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Determining the Days of Supply for Class 1 Inventory Aboard U.S. Navy Ships

December 2025

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ABSTRACT

This research addresses inconsistencies in calculating days of supply (DoS) for Class I inventory aboard U.S. Navy vessels, a challenge that threatens operational readiness in contested logistics environments. To achieve this, we analyzed nine months of historical consumption data from the Food Service Management System (FSM3) across 14 ship classes, examining the alignment between current DoS calculation methods and actual at-sea consumption patterns. Our analysis uncovered key issues: the reliance on dollar-value-based calculations that ignore consumption variability, the application of uniform assumptions across diverse ship classes, and disparities between reported DoS estimates using different Navy systems. To address these challenges, we developed the Supply Select App, an interactive R-based tool that provides fleet commanders with accurate Food Item Code (FIC)-level usage data tailored to specific ship classes. The app employs three core metrics: average daily consumption, projected DoS, and projected order quantity, which are derived from empirical consumption records rather than financial approximations. This research highlights the urgent need for data-driven approaches in naval sustainment, focusing on operational autonomy and resilience in communications-denied environments. The Navy's adoption of evidence-based logistics tools is crucial to maintain combat readiness and mission continuity while ensuring accurate sustainment of its deployed personnel.

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Finally, we thank our families, classmates, and advisors for their patience and encouragement during long nights in the Dudley Knox Library and the many iterations that brought the Supply Select App to life.

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LIST OF ACRONYMS AND ABBREVIATIONS

9M CARGO	DoD Subsistence Provisions
ADC	Average Daily Consumption
CL1P	Class 1 Operating Picture
COMPACFLT	Commander, U.S. Pacific Fleet
DAS	Days at Sea
DLA	Defense Logistics Agency
DoS	Days of Supply
FIC	Food Item Code
FSM3	Food Service Management System
NAVSUP	Naval Supply Systems Command
NSN	National Stock Number
OPNAV	Office of the Chief of Naval Operations
OPREP-5	Operational Report 5 Feeder
RDS	R Data Serialization
SPV	Subsistence Prime Vendor
SUPPO	Supply Officer
UI	Unit of Issue
USFFC	Commander, U.S. Fleet Forces Command

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EXECUTIVE SUMMARY

A. INTRODUCTION

The operational effectiveness of U.S. naval forces relies heavily on reliable subsistence, yet the current methods for calculating Class I (food) Days of Supply (DoS) are inconsistent and outdated. This research addresses the critical disparity between the dollar-value-based approach prescribed in OPNAV Instruction 2000/201 and the consumption-based models utilized by the Class 1 Operating Picture (CL1P). These legacy methods often produce conflicting estimates, creating significant risks to readiness—particularly in contested logistics environments where accurate supply chain data is vital.

This thesis investigates these discrepancies by analyzing nine months of historical consumption data from the Food Service Management System (FSM3). The research culminates in the development of the "Supply Select App," a data-driven tool that calculates DoS at the Food Item Code (FIC) level. By transitioning from broad financial or volume-based estimates to precise, ship-class-specific consumption patterns, this work establishes a benchmark for enhanced forecasting and push logistics.

B. FINDINGS

The research analysis yielded the following key findings:

1. Concentration of Demand: The analysis reveals that a small number of food items constitute a disproportionate share of actual at-sea consumption. The top 10 to 25 highest-consumed items represent the majority share of consumables during deployments. This concentration allows for more targeted and efficient procurement and storage strategies.

2. Ship Class Variability: Consumption patterns vary significantly by ship class due to differences in crew size, mission profiles, and menu compositions. A destroyer's (DDG) consumption profile differs inherently from that of an aircraft carrier (CVN). Uniform assumptions—such as the

"two cases per person per week" model—fail to capture these operational nuances, leading to inaccurate forecasting.

3. Inadequacy of Current Metrics: Comparative analysis demonstrates that dollar-value-based reporting and standardized volumetric models do not align with actual historical consumption. These methods risk underestimating shortfalls or overburdening logistics systems with unnecessary stock.

4. Viability of Offline Tools: The research validated the development of a self-contained, offline-capable tool (the Supply Select App). This tool successfully structures historical FSM3 data to facilitate "push logistics" ordering, proving that accurate sustainment decisions can be made even in communications-denied environments.

C. RECOMMENDATIONS

Based on these findings, the following actions are recommended:

1. Pilot Program Implementation: The Navy should conduct a pilot program to deploy the Supply Select App across a representative sample of ship classes. This will allow for user feedback and a comparative analysis between ships using the app and those relying on legacy methods.

2. Policy Revision: NAVSUP and OPNAV should establish a working group to review OPNAV Instruction 2000/201. Guidance should be revised to incorporate consumption-based methodologies as the primary standard or an approved alternative for units with access to historical FSM3 data.

3. Operational Integration: Fleet commanders should integrate the Supply Select App into standard operating procedures for deployment planning. Specifically, the tool should be utilized to generate "push" orders for ships operating in degraded information environments, ensuring autonomous sustainment.

D. OPERATIONAL IMPACT: RESILIENCE IN CONTESTED ENVIRONMENTS

This research highlights that accurate logistics data is a warfighting capability. In the era of Great Power Competition, adversaries may target logistics networks through cyber-attacks or electronic warfare, severing communication links between deployed ships and supply officers. The current reliance on real-time connectivity or generalized estimates creates vulnerability.

By leveraging historical consumption data to predict future needs with high accuracy, the Navy can transition from reactive ordering to proactive "push logistics." This capability ensures that ships remain fully provisioned without the need to broadcast their requirements, thereby reducing their electronic signature and maintaining mission continuity in contested waters.

E. CONCLUSION

In conclusion, this thesis demonstrates that the U.S. Navy must transition from financial approximations to empirical, consumption-based logistics. The "Supply Select App" provides the analytical depth required to close the gap between reported readiness and actual sustainment. Addressing these inconsistencies is not merely an administrative improvement but an operational necessity.

Future research should expand this methodology to track longitudinal changes in consumption and explore the application of this framework to other classes of supply (Class II, III, and IX). By adopting these data-driven tools, the Navy ensures that its logistics architecture is as resilient and adaptable as the fleet it supports.

