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

The Technology – Logistics Paradigm:
Fixing Today's Problems, Preventing Tomorrow

- 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

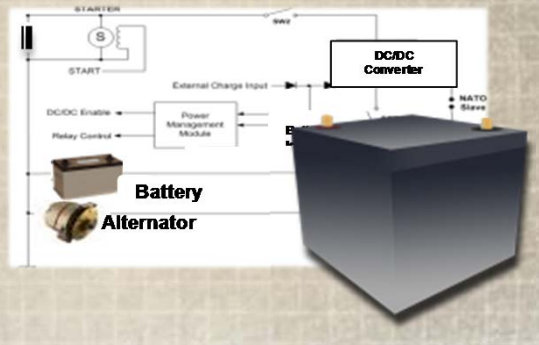
AGM Battery Failures 2002-2008	~250,000
Incorrect Voltage Output	50%
Damaged - Transport Issues	30%
Improper Electrical Performance	20%

Approximately 80% of incorrect voltage failures were serviceable

Improved charging techniques can lead to 2X life improvement

Field Battery Maintenance & Training

Improved Charging



Battery Management

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

Reducing the Fuel Logistics Burden

2007 Kuwait / OIF / OEF Fuel to FOB (M Gal)	431

Number Convoys Resulting in 1 Casualty	24
Number Convoys Per Day	2.5
Days Between Casualties	10

