TARDEC CAPABILITIES

TARDEC

U.S. ARMY TANK AUTOMOTIVE RESEARCH, DEVELOPMENT AND ENGINEERING CENTER

At the U.S. Army Tank Automotive Research, Development and Engineering Center (TARDEC), our goal is to provide warfighters with advanced technological solutions to ground vehicle systems challenges. To do that, we must overcome the numerous design, development, manufacturing and product technology gaps identified in our 30-Year Strategy. Whether you're a member of industry, academia or another government agency exploring ways to partner with us, we welcome your interest and potential contributions towards our organization's research and development (R&D) initiatives.

This handbook is designed to introduce you to our organization's unique laboratory and testing capabilities and the expertise of our technicians, scientists and engineers. This technical staff leads research in ground systems survivability, power and mobility, intelligent ground systems, force projection and vehicle electronics architecture. Consequently, our 30-Year Strategy is a dynamic plan that serves as a framework to guide our investment decisions, which includes our infrastructure, in-house R&D capabilities and the test facilities outlined herein.

TARDEC's 30-Year Strategy emphasizes the need to balance our investments among those that support current Programs of Record, and those that will provide leap-ahead technology advancements and transitional solutions to support our Future Force. Accordingly, we offer a variety of opportunities to create partnerships to accelerate the delivery of new capabilities, while avoiding unnecessary development costs along the way.

Collaborative partnerships — whether with industry, academia or other government agencies — remain vital to TARDEC's success. We can't achieve our 30-Year Strategy on our own, and we welcome any new ideas that potential partners or colleagues can bring to bear on our collective goals. We're glad you're viewing this handbook. We encourage you to engage TARDEC by visiting us at ***http://www.army.mil/tardec*** and clicking on "Contact TARDEC" for the latest news, information and opportunities. Through this site and our other communications media, I hope you gain a thorough understanding of where TARDEC is going and how we propose to get there.

Engage us! Together, we can collaboratively develop game-changing ground systems capabilities to ensure battlefield dominance for our current and future warfighters.

Paul D. Rogers, Ph.D., SES
TARDEC Director

On the cover: ***TARDEC Capabilities*** will introduce you to our unique and, in some cases, one-of-a-kind ground vehicle systems laboratory and testing capabilities in conjunction with the world-class technicians, scientists and engineers who lead the Department of Defense's research in ground systems survivability, power and mobility, intelligent ground systems, force projection and vehicle electronics architecture.

The center image depicts two of five test rigs in TARDEC's Vehicle Characterization Laboratory (VCL) — the Vehicle Inertia Parameter Evaluation Rig (VIPER) II (background), which allows for system-level mass properties for vehicles weighing up to 100,000 lbs. and with track widths up to 155 inches; and the Reconfigurable N-Post Motion Based Simulator (foreground). This rig's analytical capabilities include fatigue damage estimation, statistical time history editing and cycle counting analysis.

Clockwise, from top right to left: this industrial design rendering depicts the groundbreaking advancements in vehicle mobility that play a significant role in TARDEC's 30-Year Strategy; the Stryker M1128 Mobile Gun System; M1083 Medium Tactical Vehicle Utility Truck equipped with the Autonomous Mobility Appliqué System which provides ground forces with autonomy-enabled vehicle system capabilities; the peerless Abrams M1A2 Main Battle Tank; and MRAP All-Terrain Vehicle with Self-Protection Adaptive Roller Kits (SPARKS). These vehicle systems depict just a handful of currently fielded systems TARDEC supports. On the research and development side of our business, TARDEC is actively engaged in supporting seven of the Army's eleven persistent challenges.

A final design note, the cover composition includes the textured green armor of a Stryker vehicle as a backdrop to highlight TARDEC engineers' and scientists' relentless work in the areas of lightweighting and armor composition. The juxtaposition of the Stryker armor and the VCL is a perfect example of how TARDEC is using the most advanced technology to improve warfighter mobility, survivability and lethality on the battlefield.

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TARDEC VISION
Be the first choice of technology and engineering expertise for ground vehicle systems and support equipment — today and tomorrow.

TARDEC MISSION
Develop, integrate and sustain the right technology solutions for all manned and unmanned Department of Defense (DoD) ground systems and combat support systems to improve Current Force effectiveness and provide superior capabilities for the Future Force.

TARDEC CORE CAPABILITIES
TARDEC is committed to the development and exploration of ground vehicle system technologies that will increase Current and Future Force capabilities in the following core technology areas:

- Advanced Concepts
- Configuration Management/Data Management
- Engineered Solutions
- Force Projection
- Ground System Survivability
- Ground Vehicle Power and Mobility
- Ground Vehicle Robotics
- High Performance Computing
- Industrial Base and Advanced Manufacturing
- National Automotive Center
- Physical Test and Simulation
- Product Systems Support
- Project Management and Operations
- Prototype Integration
- Reliability, Availability and Maintainability (RAM) and Quality Assurance
- Software Engineering
- Systems Engineering
- Sustainment and Platform Integration
- Vehicle Electronics Architecture

GROUND DOMAIN PLANNING AND INTEGRATION

GROUND DOMAIN PLANNING AND INTEGRATION (GDP&I)

GDP&I is an office within TARDEC's Chief of Staff organization that supports TARDEC's leadership and two research and engineering business groups. Its teams work to develop and operationalize a comprehensive organizational long-range strategy. They also facilitate the assessment, alignment and integration of the ground maneuver portfolio to enable transition of products/capabilities that address the Army's capability gaps, needs and priorities, synchronized within the Army's strategic framework and long-range plans.

CAPABILITIES

The Warfighter Requirements and Capabilities Analysis Team (WaRCAT) is TARDEC's connection with the warfighter to determine and prioritize needs and capability gaps. With on-site science and technology (S&T) advisors, WaRCAT facilitates the alignment of TARDEC technologies/projects to Training and Doctrine Command (TRADOC) Centers of Excellence (CoE) gaps and initiatives. WaRCAT also, through Army Materiel Command (AMC) Field Assistance in Science & Technology (FAST) advisors, provides commanders immediate access to labs and expedites technology solutions to Soldiers.

The Strategic Technology Planning (STP) Team is responsible for developing and maintaining TARDEC's 30-Year Strategy. Additionally, it prepares strategic communication materials for executive-level purposeful engagements. It is responsible for managing the Technology Program Agreements with the Army Research Lab (ARL) as well as ensuring coordination and synchronization between Program Executive Office (PEO) Ground Combat Systems (GCS), PEO Combat Support & Combat Service Support (CS&CSS) and Office of Naval Research (ONR). It is also responsible for pursuing competitive funding opportunities to bring in additional resources to the organization.

The Enterprise Project Portfolio Management Team develops and manages the processes and tools to ensure that TARDEC continues to invest in the highest-valued projects and services that best achieve the strategic goals and vision of the organization, while balancing the perspectives of risk vs. reward, multiple customer needs and organizational resources. The team synchronizes top-down strategic imperatives and objectives with bottom-up projects and services and provides customized portfolio analysis results and reports to support resourcing decisions.

The Program Execution Management Team's TARGET process is a stage-gated, idea-to-launch product and technology development process for S&T projects and programs, integrating performance-driven project management, systems engineering and design to Six Sigma principles, applications and tools using government and industry best practice tools and methods. The process ingrains upfront research and product definition to reduce time to market and "scope creep."

The Annual Planning and Tactical Reporting (APTR) Team is TARDEC's primary unit responsible for leading S&T budget planning, coordination and reporting, both internally and with higher headquarters. APTR executes the yearly Program Objective Memorandum (POM) and R-form builds, supports S&T investment decision making in alignment with the 30-Year Strategy and maintains S&T funding allocation to S&T projects. The APTR team also partners with the TARDEC G8 to analyze and report on financial execution.

The Transition Management Team, a recent addition to GDP&I, addresses systemic challenges faced by S&T projects when trying to synchronize transition of their products to acquisition programs of record. It develops and manages transition databases and promotes TARDEC product transitions.

The Joint Center for Ground Vehicles (JCGV), a cross ground vehicle portfolio forum, is a Community of Interest that includes PEO CS&CSS, PEO GCS and PEO Land Systems (USMC), as well as TARDEC and the ONR. It is a collaboration forum with focus on common technology products and processes.

The Vehicle and Robotics Alliance (VRA) Program Office (PO) manages the multiservice alliance consisting of government labs and R&D centers and POs, with the common interest in advancing the technology for government vehicles and robotics through collaboration, coordination, education and Other Transaction Agreements (OTA) contracting.

BENEFITS

- Facilitates collaboration among the warfighter, acquisition program managers and TARDEC on issues and projects of mutual interest, including technology/project demos and assessments.
- Maintains an updated, prioritized listing of customer needs and capability gaps.
- Ensures all higher headquarters requirements are addressed in a "one-stop shop."
- TARDEC's 30-Year Strategy will help direct and pace technology discovery, development, demonstration and transition.
- Supports balance of investments across multiple dimensions such as risk, time horizons, customer and stakeholder priorities, funding type and core competencies.
- Provides decision makers with the right portfolio information to make defensible investment choices.
- Provides gated approach to technology development and risk reduction to increase technology transfer success rate to acquisition product, project and program manager partners.
- Provides training and tools on project management and technology road-mapping.

RESEARCH & TECHNOLOGY INTEGRATION (RTI)

ELECTRIFIED ARMOR LABORATORY (EAL)

The EAL develops technologies and methods to advance pulse power based armor components, subsystems and systems; investigates and analyzes new adaptive armor technologies; and provides depot-level nondestructive evaluation (NDE) of various types of vehicle armor structural health, real-time assessment of armor using optical and ultrasonic embedded sensors.

