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THESIS

**AN EVALUATION OF THE EFFECTIVENESS
OF THE NAVY WORKING CAPITAL FUND
(NWCF) UNIT COST RATIO**

by

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December 2023

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**AN EVALUATION OF THE EFFECTIVENESS OF THE NAVY WORKING
CAPITAL FUND (NWCF) UNIT COST RATIO**

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ABSTRACT

The Navy Working Capital Fund–Supply Management (NWCF-SM) business area attempts to maintain a Unit Cost Ratio (UCR) of 1.0 or below to ensure cash solvency. Calculated by dividing total obligations by net sales, a UCR of less than 1.0 means that sales revenue exceeds total operating costs. This thesis uses eight years of financial data to assess the usefulness of the UCR as a diagnostic metric to the financial health of NWCF-SM, considering more fiscal years in the UCR reduces the metric’s variation due to single-year aberrations, allowing for greater short-term flexibility in NWCF-SM’s operations. Non-forecastable items resulted in a -\$953.58 million net performance, do not enable full cost recovery, and force NWCF-SM management to forego procurements of future needs or higher priority requirements. This analysis estimates that \$6.6 billion in requirements were backlogged between FY15 and FY22 due to a 1.6-year lead time on wholesale items and NWCF-SM’s inability to execute forecasting purchases under UCR restrictions. PBL contracts only recovered about two cents for every dollar obligated. The resulting UCR from removing PBLs provides a more proper reflection of the fund performance related to solvency.

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LIST OF ACRONYMS AND ABBREVIATIONS

AOR	Accumulated Operating Result
ASD(S)	Assistant Secretary of Defense, Sustainment
ASN(FM&C)	Assistant Secretary of the Navy, Financial Management and Comptroller
BP	Budget Project
BSC	Business Systems Command
BSO	Budget Submitting Office
CA	Contracting Authority
CIP	Capital Investment Program
CV	Coefficient of Variation
DASN(FMB)	Deputy Assistant Secretary of the Navy, Office of Budget
DBOF	Defense Business Operations Fund
DFAS	Director, Defense Finance and Accounting Service
DLA	Defense Logistics Agency
DOD	Department of Defense
DON	Department of the Navy
DWCF	Defense Working Capital Fund
FLC	Fleet Logistics Center
FMR	Financial Management Regulation
FY	Fiscal Year
HQ	Headquarters
IWST	Integrated Weapon Support Team
MC SMAG	Marine Corps Supply Management Activity Group
NAVSUP	Naval Supply Systems Command
NDP	Navy Data Platform
NEXCOM	Navy Exchange Services Command
NIIN	National Item Identification Number

NOR	Net Operating Result
NWCF	Navy Working Capital Fund
NWCF-SM	Navy Working Capital Fund – Supply Management
OA	Obligation Authority
OMB	Office of Management and Budget
OUSD(A&S)	Office of the Under Secretary of Defense (Acquisition and Sustainment)
OUSD(C)	Office of the Under Secretary of Defense (Comptroller)
PBL	Performance Based Logistics
RFI	Ready-For-Issue
SECDEF	Secretary of Defense
SM	Supply Management
SUP01	NAVSUP Financial Management and Comptroller
SUP04	NAVSUP Assistant Commander for Supply Chain Management Policy and Performance
UCR	Unit Cost Ratio
WSS	Weapon Systems Support

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I. INTRODUCTION

The Navy Working Capital Fund (NWCF) commands over \$30 billion in transactions each year, and about \$9 billion of that amount is in the supply management business area. The NWCF's business policy as a Defense Working Capital Fund is to break even on all expenses each fiscal year by setting the price of the goods it sells to fully recover its direct and indirect costs. However, since these prices are set approximately nine months prior to the beginning of each fiscal year and only changed in extraordinary circumstances, perfect cost recovery depends on perfect forecasting and results in positive or negative operating result at the end of each year. To ensure cash solvency, the Navy Working Capital Fund–Supply Management (NWCF-SM) business area attempts to maintain a Unit Cost Ratio (UCR) of 1.0 or below. Calculated by dividing total operating costs by net sales, a UCR of less than 1.0 means that sales revenue exceeds total operating costs.

This metric, however, fails to consider several aspects of the supply management business area. Its inherent focus on one fiscal year (FY) does not recognize the NWCF as an ongoing enterprise that operates across fiscal years. The inclusion of certain types of supply assets, such as Performance Based Logistics (PBL) items and general consumables, reduces the sensitivity of the UCR to meaningful changes in the financial management of core assets that the NWCF-SM business area manages. Finally, the UCR potentially limits NWCF-SM activities' ability to make forward-looking stock posture purchases and instead favor short-sighted operations, harming the NWCF's ability to support future operations.

The purpose of this thesis is to analyze the usefulness of the UCR and the effect on inventory management from focusing on this single metric. The UCR influences decisions that affect the ability to meet NWCF-SM customer demands, potentially resulting in decreased fleet readiness and increased customer wait times. This report explores factors that significantly contribute to the restrictive nature of UCR and ways to potentially adjust UCR to better support NWCF-SM operations.

This report provides an overview of NWCF operations, the UCR, obligation authority, cost recovery, and forecasting. In addition, we provide an overview of the entities related to the NWCF management and execution.

This thesis examines eight years of data from the Navy Data Platform (NDP) covering 2015–2022, examining obligations, net sales, and expenditures to investigate four areas: fiscal year restrictions on the NWCF by comparing the current UCR model to a multiple-year model; the net performance of items within the NWCF based on the ability to forecast demand and how that influences UCR; the backlog impacts created by being unable to purchase ahead of customer requirements; and the impacts of non-cost recovering factors, such as PBL contracts, on UCR.

The results show four conclusions. First, expanding the UCR to a rolling two- or three-fiscal year metric reduces the year-to-year variance of the UCR due to single-year financial aberrations. It also potentially allows for increased supply management flexibility when balanced with appropriate long-term management practices. Second, non-forecastable items should be more scrutinized since they have a significant impact on maintaining a 1.0 UCR while attempting to service the highest priority demand. Third, the current unit cost management system incentivizes prioritizing the financial health of the NWCF over the operational requirements of the fleet, especially given the lead time of wholesale National Item Identification Numbers (NIINs) managed by Naval Supply Systems Command (NAVSUP). Finally, factors that recover obligations but do not enable full cost recovery of the NWCF, such as PBLs, should not be considered in the UCR.

II. BACKGROUND

This chapter provides an overview of the NWCF, and the commands involved in the management and execution of Defense Working Capital Funds (DWCF). The chapter describes the purpose of the NWCF, how the funds operate, who influences decision-making, and who directs policy.

A. NAVY WORKING CAPITAL FUND (NWCF)

The NWCF is one of three military department defense working capital funds, with the Army Working Capital Fund, Air Force Working Capital Fund (Keys & McGarry, 2022).

1. History

The initial version of the DWCF was created in fiscal year 1992 under the title of Defense Business Operations Fund (DBOF). The DBOF was a centrally managed fund with the goal of consolidating stock funds and industrial funds. Stock funds refer to funds that are used to buy commercial products in bulk, building inventory, with the intention to sell to customers. Industrial funds are used to fund support services such as depot maintenance, transportation, or research and development. The unit of sale for stock funds are goods, while the unit of sale for industrial funds is labor (Department of Defense [DOD], 2023).

In FY 1995, the management of the DBOF shifted from the Office of the Under Secretary of Defense (Comptroller) (OUSD[C]) to the respective DOD components. This allowed each component to manage its own cash management function while pushing accountability for the funds down to the component level (Department of the Navy, Office of the Comptroller, 2001). In FY 1997, the DBOF was replaced by the DWCF, which aimed to establish clear responsibilities for the components to manage their specific funds. Congress established these working capital funds under Title 10 United States Code 2208 (DOD, 2023).

2. Purpose

The NWCF is a revolving fund for the Department of the Navy (DON). The fund operates with the purpose of providing products and services on a reimbursable basis to customers.

The NWCF contains four business areas that provide distinct goods and services to the customer. These business areas are:

Supply Management (SM): manages the sale of weapon system components, inventory spare stock, and consumable material,

Depot Maintenance: provides for weapon system repair and maintenance, including but not limited to aircraft, ships, and their major subassemblies,

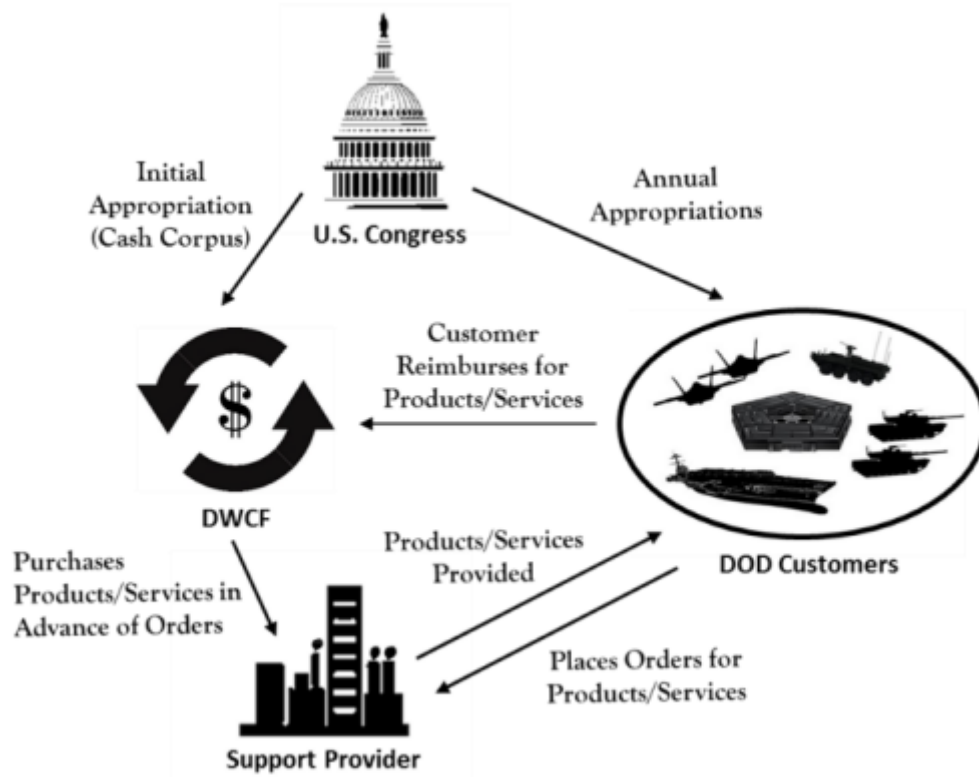
Transportation: provides for the overseas transportation and prepositioning of supplies and equipment to deployed forces, and

Research and Development: supports the development, engineering, and acquisition of weapons systems, facilities, and equipment (Department of the Navy [DON], 2023).