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I. INTRODUCTION

This thesis addresses the critical challenge of sustaining U.S. Navy Sailors at sea. As the adage holds that "an Army marches on its stomach," the Navy's operational effectiveness depends equally on reliable subsistence. Proper nutrition directly impacts morale, retention, and crucially in an era of contested logistics, combat readiness. This research delivers a data-driven tool that improves the accuracy of Class I (food and nutrition supplies) Days of Supply (DoS) calculations at the Food Item Code (FIC) level using historical consumption patterns from the Food Service Management System (FSM3). By demonstrating a more precise, ship-class-specific approach, this work establishes a benchmark for enhanced forecasting and push logistics, paving the way for future advancements in naval sustainment.

A. BACKGROUND

Resupply of ships at sea has been an issue for the U.S. Navy since the Revolution and was even faced by John Paul Jones. Today, inconsistent calculations of Days of Supply for Class I inventory pose a significant risk to the U.S. Navy's operational readiness. Sustenance is critical for Sailors' physical readiness, morale, and combat endurance, yet the Navy's current methods, such as the dollar-value-based approach prescribed in OPNAV Instruction 2000/201 and the consumption-based Class 1 Operating Picture (CL1P) dashboard, produce conflicting DoS estimates across Food Item Codes. These discrepancies complicate logistics planning and threaten mission continuity in contested environments, where accurate supply chain data is vital for fleet commanders.

Currently, units at sea report DoS using a calculation based on the dollar value of the inventory. The calculation starts by determining the daily consumption (expressed in dollars) and then uses that to calculate the number of days of on-hand inventory necessary to meet demand. The result of this calculation is applied to different FIC categories (e.g., dry, chill, eggs, fresh fruits, and vegetables) and reported daily to headquarters using the "OPREP-5 feeder," Navy standard message that provides on hand accounts for numerous ship consumables (Sailors, Fuel, Class 1 stores, etc.) or other appropriate mechanism. In contrast, the CL1P dashboard, integrated into the Advana Jupiter platform, uses consumption-based models derived from Food Service Management System (FSM3) data to estimate DoS in terms of cases per person per week, often standardized at two cases. These differing approaches can yield significantly different DoS estimates for the same inventory, particularly when consumption varies by ship class (e.g., destroyers, cruisers, aircraft carriers) or FIC category. Such inconsistencies hinder accurate sustainment planning and decision-making.

Modern naval operations require a distributed, persistent presence in contested environments, making reliable supply chain data essential. Misalignment between reported DoS and actual consumption risks underestimating shortfalls, overburdening logistics systems, or jeopardizing mission continuity. This thesis investigates these discrepancies by analyzing historical consumption data and inventory levels to develop a standardized, data-driven approach for calculating DoS at the FIC level, tailored to operational needs of fleet commanders.

B. PROBLEM STATEMENT

The U.S. Navy is constantly seeking to improve their methods for determining DoS for Class I inventory aboard deployed ships. Disparities between the dollar-value-based OPNAV Instruction 2000/201 method and the consumption-based CL1P dashboard model, which relies on FSM3 data, result in inconsistent DoS reporting. These inconsistencies create confusion in fleet logistics planning, undermine the ability to anticipate supply shortfalls, and hinder coordination of sustainment deliveries, compromising the Navy's afloat logistics architecture and operational tempo. We present as Equation 1 he current method for determining Days of Supply.

$$\text{DoS} = \frac{\text{Inventory Dollar Value}}{\text{Daily Consumption Dollar Value}} \tag{1}$$

C. PURPOSE OF STUDY

This research focuses on developing a method to enhance logistical decision-making for Class 1 inventory aboard U.S. Navy vessels. By analyzing historical consumption data from FSM3, our team has created a tool to provide fleet commanders with Class 1 usage data at the FIC level for each class of ship. This tool enables commanders to determine the actual DoS on board, based on real-world consumption patterns. This information will help to accurately calculate the current level and push a food order to ships deployed in a communications denied environment, based on the historical consumption data for that specific class of ship. Leveraging this data-driven framework, the study aims to improve sustainment planning and operational responsiveness in contested environments.

D. RESEARCH QUESTIONS

1. Primary Question

How can historical consumption data from FSM3 be used to develop a tool that provides accurate FIC usage data for determining DoS on board ships by class?

2. Sub Questions

How can the tool's FIC usage data be structured to support fleet commanders in calculating actual DoS across specific FIC categories (e.g., dry, chill, frozen) based on ship-class-specific consumption patterns?

How can the tool facilitate the initiation of push logistics orders by integrating real-time inventory data and historical consumption trends for operational decision-making?

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II. LITERATURE REVIEW

In this chapter, we review the state of the Navy's Class I supply system and summarize previous attempts to improve inventory management.

A. NAVY DOCTRINE AND REPORTING METHODOLOGIES

Throughout naval history, operational success has depended as much on the reliability of sustainment as on the heroism of those who fight. During the Revolutionary War, Captain John Paul Jones, often celebrated as the father of the U.S. Navy, struggled continuously with shortages of provisions, pay, and material support that jeopardized his missions before he ever encountered the enemy (Morison, 1959). As Samuel Eliot Morison documents in John Paul Jones: A Sailor's Biography, Jones's achievements were often accomplished despite severe logistical challenges. The Captain was compelled to expend considerable energy lobbying his American and French sponsors for essential resources, including food, gunpowder, and the settlement of prize money, which he felt should have been readily provided (Morison, 1959). These recurring deficiencies forced him to improvise maintenance, ration provisions, and rely on inconsistent local sources of supply while his ships remained idle or half-provisioned in foreign ports (Morison, 1959). His experience reflects a persistent truth of naval warfare: logistics and readiness are inseparable. The systemic sustainment challenges Jones faced in the eighteenth century, erratic accounting, delayed resupply, and inconsistent reporting, remains relevant to the modern U.S. Navy's struggle to leverage data for accurate sustainment.

The Navy's foundational guidance for calculating DoS is found in OPNAV Instruction 2000/201, which mandates a dollar-value-based calculation using daily consumption and then uses that to calculate the number of days of on-hand inventory (U.S. Navy, 2015). This standardizes reporting across units but assumes uniformity in consumption behavior, and food category usage, while ignoring price variability. Our thesis uses this data context to develop an accurate estimate of FIC usage for different ship classes, enabling fleet commanders to determine actual DoS or initiate push logistics. Recent analyses of contested logistics environments highlight the need for adaptive doctrines that incorporate real-world consumption patterns, as seen in discussions of integrating acquisition and sustainment functions to build shared knowledge for operational effectiveness (Lewis & Dew, 2025).

