



# Enabling Fleet Management With CBM+

■ By David Pack

**F**or life cycle management, Condition-Based Maintenance Plus (CBM+) is a critical link in the evolution of preventive maintenance. As defined by the CBM+ Department of Defense (DOD) Guidebook, CBM+ “is the application and integration of appropriate processes, technologies, and knowledge-based capabilities to improve the reliability and maintenance effectiveness of DOD systems and components.” This capability will help optimize supply chain efficiencies through increased awareness and accuracy.

## Maintenance When Needed

CBM+ provides reliability-centered maintenance as an enabler and ensures maintenance is performed when needed rather than on a strict schedule. It employs multiple capability sensors embedded on individual major weapons systems to record fault codes at the source of the problem, which allows analysts and engineers

to predict the real-time health status of their equipment and schedule maintenance before catastrophic failures occur.

The CBM+ process manages the health condition of assets to perform maintenance at the most opportune times, and only when needed, by optimizing the trade-off between maintenance costs and performance costs. This increases availability and reliability while eliminating unnecessary maintenance. Once a platform has exited the CBM process and has been “CBM+ enabled,” fleet managers can make better decisions concerning the level and source of repair.

The ability to accurately forecast a failure trending to a system’s not mission capable status, based on asset usage, helps prevent catastrophic equipment breakdowns.

## Enabling Fleet Management

The Army Materiel Command (AMC) has achieved significant suc-

cess in deploying CBM solutions for the Army aviation fleet managed through the Army Aviation and Missile Life Cycle Management Command (LCMC) Logistics Center in Huntsville, Ala. However, while CBM is commonly associated with aviation and ground vehicle platforms, the application of these technologies to the command, control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR) community is a relatively new concept.

The goal of fleet management for the C4ISR team is to balance acquisition, recapitalization, reset, sustainment, and divestiture decisions across systems’ life cycles. This meets the Army’s equipping and operating requirements, achieves optimized budgets,

*Above, Army Communications-Electronics Command contractors conduct maintenance on a tactical quiet generator during condition-based maintenance testing at Sierra Army Depot, Calif.*

and communicates critical knowledge to stakeholders.

The C4ISR managers must also have a common operational picture of the fleet, which is a significant and critically important step in fleet management. The activities under CBM+ associated with establishing CBM/ CBM+ technical feasibility—the CBM+ process—provide fleet managers with the material they need to baseline technical and document configurations for their supported fleets. [To baseline means to establish a standard metric and configuration.]

In order to baseline the fleet and assess technical feasibility, fleet managers must have visibility of worldwide equipment inventory and readiness status. This includes having knowledge of current configuration, system, and block upgrade information and access to real-time asset information by system, component, and other customer distribution requirements.

It also requires the ability to cross-check the accuracy of the data retrieved from Army authoritative data sources or other data management systems accessible to fleet managers. Other data needed to baseline fleets and determine technical feasibility include planned acquisition fielding, past fielding, system losses, system asset position by force composition, new or replacement systems, joint service requirements, demilitarization preparation and divestiture requirements, data interchange requirements, system modifications, and funding requirements.

The Army Communications-Electronics Command (CECOM) Logistics and Readiness Center (LRC) will baseline its fleets to gain an accurate common operational picture of the fleets, review Army objectives for each fleet, define areas of risk, and develop appropriate risk mitigation by recommending courses of action to achieve an optimized budget. Each of these is an integral and significant outcome of the fleet management process.

### **CBM+ Background**

CECOM LRC initiated its CBM+

program in 2008. It is critical to the implementation of CBM+ technologies and strategies for legacy systems across the C4ISR community. The program is driven by DOD and Army policies, including DOD Instruction 4151.22, CBM+ for Materiel Maintenance; Army Regulation (AR) 70-1, Army Acquisition Policy; AR 750-1, Army Materiel Maintenance Policy; and AR 700-127, Integrated Logistics Support. The intent of these policies is to optimize Army maintenance and supply actions by reducing costs and improving the reliability of C4ISR platforms.

CECOM has aligned its core mission with these Army and DOD policies by making its top priorities unmatched C4ISR capabilities and innovative solutions for the Army of 2020 and beyond. CECOM sustains critical C4ISR assets and replaces legacy systems by identifying and divesting obsolete, excess, and dormant equipment. The CECOM CBM+ approach involves executing a repeatable business process that enables more efficient data collection, transmission, analysis, and decision-making as they relate to a platform's health status.

The process, designed to shift the Army to more proactive and innovative fleet maintenance and planning strategies, is part of an integrated and collaborative effort with partners from the CECOM Software Engineering Center; the Army Logistics Innovation Agency (LIA); the Logistics Support Activity; the Communications-Electronic Research, Development and Engineering Center (CERDEC); the Tobyhanna, Letterkenny, and Sierra Army Depots; Aberdeen Test Center; the Aviation and Missile Research Development and Engineering Center; and the Army Materiel Systems Analysis Activity.

This dedicated team of government agencies has already completed an early operational assessment of CBM+ technology both on tactical quiet generators (TQGs) and the C4ISR command post platform. The results validated a proof of concept and provided successful demonstrations of

CBM+ data collection and transmission strategies across the Common CBM+ Architecture currently under development within CERDEC.

