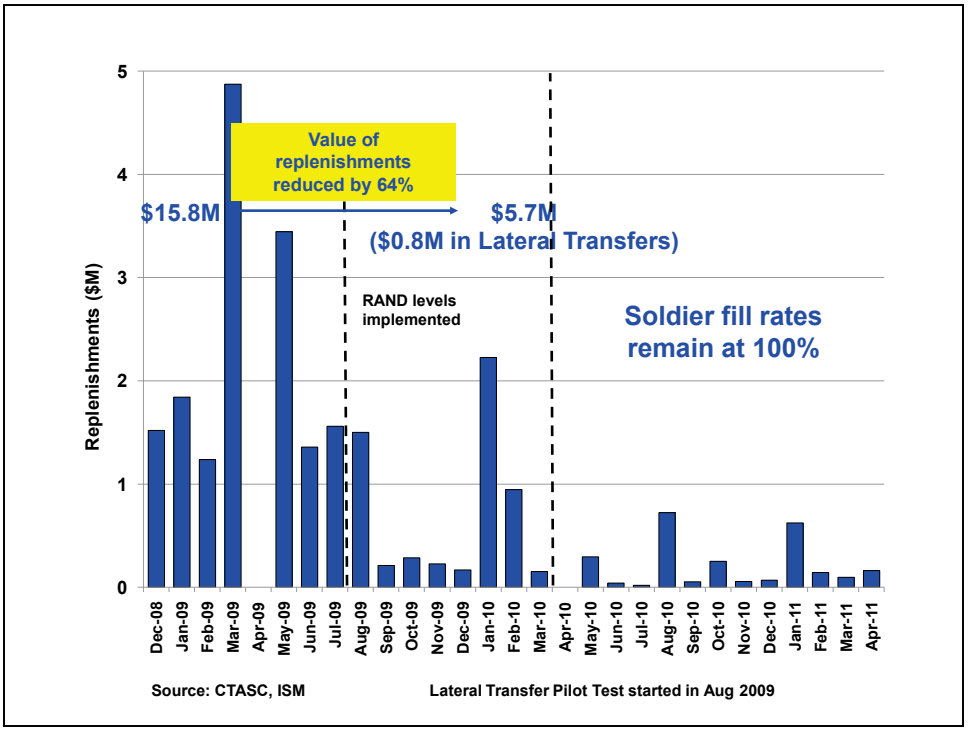
The value of replenishment requisitions decreased by as much as 64 percent. The goal of the inventory levels pilot test was to reduce the value of replenishment requisitions while maintaining high performance goals. We looked at the monthly value of replenishment requisitions at Ft. Stewart, as shown in Figure S.1.

A comparison of the eight-month period before and after inventory levels were established at Ft. Stewart shows a 64 percent reduction ($15.8 million to $5.7 million) in the value of replenishment requisitions. During this time, soldier fill rates remained at 100 percent.

Similarly, we found a 60 percent reduction ($4.5 million to $1.8 million) in the value of replenishment requisitions over the nine-month period before and after the implementation of inventory levels at Ft. Drum. During this time, soldier fill rates remained at 100 percent.

The value of authorized inventory at Ft. Stewart has started to decrease. Despite the significant reductions in the value of replenishment requisitions at Ft. Stewart, the value of overall on-hand inventory has not decreased. The fluctuations in on-hand inventory value are due

Figure S.1
Value of Replenishment Requisitions at Ft. Stewart Decreased by 64 Percent



[4] Replenishment requisitions executed before implementation between January 20, 2009, and March 22, 2010, and after implementation between April 6, 2010, and April 27, 2011.

to two receipts of body armor, valued at $4.5 million and $4 million each, as well as replenishment requisitions placed before implementation of inventory levels. However, when body armor is excluded, the value of authorized items decreased by 22 percent ($18 million to $14 million) between August 2009 and April 2011.

Plans for Army-Wide Implementation and Increased Automation Are Under Way

In August 2010, inventory levels were set and implemented at four CIFs: Fts. Stewart, Drum, and Leonard Wood, and Hunter Army Airfield. The Army-wide implementation plan is to expand along three fronts: mobilization CIFs, training CIFs, and outside the continental United States (OCONUS) CIFs.

Increased automation, including generation of replenishment recommendations based on PIM inventory levels, and approval of replenishment recommendations under a dollar threshold, will reduce workload and lessen uncertainty in the replenishment process. In August 2011, these automated features became available in Installation Support Module (ISM), the information system used at the CIFs to track OCIE.

Increased Use of Lateral Transfers Across CIFs

RAND's second recommendation was to increase lateral transfers to make better use of existing inventory at CIFs. RAND developed a standard, data-driven approach to setting a total stockage allowance (TSA) to help make the lateral transfer decision process. An algorithm and process to set TSA levels and execute the lateral transfer decision process began testing at 22 CIFs in November 2010.

The TSA Enables Easier Identification of Inventory Available for Lateral Transfer

The purpose of TSA is to facilitate the identification of materiel available for lateral transfer between CIFs. By setting TSAs for each CIF-item combination, the CMO can easily track down potential sending CIFs with on-hand inventory that exceeds the TSA, indicating that there is materiel available for lateral transfer.

The Potential Benefits of Increasing Lateral Transfers Are Significant

RAND also estimated the costs and benefits of lateral transfers. Lateral transfer costs include transportation and the labor involved in picking, packing, and shipping the lateral transfer at the sending CIF. On the benefit side, lateral transfers reduce the holding cost of inventory at the sending CIF and can reduce the time between request and receipt, particularly for items in short supply Army-wide. A final benefit is that funds that would have been obligated on a requisition to DLA are now available for other uses.

During the pilot test, RAND, CMO, and G-4 decided to focus on executing lateral transfers of items with large inventory value, i.e., greater than $10,000. The evaluation found that the

potential benefits of lateral transfers are significant. The total value of inventory above the TSA is $180 million. Of this $180 million, $100 million is in centrally managed items (CMI) inventory and, of this $100 million, $47 million is in inventory that is in short supply Army-wide. This $47 million can be leveraged immediately through lateral transfers. Within a few months of identification, CMO was able to reuse over $100,000 of this $47 million in inventory.

Plans Are Under Way to Implement the Approach for Increasing Lateral Transfers Widely

An algorithm and process to set TSA levels and execute the lateral transfer decision process began testing at 22 CIFs in November 2010. The Army-wide implementation plan is to expand along three fronts: (1) CONUS CIFs with inventory levels, (2) training CIFs with inventory levels, and (3) OCONUS CIFs.

In addition, increased automation can help with the lateral transfer decision process in three areas: identification of materiel available for lateral transfer, due-in tracking, and lateral transfer request coordination across CIFs. With this additional automation, potential lateral transfers will automatically be identified and prioritized and due-ins will be recorded automatically so that replenishment requisitions are not recommended erroneously over and over again. The implementation of data-based TSAs will increase the use of existing inventory, thereby increasing inventory efficiency while maintaining high performance goals. As of December 2011, these automated features became available in ISM.

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- Ft. Stewart: Ms. Tricia Wheeler and Mr. Hugh Blocker.

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Abbreviations

AAC	acquisition advice code
ACH	Advanced Combat Helmet
AFI	available for issue
BRAC	Base Re-Alignment and Closure
CIF	Central Issue Facility
CL	contingency level
CMI	centrally managed items
CMO	Central Management Office
CONUS	continental United States
CRP	Central Receiving Point
CTASC	Corps/Theater Automatic Data Processing Service Center
CVC	combat vehicle crewman
DAAS	Defense Automatic Addressing System
DI	due in
DLA	Defense Logistics Agency
DO	due out
DODAAC	Department of Defense Activity Address Code
DRA	materiel receipt date
DRB	pseudo receipt date
DRMO	Defense Reutilization and Marketing Office
DTTC	document transaction type code
EOQ	economic order quantity
FedLog	Federal Logistics Catalog
FFRDC	federally funded research and development center
FMS	Foreign Military Sales
FY	fiscal year
GMI	gross monthly issues
IET	Initial entry training
IP	inventory position
I&S	interchangeable and substitutable
ISM	Installation Support Module
KYLOC	Kentucky Logistics
LIN	line item number
LIW	Logistics Information Warehouse
LMP	Logistics Modernization Program

LRT	logistics response time
LT	Lateral Transfer
MRO	Materiel Release Order
NIIN	National Item Identification Number
NSN	National Stock Number
OCIE	Organizational Clothing and Individual Equipment
OCONUS	outside the continental United States
PEO	Program Executive Office
PIM	Peak Issue Methodology
PSID	Product Support Integration Directorate
PUIC	Project Unique Identification Code
QPBS	quantity possessed by soldier
RFI	Rapid Fielding Initiative
RL	retention level
RLT	replenishment lead time
RO	requisition objective
ROP	re-order point
RWT	requisition wait time
SARSS	Standard Army Retail Supply System
SDDB	Strategic Distribution Database
SIAD	Sierra Army Depot
TSA	total stockage allowance
UCP	universal camouflage pattern
USAREUR	U.S. Army Europe
USARPAC	U.S. Army Pacific

1. Introduction

Army Leaders Are Concerned About Growing Organizational Clothing and Individual Equipment (OCIE) Inventory

More than 90 Central Issue Facilities (CIFs), which are located at major installations around the world, issue OCIE[5] to Active Component soldiers and deploying National Guard and Army Reserve soldiers. The value of OCIE inventory managed by the Army is increasing. For example, between January 2008 and April 2011, the value of OCIE inventory held at CIFs in the continental United States (CONUS) increased by 33 percent, from $0.8 billion to $1.1 billion, as illustrated in Figure 1.1. In the figure, the lower segments of the sandbar chart are categorized by CIF region or purpose, e.g., CONUS CIFs or Rapid Fielding Initiative (RFI). The topmost sandbar segment (green) is the value of inventory in the hands of soldiers based in CONUS, also known as quantity possessed by soldier (QPBS).[6] In April 2011, total OCIE assets, including QPBS held by soldiers, exceeded $7 billion.

This growth was due primarily to two factors: (1) the transition to new OCIE,[7] which necessitated supporting both old and new inventory over the transition period, and (2) an overall increase in the cost of individual OCIE items. Another factor contributing to this inventory growth was the CIF managers' focus on soldier satisfaction, emphasizing availability of OCIE for soldiers on their first visit to the CIF, coupled with the lack of an automated mechanism to signal when a CIF manager should order inventory and how much to order.

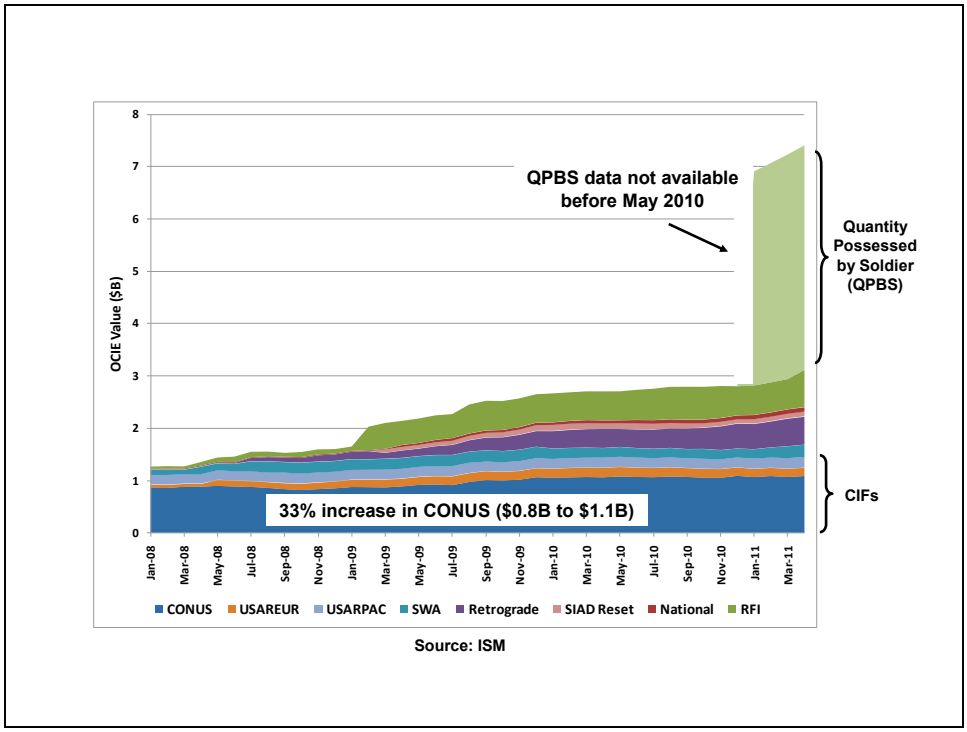
Therefore, Army logistics leaders felt that there was an opportunity to improve CIF inventory management while maintaining strong performance. RAND was asked to examine the current inventory management practices at the CIFs, develop an inventory management process, and help the Army implement it. In this report, we recommend a twofold approach: (1) adopt a standard, data-driven approach to help CIF managers make replenishment decisions and (2) increase the use of lateral transfers across CIFs to use existing inventory. These recommendations were adopted by the Army and are being included in the next update of Army Regulation 710-2. With the expected reductions in wholesale replenishments and increases in lateral transfers, the Army reduced its fiscal year (FY) 2011 centralized OCIE budget by $100 million and expects to reduce future budgets by at least $30 million per year thereafter.

[5] Common Table of Allowance 50–900, Clothing and Individual Equipment, Paragraph 9, contains the list of authorized OCIE items.

[6] Data on CONUS QPBS were not available before May 2010. Data on QPBS for soldiers based outside the continental United States (OCONUS) were not available.

[7] The RFI was the principal method used to equip deploying soldiers with modernized OCIE. Figure 1.1 shows that retrograde has also increased; however, retrograde is a shift from possession by soldier to possession by CIF; it does not increase the systemwide value of OCIE.

Figure 1.1
OCIE Inventory Value Increased from January 2008 to April 2011



NOTES: "CONUS" indicates all CONUS CIFs. "USAREUR" indicates all CIFs in U.S. Army Europe. "USARPAC" indicates all CIFs in U.S Army Pacific (USARPAC). "SWA" indicates all CIFs in Southwest Asia. "Retrograde" indicates retrograde activities at Sierra Army Depot (SIAD). "SIAD Reset" indicates Reset activities at SIAD. "National" indicates Army-wide assets, such as the Kentucky Logistics (KYLOC), which supports soldiers in theater. "RFI" indicates the Program Executive Office (PEO) Soldier RFI, which distributes new equipment to soldiers before wholesale support from the Defense Logistics Agency (DLA).

Inventory Management Can Be Improved by Adopting a Standard Data-Driven Approach to Help CIF Managers Make Replenishment Decisions and Increase the Reuse of Existing Inventory

CIF managers operate CIFs to provide OCIE in support of soldiers. OCIE materiel is issued to soldiers when they arrive at their first duty station, before deployment, and when their OCIE becomes unserviceable and needs to be exchanged. OCIE materiel is turned in by soldiers when their OCIE becomes unserviceable and before the end of their time in service.

When inventory runs low, CIF managers submit replenishment requisitions and receive materiel from the DLA for sustainment.[8] For some sustainment requisitions, the Central

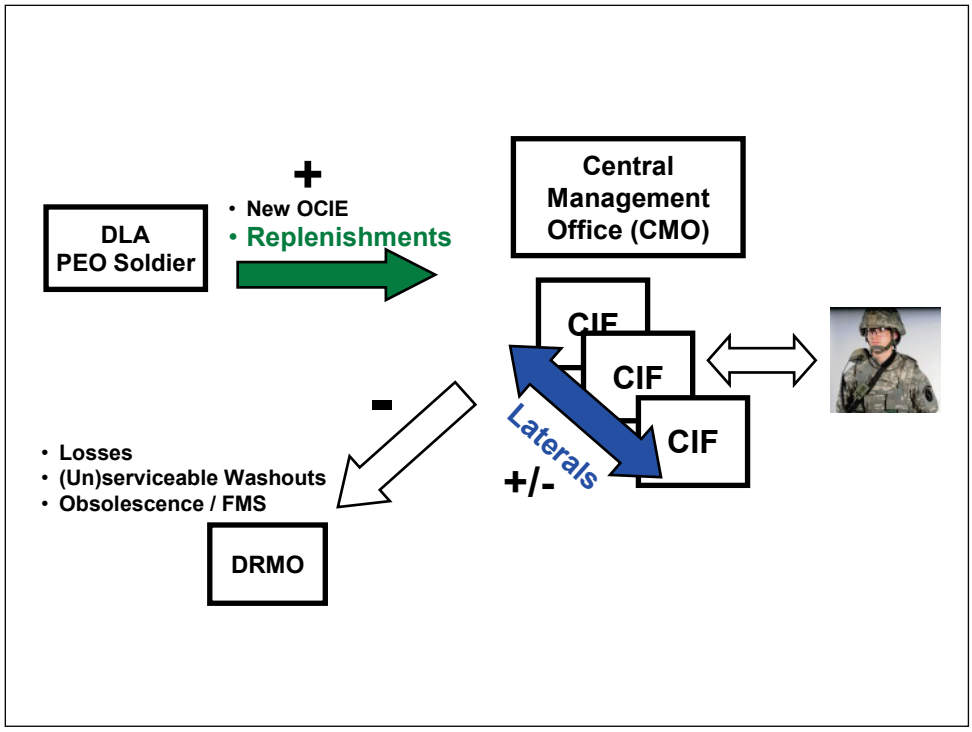
[8] CIF sustainment operations are those related to normal operating tempo, i.e., they are unrelated to deployments or to the reset of soldiers returning from deployment. As OCIE began to modernize to support the needs of soldiers

Management Office (CMO) that oversees all the CIFs may fill requisitions via lateral transfers of OCIE inventory from other CIFs. When inventory is no longer needed as a result of obsolescence, excess inventory posture, or unserviceability, CIF managers may move OCIE inventory to the Defense Reutilization and Marketing Office (DRMO) at the direction of the CMO.

