

The U.S. Army's Vehicle Intelligence Program (AVIP): The Future of Manned, Wheeled Tactical Vehicles

H. E. (Bill) Knée
Oak Ridge National Laboratory
National Transportation Research
Center
2360 Cherahala Blvd.
Knoxville, Tennessee 37932 USA
Phone: (865) 946-1300
Fax: (865) 946-1314
E-mail: kneehe@ornl.gov

David J. Gorsich
U.S. Army Tank-Automotive and
Armaments Command
AMSTA-TR-N,
Warren, Michigan 49397-5000 USA
Phone: (810) 574-7413
Fax: (810) 574-6996
E-mail: GorsichD@tacom.army.mil

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Tokyo, Japan

The logo for UT-Battelle, featuring a stylized green mountain range above the text "UT-BATTELLE" in a bold, sans-serif font.

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ITS  Intelligent Transportation Systems Research Program
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National Transportation Research Center



http://www.ornl.gov/ORNLReview/v33_3_00/features.htm

- 1. Propulsion, Vehicle and Power Systems**
- 2. Information and Decision Support Systems**
- 3. Materials, Structures, and Mechanical Systems**
- 4. Safety, Security and Human Factors**
- 5. Systems Operations and Control**
- 6. Energy Efficiency and Environment**

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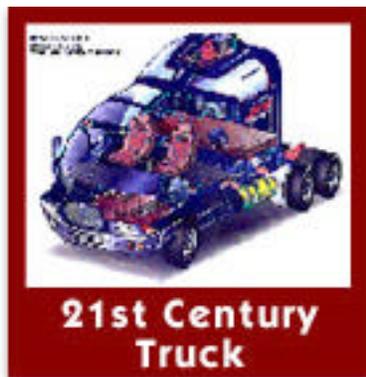
National Automotive Center

U.S. Army Tank-automotive & Armament Command



<http://www.tacom.army.mil/tardec/nac/index.htm>

- **Founded in 1992**
- **DoD/Army focal point for collaborative ground vehicle research and development (R&D)**
- **Its primary focus is to benefit current and future military ground vehicle systems through:**
 - **performance improvements,**
 - **service life extensions, and**
 - **reduction in ground vehicle design, manufacturing, production and operating and support costs.**



- increase fuel efficiency
- enhance safety
- cut total owning and operating costs
- reduce emissions
- maintain or enhance performance



- University of Alaska Fairbanks
- Clemson University
- University of Iowa
- University of Michigan
- Oakland University
- University of Tennessee
- Wayne State University
- University of Wisconsin - Madison



Vehicle Intelligence

Vehicle Intelligence (VI) is the application and integration of vehicle electronics (telematics) within vehicles in order to provide a more efficient and safer driving task/mission.

VI provides new driving functionalities, and enhances existing functionalities, that will optimize performance in real-world driving environments. Specifically, VI can:

- **enhance mission logistics**
- **optimize fuel consumption,**
- **enhance driver efficiency**
- **increase mission safety margins**
- **minimize vehicle emissions**

VI Issues in the U.S

- **Product Liability**
- **Limited Direct Control Functions**
- **Untrained Population**
- **Independent, Non-Integrated Systems**

Evolutionary Process:

- * **Driver Warning**
- * **Driver Advise**
- * **Driver Assistance**
- * **Partial Control**
- * **Autonomous Control Functions**

The Army Vehicle Intelligence Program (AVIP)

**A New U.S. Army Concept to Enhance Productivity,
Efficiency, Sustainability, Safety, and Driving Quality of
It's Wheeled Tactical Fleet...**

AVIP will:

- 1. Build on the Lessons Learned of the US-DOT ITS Program.**
- 2. Conduct Research in Advanced Vehicle Control**
- 3. Integrate Robotics Technologies**
- 4. Demonstrate Advanced Vehicle, Soldier-in-the-Loop Concepts**

AVIP Objectives:

- **Assess the utility of commercial ITS/VI technologies for application to Army Transformation, Future Combat System (FCS), and 21st Century Truck (21CT).**
- **Develop advanced vehicle control technologies that center on the soldier/driver in the loop.**



AVIP Objectives:

- **Develop on-board information management technologies that are sensitive to soldier/driver cognitive loading, the potential for distraction, and appropriately directed soldier/driver attention.**
- **Develop advanced control functions that will allow various types of soldier/driver-vehicle interactions. For Example:**
 - **Low Workload - Warnings**
 - **Higher Workload - Advice**
 - **Even Higher Workload - Driving Assistance**
 - **Semi-Autonomous Functions**
 - **Autonomous Driving**

AVIP Objectives:

- **Build on the Army's extensive robotics technologies (Unmanned Ground Vehicle, Demo III, etc.)**

- Autonomous Collaborative Systems
- Control and Coordination of Distributed Systems
- Depth Extraction
- Image Clutter Characterization
- Machine Learning
- Machine Vision
- Multi-Spectral Imaging and Analysis
- Object Recognition/Tracking
- Performance of Degraded Systems
- Sensor Fusion
- Stereo Vision
- Supervisory and other Advanced Control
- Vision-Based Navigation

AVIP Objectives:

- **Demonstrate through modeling, laboratory experiments, and Field Operational Tests, how AVIP technologies can:**
 - **improve fuel efficiencies**
 - **enhance driver/soldier efficiency/productivity**
 - **enhance mission efficiencies/logistics, and**
 - **improve safety.**



The AVIP Paradigm (a System of Systems Approach)

Vehicle

Driver

**Intelligent Vehicle
Advanced Control
Capabilities -**

**Human Factors and
Advanced
Human-System
Interfaces**

**On-Board
Information
Integration and
Management**

On-Board
Systems



Communications

External
Environment

The Importance of AVIP

- **It will stimulate the assimilation of VI Technologies into the Army's Tactical Fleet.**
- **It will allow the Army to lead research areas that are too slow in coming from the private industry.**
- **It will allow the Army to be early beneficiaries of research results that can contribute to Army Transformation, FCS, and 21CT; and enhance ground vehicle logistics, mission/fuel efficiencies, safety, etc.**
- **It will function to draw the interests of other Federal Agencies (e.g., DOT) and private industry.**

Major A VIP Research Methods

1. **Modeling** (Assessment of the Impact of VI Technologies on Military Applications).
2. **Laboratory Studies** (Functional and Physical Integration, Data/Message Handling, Human-System Interface Research, Algorithm Development).
3. **Vehicle Demonstrations** (Bringing Laboratory Results to Life).
4. **Field Operational Tests** (Collection of Data to Assess Impacts and Benefits).

AVIP Research Areas

- 1. Physical Integration of VI Technologies**
- 2. Functional Integration of VI Technologies**
- 3. VI Information Fusion**
- 4. Driver Associate Concepts**
- 5. Advanced Soldier-Vehicle Interfaces**
- 6. Advanced Control: Autonomous Functionalities and Semi-Autonomous Control**
- 7. Integration of Robotics Technologies**

Candidate ITS/VI Technologies for AVIP

- Adaptive Cruise Control
- Collision Avoidance and Prevention
- Drive-by-Wire
- Driver Condition Monitoring
- Driver's Associate
- Fleet Management. Logistics
- Fuel Burn Optimization
- In-Vehicle Information Fusion
- Lane Tracking
- Navigation Systems
- Night Vision/Vision Enhancement
- Platooning/Electronic Tow Bar/Vehicle Following
- Route Guidance
- Truck Rollover Warning
- Truck Stability Technologies

The Army's Tactical Wheeled Vehicle Fleet Several Different Families of Trucks

- Commercial Utility Cargo Vehicles (CUCVs)
- High Mobility Multi-Purpose Wheeled Vehicles (HMMWVs)
- Family of Medium Tactical Vehicles (FMTVs)
- M900 series line haul tractors and special bodies
- Heavy Expanded Mobility Tactical Truck (HEMTTs)
- Palletized Loading Systems
- Heavy Equipment Transporter Systems (HETSs)
- M809/M939 and older series 5-Ton Trucks

Representative Pictures of Three of These family types



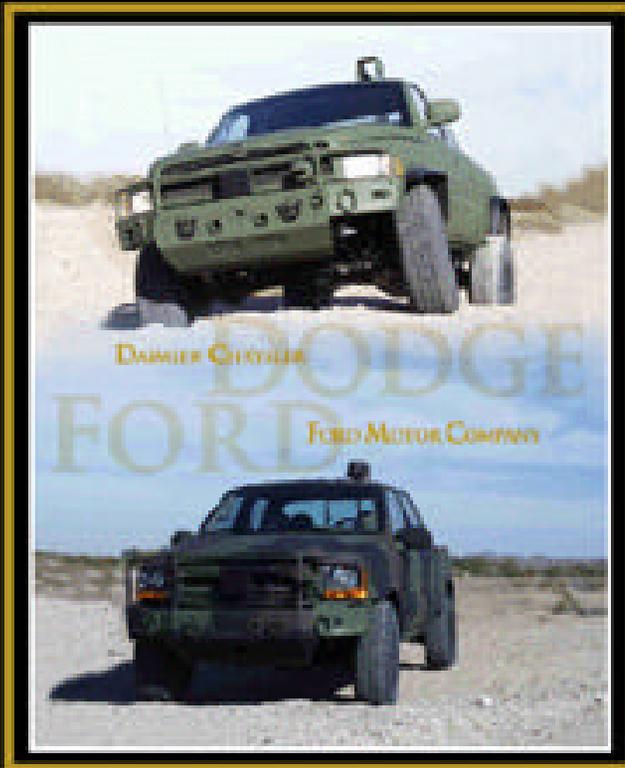
**Class IIB – HMMWV M998
Utility Vehicle**



