Singapore/U.S. Vehicle Electronics & Architecture Workshop Meeting

PM HBCT VHMS
Program

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**Vehicle Health Management System Definition**

**Approved for public release; distribution unlimited**

**briefed to SINGAPORE/US VEHICLE ELECTRONICS AND ARCHITECTURE WORKSHOP AT TACOM, 16 AUGUST 11**

**n/a**

**Standard Form 298 (Rev. 8-98) Prescribed by ANSI Std Z39-18**
Objective: Provide an overview of PM HBCT ‘s VHMS Program (Informational Brief):

- Vehicle Health Management System Definition
- User Requirements and System Engineering Artifacts
- VHMS System Software and Hardware Components
  - VHMS Key Products
- Condition Based Maintenance & Command Guidance
- Off-Platform Reporting to the GCSS-Army Enterprise
  - Tactical Logistics Systems
- Question/Answer Session
On-platform:
- Improved embedded diagnostics (self reporting platform)
- Data collection and storage (faults, supply, configuration management, etc.)
- User interface for:
  - Interactive PMCS & troubleshooting (IETMs)
  - System state, configuration & supply status management
  - Off-platform reporting & requisitioning

VHMS links to Army Logistics Enterprise networks for (Future Capability):
- Logistics reporting
- Supply requisitioning
- Fleet data storage & analysis
- CBM:
  - Predictive (use-based) maintenance
  - Development & refinement of prognostic (condition-based) maintenance algorithms
VHMS: Building the Future Incremental Capability Development

**Digital Platforms:**
- Digital Bus, Sidecar, Vehicle Databus (1553)

**Platform Information:**
- Digital PM HBCT, IETMS, BIT/FIT, VDMS

**VHMS:**
- ED, Self Reporting, Self Monitoring

**CBM:**
- Fact Based, Trend Analysis

**Prognostics:**
- Predictive Maintenance

PM HBCT
- Modernization Programs

PM HBCT
- Legacy Platform Upgrades

**SENSE**
Know more faster!

**DECIDE**
Make smarter decisions

**RESPOND**
Improve process effectiveness

SENSE
Data
Information

DECIDE
Outcome
Action
### VHMS Operational Requirement Traceability

**Operational requirements with trace to approved ORDs**

<table>
<thead>
<tr>
<th>Requirement</th>
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<tbody>
<tr>
<td>Current diagnostic performance</td>
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<tr>
<td>Record diagnostic events and data in non-volatile memory</td>
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<tr>
<td>Report equipment health to operator</td>
</tr>
<tr>
<td>Track on-hand fuel/ammunition and report to C2</td>
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<tr>
<td>Report deadlining faults to C2</td>
</tr>
<tr>
<td>Manage software and hardware configuration</td>
</tr>
<tr>
<td>Incorporate class III ETMs</td>
</tr>
<tr>
<td>Provide automated troubleshooting with ETMs</td>
</tr>
<tr>
<td>Provide wired interface for SoS sharing</td>
</tr>
</tbody>
</table>

28 VHMS operational requirements

**Operational requirements that need approval of draft ORD/CDD requirements**

<table>
<thead>
<tr>
<th>Requirement</th>
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<tbody>
<tr>
<td>Enhanced diagnostic performance</td>
</tr>
<tr>
<td>Provide prognostic capability</td>
</tr>
<tr>
<td>Track equipment capability and report to C2</td>
</tr>
<tr>
<td>Incorporate class V IETMs</td>
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<tr>
<td>Provide PMA</td>
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<tr>
<td>Provide automated PMCS</td>
</tr>
<tr>
<td>Track equipment usage</td>
</tr>
<tr>
<td>Display vehicle history</td>
</tr>
<tr>
<td>Provide wireless interface for SoS sharing</td>
</tr>
<tr>
<td>Provide fault resolution and maintenance action tracking</td>
</tr>
</tbody>
</table>

33 VHMS operational requirements

### Start with User Requirements from the Warfighter

### Increment 1 Capabilities

- Current diagnostic performance
- Record diagnostic events and data in non-volatile memory
- Report equipment health to operator
- Track on-hand fuel/ammunition and report to C2
- Report deadlining faults to C2
- Manage software and hardware configuration
- Incorporate class III ETMs
- Provide automated troubleshooting with ETMs
- Provide wired interface for SoS sharing

### Increment 2 Capabilities

- Enhanced diagnostic performance
- Provide prognostic capability
- Track equipment capability and report to C2
- Incorporate class V IETMs
- Provide automated PMCS
- Track equipment usage
- Display vehicle history
- Provide wireless interface for SoS sharing
- Provide fault resolution and maintenance action tracking

28 VHMS operational requirements

33 VHMS operational requirements
Common System Engineering Document Tree

Derive Requirements to Performance Specifications

Operational Requirements Analysis provides top-level VHMS requirements & traceability to sources.