We developed a twofold approach to improve inventory management, illustrated in Figure 1.2. The first recommendation is to adopt a standard, data-driven approach to help CIF managers make replenishment decisions, i.e., what and how much to order (indicated by the green arrow the figure). We developed an algorithm and process to set and execute inventory levels. This approach was tested at Ft. Stewart beginning in August 2009 and at Ft. Drum beginning in May 2010; in November 2010, the approach was expanded to include 18 additional CIFs

The second recommendation is to increase lateral transfers to make better use of existing inventory at CIFs (indicated by the blue arrow in Figure 1.2). RAND developed a standard, data-driven approach to setting a total stockage allowance (TSA) to help with the lateral transfer

Figure 1.2
OCIE Inventory Management Can Be Improved by Adopting a Standard, Data-Driven Approach to Help CIF Managers Make Replenishment Decisions and Increase the Use of Lateral Transfers



deploying to Iraq and Afghanistan, PEO Soldier also provided OCIE directly to CIFs or to soldiers preparing to deploy.

decision process. The purpose of the TSA is to facilitate the identification of materiel available for lateral transfer between CIFs. An algorithm and process to set TSA levels and execute the lateral transfer decision process began testing at 22 CIFs in November 2010.

Organization of This Document

The remainder of this report is organized into two chapters:

- Chapter 2 describes the approach RAND developed to help CIF managers make requisition replenishment decisions.
- Chapter 3 describes the approach RAND developed to help CMO make lateral transfer decisions.

The document also contains several appendixes designed for readers with a detailed knowledge of and experience in CIF inventory management.

2. A Standard, Data-Driven Approach to Help CIF Managers Make Replenishment Decisions

In this chapter, we describe the first of RAND's twofold recommendations for improving inventory management: the adoption of a standard, data-driven approach to help CIF managers make replenishment decisions, i.e., what and how much to order.

The current replenishment process is based on managers' experience and expert judgment, which is not always empirically based. Local differences in experience and expertise mean that the replenishment process is executed unevenly across the CIFs. Under the current system, the CIF manager reviews inventory monthly or quarterly and determines which items need to be replaced. This relatively low frequency of review and requisitioning increases the risk of buying too much of one item or not enough of another.

RAND developed a standard, data-driven approach to help CIF managers make replenishment decisions. The approach uses historical issue and serviceable turn-in data to determine the breadth and depth of items stocked, i.e., what and what quantity to requisition. RAND also recommended increasing the requisition frequency to reduce the risk of excess inventory. An algorithm and process to set and execute inventory levels were tested at Ft. Stewart beginning in August 2009 and at Ft. Drum beginning in May 2010. In November 2010, the approach was expanded to include 18 other CIFs.

This chapter first provides an overview of the process developed by RAND for setting breadth and depth. (The algorithm is described in more detail in Appendixes A-I.) We then describe the performance of inventory levels set using the RAND approach as implemented at Ft. Stewart and Ft. Drum. Finally, we discuss the plan for Army-wide implementation of RAND's approach, including plans for automation.

Process for Setting Breadth and Depth

Breadth Focuses on Centrally Managed Items That Have Had Positive Net Issues in the Past Year

The list of items to stock at a CIF focuses on centrally managed items (CMI)[9] in current use. An item qualifies to receive inventory levels if it has positive net issues, i.e., more issues than

[9] CMO provides funds to CIFs to purchase CMI. CIF managers may purchase non-CMI using installation funds at the direction of the installation commander. Although the focus of the CIF inventory levels–setting algorithm is on CMI, the algorithm can be and has been used to set inventory levels on non-CMI materiel.

serviceable turn-ins, in the past year.[10] At Ft. Stewart, 369 items qualified to receive inventory levels.

Although these 369 items represent only 17 percent of the 2,161 items on Ft. Stewart's July 2009 property book,[11] concentrating inventory on a relatively small percentage of items will still yield high performance: The expected accommodation rate is 99 percent. That is, 99 percent of orders by soldiers at the Ft. Stewart CIF were for one of the 369 items on the authorized stockage list.

Depth Calculations Are Set to Maintain High Performance Goals

We developed the Peak Issue Methodology (PIM) algorithm to determine the point at which to replenish inventories and the quantity to replenish to achieve a high level of performance. The re-order point (ROP), which determines when to place a replenishment requisition, is intended to cover the expected net issues that occur during the replenishment lead time (RLT), i.e., the time between when an item reaches its ROP and when the replenishment requisition is received, plus some overlap for safety. For each item that qualifies to receive inventory levels, we set the ROP based on the "largest need," i.e., the largest net issue quantity over a RLT-day period (termed a "bucket") that occurred over the past year.[12] Setting the ROP to satisfy the peak net issue over the past year is a conservative approach used to maintain high performance goals without having to make adjustments to address the underlying distribution of demand.

Figure 2.1 shows how the peak net issue over the past year is determined using RAND's approach. For each item, the net quantity issued is totaled for each day in the past year. For example, on a given day, if there were 10 issues and two serviceable turn-ins of an item, then the net issue quantity for that item on that day is 10 – 2 = 8.

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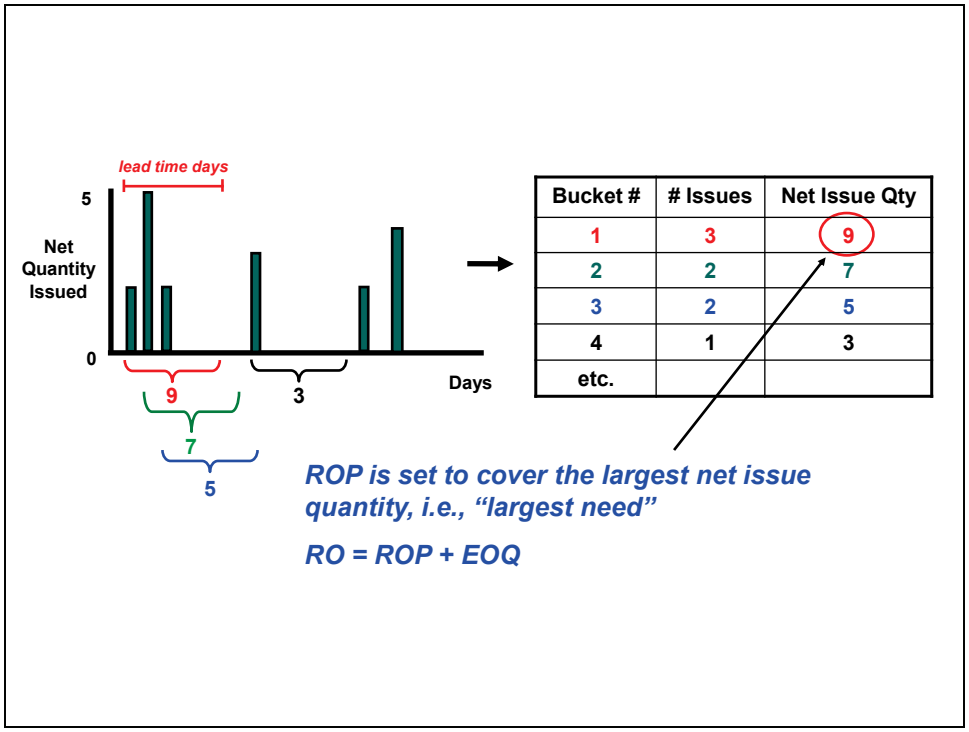
[10] To reduce the time soldiers spend in the CIF, CIF staff sometimes record all turn-ins as serviceable, even if the item is unserviceable. Appendix G describes the use of a No Turn-in List that allows the algorithm to record all turn-ins as unserviceable. All items on the No Turn-in List qualify for stockage. Another way to estimate the true serviceable turn-in rate is to estimate unserviceable turn-ins using the monthly washout rate, i.e., average monthly quantity sent to DRMO. This method was not used because of data quality issues with the monthly washout rate. CMO is investigating ways to improve the data quality of the monthly washout rate.

[11] Excluded from the property book were 3,724 items with zero on-hand inventory and with no issues in the past year. These items appear on the property book, because the property book is the accountable record of what OCIE inventory soldiers possess.

[12] One way to identify the peak net issue for an item over a RLT, is to start on January 1, calculate the number of net issues over the RLT until the end of the year, then move to January 2 and do the same; we call this the unrestricted approach. To increase computational speed, we restrict the algorithm to start creating buckets only when there is either an issue or a turn-in, so if on January 2, no issue or turn-in occurred, the algorithm does not create RLT buckets starting on January 2. For items with frequent issues and serviceable turn-ins, the difference between the restricted and unrestricted approach is minimal. However, if an item has sporadic issues or turn-ins, then calculations using the restricted method are more sensitive to the timing of the activity. Figure 2.1 illustrates such a case; the fourth bar may have been counted with the 3rd bar in the unrestricted case but is counted alone in the restricted case. Expected performance remains high even when restrictions are placed on when the bucket begins.

Figure 2.1
ROP Is Set to Cover the Largest Need



The net quantity issued in a bucket is totaled for each RLT-day period that begins with an issue or serviceable turn-in. In this example, the bucket quantities are 9, 7, 5, and 3. The largest of these bucket quantities is 9; this is the peak net issue. We set the ROP to be the peak net issue minus one, or 9 – 1 = 8.[13]

An EOQ that balances ordering and holding costs is then added onto the ROP to obtain the requisition objective (RO). Together, the RO and the ROP provide a data-based approach to the CIF replenishment process.[14]

Depth Calculations Can Be Tailored to Different Types of CIFs

The PIM can be applied to different types of CIFs, of which there are two major categories: mobilization and training. Mobilization CIFs support soldiers who are prepared to deploy overseas; the CIF at Ft. Drum is a mobilization CIF. At a mobilization CIF, OCIE is turned in

[13] We set the ROP to be equal to the largest net issue quantity minus 1, so that if the largest net issue quantity of an item is equal to 1, then setting ROP = 0 and RO = EOQ (economic order quantity) will fulfill all net issues.

[14] The inventory position (IP) of an item is defined as AFI + DI – DO, where AFI = quantity available for issue, DI = quantity due in from orders or lateral transfers, and DO = quantity due out to soldiers. If IP is less than or equal to the ROP, then a replenishment requisition should be requested for the quantity (RO – IP). In other words, RO is the "order up to" point.

only when it has been rendered unserviceable as a result of normal wear and tear, heavy use during a contingency, or at the end of a soldier's time in service. Training CIFs primarily serve training soldiers and some permanent party[15] soldiers; the CIF at Ft. Leonard Wood is a training CIF. At a training CIF, OCIE that is issued to a training soldier is generally turned in within a few weeks of the completion of his or her training exercise. Thus, the timing between issue and turn-in of an OCIE item tends to be shorter at training CIFs than at mobilization CIFs.

A CIF may also be a main or annex CIF.[16] A main CIF supports one or more annex CIFs. If an annex CIF requires replenishments, it does not submit replenishment requisitions to DLA; rather, the main CIF is responsible for identifying shortages at its supported annex CIF and transferring the needed materiel to that annex, typically on a regular schedule, e.g., weekly or biweekly. The CIF at Ft. Stewart, which supports the annex CIF at Hunter Army Airfield, is a main CIF. (Note that Ft. Stewart is both a mobilization and a main CIF.)

Table 2.1 shows how the PIM can be adapted to different types of CIFs, each with its different workloads, items stocked, and soldiers served. For mobilization CIFs, the PIM is applied to the net issues from the CIF. For main CIFs, the PIM is applied to the net issues from the main and annex. For annex CIFs that are supported by a main CIF, the PIM is applied to the net issues of the annex. For training CIFs, the PIM is applied to both net issues and QPBS.[17]

Table 2.1
Largest Need Methodology Can Be Adapted to Different CIF Types

CIF Type	PIM Consideration
Mobilization	Net issues from CIF
Main	Net issues from main and annex
Annex	Net issues from annex
Training	Net issues and QPBS

NOTES: Traditionally in inventory management, inventory levels at a main CIF are based on issues to soldiers from the main CIF and lateral transfers to supported annex CIFs. In the PIM, net issues to soldiers at the annex CIFs were used to set inventory levels instead of lateral transfers sent to supported annex CIFs, because lateral transfers to supported annex CIFs were previously not data-based decisions and their inclusion in the PIM could have resulted in larger than necessary inventory levels.

Depth Calculations Must Take into Account Up-to-Date Relationships Between New and Replaced or Substitutable Items

The PIM takes into account relationships between new and replaced or substitutable items that are necessary to maintain high performance goals. With the help of the CMO, G-4, and CIF

[15] Permanent party soldiers are soldiers who typically do not deploy during a contingency.

[16] Annex CIFs were created to meet the goal of ensuring that soldiers do not have to travel more than 30 minutes to visit a CIF.

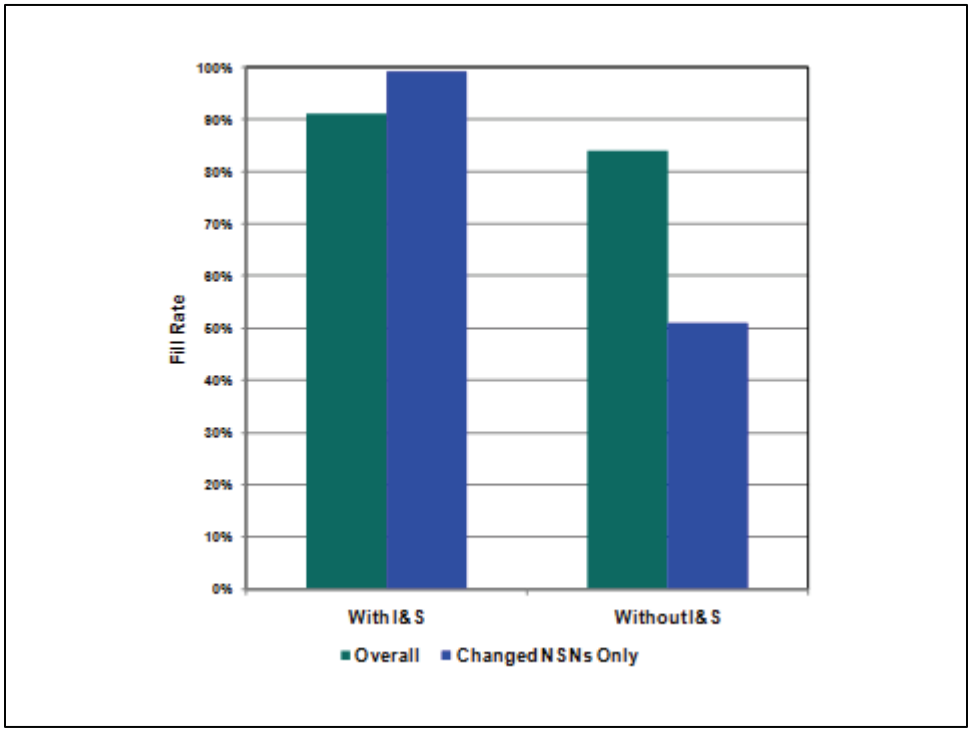
[17] This methodology is the subject of a forthcoming document.

managers, we created substitutable/replaced lists for over 22 CIFs.[18] The lists are unique to each CIF and establish linkages for over 500 items. A substitutable/replaced list divides items into two categories:

- substitutable items, i.e., items that have been replaced by new ones but the old ones can still be issued
- replaced items, i.e., items that have been replaced by new ones and the old item cannot be issued in place of the new item.

Keeping the documented linkages up to date is critical to maintaining high performance goals. Figure 2.3 shows the simulated performance with and without a substitutable/replaced list at Ft. Stewart.[19] Without an up-to-date substitutable/replaced list, the overall fill rate—the

Figure 2.3
Substitutable/Replaced List Is Critical to Achieving High Performance Goals



[18] For Class IX repair items, there is an interchangeable and substitutable (I&S) file that links old items to their new replacement item(s) and directs users to order only the new item. This file accompanies the monthly Federal Logistics (FedLog) catalog and is used Army-wide. For OCIE items, there is no Army-wide file that records the linkage between old and new OCIE items, primarily because CIFs transition from old to new OCIE according to a schedule that typically spans several years; at any given time, different CIFs issue old and/or new OCIE materiel, depending on when the CIF is scheduled to transition from old to new materiel. Substitutable/replaced lists are described in more detail in Appendix D.

[19] Depth calculation was based on historical issues and turn-ins at Ft. Stewart between May 2009 and April 2010. Simulated performance was based on issues and turn-ins at Ft. Stewart between May 2010 and April 2011.

percentage of required items issued to a soldier visiting the CIF—dropped from 92 percent to 84 percent.[20] When restricting to items that were substituted or replaced during the depth calculation period, the fill rate dropped from 99 percent to 51 percent. To achieve and preserve high performance goals, CMO has agreed to develop and maintain the substitutable/replaced lists for each CIF.

Performance of Recommended Inventory Levels at Ft. Stewart and Ft. Drum

The PIM algorithm and process to set and execute inventory levels were implemented at Ft. Stewart at the end of July 2009. The pilot test was evaluated from August 2009 to March 2010. An expansion of this pilot test was implemented at Ft. Drum at the end of April 2010. The Ft. Drum pilot test was evaluated from May 2010 to January 2011.

The pilot tests were evaluated according to these metrics during the evaluation period:

- Were replenishment requisitions reviewed weekly?
- Did the value of replenishment requisitions decrease?
- Did the value of authorized on-hand inventory (i.e., items with a positive RO) decrease?

In the following sections, we will discuss each of these three performance metrics in turn.

Replenishment Requisitions Are Being Reviewed Weekly

As stated above, we first recommended that replenishment requisitions be reviewed weekly. This approach has two key benefits. First, more-frequent reviews allow the CIF manager to keep better track of the current inventory and to better anticipate and react to potential shortfalls. Second, cutting the length of time between review periods reduces the administrative portion of the replenishment lead time and allows CIFs to reduce the amount of safety stock needed.

