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**HOW DOES THE SUPPLY
REQUISITIONING PROCESS AFFECT
AVERAGE CUSTOMER WAIT TIME
ONBOARD U.S. NAVY DESTROYERS?**

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June 2013**

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ABSTRACT

The Navy's current inventory and requisition management procedures for issuing repair parts onboard ships have remained relatively unchanged for decades. As a result of current practices, many ships are experiencing higher average customer wait times (ACWT) for repair parts onboard ship. The U.S. Navy has identified the need to reduce this wait time in order to complete shipboard repairs faster and increase readiness levels across the fleet. Applying a six sigma define, measure, analyze, improve and control (DMAIC) process approach, this report describes current procedures from initial demand to issue of repair parts, including collecting and analyzing quantitative and qualitative data. Recommendations and conclusions are offered to improve the overall process, identify bottlenecks, improve response time to demand, and reduce shipboard procedure inefficiencies.

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LIST OF ACRONYMS AND ABBREVIATIONS

2M	Miniature/Microminiature
ACWT	Average Customer Wait Time
APL	Allowance Parts Listing
ASI	Automated Shore Interface
ATG	Afloat Training Group
BMD	Ballistic Missile Defense
BPM	Business Process Management
CMP	Continuous Monitoring Program
COMNAVSURFOR	Commander Naval Surface Forces
DD	Department of Defense
DDG	Guided Missile Destroyer
DLATS	Defense Logistics Agency Transaction Services
DLR	Depot Level Repairable
DMAIC	Define Measure Analyze Improve Control
ICP	Inventory Control Point
IT	Information Technology
LCPO	Leading Chief Petty Officer
LS	Logistics Specialists
MBA	Masters of Business Administration
MDT	Mean Down Time
MTBM	Mean Time Between Maintenance
NAVSUP	Naval Supply Systems Command
NC	Not Carried
NIS	Not in Stock
NPS	Naval Postgraduate School
NRFI	Non Ready for Issue
NSLC	Naval Sea Logistics Center
NSN	National Stock Number
NTCSS	Naval Tactical Command Support System
NWCF	Navy Working Capital Fund

OARS	Open Architecture Retrieval System
OMMS NG	Organizational Maintenance Management System Next Generation
ONBD	Onboard
OPTAR	Operational Target
PUK	Pack-Up Kit
QPA	Quantity per Allowance
RFI	Ready for Issue
RIP	Remain in Place
RPPO	Repair Parts Petty Officer
RSupply	Relational Supply
SME	Subject Matter Expert
SPAWAR	Space Warfare Command
SRF	Stock Record File
SUPPO	Supply Officer
TYCOM	Type Commander
UI	Unit of Issue
UIC	Unit Identification Code

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I. INTRODUCTION

In support of national security and maritime interests, the United States Navy maintains a large surface force to perform current and future missions, including projecting power, deterring aggression, and maintaining freedom of the seas. In order to keep this fleet materially and operationally ready to perform these critical missions, the Navy must maximize the effective use of its resources to maintain the highest levels of readiness as well as ensure its ships achieve their expected service lives. As the senior ranking officer in the Department of the Navy, the Chief of Naval Operations (CNO) is responsible for fleet readiness as well as the operating efficiency of naval forces. In fact, of the CNO's top three tenets concerning the United States Navy, warfighting is first. As he explains, "The Navy has to be ready to fight and prevail today, while building the ability to win tomorrow. This is our primary mission and all our efforts must be grounded in this fundamental responsibility" ("CNO's Tenets," 2013).

A large part of this warfighting capability is directly dependent upon the quality of organizational maintenance being performed at the shipboard level to reduce the number of system casualties. In other words, the fewer systems that are down or degraded, the greater capability and lethality a ship can "bring to the fight." As a result, shipboard personnel are responsible for quickly identifying those systems that require corrective maintenance, taking action to ensure they document a record of maintenance and determine the parts needed to fix the system. By establishing a material history for each piece of equipment, vast improvements are achieved in maintainability and reliability, which ultimately result in a reduction in the cost of material ownership. In addition to the quality of maintenance performed, availability of spare parts and the amount of time it takes to deliver them to the end user play key roles in the operational availability of a system and, ultimately, a ship's warfighting capability. Having limited quantities of repairable parts stored onboard ships is essential to ensuring there is some level of safety stock to address those systems that are critical for shipboard operation. For example, basic functionality such as maintaining propulsion, keeping weapons systems online, or simply making water is essential when steaming in remote parts of the world.

Keeping these systems online at all times requires not only due diligence from the crew, but also rapid turnaround times for the delivery of spare parts for correcting material discrepancies.

Based on our personal experiences as department heads afloat, we have intimate knowledge of many of the logistical policies and procedures surrounding the onboard issue of depot level repairable (DLR) parts. Given this experience, we have noticed many of the business rules or procedures currently practiced have led to inefficiencies or created additional work requirements that result in wasted time and money for the Navy. While developing a strategy concerning our thesis, we identified various commercial business practices that could assist us in gaining efficiencies in the delivery of repair parts onboard ship.

We utilize these concepts learned at the Naval Postgraduate School to review all aspects of current logistical management practices for delivering parts afloat in order to seek efficiencies and reduce average customer wait time for the end user. Furthermore, we evaluate whether the opportunity exists to leverage current technologies and practices in order to reduce the manpower involved or eliminate redundant steps in the process, resulting in shorter wait times and improved overall warfighting capability for U.S. Navy surface combatants.

Our objective for this thesis is to review current business practices and processes concerning the Navy's logistical operation afloat, specifically ways to gain efficiencies and reduce average customer wait time (ACWT) for delivery of onboard repair parts. As such, we focus our attention on the software used to process the demand for material, examine procedural guidance governing this process, and map the computer and human interaction required to physically deliver the part to the end user. At the conclusion of our project, we offer recommendations to improve shipboard logistic operations and reduce average customer wait time for the delivery of repairable parts.

II. BACKGROUND

A. LITERATURE

Although there is a large body of work surrounding business process management, we decided to summarize a collection of leading authors and theorists to best capture a concise literature review of this topic. As a result, the following summary is paraphrased from several sources concerning business process management.

Considered the father of scientific management, Frederick W. Taylor was a pioneer in the study of the efficiency movement, which has evolved into today's business process management (BPM). His focus on time/motion studies concerning manufacturing tasks became a revolutionary system for maximizing profits where efficiency and cost minimization were the primary business drivers. During this time, business functions were stove-piped and organizations would train their workers to follow specific steps that required little skill and repeat them over and over. Controls were put into place to regulate process drivers, and this resulted in much higher production levels. As a result of these efforts, the value of work standardization continues to remain a basis for many of our business processes today.

As time progressed, so did the evolution of business process management.

In the 1960s, technology increasingly became a business driver and amplified the speed of change. This launched the first wave of process orientation. International (Japanese) companies became much more competitive, due, in part, to their focus on quality improvement programs and reduced defects. U.S. companies started to mirror the quality approach. The combination of process scrutiny and technological superiority led to the consideration of technology as process driver. American business changed its operational paradigm, and the process era began. American business scrutiny of international competition changed focus to measurable processes and to speed that could be combined into "Just in time" manufacturing. The growing use of computers in the 1970s and 80s combined with procedure specialization that accommodated technological precision in fields such as nuclear power, led to quantitative statistical software and related data gathering techniques that measured, gathered, and interpreted results. (Lusk, Paley, & Spanyol, 2005, p. 4)

As a result of this evolution, three distinct business process types emerged, as shown in Figure 1: business management, quality control, and information technology.

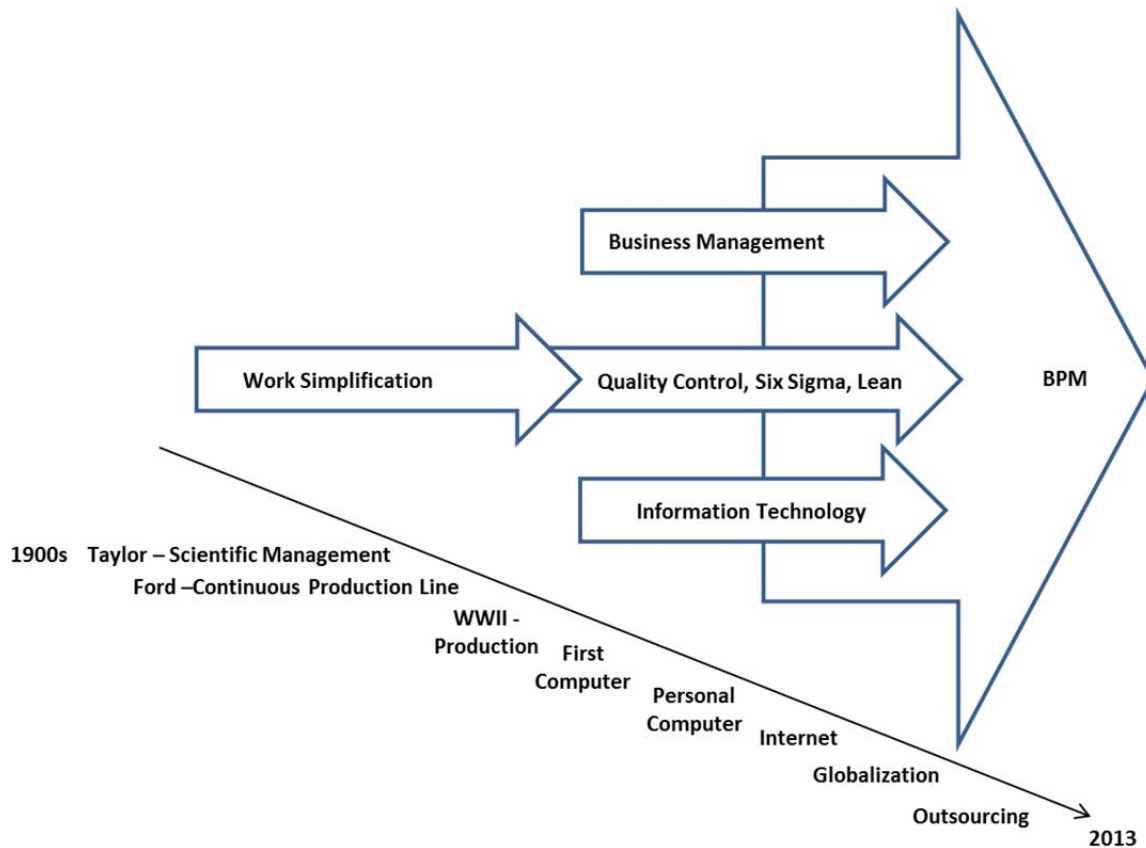


Figure 1. Business Process Management Evolution

1. Business Management

Business management is based in generic concepts surrounding the basics of business, including marketing, finance, and corporate vision rather than improvement in production or quality. In the 1980s, the United States began to lose market share in manufacturing to foreign competitors who focused on improving operations as a part of a grand business strategy. Producing large quantities, as the U.S. was accustomed to doing post-World War II, was no longer competitive in a global market. As a result, BPM took on a different role that focused on aligning all facets of a business into a greater corporate strategy in which the firm’s success was tied to the success of work performed by managers and their employees. In this light, business management suggests that every

process or activity must be managed and measured to ensure maximum performance for each subset of the firm. Management figures like Michael Porter also expanded on the idea of business management by arguing that “strategy was intimately linked with how companies organized their activities into value chains, which were, in turn, the basis for a company’s competitive advantage” (Porter, 1985, p. 34). This management practice broke down each activity of a company into either a core competency or a supporting role where achieving the best fit would determine the level of competitive advantage. As long as these activities are arranged in “proper” sequence and managers maintain a watchful eye on their own value scorecards, then a firm’s degree of success will improve.

2. Quality Control

The quality control method is a continuation of the work simplification rooted in the work of Taylor, addressing the most efficient way to perform a task. This methodology proved significant with the innovation of Henry Ford’s moving production line, which drastically cut down production time and unit cost. In fact, Ford was able to sell cars at such a low cost that every middle-class American could afford a car. Workers would begin assembling an automobile at one end of the factory while completing assembly of the final product at the other end. According to Harmon (2010), Henry Ford conceptualized the development of an automobile as a single process and designed and sequenced each activity in the process to ensure that the entire process ran smoothly and efficiently (p. 39). Furthermore, as a result of his efforts, almost every other manufacturing process throughout the world scrambled to learn this innovation and what lay behind Ford’s achievement. As mobilization for war in the 1940s ramped up, the United States was unmatched in its industrial capability concerning mass production of weaponry. This played a crucial role in an Allied victory while allowing the refinement of efficient production techniques. As the quality control movement marched into the 1970s, Japanese automakers expanded on the quality effort by introducing “lean” concepts into their production capabilities. This concept identified any effort or expenditure of resources that did not add value to a final product as waste and eliminated it from the process. In 2001, a new quality tool, Six Sigma, emerged within the business industry. By combining process analysis with statistical quality control techniques and a

program of organizational rewards, continuous process improvement was promoted to a level not seen before in previous attempts. In fact, General Electric CEO Jack Welch mandated a company-wide Six Sigma effort by tying 40% of every executive's bonus to Six Sigma results. As a result of its success, today's managers continue to tie in the benefit of Lean and Six Sigma processes into their corporate strategies.

3. Information Technology

With the introduction of desktop computers, automation of business processes has greatly increased the level of productivity in today's workplace. As a result of the ushering in of the Internet and web-enabled media, many basic job functions, such as records keeping and database management, have now expanded into global business applications. Processes that were once formally organized and staffed have been eliminated with the transition to online commerce. This allows customers to quickly transition from information gathering to ultimately purchasing items with a simple click of a button. Software development within the information technology (IT) realm has vastly improved computing power, thus allowing humans to analyze and solve complex problems in a wide variety of modeling scenarios. As a result of these developments, "business executives realize that there is no sharp contrast between a firm's business model and what the latest technology will facilitate; IT is no longer a service—it has become the pillar of the company's strategy" (Harmon, 2010, p. 51). With this in mind, a holistic approach should be taken into consideration when implementing IT applications into the business process management.

