What’s on the Horizon?  *Future Capabilities through the Logistics Lens*

Dr. Grace Bochenek  
COL Kirk C. Benson  
Dr. Vic S. Ramdass
Panel Introductions

- **Dr Grace Bochenek**
  - Director for US ARMY Tank Automotive Research Development Engineering Center (TARDEC)
  - *The Technology – Logistics Paradigm: Fixing Today’s Problems, Preventing Tomorrow’s*

- **COL Kirk Benson for Dr Wm. Forrest Crain**
  - Deputy Director for the US Army Material Systems Analysis (AMSAA).
  - *Data-Driven Analysis for Logistics*

- **Dr Vic Ramdass**
  - Director for the Logistics Innovation Agency (LIA)
  - *Addressing Logistics Up Front: More Efficiently Develop, Buy, Own, and Operate the TWV Fleet*
The Technology – Logistics Paradigm: Fixing Today’s Problems, Preventing Tomorrow’s

Army Materiel Command (AMC)
U.S. ARMY Research, Development and Engineering Command (RDECOM)
U.S. ARMY Tank Automotive Research, Development & Engineering Center (TARDEC)
Dr. Grace Bochenek, Director
• TARDEC Mission

• The Logistics-Technology Paradigm – Two Facets

• Reducing Current Logistics Burdens with Technology

• Reducing Unintended Consequences in Technology Development

• Closing
Mission

- Provide Life-Cycle engineering support and for all DOD ground combat and combat support vehicle systems.

- Develop and integrate technology solutions to improve Current Force effectiveness and provide capabilities for the Future Force.

Life-Cycle Engineering Requires Logistics to be Addressed from the Start – *Concept through Disposal*
The Logistics – Technology Paradigm

The Two Facets of Future Capabilities through the Logistics Lens

Look at Innovative ways to Reduce Logistics Burdens

Unburden the Warfighter

Look to Design Good Logistics In From Start

Reduce Unintended Consequences
Reducing the Battery Logistics Burden

Improving Charging Battery Management

Field Battery Maintenance & Training

- Annual Purchase of Vehicle Batteries: 700,000
- **AGM = Advanced Glass Mat.: “maintenance free”

<table>
<thead>
<tr>
<th>AGM Battery Failures 2002-2008</th>
<th>~250,000</th>
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<tbody>
<tr>
<td>Incorrect Voltage Output</td>
<td>50%</td>
</tr>
<tr>
<td>Damaged - Transport Issues</td>
<td>30%</td>
</tr>
<tr>
<td>Improper Electrical Performance</td>
<td>20%</td>
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- Approximately 80% of incorrect voltage failures were serviceable

Improved charging techniques can lead to 2X life improvement

Crew Station/Displays

Communications Systems

Fire Suppression

Hit Avoidance System

Autonomous Navigation System

Embedded Training

- Crew Station/Displays
- Communications Systems
- Fire Suppression
- Hit Avoidance System
- Autonomous Navigation System
- Battery Management

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.
Reducing the Fuel Logistics Burden

### IMPACTS of Saving 1% Fuel

- **$5-82B** Fewer Dollars Spent on Fuel
- **6,444** Fewer Soldier Trips
- **37** Fewer Casualties

### 2007 Kuwait / OIF / OEF Fuel to FOB (M Gal)

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<table>
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<tr>
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<tbody>
<tr>
<td>Number Convoys Resulting in 1 Casualty</td>
<td>24</td>
</tr>
<tr>
<td>Number Convoys Per Day</td>
<td>2.5</td>
</tr>
<tr>
<td>Days Between Casualties</td>
<td>10</td>
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### Modeling and Simulation: Optimize the System

### Research and Testing

### Demonstrate Systems and Technologies

**TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.**
Reducing the System Repair – Maintainability Burden

Condition Based Maintenance - Robust Solutions
Reduce Complexity / Improve Commonality
Develop Hardware to Improve Training and Avoid Issues

Technlogy Driven. Warfighter Focused.
Design Good Logistics In
Reduce Unintended
Consequences