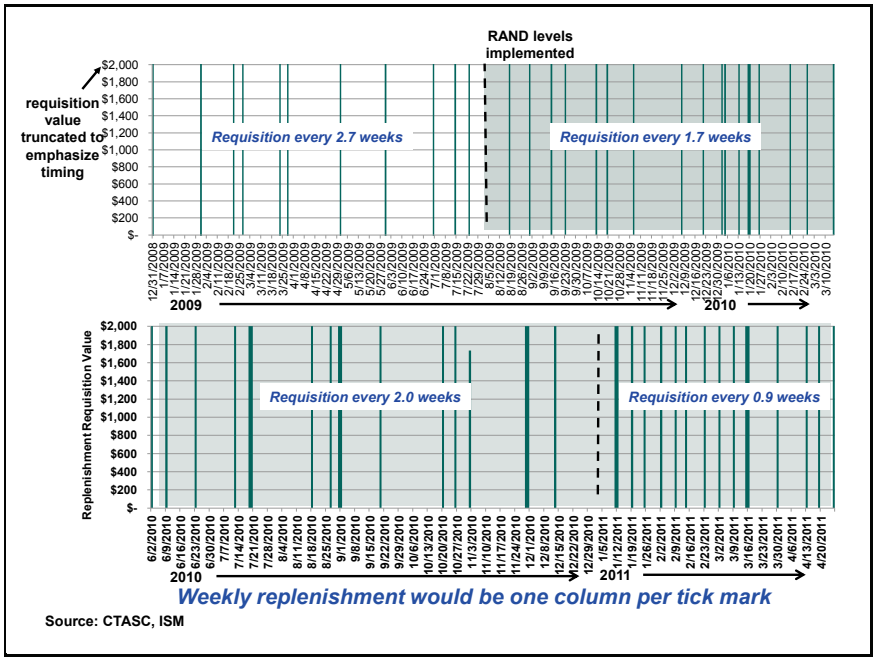
Because no data are collected when a CIF reviews replenishment requisitions, as a proxy, we look at the frequency of replenishment requisitions executed. Note that replenishment requisitions may be reviewed but not executed weekly, because there may not be a need to replenish items every week.

Figure 2.4 shows replenishment requisitions executed at Ft. Stewart beginning in 2009. Each tick mark along the x-axis represents one week. Each column represents a requisition executed that week. Before implementation of the PIM inventory levels at the end of July 2009, on average Ft. Stewart executed requisitions every 2.7 weeks.[21] After implementation, Ft.

[20] Note that in Figure 2.3, performance is measured using fill rate—the percentage of required items issued to a soldier visiting the CIF. Fill rate measures the depth of inventory. By contrast, at the beginning of the chapter, performance was measured using accommodation rate—the percentage of issues that are for items for which the CIF maintains inventory levels. Accommodation rate measures the breadth of inventory.

[21] Average number of replenishment requisitions computed between December 31, 2008, and July 23, 2009.

Figure 2.4
Replenishment Requisitions Are Being Executed Closer to Weekly at Ft. Stewart



Stewart began executing requisitions every 1.7 weeks[22] but increased to ordering every 2.0 weeks[23] during the second half of 2010. In January 2011, Ft. Stewart began executing requisitions every 0.9 weeks,[24] in other words, weekly.

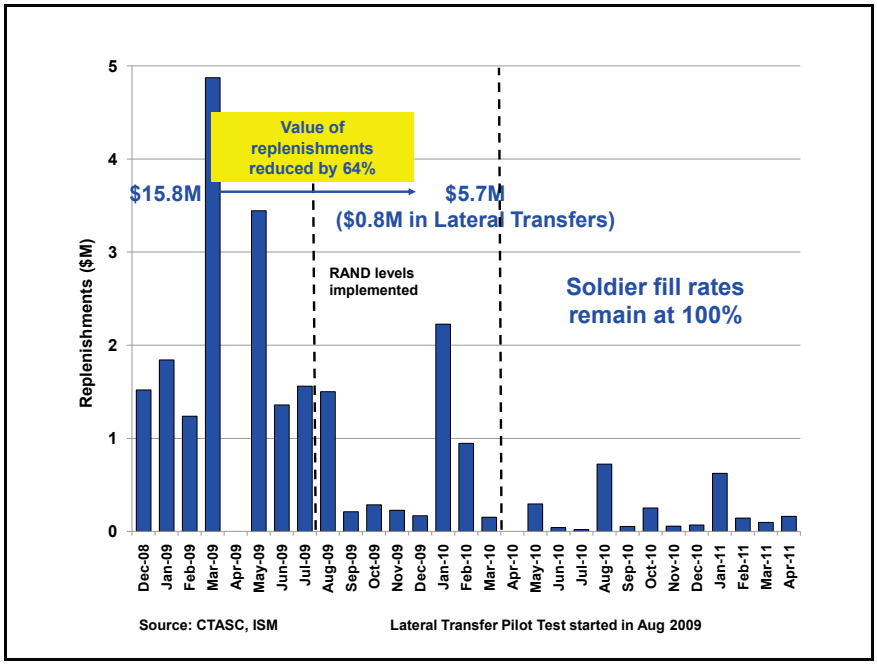
Ft. Drum showed a similar pattern in which replenishment requisitions began to be reviewed weekly after implementation.

The Value of Replenishment Requisitions Decreased by As Much as 64 Percent

We now look at results for the second performance metric, the value of replenishment requisitions. The goal of the inventory levels pilot test was to reduce the value of replenishment requisitions while maintaining high performance goals. To evaluate the pilot test performance, we looked at the monthly value of replenishment requisitions at Ft. Stewart, as shown in Figure 2.5. In this figure, the vertical dashed lines indicate the two eight-month periods before and after implementation of the RAND approach.[25] A comparison of these two periods shows that there

[22] Average number of replenishment requisitions computed between August 18, 2009, and March 15, 2010.
[23] Average number of replenishment requisitions computed between March 22, 2010, and December 13, 2010.
[24] Average number of replenishment requisitions computed between January 11, 2011, and April 26, 2011.
[25] We compare eight-month periods, since we had eight months of data available before implementation of the new approach.

Figure 2.5
Value of Replenishment Requisitions at Ft. Stewart Decreased by 64 Percent



was a 64 percent reduction ($15.8 million to $5.7 million) in the value of replenishment requisitions.[26] During this time, soldier fill rates remained at 100 percent.

Similarly, Figure 2.6 shows a 60 percent reduction (from $4.5 million to $1.8 million) in the cumulative value of replenishment requisitions over the respective nine-month periods before and after the implementation of inventory levels at Ft. Drum. During this time, soldier fill rates remained at 100 percent.

The Value of Authorized On-Hand Inventory at Ft. Stewart Has Started to Decrease

The third performance metric is the value of authorized on-hand inventory, shown in Figure 2.7 for Ft. Stewart. The higher dotted line represents the on-hand value of authorized body armor items. The fluctuations in on-hand body armor inventory value are due to two shipments, processed by CMO to support deployments, valued at $4.5 million and $4 million each.

The lower solid line represents the on-hand value of authorized non-body armor items. Without body armor, the value of authorized items increased in September 2009, because Ft. Stewart received replenishment requisitions placed before implementation of the inventory levels. Overall, the value of authorized non-body armor items decreased by 17 percent ($18

[26] At Ft. Stewart, the start of the CMO lateral transfer pilot coincided with the start of the inventory levels pilot test. The lateral transfer pilot executed $1.3 million in lateral transfers from August 2009 to March 2010. During the previous eight months, no lateral transfers were executed.

Figure 2.6
Value of Replenishment Requisitions at Ft. Drum Decreased by 60 Percent

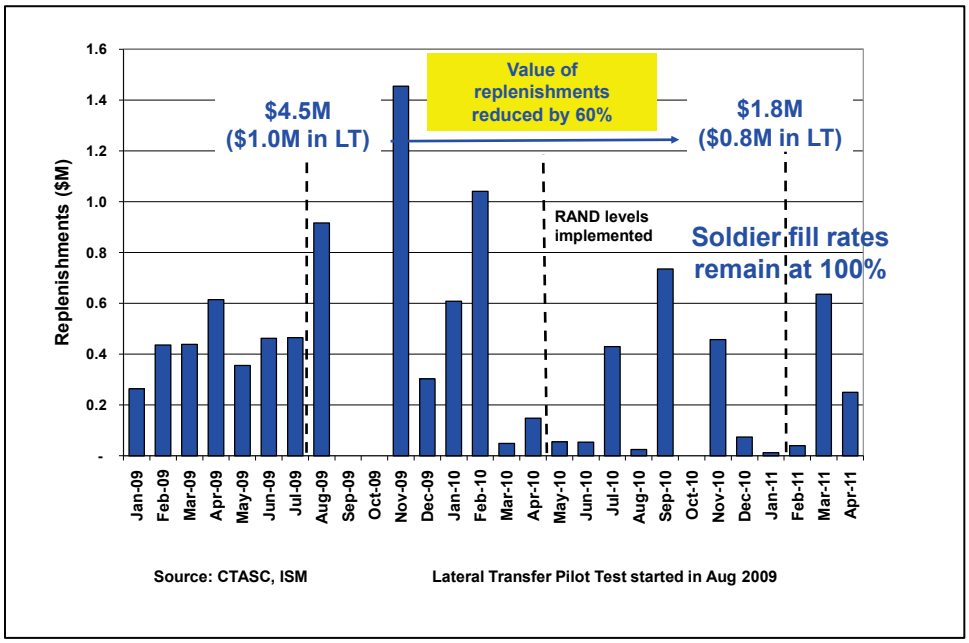
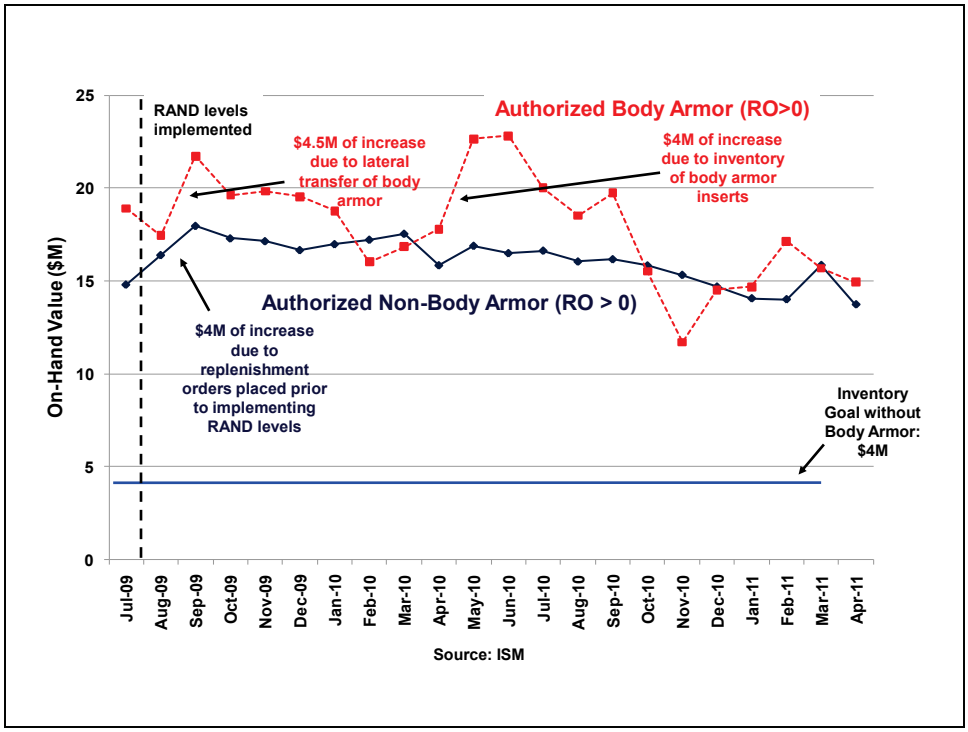


Figure 2.7
Value of On-Hand Inventory of Authorized Items Has Started to Decrease at Ft. Stewart



million to $14 million) between September 2009 and April 2011. This inventory value is still greater than the authorized inventory value goal of $4 million without body armor. The authorized inventory value goal is the sum of the RO value across all authorized National Stock Numbers (NSNs) at Ft. Stewart. The authorized inventory value goal without body armor is the sum of the RO value across all authorized non-body armor NSNs at Ft. Stewart.

Assuming a constant rate of decrease, the authorized inventory value was scheduled to reach the authorized inventory value goal in September 2012, however a steep increase in turn-ins could change the current trajectory. The time required to achieve the goal may be reduced if inventory above the RO value is laterally transferred to other CIFs; the time required to achieve the goal may be increased if a new OCIE pattern is introduced that causes remaining on-hand inventory of the old OCIE pattern to be in excess. In the latter case, inventory levels can be difficult to reduce because the items are slow-moving. The figure illustrates an important point: Inventory is "sticky," i.e., easy to acquire but difficult to eliminate, especially if items are slow-moving or the CIFs receive a sudden surge of turn-ins.

Similarly, Figure 2.8 shows the value of authorized on-hand inventory at Ft. Drum. The upper dotted line represents the on-hand value of authorized body armor items and shows a decrease as soldiers deploy and an increase as soldiers return from deployment and return enhanced body armor issued only to deploying soldiers (see the red-dotted lines for signposts of deployments and return). The value of armor on-hand at the CIF is expected to decrease as armor is issued to deploying soldiers, increase as soldiers return, this is evident in Figure 2.8. For a better barometer of how Ft. Bragg's inventory is changing as a result of instituting PIM, we look at the on-hand value of non-armor items. These items are not returned when soldiers return from deployment. The lower solid line in Figure 2.8 represents the on-hand value of authorized non-body armor items. Overall, the value of authorized non-body armor items decreased by 36 percent ($11 million to $7 million) between May 2010 and April 2011. This inventory value is still greater than the authorized inventory value goal of $1.5 million without body armor.[27]

Inventory above the RO may be considered available for lateral transfer; however, it may not be economical to move the materiel if it can be used within a reasonable amount of time. The determination of whether a lateral transfer is economical will be discussed in the next chapter.

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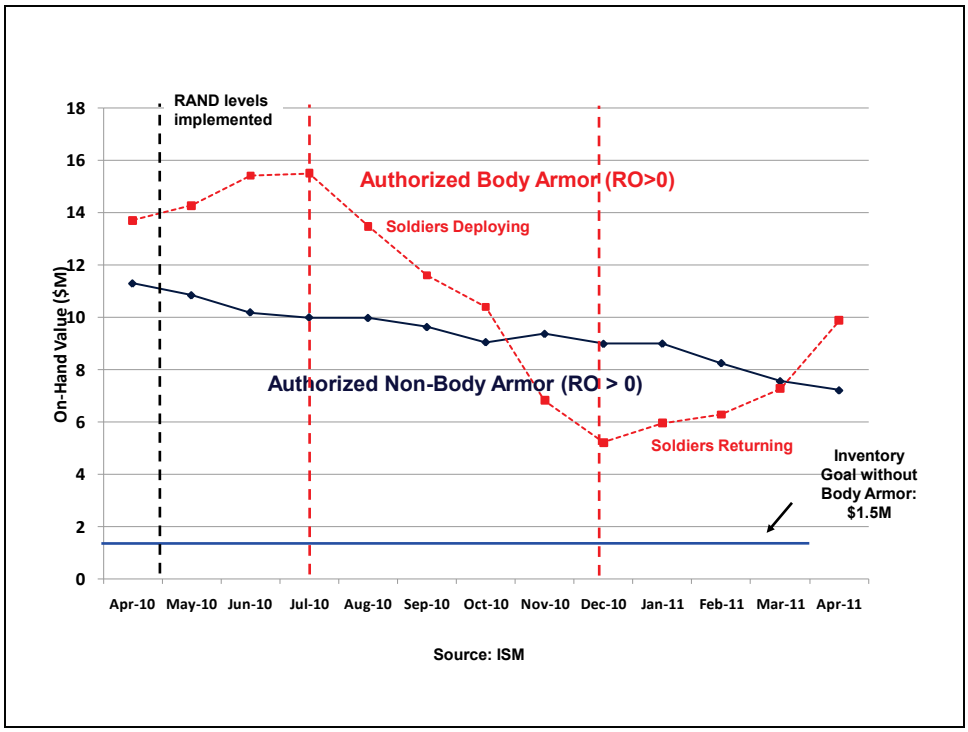
[27] The authorized inventory value goal is the sum of the RO value across all authorized NSNs at Ft. Drum. The authorized inventory value goal without body armor is the sum of the RO value across all authorized non-body armor NSNs at Ft. Drum.

Assuming a constant rate of decrease, the authorized inventory value was scheduled to reach the authorized inventory value goal in October 2012. The time required to achieve the goal may be reduced if inventory above the RO value is lateral transferred to other CIFs; the time required to achieve the goal may be increased if a new OCIE pattern is introduced that causes remaining on-hand inventory of the old OCIE pattern to be in excess or if turn-ins begin to exceed issues.

Figure 2.8
Value of On-Hand Inventory of Authorized Items Has Started to Decrease at Ft. Drum



The inventory levels pilot tests were successful along the selected performance metrics. Replenishment requisitions are now being reviewed weekly at Ft. Stewart and at Ft. Drum. The value of replenishment requisitions has decreased significantly, by 64 percent at Ft. Stewart and by 60 percent at Ft. Drum. The value of authorized inventory at Ft. Stewart and at Ft. Drum has also started to decrease. The next step is to set and implement inventory levels Army-wide.

Army-Wide Implementation Plan

As of August 2010, inventory levels had been set and implemented at four CIFs: Fts. Stewart, Drum, and Leonard Wood, and Hunter Army Airfield. The Army-wide implementation plan is to expand along three fronts:

- Mobilization and CONUS CIFs: Because of the success of the pilot tests at Ft. Stewart and Ft. Drum, we will work with the Army to set and implement inventory levels at the nine remaining mobilization CIFs.[28] Implementation will also begin at an additional nine CONUS CIFs.[29]

[28] The nine remaining mobilization CIFs are Fts. Bragg, Campbell, Carson, Dix, Hood, Knox, Lewis, McCoy, and Riley.
[29] The nine CONUS CIFs are Fts. Bliss, Gordon, Huachuca, Irwin, Leavenworth, Lee, Polk, Rucker, and Sam Houston.

- Training CIFs: We will work with the Army to continue testing and refining the training inventory levels methodology at one other training CIF. After testing, we will set and implement inventory levels at the remaining training CIFs.[30]
- OCONUS CIFs: We have begun working with U.S. Army Europe (USAREUR) to understand their CIF supply chain. We expect to set and implement inventory levels in mid-2011. After testing, we will set and implement inventory levels at Korea CIFs.

In August 2011, 66 percent of on-hand OCIE inventory value was scheduled to fall under the inventory levels implementation plan.