IMPACTS of Saving 1% Fuel

$5-82B
Fewer Dollars Spent on Fuel

6,444
Fewer Soldier Trips

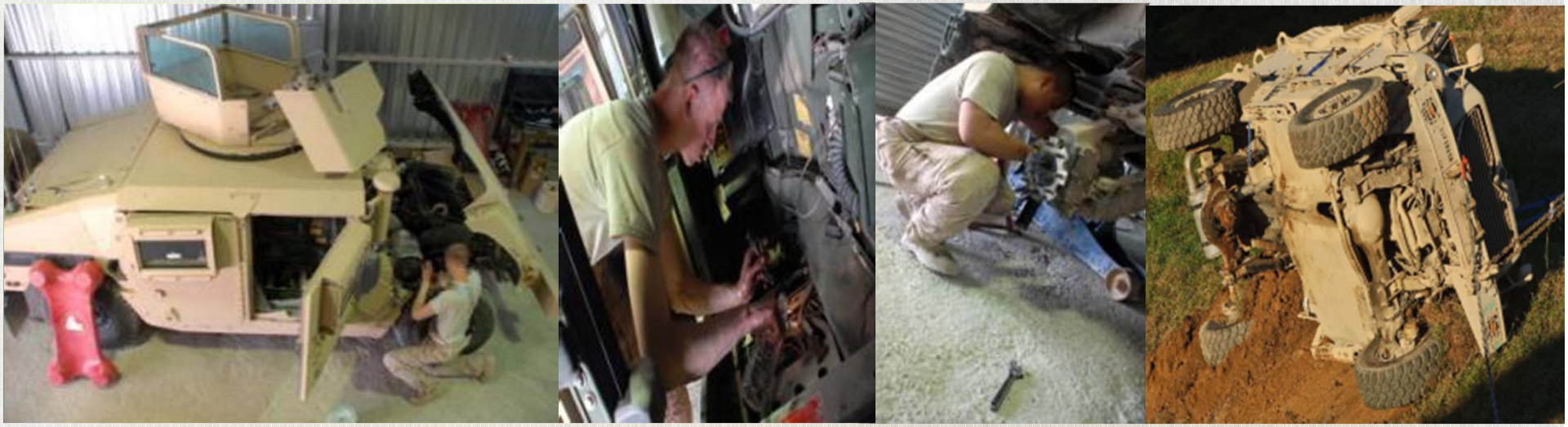
37
Fewer Casualties

Modeling and Simulation: Optimize the System

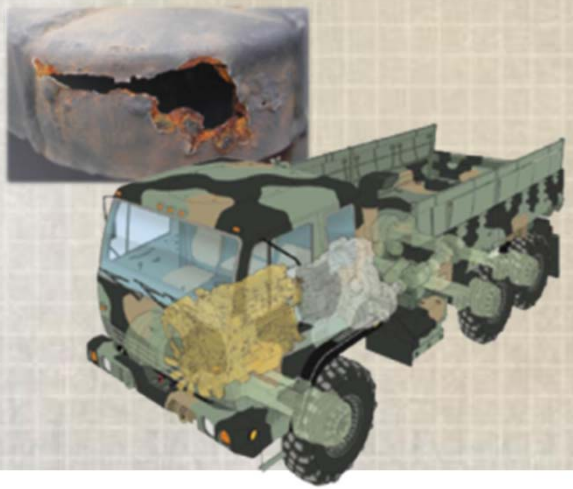
Research and Testing

Demonstrate Systems and Technologies

Reducing the System Repair – Maintainability Burden



Condition Based Maintenance - Robust Solutions