B. LEAN SIX SIGMA APPLICATION

This thesis represents a contribution to the study of process improvement from a Navy supply officer's point of view in order to promote the reduction of wait time for issuing repairable parts in a shipboard environment. As such, we believe the best business process approach for our project is focusing on quality control and the application of Lean and Six Sigma concepts.

1. DMAIC

The define, measure, analyze, improve, and control (DMAIC) methodology is considered the backbone of the Lean Six Sigma methodology for eliminating costly variation in business and manufacturing processes. The model uses statistical tools at each of its five steps; defining, measuring, analyzing, improving, and controlling to identify defects within a process and apply effective changes that will ultimately improve the entire process. A variety of statistical tools are used to briefly explain the collection of data, data analysis, and data presentation within the DMAIC process.

a. Define

Defining the problem is the first step. Defining the problem involves asking “What is the problem?” Sometimes the real problem may not be very clear; therefore, additional steps are required to define the problem, such as creating fishbone diagrams. Ultimately, defining the problem leads to identifying critical steps that are causing variations within the scope of the problem.

Fishbone diagrams are cause-and-effect diagrams. They represent a structured brainstorming analysis that identifies potential defects and hypothesizes the relationships between potential causes. Major categories of causes include methods, manpower, materials, equipment, measurements, and environment.

b. Measure

Measuring is the second step in the process. Understanding how the process works is critical in understanding how the process is measured. In order to measure the process, the baseline information, such as historical data, is often used to gain a better understanding of the events that are happening within the process. Process maps or flow charts help in understanding the current state of the process.

Swim-lane charts are a form of flow charts. They can be either vertical or horizontal and are visual flow charts outlining sub-processes within a process. They outline procedural and decision points within the process, as well as visually illustrating a starting point and an ending point for the process.

c. Analyze

Analyzing the data is the third step in the process. What are probable causes contributing to the problem? Statistical information attained from the analysis of data collected during the measurement phase provides insights for the sources of variations. Constraints in the process can be identified through formal testing of different hypotheses.

d. Improve

The improvement phase is the fourth step in the process and focuses on the top causes identified in the analyze phase that can be improved or eliminated to increase performance within the process. Once the top causes are identified, improvement solutions are brainstormed. It is important to develop a plan to implement and execute the solutions, as in a pilot program. Once the pilot program is in place, it is critical to use an evaluate phase to determine if the solutions are working. This step is repeated until the desired goal is achieved.

e. Control

The control phase is the last step in the DMAIC methodology. Many agree this is the second-most important phase after the define phase. The control phase maintains those changes identified in the improve phase to guarantee process improvements. Change is often perceived as negative. Without consistent management of this phase, it is easy to revert to conducting business the previous way. Therefore, it is important to implement the improvements identified in the improve phase and provide a new process map that outlines the new procedures, as well as employee training to communicate the new standard practice.

C. METHODOLOGY

We applied concepts and theories associated with supply chain management as well as statistical analysis techniques we learned in our 18-month MBA curriculum. The sample consisted of seven U.S. Navy Destroyers that have ballistic missile defense (BMD) capabilities, stationed in the Pacific Fleet. Then we utilized survey methods for

gathering information and conducting onboard interviews as well as observing the key players involved in the shipboard requisition process.

We embarked two U.S. Navy Destroyers home ported in San Diego, California. We conducted interviews with the supply officer, leading chief petty officer, and DLR custodians, while making observations concerning the issuance of DLRs. In addition, we electronically distributed surveys to the remaining ships based in Hawaii, Japan, or on deployment. The total survey respondents consisted of 28 sailors and seven officers that provided data concerning their respective requisition practices.

We mapped the requisition process with subject-matter experts at the Afloat Training Group (ATG), which is responsible for training shipboard personnel on IT systems used for ordering and issuing parts. Finally, we contacted Naval Sea Logistics Center and Commander Naval Surface Force commands, which provided sources of data concerning ACWT to compare with our human observations.

D. SHIPS AND ASSIGNED PERSONNEL

Shipboard personnel responsible for the process of fulfilling demand for DLR parts are called logistics specialists (LSs). Onboard ship, they fall under the departmental supervision of a commissioned officer of the U.S. Navy Supply Corps and the organization known as the Supply Department. LSs play a key role in the DLR request process by ensuring requests for parts are properly submitted, are compliant with technical specifications, and are issued in a timely manner to meet operational requirements. They use a computer database known as Relational Supply (RSupply) to process these demand requests, track inventory, and maintain financial accountability of operational target (OPTAR) funds. In addition to these requirements, LSs also perform daily duties such as procurement, receipt, and stowage of shipboard parts. We conducted extensive research concerning the time it takes a DLR part that is available in the ship's inventory to reach the end user who originally created the demand.

We sat down with each LS responsible for issuing DLR parts in order for them to walk us through every step of the DLR request process, including the electronic input required by RSupply and the human action involved in delivering the repair part to the

end user. We asked questions at each step of the process to clarify any ambiguity concerning the reasoning for starting or stopping action at a particular step. We utilized a digital device to record each step verbally and took screen shots of each step within RSupply. After recording the process, we held physical interviews with every LS in order to ask questions about the DLR request process from their personal experience. Our analysis was extensive and provided answers to the following questions:

- What was the average level of experience for logistics specialists onboard?
- How many steps were required to satisfy demand from stock to end user?
- How long did each step in the process take?
- How many steps were required within RSupply to issue a part?
- How long did each step of the process take in RSupply?
- How many steps were required outside of RSupply that involved human action?
- How many people were involved in the human action?
- How would you improve the DLR process in order to reduce ACWT?

We also conducted physical interviews with each supply officer concerning the DLR request process to gain a supervisory perspective.

E. AFLOAT TRAINING GROUP PACIFIC

The Afloat Training Group (ATG) Pacific provides training for the fleet combatants in order to evaluate their level of mission readiness. In addition, it provides learning centers and classroom instruction for all shipboard procedures as well as guidance on the latest naval instructions, directives, and publications. We contacted senior-level LSs and RSupply subject-matter experts based in San Diego to conduct interviews concerning the requisition process. We wanted to ensure they understood the

rules and regulations surrounding the requisition process and to identify the Navy publications, instructions, and shipboard policies that governed the process. We gathered information on proper procedures a request for repairable parts should follow as well as the necessary signature authorities involved and the publications that govern the process.

F. COMMANDER NAVAL SURFACE FORCE PACIFIC

The Commander Naval Surface Force (COMNAVSURFOR), Pacific, is the type commander (TYCOM) for all surface vessels in the Pacific fleet. The force provides operational commanders with highly skilled and well-trained sailors to operate sophisticated and state-of-the-art surface vessels. It provides seasoned technical expertise in all facets of surface combatants. In regards to supply operations, COMNAVSURFOR provides guidance and subject-matter expertise in financial management and inventory control procedures.

COMNAVSURFOR maintains the Continuous Monitoring Program (CMP). The CMP is a highly utilized tool that monitors the health of a ship's supply department metrics. The CMP extractor retrieves real-time data from surface ships in regards to supply, food service, and ship store divisions. According to COMNAVSURFORINST 4400.1 (Commander, Naval Surface Forces, 2008), the CMP website is continuously viewed by the type commanders, CLASSRONS, and ATGs to monitor ship performance and data trends. Based on the data trends for a particular ship, ATG will offer assistance and training to correct any discrepancies. Ships will use the CMP website to review data trends, obtain the latest extractor software, view current DLR carcass charge data, and respond to data calls by COMNAVSURFOR.

We obtained one year of historical CMP data for all seven U.S. Navy Guided Missile Destroyers (DDG) with Ballistic Missile Defense (BMD) capability home ported in the Pacific fleet. The CMP data provided ACWT for onboard and off-ship repairable and non-repairable requests and requisitions from the time a request was originally generated in RSupply. This information was valuable in determining ACWT for onboard issues of DLRs.

G. NAVAL SEA LOGISTICS CENTER

Naval Sea Logistics Center (NSLC) is the premier provider of logistics and information technology to the U.S. Navy. NSLC serves as the Naval Sea Systems Command (NAVSEA) technical agent for developing, maintaining, and assessing life-cycle logistics to provide superior, cost-effective, and innovative logistics, engineering, information technology, and quality assurance solutions that meet the life-cycle requirements of the Navy (NSLC, 2012).

NSLC utilizes Open Architecture Retrieval System (OARS) metrics to capture ACWT in OMMS-NG. NSLC provided one year of historical OARS data for all seven U.S. Navy Guided Missile Destroyers (DDG) with BMD capability home ported in the Pacific fleet. OARS data is valuable because it calculates ACWT from demand created in OMMS to issue in RSupply. CMP data calculates ACWT from request/requisition to issue in RSupply.

III. INVENTORY PROCEDURES

A. DEPOT LEVEL REPAIRABLES

DLRs are repair parts that are centrally funded and managed on a fixed allowance by NAVSUP Weapons System Support (WSS) in Mechanicsburg, Pennsylvania. Each ship's platform type is unique and is initially outfitted with the required number of allowances set by the TYCOM to support mission requirements.

Every ship is responsible for managing its DLR program via guidance from NAVSUP P485 and COMNAVSURFORINST 4400.1 (Naval Supply Systems Command, 2005a; Commander, Naval Surface Forces, 2008) to ensure the crew maintains strict controls and accountability of high-priced maintenance parts. The loss of any DLR can result in the relief of the supply officer, who is responsible for the shipboard DLR program. To keep this loss from happening, the supply officer maintains strict oversight of the program by assigning a responsible and trusted DLR custodian. The DLR custodian is primarily responsible for the inventory, ordering, receiving, validating, handling, and issuance of all DLRs. If the DLR custodian is unavailable to carry out these functions, the responsibility is delegated to the assistant DLR custodian. The fewer personnel handling DLRs, the greater the chances of maintaining 100% accountability in inventory validity.

According to COMNAVSURFORINST 4400.1 (Commander, Naval Surface Forces, 2008), the primary objective of the DLR program is to improve availability of DLRs, which ultimately results in improved fleet readiness. As a result, the procurement authority for DLRs maintains strict requirements for shipboard supply departments that require a rapid turn-in of broken or non-ready-for-issue (NRFI) DLRs to shore repair facilities. The supply officer is responsible for ensuring compliance with these DLR directives and procedures relative to shipboard departmental turn-ins. The supply officer accomplishes this objective by implementing a comprehensive and continuous DLR training program for supply and maintenance personnel stressing the importance of time for receiving and issuing DLRs.

Request and requisitioning of DLRs is a complex task that is performed by LSs. This responsibility is normally restricted to trained and experienced LSs because it involves the validation and processing of high-priced repair parts. DLRs can be processed two ways: internally and externally. DLRs processed and issued internally onboard the ship are assigned an identification number. Depending on which version of RSupply a ship is using, this identification number will be referenced by different styles of letters and numbers, but they serve the same purpose. For example, if a ship utilizes version CY04, then the identification number, known as a request number, is displayed in the form of work-center, Julian date, and a sequentially assigned serial number as seen in Figure 2.

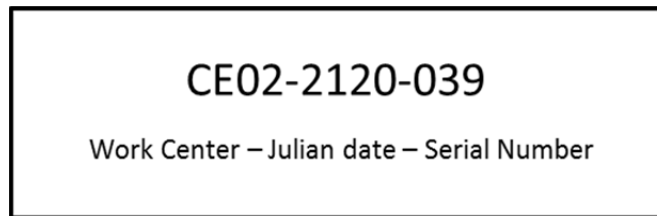


Figure 2. CY04 Identification Number

If RSupply Viking is being used, then the identification number, known as a requisition number, will be utilized. The requisition number is composed of the ship's unit identification code (UIC), Julian date, and a four-digit sequentially assigned serial number as seen in Figure 3.

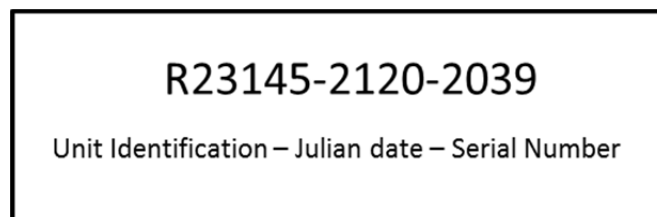


Figure 3. Viking Identification Number

All DLRs are identified by an advice code. An advice code provides amplifying instruction on the proper handling of a part based on a hierarchy of importance. In other words, as parts become less available, the more valuable they become. Among the numerous advice codes used, the most common are 5G and 5S. COMNAVSURFORINST 4400.1 Appendix D (Commander, Naval Surface Forces, 2008) defines these advice codes as follows:

- 5G: NRFI carcass will be turned in to the supply system on an exchange basis.
- 5S: remain-in-place (RIP) certification. NRFI carcass will be turned in to the supply system upon receipt of requested item.

These advice codes serve as a cost-savings initiative, allowing ships to reduce the amount of funding required to purchase new repair parts by turning in NRFI for a discount. If a repair part is designated 5G, then it requires a one-for-one exchange at the time of issue from shipboard stock. If it is a 5S part, then a new part can be issued without requiring the NRFI at the time of exchange. There are instances when the DLR advice code is 5G but the maintainer insists that the NRFI carcass must remain in the system to prevent the entire system being inoperable. In this instance, the work center is required to route an RIP chit requesting the degraded part stay installed while receiving a new one from stock. As a result, RIP chits provide command-wide visibility while notifying shore-side item managers of a possible delay concerning carcass turn-in.