Table 2.2
Army-Wide Implementation Plan for Inventory Levels

CIF	RO/ROP Computed	Replenishment Process Started	On-Hand Inventory Value ($M)
Ft. Stewart	July 2009	August 2009	65
Ft. Drum	April 2010	May 2010	30
Hunter Army Airfield (Stewart Annex)	April 2010	May 2010	8
Ft. Leonard Wood	March 2010 August 2010	September 2010	36
9 Mobilization CIFs	November 2010	November 2010	354
9 CONUS CIFs	November 2010	November 2010	121
Ft. Sill	March 2011	March 2011	37
USAREUR CIFs	May 2011	August 2011	142
Korea CIFs	May 2011	August 2011	62
Training CIFs	October 2011	October 2011	105
Remaining CONUS CIFs	October 2011	October 2011	241

NOTE: Items below the double line indicate future implementation plans.

Increased Automation Will Reduce Workload and Lessen Uncertainty in the Inventory Levels–Setting Process

The Army-wide inventory levels implementation plan is currently hampered by a lack of automation in the replenishment process. This means that even low-risk, fast-moving items cannot be addressed automatically, which would allow inventory managers to focus their time and effort on setting inventory levels for other higher-risk items. The current process requires several manual steps that add to workload and create room for error:

- CIF manager creates replenishment recommendations: This approach requires the manager's time and creates the potential for error.

[30] As of 2010, the training CIFs were Fts. Benning, Jackson, Knox, Leonard Wood, and Sill. Ft. Knox lost its training mission in the summer of 2011. Note that Ft. Benning also supports mobilizing soldiers.

- CIF manager reviews replenishment recommendations: Manual bookkeeping often makes this process time-consuming and difficult to manage.
- CIF manager creates the list of approved replenishment requisitions in the CIF information system, Installation Support Module (ISM): Because the CIF manager typically enters requisitions manually into ISM, errors in data entry can occasionally occur.
- CMO approves replenishment requisitions in ISM: This approach requires the manager's involvement and adds to workload.
- CMO submits replenishment requisitions that cannot be supported by a lateral transfer to the Logistics Modernization Program (LMP):[31] The decision process as to whether a requisition can be supported by a lateral transfer requires a data download from ISM and an offline tracking system built by Booz Allen Hamilton (the LMP Interface Tool). All data are stored electronically, but time delays in updating data between the systems may contribute to errors.
- CIF manager updates requisition status in ISM: This step also adds to CIF manager workload.

It is important to note that, by setting inventory levels, we are replacing only the first step in this process. The PIM inventory levels dictate the replenishment recommendations, thereby reducing some workload and uncertainty. The remaining steps still require manual intervention.

The plan is for increased automation to reduce workload and uncertainty in the process. As of August 2011, ISM was able to

- generate replenishment recommendations based on PIM inventory levels
- create and approve replenishment requisitions under a dollar threshold[32] in ISM (remaining replenishment requisitions must be approved by the CIF manager)
- upload requisition status from the Logistics Information Warehouse (LIW) directly into ISM.

With this additional automation, replenishment requisitions will require less workload to execute. However, one key step will still require manual intervention: submission of approved replenishment requisitions to the Army supply system.[33]

The automation of these steps in the replenishment process is critical to the success of the inventory levels implementation and to reducing inventory requirements. Recall that we set the ROP to satisfy the largest need over a RLT-day period over the past year. With additional automation, replenishment requisitions can be reviewed and executed more frequently, meaning that RLT will be reduced. As a result of RLT reductions, the PIM will compute reduced

[31] LMP is typically used by the Army wholesale level to manage major end items. Orders entered into LMP are sent to the Defense Automatic Addressing System (DAAS), which feeds into the Standard Army Retail Supply System (SARSS).

[32] The current plan is for the replenishment value threshold to be set at $500.

[33] As of August 2011, there were no plans to automate the submission of replenishment requisitions.

inventory levels, leading to reduced inventory requirements while maintaining high performance goals.

3. Increasing Lateral Transfers

Replenishment requisitions can be fulfilled either by wholesale requisitions with DLA or by lateral transfer of materiel from another CIF. The second of RAND's twofold recommendation for improving inventory management is to increase lateral transfers to make better use of existing inventory at CIFs. RAND recommended and the Army subsequently adopted a standard, data-based approach to help CMO make lateral transfer decisions, i.e., how to identify inventory that can be laterally transferred to fulfill replenishment requisitions.

The current lateral transfer decision process is manual and time-consuming:

- CMO contacts potential sending CIFs about a lateral transfer opportunity: The process can take a long time because the primary means of communication is email.
- The sending CIF notifies CMO if it can support a lateral transfer. This decision is based on experience and expert judgment and this process also can take a long time, because the primary means of communication is email. Previously, there was no data-based way to determine whether the CIF had sufficient inventory to support a lateral transfer.
- Sending CIF creates a lateral transfer document in ISM: Errors may occur because the CIF must enter the NSN manually.
- CMO notifies the receiving CIF that the lateral transfer can be supported: This step adds to workload.
- Receiving CIF updates ISM when lateral transfer is shipped. This, too, is a manual process, adding workload and time.

RAND developed a standard, data-driven approach to setting a TSA to help make the lateral transfer decision. The TSA facilitates identification of materiel available for lateral transfer between CIFs by establishing a level below which the materiel to be laterally transferred is more likely to be used at the sending CIF. An algorithm and process to set TSA levels and execute the lateral transfer decision process began testing at 22 CIFs in November 2010.[34]

This chapter provides an overview of the lateral transfer decision process using the TSA. (The algorithm that sets the retention level [RL] that is part of the TSA is described in more detail in Appendix K.) The remainder of this chapter describes the plan for Army-wide implementation, including plans for automation.

[34] The CIFs included in the TSA pilot test were Fts. Benning, Bliss, Bragg, Campbell, Carson, Dix, Drum, Gordon, Hood, Huachuca, Irwin, Jackson, Knox, Leavenworth, Lee, Lewis, McCoy, Polk, Riley, Rucker, Sam Houston, and Stewart.

Lateral Transfer Decision Process

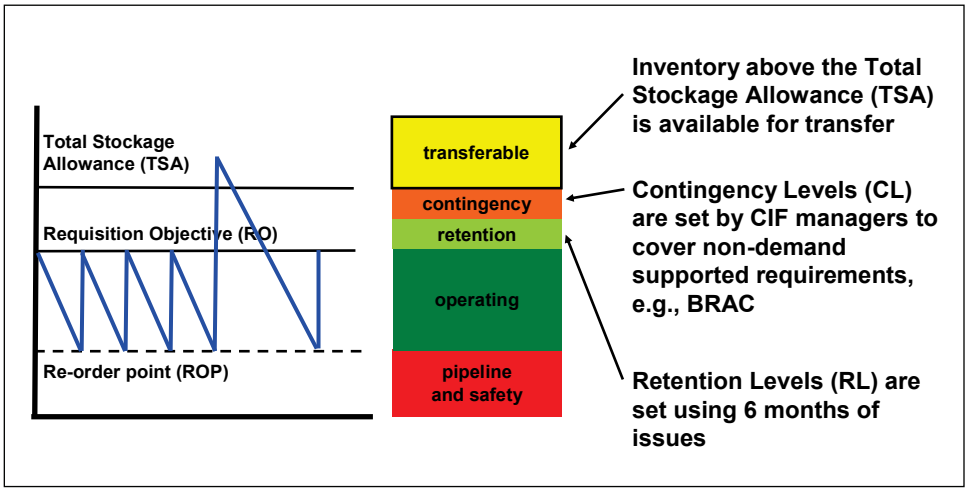
RAND developed a method for identifying inventory available for lateral transfer. We define the TSA as the sum of the RO, RL, and contingency level (CL). Figure 3.1 depicts the components of the TSA. The RO covers the operating level, and the ROP covers the pipeline and safety level. The RO is set using the PIM described in the previous chapter and in more detail in Appendix I. The RL covers materiel that can be retained at the CIF because it will likely be used within six months. The RL is computed using the method described in Appendix K. The CL is set by CIF managers and approved by CMO to cover non-demand–supported requirements.[35]

On-hand inventory above the TSA is available for lateral transfer. By setting TSAs for each CIF-item combination, the first two steps in the lateral transfer decision process can be automated: CMO does not need to contact potential sending CIFs to see if they have inventory available for lateral transfer, because inventory above the TSA is available for lateral transfer.

RAND Developed Estimates for the Economic Costs and Benefits of Lateral Transfers

The TSA identifies materiel that is available for lateral transfer but does not determine whether a lateral transfer is economically justifiable. Determining whether a lateral transfer is economical depends on several factors:

Figure 3.1
The TSA Enables Easier Identification of Inventory Available for Lateral Transfer



[35] Examples of non-demand–supported requirements include the requirement to support an additional unit as a result of Base Realignment and Closure (BRAC), the requirement to support emergency relief operations in the event of a natural disaster, or the requirement to stockpile sufficient inventory of a new item to issue the new items to an entire unit of supported soldiers, rather than to one soldier at a time.

- quantity of the item requested,
- total value of the materiel requested,
- cost of transportation,
- Army-wide supply status,
- holding cost at the sending CIF.

On the cost side, lateral transfer costs include the cost of transportation and the labor cost involved in picking, packing, and shipping the lateral transfer at the sending CIF.

On the benefit side, lateral transfers reduce the holding cost of inventory at the sending CIF. Holding costs, which include storage and obsolescence costs, can be significant, e.g., for items that experience few issues, such as odd-sized boots.[36] Another benefit of lateral transfers is that the time between request and receipt is typically less for a lateral transfer than it is for a wholesale order, particularly for items in short supply Army-wide. A final benefit is that funds that would have been obligated on a wholesale order are now available for other uses.

Ideally, all economical lateral transfers should be executed to reuse the greatest amount of existing inventory. During the pilot test, RAND, CMO, and G-4 decided to focus on executing lateral transfers of items with large inventory value, i.e., greater than $10,000. Later, all replenishment requisitions were considered for lateral transfer regardless of inventory value because of budgetary constraints. This led to a large number of lateral transfer requests, which CIFs were not necessarily staffed to execute.

As there is a decrease in excess inventory that can be reused, we recommend that only lateral transfers that meet some economic threshold be executed, e.g., lateral transfers that represent a net savings of greater than $1,000, and that this threshold be decreased over time as CIF lateral transfer workload allows. This threshold can be a fixed number based on expected cost-benefit tradeoff across all items, or it can be a number that depends on the items to be laterally transferred, the usage rates at the sending and receiving CIFs, expected transportation costs, etc.

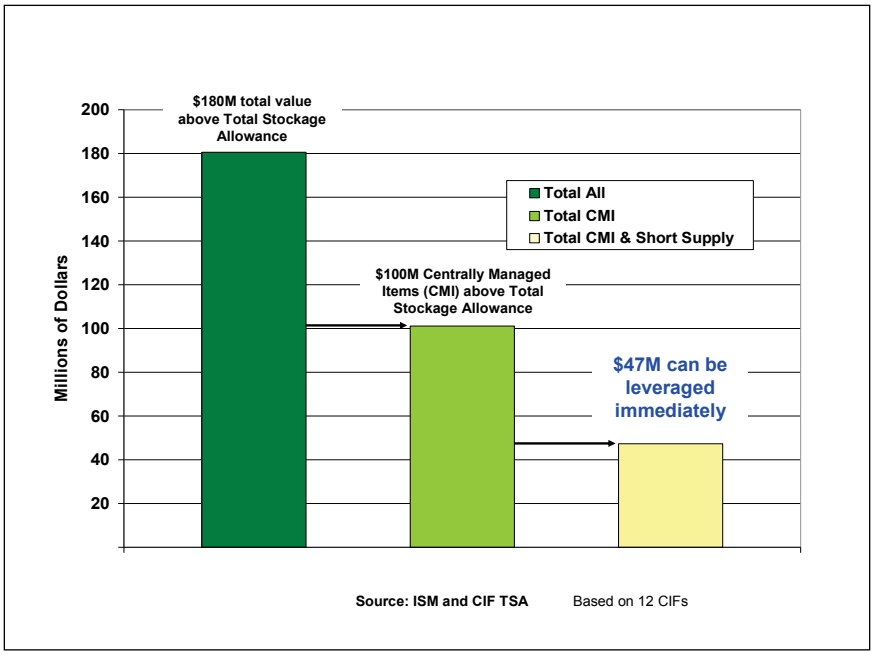
Potential Benefits of Lateral Transfers

The potential benefits of lateral transfers are significant. Figure 3.2 shows the value of inventory above the TSA at 12 CIFs. The leftmost column shows that the total value of inventory above the TSA is $180 million. The middle column shows that of this $180 million, $100 million is in CMI inventory. The rightmost column shows that of this $100 million, $47 million is in inventory that is in short supply Army-wide.[37] This $47 million can be leveraged immediately

[36] The Army uses a holding cost of 22 percent of unit price per year. For OCIE that is quickly being replaced by new patterns or improved equipment, this percentage may be higher.

[37] We define an item as being in short supply Army-wide if its backorder rate at the 20 largest CONUS CIFs is greater than 80 percent. The 20 largest CONUS CIFs include Fts. Benning, Bliss, Bragg, Carson, Campbell, Drum, Gordon, Hood, Huachuca, Irwin, Jackson, Knox, Lee, Leonard Wood, Lewis, Polk, Riley, Rucker, Sill, and Stewart.

Figure 3.2
We Identified for Lateral Transfer $47 Million of Centrally Managed Items in Short Supply Army-Wide



through lateral transfers. Within a few months, CMO was able to reuse over $100,000 of this $47 million in inventory, thereby avoiding requisitions to DLA.

Army-Wide Implementation Plan

An algorithm and process to set TSA levels and execute the lateral transfer decision process were scheduled to being tested at 22 CIFs in November 2010. The 22 CIFs represent 80 percent of CONUS on-hand inventory value.

The Army-wide implementation plan is to expand along three fronts:

- Training CIFs with inventory levels: We will test a methodology to set TSAs at Ft. Leonard Wood and Ft. Sill in July 2011. As the remaining training CIFs receive inventory levels, the methodology will be expanded to include those sites as well[38]
- CONUS CIFs with inventory levels: All CONUS CIFs with inventory levels in October 2011 will also receive TSAs
- OCONUS CIFs: We set TSAs in USAREUR as of May 2011. USAREUR has identified several million dollars of excess inventory as a result of the TSAs. This inventory will not be part of a lateral transfer decision process, because of the distance from CONUS. Once

[38] The algorithm developed for training CIFs was developed and tested. It had slightly better performance than the standard algorithm. The algorithm has not been implemented in ISM-CIF.

we have tested the TSAs in USAREUR, we will set and implement TSAs at CIFs in Korea.

Automation Is Critical to the Success of the TSA Implementation

The Army-wide TSA implementation plan is currently hampered by the lack of automation in the lateral transfer decision process. Increased automation can assist with the lateral transfer decision process in three areas: identification of materiel available for lateral transfer, due-in tracking, and lateral transfer request coordination across CIFs.

First, automation can help identify materiel available for lateral transfer. Currently, ISM computes retention levels as a percentage of the RO at the CIF level. As of December 2010, ISM allows item-level RLs, CLs, and TSAs. In addition, in August 2011, ISM began to identify and track the responses of potential sending CIFs.

Table 3.1
Army-Wide Implementation Plan for TSA

CIF	TSA Computed	Lateral Transfer Decision Process Started	On-Hand Inventory Value ($M)
Initial 22 CIFs	November 2009	November 2009	683
USAREUR CIFs	May 2011	N/A for OCONUS	142
Training CIFs with Inventory Levels	July 2011	August 2011	73
CONUS CIFs with Inventory Levels	May 2011	October 2011	102
USARPAC Korea CIFs	May 2011	N/A for OCONUS	62

NOTE: Items below the double line indicate future implementation plans.

Second, the due-in at the receiving CIF that is associated with a lateral transfer from the sending CIF is not recorded at the receiving CIF when the lateral transfer document is created. Rather, it is recorded after the sending CIF ships the materiel.[39] The delay in recording the due-in can result in replenishment requisitions being repeatedly and erroneously recommended until the due-in at the receiving CIF is recorded.[40] In December 2010, ISM began to record a due-in when the lateral transfer document was created.

Finally, lateral transfer requests must be coordinated across CIFs with available inventory. An automated search can identify CIFs with materiel available for transfer, but such a search

[39] Due-ins were tracked in ISM in this way, because as a property accountability system, the materiel was the responsibility of the sending CIF until it left that facility.

[40] Before December 2010, if a replenishment at a receiving CIF was expected to be fulfilled by a lateral transfer, then the receiving CIF created and approved a placeholder requisition to create a due-in for replenishment. This placeholder requisition was later deleted when the lateral transfer shipped from the sending CIF, creating the due-in at the receiving CIF.

may not be able to prioritize multiple requests, so that the same sending CIF is not being asked to transfer more materiel than it has available. CMO has worked with Booz Allen Hamilton to develop a tool that can help coordinate lateral transfer requests to ensure that sending CIFs are not asked to transfer more materiel than they have available and to ensure that the lateral transfers are executed in a timely fashion.[41]

The automation of these areas in the lateral transfer decision process is critical to the success of the TSA implementation. With this additional automation, potential lateral transfers will be automatically identified and prioritized, and due-ins will be recorded automatically, so that replenishment requisitions are not recommended erroneously over and over again. Thus, with additional automation, the implementation of data-based TSAs will increase the use of existing inventory, while maintaining high performance goals.

[41] Central Management Office, "Logistics Modernization Program (LMP) Interface and Inventory Redistribution Application Handbook," November 15, 2010. Documentation on the tool can be requested from CMO.

Appendix A: Overview of Peak Issue Methodology Algorithms

Purpose of This Appendix

This appendix provides a detailed description of the Peak Issue Methodology (PIM)—two algorithms developed by RAND to set inventory levels and retention levels on OCIE at CIFs. This document is designed specifically for readers with a detailed knowledge of and experience in CIF inventory management and should be of interest to individuals who participate in setting CIF inventory levels and coordinating lateral transfers between CIFs.

This appendix has two parts. The first provides a detailed description of the CIF inventory levels algorithm that identifies which items to order, when to order, and how much to order. The second part describes the CIF retention levels algorithm that identifies materiel available for lateral transfer. Both algorithms are currently being refined and improved. The algorithms described below are current as of March 2011.