In a parallel initiative, CECOM LRC built a CBM+ execution guide that provides a step-by-step process for identifying and enabling CBM+ program candidates. This process will determine the return on investment and eventually integrate CBM+ into program candidate life cycle management capabilities.

### **Fleet Management Assessment**

CECOM, an AMC LCMC, performed a series of CBM+ assessments. CECOM LRC conducted the assessments over 21 days in November and December 2012 at the Sierra Army Depot in California. The assessments proved the feasibility of condition monitoring and failure prediction from a technical perspective for several platforms operating under conditions mirroring those of Southwest Asia.

Building on lessons learned from several events, the assessment at Sierra Army Depot involved placing commercial off-the-shelf sensors on one MEP-803A TQG, one MEP-805B TQG, one MEP-806B TQG, and one AN/TSQ-232(V)2 tactical command system. CECOM LRC chose to enable the TQG based on its mission-essential equipment status. From a maintenance standpoint, these sensors represent several supportability activities that fleet managers must address.

The goal was to produce CBM+ actionable and parametric data that could be transmitted to various echelons across the Army enterprise, ensuring the timely receipt of information needed to improve operational efficiency. Sensor data was collected from the source and sent in a 5.14 and 7.12 variable message format (VMF), containing actionable information to complete a Department of the Army (DA) Form 5988-E, Equipment Maintenance and Inspection Worksheet.

The data was sent over a wired net-

work to a very small aperture terminal, then transmitted by commercial satellite to a ground station located at the Joint Satellite Communications Engineering Center (JSEC), and finally on to numerous assessment partners across the country. To ensure the equipment was pushed to its limit, the platforms were put through a series of failure tests ranging from airflow and exhaust restrictions to oil systems failures.

The concept of operations for the 21-day event consisted of program partners performing the roles associated with military organizations across the Army supply chain. Analysts at Sierra Army Depot, representing multiple tactical companies of the 3rd Infantry Division, produced Army bulk CBM data (ABCD) files and VMF messages several times per day during the continuous 24/7 operations. CERDEC oversaw the process as the data moved through the Common CBM+ Architecture to JSEC, LIA, and a contractor support facility in Jackson, N.J.

JSEC, housed at Aberdeen Proving Ground, Md., acted as a battalion headquarters. JSEC received the VMF and ABCD messages from individual companies before forwarding them on to the brigade and the Army enterprise.

LIA, located in New Cumberland, Pa., acted as a brigade headquarters. LIA received the VMF and ABCD from the battalion and then initiated the DA Form 5988-E worksheets and twice-daily parts orders. The contractor support facility simulated the role of the logistics support activity and loaded the data into the enterprise level CBM+ repository to perform fleet-level analysis.

The team successfully demonstrated the viability of data transfer and compression techniques that would not unduly strain Army server bandwidth and satellite usage. The CBM+ data arrived intact at each station in a matter of seconds. The process was achieved using the Common Information Management Service (CIMS), which is currently under development through

LIA, to divide the data into echelons of communications links.

The CIMS software takes the information and automatically distributes it so each echelon, be it the company, battalion, brigade, enterprise, or even the platform maintainer, has the right information at the right time without extraneous manual effort. This process ultimately allows real-time and near-real time health monitoring across the Army enterprise.

The value of this capability is simple: it helps optimize supply chain management. Having more accurate and relevant information about a system's health status allows for better supply chain response and faster platform inspections and fault isolations. Moreover, this capability decreases the mean time to repair and mean time between failures and brings assets back into service far more rapidly.

### The Way Ahead

Moving forward, the CECOM LRC program has slated additional assessments to mature its CBM+ technology, architecture, and data strategies. These assessments will ensure this effort continues to integrate with the Common CBM+ Architecture. The assessments will also include transmitting data across wireless handheld devices projected for future capability sets.

Concurrently, the CECOM CBM+ Program Management Office (PMO) will provide the C4ISR community with support in the application of CBM+ technology by analyzing assessment information to show increased efficiency in the execution of field-level and sustainment-level maintenance practices. The PMO will also identify any additional candidates for CBM+ systems. The PMO will foster the growth of depot "organic" capability in support of CBM+ embedded sensing systems development, manufacturing, integration, and testing at Tobyhanna Army Depot, Penn.

In total, 12 C4ISR systems will be evaluated. CECOM's focus will be collecting the appropriate documentation and assessing candidacy for

identified C4ISR systems. Furthermore, the C4ISR CBM+ team will continue to function as an integrated unit with the CECOM Software Engineering Center and CERDEC, while continuing to partner with the Army's other LCMCs. This effort is guided by AMC to share best practices and lessons learned from a system of systems perspective.

The holistic approach, technology capability, and business process, paired with stakeholder engagement, provides the Army with a means to connect integrating data systems or sources to the operator and sustainment base while obtaining enterprise-level historical and transactional data that influences operational availability. This fleet-managed information will feed more accurate data into AMC enterprise resource planning systems. It will also establish baselines for predictive analytics from failure data and reduce total ownership costs.

CBM+ fleet information will offer efficiencies across the Army enterprise, stimulating better fleet sustainment and helping our Soldiers perform needed maintenance to operate effectively every day. This will enable the Army to carry out future missions with a more proactive fleet and a maintenance and supportability strategy that is as effective as the joint forces that stand ready. Now, more than ever, CECOM capabilities like CBM+ are the critical link for meeting the needs and ensuring the readiness of our nation's forces.

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