B. AVERAGE CUSTOMER WAIT TIME (ACWT)

In order to improve operational readiness, the Navy captures data points and tracks metrics on several key processes of the request and requisitioning cycle. ACWT is continuously monitored and assessed within several Department of Defense organizations because it provides a functional baseline for a system's real-time operational availability (Ao). Defined by OPNAVINST 4441.12D (Chief of Naval Operations, 2012), ACWT is a comprehensive measure of the time elapsed between the customer requirement submission time and the time of receipt by the customer. Simply stated, ACWT is the time elapsed from when demand is created until the time when the part is issued to the

end user. As a result, ACWT impacts Ao because it determines how quickly demand is satisfied and a system is restored to normal operations as seen in Figure 4.

$$Ao = \frac{MTBM}{MTBM + MDT} = \frac{Up\ Time}{Up\ Time + Down\ Time} = \frac{(Total\ Time - CM\ Down\ Time - PM\ Down\ Time)}{Total\ Time}$$

Figure 4. Operational Availability

C. LOGISTICS RESPONSE TIME (LRT)

LRT is the portion of ACWT that measures the average time from the date of the requirement to the time the material is received by the end user. It is made up of the response time for off-station and off-ship processing. LRT consists of the following elements: requisition submission time, inventory control point (ICP) processing time, depot processing time, transportation time, and receipt take-up time.

1. Requisition Submission Time

Requisition submission time is the measure of time from the Julian date of the requisition to the time it is received by the Defense Logistics Agency Transaction Services (DLATS).

2. Inventory Control Point Processing Time

ICP processing time is the time from the referral by DLATS to the ICP until the ICP submits a referral to the depot for issue.

3. Depot Processing Time

Depot processing time is the time from receipt of the referral at the depot to the time it is shipped.

4. Transportation Time

Transportation time is the period of time from the date that material is inducted into the transportation system until the material is received at the requesting activity.

5. Receipt Take-Up Time

Receipt take-up time is the time it takes the customer's supply activity to post a receipt for the material and report that receipt to DLATS.

D. NAVAL TACTICAL COMMAND SUPPORT SYSTEM

The ship's database that captures asset inventory—to include the DLR receipt and requisitioning process—is the Naval Tactical Command Support System (NTCSS). NTCSS is a Space and Warfare System (SPAWAR) information system program that provides mission support capabilities through direct visibility from afloat activities to ashore activities. NTCSS makes possible the management of logistics, personnel, material, equipment maintenance, and finances required to maintain and operate all ships and submarines.

The NTCSS database supports three major applications: Relational Supply (RSupply), Relational Admin (RADM), and Organizational Maintenance Management System–Next Generation (OMMS–NG). For the purpose of this thesis, we discuss both RSupply and OMMS–NG, but primarily RSupply, as seen in Figure 5.



Figure 5. NTCSS Database

1. Operational Maintenance Management System–Next Generation

OMMS–NG is the system utilized by work centers to record their maintenance, create work candidates, and order parts. Each work center is identified in the OMMS by

division code, for example, ER09. Once the work center identifies a system within their division that is degraded or broken, the work center enters a work candidate to fix the system. The work candidate is a serialized number assigned to the job and describes the failed system. Once parts are identified to fix the degraded system, the work center's repair parts petty officer (RPPO) orders the parts in OMMS-NG, demand is created, and ACWT begins. OMMS-NG interfaces with RSupply and a request/requisition number is generated in RSupply.

2. RSUPPLY

RSupply is the application within the NTCSS database that LSs utilize most often for daily operations such as ordering, receiving, and issuing parts. According to *RSupply Unit User's Guide* NAVSUP P-732 (Naval Supply Systems Command, 2005b), the software was initially deployed to the fleet in 1997. In March 2005, RSupply was upgraded to version CY04. Since then, RSupply has undergone several software upgrades including the version known as Viking. Currently, 50% of the fleet is utilizing RSupply-Viking with the goal of transitioning all ships to RSupply-Viking before the end of the 2013 fiscal year. Both RSupply CY04 and Viking have five subsystems used to perform daily operations: site, inventory, logistics, financial, and query. However, for this thesis, we only focus on the logistics subsystem, as seen in Figure 6. A series of processes take place within the logistics subsystem that captures the steps from when the request/requisition is originally generated in RSupply. The request/requisition follows a series of processes that include tech edit, requirements approval, and issue.



Figure 6. Logistics Subsystem Menu in RSupply

IV. DEFINING THE PROBLEM

A. CURRENT STATE

What is the problem? The defect is ACWT per month per ship. As discussed in Chapter II, we utilized the DMAIC methodology to assist us in identifying possible reasons for excessive ACWT concerning the issue of repair parts. Since ACWT is measured monthly per ship, we wanted to find the number of defects that violated the established metrics that govern this process, as well as possible causes for these defects. In order to answer this question, we developed a fishbone diagram to assist us in brainstorming potential causes that contributed to excessive ACWT.

B. FISHBONE DIAGRAM

We began by interviewing shipboard personnel responsible for issuing DLRs. The sample size consisted of 16 LSs and seven supply officers from seven separate DDG platforms. A series of personal interviews and electronic surveys were performed to gather information about the DLR process. While we asked myriad multiple-choice questions concerning the process itself, the most valuable responses came from open-ended questions, focused on improving ACWT.

Although the fishbone diagram does not necessarily define the problem, it offers insight into possible defects that cause the problem. Based on this approach, we organized these responses into the diagram, to better explain potential causes for increased ACWT. Figure 7 shows the organization of responses into six separate categories: Machine, Manpower, Management, Method, Material, and Measurement.

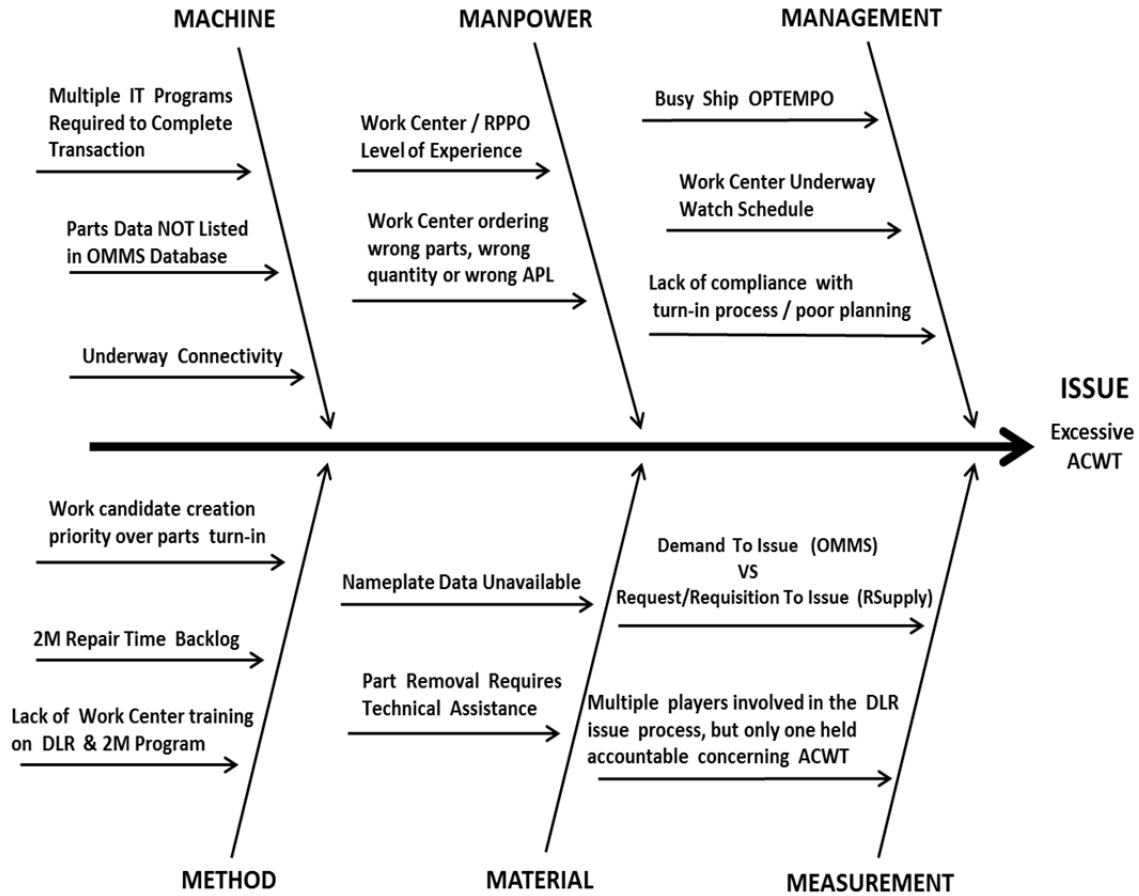


Figure 7. Fishbone Diagram

1. Machine

Once supply personnel receive demand for parts in RSupply, they must consult various databases outside of RSupply to ensure the parts data are correct during the tech edit process. This requires additional time outside of RSupply to open and search each line item, one by one. Multiply this effort by hundreds of part requests on a daily basis and delays will become apparent. Many times, parts data may not be available in the shipboard OMMS database. This causes delays in both the work center's creation of a work candidate, as well as the verification of parts by the supply department. If these configuration updates, known as automated shore interfaces (ASIs) are not current, then the entire DLR process will experience longer wait times as a result. Finally, ship connectivity continues to cause delays in the issuance of DLR parts due to a lack of

satellite communication or limited bandwidth for conducting parts research. Many of these parts databases are web-based and require a solid connection for transferring data.

2. Manpower

Work center personnel lack the level of experience required for properly entering parts data for their respective work candidates. This leads to various mistakes or the cancellation of parts due to a large number of errors. Department heads, responsible for auditing such mistakes, will many times approve work candidates to simply keep work moving and reduce the demand in their OMMS queue. In fact, many times a work center will request the wrong parts or quantity, simply to complete and push a work candidate through, to prove maintenance requirements are up to date. This causes a delay once the parts are audited by supply personnel, requiring the work center to repeat the parts entry.

3. Management

A ship's schedule is always subject to change based on geographic location as well as world events taking place. Consequently, maintenance that was scheduled during an inport time frame can easily be delayed due to a change in the ship's underway schedule. As a result, parts requested for that maintenance will also wait in the queue until the ship returns to port. While underway, a ship also requires a number of watch standers to operate and provide safe navigation. This means the number of personnel available to pick up parts or turn in carcasses is limited. As a result, parts demanded will sit idle, along with requests in the demand queue. Additional issues take place at the departmental and executive level, where leaders are more concerned about operational availability rather than following timely turn-in procedure for DLR parts.

4. Method

While entering parts data to complete a work candidate, work centers are able to see if a part is in stock, via the relationship between OMMS and RSupply. As a result, if work center personnel believe a part is in stock, they will continue to focus their efforts on maintenance production versus making a concerted effort to turn in a carcass and

receive the new part requested. In other words, there is a belief that parts in stock can wait on the work center, regardless of any timeline requirements.

If a part is determined to be miniature/microminature (2M) eligible, during work candidate creation, work center personnel are required to attempt to fix the part before requesting a replacement from stock. However, based on feedback received from the authors' surveys and interviews, most work centers ignore this notice, given in OMMS, until the supply department requests the paperwork associated with the 2M repair attempt at the time of carcass turn-in. At this point, the 2M repair must be attempted while the ACWT continues to elapse. Compounding this issue is the backlog of 2M parts waiting on repair onboard ship or at the regional maintenance facility.

Finally, a general lack of knowledge and training was evident concerning correct turn-in procedures for DLRs and 2M items for shipboard work centers.

5. Material

Identification of parts is sometimes laborious due to missing nameplate data on installed systems. This requires additional time for consulting tech manuals or contacting other ships with the same system to identify the part(s) required to make the repair. This slows down work candidate production as well as increases ACWT. Finally, depending on the skill level of work center personnel, many times, what was thought to be a simple repair may require outside assistance. This causes a pause in the issuance of repair parts demanded, while waiting on technical assistance.

6. Measurement

Ambiguity still exists concerning the best way to measure ACWT. Based on two different sets of guidance, there are consequently, two different metrics that measure it. Based on the responses given during the authors' interviews, supply personnel suggest that work center personnel are not held to the same ACWT standard or metric, which causes a type of natural tension concerning the DLR process. As a result, only one party is held accountable for ACWT, while the other continues to focus on a different set of administrative priorities.

V. MEASURING THE PROBLEM

A. ESTABLISHING A BASELINE

In order to properly measure the problem, we established a baseline understanding of the business rules that govern the issuance of DLRs. In addition, we created a process map to include both human and computer actions required to complete this action as it takes place in OMMS and both versions of RSupply. By utilizing this type of measurement, we were able to break the problem down into smaller pieces for closer analysis.

B. LOGISTICS PROCESS

DLR parts require a one-for-one turn-in known as a carcass during the procurement process. Hence, a work center cannot request a DLR unless it is directly in support of a maintenance action. As a result, this increases flexibility in procurement funding because DLRs function on a two-tier pricing system. Each DLR has a net price and a standard price. When procuring a DLR and a carcass turn-in is available, the procuring entity obligates funds at the net price. However, if a carcass turn-in is not provided because the repair part was lost, misplaced, or destroyed, the procuring activity will obligate funds at the standard price. The difference between the net price and standard price for DLRs can range from a few hundred dollars to thousands of dollars. Hence, it is extremely important to have strict inventory controls over DLRs.

To determine whether or not a DLR can be issued from stock without a turn-in, LS personnel must check the advice code for each part. An advice code is a two-digit alphanumeric code that tells the LS what type of DLR is being ordered.

