

NOAA Office of Marine and Aviation Operations Does Not Fully Utilize the Shipboard Automated Maintenance Management System to Coordinate Ship Maintenance and Repairs

FINAL REPORT NO. OIG-18-011-A

JANUARY 8, 2018



U.S. Department of Commerce
Office of Inspector General
Office of Audit and Evaluation



January 8, 2018

MEMORANDUM FOR: Rear Admiral Tim Gallaudet, Ph.D., USN Ret.
Assistant Secretary of Commerce for Oceans and Atmosphere
and Acting Under Secretary of Commerce for Oceans
and Atmosphere

Rear Admiral Michael Silah
Director
Office of Marine and Aviation Operations and the NOAA Corps

FROM: Mark H. Zabarsky
Principal Assistant Inspector General for Audit and Evaluation

SUBJECT: *NOAA Office of Marine and Aviation Operations (OMAO) Does Not Fully Utilize the Shipboard Automated Maintenance Management System (SAMMS) to Coordinate Ship Maintenance and Repairs*
Final Report No. OIG-18-011-A

Attached is our final audit report conducted to review the NOAA OMAO ship fleet, as part of our fiscal year 2016 work plan. Our objective was to determine whether NOAA OMAO coordinates ship maintenance and repairs of its fleet using SAMMS.

We found that OMAO does not consistently use SAMMS to coordinate ship maintenance and repairs of its fleet. This occurred because OMAO management did not have sufficient controls in place to effectively monitor and evaluate the performance of SAMMS. We found several issues with NOAA's use of SAMMS—specifically,

- I. SAMMS has accessibility issues,
- II. SAMMS contains inaccurate information,
- III. SAMMS does not always function as intended, and
- IV. SAMMS funds were used to satisfy other OMAO requirements.

Because of the significance and magnitude of problems that would need to be corrected to make SAMMS utilization effective—as well as the additional resources required and the history of past problems—we question whether further investment in SAMMS is the best solution. We recommend that OMAO initiate action to terminate SAMMS and that the \$5 million in program funds, currently planned to be spent as part of the current interagency agreement, be put to better use. We further recommend that OMAO conduct a comprehensive study to identify a maintenance management system that meets the capabilities necessary to fulfill NOAA ship fleet maintenance requirements.

Pursuant to Department Administrative Order 213-5, please submit to us an action plan that addresses the recommendations in this report within 60 calendar days. The final report will be posted on OIG's website pursuant to sections 4 and 8M of the Inspector General Act of 1978, as amended (5 U.S.C. App., §§ 4 & 8M).

We appreciate the cooperation and courtesies extended to us by your staff during our audit. If you have any questions or concerns about this report, please contact me at (202) 482-3884 or Ken Stagner, Audit Director, at (303) 312-7650.



Report in Brief

January 8, 2018

Background

The National Oceanic and Atmospheric Administration (NOAA) Office of Marine and Aviation Operations (OMAO) currently operates 16 ships to conduct hydrographic, oceanographic, atmospheric, and fisheries research.

According to OMAO, its fleet is expected to decline from 16 to 8 active ships between fiscal years (FYs) 2016 and 2028.

The Military Sealift Command (MSC) developed the Shipboard Automated Maintenance Management System (SAMMS) software as its primary tool for preventive maintenance and has used it for over 30 years to maintain its fleet. SAMMS is designed to provide an automated method of tracking ship maintenance and repair requirements and ensuring that the appropriate level of vessel readiness is maintained. SAMMS does this by establishing a schedule of required preventive maintenance actions for each piece of maintainable shipboard equipment and by documenting and tracking equipment maintenance history.

In 1992, NOAA decided to use the SAMMS software to manage equipment maintenance for the four primary onboard ship departments (engineering, deck, steward, and electronic technicians).

Why We Did This Review

Our objective was to determine whether NOAA OMAO coordinates ship maintenance and repairs of its fleet using SAMMS.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

NOAA Office of Marine and Aviation Operations Does Not Fully Utilize the Shipboard Automated Maintenance System to Coordinate Ship Maintenance and Repairs

OIG-18-011-A

WHAT WE FOUND

We found that OMAO does not consistently use SAMMS to coordinate ship maintenance and repairs of its fleet. This occurred because OMAO management did not have sufficient controls in place to effectively monitor and evaluate the performance of SAMMS. We found several issues with NOAA's use of SAMMS:

- *SAMMS has accessibility issues.* Specifically, (1) port engineers generally did not have access to SAMMS; (2) the SAMMS program manager could not access SAMMS for an extended period of time; and (3) shipboard personnel experienced difficulties accessing the system.
- *SAMMS contains inaccurate information.* Specifically, we found SAMMS contains inaccurate (1) ship equipment information, and (2) ship equipment maintenance schedules.
- *SAMMS does not always function as intended.* We reviewed work summary reports from the SAMMS contractor and identified a history of functionality issues with SAMMS.
- *SAMMS funds were used to satisfy other OMAO requirements.* OMAO management told us that, since FY 2011, it budgeted \$1 million annually for SAMMS. However, we found that funds intended for SAMMS were used to satisfy other priorities. For example, SAMMS funds were used to pay for unplanned repairs to ships.

These issues contributed to OMAO personnel using alternative methods and procedures such as emails, spreadsheets, databases, card systems, white boards, and individual knowledge to manage their ship maintenance and repair needs. Based on our audit results, at least \$5 million will be wasted unless several additional actions are taken to ensure that SAMMS is effectively utilized as intended.

WHAT WE RECOMMEND

We recommend the Director, OMAO and the NOAA Corps

1. initiate action to terminate the interagency agreement with MSC and discontinue using SAMMS; and
2. conduct a comprehensive study to identify a maintenance management system that meets the capabilities necessary to fulfill NOAA ship fleet maintenance requirements.

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Cover: Herbert C. Hoover Building main entrance at 14th Street Northwest in Washington, DC. Completed in 1932, the building is named after the former Secretary of Commerce and 31st President of the United States.