LOGISTICS

Commonality  Durability  Transportability  Supportability/ Maintainability  Producibility

Moving from SWaP-C  to  SWaP-C+L
Design Good Logistics In
Predictive Reliability and
Maintainability

• Reduce Time / Cost to Field
• Reduce Operations & Maintenance Costs (RAM)
• Improve Transportability
• Reduce Inventory
• Save Lives
• Reduce Injuries
• Reduce Failures
• Improve Fuel Economy
• Reduce Weight

Enforce Design Principles to TARGET Reliability
Good Systems Engineering
Data-Driven Analysis for Logistics

2011 Tactical Wheeled Vehicle Conference

Approved for public release; distribution is unlimited.

COL Kirk C. Benson

As of: 14 January 2011
AMSAA Mission/Functions

**Mission:** Provide Analytic Solutions to Enhance Warfighter Capabilities.

### Materiel Systems Analysis
- Systems Performance Analysis
- Dev. & Certification of System Perf. Data
- Dev. of System Perf. Meth and M&S
- Technology & Risk Assessment
- Exec. Agent for VV&A Item/Sys M&S
- Manage DoD’s JTCG/ME Program
- Independent Evaluator – Chem Demil

### Logistics Systems Analysis
- Supply Chain Analysis
- System Supportability M&S and Data Dev.
- Field Data Collection & Analysis
- Business Case Analysis (Cost/Economic)
- Exec. Agent: Army RAM Standards
- Reliability & Physics of Failure Analysis
- Execute AMC’s WBSAP Program

AMSAA Provides Critical Systems Analysis … That Enables Senior Army Decision Makers

**Mission Basis:**
- Army Acquisition Policy & Procedures: AR 70-1 and DA PAM 70-3
- Army Materiel Maintenance Policy AR 750-1
- AMSAA is also Army’s Asst Functional Chief – CP16/1515’s ORSA Proponent

**Acronyms:**
- JTCG/ME – Joint Technical Coordinating Group/Munitions Effectiveness
- WBSAP – Workload-Based Staffing Analysis Program

**Technology Drive. Warfighter Focused.**
Worldwide AMSAA Presence
(Primary Analytical Capabilities at APG, MD & Huntsville, AL)

AMSAA Worldwide Presence:

Germany
Vilseck
Kaiserslautern

Korea

Afghanistan

Iraq

Kuwait

Qatar

AMSAA Analysts
“On Site” w/ Strategic Partners

402nd AFSB, Iraq
401st AFSB, Afghanistan
R2TF, Kuwait

AMSAA Analysts
“Boots on the Ground”

HQ AMC (CG’s Initiative Group)
HQ AMC G-3
JIEDDO
ASA(ALT) SOSE
DUSA-TE

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.
AMSAA, TRAC & CAA Collaborate to Provide an Effective, Responsive, In-House Analysis Capability for Army Decision Makers
Unique Information Collected, Verified, & Corrected

- Serial number tracking of systems
- Collection at Operational Army Units is hands-on, verified at source with no interference to unit mission
- Field level maintenance (replacements, repairs, adjustments) — actual parts replaced, not requisitioned
- OPTEMPO
- Maintenance manhours and MOSs
- Unique data elements as required (e.g., combat loaded vehicle weights, compartment temperatures)

Examples of Critical Data & Analysis for Decision-Makers

- Fleet-wide health assessments
- OPTEMPO, parts usage, & maintenance manhours in peacetime and wartime
- Recap performance vs. baseline
- Reset cost, manhour, and repair cycle time analysis
- Aging effects analysis
- Impacts on downtime of unscheduled maintenance
- Manpower Allocation Requirements Criteria (MARC)
- Actual maintenance tasks to support Critical Task List development
- Tailored analyses for stakeholders (e.g., RAM impacts of Add-on-Armor, seasonal impact analysis)

Data Collection and Analysis for Warfighters and Decision Makers at All Levels
Condition Based Maintenance (CBM)