Due to their high monetary value, DLRs are highly visible repair parts that are governed by several instructions. Naval Supply Systems Command (NAVSUP, 2005a) provides naval supply procedures in Volume I of the P485 publication that establishes policy for management of afloat supply operations. The section titled “Special Materials

part D” establishes DLR procedures for requisitioning quantities, pricing, procurement, transfers, carcass turn-in procedures, issues, inventory adjustment, stock record cards, allowances, and inventory control.

COMNAVSURFORINST 4400.1 (Commander, Naval Surface Forces, 2008) provides policy and procedures for supply operations to include a detailed “DLR Appendix D” that establishes clear and updated guidance concerning the issue, turn-in, requisitioning, and inventory management of DLRs. In addition, this instruction amplifies and supplements previous guidance set forth in NAVSUP P485 (Naval Supply Systems Command, 2005a), stressing the importance of DLR training offered by ATG subject-matter experts (SMEs).

Naval Supply Systems Command (NAVSUP, 2005b) P-732 provides RSupply user guidance to unit-level end users. This manual provides step-by-step guidance for LSs concerning the processing of DLRs and related supply functions within RSupply.

NTCSS captures every step of the DLR issue process from work candidate entry into OMMS–NG, to parts issue in RSupply. Depending on the shipboard version of RSupply, CY04 or Viking, variability exists in the configuration of steps necessary to satisfy demand for parts.

C. OMMS–NG

All maintenance performed in the U.S. Navy is subject to a work standardization hierarchy consisting of three levels of maintenance, organizational, intermediate, and depot-level. As a result, different levels of maintenance fall into a work breakdown structure that best aligns to the various levels and capabilities of naval engineering and logistical support. This ensures maintenance tasks are consistent with job complexity and the range of work to be performed. For the purpose of this thesis, we will focus only on the Organizational level of maintenance.

Per OPNAV INST 4700.7K, “Organizational-level maintenance is the lowest maintenance level and consists of all maintenance actions within the capability of the ship’s force.” More importantly, it is considered the first line of defense against small

defects becoming major operational problems and also promoting improvement in self-sufficiency and self-assessment capabilities. As a result, today's Navy is required to recognize, identify, and report equipment failure or symptoms of operation below standards during zone inspections, preventative maintenance execution, or watch standing activities.

To help with this level of repair and maintenance, the U.S. Navy relies on software entities such as SPAWAR, to develop and maintain an evolving electronic database to schedule and document shipboard repairs. Typically referred to as "OMMS," OMMS-NG is a subset of SPAWAR's NTCSS suite, intended to provide shipboard maintenance personnel with convenient access to the latest shipboard configuration data, aid in the creation of work candidates, as well as provide the ability to input, order, and track parts.

Figure 8 gives a visual diagram of the steps involved in OMMS including the human interaction required to satisfy the demand for parts to fix a broken or degraded system. Each step that requires human action is annotated by a number, while any software program functionality is annotated with a letter. If there is a step in the diagram that does not have a number or a letter beside it, then there is no human or computer action required at that point in the process. We will utilize this type of graph to explain all software and human action involved in the DLR issue process.

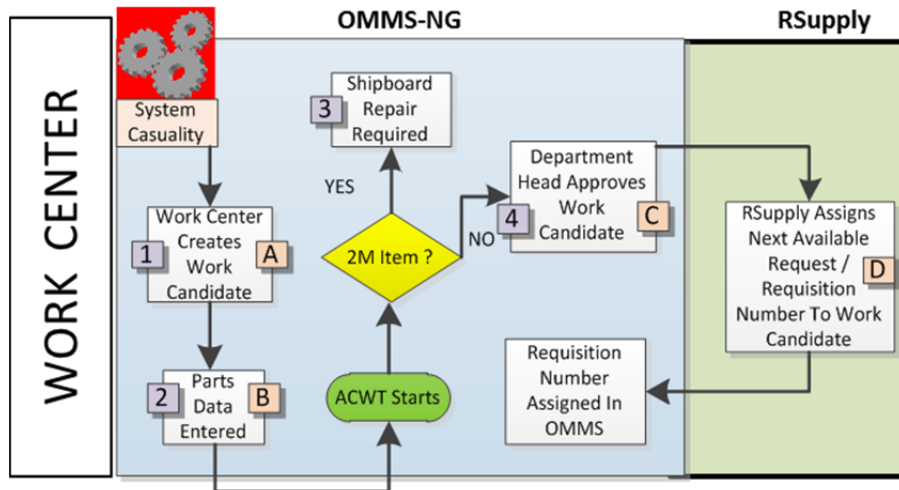


Figure 8. OMMS Swim Lane Chart

System Casualty:

Shipboard systems are complex and require constant monitoring by qualified personnel in order to maintain optimal operation. As a result, U.S. Navy ships are physically organized into spaces with groups of people assigned to those spaces and equipment in them. These groups of people are commonly referred to as work centers. This organizational structure ensures every piece of equipment or system onboard receives required maintenance as well as minimizes any ambiguity concerning ownership of a specific piece of equipment. Once a system becomes degraded or inoperable, an investigation into the casualty takes place. The work center responsible for repairing the casualty will identify the root cause for failure as well as the part or parts needed to fix the system.

Work Candidate Created:

1. Work center personnel log into the OMMS program and create a work candidate file to identify their specific body of work on a unique piece of equipment. Once the work candidate is serialized, work center personnel input data about the system casualty that includes a description of capability lost, equipment name, serial number, and priority of repair.

A. Each work candidate entered into OMMS is recognized by a sequence of numbers and letters that identify a specific ship, corresponding work center, and sequenced event number. OMMS will serialize each work candidate so that the candidate is easily recognized by work center personnel for future reference.

Parts Data Entered:

2. Work center personnel consult tech manuals and configuration data concerning the broken or degraded part that caused the system failure. Once they have identified the correct part(s) required to fix the system, they will select the part(s) from the corresponding system configuration database in OMMS and include this request for parts under the work candidate.

B. OMMS displays the latest database of parts associated with a system as well as the quantity of parts personnel are allowed to order against a single repair. This ensures actual demand is recorded for inventory purposes, rather than work centers creating their own safety stock of parts. In addition, OMMS provides amplifying information on each DLR requested, classifying it as miniature/microminature (2M) eligible or non-eligible. If a part is 2M eligible, OMMS will display a notification message during the parts request to let work center personnel know to follow 2M procedures before attempting to order the part.

Once parts data are entered under a work candidate, average customer wait time starts.

Shipboard Repair:

3. If a part is 2M eligible, then an attempt to repair the part must be performed before a new part is issued from stock. This procedure avoids dollars wasted on ordering a new part as well as increases shipboard readiness.

Department Head Approval:

4. Once a work candidate is complete, it must be reviewed by the senior officer in charge of that work center. This officer, known as the department head, is required to review all work candidates in order to screen them for accuracy and validity. If a work

candidate is deemed to be correct, the department head will approve the work candidate in OMMS. If incorrect, the department head will correct the errors, notify the work center to make corrections, or cancel the work candidate completely.

C. OMMS organizes each work candidate by work center and displays the list of work candidates ready for review under the department head access.

Request / Requisition Number Assigned:

D. Once the department head approves a work candidate, OMMS will interface with RSupply to assign an identification number to each part listed under a work candidate. Depending on which version of RSupply a ship is using, this identification number will be referenced by a different type of number, but all numbers serve the same purpose. The CY04 version of RSupply assigns a request number, while Viking assigns a requisition number. At this point, work candidates and their associated request for parts are visible to supply personnel who are responsible for managing this demand inside of RSupply.

D. RSUPPLY CY04

Figure 9 gives a visual representation of the steps involved in RSupply CY04 as well as the human interaction required to satisfy the demand for parts to fix a broken or degraded system.

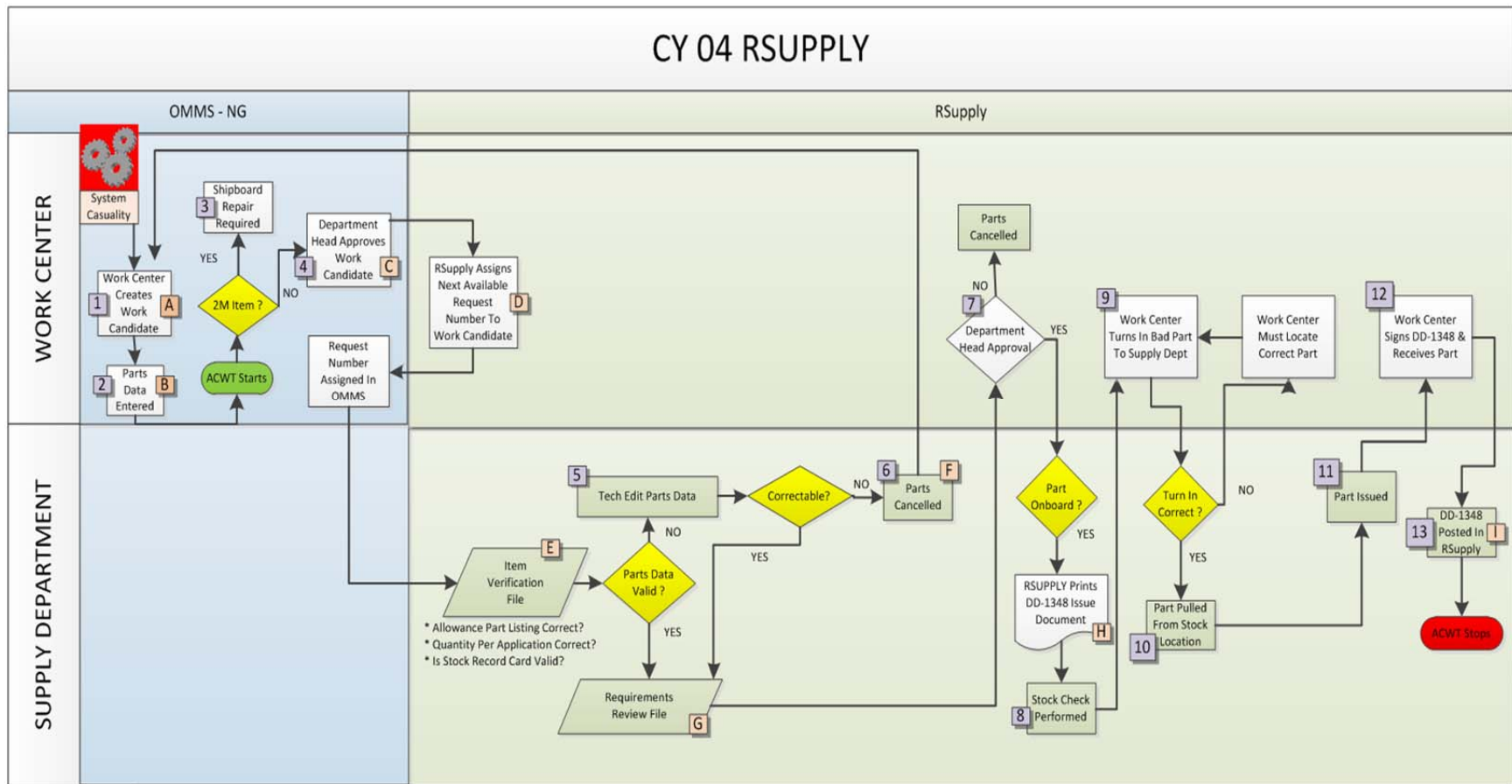


Figure 9. CY04 RSupply Swim Lane Chart

Item Verification

E. The item verification file is the first step in RSupply after the department head approves the work candidate and a request number is assigned in OMMS–NG. This is an automated process that validates the part(s) demanded against the stock record file (SRF) built into RSupply. This assures the right part is ordered for the correct corresponding system, avoiding unnecessary costs for ordering the wrong parts. In addition to proper identification, CY04 will check the quantity of a specific part requested in a work candidate so that it does not exceed the quantity required to fix the system. If the automated process deems the request valid, it will bypass tech edit and go directly to the requirements review file. However, if the request is not valid for reasons mentioned previously, it will go to tech edit for further item verification.

Tech Edit

5. Tech edit is performed on all requests that fail the initial automated item verification screening. At this point, the LS utilizes several parts management software systems outside of RSupply to verify that every category of parts data is correct. Any discrepancies overlooked can create defects resulting in an increase in price or greater quantity of parts ordered.

Parts Cancelled

6. Defects that cannot be corrected result in the cancellation of the requested part(s) by the LS in CY04. If demand is still valid, the work center will have to re-submit the request in OMMS–NG once again, this time using the correct information.

F. CY04 cancels the part(s) request associated with the work candidate and annotates that action in an electronic transaction log.

Requirements Review

G. The requirements review file receives both requests that passed the automated item verification and requests that were corrected by LSs in tech edit. It consolidates these requests into a listing of all shipboard requirements. The list is broken down alphabetically by work center as seen in Figure 10.

Approve	Delete	Request Number	NIIN	Nomenclature	Qty Rqstd	Matl Avblty	EMV	Budget
<input type="checkbox"/>	<input type="checkbox"/>	CA01 4346 -012	01-469-9115	DISK DRIVE UNIT	1	NC	154.00	Maintenance
<input type="checkbox"/>	<input type="checkbox"/>	CA02 4345 -002	01-107-1304	CIRCUIT CARD ASSEMB	1	NC	384.00	Maintenance
<input type="checkbox"/>	<input type="checkbox"/>	CE01 4337 -016	01-173-2365	CIRCUIT CARD ASSEMB	1	ONBD	613.00	Maintenance
<input type="checkbox"/>	<input type="checkbox"/>	CE01 4345 -025	01-235-3036	GASKET	1	ONBD	16.93	Maintenance
<input type="checkbox"/>	<input type="checkbox"/>	CE01 4345 -026	01-224-6803	GASKET	1	ONBD	4.99	Maintenance
<input type="checkbox"/>	<input type="checkbox"/>	CE01 4345 -028	01-236-5066	GASKET	1	ONBD	34.56	Maintenance
<input type="checkbox"/>	<input type="checkbox"/>	CE02 4344 -029	00-230-8366	ELECTRON TUBE	2	ONBD	1,793.22	Maintenance

Figure 10. Requirements Review Menu

DH Review

7. The requirements review file allows authorized users to review and approve or delete requirements in the requirements queue. Department heads are required to review their associated file and approve or disapprove these requests. If the department head disapproves a request in requirements review, the request for part(s) is cancelled and the parts are deemed no longer needed.