Introduction

The National Oceanic and Atmospheric Administration (NOAA) Office of Marine and Aviation Operations (OMAO) currently operates 16 ships to conduct hydrographic, oceanographic, atmospheric, and fisheries research. According to OMAO, its fleet is expected to decline from 16 to 8 active ships between fiscal years (FYs) 2016 and 2028, as ships are withdrawn from service because they have reached the end of their usable life. The launch years of the 16 ships span from 1967 to 2012 with an average ship age of over 23 years—three of them approaching 50 years old.¹ In FY 2016, OMAO allocated approximately \$27.5 million in operational maintenance funding to address ship maintenance and repair needs.

NOAA ship utilization priorities are determined by legislative mandates, such as the Magnuson-Stevens Fishery Conservation and Management Act,² and executive mandates like the July 19, 2010, Final Recommendations of the Interagency Ocean Policy Task Force.³ A committee of stakeholders who comprise the NOAA Fleet Council is responsible for developing a prioritized annual plan of tasks for the 16 NOAA ships.

The Military Sealift Command (MSC) developed the Shipboard Automated Maintenance Management System (SAMMS) software as its primary tool for preventive maintenance and has used it for over 30 years to maintain its fleet of more than 100 ships. SAMMS is designed to provide an automated method of tracking ship maintenance and repair requirements and ensuring that the appropriate level of vessel readiness is maintained. SAMMS does this by establishing a schedule of required preventive maintenance actions for each piece of maintainable shipboard equipment and by documenting and tracking equipment maintenance history. Besides tools for maintenance scheduling and machinery history recordkeeping, SAMMS integrates machinery vibration monitoring, used lube oil analysis, electronic watch keeping data collection, and diesel engine combustion analysis into a single program.

In 1992, NOAA decided to use the SAMMS software to manage equipment maintenance for the four primary onboard ship departments (engineering, deck, steward, and electronic technicians). In its *NOAA Ships and Aircraft Serving the Nation* publication,⁴ NOAA stated that SAMMS is designed to assist shipboard and shoreside personnel in managing maintenance and repair needs of its fleet. Further, NOAA stated in that publication that SAMMS would be a valuable tool that would “help increase the reliability of its fleet even during tight financial times

¹ National Oceanic and Atmospheric Administration, Office of Marine and Aviation Operations, November 2015. *Fiscal Year 2018 OMAO Marine Maintenance Proposal*. Silver Spring, MD: NOAA OMAO.

² The Magnuson-Stevens Fishery Conservation and Management Act is the primary law governing marine fisheries management in U.S. federal waters.

³ In order to better meet the nation’s stewardship responsibilities for the ocean, our coasts, and the Great Lakes, President Obama established the Interagency Ocean Policy Task Force on June 12, 2009. President Obama directed the Task Force with developing recommendations to enhance our ability to maintain healthy, resilient, and sustainable ocean, coasts, and Great Lakes resources for the benefit of present and future generations.

⁴ NOAA, Office of NOAA Corps Operations, July 1995. *NOAA Ships and Aircraft Serving the Nation*, C 55.2:AI 7/4. Silver Spring, MD: NOAA NC.

by contributing to wise expenditure of maintenance funds and by predicting and avoiding costly equipment failures.”

Currently, OMAO and MSC have an interagency agreement in place for SAMMS use on NOAA ships. The interagency agreement also provides for technical assistance from a contractor to support and maintain the system software. The terms of the interagency agreement include an estimated amount of \$5 million over 5 years with a start date of April 27, 2016.

Objective, Findings, and Recommendations

Our objective was to determine whether NOAA OMAO coordinates ship maintenance and repairs of its fleet using SAMMS. Appendix A further details the objective, scope, and methodology of our audit. We found that OMAO does not consistently use SAMMS to coordinate ship maintenance and repairs of its fleet. This occurred because OMAO management did not have sufficient controls in place to effectively monitor and evaluate the performance of SAMMS. We found several issues with NOAA's use of SAMMS—specifically,

1. SAMMS has accessibility issues,
2. SAMMS contains inaccurate information,
3. SAMMS does not always function as intended, and
4. SAMMS funds were used to satisfy other OMAO requirements.

These issues contributed to OMAO personnel using alternative methods and procedures such as emails, spreadsheets, databases, card systems, white boards, and individual knowledge to manage their ship maintenance and repair needs. Furthermore, over the years, OMAO has used funds intended for SAMMS operations to satisfy other requirements, which may have contributed to some of the system operational problems.⁵ OMAO has spent approximately \$5 million on SAMMS since it was first acquired more than 24 years ago, and plans to spend an additional \$5 million as part of its current interagency agreement with MSC. During the course of this audit, OMAO issued a policy directive⁶ mandating SAMMS use. However, because of the significance and magnitude of the problems that would need to be corrected to make SAMMS implementation effective—as well as the additional resources required and the history of past problems—we question whether further investment in SAMMS is the best solution. We recommend that OMAO initiate action to terminate SAMMS and that the \$5 million in program funds, currently planned to be spent as part of the current interagency agreement, be put to better use.

However, if OMAO determines that SAMMS is the best alternative, it should work with MSC to identify best practices and guidance for effective SAMMS implementation. SAMMS is MSC's primary system for preventive maintenance and has realized benefits from its implementation (see appendix B for more details). Appendix C shows the potential monetary benefits we found from our audit.

I. SAMMS Has Accessibility Issues

OMAO personnel responsible for ship maintenance and repairs could not easily access SAMMS. Specifically, (1) port engineers generally did not have access to SAMMS; (2) the

⁵ OMAO does not receive a direct appropriation for SAMMS. Rather, OMAO provides Marine Operations (the office within OMAO that is responsible for maintaining the NOAA fleet) with an allocation of discretionary funds each FY for its operations. Marine Operations develops an initial spend plan (budget) to determine how funds are going to be distributed. In addition, Marine Operations has the flexibility to adjust its spend plan (budget) as its needs and priorities change throughout the year. The initial annual spend plan (budget) for SAMMS since FY 2011 has been \$1 million according to OMAO management.

⁶ NOAA, OMAO. October 2016. *Shipboard Automated Maintenance Management System*. Silver Spring, MD: NOAA OMAO.

SAMMS program manager could not access SAMMS for an extended period of time; and (3) shipboard personnel experienced difficulties accessing the system.

Port engineers. Port engineers play a key role in ship maintenance, as they are responsible for coordinating and scheduling ship maintenance and repairs situated at shore. However, during September and October 2016, we surveyed 11 port engineers and found that the majority of them did not have any access to SAMMS or indicated they were unable to access SAMMS.