CAPABILITIES

EAL research can be applied to any system requiring pulse power systems and electro-mechanical features. Low voltage electromechanical actuator (EMA) control system testing, high-voltage bench top testing is expected in FY15. For in-house NDE, the lab has ultrasonic transducer characterization equipment, infrared imaging, a millimeter wave imaging table and a nanoelectronic, spintronic and metamaterials testing station.

BENEFITS

- Electrified armor protection to defeat threats at reduced weight.
- Adaptive armor to integrate multiple armor technologies, increasing protection at a reduced weight.
- Real-time health monitoring of opaque or transparent armor without detaching the armor from the vehicle.
- Armor-embedded radio communications to protect antenna from damage and conceal mission purpose.
- Embedded radar detection and microwave energy harvesting on the battlefield.

FIRE PROTECTION TECHNOLOGY INTEGRATION LAB (TIL)

The Fire Protection TIL provides a rapid and thorough evaluation of Automated Fire Extinguishing Systems (AFES) technologies and agents that support the Army's modernization plans for legacy vehicles and future systems. The new test facility also supports AFES integration, engineering and testing designed to protect combat and tactical ground vehicles and their crew members.

CAPABILITIES

The Fire Protection TIL provides in-house integration and test capabilities to evaluate the performance of AFES components and agents. Rapid assessments of multiple alternative approaches are performed under realistic vehicle conditions. The Ballistic Fireball Generator performs a fuel-spray test, conducted in a reconfigurable firebox, to simulate a full range of tactical and combat vehicle geometries. The TIL is also capable of bench testing optical, electrical and mechanical instrumentation and provides noise and discharge force measurements, as well as material-flammability testing.

BENEFITS

- Provides in-house ability to develop and test lifesaving technologies and quickly transition innovations to the vehicle Program Managers (PMs) and our Soldiers.
- Validates AFES performance requirements with physical testing.
- Predicts performance of AFES to reduce system testing.
- Provides simulations of vehicle AFES system design (temperatures, pressures, oxygen levels and acid byproducts).
- Provides quick turn-around time with on-site support for proof-of-principle testing.

GROUND SYSTEM SURVIVABILITY

HIT AVOIDANCE DEVELOPMENT (HAD)

The HAD provides technology assessment, subject-matter expert (SME) integration services and evaluations for PMs as well as core-funded DoD projects. Technologies addressed include Passive and Active Protection Systems (APS). HAD provides unbiased "honest broker" technology evaluations. The lab also works with industry via Cooperative Research and Development Agreements (CRADAs), collaborating with partners to improve on available technologies for potential transition to the PM community.

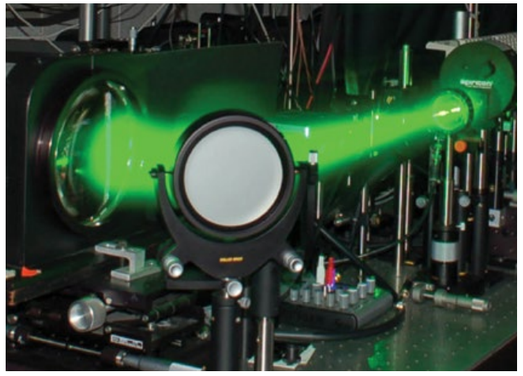
CAPABILITIES

HAD can characterize threat-point initiators, countermeasure pre-function analysis, technology optimization and system integration. Based on customer input, the lab develops theater-inspired complex attack scenarios to evaluate proposed solutions. HAD optimizes technology integrations based on performance data provided by these complex ambush scenarios. APS technology is assessed for vehicle-specific integrations in a hardware-in-the-loop, virtual battle space environment.

BENEFITS

- Provides real-time evaluations and assessments.
- Optimizes technology concepts against theater-based complex attacks.
- Optimizes integration of passive and active defeat systems on tactical and combat vehicles.
- Provides a one-team approach to the hit avoidance system optimizations and integration with controlled firing of dynamic threat surrogates and the Rapid Evaluation Capability of live-fire dynamic foreign threats.

LASER PROTECTION TIL



The Laser Protection TIL conducts research and analysis of laser protection materials along with integration schemes. The lab's objectives are to limit energy coming through combat systems and integration schemes, and incorporate laser protection materials onto day camera sensors.

CAPABILITIES

TARDEC's Laser Lab evaluates various types of power-limiting materials for their performance in a standard setup designed by TARDEC engineers. The team also designs laser protection integration strategies for various combat weapon systems based on current technologies. The Laser Protection TIL developed a methodology that allows integration of laser protection materials directly onto a day camera sensor, providing wavelength-agile laser protection against lasers anywhere in the visible spectrum. With typical filters (using absorption or reflection capabilities), a system may only be protected against certain wavelengths.

BENEFITS

- Enables warfighters to continue performing a mission while under laser attack.
- Allows day cameras to continue operating during a laser attack.

MECHANICAL COUNTERMINE

The Mechanical Countermine Team, partnering with the Michigan Tech Keweenaw Research Center (KRC), is uniquely qualified to develop mechanical IED-defeat systems and integrate mature technologies onto manned and unmanned military platforms.

CAPABILITIES

KRC performs dynamic mobility studies and system integration analysis at a 500-acre test course specifically designed to test limits and evaluate the automotive impact on both manned and unmanned systems through an increasingly progressive set of terrain and soil profiles. These test courses and lanes are designed to mimic Army Evaluation Center courses and natural terrain obstacles under desert, mud or snowy conditions.

BENEFITS

- Rapid design concepts put hardware through a rigorous testing environment.
- Full data and analysis using the latest data acquisition and modeling equipment for high-speed videos.
- A controlled test environment where system limitations and capabilities are learned and observed.

OCCUPANT PROTECTION (OP) LABORATORY

Located at the Selfridge Air National Guard Base (SANGB) the OP lab consists of five unique labs: **Anthropomorphic Test Drive (ATD) Certification Laboratory, Crew Compartment Underbody Blast Simulator (CCUBS), Foot Impact Test Fixture, Head Impact Laboratory (HIL) and Sub-System Drop Tower (SSDT).**

GROUND SYSTEM SURVIVABILITY

ATD

The ATD Certification Laboratory consists of several test fixtures to ensure ATDs are functioning correctly and within specifications prior to use in any OP testing. The fixtures in the lab evaluate each body region of the ATD. Lab personnel make necessary repairs on the ATD prior to testing. This process increases the reliability of test data collected with the ATDs and ensures the data is as realistic and accurate as possible.

CAPABILITIES

The ATD Certification Lab consists of test fixtures and data acquisition equipment to certify each body region of an ATD. Software analyzes the data collected and provides pass/fail criteria for the certification tests. ATDs failing certification tests are then repaired and reevaluated prior to use in any OP Testing.

BENEFITS

- Increases confidence in test data.
- Allows for faster, more frequent and less expensive certification of ATDs as compared to sending to a third party.

CCUBS

The CCUBS is a test device used to evaluate vehicle crew compartments in simulated underbody blasts. The CCUBS consists of a large platform with four seat-and-occupant positions. During tests, engineers can place common equipment such as steering columns, radio racks and other government furnished equipment on the platform. The CCUBS is scheduled to be operational in the fourth quarter of FY15.

CAPABILITIES

The pneumatically actuated CCUBS device is capable of testing impulses up to 350 gravitational force/acceleration (g)–5 meters per second (m/s) on a global level, and up to 1,100 g–2.5 m/s at each seating position. The total payload is 2,200 lbs. The CCUBS is also capable of testing slam-down impulses up to 90 g–20 m/s. The OP Lab uses Hybrid III ATDs – or crash test dummies – with internal instrumentation to record load data in the head, neck, spine, thorax and legs. The lab also features a full range of external instrumentation, including accelerometers, load cells, string potentiometers and high-speed video cameras to meet customer needs.

BENEFITS

- Records input and verification data for modeling and simulation (M&S).
- Increases confidence in technology performance prior to live-fire events.
- Validates M&S results quickly and inexpensively.
- Fills capability gap between component/subsystem level testing and full vehicle Live-Fire Test and Evaluation.

FOOT IMPACT TEST FIXTURE

The Foot Impact Test Fixture simulates underbody blast and IED events to evaluate floor padding materials for integration into military ground vehicles. The Foot Fixture consists of an adjustable rigid seat and pneumatically operated foot impactor. A wide variety of floor padding and energy attenuating devices can be mounted to the foot impactor to quickly evaluate and assess performance.

CAPABILITIES

- The Foot Fixture can test impulses up to 500g-5ms. The rigid seat is adjustable for all sizes of ATDs and can be set to maintain any ATD position required.

BENEFITS

- Records input and verification data for M&S.
- Increases confidence in technology performance prior to sub-system level, system level and live-fire events.
- Validates M&S results quickly and inexpensively.

HIL

The HIL uses testing devices to evaluate vehicle interior energy attenuating (EA) technologies for mitigating head injuries resulting from head impacts during mine/ IED events and vehicle crashes.

The HIL includes a free motion headform (FMH) with three accelerometers installed in the head cavity. The impactor launches the FMH within specified approach angles at the target area within the vehicle being tested to measure orthongonal accelerations at the conjugate gradient of the head assembly. Data is then recorded by the FMH and analyzed to assess potential sustained injuries.

CAPABILITIES

The HIL is capable of testing at any velocity with test fixtures located within the vehicle to allow targeting. The HIL may use any means of propelling the FMH as long as the impactor design is capable of falling within specified horizontal/vertical ranges. The FMH is built to the 50th percentile male, and methodology for testing with advanced combat helmets is ongoing. The OP Lab has a full range of external instrumentation including accelerometers, load cells, string potentiometers and high-speed video cameras to meet customer needs.

BENEFITS

- Acquisition of input and verification data for M&S.
- Increases confidence of technology performance prior to live-fire events.
- An inexpensive and quick means of validating M&S results.