Issue Document Printed

H. Once the department head approves the work candidate, RSupply will automatically compare the parts requested against shipboard inventory. For those parts that are in stock, RSupply will automatically print an issue document in the supply office, known as a NAVSUP DD 1348-1A; an example is shown in Figure 11.

STOREROOM ISSUES **PRINTED: 12175 1758**

1. FROM: X31RBX										2. SHIP FROM: EA0001										3. SHIP TO: YNCM02 ANB										4. UNIT PRICE: 7HEK5051805GRBX										5. DOLLARS: H0649100										6. CTS: 649100																																							
7. QUANTITY: RXXXXX 2175 CM41										8. SUPPL. HEADQ. ADDRESS: 6130 01 271 9705										9. OFF. BU. TION: RBX EA 00001 7H 0649100										10. PROJ. JECT.:										11. P. R.:										12. R. C. D. A.:										13. W. E. A. D.:										14. S. E. A. R. C. H.:										15. S. E. A. R. C. H.:									
16. DOC DATE:										17. MMFC:										18. FRST RATE:										19. TYPE CARGO: COSAL Type HME										20. PS: U																																																	
21. QTY RECD:										22. LP:										23. UNIT WEIGHT:										24. UNIT CUBE:										25. LFC:										26. SL: 0																																							
27. FREIGHT CLASSIFICATION NOMENCLATURE:										28. ITEM NOMENCLATURE: POWER SUPPLY										29. TY CONT:										30. NO CONT:										31. TOTAL WEIGHT:										32. TOTAL CUBE:																																							
33. RECEIVED:										34. DATE RECEIVED:										35. RECEIVED:										36. DATE RECEIVED:																																																											

SMIC: UND: B DBI: NO COSAL Sup: YES FPR: NO

CAGE: P/N:

JCN: CM020750 EIC: 5AVF000 APL: 004230541

Avail: ONBD DMD: R

TEC: BUNO:

Locations	COS	Iss Qty	Inv Qty	Sub NilNs	Locations	COS	Iss Qty	Inv Qty
B03C	HME	1	3					

Remarks:

POSTED
No 2175

3D FORM 1348-1A, NOV 87 ISSUE RELEASE RECEIPT DOCUMENT
 ADDITIONAL DATA
 1. DOCUMENT NO. (1348-1A)
 2. STOCK NO. (1348-1A)
 3. PART NO. (1348-1A)
 4. UNIT PRICE (1348-1A)
 5. DOLLARS (1348-1A)
 6. CENTS (1348-1A)

FORM APPROVED OMB NO 0704-0188

Figure 11. DD Form 1348-1A Issue Request Form

Stock Check

8. Once a DD 1348-1A prints, LS personnel responsible for issuing DLRs will conduct a physical stock check to ensure the part is onboard. Once verified onboard, the LS will look up the advice code for the DLR part demanded to determine if a carcass turn-in is required at the time of exchange.

Carcass Turn-In

9. If the DLR requested is 5G, the work center is required to bring the NRFI carcass to the DLR custodian at time of exchange. If the NRFI carcass is incorrect, the DLR custodian does not issue the ready-for-issue (RFI) part and the work center must locate the correct NRFI carcass. If the NRFI carcass is not available for turn-in, a RIP chit is required in the absence of the NRFI carcass to issue the RFI part.

Part Pulled

10. The DLR custodian retrieves the RFI DLR from the storeroom.

Part Issued

11. The DLR custodian physically gives the RFI DLR to the work center.

Work Center Receives Part

12. The work center signs and dates the DD1348-1A to confirm receipt of the RFI part.

Posting

13. The DLR custodian manually posts the issue into RSupply.

I. RSupply adjusts the SRF to reflect the part was issued and ACWT stops.

E. RSUPPLY VIKING

In addition to the CY04 version of RSupply, the latest upgraded system utilized by the Navy is Viking. Figure 12 gives a visual representation of the steps involved in Viking as well as the human interaction required to satisfy the demand for parts to fix a broken or degraded system.

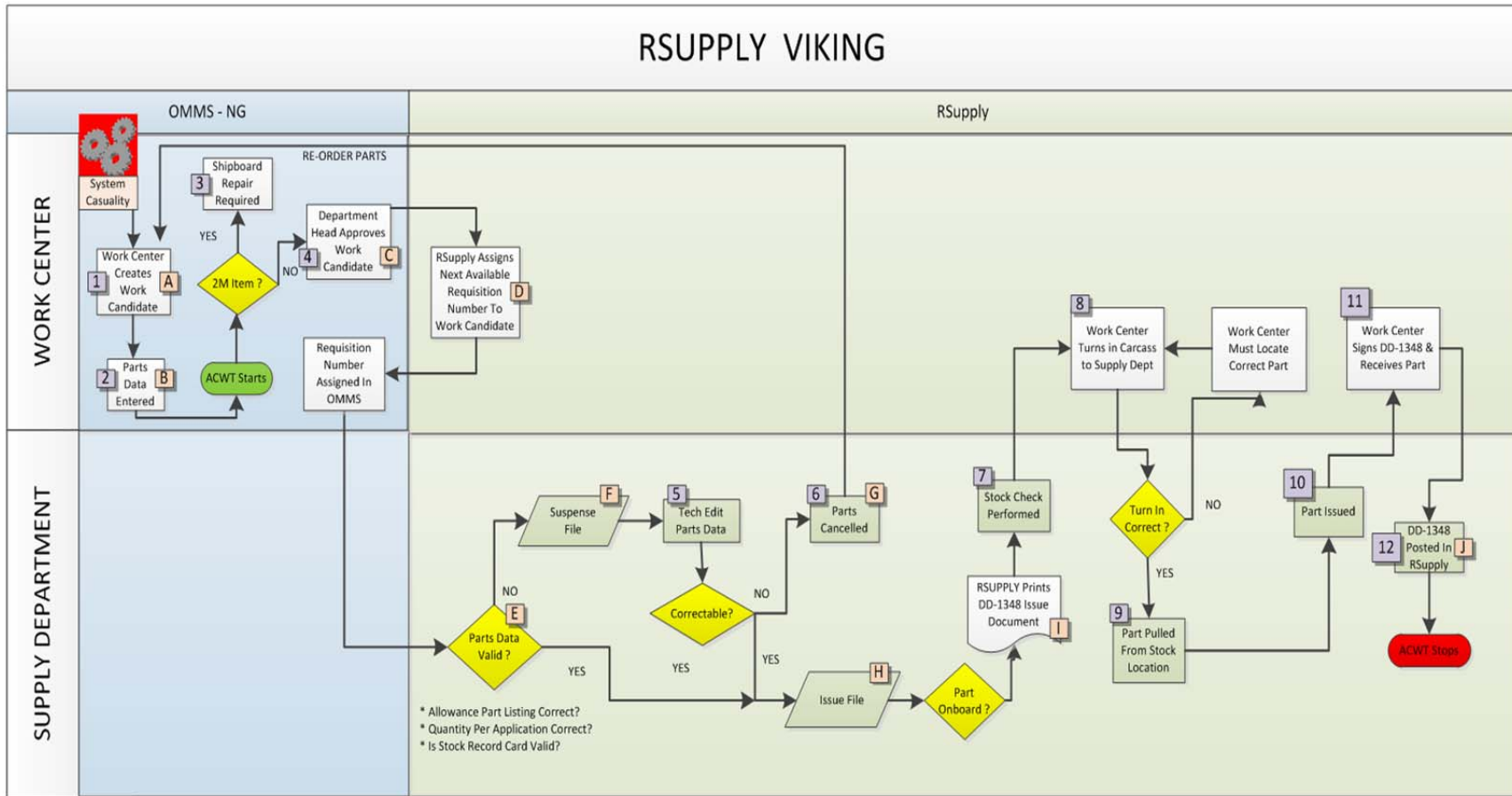


Figure 12. Viking Swim Lane Chart

Following the assignment of a requisition number in OMMS, DLR parts data enter into RSupply Viking where demand is managed by LSs in the supply department.

Validity of Parts

E. Once parts data enters into RSupply Viking, an automated process of parts screening takes place. Viking will compare each part demanded against an established SRF within Viking to ensure accurate management information and material identification. This assures the right part is ordered for the correct corresponding system avoiding unnecessary costs for ordering the wrong parts. In addition to proper identification, Viking will check the quantity of a specific part requested in a work candidate so that it does not exceed the quantity required to fix the system. If the automated process deems the requisition valid, it will bypass the suspense file and go directly to the issue file. However, if the requisition is not valid for reason mentioned previously, it will go to the suspense file for further action.

Suspense File

F. Inside of the suspense file, Viking displays a stock record file for each part demanded. Within each record, parts data are broken down by categories such as National Item Identification Number (NIIN), unit of issue, advice code, quantity requested, and price. This separation of parts data allows the LS to examine each category for accuracy and make the necessary changes.

Tech Edit

5. Tech edit is performed on all requisitions that failed parts screening. At this point, the LS utilizes several parts management software systems outside of RSupply to verify that every category of part data is correct. Any discrepancies overlooked can create defects resulting in an increase in price or greater quantity of parts ordered.

Parts Cancelled

6. Defects that cannot be corrected result in the cancellation of the requisitioned parts by the LS in Viking. If demand is still valid, the work center will have to re-submit the correct parts in OMMS.

G. Viking cancels the part(s) requisitioned associated with the work candidate and annotates that action in an electronic transaction log.

Issue File

H. Parts that are deemed to be correct or that have been corrected through the tech edit process are automatically screened against inventory onboard ship and placed in the issue file.

Issue Document Printed

I. If a part is onboard, a DD 1348–1A form prints from a dedicated printer located in the supply office.

Stock Check

7. Once a DD 1348–1A prints, LS personnel responsible for issuing DLRs will conduct a physical stock check to ensure the part is onboard. Once verified onboard, the LS will look up the advice code for the DLR part demanded to determine if a carcass turn-in is required at the time of exchange.

Turn-In Required

8. If the DLR requested is 5G, the work center is required to bring the NRFI carcass to the DLR custodian at the time of exchange. If the NRFI carcass is incorrect, the DLR custodian does not issue the ready-for-issue (RFI) part and the work center must locate the correct NRFI carcass. If the NRFI carcass is not available for turn-in, a RIP chit is required in the absence of the NRFI carcass to issue the RFI part.

Part Pulled

9. The DLR custodian retrieves the RFI DLR from the storeroom.

Part Issued

10. The DLR custodian physically gives the RFI DLR to the work center.

Work Center Receives Part

11. The work center signs and dates the DD1348–1A to confirm receipt of the RFI part.

Posting

12. The DLR custodian manually posts the issue into RSupply.

J. RSupply adjusts the SRF to reflect that the part was issued and ACWT stops.

F. DATA

To better define the problem of excessive ACWT, we collected data from two separate sources that capture DLR ACWT. NSLC and COMNAVSURFOR both track ACWT; however, they utilize separate guidance and databases to interpret the results.

NSLC utilizes the OPNAVINST 4441.12D (Chief of Naval Operations, 2012) guidance which provides policy on how to manage Navy-owned inventories at Navy activities while applying performance goal metrics. Per this instruction, ACWT is calculated from parts demand created in OMMS to issuance of the part in RSupply. Performance measures are applied in the form of ACWT goals to indicate whether customer demands are being met in a timely manner. A “two-hour” ACWT goal is established for ships that have supply inventory onboard that is readily available to the work center. Per OPNAVINST 4441.12 (Chief of Naval Operations, 2012), the supporting activity, known as the supply department onboard ship, should be capable of issuing the part within a two-hour time block once the demand for parts is generated in OMMS.

The database utilized by NSLC to capture ACWT is OARS. This program accesses OMMS to collect data, with a focus on maintenance and material repair. OARS captures data from demand created in OMMS, to issuance in RSupply, by extracting two separate date/time stamps; (1) ACWT begins at demand created, and (2) ACWT stops at issuance of part. Demand created is identified as the time the work center enters parts required for a work candidate in OMMS.

COMNAVSURFOR utilizes COMNAVSURFORINST 4400.1 (Commander, Naval Surface Forces, 2008), which provides guidance on how to manage DLRs, while

applying a different set of performance metrics. Per this instruction, ACWT is calculated from the time the request/requisition number is assigned in OMMS by RSupply to issuance of parts in RSupply.

The database utilized by COMNAVSURFOR to capture ACWT is CMP. CMP captures this performance with three separate date/time stamps within RSupply: (1) tech edit, (2) approval, and (3) issue. These data are then measured against COMNAVSURFOR's performance metric, which measures ACWT in days, rather than hours (Figure 13). A DLR requested and issued in two days or less is assessed as green. Likewise, a DLR requested and issued in more than two days, but fewer than three days is assessed as yellow. Lastly, a DLR requested and issued in three days or more is assessed as red.



Figure 13. CMP Stop Light Chart

The sample size data we collected for analysis consisted of seven U.S. Navy Destroyers with BMD capability, stationed in the Pacific Fleet. We collected 12 months of OARS data, obtained through NSLC, consisting of 716 onboard DLR requests/requisitions dated from July 2011 through June 2012. We obtained 12 months of CMP data through COMNAVSURFOR consisting of 471 onboard DLR requests/requisitions dated from December 2011 through December 2012.