NWCF-SM consists of two budget submitting offices (BSO): Naval Supply Systems Command (NAVSUP) and the Marine Corps, Supply Management Activity Group (MC SMAG) (DON, 2023). The analysis contained in this thesis focuses on activity within the NWCF-SM business area under the NAVSUP BSO.

3. Structure

Congress typically establishes a DWCF with an initial direct appropriation, which provides an initial positive cash balance called the cash corpus (Keys & McGarry, 2022). Once operating, the fund is responsible for sustaining its operations through the sale of goods and services to primarily DOD customers supported by annual appropriations from Congress. Figure 1 demonstrates the revolving process of a DWCF and the interaction between Congress, customers, and service providers.



Source: Keys and McGarry (2022, p. 1).

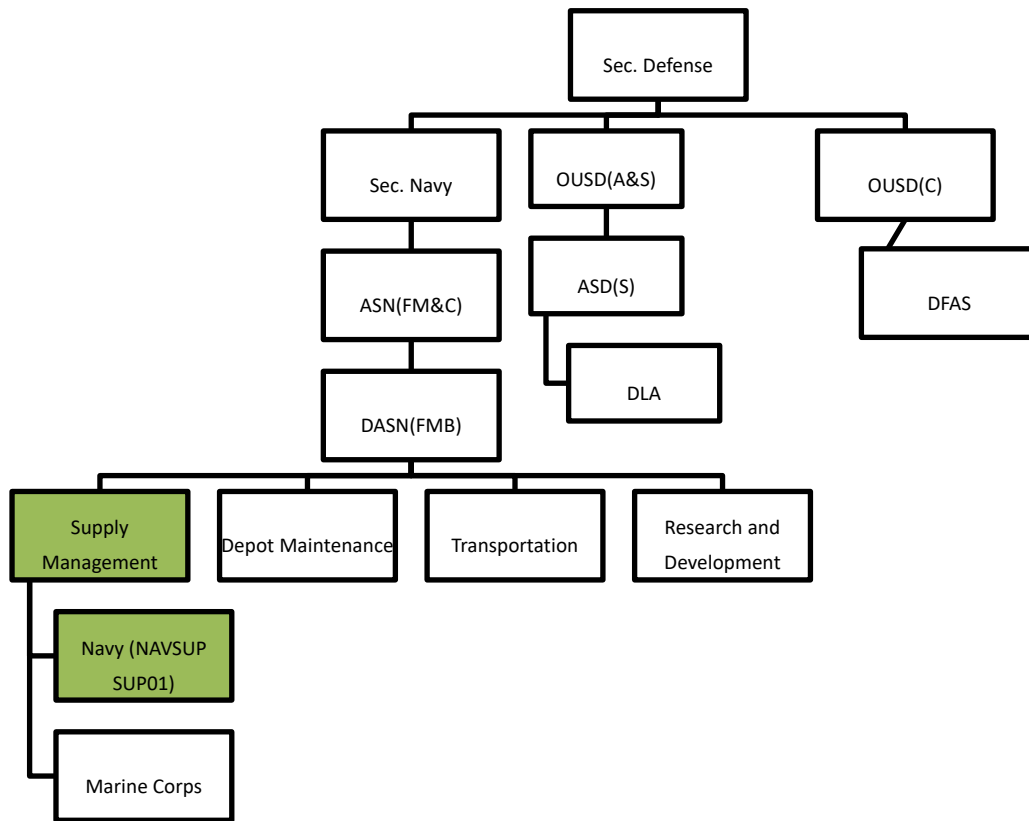
Figure 1. DWCF Operations

4. Roles

Figure 2 outlines the organizational structure that flows from OUSD(C) down to NAVSUP SUP01 as the designated NWCF-SM managers, where this paper focuses. Roles and responsibilities as outlined by the DOD Financial Management Regulation (FMR) (2023):

- OUSD(C): Establish DWCF operation and financial policies, provide oversight, approve, and rescind charters, monitor compliance, and review and approve operating and capital budgets.
- Director, Defense Finance and Accounting Service (DFAS): Advise and assist OUSD(C) and DWCF activities on accounting procedures and prepare internal and external DWCF reports.

- Military Departments and Defense Agencies: Properly manage the DWCF within approved funding limitations, designate DWCF managers, and comply with policies and regulations.
- DWCF Activities: Incur obligations and costs necessary to perform the mission, control costs, evaluate operations, and report barriers to reaching performance and cost goals.
- DWCF Customers: Properly budget for DWCF orders, provide an annual operating budget to the DWCF, and notify the DWCF activity if they intend to terminate orders.



Adapted from DOD (2023), Under Secretary of Defense (Acquisition and Sustainment) (n.d.), and Assistant Secretary of the Navy (Financial Management and Comptroller) (n.d.).

Figure 2. Organizational Structure of the NWCF-SM Business Area.

5. Operation

The financial goal of the NWCF is to break even over the long run by setting the price of goods and services to fully recover costs, including general and administrative costs (DOD, 2023). These prices are set during the annual budget process and are usually established for the entirety of the fiscal year to protect DOD customers from unforeseen price fluctuations (DOD, 2023). The annual difference between revenue and expense is called the Net Operating Result (NOR), while the total difference between revenue and cost from the fund's inception is called the Accumulated Operating Result (AOR) (DOD, 2023). To achieve its financial goal of breaking even in the long run, the NWCF budgets every year to achieve an AOR of zero.

Because the goal is to break even over the long term, the NWCF must account for any remaining balance in AOR when setting prices rather than solely breaking even for the fiscal year. Candreva (2017) illustrates this concept with the equation applying to non-SM activity groups:

$$Rate = \frac{Cost\ to\ Deliver\ Estimated\ Output - AOR + Mandated\ Adjustments}{Estimated\ Output}.$$

The mandated adjustments term captures directed changes to the fund's cash corpus, such as a Congressional requirement to raise or lower the fund's overall cash levels (Candreva, 2017). Assuming no mandated adjustments, any positive value of AOR will lower the stabilized rate below the point of estimated full cost recovery and will result in an estimated negative NOR in an amount to offset the positive AOR. Conversely, any negative value of AOR will require a stabilized rate higher than the point of estimated full cost recovery and will result in an estimated positive NOR.

For SM activity groups, the price that DOD customers pay for goods managed within the NWCF is determined by applying a markup to the total materiel cost of an item. Per the DOD FMR (2023), the standard price includes total materiel costs, non-materiel cost recovery, and other cost recovery elements.

- **Total materiel costs** include materiel costs, materiel inflation as a dollar amount published by the Office of Management and Budget (OMB), and loss, damage, washout, and obsolescence (DOD, 2023).
- **Total non-materiel costs** account for prior year operating results (AOR adjustment), operating costs such as payroll, transportation, operating materials and supplies, rent and utilities, and depreciation as well as irregular costs incurred while managing inventory, such as initial provisioning costs of weapon systems, inventory augmentation costs associated with maintaining approved materiel support levels, and covering losses that are unusual or nonrecurring in nature (DOD, 2023).
- **Other cost recovery elements**, as approved by the OUSD(C), can include cash surcharges, fund management adjustments, and mandated adjustments previously described in the non-SM stabilized rate formula (DOD, 2023).

6. Unit Cost Ratio (UCR)

The UCR is a metric that indicates if a business area's operations are fully recovering its costs. This metric only applies to SM business areas. When analyzing an SM activity's aggregate finances, the UCR is defined by the formula:

$$\text{Unit Cost Ratio} = \frac{\text{Total Obligations}}{\text{Net Sales}}$$

A NWCF activity that has fully recovered its costs for a given fiscal year will end its annual activities with a UCR equal to 1.0. If the activity incurs more operating costs than it earns in gross sales revenue, it will have a UCR of greater than 1.0. Conversely, if the activity earns more revenue than it incurs in operating costs, it will have a UCR of less than 1.0. The UCR can be used to indicate the effect of the previous fiscal year's activities on the NWCF's cash balance. For instance, a fiscal year that concludes with a UCR of 1.0 will have a net zero effect on the NWCF's overall cash balance, as total costs incurred are replenished by revenue from gross sales.

This research was unable to verify the definition of the UCR or any requirements governing its management in DOD or DON policy. However, the Navy SM business activity adheres to a 1.0 UCR in practice and provides its annual UCR results and forecasts for future fiscal years in its annual NWCF justification of estimates document (DON, 2023).

7. Obligation Authority

Obligation Authority (OA) sets the upper spending limits for each DWCF component and is required for each fund to operate. OA is granted to each DWCF component after their yearly projections are developed and provided to OUSD(C), Revolving Funds Directorate. OUSD(C) reviews the annual projections, which are submitted as part of the President's Budget for final adjudication (DOD, 2023).

Contract Authority (CA) legally allows the DWCF components to enter into contracts and incur obligations before budget resources are available. CA is only applicable to SM activities and the Capital Investment Program (CIP) within the DWCFs and must be apportioned. If SM operations collect more reimbursements for goods and services than the apportioned CA, they cannot obligate the additional funds. To obligate the additional collected funds, OMB must provide additional CA to the SM operation. CA allows the SM operation to procure goods ahead of a defined requirement from a DWCF customer (DOD, 2023).

8. Performance Based Logistics (PBL)

The NWCF-SM uses PBL in the form of contracts with original manufacturers to facilitate the direct delivery of line items or repair services from industry to the supported customer. This allows the NWCF-SM to reduce the number of items that they directly manage and enables industry to increase material availability, decrease logistics response times, reduce repair turnaround time, and reduce costs (Defense Acquisition University, n.d.). NWCF-SM funds these contracts, the equivalent wholesale cost recovery rates are applied to PBL contracts, and the cost is captured in the UCR metric.

9. Budget Projects (BP)

The Navy utilizes budget projects to organize financial activities within its business activities. Within NWCF-SM, NAVSUP manages six BPs, presented in Table 1. The wholesale category of BPs refers to parts purchased to replenish retail inventory, while the retail category refers to parts and goods stored onboard operational units (Solis, 2003). Operations reimbursables (BP91) refers to transactions supporting the cost of operations (DON, 2023). Ships' stores (BP21) under the retail category refers to non-repairable retail items.

