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Maximizing Resources through Secondary Reparable (SECREP) Residual Demand Management

December 2019

Maj Alexander Mora, USMC

Thesis Advisors: Dr. Kenneth H Doerr, Associate Professor
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Graduate School of Defense Management

Naval Postgraduate School

Prepared for the Naval Postgraduate School, Monterey, CA 93943.

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ABSTRACT

This research analyzed the practices associated with maintaining a safety stock of secondary reparables (SECREP) to meet United States Marine Corps (USMC) demand. This research found evidence of accelerated spending on SECREPs in the fourth quarter, but no evidence that increased spending improved readiness. Currently, USMC bases its annual SECREP requirement on execution data (expenditures) from previous years, rather than actual demand. We conclude that the RIPs should use actual demand data to estimate future demand, and review back-order lead time and priority codes relative to stock allowance to ensure SECREP items purchased are actually needed to improve readiness.

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ABOUT THE AUTHOR

Major Alexander Mora enlisted in the Marine Corps in August 1999, and attended recruit training at MCRD Parris Island, South Carolina. After graduation in November 1999, Private First Class Mora attended Marine Combat Training at Camp Geiger, North Carolina, and subsequently reported to Fort Leonardwood, Missouri where he received the Motor Vehicle Operator Military Occupational Specialty (MOS). Upon completion of MOS school in March 2000, he reported to Marine Wing Support Squadron (MWSS) 172, Marine Wing Support Group (MWSG) 17 in Okinawa Japan. In May 2001, Corporal Mora reported to Headquarters Battalion and the Marine Corps Warfighting Laboratory, Marine Corps Base Quantico Virginia.

In August 2005, Sergeant Mora reported to the Broadening Opportunity for Officer Selection and Training Program (BOOST). After completing BOOST in May 2006, Sergeant Mora reported to the College of the Holy Cross Consortium to participate in the Marine Enlisted Commission Education Program and to attend Worcester State University. Staff Sergeant Mora attended Officer Candidate School during the second increment of summer 2007. In June 2008, after graduating and receiving his commission to Second Lieutenant he reported to The Basic School and subsequently reported to Courthouse Bay, Camp Lejeune, North Carolina where he earned the Combat Engineer MOS.

His first tour of duty as an officer was MWSS 171, MWSG 17/Marine Aircraft Group 12 in Iwakuni, Japan where he served as Platoon Commander, Company Executive Officer, Company Commander and Assistant Operations Officer. During this tour, he led three Civic Action Programs where he supervised and managed the construction of schoolhouses in Indonesia, Philippines and Bangladesh. He also participated in two Humanitarian Assistance and Disaster Relief operations to include Operation Tomodachi after the March 2011 earthquake and subsequent tsunamis in Japan.

After completing his tour in Iwakuni Japan, Captain Mora reported to Expeditionary Warfare School (EWS) in Quantico, Virginia. After EWS, he reported to 1st Combat Engineer Battalion, 1st Marine Division and took command of Mobility

Assault Company from June 2013 to June 2014. During this company command tour, Captain Mora deployed to Helmand Province, Afghanistan in support of Operation Enduring Freedom (OEF) 13.2-14.1. During this deployment, Captain Mora led his company as they provided over 12,000 kilometers of assured mobility to all units within Regional Command Southwest. Upon returning from OEF 13.2-14.1, Captain Mora took command of Engineer Support Company which was responsible for providing motor transport and engineer support to units within 1st Marine Division. In April 2015, Captain Mora was selected to be the 1st Marine Division Staff Secretary where he served until May 2016. In June 2016 he reported to Washington D.C. where he served as the Secretary of the Navy's White House Liaison Officer. On 1 July 2018, Major Mora was promoted to his current rank and subsequently reported to the Naval Post Graduate School in Monterey, California. Major Mora's next tour of duty is at Programs and Resource, Headquarters Marine Corps, Washington D.C.

Major Mora holds a Bachelors of Arts in History from Worcester State University, a Masters of Arts in Leadership Studies from Marshall University, and a Masters of Science in Defense Systems Analysis from the Naval Post Graduate School. He is married to the former Adela Marquez and has two children; Aleksa and Eisen.

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LIST OF ACRONYMS AND ABBREVIATIONS

CAL	Consolidated Asset Listing
CLS	Contractor Logistics Support
DAB	Daily Account Balance
DASF	Due In and Status File
DoD	Department of Defense
EGEM	Enterprise Ground Equipment Management
EOFY	End of Fiscal Year
FLMMP	Field-Level Maintenance Management Policy
GAMS	General Algebraic Modeling System
GAO	Government Accountability Office
GCSS-MC	Global Combat Support System—Marine Corps
HQMC, I&L	Headquarters Marine Corps, Installations and Logistics
LOGCOM	Marine Corps Logistics Command
LSMC	Logistics Support Management Center
IMA	Intermediate Maintenance Activity
MARES	Marine Corps Automated Readiness Evaluation System
MCO	Marine Corps Order
MEF	Marine Expeditionary Force
MOS	Military Occupational Specialty
MRP	Materiel Returns Program
NIIN	National Item Identification Number
NSN	National Stock Number
RIP	Reparable Issue Point
ROME	Repair Optimization Materiel Evaluator
SECREP	Secondary Reparable Component or Subcomponent
TEEP	Training Effectiveness Evaluation Plan
USMC	United States Marine Corps

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EXECUTIVE SUMMARY

Secondary Reparables are always a topic of discussion among leaders in the United States Marine Corps and in the Department of Defense as a whole. To shed light on the topic, this paper researched the impacts of increased secondary reparable parts purchases at the end of fiscal quarters and the impacts on service levels at Repair Issue Points (RIP). The purchasing of items at the RIP was examined to determine if a "Hockey Stick Phenomenon" exists. The "Hockey Stick Phenomenon" is an increase in demand at the end of the quarter and fiscal year (Bradley & Arntzen, 1999). Hines, Holweg, and Sullivan stated, "The 'Hockey Stick'' syndrome refers to the fact that sales or production levels generally peak towards the end of a measurement period in order to comply with given performance targets" (2000, p. 829).

The conduct of this study shows the RIPs may not be rigorously monitoring their respective purchases at the end-of-year, as the metrics levels remain mainly Within Baseline Range or Unfavorable to Baseline Range in the second quarter of the following year: seemingly unaffected by the end-of-year surge in purchasing. The RIPs should review Back Order Lead Time and priority codes relative to stock allowance to purchase items that are actually needed for maintaining the desired fill rate.

The Hockey Stick Phenomenon occurs in fourth quarter only. It was difficult to tie the phenomenon to performance as there were limited performance data available. Based on the data available, I was unable to find a positive performance impact of the Hockey Stick Phenomenon purchases at any RIP. But each MEF RIP has different procedures, which makes it more difficult to gather data to analyze performance.

I then looked at the "buy list," which is the list of items the RIPs intend to purchase during the Hockey Stick Phenomenon period at the end of the year, and found that several items on that list had long and highly variable back order lead times. The RIP should purchase items with long-enough lead-times to allow leverage of the policy for potential cancellations.

For future research, examining the fill rate allowance and what is needed the most at the RIPs would be worthy of study. Additionally, what ultimately affects the metrics

involves buying items that have a low fill rate, are short compared to their allowance, and are likely to deadline an item. Additionally, during future research, a multicriteria weighting scheme to "rank" the buy list would be crucial.

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I. INTRODUCTION

The United States Marine Corps (USMC) prides itself on being a good steward of the taxpayers' money and ensuring that budget spending is conducted responsibly. Doing more with less is how the USMC operates to facilitate the overall mission of the Department of Defense (DoD). There are many budgetary practices that allow the USMC to save and reallocate funds accordingly. The USMC must continue to improve its financial processes to facilitate the overall mission. Management of the supply chain, if not properly handled, is one of the main areas that can hinder the overall mission of the USMC. The USMC's supply chain has many components that are integral to the overall mission. The Reparable Issue Point (RIP) and Secondary Reparable Components and Subcomponents (SECREPs) are the primary focus of this analysis. This SECREP topic is of importance to the USMC as SECREPs can be costly if not properly managed. Leaders throughout the USMC scrutinize the RIP process and SECREP purchases to provide the necessary funds to maintain a high level of service. Normally, the end of fiscal year (EOFY) purchases should affect only the first quarter and in a limited way the second quarters of a new fiscal year. The RIPs must continue to look at large-scale exercises on the Marine Expeditionary Force Training Exercise and Employment Plan conducted within those quarters and plan purchases to support SECREP requirements during those exercises. Using the EOFY funding to support large-scale exercises will temporarily increase the SECREP excess to responsible officer reporting if done in the above-stated strategy. The responsible officer will have SECREP items available during a training exercise, and SECREPs will be reported as excess for accountability purposes until those particular SECREP items are returned to storage. The RIPs would need to purchase only assets that are on hand and available for release and not buy anything that will go into an automatic back-order position.

A. PURPOSE

Saving money will give the USMC additional leverage when attempting to acquire the necessary capabilities for the warfighters. This research identifies effective practices that will help the USMC realize savings. This research sheds light on the second and third-

order effects caused by increased SECREP purchases at the RIP during the EOFY. The primary research question is as follows:

1. Do increased SECREP parts purchases at the end of fiscal quarters affect service levels at RIPs?

The primary research question is supported by the following secondary questions:

1. Are large SECREP purchases at the end of quarters validated (or justified) by usage data?
2. Will researching operating units and their respective usage of SECREPs validate purchases before major exercises?
3. How long do parts sit on the shelf before they are used?
4. What is the safety stock at each or more than one RIP?

These research questions assist in identifying best practices for SECREP purchases.

B. SCOPE OF WORK

The scope of work for this research includes undertaking an empirical study of past purchases, determining reasons for purchases, and evaluating item usage by direct and indirect observation. Assessing and weighting the data, or putting reparable items into context, will help planners better understand and forecast future use. Mapping out usage over a more extended period of five years and using the average to predict is more accurate than using the previous exercises or prior years' data to plan purchases for the next exercise or quarter.

C. ORGANIZATION OF THE STUDY

This research is organized into five chapters. Chapter I provides the background and purpose of this study and introduces the primary and secondary research questions. Chapter II reviews literature that relates to process improvements and best practices that facilitate the RIP and SECREP programs. Literature review from the Government Accountability Office (GAO) is utilized to capture the overall impact of reparable parts purchases. Chapter III explains the methodology of this research and how the problem was approached. Chapter IV covers the data and analysis of the research, and Chapter V includes recommendations and conclusions for the RIP and SECREP programs.