SSDT

SSDT evaluates OP technologies for performance in simulated underbody blast events. The SSDT consists of a large platform on which a variety of test specimens are mounted. The SSDT tests floors, ceilings and wall-mounted seats, floor padding materials, data acquisition black boxes and other EA devices. The SSDT is capable of simulating a wide range of mine/IED blasts and measuring the effects on vehicle occupants subjected to the impulse.

CAPABILITIES

The SSDT is capable of testing impulses up to 350 g-5ms, with a payload of up to 1,000 lbs. The lab possesses a wide range of test instrumentation to conduct testing, including Hybrid III ATDs, accelerometers, load cells, string potentiometers and high-speed video cameras.

BENEFITS

- Records input and verification data for M&S.
- Increases confidence in technology performance prior to live-fire events.
- Validates M&S results quickly and inexpensively.

RAPID EVALUATION CAPABILITY (REC)

The REC, located at Camp Grayling, MI, uses the only high-explosive impact area in the state to conduct year-round experiments and evaluations. In coordination with the Michigan National Guard, REC uses 147,000 acres to develop and assess technologies and system integrations on platforms before they undergo validation tests.

CAPABILITIES

- REC provides real-time experiments and evaluates emerging technologies against high-explosive threats, including explosively formed penetrators (EFPs), rocket propelled grenades (RPGs), anti-tank guided missiles (ATGMs), recoilless rifles, mines, direct-fire cannon and mortar, shaped charges and automated fire suppression. REC also verifies medium-caliber armor welds to quickly determine technology maturity.
- REC uses remote firing controls, multiple high-speed video camera angles and mobile experiment labs for real-time data/video capture and analysis with large workspaces and collaboration areas.

BENEFITS

- Preliminary feasibility assessments are more cost effective than conducting actual tests.
- The secluded location provides for discrete evaluation of technology readiness.
- A controlled experiment/evaluation setting allows for rapid changes as necessary.
- Mobile experiment laboratories facilitate immediate data capture, analysis and collaboration.

SURVIVABILITY ARMOR BALLISTIC LABORATORY (SABL)

The SABL provides independent analysis, ballistic testing, data collection, data reduction and qualification of current and advanced armors.

CAPABILITIES

The SABL provides the ability to launch a wide range of foreign small arms, kinetic energy threats (up to 30 mm), fragment simulating projectiles (FSP) and ballistic weld projectiles at test-specific velocities.

The lab is used to conduct 2,352 Army Tank Purchase Description (ATPD), First-Article Testing (FAT), Production Control Testing (PCT) and to support government and customer-directed research in armor development.

This team also conducts failure analysis with use of a high-speed video capture system up to 60,000 feet per second, 10 microseconds rendering and a flash X-ray system.

Existing equipment includes an Environmental Conditioning Chamber, full machine shop, a welding lab, flash X-ray and high-speed video.

BENEFITS

- Increases crew survivability due to a standard benchmark that all transparent armor is measured against.
- Reduces transparent armor acquisition costs due to more competition.
- Improves consistent ballistic performance.
- Reduces life-cycle costs.
- International Organization for Standardization (ISO) 17025 accredited.

VEHICLE ARMOR LABORATORY (VAL)

The VAL is a multifunctional facility that focuses on composite materials research, development, fabrication and integration. The VAL is a combination of two different areas: a 1,000-square-foot environmentally controlled room for fabric cutting, specimen preparation and test control, and a 6,000-square-foot open bay space containing test and fabrication equipment.

CAPABILITIES

The VAL has the capability to design and build composite systems for structural, armor and general vehicle applications.

Through the use of computer-aided design (CAD) software and a computer-controlled cutting table, VAL engineers/technicians can rapidly fabricate custom-sized and custom-shaped composite panels. For parts containing metal, ceramic or especially thick section composites, the VAL has a Computer Numerical Controlled (CNC) router, automated wet table saw, curing oven and walk-in freezer for storage of specialty materials.

Test equipment in the VAL includes a Thermotron environmental chamber, electric screw test machine and a non-fixed dual post actuator system.

BENEFITS

- Ability to design, fabricate and test composite parts at a coupon, sub-system and system level to find material issues at a stage of development that is economical to correct.
- Fabrication of prototype parts allows for improved transition and manufacturing in a full-scale production environment.
- In conjunction with the on-site ballistic test facility, armor design and integration concepts are rapidly fabricated and tested.

ELASTOMER LABORATORY

The Elastomer Lab performs research, development and testing to characterize elastomer components specific to track and suspension systems on legacy vehicles. Key objectives are characterization, failure mode analysis through benchmarking and screening current and improved materials. The team tests production materials for compliance and defines performance requirements for improved specifications. Results can be shared across other programs with elastomer, plastic and composite applications.

CAPABILITIES

The Elastomer Lab conducts failure mode analysis of bushings, tank pads, road wheels and backer pads, and establishes new test methods for material qualification. Technicians in this lab can screen and down select preferred materials for testing at Yuma Proving Ground, AZ. As a preliminary material and test qualification center, the lab establishes performance and materials specifications to ensure components meet durability and performance requirements.

BENEFITS

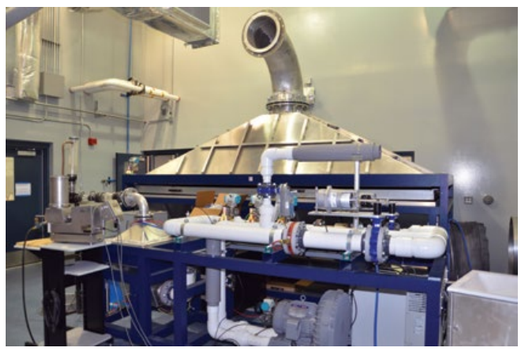
- Provides in-house expertise in track materials, design and functionality to improve durability and reliability of all combat vehicle track elastomer components.
- Updates and develops new standards for any military elastomeric components.
- Develops testing techniques to satisfy unique DoD conditions and properly test components.
- Provides DoD the capability to independently verify and validate supplied elastomeric component test results.

GROUND SYSTEMS POWER AND ENERGY LABORATORY (GSPEL)

GSPEL consists of seven unique laboratories that can test and evaluate everything from individual component systems to entire vehicles of any size.

AIR FILTRATION LABORATORY

The Air Filtration Lab provides testing of air filtration devices to demonstrate and validate new or legacy system capabilities in a controlled environment.



CAPABILITIES

The lab's four different flow benches utilize varying flows from 250 Standard Cubic Feet Per Minute (SCFM), 2,000 SCFM, 5,000 SCFM and 12,000 SCFM. Each flow stream is equipped with an automated dust feeder enabling simulations from zero visibility to four times zero visibility for evaluation of air filters, cleaners and other equipment/components.

BENEFITS

- Improves prime power life cycle.
- Evaluates proposed vehicle maintenance efficiencies.
- Provides first-article testing before vehicle implementation.
- Troubleshoots failures of current fielded systems.

CALORIMETER LABORATORY

The Calorimeter Lab is one of the largest in the world. It is capable of delivering airflow volumes up to 50,000-cubic-feet per minute with a state-of-the-art data acquisition and control system.

CAPABILITIES

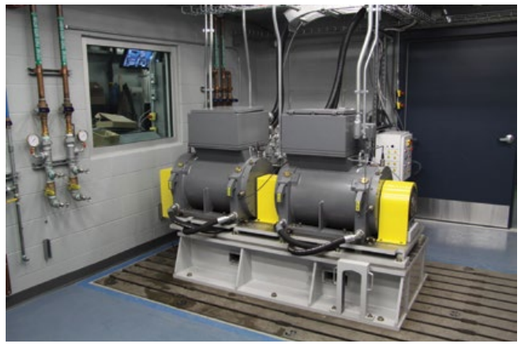
The Calorimeter Lab is designed to establish the functional characteristics and test the performance limits of heat exchangers (radiators), charge air coolers, transmissions and oil coolers, and determine and evaluate the airflow across and through ballistic grills on armored ground vehicles.

BENEFITS

- Expedites the development process for vehicle engine and transmission cooling systems under simulated field service environmental conditions.
- Provides mission-critical support for all ground vehicle thermal management systems to demonstrate future concepts, validate new systems implementation and troubleshoot legacy systems in a controlled test environment.

GROUND VEHICLE POWER & MOBILITY

ELECTRIC COMPONENTS LABORATORY (ECL)



The ECL supports research, development, characterization and testing of high-voltage, high-power components necessary for military vehicle electrification and hybrid-electric technology. This lab's research extends to a testing cell in the Propulsion Laboratory that has programmable power absorption and supply capabilities with voltage, current and power control and a 350-horsepower AC dynamometer.

CAPABILITIES

The lab's 346 kilowatt (kW) four-quadrant dynamometer supports testing of high-power traction motors and inline generators (3,321 Newton meters (Nm) torque from 0-1,000 rpm). Its 12,000 rpm capability covers the full-speed range of potential military motor/generator operation and the dual 250 kW supplies (900 volt/1,000 amp) allow testing of high-power electronic controllers and converters, as well as providing power for motor testing. AC and DC load banks provide up to 250 kW power absorption capabilities.

BENEFITS

- Analyze future electrical power generation and control technologies for the Army.
- Hardware-in-the-loop controls development.

ENERGY STORAGE LABORATORY (ESL)

The ESL, an ISO 17025 accredited laboratory, evaluates and qualifies batteries and other electrochemical technologies at the cell, module and battery pack levels.