Table 1. BPs managed by NAVSUP under NWCF-SM

WHOLESALE		
	Aviation Consumables	BP34
	Ship Repairables and Consumables	BP81
	Aviation Repairables	BP85
RETAIL		
	Ships' Stores	BP21
	General Consumables	BP28
OPERATIONS		
	Operations Reimbursables	BP91

Adapted from DON (2023).

These BPs can be used to categorize financial data into wholesale or retail sales and help to determine which SM policies may apply to a specific transaction.

10. Forecasting

NWCF-SM uses forecasting to influence procurement decisions. Forecasting provides the NWCF-SM team with data relating to how likely an item is to sell. Forecasting correctly allows NWCF-SM to procure the right material, enable full cost recovery and avoid debt incurred by inventory that does not sell to customers.

NWCF-SM uses historical demand, specifically a 20-month period, to determine if a managed item is forecastable or non-forecastable. Volatility variance measures how likely an item is to deviate from the average demand over a set period. Volatility is determined by using an item’s demand coefficient of variation (CV), or the extent to which the demand varies from the mean. Everitt (2002, p. 78) defines CV by the formula below, where σ is the standard deviation and μ is the mean of a data set:

$$CV = 100 \times \frac{\sigma}{\mu}.$$

Intermittency represents the percentage of the total historical demand periods that have non-zero demand (DOD, 2018). An item that is forecastable has a medium to low volatility variance and a strong history of demand. An item that is non-forecastable will have high volatility and a weak demand history. Forecastable items add the least amount of risk to NWCF-SM operations. DOD Manual 4140.01, Volume 2 provides Tables 2, 3, and 4 as criteria related to if an item is forecastable or not.

Table 2. Segmenting Items by Demand Intermittency

Intermittency Segment	Description	Suggested Percentage of Demand History
Limited	Almost no periods of demand	Less than 10%
Uneven	Few periods of demand	Between 10% and 60%
Erratic	A fair number of periods of demand	Between 60% and 85%
Continuous	Many periods of demand	Greater than 85%

Source: DOD (2018).

Table 3. Segmenting Items by Demand Volatility

Volatility Segment	Description	Suggested CV Percentage
Low variance	The demand history for the item has little volatility as the standard deviation of demand is less than the average demand.	Less than 75%
Medium variance	The demand history for the item has volatility but the standard deviation of demand is near the average demand.	Between 75% and 125%
High variance	The demand history for the item is highly volatility as the standard deviation of demand is greater than the average demand.	Greater than 125%

Source: DOD (2018).

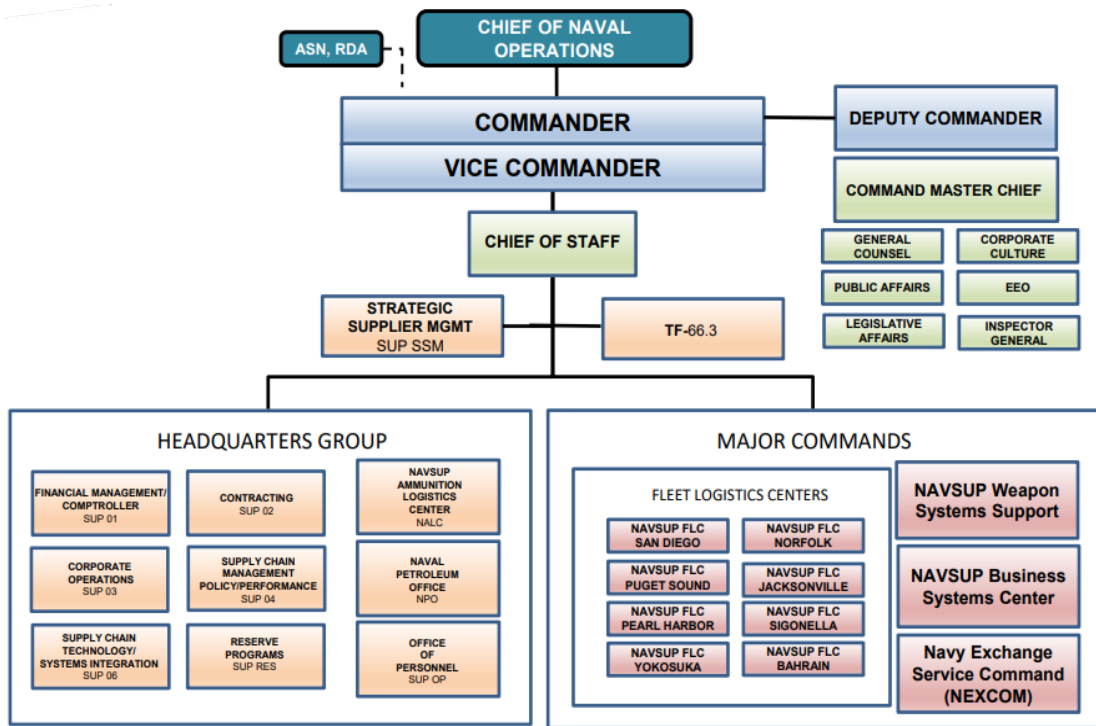
Table 4. Segmenting Items as Forecastable and Non-Forecasting Based on Demand Intermittency and Volatility

		Intermittency			
		Continuous	Erratic	Uneven	Limited
Volatility	Low variance	Forecastable	Forecastable	Forecastability dependent on accuracy	Non-forecastable
	Medium variance	Forecastable	Forecastability dependent on accuracy	Non-forecastable	Non-forecastable
	High variance	Forecastability dependent on accuracy	Non-forecastable	Non-forecastable	Non-forecastable

Source: DOD (2018).

B. NAVAL SUPPLY SYSTEMS COMMAND (NAVSUP)

NAVSUP oversees an array of logistics functions that support the readiness of the Navy and Marine Corps warfighters. They are focused on enabling mission success by providing material management, acquisition, and other logistics capabilities. An overview of the NAVSUP enterprise organization is represented by the organizational chart in Figure 3.



Source: NAVSUP (2021a).

Figure 3. NAVSUP Organizational Chart

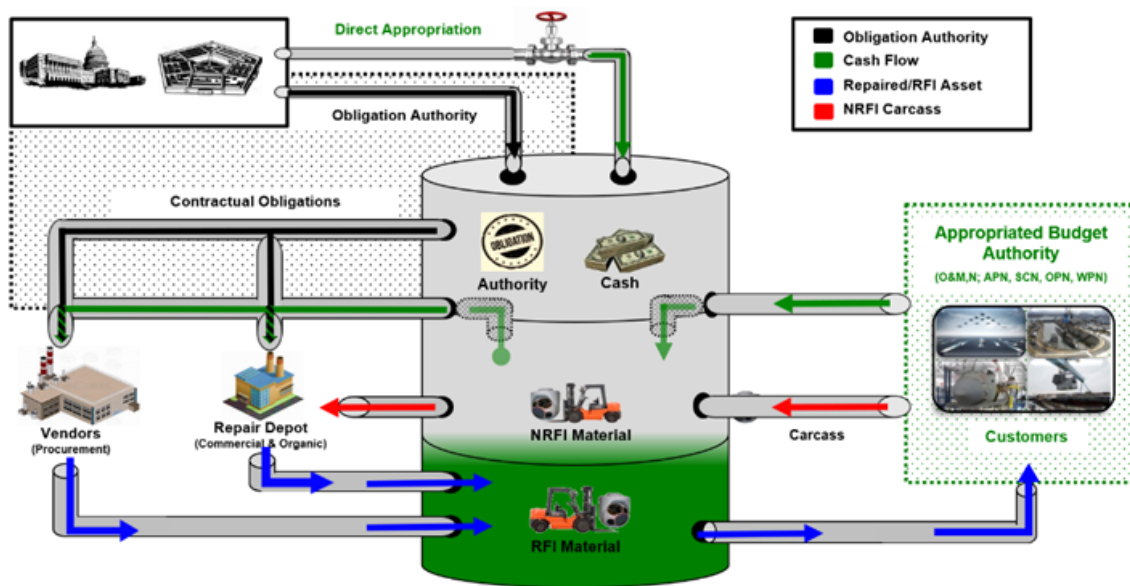
1. NAVSUP Headquarters (HQ)

NAVSUP HQ is the head organization of the NAVSUP enterprise and manages the supply chains, inventory systems, and logistics support services for Navy aircraft, ships, submarines, and other weapons systems (Naval Supply Systems Command [NAVSUP], n.d.a). Within NAVSUP HQ, there are 11 directorates tasked with managing the functional areas of the NAVSUP enterprise. The directorates most relevant to the management of the NWCF are Financial Management and Comptroller (SUP01), and Assistant Commander for Supply Chain Management Policy and Performance (SUP04). SUP01 oversees all financial planning, accounting, and allocation of funds within the NAVSUP enterprise, and SUP04 manages the enterprise’s global logistics operations (NAVSUP, n.d.a).

SUP01 is the directorate responsible for managing the NWCF-SM, which performs procurement and inventory management oversight for aviation and shipboard

repairables and consumables, as well as other goods and services that are to be purchased by Navy, Marine Corps, or other customers. A primary goal of NWCF-SM is to ensure the NWCF remains solvent or ensure they are not buying more goods and services than it can sell and has the right material to quickly support customer requirements.

Figure 4 illustrates the revolving nature of the NWCF-SM and the interactions between the customers and the goods and services it provides. For a continually operating SM activity such as NWCF-SM, SUP01 receives obligation authority from OUSD(C), which it then uses to enter contractual obligations with vendors and repair depots. SUP01 funds these obligations with cash earned from previous sales to customers funded by congressional appropriations or direct appropriations received from Congress. A vendor or repair depot provides the ready-for-issue (RFI) material to SUP01 via the appropriate inventory management activity, which they then provide to customers at their time of need. Upon receipt of the material, the customer reimburses SUP01 with the appropriated funds.



Source: NAVSUP PowerPoint slides (n.d.).

Figure 4. NWCF-SM Cash Flow

2. NAVSUP Weapon Systems Support (WSS)

NAVSUP WSS directly reports to Commander, NAVSUP and provides comprehensive supply support for operational weapon systems (NAVSUP, 2021b, n.d.b). NAVSUP WSS's Material Budget Department (N83) is responsible for developing and justifying NWCF budgetary requirements, monitoring NWCF budget performance, and managing the NWCF pricing program (NAVSUP, 2021b). NAVSUP WSS has two functional areas: NAVSUP WSS (Maritime) headquartered in Mechanicsburg, Pennsylvania, and NAVSUP WSS (Aviation) headquartered in Philadelphia, Pennsylvania.