D. CHAPTER SUMMARY

The SECREP and RIP topic in the USMC is sensitive as it affects budgets ranging from the national level to the warfighters on the ground. This chapter offers a brief synopsis of the research conducted and the purpose of the study. There are many ways to approach this topic, and this chapter explains the scope of work and how the empirical study was conducted. To deliver the overall results of this study, the organization of the research is explained in this chapter to allow the reader to effectively grasp the topic at hand.

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II. LITERATURE REVIEW

The purpose of this literature review is to analyze previously conducted work related to SECREP, RIP, inventory service levels, back order, and government and private industries' best practices on reparable parts. This literature review establishes the history, importance, and origins of the problem. Headquarters USMC and the RIPs across the Fleet Marine Force continue to analyze SECREP analysis and optimization to ensure budget spending is conducted responsibly. Through the analysis of USMC RIP data, RIP policies and procedures, and research of best practices of reparable parts management, this thesis offers recommendations that help to facilitate the SECREP process. The way forward is to conduct effective cost analysis to support recommended changes to reparable purchases.

A. UNITED STATES GOVERNMENT VISIBILITY OF REPARABLE PARTS

Inventory management of reparable parts is a topic that has captured the attention of policy makers in Washington, DC. The Government Accountability Office (GAO) conducted studies to emphasize the importance and magnitude of reparable parts spending within the DoD and USMC. The GAO (1998) stated that in 1996, "the DoD reported the value of its secondary inventory—consumable items and reparable parts—at $68.5 billion" (Government Accountability Office [GAO], 1998, p. 2). The total defense budget of 1996 was $263 billion (Government Printing Office [GPO], 1995) so $68.5 billion is a large portion of the overall defense budget and can add up to an even more significant amount over time if not properly managed. The DoD understands that more effective procedures are required to facilitate overall savings and that civilian counterparts may have better solutions. Civilian institutions have more leeway in conducting their business, but the DoD must operate within federal regulations at all times. The GAO (1998) stated,

> Best practices developed by private sector companies are compatible with DoD improvement initiatives. The GAO recognizes the use of these best practices must be accomplished within the existing legislative framework and regulatory requirements relating to defense logistics activities, such as the Office of Management and Budget Circular A-76. (GAO, 1998, p. 5)

This government literature is important to understand as it affects reparable parts operations at the tactical level.

B. REPARABLE PARTS IN THE CIVILIAN SECTOR

Reparable parts management is crucial as it impacts the overall mission; therefore, it is imperative to understand other institutions' best practices, even if their mission is profit, not defense. Like the United States government, the civilian sector continues to search for optimal solutions to manage the reparable parts issue. Abbey, Geismar, and Souza (2018) provided an analysis of the benefits of "seeding," which is "the sale of new products as remanufactured at the start of a new product's life cycle to increase core recovery quantities. Seeding allows firms to start efficient remanufacturing earlier to fulfill demands for remanufactured products throughout the product's life cycle" (Abbey et al., 2018, p. 610). The article focuses on determining whether improving the process of remanufacturing parts allows original equipment manufacturers to maximize profit of new items even if selling at lower price than remanufactured products (Abbey et al., 2018). The article focuses on refurbishing and selling remanufactured items to enhance profitability, which is similar to how the USMC operates (though the gain for USMC is to mission, not to profit). Decision-makers and planners within the USMC continue to analyze ways to save money to enable the overall DoD mission. The argument in Abbey et al. (2018) is that remanufacturing of parts saves money in the long term; the article corroborates with my thesis, as the USMC continues to spend additional funds for the RIP at the EOFY.

In another example of private-sector concern with reparable parts, Simao and Powell (2008) stated that aircraft manufacturers face problems of establishing distributed warehouses with allocated inventory in response to random, nonstationary demands. Simao and Powell (2008) suggested that, to mitigate the problem, high-end items could be fixed or refurbished and reentered into the maintenance cycle after removal from an aircraft to make up for lost time due to back order and delivery issues.

C. REPARABLE ISSUE POINT PROCEDURES

Increasing SECREP parts purchases at the end of fiscal quarters causes second and third-order effects for service levels at the RIP. Even though the RIP's deficiencies and

back orders are filled when additional funds are provided, negative effects may occur. As additional funds are given to the RIP, requests for parts are sent to the wholesaler. These requests cause the wholesaler to fill a large number of SECREPs that may not be on their shelf due to minimal requisitioning throughout the year. The RIP must not order a large quantity of SECREP simply because there are additional funds. Schneider stated that "the overshoot of the order point can be ignored if it is not too large—namely if the transactions are almost of unit size. But when the single demand cases are of appreciable magnitude the excess cannot be neglected" (1981, p. 619). The RIP must ensure it prevents overfill of deficiencies, and adding inventory by expending funds at the EOFY does not always provide optimal results.

When the RIP does not have the flexibility to requisition back orders throughout the year due to the lack of funds, it causes the wholesaler to not carry enough stock on-hand to fill requisitions fully. The RIP must ensure it communicates any potential financial issues to higher headquarters to prevent drops in service levels. The Field-Level Maintenance Management Policy (FLMMP; Dana, 2016) provides guidance and direction to RIP managers when communicating fiscal concerns to better inform capacity management decisions. The FLMMP (Dana, 2016) also addresses procedures for maintaining optimal RIP stock levels to meet demands of the customers. RIP managers and maintenance officers must collaborate to create best practices solutions for back orders/low stock levels.

The wholesaler is not required to fully fill the RIP's requests due to DoD-wide requisitioning. The action by the wholesaler creates a back-and-forth effect in the future, because if the RIP fills the back orders at the EOFY, the wholesaler may increase its stock on-hand to reflect those orders. The following year, the RIP may not have any requisitions, which would cause the wholesaler to decrease the stock on-hand. Decreasing the stock on-hand will eventually affect the service level of the RIP; the back order at the RIP will be affected. Basten and Van Houtum stated that "in the military world, the service level target can also be based on the number of back orders" (2014, p. 38).

The RIP managers must review the Marine Expeditionary Force Training Effectiveness Evaluation Plan in order to facilitate service levels at the RIP. The RIP is

unique as it does not own any requirements; requirements are only generated only when operational units within the MEF induct SECREP items into the RIP. For instance, let us say the RIP needs $1 million to replace an engine for a tank; therefore, the RIP will run a charge in its records. If the tank engine is repaired at the fourth echelon level, however, the cost will change because the RIP receives the difference between the original estimated cost and the actual cost to repair the engine. Caricato and Draper (2011) captured operational tempo issues that were occurring as far back as 2008 as comptrollers struggled to allocate money after unforeseen SECREP items induction by the operational units into the RIP maintenance cycle caused credits issues. These issues are still ongoing as the USMC continues to grapple with the EOFY spending on SECREPs.

During the conduct of my research, the Global Combat Support System—Marine Corps (GCSS-MC) was utilized to capture maintenance transactions that affect the SECREP process. The RIP heavily relies on GCSS-MC to maximize management of reparable parts. There is an art and a science to managing SECREP, but the science cannot be useful when the data in GCSS-MC (or any system) is not accurate or validated. Rice (2018) stated that the transition to GCSS-MC provides the USMC with large amounts of maintenance data and supply transactions. While there have been recent efforts across the USMC attempt to make the data usable, gaps still exist in the data. Nearly half of the data, which spans four years, contains samples of fewer than five observations, and there are missing values associated with costs and labor hours (Rice, 2018). This low data integrity leaves room for improvement in the data collection itself. The data-integrity issues Rice (2018) pointed out will impact my data collection and analysis efforts.

D. CHAPTER SUMMARY

The literature reviewed in this chapter allowed me to better understand my thesis research questions and how to answer those questions. Capturing the importance of the reparable parts topic from the federal and DoD levels down to the RIP is key to understanding the overall concept.

III. METHODOLOGY

In conducting this research, I used sources provided by II Marine Expeditionary Force RIPs. I gathered data that allowed me to answer the primary thesis question about the effectiveness of end-of-quarter RIP purchases. Data sources used are described in detail in this chapter. For this research, I needed to examine RIP purchases by date and line item, the required number of on-hand items (allowance) by line item, on-hand inventory when the purchase was made, and lead time information. These data were needed to determine the lead-time demand distribution, from which it should be possible to estimate the incremental impact of end-of-quarter RIP purchases on readiness levels. The calculations are described in this chapter. My approach is to conduct cost analysis to support recommended changes to reparable purchases to ensure that end-of-quarter purchases are made where they will make the greatest contribution to incremental readiness.

Additionally, because of the limited time allowed to conduct my analyses, I had to sample from the total pool of items the RIP manages. For instance, the II MEF RIP currently manages approximately 1,300 National Item Identification Number (NIIN), but for the sake of time, I analyzed a smaller sample set to capture their requisitions, allowance, on-hand inventory, and lead time of requisition.

I studied the Due in and Status File (DASF), Consolidated Asset Listing (CAL), Materiel Returns Program (MRP), Repeat and Redistribution documents, the Daily Account Balance (DAB) report, and Metric Score Card to enable the conduct of my research.

A. DUE IN AND STATUS FILE

The DASF is where the RIP tracks what has been requisitioned. All requisitions are listed in document number order from oldest to newest.

In the DASF provided by the II MEF RIP, the oldest item is from September 2016 (FY15). The price of the oldest NSN item (Electronic Cover) is $2,700, and the RIP obligated funds to purchase it but has not received it yet. Therefore, giving the RIP additional money to buy another Electronic Cover will not increase readiness/service level.

The data from the DASF allowed me to analyze RIP purchases versus what RIP requires to have on-hand to capture the necessary lead-time information.

B. CONSOLIDATED ASSET LISTING REPORT

The CAL report provides the RIP with allowances, inventory, and due-in/out values by NIIN. This report is used to determine excess or deficient items relative to the allowance and is used for overall management of end items by the RIP. It is an overview of the posture of all SECREP coming in and exiting the RIP. It is a fluid document that changes based on maintenance and other logistical requirements. The CAL report allowed me to reference any NIIN to determine allowance and lead time of requisitions and on-hand inventory at time of purchase.