NAVSUP Publication P-486 (Food Service Management Manual) further codifies food inventory and accountability procedures aboard U.S. Navy vessels, providing detailed operational processes for inventory documentation, receipt processing, and requisitioning (U.S. Navy, 2019). However, it is not designed as an analytical tool, and it assumes compliance with reporting policies without validating DoS accuracy. This supports our study's emphasis on developing a tool for FIC-level data analysis rather than establishing procedural execution alone. Audits in Marine Corps logistics underscore similar issues, advocating for transforming sustainment through rigorous testing and distribution planning to support contested operations (Ashley, 2025).

B. SYSTEMS FOR INVENTORY AND CONSUMPTION TRACKING

FSM3 is the Navy's platform for tracking inventory transactions aboard ships, designed for day-to-day food service operations and including data on receipts, expenditures, and on-hand quantities by FIC (U.S. Navy, 2020). However, FSM3 does not calculate DoS directly. Our research leverages FSM3 data in a novel way, using consumption trends and remaining on-hand inventory to develop a tool that provides FIC usage data for determining DoS at the ship-class level. This technique represents a key innovation in our methodology and aligns with our thesis objective of improving accuracy by moving beyond financial approximations.

In contrast, the CL1P dashboard, developed by U.S. Fleet Forces Command in conjunction with U.S. Pacific Fleet and hosted in Advana Jupiter, provides a DoS estimate using a fixed assumption of two cases per food item per person per week, improving upon financial projections by basing estimates on expected usage (U.S. Navy, 2022). However, it applies uniform assumptions across food items and platforms, potentially overlooking variability due to platform-specific menus, crew size, or mission tempo. Contemporary analyses of resilient logistics in degraded information settings highlight the need for robust detection of data anomalies to support such tools, ensuring operational continuity amid cyber threats (Snyder et al., 2017). Our thesis uses historical FSM3 data to structure FIC usage for actual DoS calculations, facilitating push logistics in contested environments.

C. EXTERNAL SUSTAINMENT AND FORECASTING DATA

The naval logistics literature extensively acknowledges the role of external data sources in enhancing subsistence sustainment, with Defense Logistics Agency (DLA) Troop Support, Subsistence Prime Vendors (SPV), and DoD subsistence provisions (9M CARGO) inventory systems frequently cited as critical components (U.S. Department of Defense, 2023). DLA Troop Support provides comprehensive demand forecasts and procurement data tailored to military needs, while SPVs serve as regional hubs that streamline supply chains by maintaining prepositioned inventory and coordinating resupply efforts, particularly in theater operations like those in the Pacific Fleet (Walton et al., 2019). The 9M CARGO system, designed to manage prepositioned food stocks for rapid deployment, offers a strategic reserve that supports sustained naval operations in contested environments, with its inventory data potentially serving as a benchmark for validating onboard supplies (U.S. Navy, 2021). Studies on resilient maritime logistics emphasize the importance of these external sources in improving end-to-end visibility, enabling proactive resupply planning, and mitigating risks of over-stocking or under-stocking during prolonged missions (Sand, 2024). For instance, analyses of contested logistics scenarios highlight how SPV data can inform timely push deliveries to ships in communication-denied environments, a concept that aligns with broader efforts across the U.S. Navy to enhance operational responsiveness.

Despite the recognized value of these external datasets, our thesis focuses on a tool developed solely from historical FSM3 consumption data, which has been meticulously analyzed to provide FIC usage for different ship classes. This approach, detailed in our methodology, leverages nine months of at-sea consumption records to enable fleet commanders to determine actual DoS or initiate push orders based on ship-class-specific patterns, without requiring real-time integration of DLA, SPV, or 9M CARGO data at this stage. The literature suggests that while these external sources offer significant potential for future enhancements, such as refining demand forecasts or validating inventory levels against prepositioned stocks, our current work establishes a robust foundation using onboard FSM3 data alone.

D. POLICY ANALYSIS AND INSTITUTIONAL STUDIES

Defense logistics research increasingly emphasizes predictive modeling and data integration as essential for sustaining operations in contested environments. The 2020 report, Robust and Resilient Logistics Operations in a Degraded Information Environment, underscores the limitations of legacy systems that rely on standardized metrics and advocates for enhanced data-driven approaches to improve operational agility and responsiveness (Snyder et al., 2017). This perspective aligns closely with our thesis, which presents a tool using historical FSM3 consumption data to provide accurate FIC usage for fleet commanders, enhancing DoS determination and accuracy of push logistics in challenging operational contexts.

The literature highlights that current DoS reporting practices, such as those outlined in OPNAV Instruction 2000/201, depend on dollar-value estimates that may not fully capture the nuances of onboard consumption (U.S. Navy, 2015). Our thesis addresses this by leveraging FSM3 data to create a tool that offers a more tailored solution, supporting fleet commanders with ship-class-specific insights. RAND's advocacy for integrated dashboards and scenario-based forecasting reinforces the value of our approach, which builds on the CL1P dashboard's progress by incorporating detailed FSM3 analysis (Snyder et al., 2017). Additionally, studies on U.S. Navy logistics integration stress the importance of unifying operational and sustainment data, a principle that underpins our tool's design to bridge these domains effectively (Lewis & Dew, 2025).

Institutional analyses, while often focused on joint or DoD-wide levels, provide strategic insights applicable to Navy-specific challenges. The push toward advanced data fusion and real-time decision-making tools validates our research direction, with our FSM3-based tool offering a practical step forward. Nutrition guides for warfighters further emphasize the need for reliable sustainment data, supporting the operational utility of our tool in maintaining readiness (Human Performance Resources by CHAMP, 2023). In summary, these studies collectively underscore the importance of data transparency and adaptability, reinforcing the relevance of our data-driven contribution to maritime logistics.

E. SYNTHESIS AND LITERATURE GAP

Across all reviewed systems and policies, a consistent gap emerges while inventory is well-documented, there is limited analytical validation of DoS accuracy or decision utility. Neither OPNAV Instruction 2000/201, FSM3, nor CL1P independently provide a validated, consumption-based estimate of actual sustainment levels. Our thesis addresses this gap by integrating these tools, using historical FSM3 data to develop a unifying product that structures FIC usage for DoS determination and push logistics. The current literature provides the operational backdrop, but our study introduces the evaluative depth needed to inform policy and guidance, particularly in contested environments.