3. Other Organizations Included in the SM Activity Group

Separate from NAVSUP HQ and WSS, NAVSUP is responsible for three other types of operations that affect the SM activity group:

- the NAVSUP Business Systems Center (BSC), which is responsible for the design, development and maintenance of logistics, supply chain, transportation, finance, and accounting information technology systems used within the Navy and DOD,
- the Navy Exchange Service Command (NEXCOM), which oversees Navy Exchange and Navy Lodge facilities, administers the Ships Store program afloat, and manages the Uniform Program Management Office as well as the Telecommunications Program Office, and
- eight globally situated NAVSUP Fleet Logistics Centers (FLCs) that provide integrated logistics, contracting, ordnance, and transportation support to the Navy's numbered fleets as well as joint customers (NAVSUP, n.d.c).

The operating obligations and revenues associated with these activities are included in the NWCF-SM aggregate calculations and are included in the aggregate UCR calculation.

**C. OFFICE OF THE UNDER SECRETARY OF DEFENSE
(COMPTROLLER) (OUSD[C])**

The OUSD(C) is the primary advisor to the Secretary of Defense (SECDEF) for budgetary and fiscal matters. The OUSD(C) organization consists of multiple sub-organizations and provides overarching guidance to the Department of Defense related to financial management matters (Under Secretary of Defense (Comptroller), (n.d.)). The DOD FMR is published and maintained by OUSD(C) and is issued under the authority of DOD Instruction 7000.14. “The DOD FMR directs statutory and regulatory financial management requirements, systems, and functions for all appropriated and non-appropriated, working capital, revolving, and trust fund activities,” (DOD, 2023). The policies related to NWCF can be found in the DOD FMR Volume 2B, Chapter 9 (Defense Working Capital Fund Budget Justification Analysis) and Volume 11B (Reimbursable Operations Policy – Working Capital Funds).

III. DATA AND METHODOLOGY

This chapter provides an overview of the data source, scope, and methods used to analyze various components of NWCF-SM's business practices. It also lists the assumptions that the analysis makes, and the limitations of the analysis.

A. DATA

The data used for this analysis is curated from data available via the Navy Data Platform (NDP). The dataset includes obligations, collections, net sales, and expenditures for wholesale, retail, and operating actions aggregated by BP, Integrated Weapon Support Team (IWST) and the transaction's status as PBL items. The focus of this study is on data in FY 2015 through 2022.

B. METHODOLOGY

The analysis focuses on the SM business area within the NWCF. We analyzed the single-FY UCR model and the effects of its sensitivity to single-year activity on NWCF-SM's ability to buy ahead of demand, how net performance of items within the NWCF-SM affects the UCR, how the current system's single-FY focus prevents the procurement of future requirements by prohibiting the accumulation of debt ahead of sales, and whether factors that do not enable full cost recovery of the NWCF, such as PBLs, affect the UCR.

1. Fiscal Year Constraints on the UCR Formula

To analyze the effects of restricting UCR terms to one fiscal year, we derived alternate UCRs that incorporate two-, three-, and four-year rolling cumulative totals for obligations and net sales and compared them to the current one-year calculation method. We then analyzed each ratio to determine the sensitivities of the new ratios and effects of forecasting errors on ratio compliance.

To develop the alternative UCRs, we took the preceding two, three or four years of obligation data as a sum and divided the result by the same number of preceding years'

net sales data as a sum. The resulting ratio represents the new UCR for a given fiscal year, represented as an equation below, where FY is the fiscal year in question and y is the number of years prior to the fiscal year considered:

$$UCR_{FY,y} = \frac{\sum_{FY-y}^{FY} Net\ Sales}{\sum_{FY-y}^{FY} Collections}$$

We then compared the alternative UCRs to the actual UCR under current policy and assessed the implications of differences on NWCF-SM decision making.

2. Net Performance of Wholesale Items

This paper defines net performance as NAVSUP's ability to collect more money per item or service than what was obligated to cover operational costs. NWCF-SM must collect more funds than what was obligated to cover the ongoing operation costs. Items with a positive net performance will have larger net sales than expenditures to support NWCF operations. Items with a negative net performance result from obligations exceeding net sales. Net performance is represented formulaically as a percentage by:

$$Net\ Performance\ (\%) = \frac{Net\ Sales}{Obligations}$$

and as a dollar amount by:

$$Net\ Performance\ (\$) = Net\ Sales - Obligations.$$

Every item managed in NWCF-SM is associated with a category based on how forecastable an item is. Table 5 displays the codes associated with each item based on its demand and likelihood of selling to a customer.

Table 5. NAVSUP Forecasting Codes

	High Sales Value (A)	Moderate Sales Value (B)	Low Sales Value (C)
Forecastable (X)	AX	BX	CX
Non-Forecastable (Z)	AZ	BZ	CZ

Source: NAVSUP, PowerPoint Slides (n.d.).

High sales value, category A, is defined as items that make up about 80% of total sales. Moderate sales value, category B, are items that make up about 15% of total sales and low sales value, category C, are items that make up about 5% of total sales. We investigated how the net performance of each category affected the UCR.

The criteria provided in Chapter 2, specifically Table 4, is used to determine if an asset is forecastable or non-forecastable. Once assets are assigned a category, i.e., AX or AZ, the NWCF-SM team can use it to make procurement decisions. Investing in non-forecastable assets brings risk to the fund because it is not known if or when an asset will be sold to a customer, which can affect the ability to ensure full cost recovery of the fund each FY.

3. Debt Accumulation Analysis

One major concern surrounding the UCR-based assessment of NWCF-SM is the inability to purchase items with a long lead time ahead of customer need because the fund’s ability to obligate for the purchase is driven by the sale of the item in need. If NWCF-SM does not begin the procurement process by obligating funds to acquire the asset in need until a customer purchases it, the UCR will reflect a healthy cost recovery. However, the average lead time for wholesale items managed by NWCF-SM is 1.6 years from order, and the average depot repair cycle time is 1.3 years from order (E. Beall, PowerPoint slides, May 2023). The concern becomes the effect on operational readiness if NWCF-SM is unable to provide an asset to a unit until greater than one year after the initial demand signal.

To assess the potential effects of this structure on the ability to purchase in support of forecasting, we compared total net sales from a given fiscal year, FY, with retail and operating obligations from the same FY plus wholesale obligations from two fiscal years in the future, FY+2. The analysis used retail obligations from the same FY because retail assets are typically filled within the same fiscal year, and therefore are not subject to the two-year lead time. This comparison approximates the effects of NWCF-SM buying ahead of customer demands and the resulting debt or surplus from each year. We assumed in this analysis that NWCF-SM incurs no additional holding costs on inventory because their purchases are assumed to be perfectly forecasted, therefore items purchased in advance of demand are sold immediately. We also calculated the resulting UCR under this simulation if all obligations were made and compared it to the FY's reported UCR under the current system.

4. Effects of Performance Based Logistics

PBLs provide flexibility to the NWCF-SM managers; however, if these contracts do not provide a sufficient cost recovery, it could have significant impacts to the UCR. The UCR would be disrupted by including a non-cost recovering factor in the equation.

This analysis assessed the impact of including PBLs in the UCR. We calculated the net performance of PBLs by FY to assess if the contracts lend themselves to full cost recovery of the NWCF. Additionally, we compared the UCR with PBLs included to the UCR without PBLs to analyze the impacts.

C. ASSUMPTIONS

For the purposes of this analysis, we assume the following conditions regarding the data and NWCF-SM's associated policies:

- No obligations, collections, or net sales made outside the six BPs listed in Table 1 (BP21, BP28, BP34, BP81, BP85, and BP91) are included in any UCR calculation. This limits the data considered strictly to core NWCF-SM transactions and does not consider any capital improvement or investment transactions.

- The financial data for FY15 through FY22 is sufficiently representative of a normal eight-year span of operations.
- No additional costs to NWCF-SM are incurred resulting from changes suggested in the following analyses.
- The forecasting data set includes all managed NIINs that are non-PBL NIINs.
- The cost recovery to support NWCF-SM full cost recovery is, on average, 15 cents per obligated dollar, or 115% in terms of net performance, or 0.15 cost recovery rate.

D. LIMITATIONS

The data used for this analysis represents behaviors under the current mode of operating for NWCF-SM. Using this historical data while imposing a different set of constraints from which the data was generated implies there would be no change in management or decision-making regarding obligations and sales.

The net sales figure is the point-in-time estimate prior to additional actions taken by the fleet (i.e., cancellations or change carcass charge), and collections represent the end state. The analysis for PBLs and net performance uses collections data instead of net sales; however, the difference between these values would likely be negligible.

While the following analysis assumes that the financial data is representative of a normal eight-year span of operations within NWCF-SM, we recognize that financial activities were likely affected during the COVID-19 pandemic. The analysis utilizes FY20 and FY21 data with the understanding that they may represent a larger than normal change to the average financial activity but that these changes are important to capture given the nature of defense-related activities, to which sharp changes in operational behavior are not unusual.

This paper does not consider inflation separately from activity variance for analysis spanning multiple years. All dollar figures are represented as nominal amounts for the year in which it was generated.

This paper takes a financial management viewpoint. The analysis does not consider all supply chain or cost recovery factors that can impact financial performance. Recommendations for policy change and future research made in this paper are made from a financial management perspective only.

IV. ANALYSIS

This chapter summarizes the current NWCF-SM management system and operating results between FY15 and FY22. It then examines four areas of the current process and their effects on the UCR. These areas are the UCR formula itself, the net performance of forecastable and non-forecastable items, the accumulation of system debt in the form of unfilled customer orders, and the management of PBLs and their associated cost recovery.

A. NWCF-SM PERFORMANCE FROM FY15 THROUGH FY22

This section analyzes the historic performance of the NWCF-SM. The NWCF-SM must adhere to a UCR of 1.0, which is intended to ensure solvency in each FY. In a perfect scenario, obligations should exactly match net sales at the end of each FY; however, this is difficult to achieve for a variety of reasons, including changes in demand from customers, supply chain delays, or the challenge of forecasting obligations and sales for current and following FYs before they occur.

1. Obligations and Net Sales

Obligations and net sales are broken down by transaction category. “Retail” represents BP21 and BP28 transactions, “Wholesale” represents BP34, BP81, and BP85 transactions, and “Operations” represents BP91 transactions. Table 6 summarizes NWCF-SM obligations from FY15 to FY22. Table 7 summarizes net sales from FY15 to FY22.