OMAO management told us it is aware that port engineers have problems accessing SAMMS and said this was primarily due to delays in implementing SAMMS Web. SAMMS Web is the connection from shore to the SAMMS shipboard component that allows port engineers to review and process repairs. Management also stated because it is focused on improving other aspects of SAMMS, such as database accuracy, there will continue to be limited emphasis on SAMMS accessibility and training for port engineers. Without SAMMS Web, port engineers cannot use SAMMS to view their assigned ships' maintenance and repair needs for facilitating repairs on shore. Our survey revealed that instead of using SAMMS, email was the primary means used to communicate maintenance and repair needs from the ship to port engineers on shore.

SAMMS program manager. OMAO policy directive 0601-15⁷ states that the program manager shall review, screen, and resolve all ship feedback requests.⁸ However, from October 2015 through May 2016, the SAMMS program manager could not access SAMMS due to server issues.⁹ This impacted the program manager's ability to perform his responsibilities for more than 7 months. For instance, the program manager could not review system feedback requests that have a direct impact on updating the preventive maintenance¹⁰ plans on the ships.

Shipboard personnel. Login and system issues have caused shipboard personnel to experience difficulties accessing SAMMS on their ships. To illustrate, in response to our survey,¹¹ chief marine engineers indicated their passwords, for reasons never identified, are being rejected and are constantly reset. In addition, one chief marine engineer indicated the modules within SAMMS do not close down properly, which then requires an entire shutdown of SAMMS. Furthermore, another chief marine engineer indicated if SAMMS does run for more than 10 minutes, then it does not shut down properly. The SAMMS contractor had to frequently visit NOAA ships in order to correct these issues.

⁷ NOAA OMAO. March 2011. *SAMM: Maintenance, Modification, and Repair*. Silver Spring, MD: NOAA OMAO.

⁸ Feedback requests are requests from personnel on the ship to make changes to SAMMS. These requests include changes to the ship's equipment listing and maintenance plans. Feedback requests are reviewed and approved by OMAO and the SAMMS contractor. If feedback requests are approved, the SAMMS contractor will make changes to the SAMMS database and software. Reports are generated monthly to track the status of feedback requests.

⁹ NOAA OMAO experienced problems with the servers when they moved the SAMMS servers to a cloud environment.

¹⁰ Preventive maintenance is maintenance performed on equipment or machinery at pre-determined intervals or according to prescribed criteria to reduce the risk of failure.

¹¹ From August through October 2016, we conducted a survey of the chief marine engineers to determine if SAMMS is utilized by shipboard personnel and how SAMMS is utilized. Chief marine engineers are responsible for coordinating and scheduling maintenance and repairs on the ship.

These access issues caused shipboard personnel to rely on alternative procedures, such as spreadsheets, databases, card systems, white boards, and individual knowledge to maintain and repair their ships.

Personnel on the ships must be able to make timely entries in SAMMS to keep equipment and maintenance interval information current, and the SAMMS program manager must have access to ensure the feedback requests are processed. Timely, current information allows shipboard managers to effectively and efficiently schedule resources and prioritize repairs that keep the ship mission capable and safe. Repairs that cannot be performed while at sea can be performed when the ship is at shore. An accurate SAMMS that can be accessed in real time by the port engineers provides valuable lead time to assemble the materials and personnel to complete repairs on shore quickly allowing the ship to return to mission capable status.

II. SAMMS Contains Inaccurate Information

Government Accountability Office *Standards for Internal Control in the Federal Government*¹² states that management should use quality information to achieve the entity's objectives. These internal control standards define quality information as information that is "appropriate, current, complete, accurate, accessible, and provided on a timely basis." We found that OMAO did not have controls in place to ensure SAMMS contained quality and accurate information. Specifically, we found SAMMS contains inaccurate (1) ship equipment information, and (2) ship equipment maintenance schedules. These deficiencies diminish OMAO maintenance personnel's ability to effectively use SAMMS for overseeing or managing maintenance and repair of ship equipment. Due to such known quality limitations of current SAMMS data, the entire system would need to be updated in order to provide reliable information. OMAO management stated that it has initiated action to improve the reliability of SAMMS shipboard data. For example, these managers stated that the quality of SAMMS data has been improved on four ships. (We did not verify the actions taken by OMAO management to improve SAMMS data on the four ships.) However, these managers also told us they do not know when this action will be completed for all ships.

A. Inaccurate ship equipment information found in SAMMS

Each NOAA ship contains many unique pieces of equipment. However, we found that SAMMS often does not contain an accurate equipment inventory listing for its ships. Our review of the monthly SAMMS feedback reports identified numerous requests from shipboard personnel to add or delete equipment in SAMMS.¹³ Despite these requests, the process to make such changes to SAMMS is not timely. For example, personnel-requested changes to SAMMS were not processed by the software contractor from January through April 2016 and in June 2016 due primarily to server issues. Even when

¹² Government Accountability Office, September 2014. *Standards for Internal Control in the Federal Government (Green Book)*, GAO-14-704G. Washington, DC: GAO.

¹³ Feedback requests are requests from personnel on the ship to make changes to SAMMS. These requests include changes to the ship's equipment listing and maintenance plans. SAMMS feedback reports are generated by the SAMMS contractor to track the status of feedback requests.

SAMMS is operational, personnel-requested changes take approximately two months¹⁴ on average to process.

Additionally, shipboard personnel have expressed frustration with SAMMS and the feedback process. For example, in response to our survey, one chief marine engineer indicated that SAMMS is difficult and challenging to use, feedback goes unanswered for long periods of time, no shoreside support exists, and information in SAMMS does not accurately reflect the equipment currently onboard ships.

In June 2016, OMAO conducted its own review of SAMMS and found that in multiple cases, the usability of SAMMS aboard its vessels was lacking and, in many cases, completely inaccurate. Equipment criticality, maintenance periodicities, maintenance descriptions, and even the equipment itself were found to be erroneous. Inaccurate equipment information can hinder OMAO management's ability to make prudent business decisions concerning the maintenance and repairs of its ships.