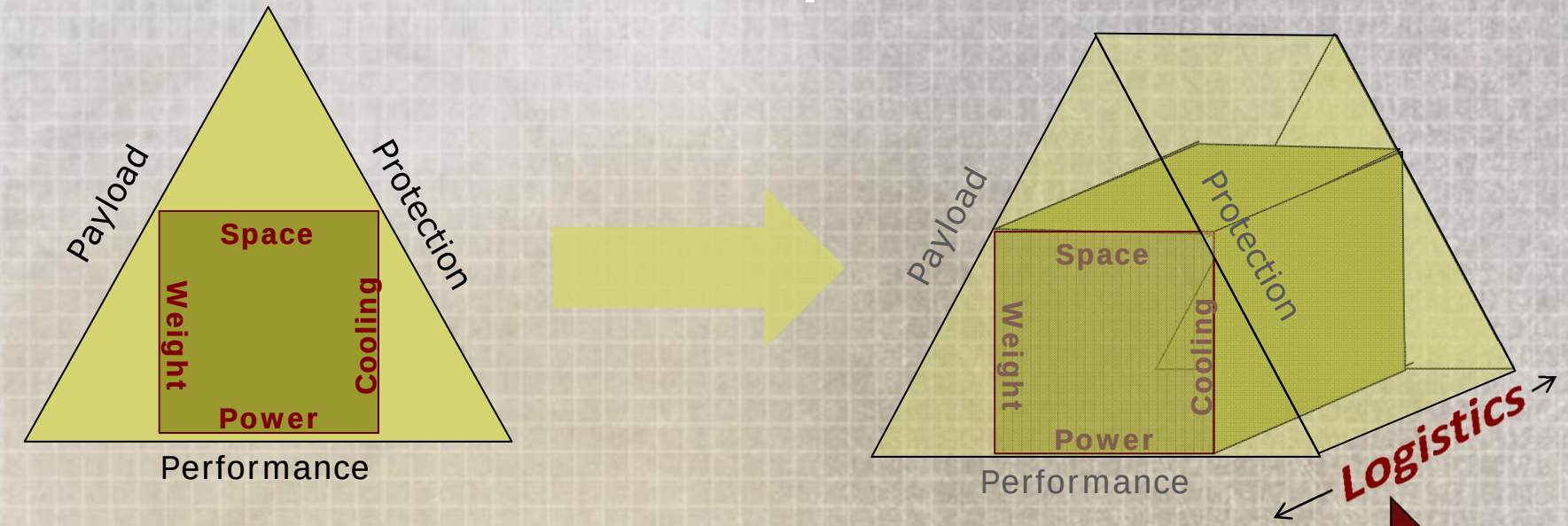


Reduce Complexity / Improve Commonality

Develop Hardware to Improve Training and Avoid Issues

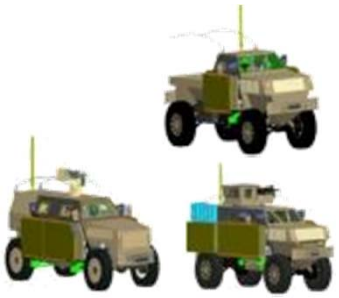
Design Good Logistics In

Reduce Unintended Consequences



Moving from SWaP-C *to* SWaP-C+L

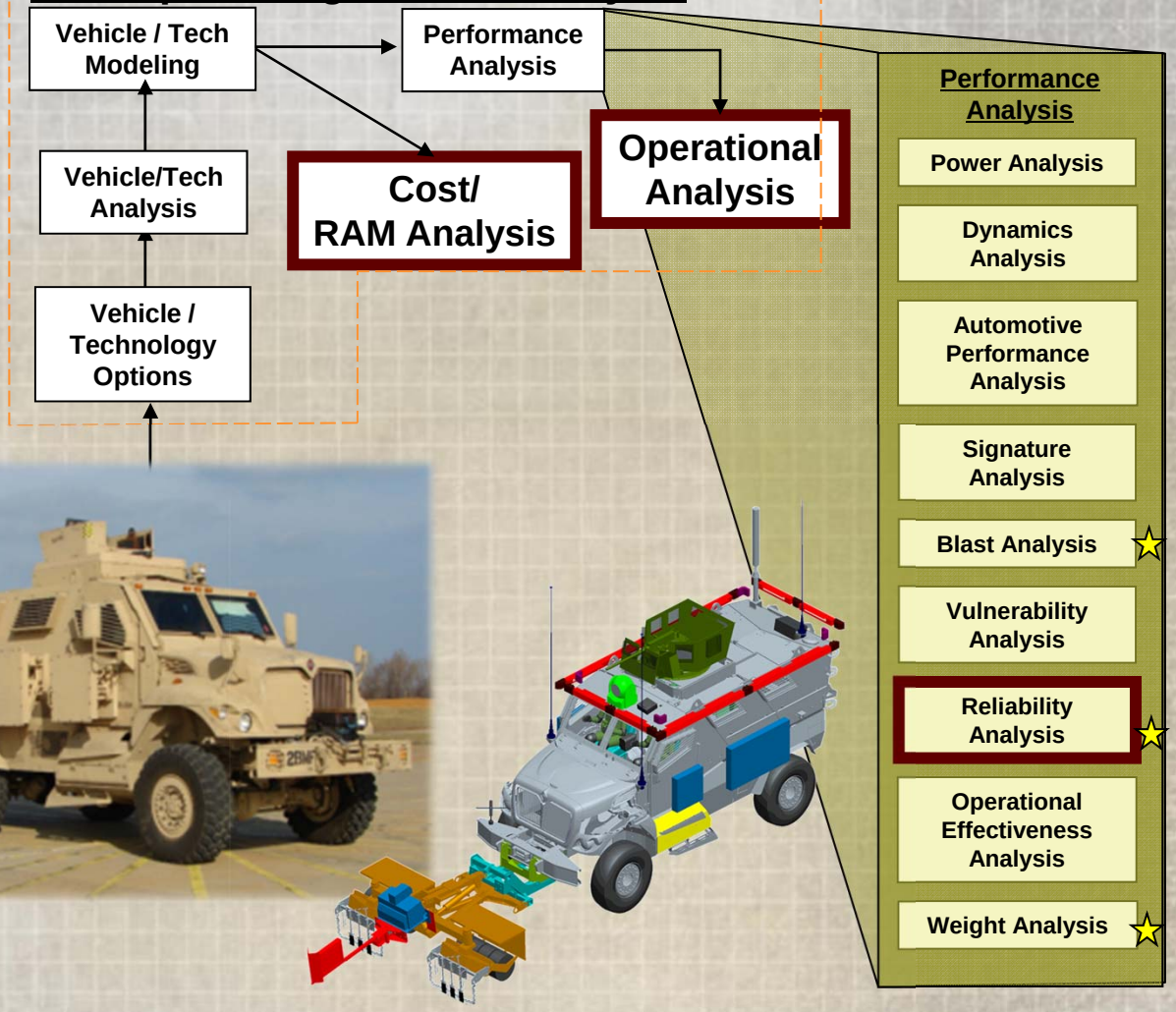
LOGISTICS

Commonality	Durability	Transportability	Supportability / Maintainability	Producibility
				