Table 6. FY15–FY22 Obligations (in Millions)

	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	Total
Retail	\$ 746.33	\$ 776.17	\$ 781.47	\$ 857.53	\$ 864.52	\$ 982.02	\$ 987.95	\$1,017.85	\$ 8,220.13
Wholesale	\$4,360.35	\$5,344.60	\$5,771.04	\$6,872.70	\$6,914.21	\$5,721.08	\$5,320.76	\$5,792.97	\$53,489.76
Operations	\$1,155.41	\$1,212.52	\$1,246.09	\$1,294.21	\$1,303.64	\$1,092.51	\$1,130.80	\$1,193.49	\$10,989.48
Total	\$6,262.09	\$7,333.28	\$7,798.61	\$9,024.45	\$9,082.38	\$7,795.62	\$7,439.51	\$8,004.31	\$72,699.37

Adapted from NDP Data.

Table 7. FY15–FY22 Net Sales (in Millions)

	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	Total
Retail	\$ 783.84	\$ 834.29	\$ 861.26	\$ 854.58	\$ 895.44	\$1,019.78	\$1,013.17	\$1,045.78	\$ 7,308.15
Wholesale	\$5,241.28	\$5,580.46	\$5,810.24	\$5,917.37	\$6,185.30	\$6,425.72	\$6,834.88	\$7,094.30	\$49,089.55
Operations	\$ 380.06	\$ 404.90	\$ 407.32	\$ 412.33	\$ 422.08	\$ 132.51	\$ 109.65	\$ 109.95	\$ 2,378.81
Total	\$6,405.18	\$6,819.65	\$7,078.83	\$7,184.28	\$7,502.83	\$7,578.01	\$7,957.71	\$8,250.03	\$58,776.51

Adapted from NDP Data.

2. UCR

NWCF-SM achieved a UCR less than 1.0 when net sales exceeded obligations, as shown in FY15, FY21, and FY22. Table 8 displays the UCR of each transaction category within the NWCF-SM between FY15 and FY22. Operations have a high UCR since it generally is not cost recovering, which leaves retail and wholesale to recover the costs associated with operations. When retail or wholesale exceeds the 1.0 UCR, it further strains the ability to recover costs. It should be noted that these ratios do not evenly affect the total UCR, as the wholesale operation encompassed the majority of the net sales and obligations.

Table 8. FY15–FY22 UCR by BP Subcategory

	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	Total
UCR (Total)	0.978	1.075	1.102	1.256	1.211	1.029	0.935	0.970	1.237
UCR (Retail)	0.952	0.930	0.907	1.003	0.965	0.963	0.975	0.973	1.125
UCR (Wholesale)	0.832	0.958	0.993	1.161	1.118	0.890	0.778	0.817	1.090
UCR (Operations)	3.040	2.995	3.059	3.139	3.089	8.245	10.313	10.855	4.620

Adapted from NDP Data.

3. Recovery Rates

The retail and wholesale operations must recover enough funds to offset operations costs to achieve full cost recovery. The wholesale operation takes on most of the burden of recovering costs for the NWCF since it accounts for a majority of the obligations and net sales. Chapter II.A.5 outlines the methods used for cost recovery. The NWCF-SM must set recovery rates each year for their managed items with the goal of

full cost recovery. As NWCF-SM sets rates, they must rely on projected sales to customers, projected obligations and projected operations costs while also considering their customers' limited resources.

Table 9 displays the required and actual cost recovery rates. The required recovery rate is the summation of the retail and wholesale obligations divided by net operations costs (the difference between BP91 obligations and net sales). This rate reflects the average collection per dollar that the NWCF-SM would have had to achieve that year to offset operations costs. The actual recovery rate takes the summation of the retail and wholesale net sales divided by the obligations (in Table 9, one is subtracted from the rate to compare the data). This rate is the rate that was achieved by the NWCF-SM retail and operations transactions for the given FY.

For example, in FY15 the required recovery rate was 15 cents per dollar obligated. The actual recovery rate for FY15 was 18 cents per dollar obligated, resulting in a positive net performance that year. During FY15 NAVSUP-SM set cost recovery rates that enabled full cost recovery. However, the NWCF lost nine cents for each dollar obligated over the eight-year period.

Table 9. FY15–22 Required and Actual Cost Recovery Rates

	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	Total
Required Recovery Rate	0.15	0.13	0.13	0.11	0.11	0.14	0.16	0.16	0.14
Actual Recovery Rate	0.18	0.05	0.02	-0.12	-0.09	0.11	0.24	0.20	-0.09
Delta	0.03	-0.08	-0.11	-0.24	-0.20	-0.03	0.08	0.04	-0.23

Adapted from NDP Data.

B. FISCAL YEAR CONSTRAINTS ON THE UCR FORMULA

The purpose of the UCR as a diagnostic metric is to indicate if the fund is recovering its costs effectively over time. Utilizing the UCR as a single-FY metric accurately represents NWCF-SM's performance in this regard over the fiscal year in question. However, the NWCF is a revolving fund that supports continuous operations across fiscal years, and the UCR does not account for activity trends outside one fiscal

year. In this analysis, we modified the UCR equation to include prior fiscal year operating results and assessed its effects on the UCR’s behavior over time. We included prior fiscal years in this modified calculation because it potentially allows increased decision-making flexibility within a given fiscal year by considering prior year operating results.

(1) Multiple Year Alternatives to the UCR Formula

Alternative UCRs that consider previous fiscal years are calculated in Table 10. The row titled, “UCR (1FY Considered)” represents the UCR currently utilized by NWCF-SM. Each subsequent row represents a UCR that takes an additional previous fiscal year into account. For instance, the cell intersecting the row labeled “UCR (2FY Considered)” and the column labeled “FY16” takes the sum of obligations for FY15 and FY16 and divides it by the sum of net sales for FY15 and FY16.

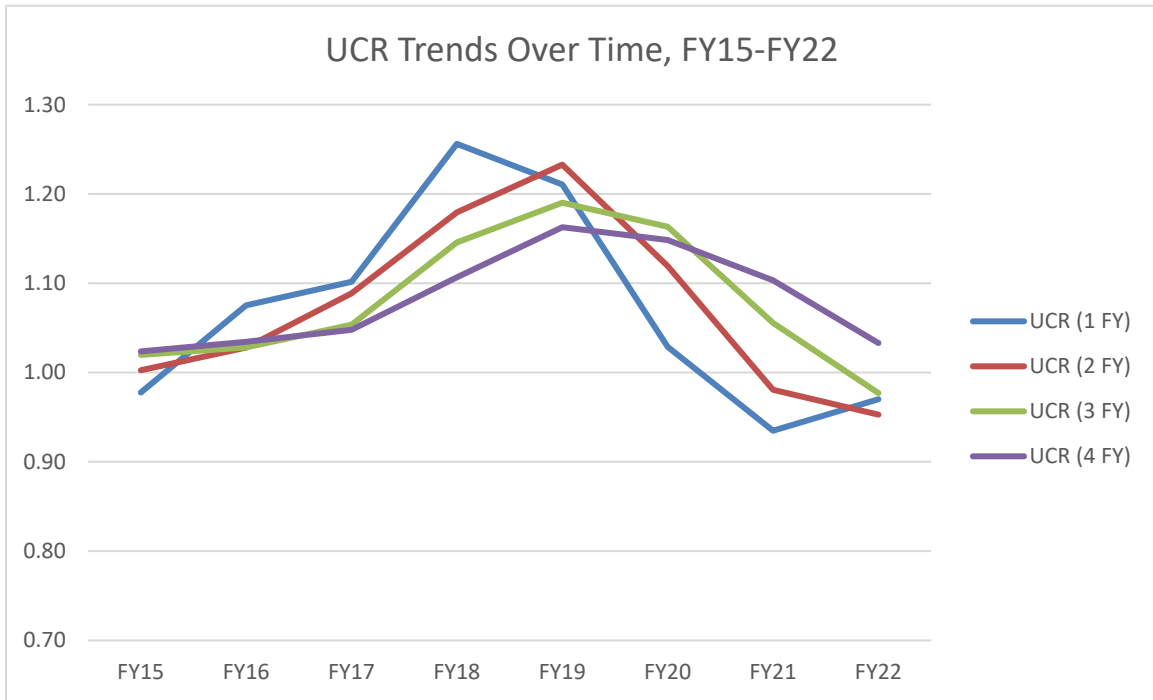
Table 10. UCRs Considering One, Two, Three, and Four Previous FYs of Obligation and Net Sales, FY15 through FY22

	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22
Total Obligations (Millions)	\$6,262.09	\$7,333.28	\$7,798.61	\$9,024.45	\$9,082.38	\$7,795.62	\$7,439.51	\$8,004.31
Total Net Sales (Millions)	\$6,405.18	\$6,819.65	\$7,078.83	\$7,184.28	\$7,502.83	\$7,578.01	\$7,957.71	\$8,250.03
UCR (1FY Considered)	0.978	1.075	1.102	1.256	1.211	1.029	0.935	0.970
UCR (2FY Considered)	1.002	1.028	1.089	1.179	1.233	1.119	0.981	0.953
UCR (3FY Considered)	1.020	1.028	1.054	1.146	1.190	1.163	1.056	0.977
UCR (4FY Considered)	1.024	1.034	1.048	1.107	1.163	1.148	1.103	1.033

Adapted from NDP Data.

A graphical representation of the data in Table 10 is shown in Figure 5. The data set contains several consecutive years where obligations exceeded net sales, initially at an increasing rate between FY16 and FY18, then at a decreasing rate between FY18 and FY20. Expanding the number of fiscal years considered reduced the variation from year

to year of the alternative UCRs compared to the default UCR. This moderating effect was present in periods of both increasing and decreasing UCR. As we included more fiscal years in the calculation of alternative UCRs, the more pronounced this moderating effect became.



Adapted from NDP Data.

Figure 5. Trends over Time of UCRs Considering One, Two, Three, and Four Previous FYs of Obligation and Net Sales, FY15 through FY22

Changing the formula of the UCR itself to include multiple prior fiscal years is the most direct modification to the current assessment system this thesis considered. Expanding the UCR formula to include prior fiscal years reduces the year-to-year variation of the metric to single-year aberrations, making it a more stable metric over time. Table 11 shows the year-over-year point change of the status quo UCR compared to the year-over-year point change of the alternative UCRs.