B. Inaccurate equipment maintenance schedules found in SAMMS

Each maintainable piece of equipment identified in SAMMS includes a maintenance schedule. This schedule simply identifies when and how often maintenance should be performed on a piece of equipment. The goal is to prevent equipment breakdowns and failures by performing maintenance at regular time intervals. However, we found that the equipment maintenance schedules in SAMMS were not always accurate. For example, one preventive maintenance item in SAMMS calls for shipboard personnel to change the auxiliary fuel oil filters in a critical piece of equipment once every 6 months. However, according to shipboard personnel, because these filters are critical to the ships' operation, they should be replaced up to four times a month. In another example, a preventive maintenance item in SAMMS calls for shipboard personnel to change the hydraulic oil in the forward crane every month. However, according to shipboard personnel, they do not frequently use the crane, perhaps 10 times a year, and the crane holds 130 gallons of oil. Changing the oil monthly, in their judgment, would be wasteful and costly. Therefore, the frequency of an oil change can vary. For instance, one shipboard person told us that an oil sample is sent to a laboratory to determine whether it needs to be replaced. As previously mentioned, OMAO reported in its June 2016 review, that in multiple cases, the usability of SAMMS aboard its vessels was lacking and, in many cases, completely inaccurate and found that maintenance periodicities and maintenance descriptions were erroneous.

We also found that the monthly SAMMS feedback reports contained numerous requests from shipboard personnel to change the equipment maintenance schedules. Similar to issues we identified with maintenance equipment in the section above, the process to make these changes to SAMMS was not timely. Chief marine engineers have also expressed frustration with the process. For example, in response to our survey, one chief marine engineer indicated the process to make changes to SAMMS is overly

¹⁴ Based on NOAA summary feedback tracking turnaround reports, the average turnaround time to complete a feedback request has been 63 days during the last eight fiscal years.

complicated. For instance, to make a simple change to SAMMS such as modifying the frequency of a filter change, they have to go through an enormous approval process, and it is very costly. The chief marine engineer also indicated there are hundreds of changes to make.

III. SAMMS Does Not Always Function as Intended

SAMMS does not always function properly or as intended onboard NOAA ships. We reviewed work summary reports¹⁵ from the SAMMS contractor and identified a history of functionality issues with SAMMS. For example, during a ship visit in February 2015, the SAMMS contractor met with chief engineers to discuss installation of SAMMS software for tracking spare parts on their ships. In October 2015, when the contractor returned to install the tracking system, it discovered the SAMMS server was experiencing significant reliability issues. Consequently, the contractor postponed the installation indefinitely until the server could be made usable again. On another ship visit during 2015, the SAMMS contractor found that the SAMMS firewall rules were incorrect. Moreover, firewall issues were later found on four other ships as well as at NOAA's SAMMS engineering lab. These issues persisted for nearly a year. As a result, OMAO personnel were not always able to utilize a fully functioning maintenance management system.

Table I shows, for the 6-month period ending June 2016, (1) the total number of feedback requests made by shipboard personnel to fix and update SAMMS; (2) the total number of feedback requests completed; and (3) the total number of feedback requests that are in a warning or violation status. Warning status means a request is more than 30 days old, and violation status means a request is more than 60 days old. The significant number of continued unresolved issues raises concern about the reliability and value of using SAMMS as a maintenance management system.

¹⁵ Work summary reports identify the work performed by the SAMMS contractor at specific locations such as on NOAA ships.

Table 1. Feedback Requests from January 2016 to June 2016

Time Period	Total Feedback	Completed Feedback	Warning Status	Violation Status
January 2016	28	0	2	14
February 2016	111	0	2	50
March 2016	111	0	2	50
April 2016	150	0	93	5
May 2016	184	17	53	78
June 2016	167	0	53	78

Source: NOAA Summary Feedback Tracking Spreadsheets

IV. SAMMS Funds Were Used to Satisfy Other OMAO Requirements

OMAO has redistributed funds intended for SAMMS operations to other OMAO priorities, thus possibly contributing to system implementation problems. OMAO management told us that, since FY 2011, it budgeted \$1 million annually for SAMMS. However, we found that funds intended for SAMMS were used to satisfy other priorities. For example, SAMMS funds were used to pay for unplanned repairs to ships. Table 2 shows the amount spent and the budgeted amount for SAMMS from FYs 2011 through 2016.

Table 2. OMAO SAMMS Investment from FYs 2011 through 2016

Fiscal Year	Spent Amount	Budgeted Amount
2011	\$500,000	\$1,000,000
2012	\$1,000,000	\$1,000,000
2013	\$1,000,000	\$1,000,000
2014	\$0	\$1,000,000
2015	\$708,378	\$1,000,000
2016	\$752,551	\$1,000,000

Source: OMAO Management

Notwithstanding the use of SAMMS funds to satisfy other requirements, OMAO issued NOAA OMAO Policy 0605, Version 1.0, "Shipboard Automated Maintenance Management System," effective date of October 1, 2016, during our audit, mandating the use of SAMMS to maintain

the NOAA fleet. Redistributing SAMMS funding to other priorities may cause delays in correcting the accessibility issues, database accuracy and functionality issues, and preclude mandatory usage of SAMMS across the NOAA fleet.

Conclusion

We found that OMAO does not consistently use SAMMS to coordinate ship maintenance and repairs of its fleet. SAMMS continues to have implementation, utilization, and accuracy problems even after more than 24 years of deployment and a policy directive (issued during the audit) mandating its use. In addition, we found that OMAO management did not implement sufficient internal controls to effectively monitor and to evaluate the performance of SAMMS, to ensure that the system was accessible, that it contained both complete and accurate information, and to promptly resolve software problems. Furthermore, over previous years, OMAO has used funds intended for SAMMS operations to satisfy other requirements, thus possibly contributing to some of the system operational problems. Instead of using SAMMS, many OMAO personnel relied on alternative methods and procedures such as emails, spreadsheets, databases, card systems, white boards, and individual knowledge to maintain and to repair ships. Based on our audit results, at least \$5 million will be wasted unless several additional actions are taken to ensure that SAMMS is effectively utilized as intended. These additional actions include doing the following:

- benchmark OMAO SAMMS implementation and utilization with best practices employed by MSC, and review and analyze benchmarking information to determine if it can be implemented by OMAO;
- apply lessons learned from SAMMS implementation and utilization efforts to avoid similar problems;
- sustain management attention and organizational commitment;
- provide comprehensive SAMMS training to all users;
- ensure all appropriate personnel have access to SAMMS to perform their assigned duties effectively and efficiently;
- establish a SAMMS database that accurately reflects the equipment found on each NOAA ship;
- develop a timely process to update the SAMMS database as equipment is added or removed from NOAA ships;
- establish a SAMMS database that accurately reflects the appropriate maintenance schedules for equipment on each NOAA ship;
- develop a timely process to update the SAMMS database to reflect accurate maintenance schedules for equipment on each NOAA ship;
- require the SAMMS contractor to enter changes and updates to SAMMS timely; and
- ensure SAMMS software functions properly on all NOAA ships.