CAPABILITIES

The ESL is comprised of three large battery test rooms, a Battery Management System (BMS) laboratory, two test chambers and storage rooms. Multiple cell/battery cyclers on a centralized control system, thermal ovens and temperature controlled water baths support a variety of electrochemical tests. The ESL has equipment that allows simultaneous testing of more than 100 batteries and cells (12V and 24V batteries at approximately 100 amps (A)) and specialized equipment allowing high-voltage battery testing and cold cranking. The ESL also has the ability to test the maturity of BMS technologies within the BMS laboratory.

BENEFITS

- Provides cradle-to-grave research and testing support for all DoD ground vehicle energy storage systems.
- Aids in assessing technical readiness levels (TRLs), understanding new technologies and supporting the PEOs when determining whether systems are ready for fielding.
- Provides warfighters with solutions for fielded and future systems.
- The ESL can test manufacturer performance claims on battery products and provide usable data for design purposes.

FUEL CELL LABORATORY (FCL)

The FCL provides testing for technology readiness of fuel cell systems and develops hybrid fuel cell installations in robots and vehicles. The FCL investigates tests and verifies the performance of fuel-cell systems and fuel reformers for use with manned and unmanned ground systems.

CAPABILITIES

Engineers in the FCL test, develop and integrate power sources for ground systems and validate fuel-cell components, fuel reformers and auxiliary power unit systems performed to ISO 17025 standards.

BENEFITS

- Provides independent government testing for TRL validation of fuel-cell systems.
- Offers complete fuel and reformate analysis to verify sulfur removal and fuel-reforming technologies.
- Uses M&S to confidently evaluate future designs.
- Integrates fuel cell power systems in ground vehicles to investigate fuel cell performance and utility.

POWER AND ENERGY VEHICLE ENVIRONMENTAL LABORATORY (PEVEL)

Equipped with multiple dynamometers, the PEVEL provides the tools required for full vehicle powertrain testing, evaluation and assessment on wheeled and tracked vehicles through external load control and data collection. PMs, PEOs, manufacturers, academics and researchers can use these tools to create, assess and validate vehicle design, functionality and utility in a fully controlled and repeatable environment.

CAPABILITIES

The PEVEL chamber enables testing at temperatures from minus 60° F to 160° F and humidity levels from 0 to 95 percent relative humidity, making it possible to produce real-world vehicle performance and capability comparisons. The PEVEL can generate wind speed up to 60 mph and solar load up to 1,200 watts/per square meter (W/m2). Additionally, the PEVEL can process electrical power up to 800 kW, wheeled vehicle torque up to 34,000 pound-foot (lb-ft) and tracked vehicle torque up to 42,000 lb-ft. Compatible fuels for testing in the PEVEL include hydrogen, DF-s, JP-8, JET-A, bio-diesel and synthetic blends.

BENEFITS

- Functions as a test-bed to evaluate vehicle system performance in any operational environment.
- Allows for testing in extreme climates under various loads.
- Performs repeatable tests on components or vehicles, producing real-world vehicle and component performance/capability comparisons.
- Functions as a systems integration laboratory (SIL); fully supports hardware-in-the-loop simulation.
- Addresses the testing gap for multi-axle wheeled vehicles and provides additional evaluation capabilities for vehicle on-road performance.

GROUND VEHICLE POWER & MOBILITY

THERMAL MANAGEMENT AND CONTROLS LABORATORY

The Thermal Management and Controls Lab is a specialized developmental test facility which is fully operational and equipped with bench breadboard build and test capabilities for component-level systems.

CAPABILITIES

The Thermal Management Lab has four workbenches with electrical and water supplies optimized for component-level testing, as well as two work tables and a chemical vent hood. It contains multiple chillers/liquid temperature controllers that allow researchers to perform a variety of tests, including thermoelectric power characterization, bench scaling and performance characterization of different modules.

BENEFITS

- Supports the test, evaluation and validation of state-of-the-art technologies on a component and module level.
- Develops advanced control systems to improve efficiency, increase capability and improve Army ground vehicle survivability.
- Aids in understanding thermoelectric generators and control systems that support the PEOs/PMs in determining system readiness.
- Provides highly efficient technologies with capabilities to increase vehicle range, operational energy, onboard electrical power and fuel economy.

PROPULSION LABORATORY

The Propulsion Lab simulates field test conditions in a controlled environment, using standardized or customized test procedures. The Propulsion Lab's 11 cells can test vehicles for full-load cooling; tractive effort vs. speed; fuel economy; air conditioning; engine (performance, endurance, qualification, acceptance); transmission performance and efficiency; and drive axle endurance.

Cell 4's upgrades open partnership opportunities for original equipment manufacturers (OEM) to collaborate with TARDEC to baseline and test potential powertrain technologies for an Armored Multi-Purpose Vehicle.

In 2015, Cell 5 will become the upgraded Combat Powertrain Lab (CPL), adding new capabilities to TARDEC's laboratory facilities including Regenerative Steer Testing and Road Load Simulation (RLS).

The CPL allows engineers to perform regenerative steer testing on complete vehicles, transmissions or power packs. Before the CPL was built, this type of testing was performed on a limited basis at an outside laboratory using inertia wheels that enable short-duration steer regeneration. The CPL provides a significant improvement by enabling continuous steering torque regeneration testing, which results in higher fidelity testing of tracked vehicle transmissions.

The CPL also enables RLS testing, which allows a vehicle, transmission or power-pack to be operated on a mission profile or simulated terrain to evaluate the performance of the component or system. Incorporating this capability with other GSPEL test cells allows the vehicle to operate on a simulated terrain in highly controlled environments. The combined effect of using the simulated terrain and controlled environment allows for highly directed studies of failure modes, performance improvements, fuel economy and capabilities of vehicle systems and sub systems.

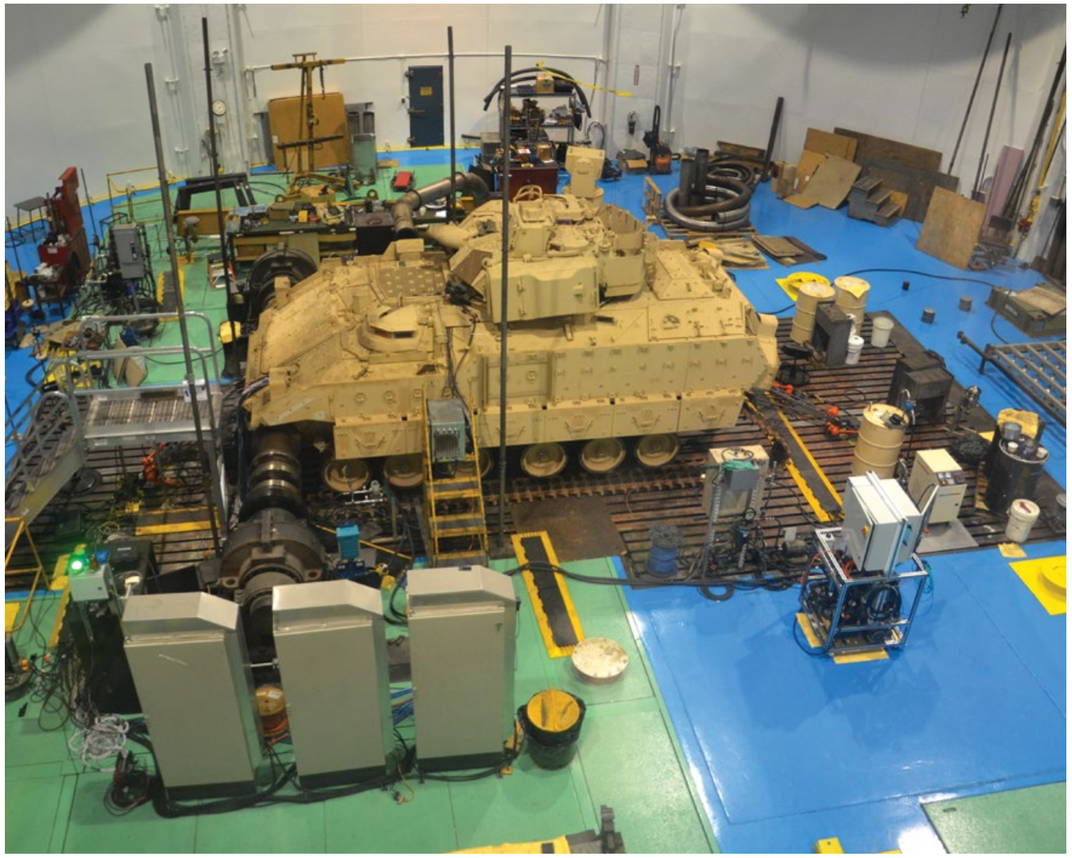
CAPABILITIES

Six cells contain dynamometers. Three full vehicle/transmission/drive axle cells are designed for both steady-state and transient tests. Cells offer simulated heat to 160° F and wind speeds up to 20 mph.

BENEFITS

- The test cell's total sprocket output load absorbing capacity permits testing of any known military ground vehicle in any transmission gear range.
- CPL's enhanced capabilities will allow testing prior to fielding, saving both time and money.
- RLS will allow vehicle testing on simulated terrain in controlled environments. The combined effect enables failure mode analysis, performance improvements, fuel economy and vehicle system capabilities.

TEST CELL 9



GVPM's Propulsion Test Cell 9 is a climatic chamber with wind capability equipped to evaluate continuous vehicle performance in extreme climates under full-load conditions.

CAPABILITIES

Cell 9 replicates solar loading up to 1,120 W/m2 and tracked vehicle loading from 88,000 lb-ft per side from 15 rpm to 250 rpm and 128,000 lb-ft per side at stall. Ambient temperature is controlled up to 160° F. Air is streamed from eight different directions with velocity control from 5 mph to 20 mph. There are more than 600 data channels for monitoring and logging data.

BENEFITS

- Cell 9 is the only facility in the United States that can test full-load cooling on heavy combat vehicles.
- The lab controls multiple aspects of environmental conditions to enable repeatable testing for vehicle diagnostics.