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III. METHODOLOGY

The operational readiness of the U.S. Navy hinges on accurate and reliable logistics, particularly for Class I inventory, which sustains Sailors' physical endurance and morale during deployments. This study adopts a quantitative, data-driven approach to address the inconsistencies in calculating Days of Supply outlined in Chapter 1 and the literature gaps identified in Chapter 2. By leveraging nine months of historical consumption data from the Food Service Management System, the research develops an interactive application, built in the 'shiny' set of tools under the R programming language: The "Supply Select App" was designed to provide fleet commanders with precise FIC-level usage data tailored to specific ship classes. This tool enables accurate DoS determination based on real-world consumption patterns and supports push orders to ships operating in communications-denied environments. The methodology emphasizes data extraction, cleaning, analysis, and application development, moving beyond the limitations of dollar-value-based calculations according to OPNAV Instruction 2000/201 and standardized case-per-person models in the CL1P dashboard. This chapter details the data sources, collection processes, analytical methods, tool development, and limitations, ensuring a reproducible framework that enhances logistical decision-making in contested maritime operations without requiring real-time integration of external systems like DLA Troop Support, SPV's, or 9M CARGO.

A. CONCEPTUAL FRAMEWORK

The methodology is rooted in consumption-based data, prioritizing empirical usage over static financial or volumetric assumptions. Historical FSM3 data, aggregated by ship class and FIC category, forms the foundation for identifying reliable consumption patterns to inform DoS calculations and resupply planning. Unlike the OPNAV Instruction 2000/201 method, or the CL1P dashboard's uniform assumption of two cases per person per week, this approach derives estimates from observed at-sea expenditures. The framework comprises three components: aggregating consumption data by ship classes (SSN, LCS, DDG, CVN, etc.) to account for variations in crew size, mission tempo, and menu composition; analyzing usage at the FIC level (dry, chill, frozen, etc.) for granular forecasting; and integrating historical trends into a tool that projects requirements over a user-specified period (1–20 days). This approach aligns with resilient logistics principles from literature, such as those emphasized by Snyder et al. (2017) and Lewis and Dew (2025), which advocate for adaptive, data-driven solutions in contested environments.

In short, we are using the most recent consumption profile of the most similar ships in the fleet as the best estimator for the consumption of a given ship.

B. DATA SOURCES

The primary data source for this study is historical FSM3 consumption and inventory logs, covering nine months of operations across multiple U.S. Navy ship classes, including submarines (SSN, SSBN), surface combatants (DDG, CG), amphibious ships (LHA, LPD), and aircraft carriers (CVN). These logs provide detailed records of receipts, expenditures, and on-hand quantities by FIC, unit of issue (UI), and date, offering a robust dataset for capturing operational consumption patterns. Data collection was coordinated with U.S. Fleet Forces Command (USFFC) and U.S. Pacific Fleet (COMPACFLT). Although future iterations could incorporate real-time data from CL1P, OPNAV reports, DLA, SPVs, or 9M CARGO for validation, the current analysis relies solely on historical FSM3 data.

C. DATA COLLECTION PROCESS

Data collection followed a structured protocol to ensure reliability and relevance. Permissions were secured from NAVSUP and COMPACFLT to export historical FSM3 data, focusing on at-sea periods (flagged by "AT.SEA == 1") to reflect operational conditions, excluding port calls or training evolutions where consumption patterns differ. Raw logs were extracted for a nine-month window, capturing daily transactions across 14 ship classes: SSN, LCS, SSBN, LHA, DDG, LPD, LCC, LHD, CG, CVN, MCM, LSD, SSGN, and T-ESB. Filters were applied to include only records with positive quantities expended, ensuring focus on actual consumption. Data was normalized to a consistent format, with dates converted to POSIXct for temporal analysis and quantities aggregated over 7-day windows to mitigate daily variability. Missing entries, representing less than 5% of records, were imputed using class medians, while larger gaps were excluded. For each ship class, consumption was summarized by FIC and UI, calculating metrics like Days at Sea (DAS) and total orders, with a sampling strategy selecting the longest continuous at-sea deployment per class to represent typical patterns. This process yielded a clean dataset of approximately 10,000 entries, ready for analysis and tool integration.

D. ANALYTICAL METHODS

Analysis was conducted using R (version 4.3.1) with packages for data manipulation (dplyr, magrittr), visualization (ggplot2, ggsci), and interactive dashboards (shiny, flexdashboard). Descriptive statistics, including mean, median, and standard deviation of daily consumption, were computed for each ship class and FIC category, revealing distinguishing characteristics such as higher usage of perishable goods on larger platforms like CVNs. A custom function, "GetList," was developed to model consumption by filtering FSM3 data by ship class and minimum DAS, selecting a representative deployment (longest DAS), aggregating expenditures over a user-specified forecast horizon (1–20 days), and grouping quantities by UI and FIC to generate order lists. This model employs linear extrapolation from historical averages, prioritizing simplicity and deployability for operational use. Preliminary regressions explored predictors like crew size and mission tempo on consumption variance, laying the groundwork for future enhancements incorporating alternative metrics, such as weight (lbs./person/day) or caloric content (Cal/person/day), as suggested in the literature for added granularity.

E. TOOL DEVELOPMENT

The "Supply Select App" was built using R Shiny and flexdashboard, and it provides an interactive interface to support fleet commanders in logistical decision-making. The application features a dropdown menu for selecting ship classes and a slider for specifying forecast days (1–20), generating two outputs: a bar chart visualizing needs by UI (e.g., cases, pounds) and a downloadable table listing FIC, UI, and projected quantities. The app loads pre-processed RDS files and reactively invokes the "GetList" function, using ggplot2 for clear visualizations without external dependencies beyond base R libraries. Its self-contained design supports offline use, making it suitable for contested environments where connectivity may be limited. The code is modular, with helper functions for data processing, ensuring maintainability and ease of updates for future iterations. The complete source code for the Supply Select App is provided in the Appendix.

F. LIMITATIONS

Several limitations scope this methodology. FSM3 data quality may be affected by human errors or inconsistencies, particularly during high-tempo operations, potentially introducing outliers in the consumption patterns. The reliance on nine months of historical data may not capture long-term shifts, such as changes in menus or global supply chain disruptions. The tool's focus on historical FSM3 data excludes real-time integration with external forecasts from DLA, SPVs, or 9M CARGO, limiting its scope to baseline projections. The linear forecasting model assumes stable consumption patterns, which may not account for variability due to weather, exercises, or crew changes. Despite these constraints, the approach establishes a robust foundation for enhancing Class 1 logistics.