As mentioned earlier, OARS and CMP data capture ACWT differently. Since CMP data only reflects ACWT from request/requisition to issuance in RSupply, we used OARS data because it provides a complete assessment of ACWT from demand created in OMMS to the issuance of parts in RSupply. We then analyzed each month of data and compared it to both corresponding performance metrics to identify potential defects contributing to excessive ACWT.

1. OARS DATA

Based on our data, we analyzed 716 total DLR requests with ACWT ranging from a minimum of six minutes to a maximum of 2,036 hours (85 days). The average wait time, as seen in Figure 14, was 71 hours (three days) with a standard deviation of 178.6 hours (7.4 days) for processing a DLR from demand to issue.

Descriptive Statistics (<i>Demand to Issue</i>) in Hours	
Mean	71.36
Standard Error	6.67
Median	20.46
Mode	0.32
Standard Deviation	178.59
Sample Variance	31896.09
Kurtosis	51.83
Skewness	6.25
Range	2035.65
Minimum	0.09
Maximum	2035.75
Sum	51091.2
Count	716

Figure 14. OARS Descriptive Statistics in Hours

Next, we created line charts for each ship displaying the ACWT of DLR requests/requisitions broken down by month as seen in Figures 16–22. Figure 23 depicts total combined request/requisitions for all seven ships. As visually depicted in the charts, the red line represents COMNAVSURFOR goals with an ACWT of less than 72 hours (three days). The blue line represents OPNAV goals with an ACWT of less than two hours. Green triangles represent the ACWT for each month, while the error bars represent 95% confidence intervals around the ACWT. Based on this information, we were able to calculate the percentage of defects that did not meet OPVNAV and COMNAVSURFOR goals. Defects are defined as any month in which ACWT was greater than the OPNAV and COMNAVSURFOR goals, as seen in Figure 15.

$$\text{Defect Rate} = \frac{\text{\# of months ACWT} > \text{goal}}{\text{Total \# of months}}$$

Figure 15. Defect Rate Calculation

Ship 1 data consist of 99 transactions with a defect rate of 100% for OPNAV goals and 25% for COMNAVSURFOR goals.

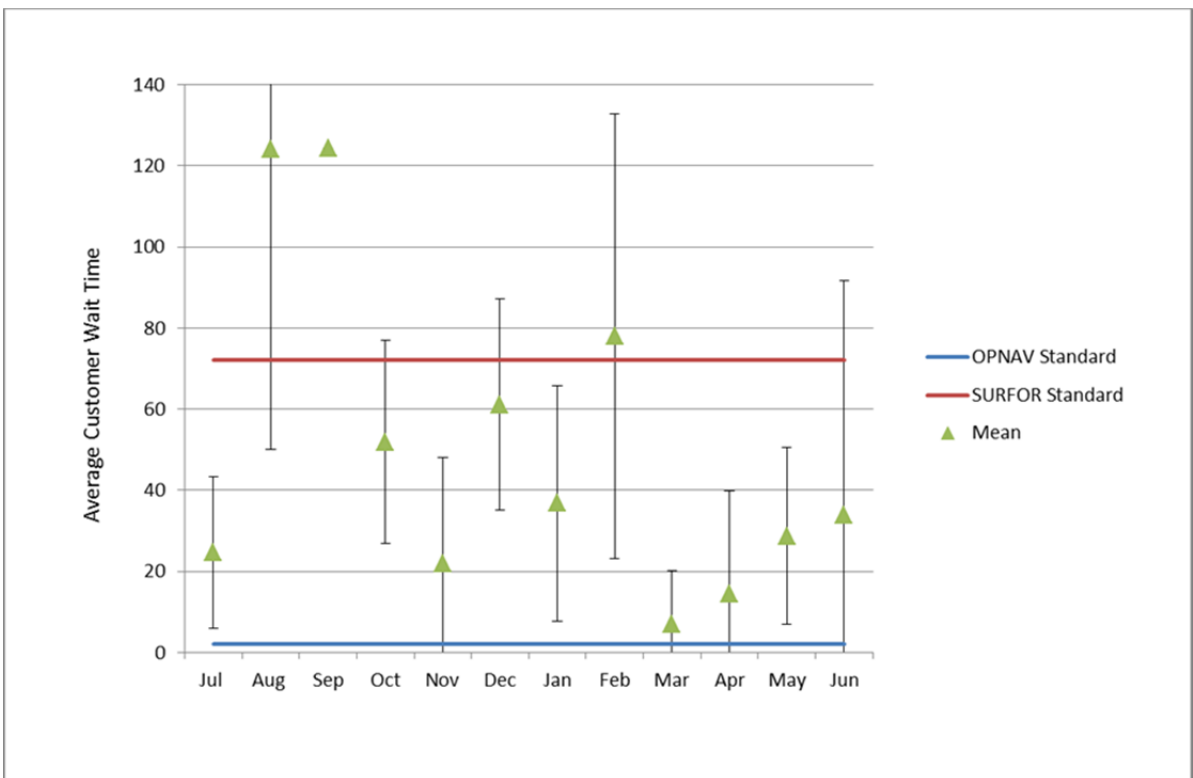


Figure 16. Ship 1

Ship 2 data consist of 115 transactions with a defect rate of 100% for OPNAV goals and 33% for COMNAVSURFOR goals.

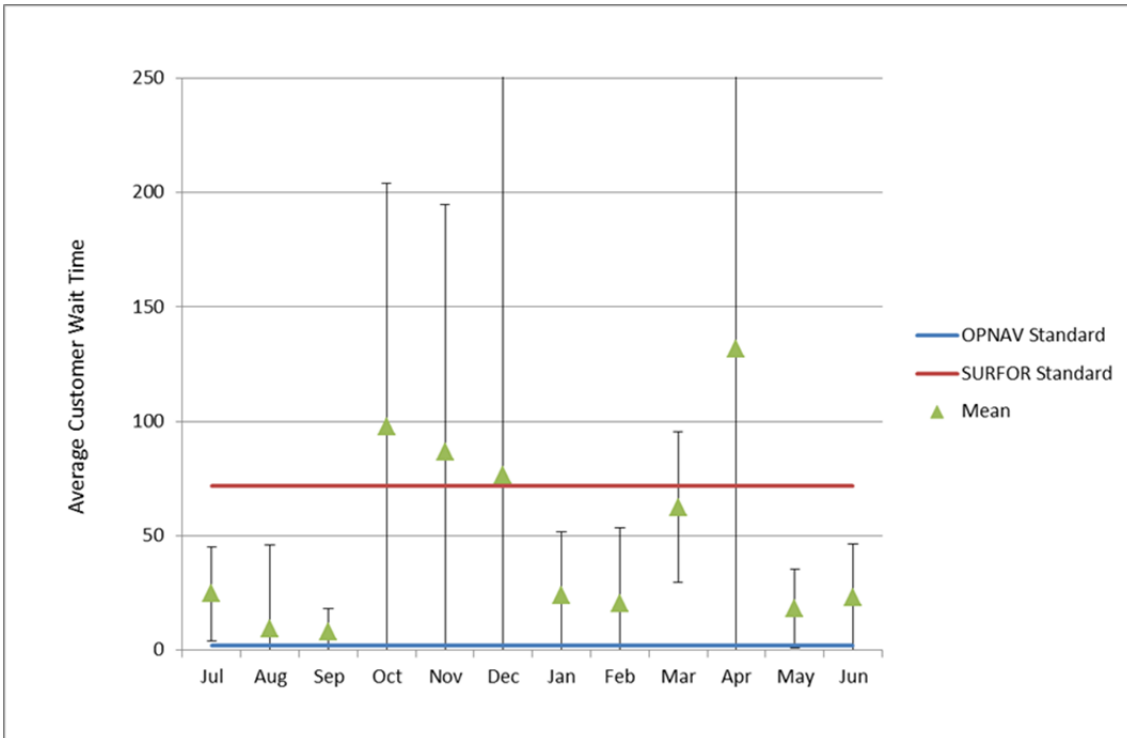


Figure 17. Ship 2

Ship 3 data consist of 69 transactions with a defect rate of 91% for OPNAV goals and 27% for COMNAVSURFOR goals.

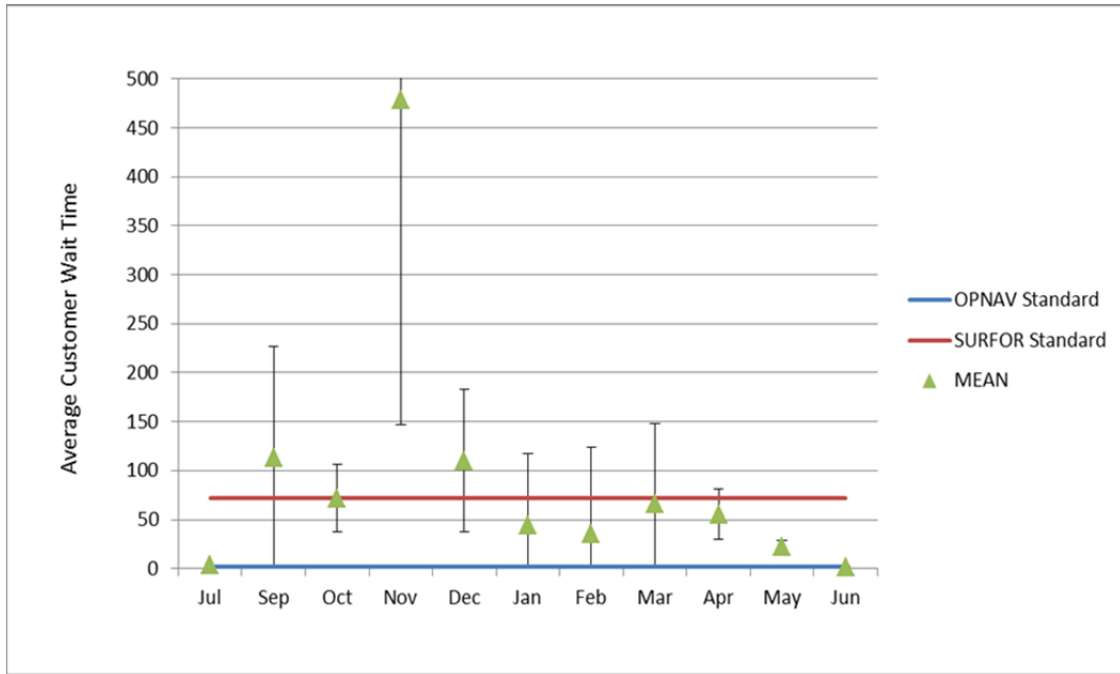


Figure 18. Ship 3

Ship 4 data consist of 159 transactions with a defect rate of 100% for OPNAV goals and 42% for COMNAVSURFOR goals.

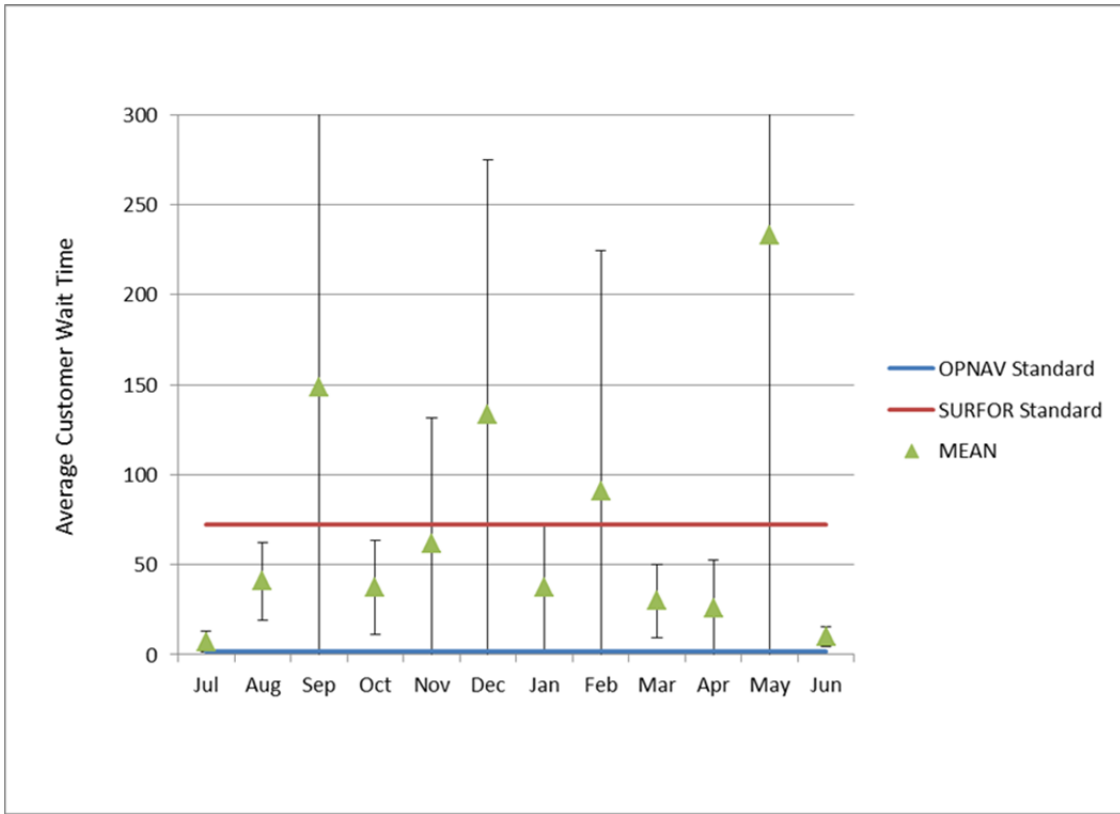


Figure 19. Ship 4

Ship 5 data consist of 120 transactions with a defect rate of 100% for OPNAV goals and 55% for COMNAVSURFOR goals.