C. MATERIEL RETURNS PROGRAM TABLE

The data in the MRP table shows the expected dollar value of the credits received by the RIP during the fiscal year. The MRP facilitates the management of the funding allocated to the RIP for the year of execution. Therefore, this data is important for the conduct of this research because it facilitates the effective forecast of credits from SECREPs in support of operational units. Although these prices can change from year to year, the RIP can predict future credits because the prices remain fixed through the entire fiscal year. The data in the MRP allows me to examine the amount of money spent after credits are received during SECREPs purchases. Examining where funds are spent will help determine whether increased SECREP purchases at the end of fiscal quarters affect service levels at the RIP.

D. REPEAT AND DISTRIBUTION

The repeat and redistribution data captures SECREP exchanges between MEF RIPs and where funding is spent by a specific MEF. These exchanges occur due to lack of funding and/or inventory at a particular MEF RIP. However, the exchanges reduce demand at the wholesaler, and an exchange is not counted against the creation of a contract or historical information. There are instances when a MEF RIP is fully funded and must facilitate a sister MEF through redistribution of funds and SECREP. For example, a MEF RIP purchases SECREP items for the other MEF RIP in order to be assisted at a later time.

This is important to know, as the service levels at both RIPs can be impacted during this process. The repeat and distribution data facilitate the analysis of the RIP funds expenditure and its connection to service levels to effectively conduct a cost analysis.

E. DAILY ACCOUNT BALANCE

The DAB spreadsheet is prepared daily by the RIP Comptroller/Fiscal section and is a running cumulative total of RIP authorizations, obligations, and available balance of funds. The DAB spreadsheet covers what the RIP spends in GCSS-MC by baseline funding and Overseas Contingency Operations funding. It captures the RIP's Raytheon contracts, third-party logistics repair contracts, and exchange prices. Exchanges are any items the RIP returns to the listed vendors; the RIP may receive a credit for a returned item. Those credit prices are fixed, which makes it easier to track what the RIPs are getting back financially. The visibility of the RIP funds is crucial for an effective cost analysis in this research. The DAB helps validates the primary idea that RIP spends proportionally more money toward the end of the quarter. The DAB data is broken down into the following separate sections:

1. RAYTHEON Tab captures base year and all option years for repairs. These contracts begin June 1 and finish May 31. This section shows what has been decremented from each contract for repairs. Since some repairs take longer than others, there is still money tied up from previous years.
2. RIP QUARTERLY SPENDING Tab explains what the RIP has spent throughout the quarters for the present fiscal year, however, not what the RIP received.
3. OBL TO EXP RECV Tab is what the RIP spent against what it received. Spending money to increase readiness does not work if there is nothing on the shelf to purchase.
4. MMFAF5 Tab is historical data for years past. It shows how there has been a significant increase in spending at the RIP since 2001. Increase in weapons systems, out of warranty, age of systems, and a decrease in personnel and inventory to conduct the repairs of the SECREPS.
5. MMFAD2 Tab is old data from the RIP's low-density accounts. Tying the funding straight to readiness without looking into available inventory is detrimental to the data. The RIPs are forced to spend money to maintain obligation rates directed by higher headquarters, yet there is no healthy stock at wholesale inventory. With the age, lack of warranty, and increase of weapons systems, the RIPs need higher headquarters to build sustainable supply support packages when going through the acquisition pipeline. The data in the MMFAD2 Tab does not show what was spent on

Intermediate Maintenance Activities (IMA) repairs, but tying repairs of SECREPS into readiness helps paint a better picture during the conduct of this cost analysis.

F. DATA LIMITATIONS

For this research, I gathered data from II MEFs to examine the needed data for my research. There were limitations when gathering data for this research as each MEF RIP operates differently; therefore, their respective data is not directly comparable in all instances.

G. CHAPTER SUMMARY

This chapter covers the data used to conduct the research studies to demonstrate that current purchases are suboptimal and suggests a heuristic approach for improving the purchases. This data helps determine how the service levels are affected by EOFY additional funding. I explained the purpose of each data set and how it facilitates the analysis portion of the research to conduct cost analysis for recommended changes to reparable purchases. In the following chapter, I discuss the linear programming model used to determine whether the service levels of the RIP are affected by end-of-year funding.

IV. DATA ANALYSIS

To facilitate the main research question of this thesis, I created a pivot chart depicting SECREP transactions provided by I MEF RIP to examine whether increased SECREP parts purchases at the end of fiscal quarters affect service levels at RIPs. The pivot chart shows that the initial authority for fiscal year 2018 was $38.5 million and the fiscal year ended with $52.9 million. After analyzing the trends of the first quarter, I discovered that most purchases were executed in the middle of the first quarter. Other large purchases were executed at the end of the first quarter after six transactions of credits were conducted.

During the second through fourth quarters, the trends were very similar as most of the purchases were conducted at the end of the quarter with credit transactions occurring before and/or after large purchases. The largest number of purchases occurred at the end of the fourth quarter. After this analysis (Chapter IV, Section B), there is enough evidence to conclude that the "Hockey Stick Phenomenon" is present. The Hockey Stick Phenomenon is an increase in demand at the end of the quarter and fiscal year (Bradley & Arntzen, 1999). Hines, Holweg, and Sullivan stated, "the 'Hockey Stick' syndrome refers to the fact that sales or production levels generally peak towards the end of a measurement period in order to comply with given performance targets" (2000, p. 829).

A. RIP EXPENDITURE ANALYSIS

1. First Quarter

During the first nine weeks (Non-Hockey Stick Period) of the first quarter of fiscal year 2018, the total value of transactions at I MEF RIP was $9.4 million, with an average weekly expenditure of $1 million. During the last three weeks (Hockey Stick Period) of the first quarter, the total dollar-volume of transactions was $6.1 million, with an average weekly expenditure of $2 million. Additionally, the two-sample t-Test shows the difference in the mean expenditure of the two periods. If the t-Test shows a statistically significant difference in means, this would support the hypothesis that more is spent during the Hockey Stick Period of the quarter. That is, a significant t-Test is support for the existence of a hockey-stick phenomenon. However, the t-Test in the first quarter does not support the

hypothesis of the hockey stick period expenditures being higher and not merely different, and the p-value is too large to be considered significant. Tables 1 and 2 results were generated with Excel for the first quarter of fiscal year 2018.

Table 1. Fiscal Year 2018, First Quarter Hockey Stick Phenomenon Results. Adapted from personal communication, D. Goodwin and A. Zuniga (2019).[1]

	1st Quarter
Non Hockey Stick Period	**Sum of OBL AMT**
Saturday, October 21, 2017	$1,779.73
Tuesday, October 31, 2017	$93,101.45
Thursday, November 2, 2017	$10,780.25
Tuesday, November 7, 2017	$12,075.00
Thursday, November 16, 2017	$341,123.62
Friday, November 17, 2017	$1,404,847.68
Monday, November 20, 2017	$250,236.72
Tuesday, November 21, 2017	$9,503.38
Monday, November 27, 2017	$6,098,561.83
Tuesday, November 28, 2017	$527,702.81
Thursday, November 30, 2017	$19,299.91
Saturday, December 2, 2017	$64.52
Wednesday, December 6, 2017	$729,023.46
Total	**$9,498,100.36**
Avg Weekly Expenditure	**$1,055,344.48**

Hockey Stick Period (8 - 30 Dec)	**Sum of OBL AMT**
Friday, December 8, 2017	$900,588.29
Friday, December 15, 2017	$27,816.20
Thursday, December 21, 2017	$3,728,194.76
Friday, December 22, 2017	$1,442,121.32
Saturday, December 23, 2017	$664.91
Total	**$6,099,385.48**
Avg Weekly Expenditure	**$2,033,128.49**

[1] The data in Tables 1 through 8 was shared via email and briefing with RIP personnel on September 16, 2019.

Table 2. Fiscal Year 2018, First Quarter t-Test Results. Adapted from personal communication, D. Goodwin and A. Zuniga (2019).

t-Test: Two-Sample Assuming Unequal Variances		
	Non Hockey Stick Period	***Hockey Stick Period (8 - 30 Dec)***
Mean	$ 730,623.10	$ 1,219,877.10
Variance	2.76874E+12	2.33762E+12
Observations	13	5
Hypothesized Mean Difference	0	
df	8	
t Stat	-0.593087892	
P(T<=t) one-tail	0.284752518	
t Critical one-tail	1.859548038	
P(T<=t) two-tail	0.569505036	
t Critical two-tail	2.306004135	

2. Second Quarter

The second quarter of fiscal year 2018 experienced higher expenditures compared to the previous quarter. During the Non-Hockey Stick Period of the second quarter, the total amount of transactions at I MEF RIP was $10.4 million, with an average weekly expenditure of $1.1 million. During the Hockey Stick Period of the second quarter, the transactions totaled $7.2 million, with an average weekly expenditure of $2.4 million. Although the mean expenditure is higher in the Hockey Stick Period, once again, the t-Test fails to detect a statistically significant difference. So, there is no support for the hypothesis of the Hockey Stick Period expenditures being higher and not merely different due to chance alone. Tables 3 and 4 present the results calculated in Excel for the second quarter of fiscal year 2018.

Table 3. Fiscal Year 2018, Second Quarter Hockey Stick Phenomenon Results. Adapted from personal communication, D. Goodwin and A. Zuniga (2019).