UNMANNED GROUND VEHICLE (UGV) INTEROPERABILITY LABORATORY

The UGV Interoperability Lab provides the capability to verify vendor conformance against government-defined interoperability profiles (IOPs). This capability allows customers to verify a system or component against their program requirements, and helps facilitate increased commonality as well as reduce life-cycle costs.

CAPABILITIES

The UGV Interoperability Lab provides capabilities to verify conformance against the UGV IOPs, including overarching, payloads, controls and Joint Architecture for Unmanned Systems profiling rules. The lab's Conformance Verification Tool software and physical/electrical interface testing tools provide a flexible, automated way to test system/payload physical, electrical and logical interfaces, as part of the lab's payload/system conformance verification bench. The lab also provides reference architectures for use in testing, including both simulated and physical reference platforms and operator control units (OCUs).

BENEFITS

- Brings IOP conformance testing capability local to TARDEC customers.
- Provides ability to select best-value components to meet program needs.
- Helps ensure commonality of components for given platforms.
- Gives knowledgeable personnel the ability to help quickly identify and address IOP issues.
- Assists government vendors in developing IOP-compliant systems and subsystems.

GROUND VEHICLE SOFTWARE DEVELOPMENT

The Software Engineering Services (SEC) Software Development Team provides support to TACOM Life Cycle Management Command (LCMC) customers to resolve software-related issues as they develop enhancements to improve Current Force effectiveness. The Software Development Team applies a systematic, disciplined, quantifiable approach for the development, operation and maintenance of software.

CAPABILITIES

The SEC Software Development Team provides expertise in the ground system software development domain with a primary focus on real-time embedded systems. SEC also expanded its capabilities to encompass growing domains and services, including on-board data collection, data analysis, diagnostic applications, prognostic applications, algorithm development and software architecture to support ongoing Army Technology Objectives.

BENEFITS

- Improves Current Force effectiveness.
- Supports the development of software requirements.
- Identifies and resolves software issues for ground vehicles.
- Effectively remediates software defects that degrade warfighter and/or system performance and readiness.
- Develops software fixes to resolve Soldier-identified field problems and/or safety issues, increasing warfighter capabilities.
- Develops customizable software adhering to unique customer requirements.

PRE- AND POST-PRODUCTION SOFTWARE SUPPORT (P3S2) TEAM

The SEC Post-Production Software Support (PPSS) team provides support to Army software-intensive/embedded weapon systems during and after production to ensure its software supports operational missions and subsequent systems modifications in accordance with Army Enterprise Architecture compliance guidelines. PPSS requirements begin the first full fiscal year after weapon system hardware production is completed.

The PM is responsible and accountable for the weapon system throughout its life cycle, from program initiation through demilitarization and disposal. The PM defines the criteria for selecting a Software Support Agency (SSA) — in this case the SEC — to manage planning, programming, budgeting and program execution. Software funding requirements for each weapon system are documented in the POM at least two years prior to the weapon system's transition date.

CAPABILITIES

The Software Engineering Institute (SEI) assesses SEC performance capabilities to ensure compliance at Level Three SEI Capability Maturity Model Integration. Funding requirements for weapon systems are prepared by the SEC and briefed at Department of the Army and AMC Operation and Programs Summaries (OPS) 29 yearly budget reviews. This process leads to scope-of-work development and requirements allocation to provide optimal software engineering management. Executing software validation, verification and testing develops an Organizational Set of Standards Processes for software development and improvement using modular open systems architecture.

BENEFITS

- The P3S2 team delivers zero defects software to warfighters.
- The P3S2 team conducts OPS 29 budget reviews.
- The PPSS team provides knowledge and expertise to the Abrams M1A2 tank through Systems Engineering Plan version 2 software.
- Prepares PPSS requirements for Core, PM Abrams, Stryker, MRAP, M1A1ED, M1200 AK, PQAS-E and Wolverine for each POM.
- Populates Depot Maintenance Operations Planning System database with PPSS funding.
- The P3S2 team provides input to Weapon System Review supporting the PM Armored Brigade Combat Team (BCT) and PM Stryker BCT.
- Participates in the TACOM LCMC resource summit each fiscal year to assess emerging modifications or upgrade initiatives, address systems supportability and military worth issues.
- Assists PMs formulate, implement and execute their sustainment strategies so that the system's design and product support package development are well integrated and contribute to the warfighter's mission requirements.

MRAP SYSTEM INTEGRATION LABORATORY (SIL)

The MRAP SIL provides the facilities and expertise to support MRAP Command, Control, Communications and Computers (C4) system insertions and deviations for MRAP vehicle variants and configurations throughout their life cycles. SIL activities include MRAP variant design, maintenance, integration, test, production support, fielding and transition to post-production program activities.

CAPABILITIES

The MRAP SIL provides a realistic environment to conduct electronics/software vehicle architecture system development. Testing, power studies, Soldier training, human factors analysis, simulations, technical manual validation and sustainment, and production support can be performed in the lab. The MRAP SIL also provides a functioning environment for verification and validation of prototype vehicle cable design and testing.

BENEFITS

- The MRAP SIL provides space claim and personnel to establish and maintain facilities that support MRAP Integrated Bridge and C4 system life cycles. The MRAP SIL supports both the M-ATV and larger MaxxPro Dash configurations.
- A platform SIL speeds development, integration and test activities by negating the need for a vehicle test platform.
- The lab facilitates research and integration activities through ease of reconfiguration not possible on a vehicle platform.
- High-fidelity simulation capabilities are provided to support mission scenario execution with Soldier-in-the loop testing.
- The SIL can be networked for interactive test or simulation with other Army assets.
- The SIL supports platform C4ISR [Intelligence, Surveillance and Reconnaissance]/data network development, and power distribution and management architectures.

TACTICAL CYBERSECURITY ENGINEERING TEAM (TCET)

The SEC's Tactical Cybersecurity Engineering Team (TCET) provides security engineering support to various PMs and organizations by addressing cybersecurity concerns for Tactical System Platforms during their development. The TCET provides security engineering support throughout the acquisition life cycle, ensuring security is designed into the system early in the process. The TCET also examines cybersecurity research efforts while transitioning applicable cyber technology onto TARDEC platforms to field secure systems.

CAPABILITIES

TCET provides security engineering support to develop tactical systems that are in compliance with Army and DoD cybersecurity rules and regulations. Capabilities include conducting, monitoring, directing and coordinating cybersecurity activities for tactical system development. TCET assists in determining and defining solution security requirements, architecting and designing security solutions and implementing the security solutions on tactical system platforms.

BENEFITS

- Expert domain knowledge in certifying and accrediting tactical systems and obtaining Authority to Operate.
- Supports the Information Assurance (IA) managers for regulation compliance.
- Provides Certified Information Systems Security Professionals trained in DoD IA Workforce Improvement Program Requirements.
- Security engineers perform IA vulnerability scans, identifying risks and weaknesses during the development process.
- Security engineers identify and harden ground domain information systems.
- Enhanced ability to identify risks associated with IA/cybersecurity and mitigate early in the project life cycle.
- Engineers conduct/analyze software assurance scans on in-house- and contractor-developed software to reduce potential vulnerabilities in software codes.
- Provide recommendations to mitigate or address security risk for tactical platforms.

GROUND VEHICLE ACOUSTICS LABORATORY (GVAL)

The Special Programs Office operates the mobile GVAL, which provides independent diagnostic and developmental assessments for both legacy and future Army vehicle acoustics. The lab supports the development of vehicle acoustics specifications, acoustics test planning and vehicle acoustics reduction efforts and has the software tools to make aural detection range predictions.

CAPABILITIES

The GVAL has a vehicle pass-by measurement system compliant with MIL-STD-1474D and two acoustic arrays capable of collecting acoustic data for both moving and stationary vehicles. Pass-by measurements support human aural detection range prediction, assess the contribution from different noise sources using overkill treatments and can determine the overall effectiveness of acoustic treatments.

The acoustic arrays are diagnostic tools supporting acoustic signature reduction efforts and can identify the frequency content and location of sound energy radiated by components as transmitted through the vehicle structure or radiated through vehicle apertures.

BENEFITS

- Provides in-house expertise and support in all aspects of vehicle acoustics.
- Focuses on quieter vehicles, which improve the warfighters' ability to maneuver.
- Reduces interior noise, improving vehicle manpower and personnel integration characteristics.

RESEARCH SYSTEM INTEGRATION LABORATORY (SIL)

The VEA Research SIL (VRS) is essential to the success of the TARDEC 30-Year Strategy. The vast majority of the TARDEC Capability Sets face challenging electronics integration issues. The VRS addresses these issues by designing, developing and implementing an advanced ground vehicle power and data network architecture along with the corresponding system designs when needed. When complete, the VRS will position TARDEC as the go-to resource for ground vehicle electronics architecture design, power architecture design and electronic/electrical engineering expertise. It will provide the ability for TARDEC to support PEO/PM modernization efforts, and build the human capital expertise in this area.

The VRS develops and demonstrates an implementation of a complete VEA reference architecture to address the power, vetronics and Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) integration challenges facing the modernization of the ground vehicle domain. The VRS also supports experimentation with future architectural concepts and implementation. This centralizes the Army's approach to integrating electronics on ground vehicles, saving cost and reducing redundant work across multiple programs. This effort also includes power management technologies.

CAPABILITIES

The VRS showcases a reference implementation of advanced architectural concepts, including high-voltage standards. The VRS has a Defense Research and Engineering Network connection to the C4ISR SIL at Aberdeen Proving Ground, MD, allowing both simulation and stimulus of representative external network components that could be integrated into a ground vehicle.