Table 11. Absolute Value Point Change in UCR Year-over-Year

	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	6-FY Avg.
UCR (1FY Considered)	0.978	1.075	1.102	1.256	1.211	1.029	0.935	0.970	
Pt. Change YoY	-	0.098	0.026	0.154	0.046	0.182	0.094	0.035	0.091
UCR (2FY Considered)	1.002	1.028	1.089	1.179	1.233	1.119	0.981	0.953	
Pt. Change YoY	-	0.026	0.061	0.091	0.053	0.114	0.139	0.028	0.073
UCR (3FY Considered)	1.020	1.028	1.054	1.146	1.190	1.163	1.056	0.977	
Pt. Change YoY	-	0.008	0.026	0.092	0.044	0.027	0.108	0.078	0.055
UCR (4FY Considered)	1.024	1.034	1.048	1.107	1.163	1.148	1.103	1.033	
Pt. Change YoY	-	0.011	0.013	0.059	0.056	0.014	0.045	0.070	0.038

Adapted from NDP Data.

Over these six fiscal years in the data set, considering additional fiscal years in the UCR calculation resulted in a lower average year-over-year change in UCR. Less variation results in smaller upward changes associated with single-year deficits between obligations and net sales as well as smaller downward changes associated with single-year surpluses. We saw the reduction in upward changes most clearly between FY16 and FY18, while the reduction in downward changes is most clear between FY19 and FY21.

A potential advantage to incorporating prior fiscal years into the UCR is that it introduces the flexibility to obligate in advance of sales while maintaining accountability for solvency. Following years where net sales exceed obligations, an extended FY UCR would allow for higher obligation rates to support forecasted buys without penalizing NWCF-SM for exceeding 1.0 UCR in a single FY. However, following multi-year periods where obligations exceed net sales, more aggressive or prolonged financial restraint is required to lower the UCR back to the 1.0 level.

This modification to the UCR formula does not affect the actual OA levels granted to NWCF-SM, nor does it change the timing of or rate at which NWCF-SM makes collections or expenditures. Expanding the UCR to include prior fiscal years only seeks to add recent historical context to the metric and, therefore, avoid discouraging decision makers from responsibly purchasing items in support of future needs.

C. NET PERFORMANCE OF WHOLESALE ITEMS

The NWCF-SM team must offset operations costs by selling assets at a price that is greater than the total material cost. NWCF-SM recovers a large majority of the cost by marking up assets sold to customers. The NWCF-SM Wholesale operation (consisting of BP-34, BP-81, and BP-85) encompasses about 74% of the total obligations between FY15 and FY22. Assets are classified into two overarching categories: forecastable (denoted by “X”) and non-forecastable (denoted by “Z”). Net performance clearly shows which categories result in more net sales than obligations or vice versa. A positive net performance is greater than 100%, which indicates the category is collecting at least one dollar for every dollar obligated. A negative net performance is below 100%, indicating that the category of items collects less than one dollar for every dollar obligated. Table 12 shows that the forecastable categories, AX, BX and CX, all result in a positive net performance, while two of the three non-forecastable categories, AZ, BZ, and CZ, resulted in a negative net performance over eight years.

Table 12. Net Performance of Managed Items from FY15–FY22 (in Millions)

	Collections	Obligations	Net Performance (%)	Net Performance (\$)
AX	\$ 19,265.05	\$ 16,588.68	116%	\$ 2,676.37
BX	\$ 3,962.84	\$ 3,581.86	111%	\$ 380.98
CX	\$ 1,021.50	\$ 964.89	106%	\$ 56.62
AZ	\$ 2,406.01	\$ 3,274.18	73%	\$ (868.17)
BZ	\$ 1,661.78	\$ 1,583.75	105%	\$ 78.03
CZ	\$ 2,457.91	\$ 2,621.35	94%	\$ (163.44)
Total Forecastable	\$ 24,249.39	\$ 21,135.42	115%	\$ 3,113.97
Total Non-forecastable	\$ 6,525.70	\$ 7,479.28	87%	\$ (953.58)
Grand Total	\$ 30,775.09	\$ 28,614.70	108%	\$ 2,160.39

Adapted from NDP Data.

A positive net performance is critical to maintaining solvency as NWCF-SM strives to cover operations costs. On average, the NWCF-SM would need to achieve a 114% net performance between FY15 and FY22 for sales to offset obligations. Over the period, the forecastable items averaged a net performance of 115%, which would be

sufficient to offset the costs of operations. However, the non-forecastable items resulted in a net performance of 87%.

1. Non-Forecastable Analysis

This analysis focused on the non-forecastable categories because they contain categories with a negative net performance which do not enable full cost recovery of the NWCF. Although non-forecastable items make up only about 26% of the total obligations in FY15-FY22, they resulted in a -\$953.58 million net performance during this period, reducing the overall net performance of the NWCF-SM by 30.6%.

Table 13 provides a breakdown of the net performance in both percentages and dollars from FY15 to FY22. Category AZ had the most significant negative net performance during this time. There were years where the AZ category collected more than it obligated; however, large negative years minimized these positive years. The overall net performance during the period was 73%, which equates to collecting 73 cents for every obligated dollar. Category AZ obligated \$868 million more than what it collected over the eight-year period.

Category BZ did have a positive net performance over the period; however, with a net performance of 105%, category BZ only recovered \$1.05 for every dollar obligated. Category BZ was able to recover a cost of about \$78 million. The impact of the BZ category is not as significant as AZ or CZ since it only consists of about 20% of the total non-forecastable obligations. Like the AZ category, BZ had years where net performance was positive and provided cost recovery; however, the positive years were muted by years with negative net performance.

Category CZ made up about 35% of the total obligations during the period, while accounting for only 5% of total sales, and resulted in a net performance of 94% or -\$163 million. On average, the CZ category lost six cents for every dollar that it obligated. The CZ category did have two years of positive net performance; however, these years did not offset the significant negative net performance years.

Table 13. Non-Forecastable Collections and Obligations (in Millions)

AZ				
	Collections	Obligations	Net Performance (%)	Net Performance (\$)
FY15	\$ 170.30	\$ 249.23	68.3%	\$ (78.93)
FY16	\$ 200.73	\$ 570.23	35.2%	\$ (369.50)
FY17	\$ 231.08	\$ 296.40	78.0%	\$ (65.33)
FY18	\$ 258.44	\$ 401.62	64.3%	\$ (143.19)
FY19	\$ 360.79	\$ 936.42	38.5%	\$ (575.63)
FY20	\$ 347.06	\$ 176.99	196.1%	\$ 170.07
FY21	\$ 423.32	\$ 88.59	477.8%	\$ 334.73
FY22	\$ 414.30	\$ 554.71	74.7%	\$ (140.41)
Total	\$ 2,406.01	\$ 3,274.18	73.5%	\$ (868.17)

BZ				
	Collections	Obligations	Net Performance (%)	Net Performance (\$)
FY15	\$ 172.41	\$ 150.77	114.4%	\$ 21.64
FY16	\$ 205.12	\$ 243.52	84.2%	\$ (38.39)
FY17	\$ 208.07	\$ 210.07	99.0%	\$ (2.01)
FY18	\$ 201.29	\$ 249.69	80.6%	\$ (48.40)
FY19	\$ 240.97	\$ 255.17	94.4%	\$ (14.21)
FY20	\$ 209.18	\$ 157.07	133.2%	\$ 52.10
FY21	\$ 213.25	\$ 108.76	196.1%	\$ 104.49
FY22	\$ 211.50	\$ 208.70	101.3%	\$ 2.79
Total	\$ 1,661.78	\$ 1,583.75	104.9%	\$ 78.03

CZ				
	Collections	Obligations	Net Performance (%)	Net Performance (\$)
FY15	\$ 537.64	\$ 305.52	176.0%	\$ 232.12
FY16	\$ 532.62	\$ 536.02	99.4%	\$ (3.40)
FY17	\$ 447.28	\$ 388.79	115.0%	\$ 58.48
FY18	\$ 333.84	\$ 366.15	91.2%	\$ (32.32)
FY19	\$ 176.55	\$ 212.40	83.1%	\$ (35.85)
FY20	\$ 142.46	\$ 168.42	84.6%	\$ (25.96)
FY21	\$ 142.49	\$ 151.19	94.2%	\$ (8.71)
FY22	\$ 145.03	\$ 492.85	29.4%	\$ (347.82)
Total	\$ 2,457.91	\$ 2,621.35	93.8%	\$ (163.44)
Grand Total	\$ 6,525.70	\$ 7,479.28	87.3%	\$ (953.58)

Adapted from NDP Data.

Overall, the items that make up the non-forecastable categories did not result in the necessary cost recovery to enable flexibility and ensure solvency. A reduction in obligations in these categories can significantly increase net performance, resulting in OA that NWCF-SM can use to procure emergent or consistent customer demands.

2. Reduction of Non-Forecastable Obligations

The purpose of this section is to demonstrate how more targeted obligations can result in additional OA that NWCF-SM can use for higher priority demands. A reduction in obligations could affect the ability to quickly provide customer demands; however, the historical negative net performance of non-forecastable items implies that assets that were procured were not sold to customers. In addition, some non-forecastable items could consist of critical items that must be held on hand although they may not result in a near-term sale. We selected a reduction in non-forecastable obligations in the AZ and CZ categories to bring total net performance to 100% for this analysis to establish a feasible range of options for NWCF-SM decision makers to reduce obligations in these categories. We did not modify the BZ category because its operations have already achieved a net performance greater than 100%. Setting the net performance of the AZ and CZ categories to 100% demonstrates how recovering total asset costs can increase overall performance.

In Table 14, we reduced the obligations to the average net performance percentage of the AZ and CZ categories in Table 13. For instance, between FY15 and FY22, the AZ category averaged a net performance of 73.5%, therefore, we reduced each annual obligation total in Table 14 to 73.5% of its original value. A uniform reduction across all fiscal years demonstrates both the annual and overall impacts to gaining a net performance of 100% in each category. The “Delta” in Table 14 displays the difference in millions of dollars between the original net performance and the calculated net performance with the reduction.