	2nd Quarter
Non Hockey Stick Period	**Sum of OBL AMT**
Wednesday, January 10, 2018	$325,107.37
Friday, January 12, 2018	$2,500,008.47
Saturday, January 13, 2018	$21.74
Tuesday, January 16, 2018	$1,073,199.93
Thursday, January 18, 2018	$80,939.47
Thursday, January 25, 2018	$4,756.11
Friday, January 26, 2018	$33,147.63
Wednesday, January 31, 2018	$84,447.22
Thursday, February 1, 2018	$2,113,772.98
Friday, February 2, 2018	$1,869,594.81
Thursday, February 8, 2018	$1,932,791.91
Friday, February 23, 2018	$45,084.32
Thursday, March 1, 2018	$394,161.69
Total	**$10,457,033.65**
Avg Weekly Expenditure	**$1,161,892.63**

Hockey Stick Period (7 - 30 Mar)	**Sum of OBL AMT**
Wednesday, March 7, 2018	$1,170,076.32
Friday, March 9, 2018	$2,501,443.56
Friday, March 16, 2018	$145,197.70
Tuesday, March 20, 2018	$3,332,874.99
Thursday, March 29, 2018	$140,706.70
Total	**$7,290,299.27**
Avg Weekly Expenditure	**$2,430,099.76**

Table 4. Fiscal Year 2018, Second Quarter t-Test Results.
Adapted from personal communication, D. Goodwin and A. Zuniga (2019).

t-Test: Two-Sample Assuming Unequal Variances		
	Non Hockey Stick Period	**Hockey Stick Period (7 - 30 Mar)**
Mean	$ 804,387.20	$ 1,458,059.85
Variance	9.13941E+11	2.03639E+12
Observations	13	5
Hypothesized Mean Difference	0	
df	5	
t Stat	-0.945882334	
P(T<=t) one-tail	0.193820773	
t Critical one-tail	2.015048373	
P(T<=t) two-tail	0.387641546	
t Critical two-tail	2.570581836	

3. Third Quarter

The third quarter of fiscal year 2018 experienced higher expenditure compared to the previous two quarters but resulted in lower means for both Non-Hockey Stick and Hockey Stick periods as more transactions occurred. During the Non-Hockey Stick Period of the third quarter, the transactions at I MEF RIP totaled $12.1 million, with an average weekly expenditure of $1.3 million. During the Hockey Stick Period of the second quarter, the transactions totaled $9.7 million, with an average weekly expenditure of $3.2 million. The two-sample t-Test shows the difference in the mean expenditure of the two periods; the mean continues to be higher during the Hockey Stick Period of the quarter. The test in the third quarter also does not support the hypothesis of the Hockey Stick Period expenditures being higher and not merely different due to chance; the relevant t-Test is the one-tailed result, and the p-value is too large to be considered significant. Tables 5 and 6 show the results generated in Excel for the third quarter of fiscal year 2018.

Table 5. Fiscal Year 2018, Third Quarter Hockey Stick Phenomenon Results. Adapted from personal communication, D. Goodwin and A. Zuniga (2019).

	3rd Quarter
Non Hockey Stick Period	**Sum of OBL AMT**
Wednesday, April 4, 2018	$27,004.46
Thursday, April 5, 2018	$7,561.95
Monday, April 9, 2018	$1,110.38
Wednesday, April 11, 2018	$44,071.00
Sunday, April 15, 2018	$21,890.04
Tuesday, April 17, 2018	$52,453.39
Tuesday, April 24, 2018	$74,247.00
Wednesday, April 25, 2018	$314,409.25
Thursday, April 26, 2018	$110,195.92
Friday, April 27, 2018	$2,476,131.87
Monday, April 30, 2018	$2,401,378.73
Thursday, May 3, 2018	$1,367,606.28
Monday, May 7, 2018	$229,594.11
Wednesday, May 9, 2018	$2,190,693.99
Wednesday, May 16, 2018	$19,413.08
Tuesday, May 22, 2018	$90,731.75
Wednesday, May 23, 2018	$105,744.61
Thursday, May 31, 2018	$2,603,258.26
Total	**$12,137,496.07**
Avg Weekly Expenditure	**$1,348,610.67**

Hockey Stick Period (7 - 30 Jun)	**Sum of OBL AMT**
Thursday, June 7, 2018	$5,514,041.80
Friday, June 8, 2018	$150,717.00
Tuesday, June 12, 2018	$38,820.00
Thursday, June 14, 2018	$7,131.00
Friday, June 15, 2018	$1,420,653.73
Tuesday, June 19, 2018	$2,350,254.77
Wednesday, June 20, 2018	$65,802.34
Friday, June 22, 2018	$2,230.20
Monday, June 25, 2018	$134,861.26
Wednesday, June 27, 2018	$32,107.32
Total	**$9,716,619.42**
Avg Weekly Expenditure	**$3,238,873.14**

Table 6. Fiscal Year 2018, Third Quarter t-Test Results. Adapted from personal communication, D. Goodwin and A. Zuniga (2019).

t-Test: Two-Sample Assuming Unequal Variances		
	Non Hockey Stick Period	**Hockey Stick Period (7 - 30 Jun)**
Mean	$ 674,305.34	$ 971,661.94
Variance	1.02088E+12	3.17257E+12
Observations	18	10
Hypothesized Mean Difference	0	
df	12	
t Stat	-0.48624776	
P(T<=t) one-tail	0.317775144	
t Critical one-tail	1.782287556	
P(T<=t) two-tail	0.635550287	
t Critical two-tail	2.17881283	

4. Fourth Quarter

The fourth quarter of fiscal year 2018 experienced higher expenditures during the Hockey Stick periods as the fiscal year closes. During the Non-Hockey Stick Period of the fourth quarter, the transactions at I MEF RIP totaled $607,260.07, which was significantly lower than the three previous Non-Hockey Stick Periods. The average weekly expenditure of the fourth quarter's Non-Hockey Stick Period was $67,473.34. During the Hockey Stick Period of the fourth quarter, the transactions totaled $11.2 million with an average weekly expenditure of $3.7 million. The two-sample t-Test shows the difference in the mean expenditure of the two periods; in this case, there is a statistically significant difference in the means, as it appears that the I MEF RIP spending was very conservative during the Non-Hockey Stick Period. At the end of the fourth quarter and fiscal year, expenditure was higher during the Hockey Stick Period of the quarter. Tables 7 and 8 show the results generated in Excel for the fourth quarter of fiscal year 2018.

Table 7. Fiscal Year 2018, Fourth Quarter Hockey Stick Phenomenon Results. Adapted from personal communication D. Goodwin and A. Zuniga (2019).

	4th Quarter
Non Hockey Stick Period	**Sum of OBL AMT**
Monday, July 9, 2018	$135,410.98
Tuesday, July 10, 2018	$75,875.77
Wednesday, July 11, 2018	$91,829.10
Friday, July 20, 2018	$159,146.65
Monday, July 23, 2018	$137,273.81
Wednesday, August 22, 2018	$1,203.87
Monday, August 27, 2018	$6,519.89
Total	**$607,260.07**
Avg Weekly Expenditure	**$67,473.34**

Hockey Stick Period (6 - 30 Sep)	**Sum of OBL AMT**
Thursday, September 6, 2018	$13,236.86
Monday, September 17, 2018	$431,636.72
Wednesday, September 19, 2018	$10,899.34
Thursday, September 20, 2018	$11,830.15
Friday, September 21, 2018	$936,976.08
Monday, September 24, 2018	$903,734.83
Tuesday, September 25, 2018	$224,836.65
Thursday, September 27, 2018	$179,129.35
Friday, September 28, 2018	$3,549,638.85
Saturday, September 29, 2018	$4,996,027.84
Total	**$11,257,946.67**
Avg Weekly Expenditure	**$3,752,648.89**

Table 8. Fiscal Year 2018, Fourth Quarter t-Test Results. Adapted from personal communication D. Goodwin and A. Zuniga (2019).

t-Test: Two-Sample Assuming Unequal Variances		
	Non Hockey Stick Period	Hockey Stick Period (6 - 30 Sep)
Mean	$ 86,751.44	$ 1,125,794.67
Variance	4010146385	2.98335E+12
Observations	7	10
Hypothesized Mean Difference	0	
df	9	
t Stat	-1.900487576	
P(T<=t) one-tail	0.044909018	
t Critical one-tail	1.833112933	
P(T<=t) two-tail	0.089818037	
t Critical two-tail	2.262157163	

B. METRICS SCORE CARD ANALYSIS

The Metrics Score Card is a monthly overview of the readiness levels of the RIPs across the USMC. The Score Card utilized during this analysis covers the period from September 2018 to August 2019. This 12-month period is important for this analysis as it shows the effects of the EOFY. The Score Card displays the metric being measured, the desired direction of the level of the metric, and the baseline range to measure the metric. The metrics are

1. SECREP R: % of Total Marine Corps Automated Readiness Evaluation System (MARES) Reportable PEIs deadline with a SECREP on order,
2. Inventory Excess Over Total Allowance,
3. Inventory Excess Over ERQ,
4. Inventory Deficiencies,
5. Backorder Customer Wait Time, and
6. Enterprise Aggregate Fill Rate to measure customer support effectiveness.

The Score Card displays three levels (Favorable Base Line Range, Within Baseline Range, or Unfavorable to Baseline Range) for each metric measuring change against the baseline to show whether readiness is getting better, worse, or staying the same.

To properly conduct the analysis of the Metrics Score Card, I utilized information from the three RIPs within each MEF. I utilized only three of the metrics to measure each RIP's effectiveness: the SECREP R: % of Total MARES Reportable PEIs, Inventory Deficiencies, and the Enterprise Aggregate Fill Rate metrics. These are the three metrics that should be improved by increased spending. The other two should be either unaffected by end-of-year spending (Backorder Customer Wait Time) or potentially degraded (Inventory Excess over ERQ). I analyzed the months of September, October, and November 2018 to examine the level of readiness before and shortly after the fiscal year ends and February, March, and April 2019, in recognition of the fact that there is often a lag of weeks or months between when purchases are authorized, and inventory arrives to improve metrics. The lag of three months was selected to allow the potential effects of the added EOFY funds to take place. To facilitate the Wilcoxon/Kruskal-Wallis Test on the JMP program in Excel, I attached a score of 3 points to the Favorable Base Line Range, a score of 2 points to the Within Baseline Range, and a score of 1 point to the Unfavorable to Baseline Range. Table 9 presents a graphical depiction of scores tied to the metrics.