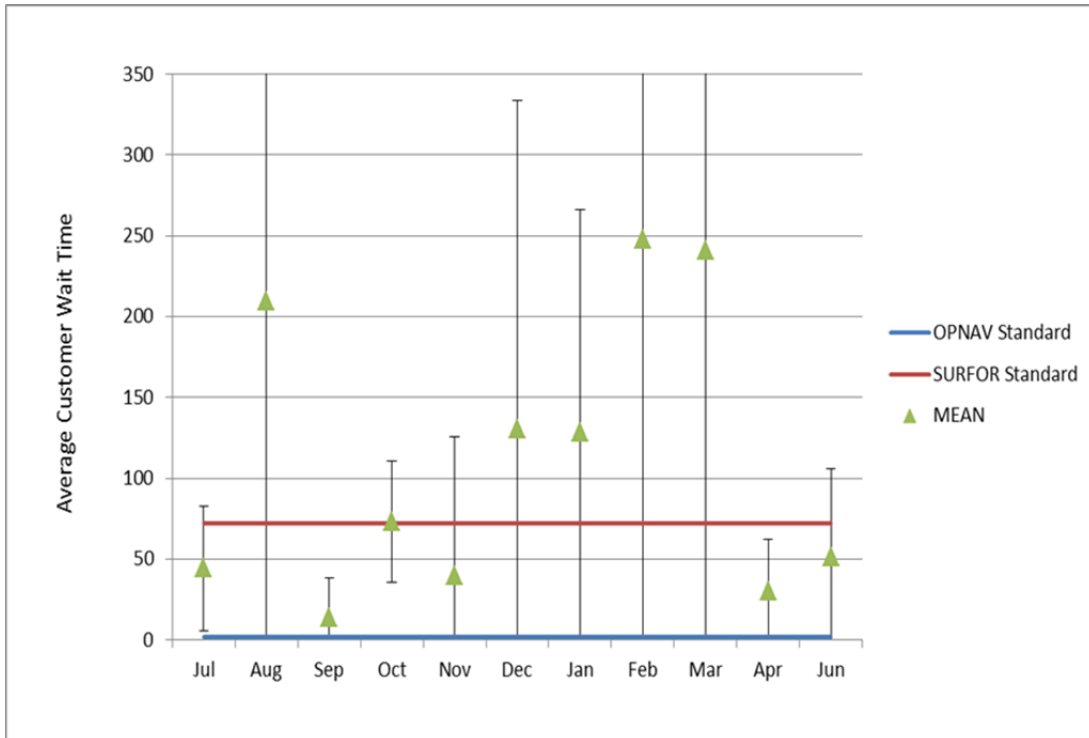


Figure 20. Ship 5

Ship 6 data consist of 55 transactions with a defect rate of 100% for OPNAV goals and 55% for COMNAVSURFOR goals.

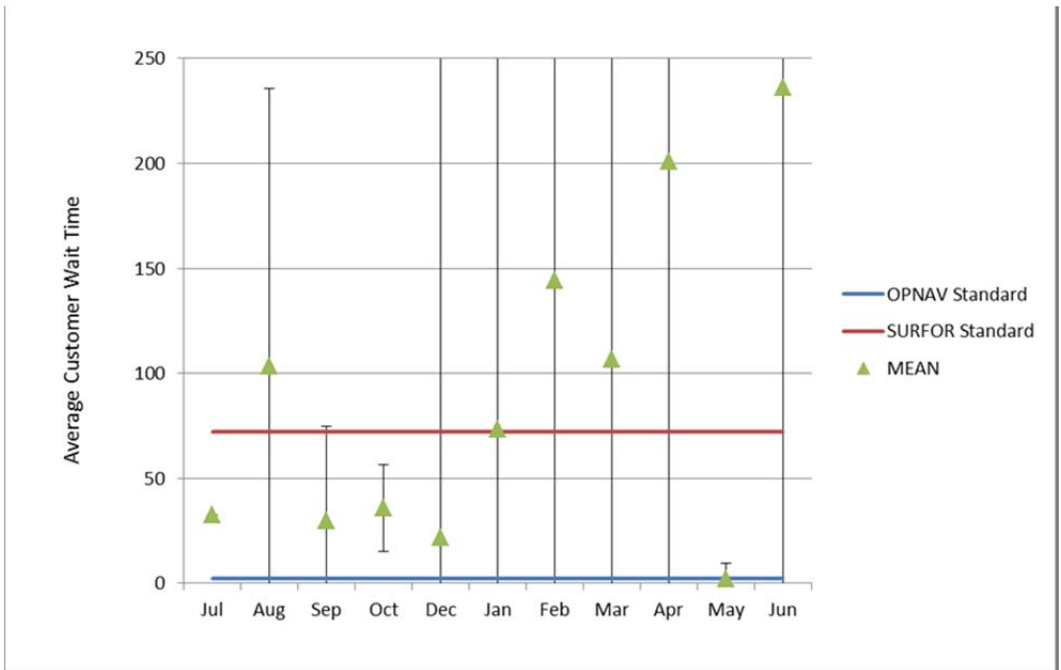


Figure 21. Ship 6

Ship 7 data consist of 99 transactions with a defect rate of 92% for OPNAV goals and 33% for COMNAVSURFOR goals.

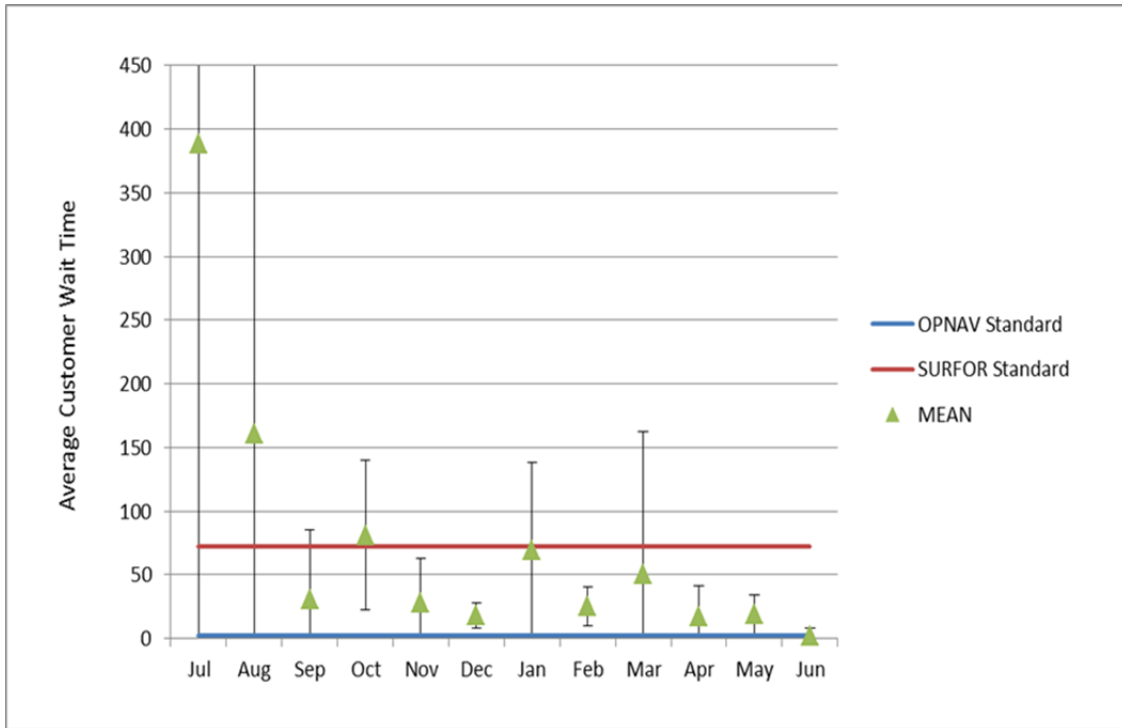


Figure 22. Ship 7

The combination of data for all seven ships consists of 716 total transactions with a defect rate of 100% for OPNAV goals and 42% for COMNAVSURFOR goals.

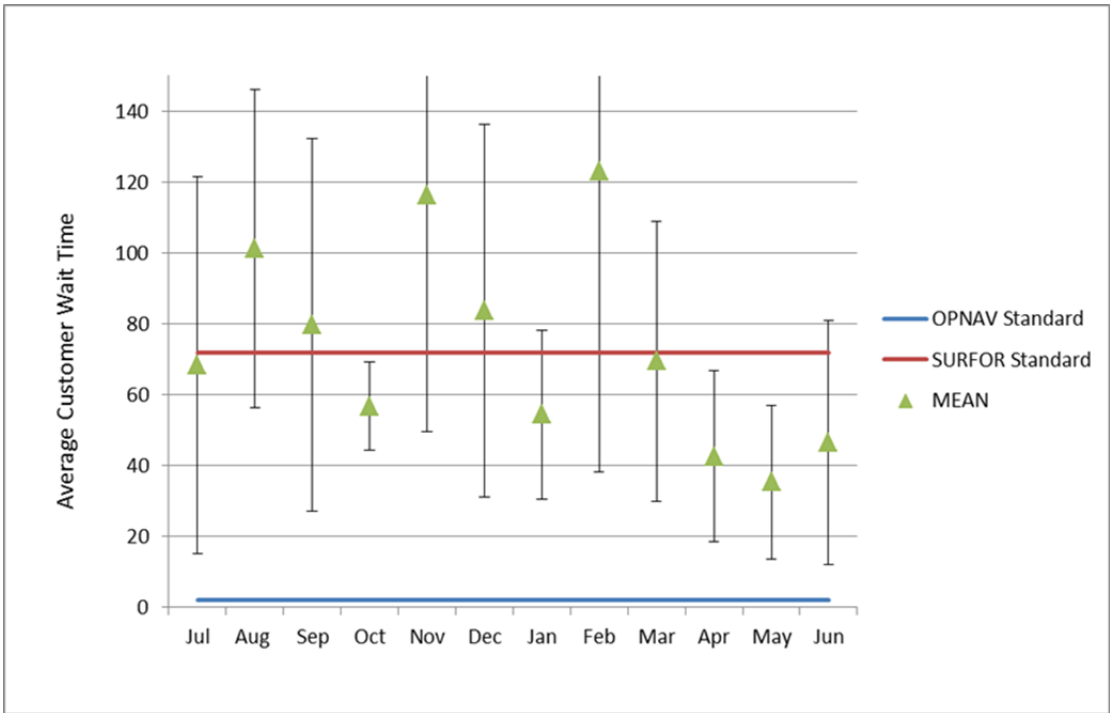


Figure 23. Combined Data

When comparing the combined data set of all seven ships to OPNAVINST 4441.12D (Chief of Naval Operations, 2012), zero ships met the monthly mandatory “two-hour” performance metric which equates to a 100% defect rate. When compared to COMNAVSURFORINST 4400.1 (Commander, Naval Surface Forces, 2008), five out of 12 months violated the COMNAVSURFOR metric resulting in a defect rate of 42%. With the combined ships defect rate at 100%, the OPNAV metric appears unrealistic.

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VI. ANALYZING THE PROBLEM

A. OARS AND CMP MATCHING DATA

Based on the feedback received from the fishbone diagram, we believe the priority placed on work candidate creation is causing a backlog in OMMS, thus increasing the ACWT. In addition, we believe work candidates that require outside technical assistance are causing an artificial inflation in ACWT calculation as well. With this in mind, we developed two hypotheses to possibly explain these assumptions.

1. Hypothesis #1

Defects are caused by a bottleneck in the DLR process that can be measured by combining OARS and CMP matching request/requisitions and comparing time-stamp data.

During our research, we discovered limitations with both sets of OARS and CMP data. OARS data provide only two date-time stamps: (1) parts demand created in OMMS and (2) parts issued in RSupply. As a result, they do not reflect a date time stamp when the request/requisition transfers from OMMS into RSupply. This is considered a critical step because it is the first time the request/requisition becomes visible to the personnel capable of satisfying the demand. In other words, the personnel responsible for issuing the parts are unaware of any requirement although ACWT has already begun.

Similar to OMMS, RSupply offers a limited view of ACWT as well. It does not take into account the time spent for parts data entry and approval of a work candidate by the department head in OMMS. RSupply provides three date time stamps: (1) tech edit, (2) approval, and (3) issue. In addition, the quantity of CMP data available may be limited based on the number of requests/requisitions uploaded by the ships.

Based on the limitations of both OARS and CMP, we combined matching requests/requisitions from each data set to create a more accurate picture of the ACWT beginning in OMMS and ending in RSupply.

We analyzed 216 matching DLR requests/requisitions with ACWT ranging from a minimum of 12 minutes to a maximum of 85 days. As seen in Figure 24, the average wait time was 3.7 days with a standard deviation of 10.9 days for processing a DLR from parts demand in OMMS to issuance of parts in RSupply.

Descriptive Statistics (<i>Matching</i>) in Days	
Mean	3.66
Standard Error	0.74
Median	0.98
Mode	1.85
Standard Deviation	10.89
Sample Variance	118.65
Kurtosis	33.36
Skewness	5.49
Range	84.82
Minimum	0.008
Maximum	84.82
Sum	790.58
Count	216

Figure 24. Matching Data in Days

By aligning OARS and CMP data sets with matching requests/requisitions, we were able to capture all four time stamps: (1) parts demand created in OMMS, (2) tech edit, (3) approval, and (4) issue in RSupply. As a result, we were able to achieve a complete picture of the ACWT. Figure 25 depicts the average amount of time spent at each date time stamp in both OMMS and RSupply for all 216 requests/requisitions. These time stamps include OMMS parts demand entry to work candidate approval, RSupply tech edit to approval, and RSupply approval to issue.