Table 14. Net Performance of Non-Forecastable Categories with Reductions in Obligations to Break Even Between FY 15 and FY22 (in Millions)

AZ (Obligations Reduced to 73.5% of Actual)					
	Collections	Obligations	Net Performance (%)	Net Performance (\$)	Delta
FY15	\$ 170.30	\$ 183.14	93%	\$ (12.84)	\$ 66.08
FY16	\$ 200.73	\$ 419.03	48%	\$ (218.30)	\$ 151.20
FY17	\$ 231.08	\$ 217.81	106%	\$ 13.27	\$ 78.59
FY18	\$ 258.44	\$ 295.13	88%	\$ (36.69)	\$ 106.49
FY19	\$ 360.79	\$ 688.12	52%	\$ (327.33)	\$ 248.30
FY20	\$ 347.06	\$ 130.06	267%	\$ 217.00	\$ 46.93
FY21	\$ 423.32	\$ 65.10	650%	\$ 358.22	\$ 23.49
FY22	\$ 414.30	\$ 407.62	102%	\$ 6.68	\$ 147.08
Total	\$ 2,406.01	\$ 2,406.01	100%	\$ -	\$ 868.17

BZ (No Change to Operations)					
	Collections	Obligations	Net Performance (%)	Net Performance (\$)	Delta
FY15	\$ 172.41	\$ 150.77	114%	\$ 21.64	\$ -
FY16	\$ 205.12	\$ 243.52	84%	\$ (38.39)	\$ -
FY17	\$ 208.07	\$ 210.07	99%	\$ (2.01)	\$ -
FY18	\$ 201.29	\$ 249.69	81%	\$ (48.40)	\$ -
FY19	\$ 240.97	\$ 255.17	94%	\$ (14.21)	\$ -
FY20	\$ 209.18	\$ 157.07	133%	\$ 52.10	\$ -
FY21	\$ 213.25	\$ 108.76	196%	\$ 104.49	\$ -
FY22	\$ 211.50	\$ 208.70	101%	\$ 2.79	\$ -
Total	\$ 1,661.78	\$ 1,583.75	105%	\$ 78.03	\$ -

CZ (Obligations Reduced to 93.8% of Actual)					
	Collections	Obligations	Net Performance (%)	Net Performance (\$)	Delta
FY15	\$ 537.64	\$ 286.47	188%	\$ 251.17	\$ 19.05
FY16	\$ 532.62	\$ 502.60	106%	\$ 30.02	\$ 33.42
FY17	\$ 447.28	\$ 364.55	123%	\$ 82.73	\$ 24.24
FY18	\$ 333.84	\$ 343.32	97%	\$ (9.49)	\$ 22.83
FY19	\$ 176.55	\$ 199.16	89%	\$ (22.61)	\$ 13.24
FY20	\$ 142.46	\$ 157.92	90%	\$ (15.46)	\$ 10.50
FY21	\$ 142.49	\$ 141.77	101%	\$ 0.72	\$ 9.43
FY22	\$ 145.03	\$ 462.12	31%	\$ (317.09)	\$ 30.73
Total	\$ 2,457.91	\$ 2,457.91	100%	\$ -	\$ 163.44

Grand Total	\$ 6,525.70	\$ 6,447.67	101%	\$ 78.03	\$ 1,031.61
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Adapted from NDP Data.

Setting the net performance of the negative net performance categories, AZ and CZ, to 100% indicates how much additional available OA could have been executed. The percentage of reduction in OA provides a trade space during the period, or a percentage that can range from zero to the maximum percentage to achieve 100% net performance. The trade space provides a targeted range of reductions to obligations that decision makers can use to optimize OA. A more targeted approach to historic obligations in the non-forecastable categories would have resulted in a trade space of 26.5% in the AZ category or up to \$868.17 million in available OA, and a trade space of 6.2% in the CZ category or up to \$163.44 million in available OA. As shown in Table 15, this targeted approach would have resulted in bringing the total net performance from 108% to 112%, which is only 2% off the target of 114% for full cost recovery between FY15 and FY22.

Table 15. Net Performance of Managed Items from FY15–FY22 Reflecting Reductions to AZ and CZ Obligations (in Millions)

	Collections	Obligations	Net Performance (%)	Net Performance (\$)
AX	\$ 19,265.05	\$ 16,588.68	116%	\$ 2,676.37
BX	\$ 3,962.84	\$ 3,581.86	111%	\$ 380.98
CX	\$ 1,021.50	\$ 964.89	106%	\$ 56.62
AZ	\$ 2,406.01	\$ 2,406.01	100%	\$ (0.00)
BZ	\$ 1,661.78	\$ 1,583.75	105%	\$ 78.03
CZ	\$ 2,457.91	\$ 2,457.91	100%	\$ (0.00)
Total Forecastable	\$ 24,249.39	\$ 21,135.42	115%	\$ 3,113.97
Total Non-forecastable	\$ 6,525.70	\$ 6,447.67	101%	\$ 78.03
Grand Total	\$ 30,775.09	\$ 27,583.09	112%	\$ 3,191.99

Adapted from NDP Data.

3. Impact on UCR

The wholesale operation is the leading factor in maintaining the 1.0 UCR ratio since it encompasses around 75% of the total obligations and is the area where cost recovery rates can be set. Overall, the non-forecastable categories are recovering 92 cents for every dollar obligated as compared to a required recovery rate of \$1.14 over the assessed period. The negative net performance associated with both categories AZ and CZ apply the restrictive nature of the UCR because other areas of the wholesale

operation must recover these costs in addition to operations costs, which forces NWCF-SM management to forego procurements of future needs or higher priority requirements.

D. BACKLOG ACCUMULATION ANALYSIS

The current system compares current FY obligations to current FY net sales and does not consider lead times for wholesale requirements. This practice is well suited to ensure solvency but does not readily allow NWCF-SM to purchase forecasted requirements to support future customer needs. The analysis in this section considers net sales for a given fiscal year compared to wholesale obligations for the second following fiscal year because if NWCF-SM were to purchase customer wholesale demands with the proper lead time to support the requirement, the obligation would need to be made two fiscal years ahead of the demand to account for the average lead time of a wholesale requirement. By considering a given fiscal year's net sales, retail obligations, and operating obligations together with these future wholesale obligations, we can simulate how effectively current practices would support future customer demands.

1. Backlog Accumulation from Buying Ahead of Requirements

To calculate the level at which net sales NWCF-SM can use to support obligations, we used net sales from a given fiscal year and compared it to a new combination of obligations. The obligation number used for a given fiscal year is retail and operating obligations for the given fiscal year plus wholesale obligations from the second following fiscal year. For instance, the calculation for FY15 used net sales, retail obligations and operating obligations for FY15 and wholesale obligations for FY17 to account for the estimated 1.6-year lead time for NAVSUP-managed NIINs. We use wholesale obligations for two fiscal years in the future of the considered fiscal year because it most accurately represents what demands would need to be bought ahead of demand to accommodate the average lead time for wholesale items. Using the example above, NWCF-SM would need to obligate in FY15 for items that would sell in FY17. We calculated a surplus or deficit by subtracting total obligations as described above from net sales. Table 16 summarizes these calculations.

Table 16. Annual Deficit Resulting from Buying Wholesale Requirements Ahead of Demand, FY15–FY21 (in Millions)

	FY15	FY16	FY17	FY18	FY19	FY20	FY21*
Net Sales, FY	\$ 6,405.18	\$ 6,819.65	\$ 7,078.83	\$ 7,184.28	\$7,502.83	\$7,578.01	\$7,957.71
Total Obligations	\$ 7,672.78	\$ 8,861.39	\$ 8,941.78	\$ 7,872.83	\$7,488.93	\$7,867.51	\$8,415.33
Retail Obligations, FY	\$ 746.33	\$ 776.17	\$ 781.47	\$ 857.53	\$ 864.52	\$ 982.02	\$ 987.95
Operations Obligations, FY	\$ 1,155.41	\$ 1,212.52	\$ 1,246.09	\$ 1,294.21	\$1,303.64	\$1,092.51	\$1,130.80
Wholesale Obligations, FY+2	\$ 5,771.04	\$ 6,872.70	\$ 6,914.21	\$ 5,721.08	\$5,320.76	\$5,792.97	\$6,296.59
Surplus/(Deficit)	\$ (1,267.60)	\$ (2,041.74)	\$ (1,862.95)	\$ (688.55)	\$ 13.91	\$ (289.50)	\$ (457.62)
UCR, Buying Ahead	1.198	-0.299	-0.263	-0.096	0.002	-0.038	-0.058
UCR, Standard	0.978	1.075	1.102	1.256	1.211	1.029	0.935

*FY21 relies on forecasted FY23 obligations.

Adapted from NDP Data.

When simulating wholesale requirements being purchased two years earlier, there is a routine deficit created each year, ranging from \$289.5 million to \$2.04 billion annually. One instance, FY19, resulted in an operating surplus of \$13.9 million. FY19 used FY21 wholesale obligations, which was the second lowest wholesale obligation figure in the data set behind FY15, and the lowest wholesale obligation figure used in this specific analysis.

When these deficits are created, the forecasted need does not disappear. The requirements roll into the next fiscal year, potentially compounding the backlog of requirements. Assuming no deficit was carried forward prior to FY15, the cumulative deficits between FY15 and FY21 suggest a backlog of approximately \$6.6 billion by the beginning of FY22.

2. Impact on UCR

Assuming NWCF-SM obligated funds for all requirements regardless of net sales levels to support, the calculation for UCR is retail obligations and operating costs from the current fiscal year plus wholesale obligations from the second following fiscal year, divided by net sales of the current fiscal year. Table 16 presents this calculated UCR as “UCR, Buying Ahead” and displays the UCR under the current system as “UCR, Standard” for comparison.

Five of the seven fiscal years considered resulted in a higher UCR than the standard calculation, and six of the seven fiscal years resulted in a UCR higher than 1.0. Analysis of the growth rates of obligations and net sales over time suggest growth in wholesale obligation is what drives this increasing effect on UCR. Table 17 summarizes the annual yearly growth in wholesale and retail obligations and net sales.

Table 17. Annual Growth in Wholesale and Retail/Operations Obligations and Net Sales (in Millions)

	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	Avg. Growth
Wholesale Obl.	\$ 4,360.35	\$ 5,344.60	\$ 5,771.04	\$ 6,872.70	\$ 6,914.21	\$ 5,721.08	\$ 5,320.76	\$5,792.97	
Wholesale Growth	-	\$ 984.25	\$ 426.44	\$ 1,101.66	\$ 41.51	\$ (1,193.13)	\$ (400.32)	\$ 472.21	\$ 204.66
Retail/Ops Obl.	\$ 1,901.74	\$ 1,988.69	\$ 2,027.56	\$ 2,151.75	\$ 2,168.17	\$ 2,074.53	\$ 2,118.75	\$2,211.34	
Retail/Ops Growth	-	\$ 86.95	\$ 38.88	\$ 124.18	\$ 16.42	\$ (93.63)	\$ 44.21	\$ 92.59	\$ 44.23
Net Sales	\$ 6,405.18	\$ 6,819.65	\$ 7,078.83	\$ 7,184.28	\$ 7,502.83	\$ 7,578.01	\$ 7,957.71	\$ 8,250.03	
Net Sales Growth	-	\$ 414.46	\$ 259.18	\$ 105.45	\$ 318.55	\$ 75.17	\$ 379.70	\$ 292.32	\$ 263.55

Adapted from NDP Data.