G. CORE ANALYTICAL METRICS AND FORMULAS

The foundational metric is the Average Daily Consumption (ADC). Derived directly from the historical nine-month FSM3 dataset, the ADC represents the empirically observed usage rate for a specific item on a specific type of vessel. This approach acknowledges that a destroyer's consumption will inherently differ from that of an aircraft carrier due to variances in crew size, mission profiles, and menu choices. The ADC is formally defined as

$$\mathrm{ADC}_{\mathrm{FIC,ShipClass}} = \frac{\sum \text{Quantity Expended}_{\mathrm{FIC}} \text{ during period at sea}}{\text{Total Days at Sea}} \tag{2}$$

Leveraging the historical ADC, the Projected Days of Supply can then be calculated, providing an accurate, consumption-validated assessment of sustainment. By dividing the ship's current, on-hand inventory by the historically reliable usage rate (ADC), fleet commanders can assess the true remaining endurance for any given FIC. The formula is

$$\text{Projected DoS}_{\text{FIC}} = \frac{\text{Current Inventory}_{\text{FIC}}}{\text{ADC}_{\text{FIC,ShipClass}}} \tag{3}$$

Finally, the ADC is essential for facilitating push logistics; providing fleet planners with the ability to send orders to ships operating in communications-denied environments. By inputting the desired Forecast Days, the Supply Select App uses the ADC to calculate the Projected Order Quantity required to meet the operational timeline. The formula used for calculating the resupply order is:

$$\text{Projected Order Qty}_{\text{FIC}} = (\text{Forecast Days} \times \text{ADC}_{\text{FIC,ShipClass}}) \tag{4}$$

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IV. DATA ANALYSIS

This chapter presents the analytical foundation and application for an alternative approach for measuring and visualizing DoS for Pacific Fleet ships. Currently used planning methods such as the two cases per sailor per week model have been used previously but overlook historically accrued consumption data during deployments. To address this gap and identify the true needs for ships and submarines at sea, nine months of FSM3 at-sea consumption data were analyzed to capture a realistic picture of what ships consume while underway. After analysis, the data was streamlined to act as a foundation for efficient planning to remove guesswork and estimates for both deployed units and operational planners supporting deployed operations.

While current and previous models for planning have been helpful in decision making regarding onboard supply, they are well-intentioned estimates. By shifting to an approach grounded in carefully analyzed consumption data, this research addresses actual needs and user accessibility, offering a more responsive, targeted, and efficient way to plan for DoS. The primary analytical objective was to understand how DoS, down to the FIC level, could be best calculated using actual consumption data rather than broad planning factors; the goal was to use historical records to better represent what ships require while deployed, providing a more accurate and reliable understanding of onboard needs.

The primary objective called for a dramatic shift from a planning model based on general projections to one that affords the user clear insight into consumption analytics. Data analysis and assessment functioned together to quantify DoS beyond a broad, macro-level view and instead examine it through a micro lens, down to the FIC level for specific ship and submarine types and their time at sea. Such in-depth analysis allows for a deeper, more comprehensive understanding of how individual items come together to create an overview of DoS. With a holistic, while deeply specific, view DoS ordering decisions can be uniquely tailored and become more appropriately suited for actual operational requirements, improving both accuracy and efficiency.

Early attempts at sorting and viewing data to meet this objective involved static spreadsheet models and manual filters that did not produce the level of insight, flexibility, or complexity required from such an analysis. It became increasingly clear that a more dynamic method of processing data to streamline presentation and accessibility for the user-interface was required. Static spreadsheets and filters under delivered and helped to identify the need for access to quick insights for real-time decision-making. These limitations led to the development of an interactive application built in the R programming language and easily translated to Python if required, rather than a static spreadsheet. Programming allows operations to happen at speed and scale with a wholly different mindset than spreadsheet analyses. This approach allows FSM3 consumption data to be transformed into an interactive, searchable application. The application is designed to support planning and decision-making quickly and effectively, using a more relevant and actionable pool of data through visualization. Housing multiple overlapping operational variables, the dynamic application cross-compares these factors simultaneously, tailoring outputs to highly specific and mission-relevant requirements.

The application serves as more than a visualization tool; it serves as the bridge to close the gap in planning for individuals at-sea and fleet planners. The application removes the conceptual guesswork from DoS and crafts a real-life view that is highly specific and responsive to the needs of each ship or submarine based on real-world historical consumption data. This application is meant to serve as a tool that encourages a more responsive and autonomous approach to ordering strategies behind DoS, reflecting the real-time needs of naval operations.

A. DATA PREPARATION AND PROCESSING

The foundation of this analysis lies in the comprehensive data used from FSM3, which houses daily consumption of items among the Navy. This dataset consisted of over 600 FICs, records that detail the quantities of each specific item consumed per day and at which rate. Each data entry included operational variables such as ship name, date, at-sea status, FIC, National Stock Number (NSN), unit of issue, quantity, and ship class. Because this data is so specific, zooming in to examine and manipulate consumption data to create derived metrics of tangible data for DoS purchasing enabled highly precise exactness in an operational context, rather than employing the assumption under the two cases per sailor per week model. The dataset, originally provided by COMPACFLT N41, was prepared and formatted for use in the application after appropriate filtering and structuring to ensure compatibility with the analytical environment, including filtering out data specifically for the at-sea fleet to ensure the data in the application was properly oriented for the at-sea user.

The data cleanup and organization process was intended to promote accuracy, reliability, and efficiency within the application, naming each standardized data piece as a standout key operational variable: NAME, DATE, AT-SEA, FIC, NSN, UI, QUANTITY, and CLASS. These variables intersect to construct a fully matured view of consumption records across various ships and submarines across different time periods of at-sea deployments and underways. The at-sea extrapolation of operational variables is critical for clear distinction against at-port data compilations and allows the application to capture deployed consumption rates with specificity. This data cleanup involved standardization of data formats and verification that data fields are aligned with overall data manipulation for the application's primary objective. These targeted steps helped to ensure data optimization and overall performance efficiency once entered into the application's interactive interface.