The analysis revealed it took an average of 3.66 days to complete a transaction from demand entry to issuance of a DLR. Moreover, the largest amount of time spent in the process took place in OMMS, averaging 2.09 days, followed by RSupply approval to issue, averaging 1.26 days. Based on this sample of matching data, our analysis revealed

the bottleneck resides in OMMS, lending strong support to our first hypothesis. As a result, initial efforts to reduce the ACWT should begin with a focus on OMMS-related activities.

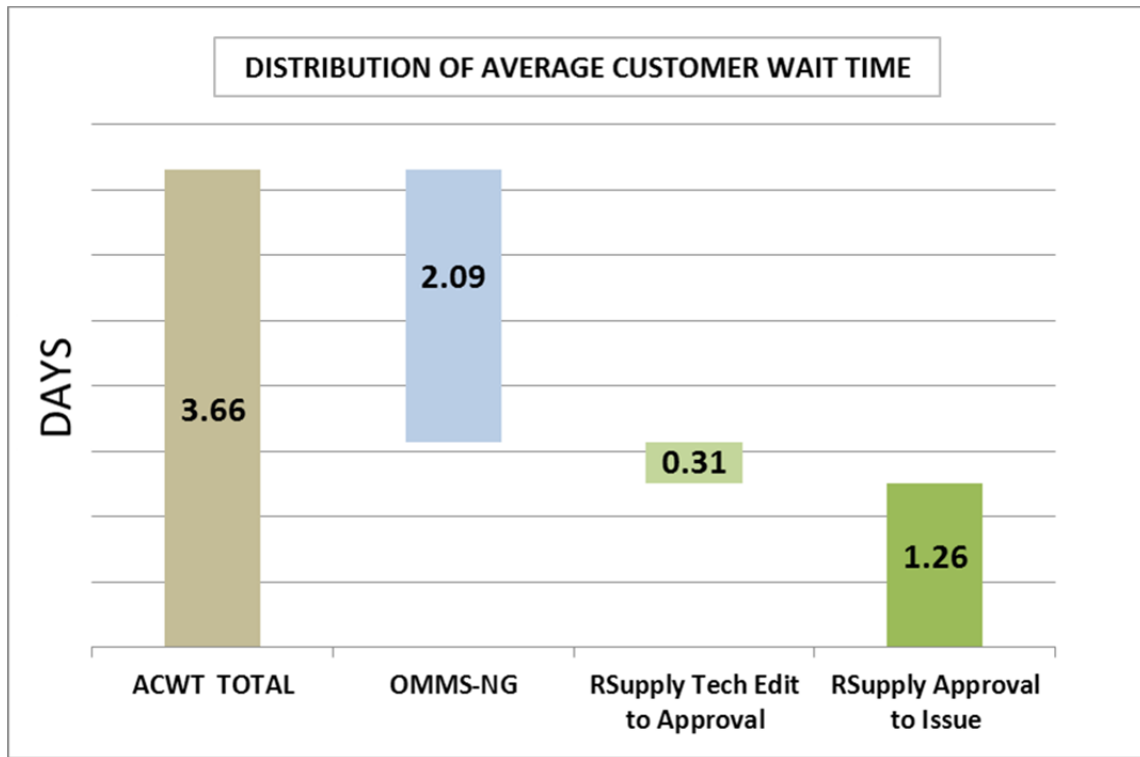


Figure 25. Distribution of Average Customer Wait Time

2. Hypothesis #2

Defects are caused by a limited number of excessively large outliers that artificially inflate ACWT.

For our second hypothesis, we utilized the same data in the first hypothesis to create two separate histograms showing the frequency of DLR request/requisitions broken down by the number of hours it took to issue them. Initially, we calculated the original data set without removing any outliers as seen in Figure 26. This resulted in a calculate mean of 82 hours and a standard deviation of 152 hours. Note that these statistics are for the entire set of matching data and are not specific to one particular ship or one particular month; this is different from the metric of ACWT which is specific to a

ship and a month. However, it established a baseline that we utilized to remove outliers that were greater than three standard deviations from the mean.

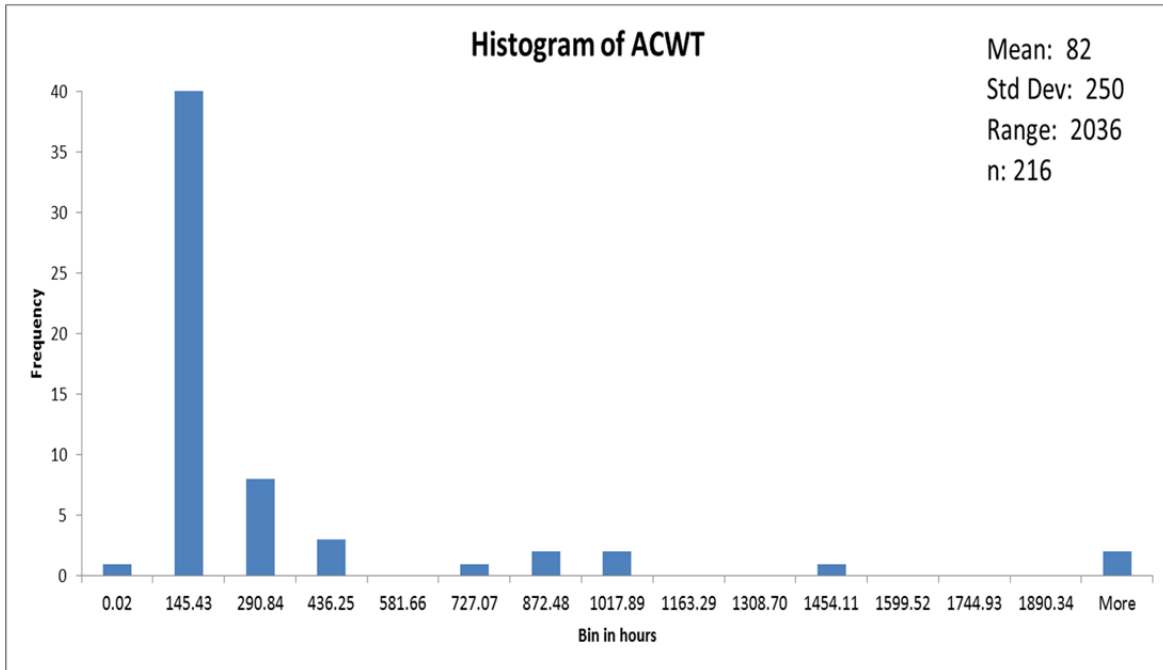


Figure 26. Original Matching OARS and CMP Data

After seven outliers were removed, the statistics adjusted to a new mean of 42 hours and a new standard deviation of 73 hours as seen in Figure 27. As a result of removing the seven outliers the mean was cut in half.

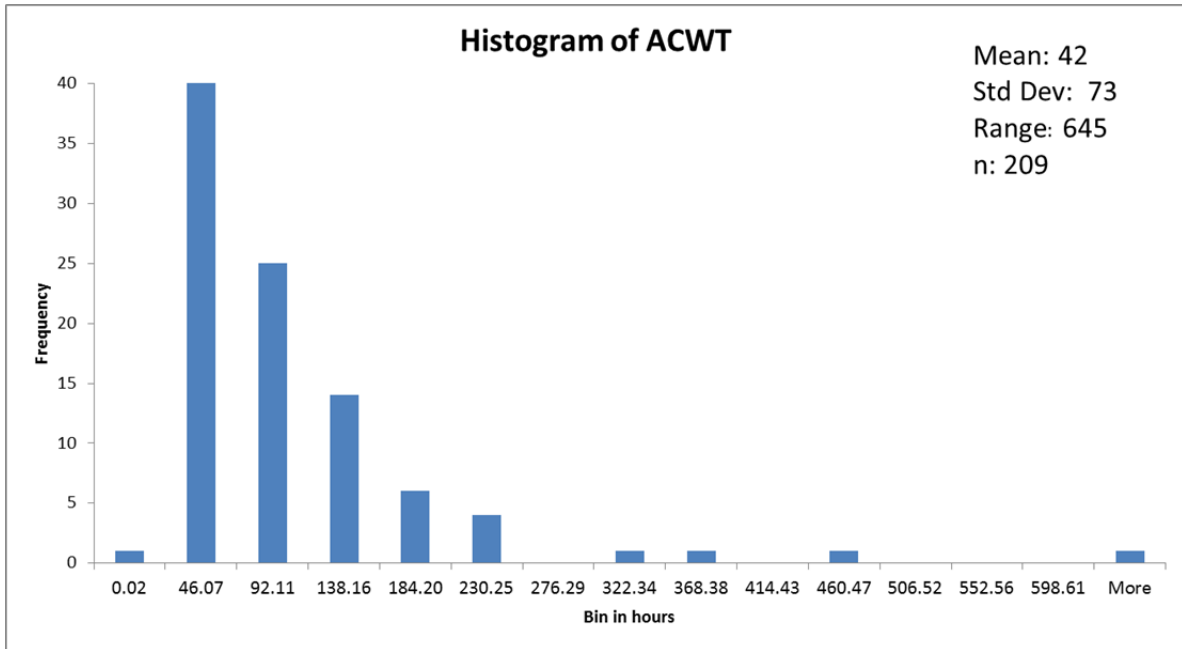


Figure 27. Matching OARS and CMP Data Without Outliers

Ideally, we wanted to show how the removal of outliers would affect the defect rate (percentage of ship/months not currently meeting ACWT standards), but based on a limited sample size of matching data, we were unable to calculate it (on average there was only 5 requests per ship per month). However, our results provided directional support for our second hypothesis; mainly, that with the removal of outliers the overall average (as opposed to ship/month averages) was reduced in half and the variance was significantly reduced. While the removal of the outliers improved the overall average and standard deviation, further analysis should be conducted to identify the root cause of long wait times for each outlier. Once these root causes are identified, another DMAIC analysis should be performed beginning with the fishbone cause and effect diagram.

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VII. IMPROVING AND CONTROLLING THE PROBLEM

A. INTRODUCTION TO IMPROVEMENTS

Based on the DMIAC analysis we conducted, we believe there are numerous areas where efficiencies can be gained in terms of reducing ACWT through more efficient processes, training, and intrusive leadership.

As outlined in the analysis chapter, the data set of matching requests for OMMS and RSupply revealed the largest total ACWT took place in OMMS, from demand entry to approval. This portion of time represents 57% of the total time from demand entry to issue of a DLR. This is clearly a bottleneck to the entire DLR issuing process and provides strong evidence that any efficiencies leveraged against this process should begin in OMMS.

Additional focus areas include RSupply approval to issue, which represented 34% of the ACWT. This is where we believe that ACWT becomes heavily influenced by human responsiveness rather than any computer-based requirements. As our qualitative analysis indicated, there is a cultural difference between those requesting parts and those satisfying the demand. Many work centers are not aware of the 2M requirements for repairing a bad part before requesting a replacement or the time requirements set forth by naval guidance for turning in a carcass. As a result, the level of training and accountability provided by shipboard leadership becomes a crucial part of reducing the ACWT.

Based on these findings, we suggest the following recommendations to reduce the ACWT for issuing DLRs onboard ship.

B. IMPROVEMENT #1

Training should be conducted at all shipboard levels of authority concerning the importance of timely work candidate creation and DLR turn-in procedures. At the basis of any problem involving multiple levels of leadership, resides a minority of personnel conducting the majority of the work. As a result, only a select few personnel are aware of

the importance of adhering to standards, while the others subscribe to a “that’s the way it’s always been done” mentality. As a result, possible improvements to a process or strategy are sacrificed due in part to poor leadership or accountability. Therefore, we recommend that supply officers, as well as chief engineers, onboard surface combatants conduct training at the Wardroom level concerning the relationship between timely maintenance and proper DLR issuing procedures. This will create a top-down training initiative to eliminate a culture of division between work center and supply personnel, and establish a baseline for improving ACWT. Furthermore, strict accountability to these standards must be maintained and enforced by shipboard leadership.

C. IMPROVEMENT #2

Additional ACWT standards for OMMS and the maintenance side of the DLR request process should be established and measured. This will increase awareness of performance for work centers, as well as create accountability for work candidate creation, parts entry, and approval. Just like the matching data analysis we conducted in the previous chapter, time stamp data will quickly display any bottlenecks that require additional focus for improvement. Moreover, this should be promulgated Navy wide by incorporating a baseline standard, much like CMP, into the surface force readiness database called Training and Operational Readiness Information Services (TORIS). This will allow commanding officers to quickly identify any areas of weakness concerning readiness and to allocate resources or additional training towards improvement.

D. IMPROVEMENT #3

In addition to establishing accountability standards for ACWT in OMMS, we argue that third-party audits within RSupply should be performed by the ATG as well. Much like the quarterly audits the ATG currently performs when reviewing a ship’s government purchase card records, ACWT trends within RSupply could be examined to pinpoint any areas of weakness concerning the issuance of DLRs. This creates an additional layer of accountability for the supply personnel as well as reinforces the training component for reducing ACWT.

E. IMPROVEMENT #4

ACWT performance data for onboard DLRs should be readily available within the CMP website. Currently, CMP programmers do not separate the ACWT for onboard issue of DLRs from consumable requests. As a result, poor performance concerning the issue of DLRs goes unnoticed with a larger number of consumable requests to offset the data. With such a strong correlation between a ship's level of readiness and the ACWT for issuing DLRs, a simple software patch would reap immediate benefits.

F. CONCLUSION

To have the greatest effect, recommendations 1 through 3 should be executed in tandem rather than separately. As a result, they will strengthen one another providing good "fit" concerning operational effectiveness and promoting reduction of ACWT. Training to a minimum standard, holding sailors accountable for execution, and measuring that performance effectively are key elements that must be accomplished to minimize ACWT.

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