Operational Views & OV Use Cases describe VHMS capabilities through user scenarios.

System Views & Black Box Use Cases decompose VHMS capabilities into system functions and define interfaces.

GCS Requirements needed to implement VHMS.

VHMS scope, purpose, definitions and technical standards.

Operational concept describing the “as is” and “to be VHMS concept.”

Interface requirements between on components on platform and requirements to communicate off-platform. (i.e., GCSS-Army)

Common user interface design for each VHMS screen. Style guide to facilitate tailoring an individual screen.
VHMS Requirements Flow-Down

Requirements Across Platforms and Future Capability Increments

- Current Generation HBCT Vehicles
- VHMS Common
- Modernization

Vehicle ORD

Vehicle Performance Spec

Vehicle SSS

Vehicle SSSDD

Vehicle Component Specs

VHMS SSS

VHMS SSDD

VHMS Component Specs

VHMS Operational Requirements Analysis

VHMS GCS Spec/IRS

VHMS GCS SSDD

VHMS Component Specs

Vehicle CDDs

Vehicle Performance Spec

Vehicle SSS

Vehicle SSDD

Vehicle Component Specs

- Current Gen Upgrades

- VHMS Tech Development

- Modernization

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Vehicle Health Management System (VHMS)

- Development of overarching system requirements and architecture for a PM HBCT VHMS implementation
- Enhance and Integrate Diagnostics on platform
- Coordinate off-platform interfaces with Enterprise-level logistics systems (GCSS-A, CBM Data Warehouse)

- Enhance Embedded Diagnostics
- Enable platform data storage and transfer
- Develop & integrate IETMs
- Integrate Ground Digital Log Book (GDLB)
- Plan for future upgrades (LRMs, SRU-level Fault Isolation)

- Centralized Health Management Application
- Common GUI that reduces training footprint for HBCT maintainers

Commonality where feasible with Industry Partners
GCS Software Architecture

OEMs Responsible to Integrate VCN Component

- VCN – VHMS Communication Network
- VHM – Vehicle Health Management
- IETM-M – IETM Management
- DPC – Diagnostics, Prognostics, CBM
- LDB – Logistics Database
- LDBM – LDB Management

OEMs to integrate as GFM

PMA / MSD V3

Secure Point to Point Connection

LDB – Logistics Database

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## Hardware Approaches

<table>
<thead>
<tr>
<th></th>
<th>PMA</th>
<th>EDC</th>
<th>Ethernet Switch</th>
<th>Wireless NIC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Abrams</strong></td>
<td>Portable Multi-Functional Display*</td>
<td>Recording &amp; Simulation Unit (RSU)</td>
<td>E-Switch</td>
<td>Common WNIC</td>
</tr>
<tr>
<td><strong>Bradley &amp; PIM</strong></td>
<td>Display/EDC</td>
<td>SMART Display*</td>
<td>E-Switch</td>
<td>Common WNIC</td>
</tr>
<tr>
<td><strong>Maintainer</strong></td>
<td>MSD V3</td>
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</table>

* MSD V3 to be used for At-Platform Functions & Off-Platform Data Transfer

* Current display HW are surrogates until common display IPT does official RFI/RFP
VHMS Key Products

Materiel Solutions
- Ground Digital Logbook
- IETMs
- VHMS Comms Network (VCN)
- E-switch
- Wireless Network Card

Integrated Solutions

Platform Software
- Vehicle Health Management
- Enhanced Diagnostics
- Logistics Database Management
- Integrating GFM

Systems Engineering Work Products
- GCS Specification
- Interface Requirements
- User Interface Descriptions
- DoDAF Architecture Artifacts

DoDAF Architecture Artifacts

Common Screens

Specifications

EMS-NG(IETM)

Ground Digital LB

Wireless NIC

E-switch

GDLB

VHM

IETM

GDBL

LDBM

VCN

DPC

GFM

OEM

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Baseline Benefits of Vehicle Health Management

- PM HBCT capabilities based initiative
  - Mission Readiness Assessment
  - Improved diagnostics and provides data storage & transfer capability
  - Provides a systems engineering approach to obsolescence

- Reduce Logistics Footprint and increase reliability
  - STE / BRADS / ATE Reduction/Elimination (cost avoidance)
  - Reduces Troubleshooting burdens (IETMS, GDLB)
  - Self diagnosing, self reporting and verification on board (real time)
  - Automates maintenance processes (PMCS)
  - Common User Interface (Screens)
  - Leverages existing platform diagnostics and vehicle networks

