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# Condition-Based Maintenance Implementation and Potential in USMC Ground Transport

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Monterey, California: Naval Postgraduate School

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**NPS NRP Executive Summary**

Condition-Based Maintenance Implementation and Potential in USMC Ground Transport

Period of Performance: 10/24/2021 – 12/30/2022

Report Date: 12/30/2022 | Project Number: NPS-22-M273-A

Naval Postgraduate School, Department of Defense Management (DDM)



**NAVAL RESEARCH PROGRAM**  
NAVAL POSTGRADUATE SCHOOL  
MONTEREY, CALIFORNIA

**CONDITION-BASED MAINTENANCE IMPLEMENTATION  
AND POTENTIAL IN USMC GROUND TRANSPORT  
EXECUTIVE SUMMARY**

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**Additional Researcher(s):** Mr. Bryan Hudgens, DDM

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### Project Summary

The Marine Corps is undergoing organizational change efforts to integrate Condition-Based Maintenance Plus (CBM+) as a maintenance strategy to support ground equipment across the enterprise. We studied the implementation of CBM in industry and identified common themes, including guidelines for identifying platforms most suited to CBM—those that are critical and costly to replace. We studied people and processes for implementation of CBM+ and identified critical barriers including incompatibility among policies.

Existing tools within the Marine Corps policy refinement process, such as the Total Life Cycle Management Cross Functional Team, can be used to establish a CBM+ guiding coalition. We recommend creating an environment that fosters short-term wins through interim exceptions to policy and consolidating these gains in a single volumized maintenance order. The Field Supply and Maintenance Analysis Office can be utilized as a key contributor in communicating and enabling the CBM+ vision for Marine Corps maintenance through evaluating, training, and consolidating best practices of CBM+ processes. This further supports the current Commandant's priority initiatives, both Force Design 2030 and Talent Management 2030. Reducing unnecessary maintenance actions and cross-functional training will support both retention and development of high-performing Marines.

Stuetelberg and Thomas briefed their work to BGen. Chalkley, then at Headquarters Marine Corps Installations and Logistics, and currently Commander of 3<sup>rd</sup> Marine Logistics Group (3d MLG). Their report was also sent to the Secretary of the Navy's Chief of Staff, the Honorable Tommy Ross. During a guest lecture in a Naval Postgraduate School (NPS) logistics capstone course, the Honorable Mr. Ross specifically identified their topic as a great example of "key" topics (direct quote). Harding and Pennington briefed senior leaders including Maj. Gen. Maxwell, at the time Vice Director for Logistics, Joint Staff, and now Assistant Deputy Commandant, Installations & Logistics (Facilities).

**Keywords:** *condition-based maintenance, logistics, USMC, private sector, best practices, metrics, expeditionary logistics, decision analysis, decision support*

**Background** The Marine Corps is undergoing organizational change efforts to integrate CBM+ as a maintenance strategy to support ground equipment across the enterprise. Currently, the Marine Corps uses a traditional time-based strategy for ground equipment maintenance, conducting preventative maintenance at specified time intervals and corrective maintenance when failure occurs. CBM+ will generate increased cost-savings, reduce man-hour requirements, and improve operational availability for Marine Corps' ground systems.

CBM has already been widely adopted in industry for several decades. We reviewed the literature on CBM and interviewed maintenance professionals in the mining, railroad, and heavy equipment industries to learn about their implementation strategies, challenges and lessons learned. Using a case study methodology, we synthesized themes on best practices. We evaluated the applicability of their experiences



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in the context of Marine Corps ground systems maintenance and developed findings and recommendations for the implementation of CBM+ sensors and data analytics in the Marine Corps.

The three pillars of CBM+ are people, processes, and technology (Headquarters Marine Corps, 2020). During this project, the Marine Corps stood up a Program Office for CBM+ which is addressing the technology portion of the transition. To identify gaps in the Marine Corps' organization-wide policies, processes, and personnel to be technology-empowered and data-driven in its maintenance strategies, we conducted a second phase of the research.

To identify gaps in the Marine Corps, we reviewed ground maintenance policies considering prior findings on CBM implementation and the organizational change literature. We interviewed fifteen military and civilian ground maintenance subject matter experts in key roles in the organization. Based on the information collected, we identified barriers to and opportunities for change within the Marine Corps ground maintenance community, and further recommendations for CBM+ implementation.

### Findings and Conclusions

In industry, CBM is heavily predicated on collecting and analyzing data. Companies that are successful with this strategy all possess an internal data analytics department staffed with specialized professionals in this field. Moreover, data analysis was enabled by effective and interoperable software and hardware suites. Neither of these is readily achievable given current Marine Corps maintenance manpower structure and limitations on available technology and data security requirements. CBM is not one size fits all. CBM implementation should prioritize costly pieces of equipment, low-density assets that are crucial to revenue-producing activities, or equipment where unplanned mechanical failure presented significant worker safety risks.

Four organizational barriers to CBM+ emerged from our interviews with Marine Corps subject-matter experts. First, there is a lack of clear and consistent understanding of CBM+ across the Fleet Marine Force. Second, there is conflict among various orders and policies that delineate Marine Corps maintenance strategy, and many legacy policies directly conflict with CBM+ strategies. Third, inspections heavily influence maintenance actions at the operational unit level and hinder implementation of CBM+ initiatives. Finally, competing priorities reduce focus and capacity necessary to change maintenance strategies.

Our primary recommendations for improving CBM+ implementation are focused on aligning the effort with other enterprise priorities and aligning policies to permit and support innovation in implementing CBM+. We recommend creating an environment that fosters short-term wins through interim exceptions to policy and consolidate these gains in a single volumized maintenance order. Operational units need to be empowered to seek out process improvements and opportunities to apply CBM+ practices. The Field Supply and Maintenance Analysis Office can be utilized as a key contributor in



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communicating and enabling the CBM+ vision for Marine Corps maintenance through evaluating, training, and consolidating best practices of CBM+ processes.

Existing tools within the Marine Corps policy refinement process, such as the Total Life Cycle Management Cross Functional Team model, can be used to establish a CBM+ guiding coalition. A CBM+ guiding coalition would guide, coordinate, and communicate CBM+ implementation throughout the Marine Corps, including communicating to the Fleet Marine Forces how CBM+ supports the current Commandant's priority initiatives, both Force Design 2030 and Talent Management 2030. Reducing unnecessary maintenance actions and cross-functional training will support both retention and development of high-performing Marines, with agility and resilience to operate in challenging operational environments.

### Recommendations for Further Research

The Condition-Based Maintenance Plus (CBM+) implementation is moving forward. The Marine Corps stood up a new program office for CBM+ which is addressing the technology portion of the transition, while 3<sup>rd</sup> Marine Logistics Group (3d MLG), under the command of BGen. Chalkey, was briefed on the first phase of our research. 3d MLG completed a one-year pilot of CBM process-level innovation (3d MLG, 2022). The research team has been in regular correspondence with Headquarters Marine Corps Installations and Logistics regarding our findings and recommendations with respect to people and processes. No additional research following on this project has been identified. We have transitioned the results to the fleet.

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### Acronyms

3d MLG	3 <sup>rd</sup> Marine Logistics Group
CBM+	Condition-Based Maintenance Plus
NPS	Naval Postgraduate School