Table 9. Metric Score Card: Adapted from MEF RIPs, personal communication, J. Pribyl (2019).[2]

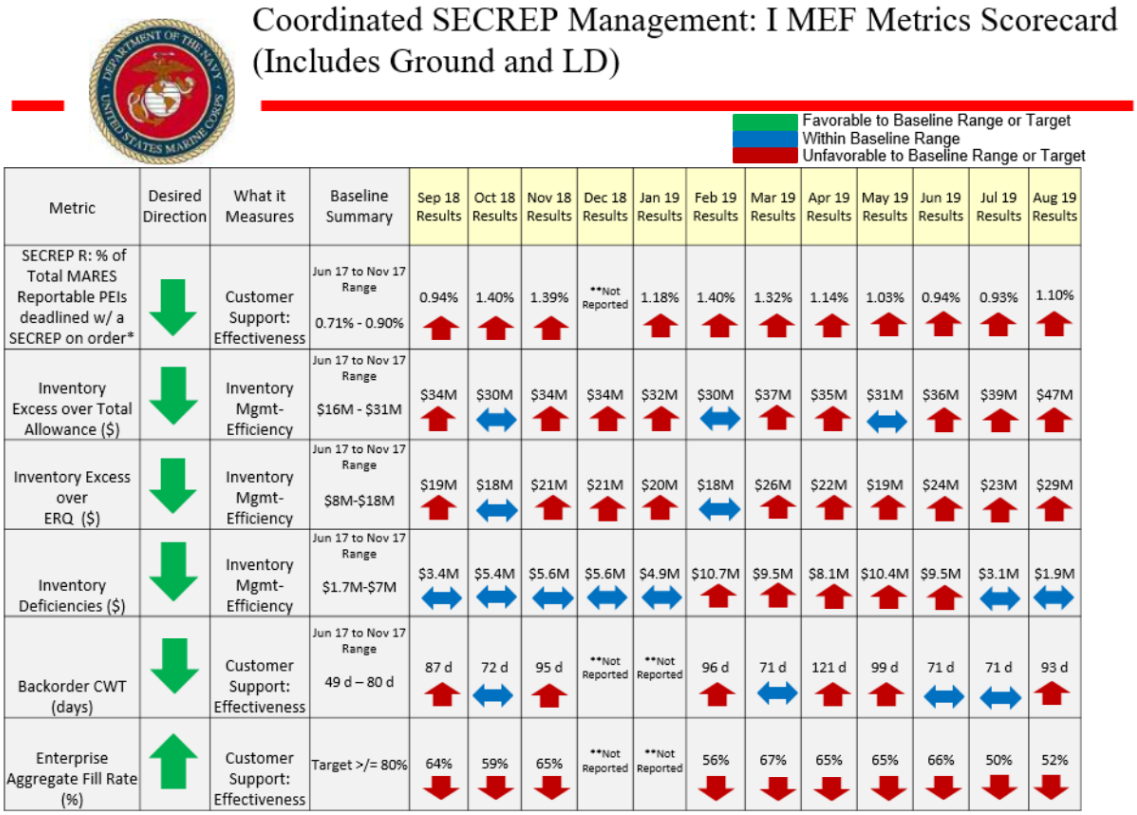
	I MEF RIP						II MEF RIP						III MEF RIP					
	Sep-18	Oct-18	Nov-18	Feb-19	Mar-19	Apr-19	Sep-18	Oct-18	Nov-18	Feb-19	Mar-19	Apr-19	Sep-18	Oct-18	Nov-18	Feb-19	Mar-19	Apr-19
METRICS																		
SECREP R: % of Total MARES Reportable PEIs deadlined w/ a SECREP on order*	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1
Inventory Deficiencies ($)	2	2	2	1	1	1	2	2	2	2	2	2	1	1	2	1	1	1
Enterprise Aggregate Fill Rate (%)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Favorable to Baseline Range or Target	3
Within Baseline Range	2
Unfavorable to Baseline Range or Target	1

1. I MEF Metrics Score Card Analysis

In the I MEF analysis, the SECREP R: % of Total MARES Reportable PEIs and the Enterprise Aggregate Fill Rate metrics all have scores of 1 in the observed first three months and second set of three months. The Inventory Deficiencies metric has scores of 2 during the first three months and scores of 1 in the second set of three months (see Figure 1).

[2] The data in Tables 9 through 14, and was shared via email and briefing with RIP personnel on September 24, 2019.



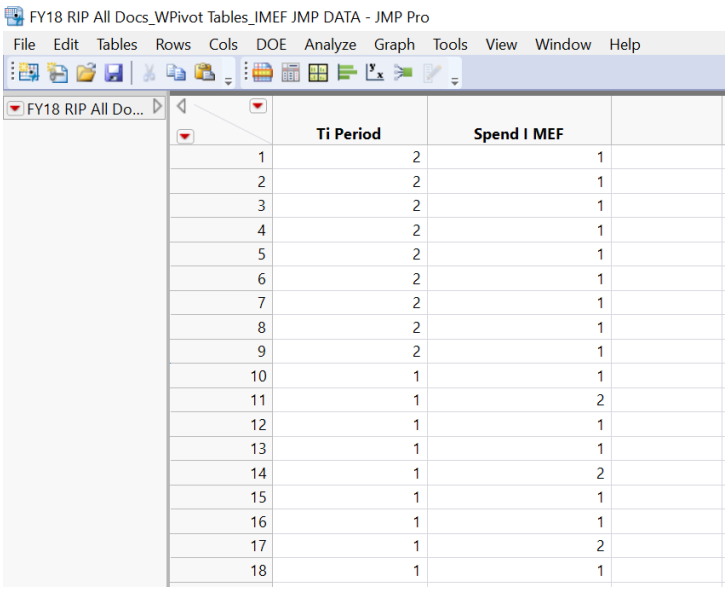
Metric	Desired Direction	What it Measures	Baseline Summary	Sep 18 Results	Oct 18 Results	Nov 18 Results	Dec 18 Results	Jan 19 Results	Feb 19 Results	Mar 19 Results	Apr 19 Results	May 19 Results	Jun 19 Results	Jul 19 Results	Aug 19 Results
SECREP R: % of Total MARES Reportable PEIs deadlined w/ a SECREP on order*	↓	Customer Support: Effectiveness	Jun 17 to Nov 17 Range 0.71% - 0.90%	0.94% ↑	1.40% ↑	1.39% ↑	**Not Reported	1.18% ↑	1.40% ↑	1.32% ↑	1.14% ↑	1.03% ↑	0.94% ↑	0.93% ↑	1.10% ↑
Inventory Excess over Total Allowance ($)	↓	Inventory Mgmt-Efficiency	Jun 17 to Nov 17 Range $16M - $31M	$34M ↑	$30M ↔	$34M ↑	$34M ↑	$32M ↑	$30M ↔	$37M ↑	$35M ↑	$31M ↔	$36M ↑	$39M ↑	$47M ↑
Inventory Excess over ERQ ($)	↓	Inventory Mgmt-Efficiency	Jun 17 to Nov 17 Range $8M-$18M	$19M ↑	$18M ↔	$21M ↑	$21M ↑	$20M ↑	$18M ↔	$26M ↑	$22M ↑	$19M ↑	$24M ↑	$23M ↑	$29M ↑
Inventory Deficiencies ($)	↓	Inventory Mgmt-Efficiency	Jun 17 to Nov 17 Range $1.7M-$7M	$3.4M ↔	$5.4M ↔	$5.6M ↔	$5.6M ↔	$4.9M ↔	$10.7M ↑	$9.5M ↑	$8.1M ↑	$10.4M ↑	$9.5M ↑	$3.1M ↔	$1.9M ↔
Backorder CWT (days)	↓	Customer Support: Effectiveness	Jun 17 to Nov 17 Range 49 d – 80 d	87 d ↑	72 d ↔	95 d ↑	**Not Reported	**Not Reported	96 d ↑	71 d ↔	121 d ↑	99 d ↑	71 d ↔	71 d ↔	93 d ↑
Enterprise Aggregate Fill Rate (%)	↑	Customer Support: Effectiveness	Target >/= 80%	64% ↓	59% ↓	65% ↓	**Not Reported	**Not Reported	56% ↓	67% ↓	65% ↓	65% ↓	66% ↓	50% ↓	52% ↓

Figure 1. I MEF Metrics Score Card.
Source: personal communication, J. Pribyl (2019).[3]

To facilitate the Wilcoxon/Kruskal-Wallis Test on the JMP program, Excel created two columns with 18 rows. One column has the 10 scores of 2 and 10 scores of 1. The second column (Spend I MEF) consists of the I MEF scores for the observed six months. The JMP Excel set-up is displayed in Table 10.

[3] The data in Figures 1 through 7, was shared via email and briefing with RIP personnel on September 24, 2019.

Table 10. I MEF Wilcoxon/Kruskal-Wallis Test Data. Adapted from personal communication, J. Pribyl (2019).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	Ti Period	Spend I MEF
1	2	1
2	2	1
3	2	1
4	2	1
5	2	1
6	2	1
7	2	1
8	2	1
9	2	1
10	1	1
11	1	2
12	1	1
13	1	1
14	1	2
15	1	1
16	1	1
17	1	2
18	1	1

After assigning score values to the metrics, I arranged the scores accordingly to allow the Wilcoxon/Kruskal-Wallis Test in the JMP program in Excel to provide the proper results. The Wilcoxon/Kruskal-Wallis Test is a "nonparametric test based on ranks and so is resistant to outliers and does not require normality" (JMP Statistical Discovery [JMP], 2018). The observed value of the test statistic is S = 72. The normal approximations for the Wilcoxon test statistic indicate significance at a p-value of 0.0758. The chi-square p-value is 0.0652, so we do not reject the null hypothesis, and there is not sufficient evidence to reject the claim that the metrics levels are unchanged within I MEF RIP after the EOFY are added (JMP, 2018). That is, we are unable to detect a statistically significant improvement in performance to go along with the statistically significant increase in spending. The JMP Wilcoxon/Kruskal-Wallis Test results are displayed in Figure 2.

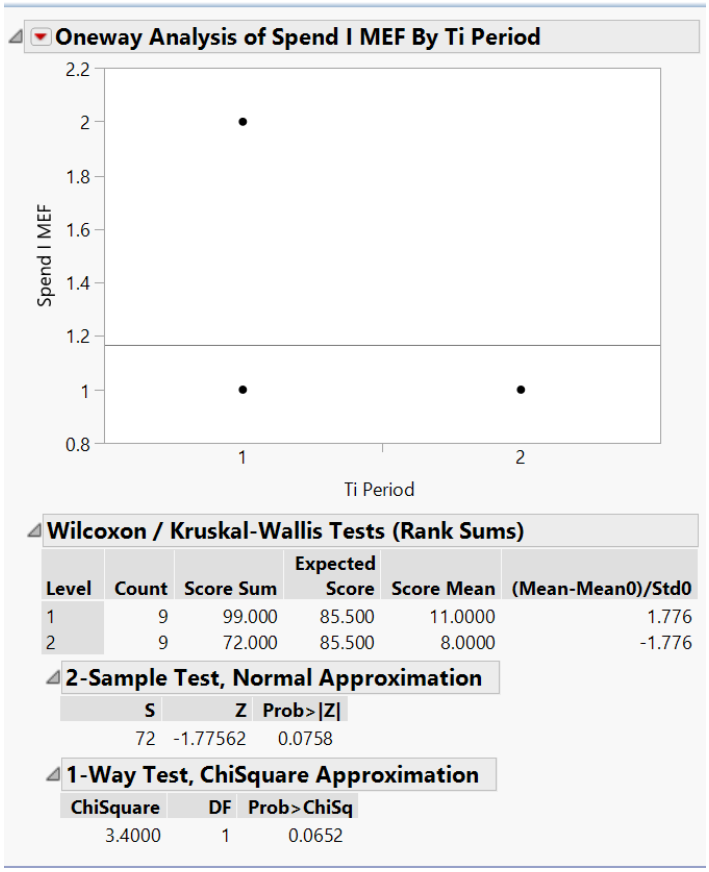


Figure 2. I MEF Wilcoxon/Kruskal-Wallis Test Results.
Adapted from MEF RIPs, personal communication, Pribyl (2019).