BENEFITS

- Provides SIL environment where contractors and vendors can bring electronic equipment to be integrated.
- Provides "proving ground" for future architectural concepts.
- Provides connectivity and insight into next-generation Communications-Electronics Research, Development and Engineering Center C4ISR systems.

VICTORY* SYSTEM INTEGRATION LABORATORY (VICTORY SIL)

The VICTORY SIL was developed to help facilitate verification and validation of the VICTORY standards in support of near-term PEO GCS Engineering Change Proposal efforts. It also provides a facility where vendor components are independently verified to VICTORY standards. The VICTORY SIL has a representative vehicle cabin to demonstrate the VICTORY standards in a system-level vehicle environment.

CAPABILITIES

The VICTORY SIL offers contractors the ability to bring hardware and software solutions to be tested and verified at VICTORY standards. The testing would be performed via a Test Service Agreement between the contractor and TARDEC.

BENEFITS

- Provides an independent implementation of VICTORY proposed standards.
- Advances VICTORY standards from "proposed" to "draft."
- Identifies and clarifies issues with the VICTORY proposed standards.

* VICTORY — Vehicular Integration for Command, Control, Communication, Computers, Intelligence, Surveillance, Reconnaissance (C4ISR)/Electronic Warfare Interoperability.

SYSTEMS INTEGRATION & ENGINEERING (SIE)

GROUND SYSTEMS CONCEPTS LABORATORY (GSCL)

GSCL consists of high-performance CAD stations and associated software located in a secure facility.

CAPABILITIES

The GSCL provides infrastructure that allows the generation of realistic, conceptual-level ground systems computer models and industrial design ideation for the joint forces. Ground system projects include modifications to existing systems as well as new concepts. The laboratory also allows for classified model generation. The lab's database contains current and future vehicle conceptual models and technologies, increasing the efficiency of generating new vehicle concepts as well as streamlining modifications to existing ground vehicle systems.

BENEFITS

Provides the joint ground systems acquisition, combat developer and S&T communities with the answers to key questions:

- What are the expected concept weights or system-level weight impacts?
- What are the overall expected concept system dimensions?
- What is the concept's physical architecture?
- What are the tradeoffs and impacts of different concepts and/or technologies?
- What are the system-level impacts of operational or technical requirements?

MODELING AND SIMULATION

The TARDEC **Systems Engineering (SE)** group serves as the DoD's premier organization for fast and accurate ground vehicle system computational M&S services.

SE Analytics uses in-house engineering analysts to perform Soldier-centric vehicle assessments of new systems and modifications to existing systems. SE assessments advise customers on impacts to system-level performance and also identify improvements to Army and DoD vehicle designs. Analytics has world-class experts in numerous areas including: vehicle dynamics, blast and crash M&S, injury biomechanics, physics of failure, engine and power-train M&S, computational fluid dynamics, reduced order modeling, and data mining and optimization analyses. The group enables TARDEC to provide DoD with a one-stop shop for rigorous evaluation of existing and conceptual vehicle systems.

CAPABILITIES

The **Energetic Effects and Crew Safety Team** focuses on providing the Army with superior computational M&S capability for assessing Soldier-centered survivability. Soldiers in Army ground vehicle systems are vulnerable to normal automotive-type collisions, rollovers and explosively induced vehicle damage. Advanced occupant and vehicle modeling techniques pioneered by Detroit's automotive industry, and further refined by combining years of industry and Army experience, are used to evaluate performance assessments in vehicle structural integrity and occupant injury risk.

The **Powertrain M&S Team** provides the Army with vehicle power and efficiency models to improve ground platform mobility and fuel efficiency. The team assesses vehicle capabilities such as top speed, acceleration and off-road performance before an initial prototype is built. This allows the Army to construct a multitude of vehicle designs and conduct performance comparison studies to ensure only optimal designs are built. PMs across DoD rely on the team to ensure platforms deliver the required power and mobility objectives while minimizing logistics and sustainability costs.

The **Dynamics and Durability M&S Team** is the Army's frontrunner in assessing ground vehicle stability, handling, automotive performance, reliability, durability and fatigue. TARDEC pioneered vehicle dynamics modeling techniques more than 30 years ago and continues to build on these techniques. State-of-the-art software technologies are applied to ground systems to conduct physics-based performance assessments for dynamics, on-road/off-road mobility, durability and fatigue.

The **Thermal and Signature M&S Team** brings computational fluid dynamics and signature capabilities to the Army ground vehicle community and forms a cornerstone of research to improve Army ground vehicle effectiveness. Computational fluid dynamics simulation allows the Army to assess:

- Air flow through heat exchangers for propulsion cooling.
- Requirements compliance associated with the thermal environment for electronics through HVAC (heating, ventilating and air condition) simulation.
- Fire suppression systems to improve crew survivability.
- Hydrodynamic and motion dynamics performance for wet gap bridging/rafting systems with ground vehicle loading scenarios.
- External vehicle airflow to improve vehicle drag for increased fuel economy.

In addition, radiative energy simulations allow the Army to assess a vehicle system's acoustic, infrared and radar signatures, leading to the design of more efficient and less detectable vehicles.

The **Computational Methods & System Behavior Team** combines numerous M&S areas within TARDEC's Analytics Group to perform multi-disciplinary optimization, reduced order or meta modeling, response-surface methodologies to enhance system-of-systems level analysis and system engineering processes to optimize vehicle design.

BENEFITS

- Analytics is the Army's premier organization for providing fast and accurate system-level computational physics and math-based M&S technical services.
- In-house M&S analysts utilize specialized tools and processes to perform Soldier-centric vehicle assessments of new systems and modifications to existing systems.
- Assessments advise customers on impacts to system-level performance, risk mitigation and recommend improvements to Army and DoD ground vehicle designs.
- The group provides timely, cost-effective computational and full-spectrum advanced computational M&S services for ground vehicle systems, enabling superior product quality and reduced development costs.

CENTER FOR SYSTEMS INTEGRATION (CSI)

CSI was established to harness the intellectual and physical capital of the Army's organic Research, Development and Engineering Centers (RDECs) to conduct robust systems development and integration using a repeatable systems engineering approach. CSI provides core engineering, prototyping and project management capabilities, and complements these skills by leveraging the distributed capabilities of other RDECs, depots, arsenals, government agencies and industry.

CAPABILITIES

CSI employs best engineering practices to develop and integrate solutions at the component, subsystem and integrated vehicle system levels. It applies these same approaches successfully to diverse products such as bridges and capability insertion into Army watercraft. Core capabilities include mechanical and electrical engineering, reverse engineering, electronics, circuit boards, wiring harnesses and embedded software. Solutions are documented and transitioned through technical data packages (TDPs), including production-ready engineering drawings, bills of materials and user manuals. Tools include Creo computer-aided design (CAD) modeling, Finite Element Analysis (FEA), human factors and failure analysis.

CSI houses TARDEC's Prototype Integration Facility (PIF) where engineering solutions are realized in physical form for evaluation and delivery to customers. Capabilities include an extensive machining and welding area with laser and water jet cutting machines, computer numerical control (CNC) machining, ballistic-certified welding and Chemical Agent Resistant Coating (CARC) painting. The PIF has more than 22,000 square feet of assembly area, including 15 fully customizable assembly bays and multiple overhead rail cranes that allow the physical integration of engineered systems and subsystems onto many ground platforms.

CSI combines its engineering and prototype integration capabilities, as well as those of its contributing partners, through a detailed project management process. It enables management of the entire project's cost, schedule, performance and risk, from project requirements definition through system development, to TDP delivery.

BENEFITS

CSI's ability to do internal government engineering, prototyping and integration results in several benefits:

- Ability to start a project within days of identifying a need.
- Flexibility to adapt to evolving project requirements.
- Flexibility in production and sustainment through delivery of a government-owned TDP.
- Early production options through partnerships with depots and arsenals.
- Capability to fabricate small quantities to meet urgent timelines.

CENTER FOR SYSTEMS INTEGRATION

DIRECT METAL DEPOSITION (DMD) SYSTEM

The DMD system is the latest technology available through CSI to assist the warfighter. By utilizing laser and powdered metal processes, this system remanufactures worn and damaged parts for ground systems without the added cost and time associated with standard production.

CAPABILITIES

The DMD system is a laser-based, additive fabrication technology which combines five common manufacturing technologies together (lasers, CAD, computer-aided manufacturing (CAM), sensors and powder metallurgy) to repair and rebuild worn/damaged components that are difficult to weld. This additive metal technology also reconfigures parts to accommodate design changes, improving efficiency and reducing lead time.

BENEFITS

- Adds additional metal to a 3D surface using a 5-axis motion system.
- Narrows heat affected zone, resulting in reduced microstructure modifications.
- Offers a wide variety of material capability, including steels, stainless steel and titanium alloys, among others.

ELECTRONIC DEVELOPMENT TEAM (EDT) LABORATORY

The EDT supports the Soldier by providing quality solutions to electrical engineering problems. CSI's EDT is committed to providing quality design and analysis, quickly and efficiently. Utilizing the EDT Labs are dedicated engineers and technicians capable of solving a variety of electrical problems, ranging from basic electrical design to advanced system-wide troubleshooting.

CAPABILITIES

EDT capabilities include circuit board design and fabrication, industrial control solutions, radio frequency (RF) communication systems, RF/Power cable design and fabrication, CANBus architecture design and complete vehicle integrations. The EDT Labs include RF spectrum analyzers, oscilloscopes, frequency and function generators, communication interface monitors, automated cable inspectors, high power microscopes for circuit board trace analysis, RF network analyzers and power and load banks for testing vehicle electrical systems.

BENEFITS

- Diagnose electrical problems for various pieces of communication systems, circuit boards, antenna and other electronic devices.
- Uses dedicated high bays equipped with exhaust extraction systems for prolonged vehicle operation indoors.
- Offers a secured high bay capable of supporting secret clearance level programs.