We do not know how much program costs may increase or if any increase will be offset by efficiencies gained through effective implementation and utilization of SAMMS if these changes are implemented. However, because of the magnitude of problems that must be corrected to make SAMMS utilization effective, as well as the additional resources required and the history of past failures, we question whether further investment in SAMMS is the best solution. We recommend that OMAO initiate action to terminate SAMMS and that the \$5 million in program funds be put to better use.

Recommendations

We recommend that the Director, OMAO, and the NOAA Corps

1. initiate action to terminate the interagency agreement with MSC and discontinue using SAMMS; and
2. conduct a comprehensive study to identify a maintenance management system that meets the capabilities necessary to fulfill NOAA ship fleet maintenance requirements.

Summary of Agency Response and OIG Comments

In responding to our draft report, NOAA agreed with recommendation 2 and has initiated action to determine whether there are other management systems that can more effectively assist with ship maintenance. Because NOAA responded that the immediate termination of the agreement with MSC and discontinuing the use of SAMMS prior to finding a new system would be detrimental, OIG would find it acceptable for NOAA to take time to research and acquire a new ship maintenance management system prior to terminating SAMMS. Nonetheless, recommendation 1 stands, despite NOAA's lack of concurrence with that recommendation. OIG asserts that the steps that NOAA has initiated to comply with recommendation 2 are steps necessary for NOAA to comply with recommendation 1 as soon as practicable after NOAA has identified a replacement ship maintenance management system that better fulfills NOAA ship maintenance requirements. This is consistent with NOAA's acknowledgment that there may be a better alternative to SAMMS. We are encouraged that steps have already been initiated to address our findings, and we look forward to NOAA's action plan that will provide details on the corrective actions to be taken. We have included NOAA's complete response as appendix D to this report.

Furthermore, NOAA raised some concerns about our findings:

- NOAA stated that finding IV is misleading because it gives the impression that NOAA misallocated funds dedicated to SAMMS in a separate program, project, or activity allocation. NOAA noted that it does not receive direct appropriations for SAMMS. We agree with NOAA that SAMMS does not receive a direct appropriation; our report makes reference to that in footnote 5. However, OMAO provides Marine Operations (the office within OMAO that is responsible for maintaining the NOAA fleet) with an allocation of discretionary funds each fiscal year for its operations. Marine Operations develops an initial spend plan (budget) to determine how funds are going to be distributed. In addition, Marine Operations has the flexibility to adjust its spend plan as needed. According to OMAO management, the initial annual spend plan for SAMMS since FY 2011 has been \$1 million.
- NOAA stated that the budgeted amount in table 2 (column 3) is incorrect for all fiscal years except for FY 2012 and FY 2013 because the \$1 million identified for each fiscal year reflects the funding cap on the interagency agreement, not the actual amount budgeted. However, during our audit, senior OMAO managers told us that they budget \$1 million a year to spend on SAMMS. Furthermore, the interagency agreement does not identify a cap amount for each fiscal year—instead, it identifies an overall cap amount for the entire agreement period. Because NOAA's audit response is inconsistent both with the information that senior OMAO managers told us during the audit and with the information included in the interagency agreement, table 2 (column 3) has not been adjusted based on NOAA's audit response.

- NOAA stated that it was already aware of the issues our audit surfaced and had been developing a plan to address them. Our audit results do not fully support that position. For example, SAMMS continued to have implementation, utilization, and accuracy problems even after more than 24 years of deployment. In fact, our report makes reference to the fact that OMAO issued a policy directive during the audit mandating its use. Additionally, OMAO management did not effectively monitor and evaluate the performance of SAMMS, to ensure that the system was accessible, to confirm it contained both complete and accurate information, and to promptly resolve software problems. Consequently, many OMAO personnel relied on alternative methods and procedures such as emails, spreadsheets, databases, card systems, white boards, and, in some cases, individual knowledge to maintain and to repair ships.
- NOAA stated that it estimates the total cost for SAMMS over the 5-year interagency agreement period will be approximately \$2.9 million, not the \$5 million quoted in the report. However, the \$5 million quoted in the report represents the cap amount of the interagency agreement and the potential amount that NOAA could spend on SAMMS over the entire agreement period, which extends through April 26, 2021.

Appendix A: Objective, Scope, and Methodology

The objective of this audit was to determine whether NOAA OMAO coordinates ship maintenance and repairs of its fleet using SAMMS. To accomplish our objective, we did the following:

- obtained an understanding of SAMMS by interviewing OMAO management including the deputy director, chief of engineering, chief of planning and operations, chief of applied electronics and technology, SAMMS program manager, and the former SAMMS program manager;
- conducted site visits to assess the use and function of SAMMS onboard the NOAA ships Bell M. Shimada, Nancy Foster, and the Thomas Jefferson;
- conducted a survey of the chief marine engineers to determine whether SAMMS is utilized by shipboard personnel and how SAMMS is utilized (surveys were sent to all 16 chief marine engineers and to one relief/backup chief marine engineer; we received responses from 10 chief marine engineers and from the one relief/backup chief marine engineer);
- conducted a survey of the port engineers to determine if shoreside personnel have access to SAMMS (surveys were sent to 11 port engineers; we received responses from all 11 port engineers);
- reviewed summary payment information to determine the amount of funds OMAO spent on supporting and maintaining SAMMS (we also reviewed the current interagency agreement between OMAO and MSC);
- obtained and analyzed SAMMS reports in order to assess SAMMS usage and identify changes, modifications, and repairs made to SAMMS; and
- interviewed NOAA and OMAO budgeting personnel to gain a general understanding of the maintenance and repair budget.