2. II MEF Metrics Score Card Analysis

In the II MEF analysis, the SECREP R: % of Total MARES Reportable PEIs and the Enterprise Aggregate Fill Rate metrics all have scores of 1 in the observed first three months and second set of three months. The Inventory Deficiencies metric has a score of 2 during the first three months and in the second set of three months. The scores were generated from the Metric Score Card in Figure 3.

Coordinated SECREP Management: II MEF Metrics Scorecard (Includes Ground and LD)

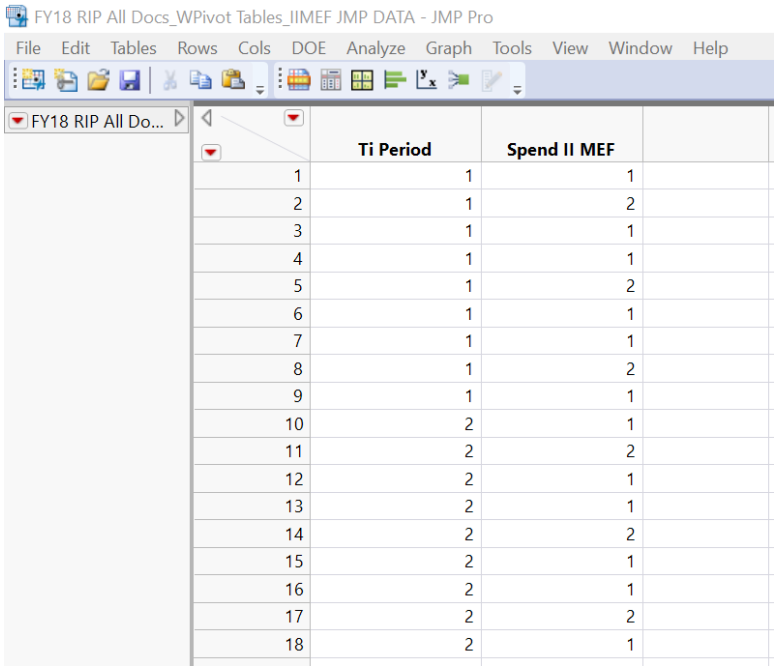
Favorable to Baseline Range or Target
Within Baseline Range
Unfavorable to Baseline Range or Target

Metric	Desired Direction	What it Measures	Baseline Summary	Sep 18 Results	Oct18 Results	Nov 18 Results	Dec 18 Results	Jan 19 Results	Feb 19 Results	Mar 19 Results	Apr 19 Results	May 19 Results	Jun 19 Results	Jul 19 Results	Aug 19 Results
SECREP R: % of Total MARES Reportable PEIs deadlined w/ a SECREP on order*	↓	Customer Support: Effectiveness	Jun 17 to Nov 17 Range 0.69% - 0.80%	0.92%	1.37%	1.31%	**Not Reported	1.40%	1.62%	1.65%	1.74%	1.62%	1.44%	1.38%	1.20%
Inventory Excess over Total Allowance ($)	↓	Inventory Mgmt-Efficiency	Jun 17 to Nov 17 Range $17M-$28M	$27M	$23M	$24M	$19M	$19M	$16M	$15M	$18M	$17M	$16M	$17M	$14M
Inventory Excess over ERQ ($)	↓	Inventory Mgmt-Efficiency	Jun 17 to Nov 17 Range $10M-$14M	$14M	$12M	$13M	$11M	$13M	$12M	$10M	$12M	$11M	$12M	$14M	$11M
Inventory Deficiencies ($)	↓	Inventory Mgmt-Efficiency	Jun 17 to Nov 17 Range $0.3M-$1.6M	$0.9M	$0.8M	$0.3M	$0.4M	$0.8M	$0.7M	$0.7M	$1.3M	$0.5M	$6.4M	$1.9M	$1.6M
Backorder CWT (days)	↓	Customer Support: Effectiveness	Jun 17 to Nov 17 Range 35 d – 62 d	71 d	82 d	83 d	**Not Reported	**Not Reported	73 d	56 d	66 d	77 d	56 d	64 d	84 d
Enterprise Aggregate Fill Rate (%)	↑	Customer Support: Effectiveness	Target >/= 80%	54%	47%	52%	**Not Reported	**Not Reported	51%	49%	60%	48%	46%	44%	50%

Figure 3. II MEF Metrics Scorecard. Source: MEF RIPs, personal communication, J. Pribyl (2019).

The II MEF Wilcoxon/Kruskal-Wallis Test in the JMP program in Excel is set up identically as I MEF; the JMP Excel set-up is displayed in Table 11.

Table 11. II MEF Wilcoxon/Kruskal-Wallis Data. Adapted from MEF RIPs, personal communication, J. Pribyl (2019).



	Ti Period	Spend II MEF
1	1	1
2	1	2
3	1	1
4	1	1
5	1	2
6	1	1
7	1	1
8	1	2
9	1	1
10	2	1
11	2	2
12	2	1
13	2	1
14	2	2
15	2	1
16	2	1
17	2	2
18	2	1

The observed value of the test statistic is S = 85.5. The normal approximations for the Wilcoxon test statistic indicate significance at a p-value of 1.0000. The chi-square p-value is 1.0000, so we do not reject the null hypothesis, and there is no sufficient evidence to reject the claim that the metrics levels are unchanged within II MEF RIP after the EOFY funds are added (JMP, 2018). Again, there is no evidence that the increased spending in the fourth quarter improved performance. The JMP Wilcoxon/Kruskal-Wallis Test results are displayed in Figure 4.

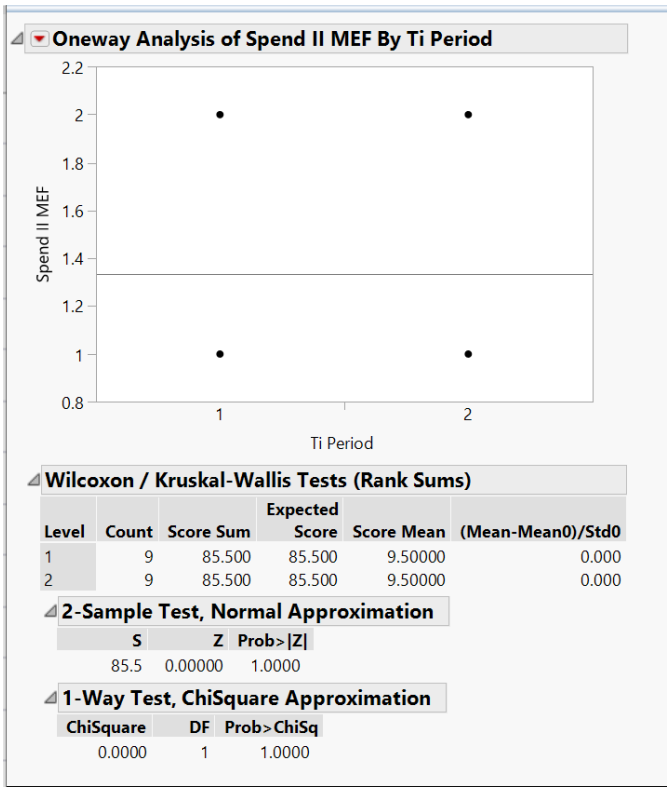


Figure 4. II MEF Wilcoxon/Kruskal-Wallis Test Results.
Adapted from MEF RIPs, personal communication, J. Pribyl (2019).

3. III MEF Metrics Score Card Analysis

For the III MEF analysis, all three metrics mostly have scores of 1 across all the covered months except SECREP R: % of Total MARES Reportable PEIs has a score of 2 in September 2018 and Inventory Deficiencies metric has a score of 2 for November 2018. The scores were generated from the Metric Score Card in Figure 5.

Coordinated SECREP Management: III MEF Metrics Scorecard
(Includes Okinawa and Hawaii)

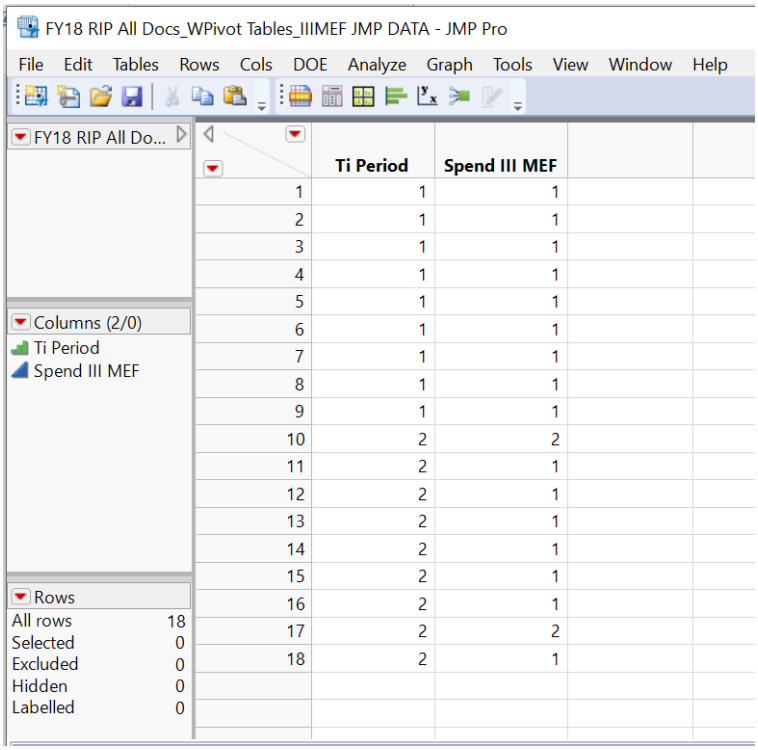
Favorable to Baseline Range or Target
Within Baseline Range
Unfavorable to Baseline Range or Target

