• Connected to World-Class Automotive Engineering Universities at our Doorstep

• Defense Industry Ground Systems Hub

• Direct Linkage to World-Class Automotive Research and Development Centers

• Strategic Engagement with 1st, 2nd & 3rd Tier Automotive Supplier Network

The Arsenal of Democracy
Capabilities

Research

Technology Development

Systems Engineering

Integration

Production Support

Field Support

Technical Management Process
- Technical Planning
- Requirements Management
- Configuration Management
- Technical Assessment
- Decision Analysis
- Risk Management
- Interface Management
- Technical Data Management

Technical Process
- Stakeholder Requirements Definition
- Requirements Analysis
- Architecture Design
- Implementation
- Integration
- Verification
- Validation
- Transition

Stakeholder Requirements Definition

Risk Management

Interface Management

Technical Data Management

Implementation

Integration

Verification

Validation

Transition
Key Technical Thrust Areas

• Ground System Survivability
• Vehicle Electronic Architectures
• Ground Vehicle Robotics and Intelligent Systems
• Ground Systems Power, Energy and Mobility
• Force Projection Technology; Alternative Fuels, Lubricants and Water Purification
Facilities

Laboratory Capabilities

- Ground Systems Power and Energy Laboratory (GSPEL)
- Advanced Concepts Laboratory
- Advanced Collaborative Environments (ACE)
- Laser Protection Laboratory
- Armor Nondestructive Testing Laboratory
- Robotics Systems Integration Laboratory
- Ground Vehicle Systems Integration Laboratory
- GVR Robotic Laboratories
- Electronics Integration
- Physical Prototyping
- Design & Digital Mock-up
- Metallurgy Test Laboratory
- Survivable Structures Laboratory
- Ground Vehicle Power & Mobility Elastomer Improvement Laboratory
- Ground Vehicle Power & Mobility Propulsion Laboratory
- Physical Simulation Laboratory
- Analytical Simulation Laboratory
- TARDEC Simulation Labs
- Survivability Armor Ballistic Laboratory (SABL)
- Fuels & Lubricants Laboratories
- Water Purification, oil, fuels and lubricants Laboratory
- Fresh Water Test Facility
- NFESC Seawater Test Facility
- Dynamic Structural Load Simulation Lab

TARDEC’s Warren, MI operations have a resource value of over $1.1B and occupy 12 facilities on the Detroit Garrison totaling over 936,000 square feet of laboratory space
Army Technical Challenge
More Mobile, Fuel Efficient, Safer Vehicles

**Mobility & Energy Efficiency**

- Vehicle Dynamics
  - Newton-Euler Equations of Motion
  - Solve for vehicle mobility and component loads
- Hi-Energy, Hi-Density Energy Storage
- Comprehensive Thermal Management of Propulsion & Cabin

**Occupant Centric Survivability**

- Active Protection Systems
- Holistic Occupant Centric Protection
- Affordable, Multi-hit Ceramic Armor

**Multi-Physics Optimization**

- High Power Density, Low Heat Rejection & Fuel Efficient Engines
- Fire and Toxic Fume Resistant Materials

\[
\begin{align*}
\mathbf{M} \ddot{\mathbf{q}} + \mathbf{C}(\mathbf{q}, \dot{\mathbf{q}}, t) = \mathbf{Q} + \mathbf{Q}_0
\end{align*}
\]

\[
\begin{align*}
\int_{V(t)} f(x, t) dV = \int_{V_0} \frac{\partial f(x, t)}{\partial t} dV + \int_{S_{\text{exit}}} f(x, t) \cdot n dS
\end{align*}
\]
Ground Systems Power, Energy and Mobility

Increasing Demands and Operational Flexibility Require Strategic Investments in Key Areas

- Weight/Power Demand
- Fuel Demand
- Agility Requirements
- Electrical Power Demand

Powertrain
Thermal Management
Track & Suspension
Non-Primary Power
Energy Storage
Advanced Propulsion
Occupant Centric Survivability

Increasing Demands and Operational Flexibility Require Strategic Investments in Key Areas

Threat Lethality

Technical Complexity

- Top Attack
- Smart Top
- Fallers
- Tank Fired
- HEAT
- ATGM
- IED
- HE Frag
- RPG
- RKG
- XL IED

Cause Agent Breakdown (BI) 2002-2008

- Firearms 20%
- Munitions and Explosives 77%
- Others 1%
- Motor Vehicle Traffic 1%
- Falls 1%
- N= 7,092 patients

N= 7,092 patients

- Cause Agent Breakdown (BI) 2002-2008
- XL IED

- Hit Avoidance
- Detection Avoidance
- Encounter Avoidance
- Acquire Avoidance
- Penetrate Avoidance
- Kill Avoidance

- Kill Avoidance
- Penetration Avoidance
- Hit Avoidance
- Detection Avoidance
- CVC ver 1
Advanced full vehicle, system level design tools are key enablers to:
• Assessing Occupant Injury Risk
• Developing new protection technologies
• Improving force vehicles for current threats
• Designing new occupant-centric vehicles
Technology Integration & Engineering

Integration Services:

- Advanced Concepts Modeling
- Physics Based Analysis
- Statistics based analysis in Man-in-the-loop simulation
- Integrated System Level Demonstrators and Prototypes
- High Performance Computing & Data Management
Reducing the Fuel Logistics Burden

1 in 46 convoys suffered a casualty in 2010, leaving some 3,000 wounded or dead.

A 1% fuel savings will lead to 6444 fewer Soldier trips in dangerous battlefield convoys.

Modeling and Simulation: Optimize the System

Research and Testing

Demonstrate Systems and Technologies
Track Systems are the 2nd Highest Operation & Sustainment (O&S) Costs

- Abrams T-158LL Track Life is -2,200 miles
- Bradley T-157i Track Life is - 3,000 miles
- Elastomer Components are the primary failure mechanisms for track systems
Reducing the Battery Logistics Burden

**AGM Battery Failures 2002-2008**

- Incorrect Voltage Output: 50%
- Damaged - Transport Issues: 30%
- Improper Electrical Performance: 20%

~250,000

- **Approximately 80% of incorrect voltage failures were serviceable**

**Improved charging techniques can lead to 2X life improvement**

- Crew Station/Displays
- Fire Suppression
- Hit Avoidance System
- Communications Systems
- Autonomous Navigation System
- Embedded Training

**Field Battery Maintenance & Training**

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

- Light Armored Vehicle-Recovery (LAV-R)
- Paladin Integrated Management (PIM) Air Grills
- Stryker Command and Control on the Move (C2OTM)
- RPG Defeat Net
TARDEC’s Ground Vehicle Gateway is YOUR entry point!

Submit your technology for review
https://tardec.groundvehiclegateway.com

Dr. David Gorsich
david.j.gorsich.civ@mail.mil
BACK UP
The Logistics – Technology Paradigm

The Two Facets of Future Capabilities through the Logistics Lens

Look at Innovative ways to Reduce Logistics Burdens

Look to Design Good Logistics In From Start

Unburden the Warfighter

Reduce Unintended Consequences

UNCLASSIFIED
Integration Services:

- Advanced Concepts Modeling
- Physics Based Analysis
- Statistical-based Hardware & Man-in-the-Loop Simulation
- Integrated System Level Demonstrators and Prototypes
- High Performance Computing & Data Management