Design Good Logistics In

Predictive Reliability and Maintainability

Concepts, Integration & Analysis



- 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

It's All About the Warfighter

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

Data-Driven Analysis for Logistics

2011 Tactical Wheeled Vehicle Conference

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

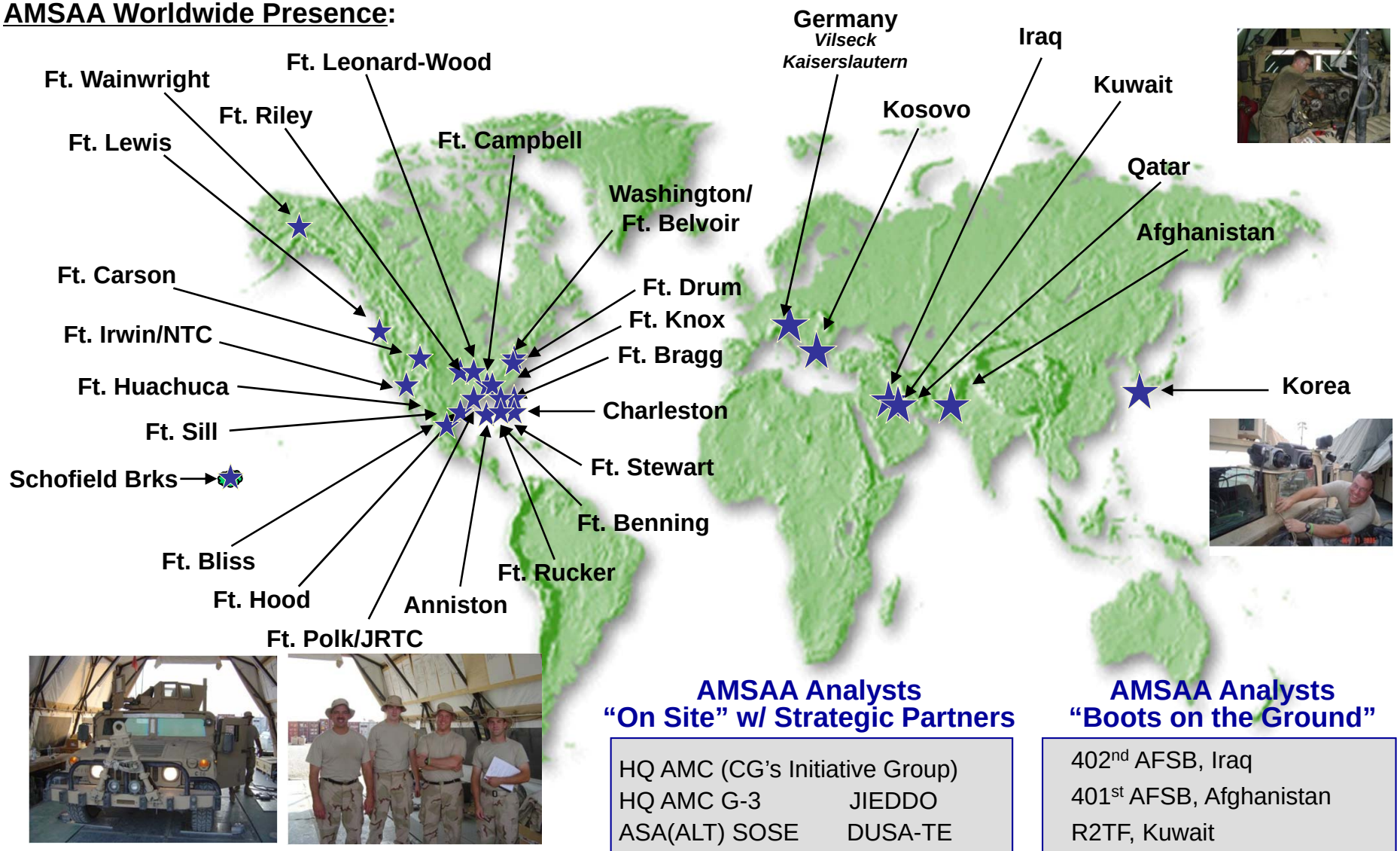
Mission Basis: Army Acquisition Policy & Procedures: AR 70-1 and DA PAM 70-3; Army Materiel Maintenance Policy AR 750-1
AMSAA is also Army's Asst Functional Chief – CP16/1515's ORSA Proponent