Metric	Desired Direction	What it Measures	Baseline Summary	Sep 18 Results	Oct 18 Results	Nov 18 Results	Dec 18 Results	Jan 19 Results	Feb 19 Results	Mar 19 Results	Apr 19 Results	May 19 Results	Jun 19 Results	Jul 19 Results	Aug 19 Results
SECREP R: % of Total MARES Reportable PEIs deadlined w/ a SECREP on order*	↓	Customer Support: Effectiveness	Jun 17 to Nov 17 Range 0.24% -0.60%	0.60% ↔	0.98% ↑	0.99% ↑	**Not Reported	1.24% ↑	1.09% ↑	1.29% ↑	1.35% ↑	1.18% ↑	1.26% ↑	1.20% ↑	1.24% ↑
Inventory Excess over Total Allowance ($)	↓	Inventory Mgmt-Efficiency	Jun 17 to Nov 17 Range $12M-$16M	$20M ↑	$18M ↑	$20M ↑	$18M ↑	$17M ↑	$20M ↑	$20M ↑	$21M ↑	$19M ↑	$19M ↑	$17M ↑	$20M ↑
Inventory Excess over ERQ ($)**	↓	Inventory Mgmt-Efficiency	Jun 17 to Nov 17 Range $8M-$9M	$13M ↑	$12M ↑	$13M ↑	$11M ↑	$10M ↑	$13M ↑	$13M ↑	$13M ↑	$12M ↑	$12M ↑	$11M ↑	$12M ↑
Inventory Deficiencies ($)	↓	Inventory Mgmt-Efficiency	Jun 17 to Nov 17 Range $0.5M-$1.0M	$1.3M ↑	$1.4M ↑	$1.0M ↔	$0.6M ↔	$1.0M ↔	$1.8M ↑	$1.7M ↑	$1.8M ↑	$1.5M ↑	$2.3M ↑	$1.6M ↑	$1.4M ↑
Backorder CWT (days)	↓	Customer Support: Effectiveness	Jun 17 to Nov 17 Range 32 d – 53 d	55 d ↑	53 d ↔	86 d ↑	**Not Reported	**Not Reported	101 d ↑	67 d ↑	52 d ↔	45 d ↔	67 d ↑	73 d ↑	68 d ↑
Enterprise Aggregate Fill Rate (%)	↑	Customer Support: Effectiveness	Target >/= 80%	63% ↓	52% ↓	53% ↓	**Not Reported	**Not Reported	53% ↓	51% ↓	41% ↓	41% ↓	49% ↓	57% ↓	58% ↓

Figure 5. III MEF Metric Score Card. Source: Adapted from MEF RIPs, personal communication, J. Pribyl (2019).

The II MEF Wilcoxon/Kruskal-Wallis Test in the JMP program in Excel is set up identically as I MEF and II MEF; the JMP Excel set-up is displayed in Table 12.

Table 12. III MEF Wilcoxon/Kruskal-Wallis Data. Adapted from MEF RIPs, personal communication, J. Pribyl (2019).



	Ti Period	Spend III MEF
1	1	1
2	1	1
3	1	1
4	1	1
5	1	1
6	1	1
7	1	1
8	1	1
9	1	1
10	2	2
11	2	1
12	2	1
13	2	1
14	2	1
15	2	1
16	2	1
17	2	2
18	2	1

The observed value of the test statistic is S = 94.5. The normal approximations for the Wilcoxon test statistic indicate significance at a p-value of 0.1686. The chi-square p-value is 0.1449, so we do not reject the null hypothesis, and there is not sufficient evidence to reject the claim that the metrics levels are unchanged in III MEF RIP after the EOFY funds are added (JMP, 2018). The JMP Wilcoxon/Kruskal-Wallis Test results are displayed in Figure 6.

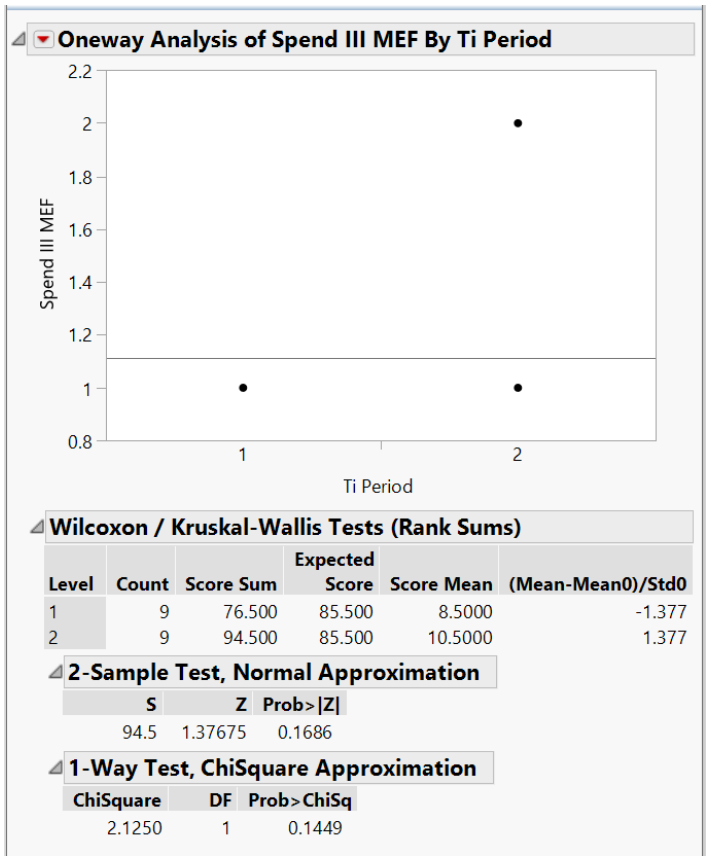


Figure 6. III MEF Wilcoxon/Kruskal-Wallis Test Results.
Adapted from MEF RIPs, personal communication, J. Pribyl (2019).

4. What Is Being Bought by the MEF RIPs at Year End

Figure 7 is a recommended buy list from I MEF RIP. The buy list can be executed at year end so that funds can be used on needed items before those funds expire. With evidence of a "hockey stick phenomenon" in fourth quarter purchasing that produces no statistically significant impact on performance metrics, questions about the efficacy of the buy list arise. The back order (BO) is the number of quantities of line items I MEF RIP has on back order. The AA is purpose/condition code, which is serviceable items ready for issue. AF is purpose/condition code, which is unserviceable items not ready for issue. The Source of Supply (SOS) shows the quantity of how many I MEF RIP are due in from the SOS that I MEF RIP requisitioned.

PRIME NSN	ALL	IIP	IIP_END_DATE	AA	AF	DUE F	RIP	3PL	IMA	SOS	OUT RIP	BO	OUT F	AAC	PC	CIIC	CIC	SAC	SMRC	REC	UI	REC	PRIME	EXC	EXC V	DEF	DEF V	PRIME NOMENCLATURE	2L	4G	TOTAL
1440001960038	0	0		1	0	3	3	0	0	0	2	4	0	V		7	A	2		D	EA	1945	1945	1	1945	0	0	TUBEGUIDED MISSILE	8		$ 15,560.00
6110015884725	0	0		0	0	1	1	0	0	0	1	1	0	C		U	A	2		D	EA	8389	8389	0	0	0	0	CONTROL BOXGENERAT	1		$ 8,389.00
6665015526341	0	0		0	2	0	0	0	0	0	0	4	0	B		7		2		D	EA	1094.29	1094.29	0	0	2	2188.58	RADIAC SET	4		$ 4,377.16
2835010743788	0	0		0	1	0	2	0	0	0	2	2	0	C		U		2		D	EA	9413	9413	0	0	1	9413	TANKLUBRICATING OI	2		$ 18,826.00
4320015311844	0	0		0	0	0	0	0	0	0	0	2	0	H		U		1		F	EA	10212.8	10212.8	0	0	2	20425.6	PUMP UNITCENTRIFUG	2		$ 20,425.60
1430016170917	0	0		0	0	0	0	0	0	0	0	1	0	C		U	A	2		L	EA	1255	1255	0	0	1	1255	CABLEPADS TO TAS	1		$ 1,255.00
2540200051999	0	0		0	1	0	0	0	0	0	0	1	0	C	R	7	A	2		D	EA	18069.6	18069.6	0	0	0	0	ARMORSUPPLEMENTAL		1	$ 6,324.37
2815010160425	0	0		0	0	0	1	0	0	0	1	1	0	D		U		1		H	EA	1180.03	1180.03	0	0	1	1180.03	COVER ASSEMBLY	1		$ 1,180.03
5895015065533	0	0		0	0	0	0	0	0	0	0	1	0	D		U		1		H	EA	1861.62	1861.62	0	0	1	1861.62	CONTROLINTERFACE	1		$ 1,861.62
6150015924883	0	0		0	1	0	0	0	0	0	0	1	0	C	R	U		2		L	EA	12542.7	12542.7	0	0	0	0	POWER STRIPELECTRI		1	$ 4,389.96
2815016223891	1	1	10/11/2021 0:00	1	1	1	0	0	0	0	0	2	0	C		U	A	2		D	EA	14018	14018	0	0	0	0	ENGINEDIESEL	1		$ 14,018.00
6830004359415	3	0		3	2	1	0	0	0	0	0	2	0	D		U		1		F	EA	2151.27	2151.27	1	2151.27	0	0	MONOBROMOTRIFLUOROM	1		$ 2,151.27
4933012739861	4	0		4	0	0	0	0	0	3	0	5	0	C	R	U	A	2		D	EA	1741.58	1741.58	0	0	2	3483.16	TEST SETELECTRICAL	2		$ 3,483.16
5985015301552	1	0		1	2	0	0	0	0	0	0	1	0	C		Y		2		D	EA	14501.9	14501.9	1	14501.88	0	0	ANTENNA PEDESTAL SU	1		$ 14,501.88
5820015549530	1001	0		195	311	154	158	0	431	100	109	606	0	C	G	9	A	2		D	EA	6000	6000	0	0	367	2202000	RECEIVER-TRANSMITTE		200	$ 514,432.00
2530012014816	200	0		161	36	10	306	0	0	170	266	120	0	C		7		2		D	EA	658	658	97	63826	0	0	WHEELSOLID RUBBER	40		$ 26,320.00
5820016143307	200	0		44	54	17	5	34	129	21	5	117	0	C	G	9	A	2		L	EA	35629	35629	0	0	18	641322	RECEIVER-TRANSMITTE		18	$ 224,462.70
5820015817287	96	0		22	39	1	3	0	13	69	3	48	0	B		9	A	2		D	EA	6000	6000	0	0	0	0	RECEIVER-TRANSMITTE		39	$ 81,900.00
5820015487056	162	0		74	55	38	1	0	0	9	0	32	0	C	R	U	A	2		L	EA	1802.85	1802.85	0	0	17	30648.5	RECEIVER-TRANSMITTE		17	$ 9,736.07
5998016049538	24	11	12/9/2019 0:00	0	3	0	1	8	0	30	1	27	0	C	R	U	A	2		D	EA	4232.43	4232.43	0	0	10	42324.3	CIRCUIT CARD ASSEMB		7	$ 14,112.56
5998016151897	20	0		2	16	0	10	18	0	5	9	26	0	J	G	7	A	2		D	EA	7382.31	7382.31	0	0	4	29529.2	CIRCUIT CARD ASSEMB		4	$ 10,335.24
5895015627515	15	0		3	8	1	2	4	7	6	1	20	0	J		7	A	2		D	EA	4723	4723	0	0	5	23615	CONTROLRADIO SET T		5	$ 8,265.25
5820015805471	29	0		27	3	4	4	0	13	0	4	19	0	C	R	9	A	2		D	EA	8818.21	8818.21	0	0	1	8818.21	RECEIVER-TRANSMITTE		1	$ 3,086.37
2815014900796	14	0		5	23	5	7	2	1	0	7	18	0	D		U		1		H	EA	3479	3479	4	13916	0	0	CYLINDER HEADDIESE	10		$ 34,790.00
5998015943320	15	0		8	0	0	8	15	0	0	7	11	0	J	R	7	A	2		D	EA	1828.52	1828.52	0	0	2	3657.04	CIRCUIT CARD ASSEMB		2	$ 1,265.54
5830011385787	46	0		32	0	2	0	0	10	8	0	8	0	B	R	7	A	2		D	EA	4125.97	4125.97	0	0	2	8251.94	CONTROLINTERCOMMUN		2	$ 2,517.24
2350011996319	20	0		11	9	2	0	0	4	2	0	1	0	U	7	7	A	2		D	EA	25858.4	25858.4	7	181008.9	0	0	PANELINSTRUMENTMO		2	$ 4,590.12
6130015640122	8	0		2	8	1	2	0	4	0	2	3	0	H	7	U	A	2		L	EA	5750.12	5750.12	4	23000.48	0	0	POWER SUPPLY		4	$ 8,050.16
2815014900312	37	0		6	9	4	3	3	22	0	3	4	0	C	7	7	A	2		D	EA	92530.9	92530.9	3	277592.6	0	0	ENGINE W CONTAINER		6	$ 336,499.74
7025014999143	25	0		19	4	1	1	0	5	0	0	2	0	D		U		1		F	EA	2115.31	2115.31	3	6345.93	0	0	DISPLAY UNIT	1		$ 2,115.31
1240015455913	4	0		3	3	1	2	0	0	0	2	1	0	C	R	7	A	2		L	EA	40931.6	40931.6	2	81863.22	0	0	RANGEFINDERLASER E		1	$ 14,326.06
2520219064746	10	0		6	3	2	1	0	1	0	0	1	0	C	H	7	A	2		D	EA	10164.9	10164.9	2	20329.76	0	0	TRANSMISSION WITH C		1	$ 3,557.71
2520010673873	4	0		1	4	2	3	0	0	0	3	1	0	D		U		2		D	EA	1594	1594	2	3188	0	0	COOLERFLUIDTRANSM	2		$ 3,188.00
5840015094897	12	0		2	3	0	3	0	0	10	3	1	0	C	G	7	A	2		D	EA	84140.1	84140.1	2	168280.1	0	0	TRANSMITTERRADAR		1	$ 29,449.02
7021015542707	75	75	7/29/2019 0:00	59	14	1	1	0	5	0	1	3	0	C	7	Y	A	2		L	EA	6843	6843	1	6843	0	0	COMPUTERDIGITAL	5		$ 34,215.00