ROBOTIC WELD LABORATORY (RWL)

The RWL consists of a reconfigurable robotic arc welding cell and flexible tooling. This CSI lab also has hardware and software for writing welding programs.

CAPABILITIES

The RWL is used to perform accurate arc welding on steel and aluminum alloys. The arc welder is capable of pulse, short circuit, spray and surface transfer tension welding modes. The flexible tooling is dual sided and can hold multiple parts up to 5,000 pounds in a 4-foot by 8-foot working envelope. The WeldPro software allows for less programming time on the robot and faster cycle times by simulating the weld beforehand. In addition, TARDEC welding staff can provide technical support to resolve welding-related manufacturing issues, evaluate OEM weld processes for conformance to weld standards and develop welding requirements for acquisition programs.

BENEFITS

- Conduct research projects for various arc welding transfer modes.
- Study both filler materials and base materials and the effects welding has on them.
- Build prototypes without the worry of human error in the welding process.
- Efficiently and rapidly weld production projects from small-to-large-scale.
- Reduce total weapon system life-cycle cost by reducing repair costs associated with weld-related cracks.
- Additive layer manufacturing capabilities.

CENTER FOR SYSTEMS INTEGRATION

TOWING AND RECOVERY

CSI recently acquired the Towing and Recovery mission area for TARDEC. It now provides engineering support for the towing and recovery needs of current and future vehicle platforms. Areas of expertise include tow bars, winches, trailers, wreckers, and traditional and expedient recovery techniques.

CAPABILITIES

CSI now provides support for identifying gaps in requirements or equipment capabilities, finds custom or commercial solutions to address gaps, creates and manages test plans to validate the recommended solutions, and writes usage instructions and training plans for new equipment. As the Joint Forces Towing and Recovery lead, TARDEC maintains dedicated pages on the AKO, milSuite and Sharepoint websites, with recovery information, project updates and lessons learned. CSI facilitates collaboration across the DoD, working with multiple agencies to improve requirements definition, training, testing and equipment design to make towing and recovery operations safer and more efficient for warfighters.

BENEFITS

- Provides support to warfighters in the field by responding to requests for information and suggestions for improvement.
- Identifies capability gaps and finds solutions.
- Increases warfighter safety by providing more robust equipment.
- Enables faster vehicle recovery with minimal equipment damage, reducing life-cycle cost.
- Shares information throughout DoD's towing and recovery community.

ARMY PETROLEUM LABORATORY (APL)

The APL is a tenant organization at the Defense Depot Susquehanna. APL provides quality surveillance testing of bulk fuels including jet fuel, aviation (AV) gas, automotive gasoline, diesel fuel, burner fuel, kerosene, E-85 and bio-diesels in accordance with Military Standard (MIL-STD) 3004 and Army Regulation (AR) 710-2, Supply Policy Below the National Level. APL packaged products testing includes lubricating oils, hydraulic fluids, brake fluids, gear oils, engine coolants and select cleaners. These analyses typically support either shelf-life extensions or first-article testing. Coal testing performed for all DoD activities supports the qualification of coal seams at mines, and documents the quality of products delivered to installations.

CAPABILITIES

APL occupies 12,327 square feet of laboratory and office space in New Cumberland, PA. The space is further divided into six distinct labs for testing of coal, fuels and filter effectiveness. To support timely delivery of test results, customers can access reports electronically through secure Web servers.

BENEFITS

- Quick testing turnaround.
- Cost-effective, continuous tests.
- Skilled lab associates operating equipment.
- Single-point testing to easily send samples.
- Test results are maintained and accessible electronically.

BRIDGING TECHNOLOGY LABORATORY

The Bridging Technology Lab is located at Selfridge Air National Guard Base (SANGB), Harrison Township, MI. The lab is capable of evaluating bridging components, subassemblies and complete systems in a simulated environment. The lab offers unobstructed access within the building and storage of large bridge components outside of the building when they are not being tested.

CAPABILITIES

TARDEC's Bridging Technology Lab can support testing for complete bridges up to 210 feet long, 32 feet wide and 23 feet tall. The lab contains 10 hydraulic actuators capable of simulating vehicle crossings at weights up to 1 million pounds — a system that minimizes risk to people and vehicles during evaluations of new materials and design concepts. Dedicated data acquisition equipment is also available to measure and record relevant information during tests.

BENEFITS

- Controlled environment for year-round testing.
- Proximity to TACOM LCMC and the PEOs.
- Data collection is more repeatable and at lower cost than field tests.
- Tests can be completed quickly with fewer personnel than live bridge crossings.
- Fatigue-to-failure testing conducted without risking injury to people or damage to equipment.

FRESHWATER TREATMENT AND TEST FACILITY

The Freshwater Treatment and Test Facility, located at SANGB, has direct year-round access to water from Lake St. Clair and has a State of Michigan approved National Pollution Discharge Elimination System (NPDES) permit that allows discharge of up to 500,000 gallons per day of fresh water back into the lake. Daily monitoring is conducted with monthly reports submitted to the state.

CAPABILITIES

The Freshwater Treatment and Test Facility has two 3,000-gallons-per-hour Reverse Osmosis Water Purification Units (ROWPUs); four 600-gallons-per-hour ROWPUs in types one, two and three; two 1,500-gallons-per-hour Tactical Water Purification Systems; and four Lightweight Water Purifiers, representing the majority of fielded systems in the Army inventory. These systems help resolve field issues, test new components and media, and support research on emerging technologies. The team also trains Soldiers on the equipment's operation and maintenance.

The Freshwater Treatment and Test Facility also has the capability to test and evaluate gray water recycle/reuse systems and system components using a test water developed by the Water Treatment and Handling Equipment Team based on gray water generated by shower and laundry systems used on military contingency bases.

TARDEC also has access to the Seawater Desalination Test Facility, located at and operated by the Naval Facilities Engineering Service Center, Port Hueneme, CA. The Seawater Desalination Test Facility capabilities are comparable to the Freshwater Treatment and Test Facility but use natural seawater as the test water. TARDEC has two permanent employees stationed at Port Hueneme to support the Army's water treatment and handling mission there, and to facilitate use of the facility.

BENEFITS

- Availability of most Army water purification equipment for use in test programs.
- Controlled test environment with highly skilled operators.
- Access to year-round testing using a natural water source within a controlled environment.
- New equipment and sustainment training on military water treatment equipment.
- Ability to test and evaluate gray water treatment systems and components using contingency base representative gray water.

FUELS AND PETROLEUM, OIL & LUBRICANTS (POL) LABORATORIES

The Fuels and Lubricants Technology Team operates and maintains the Fuels and POL Labs at TARDEC. Lab experts adhere to standardized American Society for Testing and Materials (ASTM), Society of Automotive Engineers (SAE) International, ISO and federal testing methods. It also conducts highly specialized tests supporting basic research, product development, qualification and other TARDEC lab efforts. Testing capabilities cover necessary powertrain products for vehicles and equipment, including coolants and other fluids/solvents.

CAPABILITIES

TARDEC Fuels and POL Labs comprise 7,075 square feet with an additional 1,600 square feet of space for POL storage. Products tested at the labs include engine oil, gear oil, grease, coolants, hydraulic fluids, alternative and conventional fuels, solid film lubricants, brake fluids, nano-lubricants, solvents and cleaners.

Qualification testing is conducted on vendor-supplied products to military specifications. Once the vendor product successfully passes test requirements, it's added to the Qualified Products List for procurement.

The TARDEC Fuels and Lubricants Research Facility at Southwest Research Institute, San Antonio, TX, is a government-owned, contractor-operated stand-alone laboratory with engine testing and analytical chemistry experiment capabilities and hundreds of standardized tests methods.

BENEFITS

- Independent government analysis, testing and interpretation of results.
- Timely testing supporting in-house TARDEC projects, especially in conjunction with tests conducted in the GSPEL.
- Historical background on products.
- Development of custom products and associated specifications and documentation necessary for procurement.

INTEGRATED SYSTEMS ENGINEERING FRAMEWORK (ISEF)

The ISEF is an integrated SE framework built to create and capture knowledge using a decision-centric method, high-quality data visualizations, intuitive navigation and systems information management. It provides a collaborative environment for all stakeholders, practitioners and leaders to engage in and facilitate decision making based on a mix of qualitative and quantitative inputs. All facets of SE knowledge (requirements, decisions, risks, opportunities and tests) are created, managed and presented in context within a single framework to support Model-Based Systems Engineering information.

CAPABILITIES

- Technical planning and management
- Decision breakdown structure
- Trade studies
- Requirements to plan traceability
- Requirements analysis and decomposition
- Operational and functional requirements decomposition
- Requirements validation/verification
- Portfolio management
- Roadmapping – capability, technology and platform
- Risk, opportunities and issues management
- High-quality visualizations
- Evaluation of performance against criteria
- Embedded recursive methods for application
- Collaboration Web space to connect all stakeholders

BENEFITS

- Decision confidence
- Accelerated delivery
- Requirements compliance
- Reduced risk
- Ability to architect for adaptability, commonality and modularity

ISEF is an integrated SE knowledge creation and capture framework built on a decision-centric method, high-quality data visualizations, intuitive navigation that enables continuous data traceability, real-time collaboration and knowledge pattern leverage supporting the entire system life cycle.

Project Recon Tool Benefits

- Promotes collaboration and communication; links risks and issues.
- Captures data uniformly.
- Provides traceability, historical record and a reference for lessons learned.
- Leads to integrated and customizable workflows.
- Provides standard and customizable reporting options.
- Utilizes secure DoD database/access control — web accessible.
- Offers risk, issue and opportunity management tools.