CIF Inventory Levels Algorithm

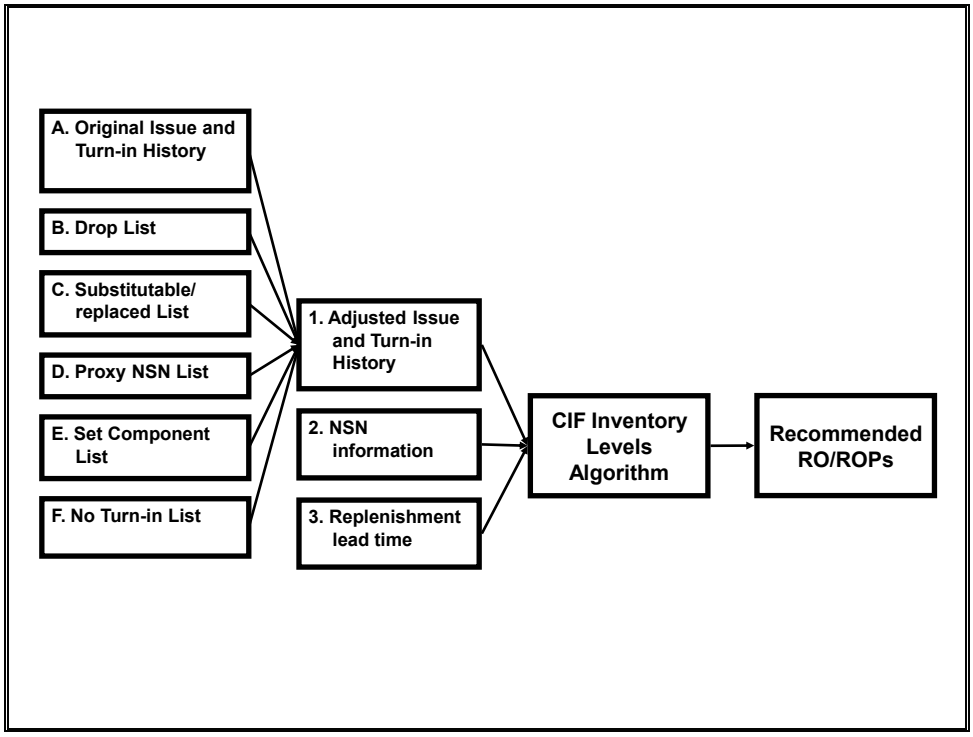
This section provides an overview of the CIF inventory levels–setting process and serves as a guide to subsequent appendixes, each of which focuses on a different aspect of this process, as described below.

Figure A.1 gives an overview of the process used to set inventory levels at CIFs during the prototype period 2010–2011. The first step, as shown in the leftmost column of boxes in Figure A.1, is to create an adjusted issue and serviceable turn-in[42] history using the following files:

A. original issue and turn-in history for a given item
B. drop list, which is a list of items that will not receive inventory levels
C. substitutable/replaced list, which is a list of old items and their corresponding replacement or substitute items
D. proxy National Stock Number list, which is a list of items that have similar issue and turn-in history
E. set component list, which is a list of sets and their indentured components
F. no turn-in list, which is a list of items whose turn-ins should be removed.

[42] In the remaining appendixes, we refer to serviceable turn-ins simply as turn-ins.

Figure A.1
Overview of the Prototype Process Used to Create Recommended ROs and ROPs



The second step, as shown in the second column of boxes from the left, is to input the following files into the CIF inventory levels algorithm to generate a recommended requisition objective and re-order point):[43]

1. adjusted issue and turn-in history created above
2. replenishment lead time, which is the time between order and receipt of an item
3. NSN information, i.e., item catalog information.

The process can be described in terms of three major components, each of which is discussed in a subsequent appendix in this report.

- Construct original issue and turn-in history and adjustment files. The construction of the original issue and turn-in history is described in Appendix B. The adjustment files described above (drop list, substitutable/replaced list, proxy NSN list, set component list, and no turn-in list) needed to adjust issue and turn-in history are tailored to each CIF and are the result of collaboration among RAND,

[43] The inventory position (IP) of an NSN is defined as AFI + CC_L_QTY + CC_M_QTY + DI – DO, where AFI = quantity available for issue, CC_L_QTY = quantity in laundry, CC_M_QTY = quantity in maintenance, DI = quantity due in from orders or lateral transfers, and DO = quantity due out to soldiers. If IP is less than or equal to the ROP, then a replenishment or lateral transfer should be requested for the quantity (RO – IP). In other words, RO is the "order up to" point.

the OCIE CMO,[44] G-4, and CIF managers. These adjustment files are described in Appendixes C-G.

- Construct algorithm Input files. The algorithm input files (adjusted issue and turn-in history, NSN information file, and replacement lead time file) required for the CIF inventory levels algorithm are described in Appendix H. The NSN information file and replacement lead time file are derived from supply system information and catalog data.
- Use algorithm to generate RO and ROPs. The algorithm uses the input files to generate RO and ROPs and is described in Appendix I.

CIF Retention Levels Algorithm

RAND recommends adopting a standard, data-based approach to setting retention levels (RLs) to help CIF managers make lateral transfer decisions. We define the total stockage allowance as the sum of the RO, RL, and contingency level (CL). The RO is set using the CIF inventory levels algorithm described in this report; the RL is set using the CIF RL algorithm described below; the CL is set by CIF managers and is approved by CMO to cover non-demand–supported requirements.[45] The purpose of the TSA is to set an upper bound on the amount of materiel allowed to be held at a CIF and to facilitate the identification of materiel available for lateral transfer between CIFs. An algorithm and process to set RLs began testing at 21 CIFs in November 2010.

This section provides an overview of the CIF RL-setting process and serves as a guide to subsequent appendixes, each of which focuses on a different aspect of this process, as described below.

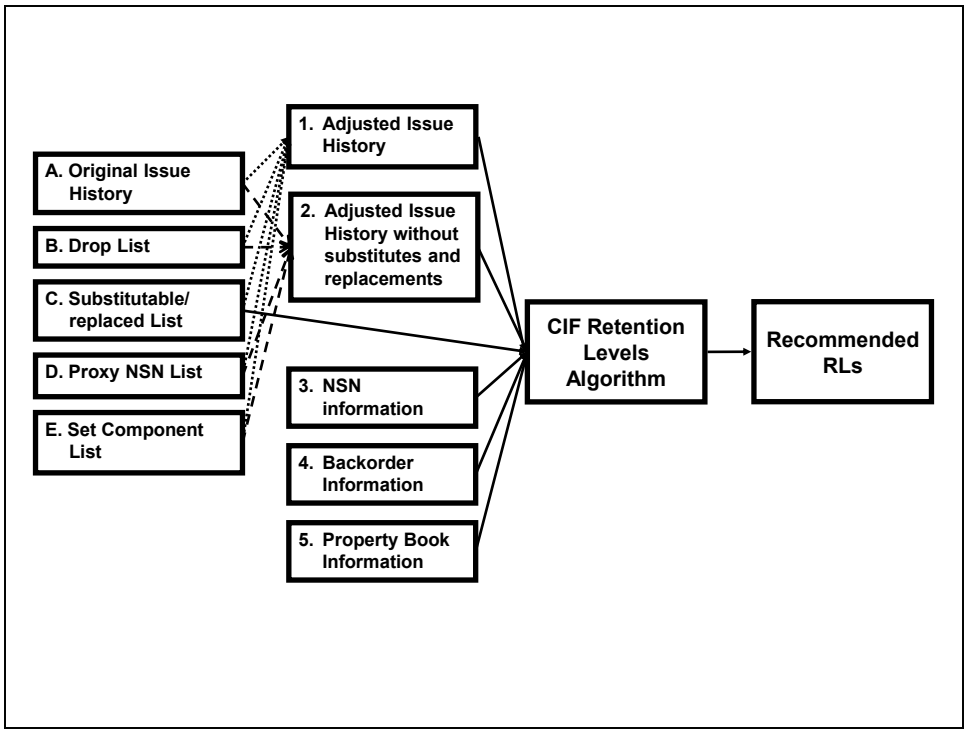
Figure A.2 is an overview of the process used to set RLs at CIFs during the prototype period of early 2011. The first step, as shown in the leftmost column of boxes in Figure A.2 and the *dotted* arrows, is to create an adjusted issue history using the following files:

A. original issue and turn-in history for a given item
B. drop list

[44] The CMO manages inventory replenishment funding and oversees CIF inventory management operations.

[45] Examples of non-demand–supported requirements include the requirement to support an additional unit because of BRAC, the requirement to support emergency relief operations in the event of a natural disaster, or the requirement to stockpile sufficient inventory of a new item to issue the new items to an entire unit of supported soldiers, rather than to one soldier at a time.

Figure A.2
Overview of the Prototype Process Used to Create Recommended RLs



A. substitutable/replaced list
B. proxy NSN list
C. set component list.

The second step, as shown in the leftmost column of boxes in Figure A.2 and the *dashed* arrows, is to create an adjusted issue history without substitutes or replacements using the following files:

A. original issue and turn-in history for a given item
B. drop list
C. proxy NSN list
D. set component list

The third step, as shown in the first and second column of boxes from the left and the *solid* arrows, is to input the following eight files into the CIF RL Algorithm to generate recommended RLs:

A. substitutable/replaced list
    1. adjusted issue history created above
    2. adjusted issue history without substitutes or replacements created above
    3. property book information, which is an NSN-level record of OCIE activity and inventory

4. backorder information, which is the percentage of orders to the DLA that experienced a backorder status46
5. NSN information.

The process can be described in terms of three major components, each of which was described above and corresponds to a subsequent appendix in this report.

[46] Backorders are defined as items with a BB status at any time before its receipt date.

Appendix B: Original Issue and Turn-In History

Original issue and turn-in history is a list of NSN-level soldier clothing record and hand receipt transactions at a CIF. The issue and turn-in history of an item is used to set a ROP that provides enough inventory to ensure high OCIE availability goals. In addition, the issue (but not turn-in) history of an item is used to set RLs that limit unnecessary movement of materiel. This appendix describes how to construct original issue and turn-in history from the CIF information system ISM.

CIF personnel record each clothing record and hand receipt transaction into ISM to maintain property accountability. Each transaction is assigned a date according to when the transaction was recorded in ISM; this date is the "created_dt" in the CIF DOCUMENTS table in ISM. Table B.1 lists the different ISM document transaction type codes (DTTCs) included in this history.[47]

The field that records the quantity issued from or turned in to the CIF varies by transaction type. A clothing record or hand receipt transaction records quantity issued in the fields "cc_a_issued_qy" and "cc_b_issued_qy" fields.[48] A clothing record turn-in is captured in the fields "cc_a_turnin_qy" and "cc_b_turnin_qy," and a hand receipt turn-in is captured in the field "turned_in_qy." We consolidate these fields into one field called "qty," which takes on the values as shown in Table B.2.

Table B.1
ISM Transaction Type Codes Included in Original Issue and Turn-In History

TRANSACTION TYPE	DTTC	DESCRIPTION
Clothing Record	36	Additional issue
	76	Complete turn-in
	86	Due out issue
	96	Direct exchange
	176	Initial issue
	246	Partial turn-in
Hand Receipt	336	Issue
	356	Turn-in
	366	Direct exchange

[47] Only transactions with DISPUTED_CANCELED_IND = NULL from the CID_DOCUMENTS table are included.

[48] Condition code A materiel is new materiel issued from DLA. Condition code B materiel has been previously issued to a soldier. Many CIFs do not keep track of these two condition codes separately; these CIFs change the condition code of all condition code A materiel received from the DLA to condition code B on receipt from DLA. These changes are recorded in the administrative adjustment report in ISM.

Table B.2
Value of Field "Qty" in Initial Issue and Turn-In History

TRANSACTION TYPE	ISSUE	TURN-IN
Clothing Record	qty = cc_a_issued_qty + cc_b_issued_qy	qty = (-1)*cc_a_turnin_qy + (-1)*cc_b_turnin_qy
Hand Receipt	qty = cc_a_issued_qty + cc_b_issued_qy	qty = (-1)*turned_in_qy

Each CIF-NSN combination will have its own issue and turn-in history. The issue history for a CIF-NSN combination excludes all turn-ins. The structure of the issue and turn-in history is shown in Table B.3. Both the original and adjusted issue and turn-in history files have this structure. The algorithm uses only the CIF_UID, NSN, DOC_DATE, and QTY fields.

Table B.3
Structure of the Original and Adjusted Issue and Turn-In History File

CIF_UID	DOC_DATE	NSN	NOMEN	QTY
336	1/2/2010	8465-01-547-2757	MODULAR SLEEPING BAG - (COMPONENTS - 5) REGULAR	-1
336	1/2/2010	8465-01-547-2757	MODULAR SLEEPING BAG - (COMPONENTS - 5) REGULAR	1

Where:

CIF_UID = a unique identifier associated with the CIF
DOC_DATE = the date that the transaction was recorded in ISM
NSN = the item's 13-digit national stock number
NOMEN = the nomenclature of the NSN
QTY = the quantity of NSN issued (if positive) or quantity of NSN turned in (if negative).

Appendix C: Drop List

The drop list includes items that will not receive inventory levels under the RAND approach; the initial drop list was created by RAND in collaboration with the CIF manager at Ft. Stewart. This drop list was used as a template for subsequent implementations. CIF and CMO managers are responsible for creating and maintaining each CIF's drop list. The drop list is needed because not every NSN that is issued by the CIF should receive inventory levels. For example, a CIF may have issued items that have no replacement or that are not supported by the CMO, or a CIF may have issued items through the Rapid Fielding Initiative[49] that are not yet supported by the wholesale system.[50] Such items are typically included in the drop list.

If an NSN is on the drop list, then all issues and turn-ins of this NSN are removed from the original issue and turn-in history. The resulting adjusted issue and turn-in history will have no issues or turn-ins from NSNs on the drop list. Inventory levels will not be computed for NSNs on the drop list, and no replenishment orders should occur for these NSNs.

Each CIF may have its own drop list, or if a CIF has not yet developed its own drop list, it may use a generic drop list. A sample entry for the drop list is shown in Table C.1. The algorithm uses only the NSN and TYPE REPLACEMENT fields.

Table C.1
Sample Entry for the Drop List Used to Adjust Issue and Turn-In History

CIF_UID	NSN	NOMEN	TYPE REPLACEMENT
336	8415-01-548-3168	COAT, COMBAT M-S UCP	drop

Where:

CIF_UID = a unique identifier associated with the CIF
NSN = the item's 13-digit national stock number
NOMEN = the nomenclature of the NSN
TYPE REPLACEMENT = the replacement type of the NSN.

[49] RFI was designed by PEO Soldier to provide soldiers with the most technically advanced OCIE in advance of wholesale support.

[50] CMO provides funds to CIFs to purchase centrally managed items. CIF managers may purchase non-CMI using installation funds at the direction of the installation commander. Although the focus of the CIF inventory levels–setting algorithm is on CMI, the algorithm can be and has been used to set inventory levels on non-CMI materiel.

Appendix D: Substitutable/Replaced List

In most cases, when a new OCIE item is introduced, it is replacing or serving as a substitute for an existing OCIE item. In this case, we can use this relationship to set inventory levels on the new item by using the issue and turn-in history of the old item as a proxy for the usage pattern of the new item.[51]

With the help of CMO, G-4, and CIF managers, RAND created substitutable/replaced lists for over a dozen CIFs.[52] The lists are unique to each CIF and establish linkages for over 500 items. A substitutable/replaced list divides NSNs into two categories:

- *substitutable* items, i.e., items that have been replaced by new ones, such that the old ones can still be issued
- *replaced* items, i.e., items that have been replaced by new ones, such that the old item cannot be issued in place of the new item.

Using these categories, Figure D.1 shows a decision tree for using issue and turn-in histories of old items to set inventory levels for new items.

Item Type "Substitutable"

A new item is substitutable if it has replaced an old item, but the old item may still be issued in kind for the new item. For substitutable items, the CIF should first exhaust the old item inventory and then phase in the new item inventory and start issuing it.[53] The issue and turn-in history of the old item can be used to set inventory levels for the new item, and the old item will not receive a RO and ROP but rather just a RL so that it can be phased out and not replenished.[54]

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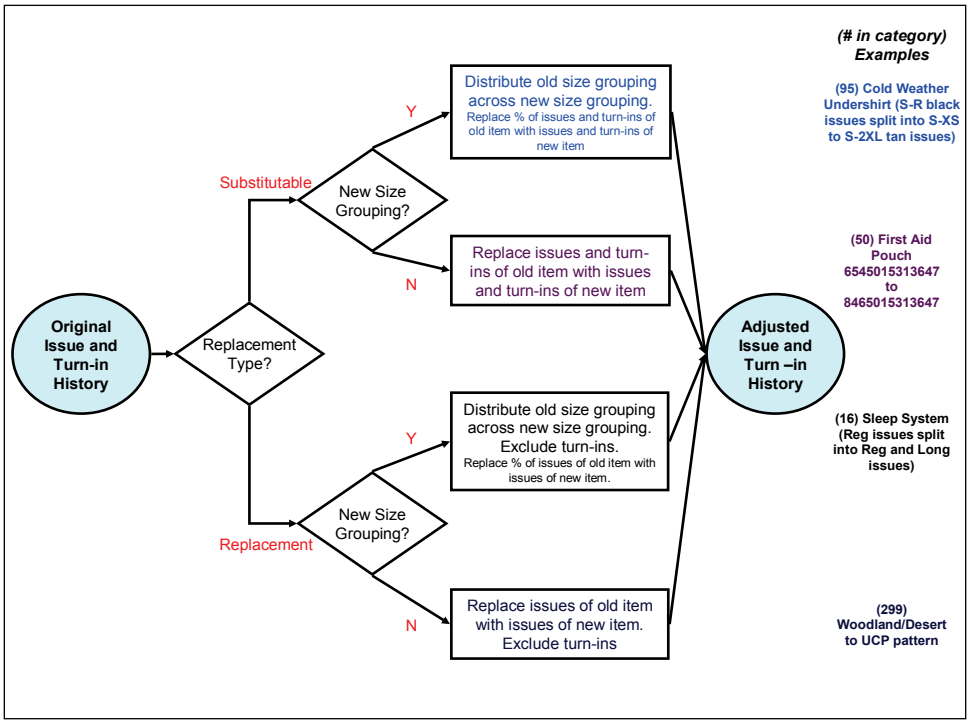
[51] If the replaced or substituted item is still in use, then both the new items and replaced or substituted items may require inventory levels.