While net sales grew by an average of \$263.5 Million per year between FY15 and FY22, which is nearly \$60 million per year more than the wholesale obligation growth of \$204.6 Million, each given fiscal year's net sales is responsible for offsetting demands two years in the future. As a result, current sales need to account for over \$400 Million in growth over current obligations to sustain future demand. To maintain parity with these future obligations, current net sales would need to increase on average by nearly 14% each year over the period considered. Table 18 details the percentage difference between the total calculated obligations from Table 16 and net sales for each year.

Table 18. Percentage Difference between Obligations in Advance of Demand and Net Sales (in Millions)

	FY15	FY16	FY17	FY18	FY19	FY20	FY21*	Avg. Pct Diff.
Net Sales	\$ 6,405.18	\$ 6,819.65	\$ 7,078.83	\$ 7,184.28	\$ 7,502.83	\$ 7,578.01	\$ 7,957.71	
Obligations	\$ 7,672.78	\$ 8,861.39	\$ 8,941.78	\$ 7,872.83	\$ 7,488.93	\$ 7,867.51	\$ 8,415.33	
Retail Obligations, FY	\$ 746.33	\$ 776.17	\$ 781.47	\$ 857.53	\$ 864.52	\$ 982.02	\$ 987.95	
Operating Obligations, FY	\$ 1,155.41	\$ 1,212.52	\$ 1,246.09	\$ 1,294.21	\$ 1,303.64	\$ 1,092.51	\$ 1,130.80	
Wholesale Obligations, FY+2	\$ 5,771.04	\$ 6,872.70	\$ 6,914.21	\$ 5,721.08	\$ 5,320.76	\$ 5,792.97	\$ 6,296.59	
Pct Diff, Obl. to Net Sales	19.79%	29.94%	26.32%	9.58%	-0.19%	3.82%	5.75%	13.57%

*FY21 relies on forecasted FY23 obligations.

Adapted from NDP Data

To adopt a system that can maintain a UCR of 1.0 or less and adequately purchase wholesale requirements by the lead time required to minimize customer wait time, NWCF-SM would need to raise its prices to recover the additional cost associated with the annual growth in demand.

E. EFFECTS OF PERFORMANCE BASED LOGISTICS

The data in this section focuses on the PBLs within the NWCF-SM wholesale operation. The purpose is to determine if PBL contracts are inherently solvent over time, that is, recovering one dollar for every dollar obligated, and assess if such a factor manipulates the UCR.

PBLs accounted for about a third of the total wholesale obligations between FY15 and FY22, with a net performance of 101.88% or recovering about \$1.02 for every dollar obligated. Table 19 shows the net performance of PBL contracts over time, which results in collections and obligations that are almost equal. There were years of positive cost recovery; however, these were offset by years where obligations outpaced collections.

Table 19. Net Performance of PBLs from FY15–FY22 (in Millions)

	Collections	Obligations	Net Performance (%)	Net Performance (\$)
FY15	\$ 2,036.15	\$ 1,907.37	106.75%	\$ 128.79
FY16	\$ 2,072.10	\$ 1,821.75	113.74%	\$ 250.35
FY17	\$ 2,077.81	\$ 2,161.56	96.13%	\$ (83.76)
FY18	\$ 2,227.40	\$ 1,491.50	149.34%	\$ 735.90
FY19	\$ 2,077.09	\$ 2,416.18	85.97%	\$ (339.10)
FY20	\$ 2,130.56	\$ 2,461.69	86.55%	\$ (331.13)
FY21	\$ 2,370.89	\$ 2,509.77	94.47%	\$ (138.88)
FY22	\$ 2,376.37	\$ 2,278.18	104.31%	\$ 98.19
Grand Total	\$ 17,368.36	\$ 17,048.00	101.88%	\$ 320.36

Adapted from NDP Data

(1) Impact on UCR

PBLs had a wide range of net performances between FY15 and FY22; however, these contracts resulted in recovery of obligations but did not consistently provide full cost recovery to offset operations costs. Table 20 illustrates the effects PBLs had on the UCR, which are irregular from fiscal year to fiscal year but ultimately end up very close to recovering one dollar for every dollar obligated.

Table 20. Comparison of UCR With and Without PBL Collections and Obligations (in Millions)

	UCR	Collections less PBL	Obligations less PBL	UCR Excluding PBL	Delta
FY15	0.978	\$ 4,365.97	\$ 4,354.72	0.997	-0.019
FY16	1.073	\$ 4,762.85	\$ 5,511.53	1.157	-0.084
FY17	1.103	\$ 4,995.28	\$ 5,637.04	1.128	-0.026
FY18	1.261	\$ 4,928.61	\$ 7,532.95	1.528	-0.267
FY19	1.209	\$ 5,437.15	\$ 6,666.20	1.226	-0.017
FY20	1.030	\$ 5,435.53	\$ 5,333.93	0.981	0.049
FY21	0.934	\$ 5,598.16	\$ 4,929.74	0.881	0.053
FY22	0.969	\$ 5,881.16	\$ 5,726.13	0.974	-0.004
Grand Total	1.061	\$ 51,148.07	\$ 55,651.37	1.088	-0.027

Adapted from NDP Data

The resulting UCR from removing PBLs, as shown in Table 20, provides a more proper reflection of the fund performance related to solvency. Over time PBLs contracts appear to be effectively solvent, their irregular performance inflates or deflates the UCR for the fiscal year. Removing PBLs as an unpredictable cost-recovering subset of assets can provide a more accurate recovery rate for the remaining NWCF-SM business activities.

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V. CONCLUSIONS AND RECOMMENDATIONS

This chapter provides conclusions based on our analysis of the NDP data and recommendations for policy changes and future research.

A. CONCLUSIONS

Adhering to the UCR assumes obligations results in sales in the same FY and there is less than one FY lead time for customer demands. This assumption makes it difficult for the NWCF-SM to procure projected future demands; however, the UCR forces solvency within a single FY's operations.

1. UCR and NWCF-SM Solvency

If the only management consideration for NWCF-SM is solvency by the end of each FY, the UCR is an effective metric by which to measure. Based on this analysis, from a financial management standpoint, it would be difficult to adjust the UCR without accepting a level of risk to solvency. However, with a balanced approach leveraging a combination of the recommendations in this chapter, progress toward a more forward-looking financial management of NWCF-SM may be feasible.

2. Smoothing the UCR Over Time and Flexibility

This analysis simulated including prior fiscal year operating data into the UCR calculation to assess its effect on the flexibility and responsiveness of the metric. Increasing the number of fiscal years considered in the UCR does reduce the metric's variation due to single-year aberrations and potentially provides NWCF-SM with some additional spending flexibility regarding the 1.0 UCR requirement. However, NWCF-SM can leverage this flexibility only in periods closely following fiscal years where net sales exceed obligations. For periods following fiscal years where obligations exceed net sales, using an extended UCR increases the restrictiveness of the metric on spending power. To balance the potential benefits with the potential drawbacks, no more than three fiscal years should be considered when revising the UCR in this way.

3. Full Cost Recovery

This analysis looked at the net performance of items by categories. Net performance is directly related to the full cost recovery of the NWCF and is a major driving factor that creates the restrictiveness caused by the UCR. Since this research takes only a financial management viewpoint, other factors, such as urgent unplanned requirements or long lead times, may add to the wholesale operation's inability to fully cost recover each year and were not captured in this analysis.

Non-forecastable items make it extremely hard to achieve full cost recovery. Since the goal of the NWCF is to break even in the long run, the wholesale operations, which made up about three-quarters of the total obligations for the period analyzed, must have a cost recovery rate that recovers funds to offset operation costs. The majority of the non-forecastable category consistently fell below the required cost recovery rate, forcing the other areas of the wholesale operation to recover the cost of operations. The result of having to recover costs of operations in addition to wholesale assets compound the restrictiveness of the UCR and reduce available OA that NWCF-SM could have used to support current or future demands.

4. Offsetting the Cost of Forecasting

Considering a wholesale asset lead time of greater than one year makes it necessary to use current FY sales to finance future obligations up to two years in advance. This analysis demonstrated that under the current UCR system and current cost recovery policies, NWCF-SM cannot support future wholesale requirements. Between FY17 and the forecasted estimates for FY23, wholesale obligations grew by over \$200 million per year on average. This rate of increase translates to net sales needing to grow by nearly 14 percent in each supporting year to sufficiently fund these forecasted buys.

Without this growth in net sales, the difference in requirements that remain unfunded will roll into the next fiscal year, and eventually become realized as a customer order that NWCF-SM cannot fill. This phenomenon negatively affects the material readiness of operational units. However, from a financial management standpoint, the UCR indicates that NWCF-SM is being well-managed. NWCF-SM should consider the

effects of future unfilled customer orders alongside the UCR and balance them appropriately with relevant guidance to ensure they address both needs.

5. Non-cost Recovering Factors

Factors within the UCR that result in a dollar of sales for every dollar obligated artificially inflate or deflate the UCR. The analysis shows that over an eight-year period, PBL contracts recovered almost exactly one dollar for each dollar obligated. Assuming PBL contracts can maintain this performance, removing them from the UCR equation would be beneficial. The resulting UCR can be utilized more effectively by management to inform supply chain posture and promote full cost recovery.

B. RECOMMENDATIONS

As a result of this research, the authors recommend the following actions and further research:

- It is the highest recommendation of the authors that the UCR, its formula, variables, and intent are clearly defined in the highest applicable level of guidance, in either DOD or DON policy. This definition should describe the purpose of the metric and the level of managerial flexibility afforded to individual business area managers regarding meeting metric thresholds.
- Pursue a revision to the UCR to include the present fiscal year plus two prior fiscal years.
- Perform a quarterly review of OA for potential supplementation due to non-forecastable requirements, especially for critical items that do not have an immediate intent of sales. OA can be increased to offset the unplanned requirements, which could provide more flexibility for NWCF-SM; however, additional cost recovery measures would need to be implemented.

- Review cost recovery efforts for PBLs. If PBL contracts are intended to recover costs the same as other wholesale items, they should have a higher net performance.
- Review any other factors that result in a one-dollar collection per one-dollar obligation, such as DLA retail operations. If elements are meant to be self-sustaining and do not collect additional funds that lead to full cost recovery of the NWCF, they should not be considered within the UCR since these factors are inherently solvent over time.
- Recommend additional research on the concept of long-term solvency vs. short-term solvency and explore additional factors, such as lead times or product turnaround time, impacts to NWCF financial health.
- Explore opportunities to encompass non-forecastable items in PBLs to minimize risk to the NWCF.

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