Improved diagnostics, reduced maintenance time, increased reliability, reduced NEOF’s = improved OR rates and improved combat power for soldiers and reduced costs
Summary of Benefits
Achievable with VHMS & CBM+

- Reduce or eliminate reliance on DSESTS in Field (cost avoidance)
- Reduce NEOF rates in Field & Sustainment (cost avoidance, inventory reduction)
- Platforms become self-diagnosing & self-reporting (workload reduction, accuracy increase)
- Automate maintenance (workload reduction & increase accuracy)
- Common maintenance display (reduced training assets, cross-functional field diagnosis)
- Increase Ao
- Reduce MDT (shorter diagnostic time, reduced maintenance workload, reduced part order errors)
  - Automate PMCS (workload reduction & increase accuracy)
- Reduce time to process repair parts requisitions
- Increase asset visibility, situational understanding of combat power, consumables & crew situation
- Contribution to net-centric warfare & logistics capabilities
- Increase early warning of possible failures through CBM condition advisories (increase MTBSA, reduce potential collateral damage)

VHMS Program is being implemented with incremental capabilities on Current Legacy and future Modernization Programs (P3I)
Command Guidance for CBM

- DUSD(L&MR) memorandum, 25 Nov 2002
- ASA(ALT) memorandum, 25 Jul 2003
- MILDEP & G-4 memorandum, 05 May 2005
- ASA(ALT) memorandum, 17 August 2005
- AR 750-1, 20 Sep 2007
- DOD Instruction 4151.22, 2 Dec 2007
- ASA(ALT) memorandum, March 20 2008
- CLOE/CBM+ Policy Memorandum, 09 Feb 2009

**Bottom line:**

- PMs must implement CBM+ and integrate CLOE standards into both new and existing systems when deemed feasible and cost effective.

- Requires cost-benefit analysis for existing systems.
Condition Based Maintenance (CBM)

A set of proactive maintenance processes and capabilities that improve **operational availability** and reduce the soldier’s **maintenance burden** by performing maintenance based upon evidence of need in lieu of scheduled based or run-to-failure maintenance processes.

Accomplished through:
- Digitized platform (embedded sensors and vehicle network)
- Enhanced diagnostics
- Evolving systems to predict remaining useful life of components
- Then to automate supply transactions

Derived from near real-time assessment and analysis of data from:
- Embedded Sensors
- Platform Maintenance Environments
- Platform Supply & Maintenance Data (historical)
Ground Platform VHMS
Visualizing the Enterprise

Platform Level | Battalion Level | Enterprise Level
---|---|---
Aviation
- Aviation Fault Data
- Aircraft Fault Data
- Battle Order

Ground
- Battle Order
- Battle Order

Production Control
- Production Control

Quality Control
- Quality Control

Tech Supply
- Tech Supply

LiW
- Log Integrated Warehouse

LOGSA
- Local Data Management

CBM D/W
- C BM Data Warehouse

GCSS-Army
- GCSS-Army

GCSS-Army
- GCSS-Army O&S

LOGSA
- LOGSA O&S

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Benefits of GCSS-Army/CLOE

Today’s Tactical Logistics Systems:
- SARSS-1
- SARSS-GW
- SARSS-2AC/B
- PBUSE
- SAAS-MOD
- ULLS-A(E)
- SAMS-E

Provides ACCURATE VISIBILITY OF PARTS in the Supply Chain

GCSS-Army
IOC in FY12
FOC in FY15

Provides Accurate EQUIPMENT READINESS Data

Captures Total Weapons System COSTS

Equipment Master
Enables Accurate PROPERTY ACCOUNTABILITY

Performs Tactical Logistics FINANCIAL FUNCTIONS

Provides a CENTRALIZED AMMUNITION MANAGEMENT System

Equipment Master
Enables Accurate PROPERTY ACCOUNTABILITY

The Tactical Army’s Logistics ERP

Today’s Tactical Logistics Systems:

- GCSS-Army

Equipment
Supplies
Finance

AMMO VISIBILITY AND ACCOUNTABILITY

Today’s Tactical Logistics Systems:

- GCSS-Army

Equipment
Supplies
Finance

AMMO VISIBILITY AND ACCOUNTABILITY

Provides Solders a Single System to accomplish a wide range of Logistics Missions

HBCT is Leveraging “Big Army” Initiatives
The VHMS program has developed and delivered system engineering documentation and a set of common materiel solutions.

VHMS team is now developing platform specific materiel solutions to implement a VHMS system to connect to End to End Logistics Systems and Data Warehouses (logistics, engineering and CBM data).

VHMS will connect to the Global Combat Support System Army (GCSS-A) – which is the Army’s future Enterprise Resource Planning (ERP) system.
Question/Answer Session