[52] For Class IX repair items, an I&S file links old items to their new replacement items and directs users to order only the new item. This file accompanies the monthly FedLog catalog and is used Army-wide. For OCIE items, there is no Army-wide file that records the linkage between old and new OCIE items, primarily because CIFs transition from old to new OCIE according to a schedule that typically spans several years; at any given time, different CIFs issue old and/or new OCIE materiel, depending on when the CIF is scheduled to transition from old to new materiel.

[53] Currently, ISM cannot link substitutable items, so that when an old substitutable item is issued in place of the new item, the soldier is not considered to have a successful first-time fill despite the fact that the two items are substitutable.

[54] The inventory position of an NSN is defined as AFI + CC_L_QTY + CC_M_QTY + DI – DO, where AFI = quantity available for issue, CC_L_QTY = quantity in laundry, CC_M_QTY = quantity in maintenance, DI = quantity due in from orders or lateral transfers, and DO = quantity due out to soldiers. If IP is less than or equal to

Figure D.1
Decision Tree for Using the Substitutable/Replaced List to Adjust Issue and Turn-In History



One complication can occur if the sizes available for the old item do not have a one-to-one correspondence to the sizes available for the new item. For example, the old black cold weather shirt is available in size small, but its replacement, the tan cold weather shirt, is available in sizes small-extra short, small-short, small-regular, small-long, small-extra long, and small-extra extra long. In this case, we say that there is a "new size grouping." We explain below how to set inventory levels in the case of a new size grouping.

No New Size Grouping

If there is no new size grouping for the substitutable item, then the issues and turn-ins of the old item are transformed one-for-one into issues and turn-ins of the new item. The transformed issues and turn-ins of the old item are combined with any issues and turn-ins for the new item over the forecast period, and inventory levels are then set based on this combined issue and turn-in history.

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the ROP, then a replenishment or lateral transfer should be requested for the quantity (RO – IP). In other words, RO is the "order up to" point.

Classically, if AFI is greater than the RL, then (AFI – RL) is available for lateral transfer and may be sent to another CIF, to a central retrograde point, or to the DRMO. The second half of the appendix describes the creation of a TSA, such that if AFI is greater than the TSA, then (AFI – TSA) is available for lateral transfer.

For example, for non-deploying soldiers at Ft. Stewart, non-fire-retardant combat vehicle crewman (CVC) coveralls can still be issued as substitutes for new fire-retardant CVC coveralls. Thus, the issue and turn-in history of the non-fire-retardant CVC coveralls are used to set inventory levels for the fire-retardant CVC coveralls, and the old non-fire-retardant CVC coveralls do not receive ROs and ROPs but may receive RLs.

Replenishment orders should be executed based on the sum of the inventory positions of the old and new substitutable items. If the sum of the IPs is less than or equal to the ROP, then the new item should be ordered. No replenishment orders should be placed for the old item.

New Size Grouping

Suppose there is a new size grouping. To set appropriate inventory levels on the new items, the issue and turn-in histories of the old items are allocated across the new sizes of the substitute items based on the size tariff, i.e., estimates of the distribution of these sizes within the population.

As an example, we return to the previously mentioned cold weather shirt. Table D.1 shows the allocated percentage of issues and turn-ins of the old cold weather shirt to the projected issues and turn-ins of the new sizes.

For example, if in the original issue and turn-in history there were 100 issues of size small black cold weather shirts, then in the adjusted issue and turn-in history, there will be five issues of size small-extra short, 10 issues of size small-short, 50 issues of size small-regular, 20 issues of size small-long, 10 issues of size small-extra long, and five issues of size small-extra extra long. The precise allocation of issues and turn-ins of the old item across the sizes of the new item is determined by the size tariff at the CIF.[55] Using this allocation, the adjusted issue and turn-in history contains representative issues and turn-ins of the sizes of the new item.[56] Hence, appropriate inventory levels can be set for each size of the new item.

Once inventory levels have been set, replenishment orders should be executed based on the IP of the old and new substitutable items, if they both exist on the property book. The IP of the old substitutable item should be combined with the IP of the new item size with the largest allocation percentage; the IPs of the remaining new item sizes do not need to be combined with the IPs of any other items. Only the new items should be ordered.

In the example of the cold weather shirts above, replenishment orders of the new small-extra short, small-short, small-long, small-extra long, and small-extra extra long cold weather shirts

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[55] The size tariff is determined by analyzing one year of issue history across the 20 largest CIFs in the continental United States: Fts. Benning, Bliss, Bragg, Carson, Campbell, Drum, Gordon, Hood, Huachuca, Irwin, Jackson, Knox, Lee, Leonard Wood, Lewis, Polk, Riley, Rucker, Sill, and Stewart. The distribution of issues across the new size grouping determines the size tariff.

[56] We allocated the issues and turn-ins of the old NSN across the issues and turn-ins of the new size grouping NSNs using a random sampling technique, which mimics the distribution of size tariff determined by one year of issue history across the 20 largest CONUS CIFs.

Table D.1
Sample Entry for Substitutable Item with New Size Grouping

Old NSN	Old Size	Allocation %	New NSN	New Size
8415-01-501-7074	Small	5	8415-01-547-6678	Small-Extra Short
8415-01-501-7074	Small	10	8415-01-547-7780	Small-Short
8415-01-501-7074	Small	50	8415-01-538-7780	Small-Regular
8415-01-501-7074	Small	20	8415-01-547-6681	Small-Long
8415-01-501-7074	Small	10	8415-01-547-6684	Small-Extra Long
8415-01-501-7074	Small	5	8415-01-547-6687	Small-Extra Extra Long

should be based on the IPs of these items only. However, replenishment orders of the new small-regular cold weather shirt should be based on the sum of the IPs of the old size small cold weather shirt and the new size small-regular cold weather shirt, because the new size small-regular cold weather shirt has the largest allocation percentage.

Item Type “Replaced”

An old item that has been replaced by a new item and that should no longer be issued is categorized as a replaced item. For replaced items, the CIF may only issue the new item and not the old item to soldiers. The issue history of the old item can be used to set inventory levels for the new item, and the old replaced item will not have an RO, ROP, or RL.

As with substitutable items, the complication of a new size grouping can occur if the sizes available for the old item do not have a one-to-one correspondence to the sizes available for the new item. For example, the old sleep system was available in one size, but the replacement sleep system is available in both regular and long. For the purposes of setting appropriate inventory levels on the new items, the issue history of the old item is allocated across the new sizes of the replaced items based on the size tariff.

No New Size Grouping

If there is no new size grouping for the replaced item, then the issues of the old item are transformed one-for-one into issues of the new item. Note that turn-ins of the old item are not transformed into turn-ins of the new item, because the old item cannot be issued in place of the new one. The transformed issues of the old item are combined with any issues of the new item over the forecast period to set the inventory levels.

For example, at Ft. Stewart, universal camouflage pattern (UCP) elbow pads have replaced woodland and desert elbow pads. Thus, the issue history of woodland and desert elbow pads can be used to set inventory levels on the UCP elbow pads, and the woodland and desert elbow pads will not receive inventory levels.

Once inventory levels have been set, replenishment orders should be executed based on the IP of the new item only, because the old item cannot be issued in place of the new item. Replenishment orders should be executed only for the new item; no replenishment orders should be placed for the old item.

New Size Grouping

Suppose there is a new size grouping. To set appropriate inventory levels on the new items, the issue history of the old item is allocated across the new sizes of the replaced items based on the size tariff.

We return to the example of the sleep system. The long sleep system has rarely been issued, so 100 issues of the old sleep system are transformed into, say, 99 issues of the regular size new sleep system and one issue of the long size new sleep system. Replenishment orders of the new regular and long sleep system should be based on the respective IPs of these items. The old sleep system should not be ordered.

Substitutable/Replaced List

Each CIF may have its own substitutable/replaced list to account for local differences in mission and menus. Sample entries for the substitutable/replaced list are shown in Table D.2. The algorithm uses only the NSN, TYPE REPLACEMENT, and NEW NSN fields.

Where:

CIF_UID =	a unique identifier associated with the CIF
NSN =	the old item's 13-digit national stock number
NOMEN =	the nomenclature of the old NSN
TYPE REPLACEMENT =	the replacement type of the old NSN, either "substitutable" or "replaced"
NEW NSN =	the new NSN on which the issues and turn-ins of the old NSN are based
NEW NOMEN =	the nomenclature of the new NSN.

Table D.2
Sample Entries for the Substitutable/Replaced List Used to Adjust Issue and Turn-In History

CIF_UID	NSN	NOMEN	TYPE REPLACEMENT	NEW NSN	NEW NOMEN
336	8465-01-398-0685	SLEEPING BAG - (A-A-55262)	replacement	8465-01-547-2706	SLEEPING BAG - (REGULAR)
336	8470-01-506-6369	HELMET, ADVANCED COM - (NONE KNOWN)	substitute	8470-01-529-6329	HLMT ADVNCD CBT MD

Appendix E: Proxy NSN List

In some cases, when a new OCIE item is introduced, it is *not* replacing or serving as a substitute for an existing OCIE item. However, it may be possible to select an item in current use whose usage pattern is similar to or predicted to be similar to that of the new NSN and use this proxy NSN to set inventory levels on the new item by using the issue and turn-in history of the proxy NSN. We say that the *base NSN* receives inventory levels based on the issue and turn-in history of the *proxy NSN*. Two main categories of NSNs appear on the proxy NSN list:[57] new items and expendable items.[58]

First, one may want to set inventory levels on a new NSN based on a proxy NSN that has the expected issues and turn-ins of the new NSN. For example, at Ft. Leonard Wood, each permanent party soldier is issued an improved first aid kit. But these first aid kits were relatively new to the CIF and had only a few months of issue and turn-in history. Because flyers gloves are also issued to these permanent party soldiers, inventory levels for the improved first aid kit were set using all sizes of the flyer gloves as proxy NSNs. In this case, one base NSN is paired with more than one proxy NSN because of the multiple sizes of the flyers gloves.

Second, the issues and turn-ins of expendable items are not necessarily recorded, because property books need not track expendable items. For example, there are several components to a complete Advanced Combat Helmet (ACH): the helmet itself, the helmet pad, and the chin strap. The issue of an ACH is always recorded, but the accompanying issue of the helmet pad and chin strap, which are considered expendable components, may not be recorded. Thus, the issue and turn-in history of, say, the helmet pad is not suitable for use in setting inventory levels on helmet pads. In this case, it is possible to use all sizes of the ACH as proxy NSNs for helmet pads. Again, one base NSN is paired with more than one proxy NSN because of the multiple sizes of the ACH. Note that setting inventory levels on such expendable items as the helmet pad requires using the proxy NSN list and also the no turn-in list described in Appendix G.

Table E.1 shows the proxy NSNs paired with base NSN 8470-01-552-4607, which is the small-medium helmet pad.

The following steps are taken to adjust initial issue and turn-in history using the proxy NSN list:

1. Remove all issues and turn-ins of base NSNs from the initial issue and turn-in history.
2. For each issue/turn-in of a proxy NSN, add a record of an issue/turn-in with the same issue/turn-in quantity for the associated base NSN on that date to the adjusted issue and turn-in history.

[57] This list is also referred to as "special lines."

[58] Expendable items are no longer required to be tracked in the property book.

Table E.1
Proxy NSNs Paired with Base NSN 8470-01-552-4607

NSN	NOMEN	SIZE	QTY
8470-01-529-6302	HLMT ADVNCD CMBT SM	S6 GREEN	1
8470-01-529-6329	HLMT ADVNCD CBT MD	M6 GREEN	1

In the resulting adjusted issue and turn-in history, the base NSN will have the same issues and turn-in history as its proxy NSNs.

In the example shown below, the original issue and turn-in history in Table E.2 is converted to an adjusted issue and turn-in history in Table E.3 using the base and proxy NSN relationship described in Table E.1. For clarity, we also show the issues and turn-ins of the proxy NSNs in the adjusted issue and turn-in history in Table E.3.

Replenishment orders of the base NSN should occur based on the base IP, RO, and ROP; replenishment orders of the base NSN are independent of the IP, RO, and ROP of its proxy NSNs.

Each CIF may have its own proxy NSN list, or if a CIF has not yet developed its own proxy NSN list, the CIF may use a generic proxy NSN list. Sample entries for the proxy NSN list are shown in Table E.4. The algorithm uses only the BASE NSN, FACTOR, and PROXY NSN fields.

Table E.2
Sample Entries for Original Issue and Turn-in History

DOC_DATE	TRANSACTION TYPE	NSN	NOMEN	QTY
1/5/2010	ISSUE	8470-01-529-6302	HLMT ADVNCD CMBT SM	2
1/11/2010	TURN-IN	8470-01-529-6329	HLMT ADVNCD CBT MD	-5
1/1/2010	ISSUE	8470-01-552-4607	PAD ADVANCED COMBAT HELMET	10

Table E.3
Sample Entries for Adjusted Issue and Turn-in History

DOC_DATE	TRANSACTION TYPE	NSN	NOMEN	QTY
1/5/2010	ISSUE	8470-01-529-6302	HLMT ADVNCD CMBT SM	2
1/11/2010	TURN-IN	8470-01-529-6329	HLMT ADVNCD CBT MD	-5
1/5/2010	ISSUE	8470-01-552-4607	PAD ADVANCED COMBAT HELMET	2
1/11/2010	TURN-IN	8470-01-552-4607	PAD ADVANCED COMBAT HELMET	-5

Table E.4
Sample Entries for the Proxy NSN List Used to Adjust Issue and Turn-In History

CIF_UID	BASE NSN	NOMEN	SIZE	FACTOR	PROXY NSN	NOMEN	SIZE
336	8470-01-552-4607	PAD ADVANCED COMBAT HELMET	S-M H-STYLE	1	8470-01-529-6302	HLMT ADVNCD CMBT SM	S6 GREEN
336	8470-01-552-4607	PAD ADVANCED COMBAT HELMET	S-M H-STYLE	1	8470-01-529-6329	HLMT ADVNCD CBT MD	M6 GREEN

Where:

CIF_UID = a unique identifier associated with the CIF
BASE NSN = the base item's 13-digit national stock number
NOMEN = the nomenclature of the base NSN
SIZE = the size of the base NSN
FACTOR = the number of the base NSN required for each proxy NSN
PROXY NSN = the proxy NSN on which inventory levels of the base NSN should be based
NOMEN = the nomenclature of the proxy NSN.

Appendix F: Set Component List

We say that a *set* consists of two or more *components*. For example, the modular sleep system set consists of five components: one bivy cover, one small stuff sack, one large stuff sack, one intermediate cold weather sleeping bag, and one patrol bag. Table F.1 shows the components that make up the modular sleep system, which is identified by NSN 8465-01-547-2757.

Different items have different washout rates, that is, different items are worn out at different rates and therefore have to be replaced at different rates. To accommodate the different washout rates, G-4 and CMO have decided that replenishment orders should be executed at the component level. In other words, components will receive inventory levels and will be ordered but sets will not.[59]

To set inventory levels on components but not on sets, the adjusted issue and turn-in history must contain issues and turn-ins only of *components* and not of *sets*. However, sometimes, issues to soldiers are recorded as issues of a set rather than issues of several components.[60] To adjust for this, for each issue/turn-in of a set, the following steps are taken to adjust the original issue and turn-in history using the set component list:

1. Delete the original issue/turn-in of the set.
2. Insert an issue/turn-in for each component of the set (according to the quantity of that component in the set) to the adjusted issue and turn-in history.

The resulting adjusted issue and turn-in history will contain only issues/turn-ins of components, so that only components will receive inventory levels.

In the example shown below, the original issue and turn-in history in Table F.2 is converted to an adjusted issue and turn-in history in Table F.3 using the set component relationship of the modular sleep system set described in Table F.1. For clarity, we show the issue of the modular sleep system set in the adjusted issue and turn-in history in Table F.3 as an issue of quantity zero.

Replenishment orders of each component NSN should occur based on a set-component-adjusted IP and the computed RO and ROP of the component NSN. The set-component-adjusted IP is computed by adding the IP of the *component* to a factor of the IP of the *set*, where the factor is the number of that component in the set. If the set-component-adjusted IP of the component

[59] An exception to this rule is body armor, which is ordered as a full set.

[60] ISM runs a monthly computer program that translates any sets on soldier records into components. For example, if a soldier's clothing record shows that he or she has been issued a modular sleep system set, then after the monthly program has been run, the soldier's clothing record will show that one bivy cover, one small stuff sack, one large stuff sack, one intermediate cold weather sleeping bag, and one patrol bag were issued.

Table F.1
Components of Modular Sleep System Set, NSN 8465-01-547-2757

NSN	NOMEN	QTY
8465-01-547-2644	COVER, BIVY - (REGULAR)	1
8465-01-547-2656	STUFF, SACK SMALL	1
8465-01-547-2670	STUFF, SACK LARGE	1
8465-01-547-2694	SLEEPING BAG - (REGULAR) GREY	1
8465-01-547-2706	SLEEPING BAG - (REGULAR) GREEN	1

Table F.2
Sample Entry for Original Issue and Turn-In History

DOC_DATE	TRANSACTION TYPE	NSN	NOMEN	QTY
1/2/2010	ISSUE	8465-01-547-2757	MODULAR SLEEPING BAG - (COMPONENTS - 5) REGULAR	2

Table F.3
Sample Entries for Adjusted Issue and Turn-In History

DOC_DATE	TRANSACTION TYPE	NSN	NOMEN	QTY
1/2/2010	ISSUE	8465-01-547-2644	COVER, BIVY - (REGULAR)	2
1/2/2010	ISSUE	8465-01-547-2656	STUFF, SACK SMALL	2
1/2/2010	ISSUE	8465-01-547-2670	STUFF, SACK LARGE	2
1/2/2010	ISSUE	8465-01-547-2694	SLEEPING BAG - (REGULAR) GREY	2
1/2/2010	ISSUE	8465-01-547-2706	SLEEPING BAG - (REGULAR) GREEN	2
1/2/2010	ISSUE	8465-01-547-2757	MODULAR SLEEPING BAG - (COMPONENTS - 5) REGULAR	0

NSN is less than or equal to the ROP of the component NSN, then the component NSN should be ordered. No replenishment orders should be placed for the set NSN.