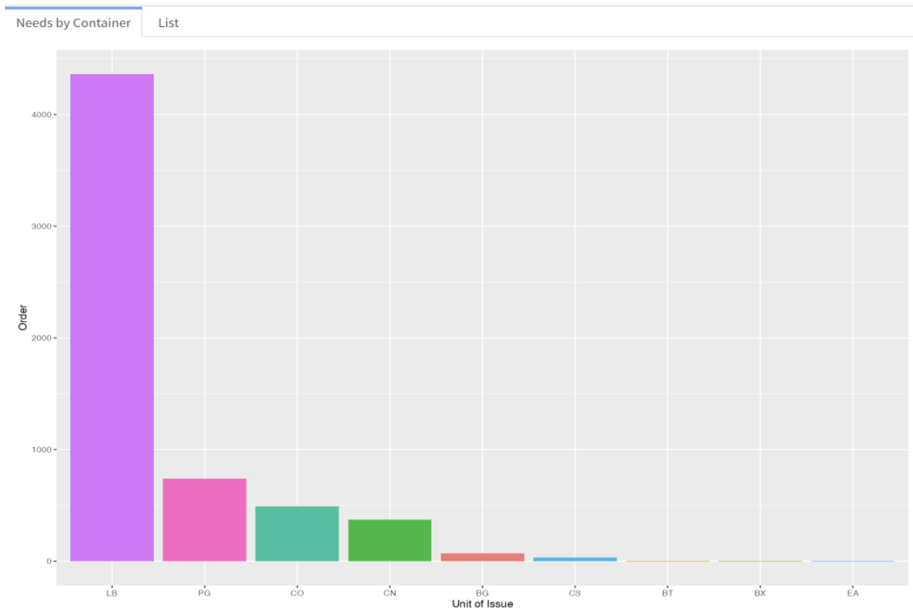
Once cleanup was completed and data was structured, the operational variables were refined further using three criteria: operational status, historical FIC use by ship class. Only data associated with time periods of at-sea consumption were retained, which narrowed the scope of analysis to the relevant conditions used when making DoS decisions. Additionally, an effort was made to afford flexibility during procurement cycles or short-term deployment and underway consumption modeling for decision-makers by limiting durations to 20 days or fewer. Together, these refinements allowed the application to produce results that display high-demand items when executed and provide users with a strong understanding of which items to prioritize for planning around DoS.

B. DEVELOPMENT OF THE SUPPLY SELECT APPICATION

The culmination of this was the entering, analyzing, and manipulation of this data into R-Studio where lines of coding transformed the data into a dynamic application, the Supply Select App. This application was created to meet the need of turning large amounts of itemized raw consumption data into something usable. The application meets the needs of planners, logisticians, and provision decision-makers fleet wide. This application answers the need for a user-friendly data synthesis tool that employs historical, real data filtered by individualized needs for the Navy's at-sea fleet. Once deployed, the application uses this data to guide clear and precise decision-making and generate accurate recommendations related to DoS.

The Supply Select App was designed with a focus on accuracy, ease of use, and relevance. Its accuracy is derived from actual, historical consumption data rather than estimated averages. Implementing this data allows for a more precise user experience, reflecting real-life conditions. The straightforward interface ensures a streamlined user experience by allowing simple input options that produce fast results and require very little technological literacy from the user. Each part of the Supply Select App was designed to respond to the needs of real-world operations, developed to aid in provisioning, planning, and purchasing decisions implementing visualization tools and improving current procurement calculation methods.

At the very core of this application, its algorithm uses key details once entered by the user. These details include user-provided information such as the class of the ship and how long it will be at sea, at which point the algorithm searches the housed dataset to find the most historically similar instance in historical data and retrieves the key consumption records for those specific criteria. Rather than relying on traditional methods such as calculated daily averages, this function uses real-world data, providing results that are accurate and specific. FICs are grouped together by unit of issue and total quantity consumed indicating what is used, how much is needed, and how demand of provisions changes over time as seen in Figures 1 and 2. This information gives planners a clear picture of expected needs and supports more accurate ordering and replenishment for DoS decisions.



This display illustrates how food items were consolidated to simplify analysis. This waterfall bar chart view is more intuitive and gives a sense of the magnitude of supply needs than previous analytic tools.

Figure 1. Visualization of FIC groupings by category.

Needs by Container | List

Show 10 entries

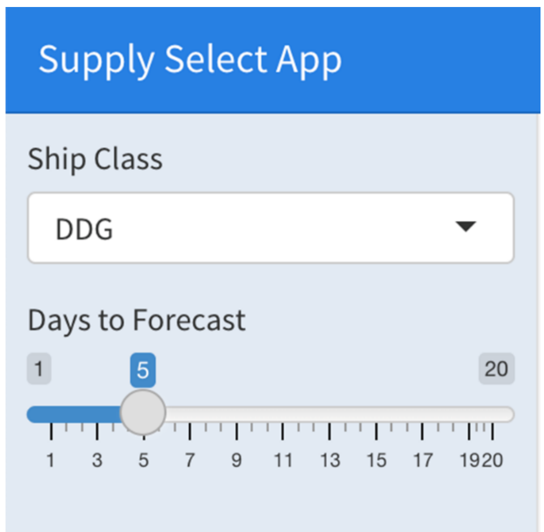
Search:

	FIC	UI	Order
1	NMF	PG	576
2	Q37	LB	477
3	L41	LB	300
4	Q15	LB	250
5	Q65	LB	250
6	V83	LB	240
7	W41	LB	220
8	S01	CO	198
9	W39	LB	175
10	W15	LB	150

This visualization displays total recommended amounts for each FIC, enabling precise forecasting and resupply planning at the line-item level. This data is easily exported as a spreadsheet for order fulfilment.

Figure 2. Recommended order quantities by individual FIC.

The Supply Select App's dashboard was built to be simple and practical for the user, intending that users interact with the application primarily through a sidebar where they enter main criteria including ship class and days at-sea to forecast as seen in Figure 3. Once that data is input, the application produces two separate results. The first result, a bar graph showing overall consumption by unit of issue, gives a visual reference of trends. The second result, a detailed table that lists each FIC alongside their recommended order quantities and other relevant details. Both application outputs work together to provide users with a high-level overview of details needed for DoS decisions.



The dropdown and sidebar enable filtering of ship class and time at-sea to generate tailored DoS estimates.

Figure 3. User interface features of the logistics tool.