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

Worldwide AMSAA Presence

(Primary Analytical Capabilities at APG, MD & Huntsville, AL)

AMSAA Worldwide Presence:



AMSAA Analysts "On Site" w/ Strategic Partners

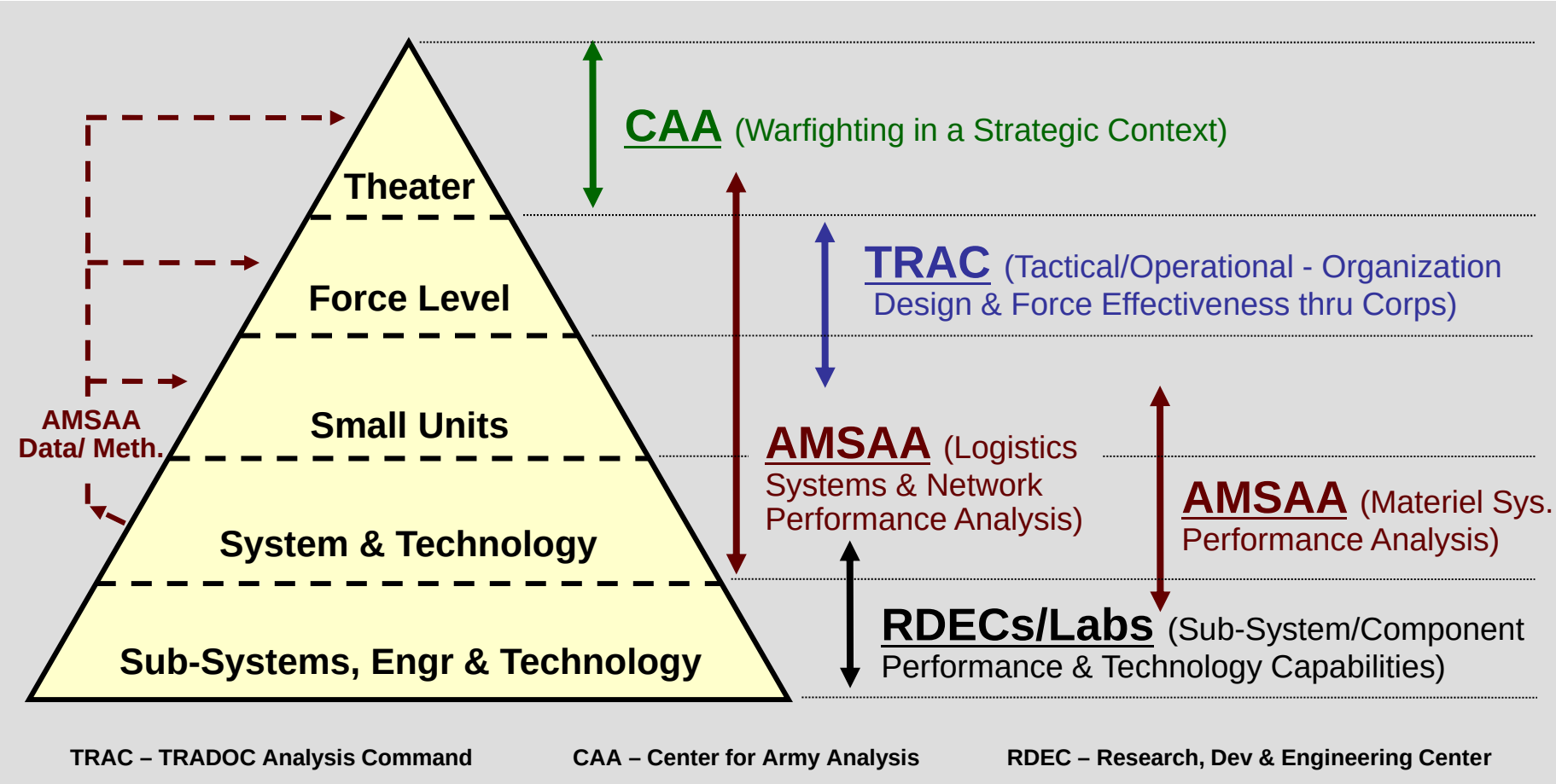
HQ AMC (CG's Initiative Group)
HQ AMC G-3 JIEDDO
ASA(ALT) SOSE DUSA-TE