We gained an understanding of internal controls significant within the context of the audit objective by interviewing NOAA and OMAO agency officials and reviewing documentation for evidence of internal controls. While we identified and reported on internal controls deficiencies, no incidents of fraud, illegal acts, violations, or abuse were detected within our audit. We identified control weaknesses regarding management's oversight of SAMMS. We assessed the reliability of computer-generated data by interviewing agency officials knowledgeable about the data and by obtaining corroborating evidence. We determined that the data were sufficiently reliable for the purposes of this report. We conducted this performance audit from February 2016 to January 2017 and performed fieldwork in Washington, DC; Florida; Maryland; Oregon; and Virginia.

We conducted this performance audit in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain

sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objective. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objective. We performed our work under the authority of the Inspector General Act of 1978, as amended (5 U.S.C. App), and Department Organizational Order 10-13, dated April 26, 2013.

Appendix B: MSC and SAMMS

MSC developed SAMMS and has been using the maintenance system for more than 30 years on all of its ships. According to MSC personnel, they use SAMMS to assist in optimizing equipment performance and ensuring that personnel maintain the appropriate level of ship readiness. MSC personnel also said that SAMMS promotes the cohesive efforts of the shipboard and shoreside engineering staff to identify issues and to address them efficiently.

In an August 1, 2016, email to us, MSC stated that it has saved a large amount of money in maintenance and repairs during the last 30 years by utilizing a fully comprehensive SAMMS. For example, the tail shaft inspection frequency was cut in half thereby reducing costs to the government by a few million dollars each year. Also, all MSC ships are inspected by the American Bureau of Shipping¹⁶ and the Coast Guard. Many open and inspection requirements are waived by inspectors when good machinery history and condition monitoring records are kept in SAMMS. This saves money because equipment does not have to be disassembled for inspection, reassembled, and then fixed if the equipment reassembly was incorrect. MSC also replaces oil in large oil sumps based solely on oil analysis—saving money in oil disposal and oil purchasing costs.

MSC personnel also stated that SAMMS works well because their engineers take the time to put the required information into SAMMS so that there is enough quality information in the system to make business decisions. Finally, MSC personnel said they use many of the major components of SAMMS, including:

Preventive maintenance. MSC uses SAMMS to distribute standard maintenance requirements to its fleet. SAMMS does this by establishing a schedule of required preventive maintenance actions for each piece of maintainable shipboard equipment and by documenting and tracking equipment maintenance history. Shipboard personnel must complete each preventive maintenance action or document a valid reason why they need to postpone the performance of the preventive maintenance.

Feedback function. MSC uses the SAMMS feedback function to request changes in the equipment's maintenance plan and/or the SAMMS equipment list.

*Predictive maintenance.*¹⁷ MSC uses SAMMS for the following predictive maintenance activities:

- lube oil analysis;
- fuel, coolant, boiler water, and chemical analysis;

¹⁶ The American Bureau of Shipping is a non-profit technical organization, recognized as the official vessel classification society for NOAA.

¹⁷ Predictive maintenance techniques are designed to help determine the condition of in-service equipment in order to predict when maintenance should be performed. Examples of predictive maintenance include oil analysis and vibration analysis. Oil analysis consists of collecting, testing, and replacement based on analysis results rather than scheduled replacement. Vibration analysis is used to detect faults (usually imbalance or misalignment) in rotating equipment such as fans, motors, pumps, and gearboxes.

- vibration analysis; and
- diesel engine combustion analysis.

Watch keeping. MSC uses SAMMS electronic watch keeping technologies that provides another level of predictive maintenance. The technologies include the automatic recording of gauge readings from electronic signals around the ship. They also include the manual recording of gauge readings utilizing portable data collectors. The data is trended over time and used to make decisions on how to most efficiently operate and to support a root cause analysis when equipment failure occurs.

Repair tracking. MSC's shipboard chief engineers use SAMMS to assign repairs to either shipboard personnel or shoreside personnel. If shipboard personnel are capable of performing the repair then the chief engineer will assign the repair to shipboard personnel and add the repair to the ship's force work list in SAMMS. If shipboard personnel do not have the capability to perform the repair, then the chief engineer will request assistance from shoreside personnel by submitting a voyage repair request¹⁸ in SAMMS.

Work package development and execution. MSC uses SAMMS to assist in the development and execution of shoreside work repair packages.

Virtual technical library. MSC maintains a virtual technical library in the SAMMS database that contains all ship drawings, manuals, and bulletins stored in electronic format. The virtual technical library ensures that both shipboard and shoreside engineers have access to the same technical documentation.

Data transfer mechanism. MSC uses a mechanism within SAMMS to transfer data between MSC's shoreside systems and shipboard systems.

¹⁸ A voyage repair request is a correspondence from the chief engineer to the port engineer requesting assistance for repairs that are beyond the scope of the shipboard personnel to accomplish.

Appendix C: Potential Monetary Benefits

	Questioned Costs	Unsupported Costs	Funds To Be Put To Better Use
Recommendation I			\$5,000,000

Appendix D: Agency Response



UNITED STATES DEPARTMENT OF COMMERCE
The Deputy Under Secretary for Operations
Washington, D.C. 20230

MEMORANDUM FOR: Mark H. Zabarsky
Assistant Inspector General for Acquisition
and Special Program Audits OCT 18 2017

FROM: Benjamin Friedman
Deputy Under Secretary for Operations
Performing the duties of Under Secretary
of Commerce for Oceans and Atmosphere
and NOAA Administrator 

SUBJECT: *NOAA Office of Marine and Aviation Operations (OMAO)
Does Not Fully Utilize the Shipboard Automated Maintenance
Management System (SAMMS) to Coordinate Ship
Maintenance and Repairs
Draft Report*

The National Oceanic and Atmospheric Administration (NOAA) appreciates the opportunity to review and comment on the Office of the Inspector General (OIG) draft report entitled, *NOAA Office of Marine and Aviation Operations (OMAO) Does Not Fully Utilize the Shipboard Automated Maintenance Management System (SAMMS) to Coordinate Ship Maintenance and Repairs*.