In the example shown below, the original IP for each component of the modular sleep system set in Table F.4 is converted to a set-component-adjusted IP in Table F.5 using the set component relationship described in Table F.1. Note that the factor is one for each component of the modular sleep system set, because there is one of each component in the modular sleep system set. For clarity, we show the set-component-adjusted IP of the modular sleep system set in Table F.5 to be zero.

Table F.4
Sample Entries for Original IP

NSN	NOMEN	ORIGINAL INVENTORY POSITION
8465-01-547-2644	COVER, BIVY - (REGULAR)	10
8465-01-547-2656	STUFF, SACK SMALL	5
8465-01-547-2670	STUFF, SACK LARGE	3
8465-01-547-2694	SLEEPING BAG - (REGULAR) GREY	6
8465-01-547-2706	SLEEPING BAG - (REGULAR) GREEN	2
8465-01-547-2757	MODULAR SLEEPING BAG - (COMPONENTS - 5) REGULAR	2

Table F.5
Sample Entries for Set-Component-Adjusted IP

NSN	NOMEN	SET-COMPONENT-ADJUSTED INVENTORY POSITION
8465-01-547-2644	COVER, BIVY - (REGULAR)	10 + 2 = 12
8465-01-547-2656	STUFF, SACK SMALL	5 + 2 = 7
8465-01-547-2670	STUFF, SACK LARGE	3 + 2 = 5
8465-01-547-2694	SLEEPING BAG - (REGULAR) GREY	6 + 2 = 8
8465-01-547-2706	SLEEPING BAG - (REGULAR) GREEN	2 + 2 = 4
8465-01-547-2757	MODULAR SLEEPING BAG - (COMPONENTS - 5) REGULAR	2 – 2 = 0

Each CIF may have its own set component list, or the set component list found in ISM may be used.[61] Sample entries for the set component list are shown in Table F.6. The algorithm uses only the SET NSN, FACTOR, and COMPONENT NSN fields.

[61] The MODULAR NSNS table in ISM contains set component information.

Table F.6
Sample Entries for the Set Component List Used to Adjust Issue and Turn-In History

CIF_UID	SET NSN	SET NOMEN	FACTOR	COMPONENT NSN	COMPONENT NOMEN
336	8465-01-547-2757	MODULAR SLEEPING BAG - (COMPONENTS 5) REGULAR	1	8465-01-547-2644	COVER, BIVY - (REGULAR)
336	8465-01-547-2757	MODULAR SLEEPING BAG - (COMPONENTS - 5) REGULAR	1	8465-01-547-2656	STUFF, SACK SMALL
	8465-01-547-2757	MODULAR SLEEPING BAG - (COMPONENTS - 5) REGULAR	1	8465-01-547-2670	STUFF, SACK LARGE
	8465-01-547-2757	MODULAR SLEEPING BAG - (COMPONENTS - 5) REGULAR	1	8465-01-547-2694	SLEEPING BAG - (REGULAR) GREY
	8465-01-547-2757	MODULAR SLEEPING BAG - (COMPONENTS - 5) REGULAR	1	8465-01-547-2706	SLEEPING BAG - (REGULAR) GREEN

Where:

CIF_UID = a unique identifier associated with the CIF
SET NSN = the set item's 13-digit national stock number
SET NOMEN = the nomenclature of the set NSN
FACTOR = the number of the component NSN included in each set NSN
COMPONENT NSN = the component NSN that makes up the set NSN
COMPONENT NOMEN = the nomenclature of the component NSN.

Appendix G: No Turn-In List

The no turn-in list includes items whose turn-ins are not included in the adjusted issue and turn-in history; the turn-in list is needed, because turn-ins of expendable NSNs cannot be reissued to the soldier. For example, the ACH helmet pad is an expendable item; when helmet pads are returned to the CIF, they cannot be reissued to another soldier. Such items are typically included in the no turn-in list.

If an NSN is on the no turn-in list, then all turn-ins of this NSN are removed from the original issue and turn-in history. The resulting adjusted issue and turn-in history will have no turn-ins from NSNs on the no turn-in list. Inventory levels for NSNs on the no turn-in list will be computed based on issues only. Replenishment orders of items on the no turn-in list should occur based on the IP, RO, and ROP as usual.

Each CIF may have its own no turn-in list, or if a CIF has not yet developed its own no turn-in list, the CIF may use a generic no turn-in list. A sample entry for the no turn-in list is shown in Table G.1. The algorithm uses only the NSN field.

Table G.1
Sample Entry for the No Turn-In List Used to Adjust Issue and Turn-In History

CIF_UID	NSN	NOMEN
336	8470-01-552-4607	PAD ADVANCED COMBAT HELMET

Where:

CIF_UID = unique identifier associated with the CIF
NSN = the item's 13-digit national stock number
NOMEN = the nomenclature of the NSN.

Appendix H. Input Files to Inventory Levels Algorithm

As described in Appendix A, there are three main input files to the CIF inventory levels algorithm: (1) adjusted issue and turn-in history, (2) NSN information, and (3) replenishment lead time. We describe each of these files and their construction in this appendix.

Adjusted Issue and Turn-In History

The original issue and turn-in history is created using the procedure described in Appendix B. For CIFs that support an annex, the original issue and turn-in history of the annex is added to that of the main.[62]

The original issue and turn-in history is then adjusted as follows:

1. Issues and turn-ins for items that should not receive inventory levels are dropped using the procedure described in Appendix C.
2. Issues and turn-ins of substituted and replaced NSNs are transformed to issues and turn-ins of new NSNs using the procedure described in Appendix D.
3. Issues and turn-ins of NSNs with proxy NSNs are replaced with issues and turn-ins of their proxy NSNs using the procedure described in Appendix E.
4. Issues and turn-ins of set NSNs are converted to issues and turn-ins of component NSNs using the procedure described in Appendix F.
5. Turn-ins of NSNs on the no turn-in list are removed using the procedure described in Appendix G.

The resulting adjusted issue and turn-in history is ready to be input into the CIF inventory levels algorithm.

NSN Information

Catalog information, such as unit price and unit cube, is used by the algorithm and is obtained from two sources: ISM and the most recent FedLog file.

Information for each NSN is taken from the ISM NATIONAL_STOCK_NUMBERS table.

[62] For example, the main CIF at Ft. Stewart supports the annex CIF at Hunter Army Airfield. To set inventory levels at the main CIF at Ft. Stewart, the original issue and turn-in history used includes issues and turn-ins from the CIFs at both Ft. Stewart and Hunter Army Airfield.

The fields obtained this table include[63]

- lin_id (line item number [LIN])
- nsn_mcn_id (NSN)
- nsn_nomenclature_tx (nomenclature)
- nsn_size_cd (size)
- core_ind (if core_ind=Y, then the item is centrally managed by CMO)
- nsn_unit_price_am (unit price)
- nsn_unit_pack_qy (quantity of the item that is typically packed and shipped from regional distribution centers)
- nsn_unit_of_issue_tp_tx (unit of issue, e.g., each or pair)
- nsn_start_dt (date record was created in ISM)
- ism_status_ind (status assigned to record in the NATIONAL_STOCK_NUMBERS table).

Unit price (nsn_unit_price_am) is used in the economic order quantity described in Appendix I. The rest of these fields are used for review purposes, e.g., only centrally managed items are funded through CMO.

FedLog information for each National Item Identification Number (NIIN)[64] is taken from the most current set of FedLog, phrase code[65] and order of use substitutions applied, so that all information is assigned to its prime NIIN. The fields obtained from the FedLog include

- AAC (acquisition advice code), which identifies obsolete items and how to this item can be ordered)
- weight (cubic weight in pounds).

AAC is used for review purposes. Items with AAC = Y are no longer supported by the wholesale system and are typically not issued from CIFs. Weight is used to determine whether a lateral transfer is economical.[66]

Sample entries for the NSN information file are shown in Table H.1. The algorithm uses only the NSN and UNIT PRICE fields.

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[63] When duplicate NSNs appear in the ISM NATIONAL_STOCK_NUMBERS table, the entry with ISM_STATUS_IND = "ACTV" and the latest NSN_START_DT is used first. Second priority goes to items with ISM_STATUS_IND = "PNDING" and latest NSN_START_DT. Finally, the remaining items with latest NSN_START_DT are taken.

[64] The NIIN is the last nine characters of the NSN.

[65] Phrase codes are used to identify new NIINs associated with old NIINs that can no longer be ordered from the wholesale system.

[66] The decision as to whether a lateral transfer is economical is not discussed in this report.

Replenishment Lead Time

The replenishment lead time is the time needed to restock an item after the IP of the item reaches or goes below the re-order point and a replenishment order is submitted to the Army supply system. In other words, RLT is defined as the order review period plus the requisition wait time (RWT), which is the time between order and receipt of materiel. We expect CIF managers to order weekly; therefore, the order review period is, on average, 3.5 or 4 days. The ROP is set based on the RLT of the item at the CIF; an item with a long RLT requires a large ROP so that the CIF will be able to satisfy, to a desired level of performance, the issues to soldiers expected during the RLT.

Data for CIF-NSN level RWT are taken from the Strategic Distribution Database (SDDB), which is based on logistics response time (LRT) data from the DAAS. Replenishment orders with the following characteristics are used to set CIF-NSN level RLT:[67]

Table H.1
Sample Entries for the NSN Input File to the CIF Inventory Levels Algorithm

LIN	NSN	NOMEN	SIZE	CORE_IND	UNIT PRICE	UNIT PACK QTY	UNIT OF ISSUE	AAC	WEIGHT
DA653U	8465-01-547-2656	STUFF, SACK SMALL	GREEN	Y	$15.15	1	EA	D	2
DA658R	8465-01-547-2644	COVER, BIVY - (REGULAR)	REG UCP	Y	$147.03	1	EA	D	.999

Where:

LIN = the item category with a six-character line item number
NSN = the item's 13-digit national stock number
NOMEN = the nomenclature of the NSN
SIZE = the size of the NSN
CORE_IND = whether the NSN is centrally managed by CMO
UNIT PRICE = the unit price of the NSN
UNIT PACK QUANTITY = the unit pack quantity of the NSN
UNIT OF ISSUE = the unit of issue of the NSN
AAC = the acquisition advice code of the NSN
WEIGHT = the unit weight of the NSN.

[67] Note that RWT and not RLT data can be computed from SDDB data. Reliable data to compute RLT are not available at this time. As data quality increases, true RLT should be computed.

- Customer is a Department of Defense Activity Address Code that is funded by the CMO.[68]
- Receipt is dated within the past year.
- Receipt document identifier code is one of D6K, D6S, or D6M.
- Item condition code is A, B, or C (i.e., a serviceable asset).
- Any priority.
- Any backorder status.[69]

For a CIF-NSN combination with sufficient receipts (greater than six per year), the RLT is set to be the 75th percentile of RWT for that CIF-NSN combination, where RWT is the difference between the record posting date[70] and the document date.[71] For a CIF-NSN with fewer than six receipts per year, the RLT for that CIF-NSN combination is set to be a weighted average of two values: (1) the 75th percentile of the RWT for that CIF-NSN combination and (2) the 75th percentile of RWT without backorder time for all NSNs at the CIF over the past year.[72] The latter value in the weighted average does not include backorder time to limit the adverse effects on the supply chain of increasing inventory in response to long lead times.

In addition, the choice of a minimum and maximum RLT is imposed to reduce the risk that on-hand materiel will run out before the replenishment order is received and again to limit the adverse effects on the supply chain of increasing inventory in response to long lead times.

To summarize, the formula for RLT[73] used is

replen = max(minRLT, int(((min(ntot/6,1))*(min(tot75,maxRLT))) + (max((1-(ntot/6)),0)*(min(all75,maxRLT))) + .5))

[68] CIFs may order OCIE using different DODAACs. The CMO provides funding to CIFs to purchase centrally managed items. This funding is accessed using the centrally managed DODAAC.

[69] Backorders are defined as items with a BB status at any time before its receipt date.

[70] The record posting date is the D6S (materiel receipt), DRA (materiel receipt date), or DRB (pseudo receipt date). If the record posting date in SDDB matches the DRB date found in the Corps/Theater Automatic Data Processing Service Center (CTASC) data, then we replaced the SDDB DRB date with the CTASC D6S or DRA date. Note that the record posting date is typically the date the materiel was received by the installation Central Receiving Point (CRP). To compute true RWT, the receipt date should be the date on which the customer CIF receives the materiel from the CRP. Reliable data on when the CIF receives the materiel from the CRP are not available at this time. As data capture and quality increase, the CIF receipt date should be used.

[71] The document date is the four-character Julian date found in the 7th to 10th characters of the document number. The first character of the Julian date signifies the year, e.g., "0" means the year 2010; the remaining three characters of the Julian date signify the date of the year, e.g., "003" means January 3, this date is generated automatically when an order is entered into the system.

[72] Backorder time is the difference between the date the Materiel Release Order (MRO) was issued from the DLA and the date the order was established in the Army supply system. An MRO is issued when the materiel is ready to be shipped to the customer. The date the order was established in the Army supply system is the date the request reached the Standard Army Retail Supply System. To compute RWT without backorder time, we set the difference between the MRO date and the establish date to be one day.

[73] Recall that RLT is defined as the order review period plus the RWT, which is the time between order and receipt of materiel.

Where:

max =	the maximum function
minRLT =	the minimum RLT for any CIF-NSN combination, typically set at 30 days
int =	the integer function
min =	the minimum function
ntot =	the number of RWT data points for valid D6* receipts for the CIF-NSN combination
tot75 =	the 75th percentile of RWT for valid D6* receipts for the CIF-NSN combination
maxRLT =	the maximum RLT for any CIF-NSN combination, typically set at 100 days
all75 =	the 75th percentile of RWT without backorder time for valid D6* receipts for the CIF.

The value 6 in the formula above is a parameter defining the minimum number of receipts at the CIF-NSN level needed to avoid using a weighted average. Note that the minRLT and maxRLT values need to take the order review period into account.

As RLT decreases, minRLT and maxRLT can be chosen to be smaller values to reduce inventory while maintaining performance.

Each CIF will have its own RLT file. A sample entry for the RLT file is shown in Table G.2. The algorithm uses only the CIF, NSN, and REPLEN fields.

Table H.2
A Sample Entry for the RLT Input File to the CIF Inventory Levels Algorithm

CIF_UID	NSN	REPLEN
336	8465-01-547-2706	45

Where:

CIF_UID =	a unique identifier associated with the CIF
NSN =	the item's 13-digit national stock number
REPLEN =	the computed replenishment lead time.

Appendix I: CIF Inventory Levels Algorithm

Once the input files described in Appendix H have been created, we use a standard approach to setting inventory levels as described in this appendix. This algorithm is being refined and improved. The algorithm described below was current as of the end of 2010.

Breadth

An item qualifies to receive inventory levels based on the quantity of adjusted issues and turn-ins an item experiences in a year.[74] Items that do not have AAC = Y, that are not on the drop list or on the substitutable/replaced list, and that had more adjusted issues than turn-ins also received inventory levels.[75] At Ft. Stewart, fewer than 400 NSNs received inventory levels; these NSNs accounted for 99 percent of issues between January and December 2009.

Depth

Depth is set using a non-parametric approach, because net issues are not well modeled by a parametric distribution. To achieve a high level of performance, for each item that qualifies to receive inventory levels, we set the ROP—which is a combination of the safety level and the expected demand over the RLT—to satisfy the largest net issue quantity over any RLT-day period in the adjusted issue and turn-in history.

To determine the largest net issue quantity, the net issues are totaled between the day of an issue or turn-in and a RLT-ahead (termed a "bucket") day in the adjusted issue and turn-in history; this results in at most 365 bucket quantities for one year of adjusted issue and turn-in history. Note that each bucket begins with either an issue or a turn-in. The maximum bucket quantity minus 1 becomes the ROP.[76]

Figure I.1 illustrates how an item's net issue history is bucketed to determine the ROP. The upper left corner of the figure shows the net issue history for an item that has qualified to receive an inventory level. This item has demands such that the net issue quantity over RLT-ahead buckets are 9, 7, 5, 3, etc. Because the largest of these values is 9, we set the ROP = 9 – 1 = 8.

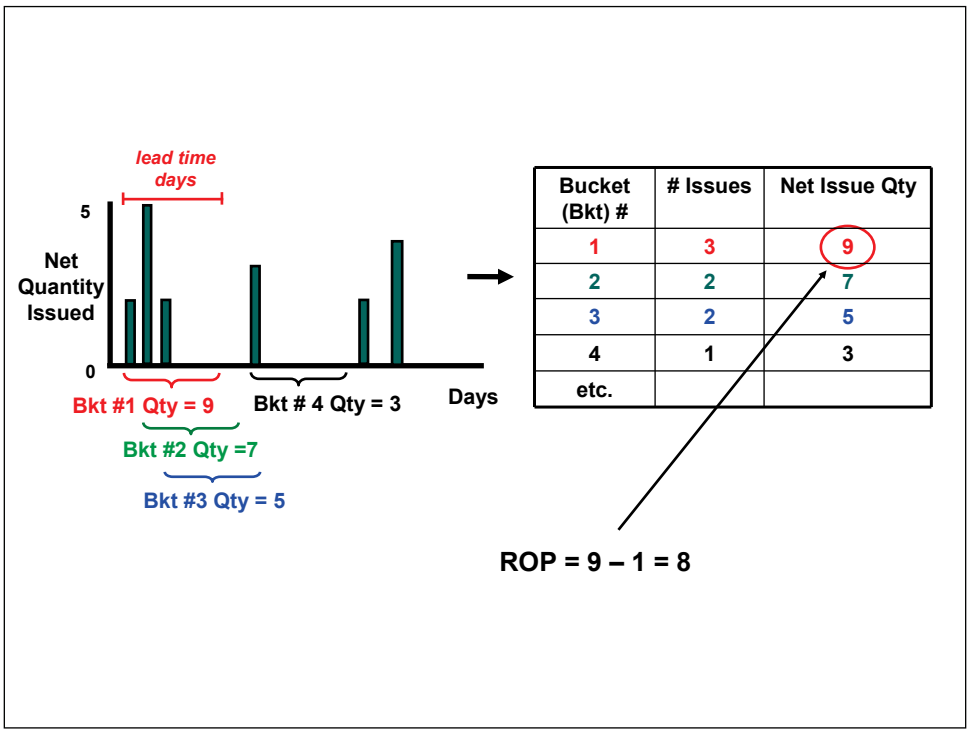
[74] Although this research focuses on centrally managed items, this methodology can be used to set inventory levels on non-centrally managed items as well.