AMSAA Analysts "Boots on the Ground"

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

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

AMSAA Role in Analytic Community



AMSAA, TRAC & CAA Collaborate to Provide an Effective, Responsive, In-House Analysis Capability for Army Decision Makers

Sample Data Collection and Analysis Program

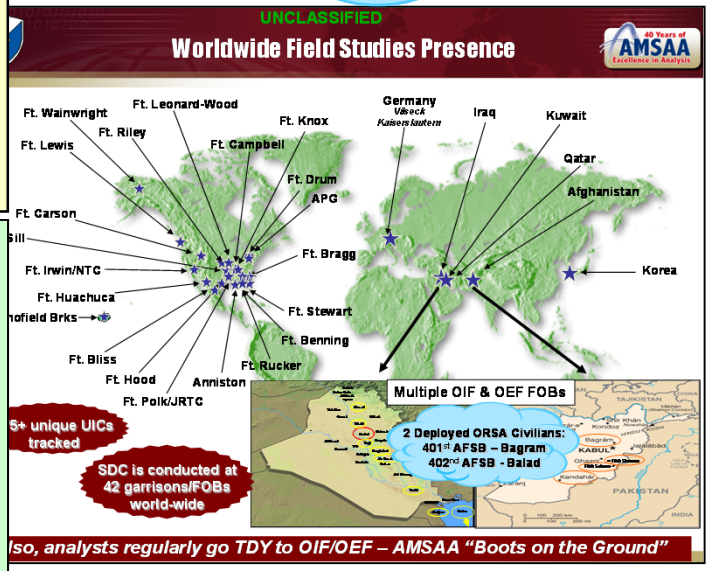
Unique Information Collected, Verified, & Corrected

- ✓ 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)

SDC is conducted at multiple OIF and OEF FOBs



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
- Wide-spread implementation
- Smaller file sizes
- At-vehicle reports
- Incorporates algorithms developed on SHARC
- 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