Current CBM Systems
- System Health And Reliability Computer (SHARC)- AMSAA’s larger “smart black box”
  - Highly programmable
  - Designed for special studies
- Vehicle Monitoring Unit (VMU)- AMSAA’s smaller “smart black box”
  - Less expensive
  - At-vehicle reports
  - Wide-spread implementation
  - Incorporates algorithms developed on SHARC
  - Smaller file sizes
  - Outputs Information (statistics, histograms, alarms, algorithm results)

Current CBM Implementation
- OEF
  - 28 Strykers
  - 3 MTVRs and 2 LVSRs
  - 6 Linehaul trucks
  - 4 M-ATVs
  - 5 HEMTTs
- FT Irwin
  - 2 MRAPs
  - 2 HEMTTs
- FT Lewis
  - 6 Strykers

CBM Pilot Program in conjunction with TACOM
- 2000 Various TWV Platforms (including FMTV, HET, HEMTT, PLS, M915)
- Collecting usage data for logistics/engineering purposes
- Vehicle health data & fault codes for CBM analysis and initial CBM capabilities
- 2 year initiative starting late FY 11
**Terrain Regime Identification and Classification (TRIC)**

- TRIC is the on-board identification and classification of terrain environments for in-operation wheeled vehicles.
- This data can add valuable information to developing predictive algorithms, directing new vehicle development, test scenario development, modeling & simulation inputs, usage reports.

**Seeded Fault**

- Determine how vehicle performance changes due to these “faults”
- Create and Implement algorithms to predict and alert operators and maintainers of “faults”
- Faults include engine, transmission, cooling system & electrical system
AMSAA’s Custom Data Analysis Tool
Easy to use interface for data analysis and reporting over user specified conditions (e.g. time and location)

Facets
- Automated vehicle comparison and rollup reporting across variants and platforms
- Automated vehicle usage and health reports instantly available for commanders, maintainers, logisticians
- Customizable reports available for each user
Center for Reliability Growth
Vision

Lessons Learned
Identify & archive as new reliability growth policies are applied to acquisition programs

Improve Reliability Growth:
- Policy
- Guidance
- Standards
- Methods
- Tools
- Training

Drive Change
Increase: Reliability, Materiel/Operational Availability, Initial Operational Testing Success Rate
Decrease: Support Costs, Logistics Footprint
Guide: Integration of Developmental & Operational Testing, Integrated Logistics Support Analyses
Tactical Wheeled Vehicles Conference Technology Panel

Dr. Vic Ramdass
Director, U.S. Army Logistics Innovation Agency

U.S. Army Logistics Innovation Agency
https://lia.army.mil
BLUF: Benefits of Addressing Logistics Up Front?

To more efficiently develop, buy, own and operate the TWV fleet

- **Reduce Operations and Maintenance demand**
  - DOD FY 10 budget: Maintenance -- $85B (gov’t/private) plus military maintainers -- ~ $33B
- **Improve materiel availability and reliability...and maintainable systems**
  - Reduce Operations and Support (O&S) costs
  - Increase mean time between failure
  - Improve maintenance processes
  - Reduce repair cycle time
- **Support planning, forecasting, and budgeting**
  - Enable weapon system lifecycle manager to predict spares requirements/associated costs.
- **Opportunities for cost reduction occur throughout materiel solution analysis, technology development, engineering and manufacturing development, production and deployment, and operations and support phases.**
The Environment

- Ubiquitous TWV’s
  - In every phase of operations
  - On every part of the battlefield
  - Multiple roles for basic platforms
- No longer unprotected – armor kits/anti-IED
- Recapping of Army and USMC TWV while in midst of developing new TWV
- Preparing for expeditionary and full spectrum operations
- Joint, interagency, intergovernmental, and multinational (JIIM) operations

Protected, sustained, networked mobility – travel further, carry more, engage longer, survive when engaged, retain flexibility to accomplish broad range of missions.
Tactical Wheeled Vehicle Challenges