Designed with accessibility and flexibility at the forefront, all filtered results can be exported and downloaded for offline use, allowing planners to access the Supply Select App during meetings or times without internet connection. This allows easier incorporation of the tool into real-time workflows including in instances of procurement planning, shipboard logistics, and mission preparation. Through the combination of real data analysis, visualization, and export functionalities, the Supply Select App transforms accurate historical consumption data into a practical decision-making tool that improves upon current supply planning and supports operational readiness.

C. KEY FINDINGS AND OPERATIONAL OUTCOMES

While working with this data, it became clear that a small number of food items constitute a disproportionate amount of the larger share in actual at-sea consumption; a small portion of FICs account for the majority share of the consumption. For example, the top ten highest consumed items represent the majority share of consumables during deployments and underways, and the top 25 make up an even larger majority. This discovery creates several impacts for planning and operations, allowing purposeful and careful DoS purchasing approaches.

By understanding that only a small share of the total FICs composing DoS, planners can focus their attention and resources on those high-demand items, rather than trying to create an equal spread of attention paid to underutilized DoS. As such, procurement schedules and suppliers can place a priority on the FICs that are most used, making ordering faster and reducing the number of suppliers needed and creating a more efficient ordering process. Additionally, this information helps planners to understand storage and loading processes, as they are better equipped to plan storage space, onboarding, and handling efforts when sailors can focus on high-volume supplies. Such planning and handling results in maximized use of space and reduction of time spent on organization and tracking.

In addition to the positive logistical implications of concentration of demand, a firm grasp on the importance of having consumption items is integral to ensuring positive DoS. If an item is delayed, unavailable, or at limited supply, its status could impact overall mission readiness. The Select Supply App meets the need of mitigating risk related to unavailable or limited stock of items and any impediments that occur when they are not accessible by making proactive at-sea planning easy and efficient.

The storage of items is unavoidably impacted by their packaging, otherwise known as their unit of issue, another operational variable considered within the Supply Select App. Knowing the unit of issue and quantity needed helps to plan storage once onboard. Using the Supply Select App helps planners to see these operational variables side-by-side when weighing procurement decisions. With grouped consumption data using unit of issue, the Supply Select App displays different units of issue potentially affecting storage needs making what used to be an incredibly nuanced and complex decision more streamlined, allowing planners to rely on the algorithm in the application rather than their own cognitive lift.

Given the application's functions, planners are better equipped to support ships and submarines in varying operational scenarios such as times of limited communication where they may not be able to receive direct orders or talk to the onboard SUPPO. The Supply Select App bridges the gap between hard-to-reach ships and submarines and onshore planners by providing accurate historical data insights to plan with self-sufficiency and without a real-time procurement list from a SUPPO onboard. Planners can use the Supply Select App to run hypothetical circumstances for looking ahead, such as deployments or underway extensions, and apply swift decision-making for procurement and timing. The application's algorithm is designed with efficiency and reliability in mind. Overall, the application does much more than simply calculate DoS; it changes the planning process using real historical data, highlighting each class of ship's specific needs with layered variation impacting unique outcomes, and helps to ensure that ships and submarines have the items they need.

V. CONCLUSION AND RECOMMENDATIONS

This thesis addresses a critical challenge in naval logistics: the inconsistent calculation of DoS for Class I inventory aboard U.S. Navy vessels. The previous chapters speak to the disparity between the dollar value-based methods prescribed in OPNAV Instruction 2000/201 and the consumption-based models used in the CL1P dashboard highlight the challenges in fleet logistics planning which complicate efforts to anticipate supply shortfalls and in coordinating sustainment deliveries. These inconsistencies pose both individual and a collective threat to operational readiness, especially in contested environments where accurate supply chain data is critical for maintaining mission continuity.

Using a thorough, data-driven approach leveraging nine months of historical consumption data from FSM3, collected research was used to create the Supply Select App, an interactive tool that provides fleet commanders with accurate and specific FIC level usage data tailored to specific ship classes. The app allows precise DoS determination by using real-world consumption patterns to support push logistics orders for ships operating in environments where communications are unavailable. Pushing past the limitations of financial approximations and standardized assumptions, this research establishes a new benchmark for Class I logistics planning that places empirical evidence ahead of theoretical models.

A. SUMMARY OF KEY FINDINGS

The research yields significant findings that address the primary research question of “How can historical consumption data from FSM3 be used to develop a product that provides accurate FIC usage data for determining DoS on board for different ship classes?” The analysis reveals that a small number of food items comprise a disproportionate share of actual at-sea consumption. The top ten highest consumed products represent most of the consumables during deployments and underways, with the top 25 accounting for an even larger proportion. This concentration of demand has profound implications for procurement efficiency, storage planning, and risk mitigation.

The Supply Select App seamlessly translates historical FSM3 consumption data into actionable intelligence through three core analytical metrics: ADC, representing empirically observed usage rates specific to vessel type; Projected DoS, calculated by dividing on-hand inventory by the ADC to assess true remaining endurance; and Projected Order Quantity, which multiplies ADC by the desired forecast days input to facilitate push logistics. These metrics, supported by nine months of at-sea consumption records across 14 ship classes, provide a more accurate and reliable alternative to existing methods.

The presented research demonstrates that consumption patterns vary significantly by ship class due to differences in crew size, mission profiles, and menu compositions. A destroyer's consumption inherently differs from that of an aircraft carrier, and these variations cannot be adequately captured by uniform assumptions such as the two cases per person per week model employed by the CL1P dashboard. The Supply Select App's ship class specific approach addresses this limitation by providing tailored forecasts that reflect actual operational requirements.

Furthermore, the research validates the feasibility of developing a self-contained, offline capable tool that does not require real-time integration with external systems such as DLA Troop Support, SPVs, or 9M CARGO. This design choice ensures operational utility in contested or communications denied environments where connectivity may be limited or compromised, aligning with the Navy's emphasis on resilient logistics in degraded information environments.

B. CONTRIBUTIONS TO NAVAL LOGISTICS

This research makes several important contributions to the field of naval logistics. First, it provides empirical validation of the limitations inherent in current DoS calculation methods, demonstrating through comparative analysis that dollar-value based approaches and uniform consumption assumptions produce significantly different estimates than those derived from actual consumption data. This validation supports the need for policy revision and establishes a foundation for evidence-based improvements to existing guidance.