**Class VIII – M915 Line
Haul Rig**

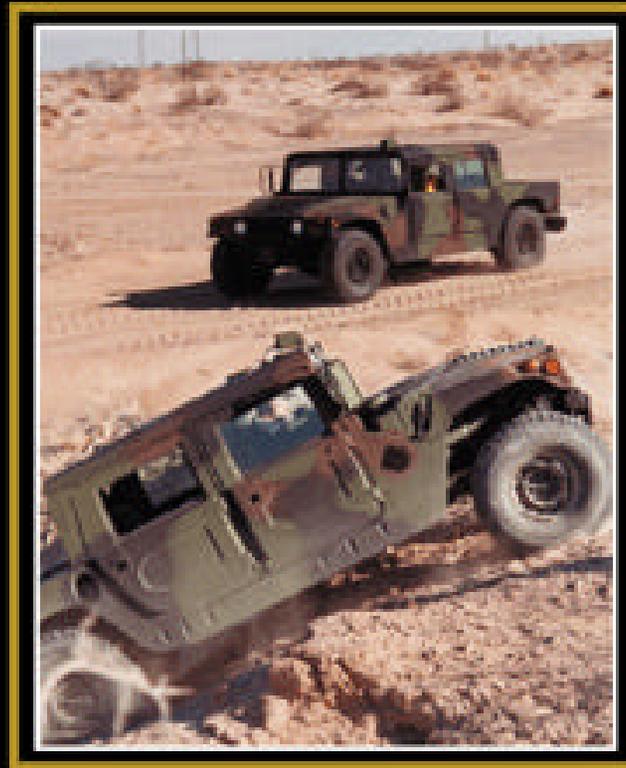


Class VI – FMTV Tactical Truck



· COMBATT ·

[This Year] in the Dodge 2500/3500 and Ford F350 vehicles used for the COMBATT program have received modifications to improve their off-road mobility and payload capacity. [The National Automotive Center and its COMBATT partners Veridian ERM International, AM General Corporation, Daimler-Chrysler, AG and Ford Motor Company are up-fitting these vehicles with the latest in automotive technology.]



· COMBATT ·

[This Year] in this new approach to Light Tactical Wheeled Vehicles is being demonstrated in an existing test program named COMBATT. [The National Automotive Center, along with its partners Veridian-ERM International, AM General Corporation, Daimler-Chrysler, AG and Ford Motor Company are up-fitting these vehicles with the latest in automotive technology.]

COMmercially BAsed Tactical Truck (COMBATT)

SMART TRUCK



Audiovox Mobile Video Countermeasures
Delphi QUADRASTEER™
ECLIPSE Commander
Cutler-Hammer PanelMates
Biocentric/AuthenTec Fingerprint Identification
ICRC Remote Control Weapon Station

Raytheon Night Vision
Valde Vehicle PC
DriverTech Truck PC

Integrate and demonstrate a hybrid electric drivetrain for improved fuel economy and range

Integrate next generation voice controlled navigation computer with map display

Develop and evaluate a satellite linked data acquisition system and flight recorder box for improved soldier safety

Lower maintenance, operating and support costs with on-board computers used for improved and faster diagnostics and service.

Demonstrate first multiple databus concept on military trucks

Reduce cost and increase frequency of computer communications upgrades by embracing "plug-and-play" commercial and off-the-shelf technology

Share cost of research and development with private industry.

Future Direction

- **DOD funding is being put into place.**
- **Leveraging opportunities are being sought with other U.S Federal Agencies.**
- **Team building with private industry/academia is taking place.**
- **Initial efforts (~ \$2M) are being planned for FY-02.**
- **Longer-term efforts (~\$15M/yr.) are being defined.**

Conclusions

- **AVIP is an important element in the Army's Transformation.**
- **The soldier/driver will remain a key element of the Army's Interim and Objective Force Projections.**
- **AVIP will improve fuel efficiencies, mission efficiencies, logistics, safety, and sustainability.**
- **AVIP will be the catalyst for implementing ITS/VI technologies into the Army's wheeled tactical fleet, and will lead the development of advanced control technologies.**