[75] An item has more adjusted issues than turn-ins if the quantity of adjusted issues for items in the same LIN is greater than the quantity of adjusted turn-ins for items in the same LIN. The inequality tested is

(Quantity of Adjusted Issues for NSNs in the LIN) > (Quantity of Adjusted Turn-ins for NSNs in the LIN).

[76] We set the ROP to be equal to the maximum bucket quantity minus 1 so that if the maximum bucket quantity of an item is equal to 1, then setting ROP = 0 and RO = EOQ (EOQ is a minimum of 1) will fulfill all net issues.

Figure I.1
Bucketing Net Issue Quantity to Determine the Re-Order Point



A modified EOQ formula, described in more detail below, is used to compute the order quantity in a way that most efficiently trades off holding and ordering costs. The RO is then set to be the sum of the ROP and modified EOQ. Some post-processing of the RO and ROP occurs that is described below.

Modified Economic Order Quantity

To obtain the modified EOQ, first, the standard EOQ formula is computed for each NSN:

EOQ = sqrt(2aK/(h*unit price))

Where:

sqrt =	the square root function
a =	the average yearly net issue quantity for the item
K =	the marginal order cost (the Army uses $13.26)
h =	the annual marginal holding cost as a percentage of unit price, to include the costs of warehousing and obsolescence (the Army uses 22 percent)
unit price =	the unit price of the item

The EOQ is then modified so that it is not larger than one year of issues. To summarize, the formula for the modified EOQ used is

modified EOQ = min(a,EOQ)

Where:

min =	the minimum function
a =	the average yearly net issue quantity for the item
EOQ =	the standard EOQ formula given above.

Post Processing

Additional logic is applied to the computed inventory levels in some cases. If the largest net issue quantity is positive, but the second largest net issue quantity is zero or negative, then set RO = largest net issue quantity and ROP = 0. This sets lower inventory levels for items that are more likely to be turned in.

The final output of the CIF inventory levels algorithm is an RO and ROP for each qualified NSN. This methodology is a conservative approach to setting inventory levels and yields high fill rates during simulations of past issue and turn-in history.

Appendix J: Input Files to Retention Levels Algorithm

As described in Appendix A, there are six main input files to the CIF RL algorithm: (1) substitutable/replaced list, (2) adjusted issue history, (3) adjusted issue history without substitutes or replacements, (4) NSN information, (5) backorder information, and (6) property book information. We describe each of these files and their construction in this appendix.

Substitutable/Replaced List

The substitutable/replaced list is created using the procedure described in Appendix D.

Adjusted Issue History

The original issue history created above is modified to create an adjusted issue history as follows:

1. Issues for items that should not receive inventory levels are dropped using the procedure described in Appendix C.
2. Issues of substituted and replaced NSNs are transformed to issues of new NSNs using the procedure described in Appendix D.
3. Issues and turn-ins of NSNs with proxy NSNs are replaced with issues and turn-ins of their proxy NSNs using the procedure described in Appendix E.
4. Issues of set NSNs are converted to issues of component NSNs using the procedure described in Appendix F.

The resulting adjusted issue history is ready to be input into the CIF RL algorithm.

Adjusted Issue History Without Substitutes or Replacements

The original issue history created above is modified to create an adjusted issue history without substitutes or replacements as follows:

1. Issues and turn-ins of NSNs with proxy NSNs are replaced with issues and turn-ins of their proxy NSNs using the procedure described in Appendix E.
2. Issues of set NSNs are converted to issues of component NSNs using the procedure described in Appendix F.

The resulting adjusted issue history without substitutes or replacements is ready to be input into the CIF RL algorithm.

NSN Information

The NSN information file used for the CIF RL algorithm is the same as that used for the CIF inventory levels algorithm and is described in Appendix H.

Backorder Information

An order for an item is backordered if the wholesale system cannot immediately fulfill the order.[77] Items whose orders are often backordered can be difficult to obtain and may require higher retention levels.

Data for CIF-NSN–level backorder rates are taken from the same data source from which replenishment wait time information was obtained for the CIF inventory levels algorithm—the SDDB, which is based on LRT data from DAAS. Replenishment orders with the following characteristics are used to determine the CIF-NSN level backorder rate:

- Customer is a DODAAC that is funded by the OCIE CMO.[78]
- Receipt is dated within the past year.
- Receipt document identifier code is one of D6K, D6S, or D6M.
- Item condition code is A, B, or C (i.e., a serviceable asset).
- Item has any priority.
- Item has any backorder status.[79]

The backorder rate is computed as the percentage of orders to DLA that were given a backorder status.

Each CIF will have its own backorder information file. A sample entry for the backorder information file is shown in Table J.1. The algorithm uses only the CIF, NSN, and BO RATE fields.

Table J.1
Sample Entry for the Backorder Information Input File to the CIF RL Algorithm

CIF	NSN	BO RATE
Stewart	8465-01-547-2706	0.8

Property Book Information

The CIF property book serves as an NSN-level record of OCIE activity and of inventory that is stocked at the CIF or in the hands of soldiers served by the CIF. The property book is updated when inventory is received at or leaves the CIF and when soldiers served by the CIF are issued or turn in OCIE. A property book is accurate at the time of retrieval and typically changes soon afterward as a result of CIF activity.

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[77] Backorders are defined as items with a BB status at any time before its receipt date.
[78] CIFs may order OCIE using different DODAACs. The CMO provides funding to CIFs to purchase centrally managed items. This funding is accessed using the centrally managed DODAAC.
[79] The field "corp_fill_type" is the backorder indicator in the LRT database.

Property book information is obtained via a discoverer query of the ISM database.[80] Each CIF will have its own property book information. The relevant fields in the property book for the RL algorithm are RO, ROP, AFI, quantity possessed by soldier on clothing records (QPBS_CR) or hand receipts (QPBS_HR), and gross monthly issues (GMI). The AFI is the total serviceable[81] assets on-hand at the CIF. The QPBS is the total quantity of an item on the clothing records or on hand receipts of soldiers served by the CIF.[82] The GMI is a moving average of monthly issues as computed by ISM.[83]

The retention level of an item is based on its set-component QPBS, that is, the QPBS of the item obtained after the QPBS of the set is allocated across the QPBS of the components. If an item is not a component of a set, then its set-component QPBS is equal to its QPBS from the property book.

A sample entry for the property book information is shown in Table J.2. The algorithm uses only the fields NSN, RO, ROP, AFI, and SET-COMPONENT QPBS.

Table J.2
Sample Entry for the Property Book Information Input File to the CIF RL Algorithm

NSN	RO	ROP	AFI	SET-COMPONENT QPBS	GMI
8465-01-547-2706	685	579	530	3523	30

Where:

NSN =	the item's 13-digit national stock number
RO =	the requisition objective of NSN
ROP =	the re-order point of NSN
AFI =	the quantity of NSN in condition code A or B on-hand
SET-COMPONENTS QPBS =	the quantity of NSN on the clothing records or hand receipts of soldiers served by the CIF modified such that QPBS of a set has been allocated to the QPBS of its components
GMI =	the average quantity of NSN issued in a month.

[80] The query is called "CIF-PROPERTY-BOOK.DIS".

[81] An OCIE item is serviceable if it has condition code A or B.

[82] For the remainder of the document, we refer to the QPBS_CR and QPBS_HR as simply QPBS.

[83] ISM computes the GMI as the average GMI over all data that are available, up to the most recent 24 months, or as the GMI that was computed 10 months ago if the average GMI deviates from the GMI that was computed 10 months ago by more than 20 percent. The 20 percent value is a parameter that can be altered within ISM.

Appendix K: CIF Retention Levels Algorithm

Once the input files described in Appendix J have been created, we use a standard approach to setting RLs as described in this appendix. This algorithm is being refined and improved. The algorithm described below was current as of the end of 2010.

Breadth

Items with a positive RO qualify to receive RLs.[84] In addition, items that appear on the substitutable/replaced list may also qualify for a RL, because the soldiers supported at the CIF may not have yet received the new item and additional inventory of the new item may not be readily available from the wholesale system. At Ft. Stewart, fewer than 500 NSNs received RLs.

Depth

Depth is set using a standard approach based on months of supply. For items with a positive RO, RL equals the number of adjusted issues in the past six months.[85]

Replaced and substituted items are treated separately based on the degree of availability of their associated new items from the wholesale system and are discussed below.

High Availability of New Item from Wholesale

If the availability of the new item associated with a replaced or substituted item is high,[86] then there is no need to retain the associated replaced or substituted items. The RL of the replaced or substituted item is set to zero.

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[84] If ROs and ROPs have not been set at the CIF using the PIM, then core items with issues in the past six months of the adjusted issue history qualify for a RL. In addition, core items that appear on the substitutable/replaced list may qualify for a RL.

[85] Installations that support initial entry training (IET) are Fts. Benning, Jackson, Knox, Leonard Wood, and Sill. If ROs and ROPs have not been set at the CIF using the PIM and the CIF is *not* at an installation that supports IET, then for items that do not appear on the substitutable/replaced list, we set RL equal to the number of adjusted issues in the past 12 months, and we set TSA = RL + CL. If ROs and ROPs have not been set at the CIF using the PIM and the CIF *is* at an installation that supports IET, then for items that do not appear on the substitutable/replaced list, we set RL equal to the number of adjusted issues in the past six months, and we set TSA = RL + CL. As the supply system improves, the number of months of supply represented by the RL should be reduced.

[86] We say that the availability of the new item from the wholesale supply system is high if the backorder rate of the new item is less than 0.2.

Moderate Availability of New Item from Wholesale

If the availability of the new item associated with a replaced or substituted item is moderate,[87] then the quantity of the new item that is available for issue determines whether or not there is a need to retain the associated replaced or substituted items.

- If there is sufficient inventory of the new item to issue the new item to each soldier who possesses a replaced or substituted item,[88] then the RL of the replaced or substituted item is set to zero.
- If there is insufficient inventory of the new item to issue the new item to each soldier who possesses a replaced or substituted item, then the percentage of soldiers possessing the new item[89] determines whether there is a need to retain the associated replaced or substituted items.
  - If more than 70 percent of soldiers possess the new item, then few soldiers need the new item. The RL of the replaced or substituted item is set to zero.
  - If less than 70 percent of soldiers possess the new item, then many soldiers still need the new item. In this case, the RL of the replaced or substituted item is set to support any continuing sustainment for soldiers with the replaced or substituted item.
    - If neither the new item nor its replaced or substituted item has been issued in the past three months,[90] then no continuing sustainment for soldiers with the replaced

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[87] We say that the availability of the new item from the wholesale supply system is moderate if the backorder rate of the new item is between 0.2 and 0.8.

[88] There is sufficient inventory of the new item to issue the new item to each soldier who possesses a replaced or substituted item if the AFI of the new item is greater than the QPBS of the replaced or substituted item. The inequality tested is

(AFI of New Item) > (QPBS of Replaced or Substituted Item).

In some cases, an old item has been replaced by or is substitutable with many new items. In this case, the AFI of all the new items must be included when comparing to the QPBS of the replaced or substituted item. The inequality tested is

(AFI of New Items) > (QPBS of Replaced or Substituted Item).

[89] The percentage of soldiers possessing the new item is equal to the QPBS of the new item divided by the sum of the QPBS of the new item and the QPBS of the associated replaced or substituted item. The equation is

(Percentage of Soldiers Possessing New Item) = (QPBS of New Item) / [(QPBS of New Item) + (QPBS of Replaced or Substituted Item)].

In some cases, an old item has been replaced by or is substitutable with many new items. In this case, the QPBS of all the new items must be included when computing the percentage of soldiers possessing the new item. The equation is

(Percentage of Soldiers Possessing New Items) = (QPBS of New Items) / [(QPBS of New Items) + (QPBS of Replaced or Substituted Item)].

[90] The new item and its replaced or substituted item have been issued in the past three months if, in the adjusted issue history, there are issues for the new item. The inequality tested is

(Issues in Past 3 Months for New Item in Adjusted Issue History) > 0.

In some cases, an item has been replaced by or is substitutable with many new items. In this case, we check whether the new items and their replaced or substituted items have been issued in the past three months. The inequality tested is

(Issues in Past 3 Months for New Items in Adjusted Issue History) > 0.

or substituted item is necessary. In this case, the RL of the replaced or substituted item is set to zero.

- If either the new item or its replaced or substituted item has been issued in the past three months, then continuing sustainment for soldiers with the replaced or substituted item is necessary. We set the RL of the replaced or substituted item equal to the ROP of the new item.[91]

Low Availability of New Item from Wholesale

If the availability of the new item associated with a replaced or substituted item is low,[92] then the quantity of the new item that is available for issue determines whether there is a need to retain the associated replaced or substituted items.

- If there is sufficient inventory of the new item to issue the new item to each soldier who possesses a replaced or substituted item, then the RL of the replaced or substituted item is set to zero.
- If there is insufficient inventory of the new item to issue the new item to each soldier who possesses a replaced or substituted item, then the percentage of soldiers possessing the new item, and whether the item has been replaced or substituted, determines whether there is a need to retain the associated replaced or substituted items.
  - If more than 70 percent of soldiers possess the new item, then few soldiers need the new item. The RL of the *replaced* item is set to zero, because soldiers cannot be issued the replaced item. The RL of the *substituted* item is set to the ROP of the new item, because the new item has low availability.[93]

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[91] If ROs and ROPs have not been set at the CIF using the PIM and the CIF is *not* at an installation that supports IET, then we set the RL of the replaced or substituted item to be the greater of six months of issues of the replaced or substituted item in the original issue history or three months of gross monthly issues of the replaced or substituted item. The maximum of these two values is taken in case one of these values is zero. Only three months of GMI is taken so that RLs are not set too large. The equation is

(RL of the Replaced or Substituted Item) = max[(6 Months of Issues of the Replaced or Substituted Item in the Original Issue History),3*(GMI of the Replaced or Substituted Item)].

If ROs and ROPs have not been set at the CIF using the PIM and the CIF *is* at an installation that supports IET, then we set the RL of the replaced or substituted item to be the greater of three months of issues of the replaced or substituted item in the original issue history, or 1.5 months of gross monthly issues of the replaced or substituted item. The maximum of these two values is taken in case one of these values is zero. Only 1.5 months of GMI is taken so that RLs are not set too large. The equation is

(RL of the Replaced or Substituted Item) = max[(3 Months of Issues of the Replaced or Substituted Item in the Original Issue History),1.5*(GMI of the Replaced or Substituted Item)].

As the supply system improves, the number of months of supply represented by the RL should be reduced.

[92] We say that the availability of the new item from the wholesale supply system is low if the backorder rate of the new item is greater than 0.8.

[93] If ROs and ROPs have not been set at the CIF using the PIM and the CIF is *not* at an installation that supports IET, then we set the RL of the substituted item to be the greater of six months of issues of the substituted item in the original issue history or three months of gross monthly issues of the substituted item. The maximum of these two values is taken in case one of these values is zero. Only three months of GMI is taken so that RLs do not become too large. The equation is

(RL of the Substituted Item) = max[(6 Months of Issues of the Substituted Item in the Original Issue History),3*(GMI of the Substituted Item)].

– If less than 70 percent of soldiers possess the new item, then many soldiers still need the new item. In this case, the RL of the replaced or substituted item is set to support continuing sustainment for soldiers with the replaced or substituted item. We set the RL of the replaced or substituted item equal to the ROP of the new item.[94]

The final output of the CIF RLs algorithm is a RL for each qualified NSN. The RL is added with the RO and CL to obtain the TSA. Serviceable on-hand inventory above the TSA is considered inventory available for lateral transfer.[95]

If ROs and ROPs have not been set at the CIF using the PIM and the CIF *is* at an installation that supports IET, then we set the RL of the substituted item to be the greater of three months of issues of the substituted item in the original issue history, or 1.5 months of gross monthly issues of the substituted item. The maximum of these two values is taken in case one of these values is zero. Only 1.5 months of GMI is taken so that RLs do not become too large. The equation is

(RL of the Substituted Item) = max[(3 Months of Issues of the Substituted Item in the Original Issue History),1.5*(GMI of the Substituted Item)].

As the supply system improves, the number of months of supply represented by the RL should be reduced.

[94] If ROs and ROPs have not been set at the CIF using the PIM and the CIF is *not* at an installation that supports IET, then we set the RL of the replaced or substituted item to be the greater of six months of issues of the replaced or substituted item in the original issue history or three months of gross monthly issues of the replaced or substituted item. The maximum of these two values is taken in case one of these values is zero. Only three months of GMI is taken so that RLs do not become too large. The equation is:

(RL of the Replaced or Substituted Item) = max[(6 Months of Issues of the Replaced or Substituted Item in the Original Issue History),3*(GMI of the Replaced or Substituted Item)].

If ROs and ROPs have not been set at the CIF using the PIM and the CIF *is* at an installation that supports IET, then we set the RL of the replaced or substituted item to be the greater of three months of issues of the replaced or substituted item in the original issue history or 1.5 months of gross monthly issues of the replaced or substituted item. The maximum of these two values is taken in case one of these values is zero. Only 1.5 months of GMI is taken so that RLs do not become too large. The equation is

(RL of the Replaced or Substituted Item) = max[(3 Months of Issues of the Replaced or Substituted Item in the Original Issue History),1.5*(GMI of the Replaced or Substituted Item)].

As increased trust builds in the lateral transfer system, RLs for items with low availability from wholesale can be reduced. The Army benefits from greater sharing when items are in short supply.

[95] The property book value AFI tracks the serviceable on-hand inventory available for issue at the CIF. Thus, if AFI > TSA, then (AFI – TSA) is available for lateral transfer.

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