Second, the research introduces a practical, deployable tool that bridges the gap between operational data systems (FSM3) and tactical decision making. The Supply Select

App represents a novel application of consumption analytics to Class I logistics, transforming raw transaction data into actionable intelligence. Its user-friendly interface requires minimal technical literacy while providing sophisticated analytical capabilities, making it accessible to a wide range of users from shipboard supply personnel to fleet level planners and decision makers.

Third, the methodology establishes a reproducible framework for analyzing consumption patterns that can be adapted to other logistics domains beyond Class I inventory. The data collection, cleaning, and analysis procedures detailed in Chapter 3 provide a template for similar efforts in other supply classes, potentially extending the benefits of consumption-based forecasting throughout the naval logistics enterprise.

Finally, the research contributes to the broader discourse on contested logistics by demonstrating how historical data analysis can enhance operational autonomy and resilience. In an era where adversaries may target logistics networks through cyber attacks, electronic warfare, or kinetic strikes, the ability to make informed supply decisions without real time connectivity represents a significant operational advantage. The Supply Select App embodies the principles of resilient logistics advocated by defense institutions and research organizations, providing a concrete example of how data driven tools can support operations in degraded information environments.

C. LIMITATIONS AND AREAS FOR IMPROVEMENT

While the Supply Select App represents a significant advancement in Class I logistics planning, several limitations must be acknowledged. The reliance on nine months of historical FSM3 data may not capture long-term shifts in consumption behavior resulting from changes in menu standards, crew demographics, or supply chain dynamics. Data quality depends on the accuracy of FSM3 entries made by shipboard personnel, and human errors during high tempo operations could potentially skew consumption patterns.

The linear forecasting model assumes relatively stable consumption patterns and may not adequately account for variability introduced by severe weather, intensive training exercises, or sudden crew changes. The app operates independently without real time integration of external data sources such as DLA Troop Support, SPV inventory levels, or

9M CARGO stocks, limiting its ability to validate projections against broader supply chain data. Additionally, the app currently focuses exclusively on quantity-based metrics without incorporating weight-based calculations or caloric content, which could provide additional insights into nutritional adequacy.

D. LIMITATIONS AND AREAS FOR IMPROVEMENT

Based on the findings of this research, several recommendations are offered for implementation. First, the Navy should conduct a pilot program to deploy the Supply Select App to a representative sample of ships across multiple classes. This pilot should include user training, feedback collection, and comparative analysis between ships using the app and those relying on traditional methods. Second, NAVSUP and OPNAV should establish a working group to review current DoS calculation guidance and compare it to that of this research's findings. Consideration should be given to revising OPNAV Instruction 2000/201 to incorporate consumption-based methodologies as either the primary standard or an approved alternative for units with access to historical FSM3 data. Lastly, fleet commanders should integrate the Supply Select App into standard operating procedures for deployment planning and push logistics scenarios. This thesis opens several avenues for future research. First, longitudinal studies should track how consumption patterns evolve over time and across different operational contexts, examining variations between routine deployments and high tempo operations, different geographic regions, and time periods reflecting changes in menu standards.

Additionally, research should explore the application of machine learning and advanced analytics to Class I forecasting, balancing analytical sophistication with operational deployability. Lastly, research should investigate extending consumption-based forecasting to other supply classes such as Class II, III, or IX.

E. RECOMMENDATIONS FOR FUTURE RESEARCH

This thesis opens several avenues for future research. To start, longitudinal studies should track how consumption patterns evolve over time and across different operational contexts, examining variations between routine deployments and high tempo operations, different geographic regions, and time periods reflecting changes in menu standards.

Further, research should explore the application of machine learning and advanced analytics to Class I forecasting, balancing analytical sophistication with operational deployability. Lastly, research should investigate extending consumption-based forecasting to other classes of supply such as Class II, III, or IX.

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APPENDIX. SOURCE CODE

```
title: “Supply Select App”
output:
 flexdashboard::flex_dashboard:
   orientation: columns
   vertical_layout: fill
runtime: shiny

---

```{r}
#info
#Harrison Schramm, Spence Wilson, Sean Harlow Marc Walker

#Supply Dashboard
#NPS 3 Sept 2025
#harrison.schramm@nps.edu

```


```{r setup, include=FALSE}
library(flexdashboard)
library(shiny)
library(magrittr)
library(dplyr)
library(ggplot2)
library(ggsci)

SDSlim = readRDS(“SD.rds”)
LJ = readRDS(“LJ.rds”)

```

```{r helpeRs}
GetList = function(SDSlim, LJ, CL, Days){
 library(magrittr)
 library(dplyr)
 library(reshape2)

 SampShip =  SDSlim %>%
   filter(Class == CL) %>%
   filter(DAS > Days) %>%
```
```

```
  arrange(-DAS)

 SS = SampShip$Name [1]

 #Now get strip data from the first ship in the line

 LJ %>% filter(Name == SS) %>% filter(AT.SEA == 1) -> ShortList
 FirstDay = ShortList$Date [1]
 LastDay = FirstDay + Days

 ShortList %<>% filter(between(Date,FirstDay, LastDay)) %>%
  select(FIC, UI, QUANTITY) %>%
  group_by(FIC, UI) %>%
  summarize(Order = sum(QUANTITY)) %>%
  filter(Order > 0) %>%
  ungroup() %>% arrange(-Order)

 return(ShortList)
}
```
```

Inputs {.sidebar}
-------------------------------------

```{r}
classes = c("SSN," "LCS," "SSBN," "LHA",
        "DDG," "LPD," "LCC," "LHD," "CG",
        "CVN," "MCM," "LSD," "SSGN," "T-ESB")



selectInput("Class," "Ship Class," choices = classes)
sliderInput("Days," "Days to Forecast," value = 5, min = 1, max = 20, step = 1)

```


Column {.tabset}

Needs by Container

```{r}
renderPlot({
```
```

```
 GetList(SDSlim, LJ, input$Class, input$Days) %>%
   group_by(UI) %>%
   summarize(Order = sum(Order)) %>%
   ggplot(aes(x = reorder(UI, -Order),
              y = Order,
              fill = UI)) +
   geom_col() + xlab("Unit of Issue") + theme(legend.position = "none")
})
```
```

### List

```{r}

DT::renderDataTable({
 DT::datatable(
   GetList(SDSlim, LJ, input$Class, input$Days)
 )
})
#renderTable({
#  GetList(SDSlim, LJ, input$Class, input$Days)# $%>% DT::datatable()
#})

install.packages("shiny")
```
```

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