While NOAA agrees with the majority of OIG's findings and is committed to remedying the accessibility, accuracy, and functionality issues within the SAMMS program, NOAA is unable to concur with Recommendation #1 to terminate the inter-agency agreement with Military Sealift Command (MSC) and discontinue using SAMMS. Without use of SAMMS, NOAA would revert to a decentralized manual tracking of maintenance and repairs. In the last two years, NOAA invested a significant amount of time and money into training and updating SAMMS, and those efforts have yielded promising results. Terminating the agreement and discontinuing use of SAMMS prior to identifying a new maintenance management system would be detrimental to the fleet program. Notwithstanding NOAA's commitment to working with MSC to identify best practices and guidance for effective SAMMS implementation, NOAA acknowledges that there may be a better alternative to SAMMS. Accordingly, NOAA concurs with Recommendation #2 to conduct a comprehensive study to identify a maintenance management system that meets the capabilities necessary to fulfill NOAA ship fleet maintenance requirements.

We appreciate the opportunity to respond to the draft report. If you have questions, please contact Mack A. Cato, Director, Audit and Information Management Office on (301) 628-0949.

Attachment



Department of Commerce
National Oceanic and Atmospheric Administration
Comments to the OIG Draft Report Entitled
“NOAA Office of Marine and Aviation Operations (OMAO) Does Not Fully Utilize the
Shipboard Automated Maintenance Management System (SAMMS) to Coordinate Ship
Maintenance and Repairs”
(September 2017)

General Comments

The National Oceanic and Atmospheric Administration (NOAA) appreciates the opportunity to review and comment on the Office of the Inspector General (OIG) draft report titled “NOAA Office of Marine and Aviation Operations (OMAO) Does Not Fully Utilize the Shipboard Automated Maintenance Management System (SAMMS) to Coordinate Ship Maintenance and Repairs”. NOAA agrees with the majority of OIG’s findings and it is committed to remedying the accessibility, accuracy, and functionality issues within the SAMMS program. NOAA is unable to concur with Recommendation #1 to terminate the inter-agency agreement with Military Sealift Command (MSC) and discontinue using SAMMS because, without use of SAMMS, NOAA would have to revert to decentralized manual tracking of maintenance and repairs. In the last two years, NOAA invested a significant amount of time and money into SAMMS program, which has yielded promising results. Terminating the agreement and discontinuing use of SAMMS prior to identifying a new maintenance management system would be detrimental to the fleet program. Notwithstanding NOAA’s commitment to working with MSC to identify best practices and guidance for effective SAMMS implementation, NOAA acknowledges that there may be a better alternative to SAMMS. Accordingly, NOAA concurs with Recommendation #2 to conduct a comprehensive study to identify a maintenance management system that meets the capabilities necessary to fulfill NOAA ship fleet maintenance requirements.

In findings #1 – 3, OIG found that SAMMS had accessibility issues, contained inaccurate information, and did not always function as intended. Prior to and during the audit field work, NOAA was aware of these issues and had been developing a plan to address them. NOAA established a dedicated SAMMS team, which focused on accessibility and accuracy. NOAA has taken actions to address these concerns and improve the utilization and effectiveness of the SAMMS program. Accordingly, NOAA concurs with findings #1-3.

In finding #4, OIG found that SAMMS funds were used to satisfy other NOAA requirements. This finding is misleading because it gives the mistaken impression that NOAA misallocated funds that were dedicated to SAMMS in a separate Program, Project or Activity allocation. In fact, NOAA does not receive direct appropriations for SAMMS. NOAA has made a significant investment in the SAMMS program over the last five years by using its Fleet Services PPA funding, which includes discretionary funds for marine operations. NOAA disagrees with finding #4 because it is ambiguous.

NOAA's Response to the Findings of the Office of Inspector General

1) SAMMS had accessibility issues

Resolution to the remote access (shore-side) issue is expected to be completed at the start of FY 18 with the successful procurement of Client Access licenses. The lack of reliable remote access has significantly hindered efforts to monitor the program from shore and to effect changes, particularly for the SAMMS Program Manager. Port engineers must gain access to successfully support the SAMMS program for their assigned ship. After the close-out of winter dockside and dry-dock repair contracts, Port Engineers and Mission Systems Engineers will receive training on accessing SAMMS.

Additional access issues may have been caused by complications with local (shipboard) software or installations and lack of familiarity with the system. To alleviate these issues, all ships were visited to perform system checks and training was provided to users to resolve any access issues (e.g. passwords) as well as to ensure familiarity with the program. Additionally, ad hoc training on ships has been conducted as use of the system has increased.

2) SAMMS contained inaccurate information

In June 2016, OMAO conducted an internal review of SAMMS and found that, in multiple cases, SAMMS contained inaccurate equipment information. Equipment criticality, maintenance periodicities, maintenance descriptions, and even the equipment itself were found to be erroneous. As a result of the internal review, the Marine Operations Engineering Branch assigned a new SAMMS Program Manager and implemented a focused approach to correcting the accuracy issues.

During FY 17, the major scope of SAMMS support efforts was redirected to correcting the inaccurate information in the system such as, shipboard equipment lists, preventative maintenance criticality, periodicities, and descriptions for the Engineering and Deck equipment on each vessel. The three Product Line Managers were tasked with establishing a minimum baseline of equipment and maintenance activities that would be uniformly required across all vessels of the product line (class). Chief Marine Engineers (CMEs) could tailor the system above this baseline, but they could not reduce activities below it. A tiger team comprised of NOAA personnel and Emprise (product vendor) contractor personnel went to each ship and worked with the respective CME to gather ship specific equipment lists, nameplate data and to implement the majority of the maintenance activity corrections on the spot. Only those requiring additional research were subsequently corrected via the feedback process. See table below. By May 2017, all ships were checked and currently all have accurate information for equipment lists and maintenance schedules for the engineering and deck departments.