Figure 7. I MEF Recommend Buy List. Source: I MEF RIPs, personal communication, I. Perez (2019).

It is my recommendation that each item should have a "Do Not Order" date to guarantee arrival before the EOFY. I utilized the Quarterly Demand/IMA Data Summary Report to analyzed items and their respective back-order lead times. I chose three items (NSNs 5820015549530, 5820015709746, and 5820016143307) to examine acceptable risks of arrival. I sorted each item from smallest back-order lead time to greatest. Then I divided the back-order days by seven to convert to weeks. Based on the weeks it normally takes for an item to arrive at the RIP, I determined the chances (in percentage) of an item's on-time arrival. To determine the probability of an item's on time arrival, I divided each item (in its respective order of least amount of back-order lead time) by the overall amount. Next, I subtracted the arrival percentage from 1 to give the probability the item not arriving on time. Table 13 is a snapshot of the first 10 NSN 5820015549530 items.

Table 13. Target Deadline Table. Adapted from MEF RIPs, personal communication, J. Pribyl (2019).

Target Deadline			
	Arrive	Weeks	Not Arrive
1	0.01639	3	0.983606557
2	0.03279	3	0.967213115
3	0.04918	4	0.950819672
4	0.06557	4	0.93442623
5	0.08197	6	0.918032787
6	0.09836	6	0.901639344
7	0.11475	6	0.885245902
8	0.13115	6	0.868852459
9	0.14754	6	0.852459016
10	0.16393	7	0.836065574

Table 14 shows acceptable risk for the three observed NSNs by the number of weeks before an item should not be ordered. For example, if a RIP wants a 95% chance of NSN 5820015549530 arriving on time, the item must be ordered 47 weeks before the EOFY closes.

Table 14. Acceptable Risk Chart. Adapted from MEF RIPs, personal communication, J. Pribyl (2019)

# of Weeks Before EOFY Closes			
Acceptable Risk	NSN5820015549530	NSN5820015709746	NSN5820016143307
5%	47 Weeks	87 Weeks	73 Weeks
10%	44 Weeks	76 Weeks	64 Weeks
20%	38 Weeks	61 Weeks	51 Weeks
30%	34 Weeks	57 Weeks	9 Weeks

The NIINs fluctuate based on wholesale inventory due to the changes of demands from the operating forces, contracting issues, and availability of funds from higher headquarters. The best practice is to avoid purchasing items with long lead times at the EOFY; the MEF RIPs should continue to purchase the items with longer lead times at the beginning of the fiscal year because once the new fiscal year begins, the funds are lost if the document/order is canceled.

C. CHAPTER SUMMARY

This analysis in this chapter captured similarities and differences in expenditure patterns across all three MEFs RIPs. The results show that EOFY additional (hockey stick) purchases do not always positively impact the metrics within all three observed MEF RIPs. The pivot chart depicting SECREP transactions provided by I MEF RIP and Metric Score Cards allowed me to examine whether increased SECREP parts purchases at the end of fiscal quarters affect service levels at MEF RIPs. The above analysis supports the (tentative) claims and recommendations favoring items with moderately-long back-order lead times on the buy list, at the beginning of the year.

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V. CONCLUSION, ASSUMPTIONS, AND RECOMMENDATIONS

For the conduct of this research, I explored whether increased SECREP parts purchases at the end of fiscal quarters affect service levels at RIPs. A secondary research focus is whether large SECREP purchases at the end of quarters are validated by usage data. It appears that the RIPs may not be rigorously monitoring their respective end-of-year purchases, as the metrics levels remain mainly Within Baseline Range or Unfavorable to Baseline Range in the second quarter of the following year, seemingly unaffected by the end-of-year surge in purchasing. Additionally, I discovered that the RIPs formulated a recommended buy list to purchase items when additional funds are allocated. After examining the list, I concluded that the items on the list are "nice to have" at the EOFY. That is, a buy list exists for items that are needed, but not needed critically—critically needed items are ordered right away. It appears that the RIPs buy items from the recommended buy list only when an item that is needed more critically does not arrive in a timely manner. Future researchers can make direct recommendations about the sort of back-order lead times the RIPs should be looking for. The RIP should purchase items with long-enough lead times to enable leverage of the policy on cancellations if higher-priority spending needs arise, but short enough lead times so that the purchases can impact performance in the time frame for which those allocated funds were intended.

A. ASSUMPTIONS AND LIMITATIONS

Hockey Stick Phenomenon spending occurs at EOFY regardless of procedures in place. Another set of assumptions I made during this research is that the metrics should improve after three months, with the additional EOFY funds used by the MEF RIPs. It is possible that the impact shows up in less time (two months or fewer) or more time (only after six months)—no other lag structures were tested. The lack of detailed data was a limitation during the conduct of this research. Detailed data may have enabled detecting a statistically significant improvement, but the fact that these aggregate data showed no improvement is what we would expect to see if the spending had no impact, or only a trivial impact, on the performance.

During this research, I did not have the data underlying Metric Score Cards. Had that been so, I could have conducted a stronger test. This data is important because there is a difference between not finding the positive result of the spending (my result) and being able to demonstrate that there was no positive result of the spending. A test on the detailed data might have detected the difference in spending.

The bigger the impact/effect, the more likely the test I conducted on this limited data set would have detected it. Thus, while the result on these Metric Score Card data is not evidence that the spending had no result, it is what we would expect to see, if the impact was small, or insignificant.

Finally, since we had spending data for only one RIP, but examined performance improvement across all RIPS, we have implicitly assumed that all MEF RIPs have similar spending patterns and similar procedures and operations when dealing with SECREPs and spending. Future research on the spending patterns of the other RIPs would need to be conducted to test that assumption.

B. RECOMMENDATIONS

The RIPs should review back-order lead time and priority codes relative to stock allowance to purchase items that are actually needed for maintaining the desired fill rate. For future research, examining the fill rate allowance and what is needed the most at the RIPs would be worthy of study. Although I conducted research to examine whether increased SECREP parts purchases at the end of fiscal quarters and EOFY affect service levels at the RIPs, a deeper dive would generate further information worthy of a thesis. For future research, an "impact" on the metrics involves buying items that have a low fill rate, are short compared to their allowance, and (most importantly) are likely to deadline an item. A multicriteria weighting scheme to rank the buy list might be helpful.

Additional questions for future research include: Will researching operating units and their respective usage of SECREPs validate purchases before major exercises? How long do parts sit on the shelf before they are used? What is the safety stock at each, or more than one RIP? These questions may shed further light on the complex operations of the RIPs and SECREP handling to enable overall success for the USMC and the DoD.

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