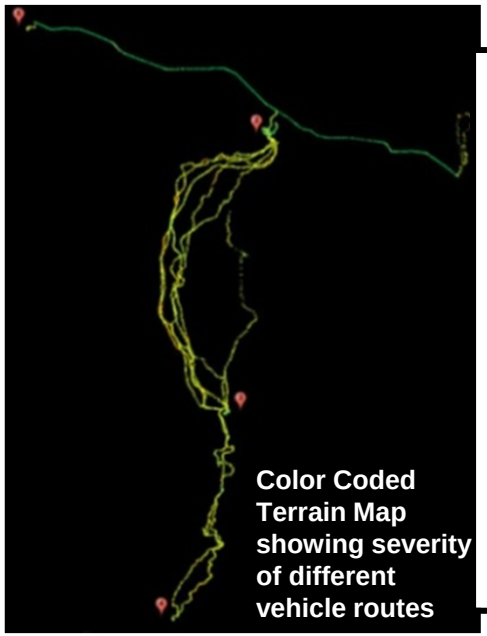
CBM Pilot Program in conjunction with TACOM

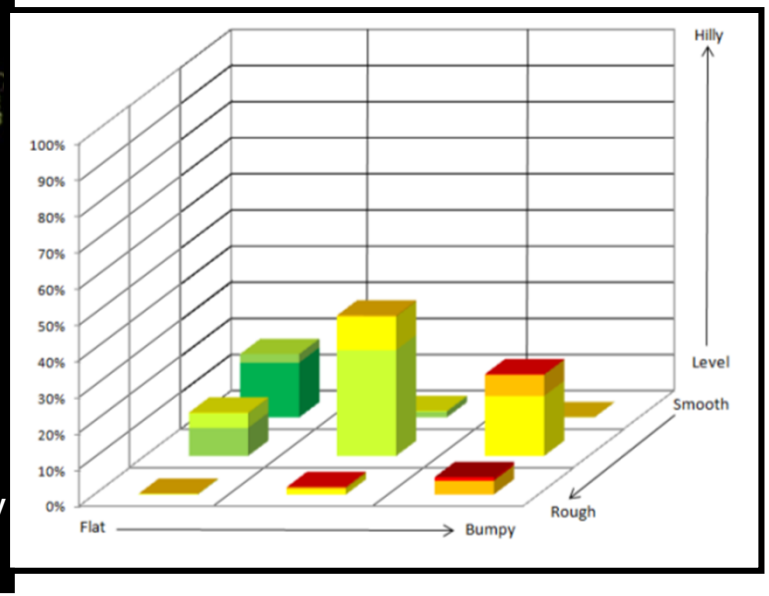
- 2000 Various TWV Platforms (including FMTV, HET, HEMTT, PLS, M915)
- Collecting usage data for logistics/engineering purposes
- Vehicle health data & fault codes for CBM analysis and initial CBM capabilities
- 2 year initiative starting late FY 11

CBM Analysis Efforts

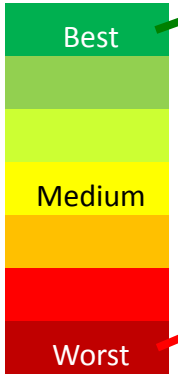
Terrain Regime Identification and Classification (TRIC)

- 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





Overall System Severity Index:



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

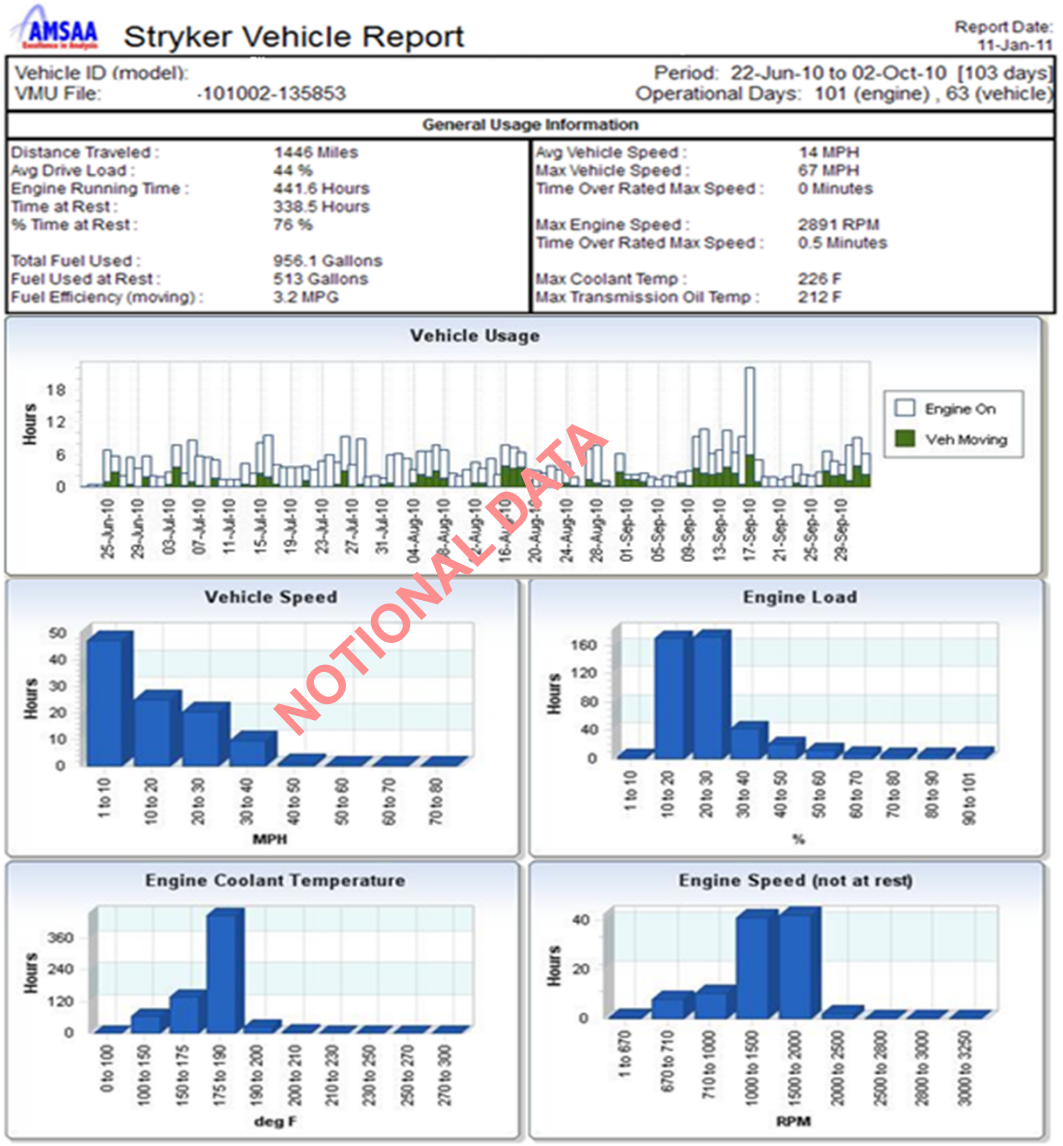
CBM Analysis Tool

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



TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

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






AMERICA'S ARMY: THE STRENGTH OF THE NATION™

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

Control Requirements Creep!

- **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.)

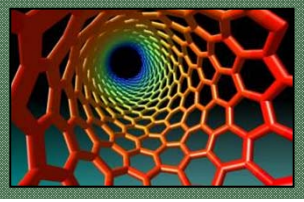
Maintainability & supportability
should be designed-in and not considered as an "add-on."

Army G-4/LIA Enablers

Agile Robotics

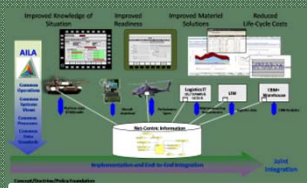
Agile, semi-autonomous robotics capabilities.

Anti-Corrosion Nanotechnology Solutions – Logistics



Nano-engineered coatings and materials.

Common Logistics Operating Environment



New generation of technologies in a single operational and technical architecture.

Energy

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

Unmanned Aerial Systems

Cargo Unmanned Aerial System for future Aerial resupply.

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…