Vessel	Ship check Dates:	Changes made in SAMMS:	Changes made on site:	Changes made via Feedback:	Maintenance Review completion date:
Henry Bigelow	05 - 09 Jan 2015 Newport, RI	121	120	1	9-Jan-15
Pisces	12 - 19 Sept 2016 N. Kingstown, RI	85	40	45	9-Nov-16
Thomas Jefferson	04 - 07 April 2016 Baltimore, MD	252	251	1	10-Nov-16
Oregon II	29 - 30 Aug 2016 Pascagoula, MS	405	357	48	28-Oct-16
Gordon Gunter	01 - 02 Sept 2016 Pascagoula, MS	354	257	97	20-Dec-16
Okeanos Explorer	10 - 14 Oct 2016 Honolulu, HI	134	127	7	13-Jan-17
Ronald Brown	25 - 28 Oct 2016 San Diego, CA	82	38	44	30-May-17
Oscar Sette	14 - 18 Nov 2016 Honolulu, HI	335	331	4	31-Mar-17
Bell Shimada	13-17 Mar 2017 Newport, OR	626	624	2	31-Mar-17
Oscar Dyson	17 -23 Jan 2017 Bellingham, WA	85	84	1	20-Apr-17
Hi'ialakai	17 -23 Jan 2017 Bellingham, WA	315	315	0	18-May-17
Nancy Foster	May 03, 2017 Key West, FL	312	105	207	1-Sep-17
Rainier	20 - 24 Feb 2017 Newport, OR	186	0	186	28-Aug-17
Reuben Lasker	13 - 18 Feb 2017 San Diego, CA	231	224	7	28-Mar-17
Ferdinand Hassler	May 03, 2017 Baltimore, MD	230	0	230	1-Jun-17
Fairweather	20 - 24 Feb 2017 Newport, OR	221	219	2	1-May-17

The second phase of this effort, planned for FY 18, includes another round of ship checks and data clean-up for the remaining departments, including the Chief ETs mission systems and bridge equipment and Stewards galley equipment. These ship checks commenced September 1, 2017 and are scheduled to be completed by May 31, 2018.

Processes for completing these updates are being captured in engineering procedures and policies, such as the NOAA Ship Configuration Management Plan. Increased oversight of configuration changes is possible largely due to the increased shore-side support, as the Marine Engineering Branch is nearly fully staffed as of October 2017, with Port Engineers assigned to the majority of our vessels and Product Line Managers working between platforms to ensure compatibility.

3) *SAMMS did not always function as intended*

These issues may be related to shipboard database instability or may be related to individual user actions/practices during shipboard SAMMS interactions. Access issues (password issues, SAMMS application/module issues, etc.) have been referred back to the vendor for resolution. OMAO is in concurrence with the OIG team's recommendation to evaluate alternative software products as a possible replacement for SAMMS in the future. We are doing so concurrently while working with the SAMMS vendor to resolve these application software issues.

To further improve the timeliness of entering and updating changes and responding to feedback generated on the ships, we are currently in the process of bringing most of the database editing in-house with a dedicated (non-contractor) employee. This will not only increase efficiency and it will also reduce cost to the government.

Recommended Changes for Factual/Technical Information

Page 8, section IV. SAMMS Funds Were Used to Satisfy Other OMAO Requirements:

The finding that SAMMS funds were used to satisfy other NOAA requirements is misleading because it gives the mistaken impression that NOAA misallocated funds that were dedicated to SAMMS in a separate PPA allocation. In fact, NOAA does not receive direct appropriations for SAMMS.

Although there is no separate PPA allocation for SAMMS, OMAO has made a significant investment in the SAMMS program over the last five years using its Fleet Services PPA funding, which is the general funding for marine operations. Marine Operations is the operating unit that is responsible for maintaining NOAA's fleet. OMAO allocates discretionary funding via the Fleet Services PPA to Marine Operations each fiscal year for its operations. Marine Operations develops a spend plan to determine the distribution of those funds. Marine Operations has the discretion to adjust the spend plan as necessary as priorities change throughout the year. Given some unforeseen urgent ship repairs, Marine Operations has on occasion adjusted the amount of discretionary funding use for SAMMS.

The total amount of funds obligated from 2011-2016 is accurately identified in Table 2 on page 8 of the draft report. While it is correct that no funds were obligated against the Inter-Agency Agreement (IAA) with Military Sealift Command (MSC) in FY 14, services continued from the contract provider throughout that year, as services were yet to be rendered from FY 13 agreements. The budgeted amount in Table 2, Column 3, is incorrect for all years except for FY 12 and FY 13 – the \$1M for the other years actually reflects the cap of the IAA. Actual expenditures are planned and executed based on the continuous work prescribed through the contract provider. As currently planned, the estimated cost for the remaining three years of the agreement is \$1.4M, and total cost over the 5-year IAA (FY 16 – FY 21) with MSC will be approximately \$2.9M – not the \$5M quoted in the draft report. Costs are going down because the level of effort requested of the contract provider to adapt SAMMS for effective use is nearing completion. The steady state SAMMS support costs after FY 21 are expected to remain level, at approximately \$400K per year or approximately \$25K per ship, per year.

NOAA's Response to OIG Recommendations

Recommendation 1: "Initiate action to terminate the inter-agency agreement with MSC and discontinue using SAMMS."

NOAA does not concur with the recommendation to terminate the agreement, as a significant investment in both time and money has been made into SAMMS, yielding promising results, especially in the last two years. Additionally, terminating without first identifying an alternative system would be detrimental to maintenance in the fleet.

Maximizing NOAA's investment in SAMMS has been widely communicated as a priority for the organization. Progress and performance results are actively monitored by the SAMMS program manager. This information is provided to Marine Operations leadership on a weekly, monthly, and quarterly basis. A performance "dashboard" has been established, which displays SAMMS metrics for percent completions, deferrals and incompletes. Phase II (FY 17) of the current SAMMS effort also included a 120-day compliance ramp up effort to get all the ships into the "green" and condition the ships-force to use the system as part of a normal daily routine. Adherence to SAMMS requirements are communicated as essential components of satisfactory job performance.

Recommendation 2: "Conduct a comprehensive study to identify a maintenance management system that meets the capabilities necessary to fulfill NOAA ship fleet maintenance requirements."

NOAA concurs with this recommendation to commence a comprehensive study to determine if there are other maintenance management systems available that could more effectively assist with maintenance monitoring and management in the fleet. NOAA has initiated this process. We are currently evaluating the American Bureau of Shipping (ABS) Nautical Systems RS Enterprise software system. We are also conducting a benchmark maintenance study of the maintenance practices including maintenance management systems used by the University National Oceanographic Laboratory System (UNOLS) fleet to determine if the systems they use could be effectively adapted for the NOAA fleet. If we identify a better and more economical system, we will develop a transition strategy and terminate the interagency agreement with MSC.