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CNO Ship Availability Maintenance Team Workload and Manning

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CNO SHIP AVAILABILITY MAINTENANCE TEAM WORKLOAD AND MANNING EXECUTIVE SUMMARY

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Project Summary

The research project studied the planning process for major surface ship maintenance activities, termed availabilities, and sought to determine whether the Navy's estimates for maintenance availabilities could be improved. We analyzed data on the estimated and actual durations of surface ship availabilities conducted at the Southwest Regional Maintenance Center (SWRMC). For estimates, we narrowed the project scope to examine estimates for tanks and voids work conducted as part of each availability. Data was collected for 30 surface ships and various regression analyses were conducted, but none of the analyses showed any statistically significant relationships. We separately compared the contractor estimates of man-day requirements for complete availabilities to Navy estimates and found the contractors consistently underestimated the number of man-days required to complete the availabilities. We also found a contributor to poor estimates is growth work, specifically requests for contract change submitted by contractors after the scope of work to be conducted as part of an availability is finalized. We found a correlation between growth work and maintenance delays. Likewise, we found a positive correlation between growth work and the age of the ship. One challenge was the lack of data on ship maintenance in a single database and the inconsistency in the maintenance data. The findings can help inform decisions on manning, resource allocation, and processes for surface ship maintenance planning and execution.

Keywords: *ship maintenance, availabilities, regional maintenance centers, project estimation, late projects, surface ship maintenance*

Background

As the US Navy faces an aging fleet, the ability to quickly perform maintenance activities is important for ship availability. The current chief of naval operations (CNO), Admiral Michael Gilday, set a goal of zero lost operational days due to maintenance by the end of FY21. This will require a substantial improvement on performance from 2020, when only 40% of ships had their maintenance completed on time. Ship maintenance has received substantial attention because the majority of scheduled maintenance availabilities are delayed, sometimes by years. These long delays impact operational availability of the ship.

The objective of the research was to conduct duration analyses that inform the development of future availability duration estimates. In particular, this project focuses on the Availability Duration Scorecards (ADS), which are used by both the Naval Sea Systems Command and Regional Maintenance Centers (RMCs) to allocate resources and personnel to individual availabilities. An availability describes when a Navy ship is made "available" for a major maintenance activity conducted in dry dock. The ADS is an important planning document for ship maintenance, and lateness is measured with respect to the duration estimate from the ADS.

There have been a number of related studies conducted in recent years to inform ship maintenance planning and execution. Caprio and Leszczynski (2012) investigated CNO availability schedule overruns and found aircraft carrier availabilities tend to finish on schedule more frequently than other ship classes; late availabilities charge less for work per month than the budgeted amount of work; and late availabilities generally have more work stoppages prior to the initiation of work than on schedule availabilities. Other studies were conducted by De Vlaming (2018) and Sears (2021), as well as the many reports generated by the Government Accountability Office (Mauer, 2022).

This research addressed the problem through the lens of lean systems thinking to identify bottlenecks and improve workflow. We evaluated the end-to-end process of maintenance from availability planning to execution. The project gathered data on ship maintenance from about 30 CNO Availabilities conducted at SWRMC from FY16 to FY21 for guided-missile cruisers (CGs), guided-missile destroyers (DDGs), and littoral combat ship (LCSs). The data was taken from multiple sources, including the Navy Data Environment, Navy Maintenance Database, Ship Maintenance Data Improvement Initiative, and Ship Maintenance Model. The data was then combined into an MS Excel spreadsheet for analysis. We performed multiple types of regression analysis on the data seeking out any correlations between the independent variables (e.g., ship age, ship type, number of tanks and voids) with the dependent variables (e.g., availability duration, number of man days, and number of requests for contract changes).

Findings and Conclusions

We were able to find several interesting correlations in the ship maintenance data. One finding was the contractor estimations of the man-days required to execute an availability were consistently lower than the actual number of man-days required to complete the availability. Other estimates from the Navy Maintenance Database, Ship Maintenance Data Improvement Initiative, and Ship Maintenance Model provided more accurate estimates of the man-days required to complete availabilities. A second interesting finding was an increase in the number of requests for contract changes, i.e., growth work, for older ships and those ships that had extended deployments between availabilities. This finding was more noticeable for DDG class ships than for either CG or LCS class ships, likely due to the larger sample size available for DDGs. Other than these findings, the regression analyses were unable to find any statistically significant relationships in the data.

The inability to find statistically significant effects can be due to one or more of the following reasons. There may be no relationships between the variables, or we examined the wrong independent variables. The sample size was small and may have been too small for trends to emerge in the data. Notably there were several statistical trends that conflicted between ship class, such as the relationship between ship age and the number of requests for contract change. Due to the small sample sizes, we note the discrepancies rather than suggest an actionable conclusion to avoid building recommendations based on potentially spurious statistical relationships. The data was collected from multiple sources and may have had errors in it. Lastly, the unique aspects of each ship and the associated maintenance work on each ship results in a substantial number of exceptions being made to standard practices. While understandable, the uniqueness of the maintenance strategy for each ship is particularly challenging for large scale data analysis. These unique aspects and special circumstances create outliers in the data that skew the results.

The research work contributes to a greater understanding of the maintenance process. The SWRMC can take the results and investigate how contractors make their estimates, and they can also explore the proficiency and number of Naval civilians supporting the process and whether improvements in either could affect maintenance duration.

Recommendations for Further Research

In order to manage an activity, you need to measure it and know what is going on. The current approach that the Navy utilizes to conduct major maintenance activities, termed availabilities, for surface ships' situations, makes this very difficult. In order to better manage the maintenance process for surface ships, the Navy and its contractors need to improve their collection and

organization of relevant maintenance data. The Navy collects a lot of data, but there are inconsistencies in the data between systems, and some of the data on task durations and each job are highly suspect. The Navy is attempting to address this issue through a new relationship with the Naval Surface Warfare Center, Corona Division to lead the development of the Ship Maintenance Data Improvement Initiative, which is envisioned as a consistent data warehouse. We feel that this is a step in the right direction but note that the data in the warehouse is necessarily dependent on input from shipyards and regional maintenance centers. We recommend that better data could be collected if bar coding or some other electronic means were used in the shipyards to track the start and end of each individual job.

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Acronyms

ADS	Availability Duration Scorecard
CG	guided-missile cruiser
CNO	chief naval officer
DDG	Guided-Missile Destroyer
LCS	littoral combat ship
RMC	regional maintenance center
SWRMC	Southwest Regional Maintenance Center