- Army leverages commercial truck developments but Army market share is small
- Expensive to add military unique improvements or needs:
  - Engines and transmissions ruggedized for field operations
  - Terrain and field operating conditions vs. economical and environmental performance standards
  - Fuel systems used for military limited by operational necessity (JP-8)
  - Protective measures for crews and cargo
- Lessons learned to apply and improvements to equipment:
  - Transportability and deployability by air
  - Rugged suspension, engines and drive trains – but repairable
  - Recovery operations
  - Soldier safety and fire suppression
  - Simplified and quicker maintenance actions
  - Electrical systems to handle new loads and battery charging on board
- MRAPs are $430K to $900K starting from a basic commercial platform
- HMMWV was $70K initially...now over $220K with fragmentation kits
- The lightest of the JLTV’s will weigh 7.5 tons, 3X heavier than the HMMWV
- Projected cost for JLTV in excess of $300K before equipping with essential systems due to “custom” design
- Need to drive improved reliability, availability, maintainability (RAM) into the fleet
Supportability Can’t Be a Trade-Off...

- **Capability**
  - Deployability/mobility
  - Systems – growth (e.g., electric)
  - Technology integration (e.g., AIT/RFID/GPS/On-Star, etc.)
  - Deployability – size and weight
  - Power source (e.g., diesel, electric, fuel cells, solar, hybrid, etc.)

- **Reliability**
  - CBM+
  - Materials – lighter/stronger/simpler

- **Maintainability**
  - 2-Level Maintenance
  - Embedded systems – plug and play

- **Affordability**
  - Durable vs. expendable
  - Incremental introduction and upgrade vs. bulk purchase

- **Expandability**
  - Family of systems/commonality/interoperability (e.g., drive trains, etc.)
  - Adaptable for new mission roles not anticipated

Must Also Consider Non-Materiel Implications
Lifecycle Solutions

- Pre-acquisition efforts are needed to achieve improved system sustainment and reduced costs.
- **How do we make our input and how?**
  - Identify the problems
  - Collect data for solid analysis
  - Meet Warfighter needs
- Designed, maintained, and modified to continuously reduce the demand for logistics support
  - Warfighter requirements and early development decisions are vital
  - Sustainment strategies must be planned and adaptable
- **Benefits of addressing logistics up front in the product lifecycle**
  - Pay now or pay more later
  - Low maintenance materials (e.g., composites, coatings, ceramics, etc.)

Maintainability & supportability should be designed-in and not considered as an “add-on.”
Army G-4/LIA Enablers

Agile Robotics
- Agile, semi-autonomous robotics capabilities.

Energy
- High-impact innovative solutions to reduce fuel consumption and provide alternate energy sources.

Anti-Corrosion Nanotechnology Solutions – Logistics
- Nano-engineered coatings and materials.

Unmanned Aerial Systems
- Cargo Unmanned Aerial System for future Aerial resupply.

Common Logistics Operating Environment
- New generation of technologies in a single operational and technical architecture.

Condition-Based Maintenance Plus
- Proactive equipment maintenance capability to predict failure and take appropriate action.

Technical demonstrations of innovative technologies shape and influence up-front design that help reduce system life-cycle costs and sustainment footprint...
What We Need From You...

- **Industry plays a key role**
  - Develops systems that are adaptable to DOD requirements (e.g., wiring harnesses, sensors, durability, diagnostics, etc.)
  - Solutions for collecting and moving platform data for analysis and improvement
  - New technologies/insertions
  - Improved batteries/power reduction/flexible power
  - Unmanned systems and robotics
  - Common repair parts and components to facilitate supportability

- **Legacy vehicle support through Army Force Generation (ARFORGEN) process and the Army Equipping Strategy**

- **Advancements in materials**
  - Lighter/stronger/lower cost

- **Creative and innovative solutions that help drive down costs while improving reliability, maintainability, survivability**

Help identify what technologies are appropriate for upgrade, and at what point in the life-cycle...give us your BEST and most RELIABLE products up-front...