CAVE AUTOMATIC VIRTUAL ENVIRONMENT (CAVE)

TARDEC's CAVE capability provides the ability to conduct full-scale interactive virtual CAD reviews.

CAPABILITIES

TARDEC's CAVE helps users understand physical vehicle systems using CAD data and immersive 3-D technologies. Design reviews are performed for evaluating vehicle exteriors and interior compartments from virtually any vantage point, and can determine lines of sight, evaluate general "fit-form-function" studies and crew usability.

Alternative designs, configurations or variants are compared early in the design process and throughout life-cycle phases as necessary, which allows for "if-then" studies to be conducted at minimal cost. Videos can also be developed to present findings and scenarios to decision makers.

BENEFITS

- The CAVE provides better communication of design intent than alternative types of presentations.
- A better understanding of fit-form-function and crew usability early in the design process.
- Full-scale dynamic visual lines of sight identify crew blind spots early, precluding future issues.
- Exploring alternatives early in design stage leads to better decisions and reduced cost.
- Detailed videos can be viewed anywhere and used for presentations, or as an official record.

DEFENSE RESEARCH AND ENGINEERING NETWORK (DREN)

TARDEC's DREN implementation is its official network for S&T and test-and-evaluation mission-related programs. It allows the group to apply commercial-off-the-shelf and in-house developed software for use on TARDEC, PEO and Army ground vehicle programs and initiatives that could not operate on other networks. TARDEC's DREN connects to other DREN locations, allowing access to their resources and providing S&T exchanges with our partners.

CAPABILITIES

TARDEC's DREN provides connectivity to the organization's High Performance Computing (HPC) Center, enterprise license servers, SILs, software development environments, Defense Supercomputing Resource Centers and other external DREN sites. Centralized administration and services allow the user to concentrate on performing the mission at hand instead of executing system administration and other IA duties.

BENEFITS

- Use of software/services that might not be allowed on the Non-Secure Internet Protocol Router Network (NIPRNET).
- More freedom to pursue state-of-the-art engineering and scientific endeavors.
- Connection to the DREN and other sites.
- Centralized services that eliminate user-level redundancies.
- Access to Defense Supercomputing Resource Centers for large, resource-intensive HPC analyses.
- Allows for a development environment of applications to be hosted on the NIPRNET or DREN.

HIGH PERFORMANCE COMPUTING (HPC)

TARDEC's HPC Center enhances research, development, engineering, testing and evaluation capabilities through state-of-the-art scientific and engineering computing. By aggregating computing power, the system delivers higher performance than a typical desktop computer or workstation could produce to solve large analytical problems. The HPC Center provides a full-spectrum, high-end computing environment for use on TARDEC, PEO and Army ground vehicle programs and initiatives.

CAPABILITIES

HPC assists in quickly providing decision makers required information within challenging timelines. The HPC Center houses two systems to provide unclassified and classified analysis capabilities. The systems allow for the creation and analysis of high-end physics-based models to provide a better (and sometimes the only) insight into complex, real-world issues.

BENEFITS

- Solving analytical problems that cannot be done or completed on time via desktop resources.
- Centralized support and management allows the HPC user to concentrate on the problem at hand and not on system operation.
- Separate classified and unclassified assets are available.
- Local administration allows for faster reprioritization of resources when needed.

SHAREPOINT

SharePoint is a collaboration tool maintained by TARDEC's Knowledge and Data Management (KDM) Group to facilitate knowledge sharing within the organization. SharePoint allows each team or project to maintain and customize its own site.

CAPABILITIES

- Provides the right people the right access to team, project, and organizational documents and data.
- Through the TARDEC Portal, quickly search and locate relevant information.
- Use OOTB (Out-of-the-Box) functionality; or build custom solutions. TARDEC-wide custom solutions include:
  - Portal announcements
  - Software request
  - Conference room scheduler
  - EMS (Environmental Management System) ISO 14001
  - LQMS (Lab Quality Management System)

BENEFITS

- Short lead time; new sites can be quickly setup and utilized.
- Robust permission model; configure who can read, edit and delete site content.
- Versioning and publishing; use standard features to track and control changes to a document.
- Integrate with other Microsoft products; including Excel, Access, PowerPoint and Outlook.
- Comprehensive search capabilities; including the ability to search within a document.
- Use workflows to collect feedback, approve documents or collect signatures.
- Users maintain their sites, allowing them full control of the content and the format that it is presented.
- Easily create and manage a variety of lists and libraries including tasks, issues, surveys, calendars, announcements, discussion boards, document libraries, picture libraries and slide libraries.
- SharePoint training provided to allow users to get up to speed quickly, with Continous Learning Points (CLPs) earned for taking the course.

KNOWLEDGE AND DATA MANAGEMENT

WINDCHILL

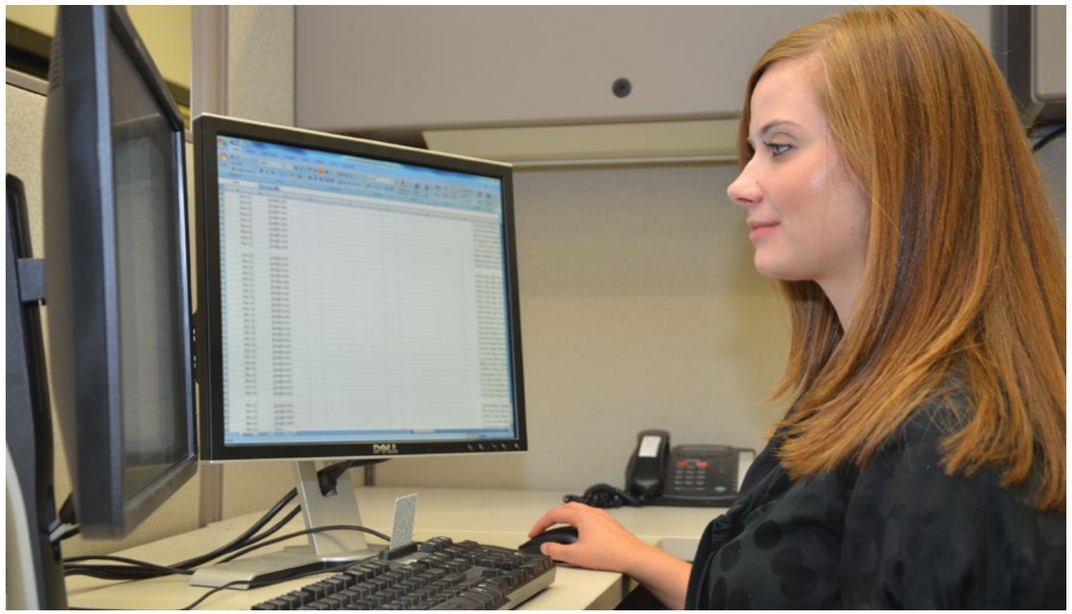
ProductLink is a product data and knowledge management tool maintained by TARDEC's KDM group to manage vehicle product data. Based on PTC Inc.'s Windchill, it allows users to maintain configuration management discipline, track progress and automate business processes. ProductLink is a data and knowledge management tool that allows users to create and maintain documents, view change history and provides routing options.

CAPABILITIES

- Configuration management includes parts, product structure, documents, CAD bills of material (BOM) with supporting documents, end item and multi-BOM management.
- Detail design (heterogeneous CAD data management).
- Change management and process workflows — engineering change proposals, engineering revision records and requests for deviation.
- Tech Loop — preparation of TDPs for secondary parts procurement and communication among participants through defined workflow.

BENEFITS

- Improved product quality through use of authoritative source of data.
- Reduced process errors and engineering rework through comprehensive change management with automatic documentation revision and iteration history.
- Web-based architecture to facilitate collaboration.
- Configuration management — creates and manages multiple product structure views.
- Best practice change management process to create, manage, route and track problem reports, change requests and change notices.
- Comprehensive product content management with securely vaulted product data, managed and associated product content, and embedded search engine for product-related queries.
- Business process automation and reporting using workflow-driven processes to automate and manage product development tasks.
- Pervasive visualization — easily identify parts by viewing thumbnail images.



CAD MODEL-BASED ENGINEERING

The CAD Model-Based Engineering Team is the lead TARDEC resource for 2-D and 3-D CAD and digital modeling. The team provides leadership in digitization technologies for developing new digitization processes, establishing in-house capabilities to produce digitized procurement technical data, and developing a repository of digitized drawings and models for life-cycle management of systems under development and existing legacy weapon systems.

CAPABILITIES

The team establishes best practices and standards for 3-D modeling, converts technical data packages from developmental-level to production-level, prepares 3-D solid models in multi-format CAD systems and supports engineering in making drawing or model changes. Technical data requirements can be written or reviewed for inclusion in statements of work and include contract data requirements lists, data item descriptions, standards, best practices and special data requirements based on PM and engineering needs. The team can also convert data between CAD formats, convert 2-D CAD data to 3-D, convert legacy data and provide clean raster drawings. It also provides support for review and validation of 3-D solid model submittals or geometric dimensioning and tolerancing (GD&T) analysis.

BENEFITS

- GD&T analysis improves manufacturability and eliminates potential interference conditions.
- Model-based definition eliminates discrepancies between models and drawings.
- CAD data can be used for M&S studies.
- Including CAD data in the procurement package supports advanced manufacturing and provides cost savings.
- Design and engineering changes can be incorporated in a timely manner.

CONFIGURATION MANAGEMENT (CM)

TARDEC's CM team manages the configuration data for DoD ground combat systems and combat support systems throughout their product life cycles. The team provides expertise and follows best practices as it supports the six CM principles: management, planning, configuration identification, configuration control, configuration status accounting and data management.

CAPABILITIES

The CM team helps customers define and implement an overall CM strategy by preparing or providing input for statements of work, contract data requirements lists, CM plans, systems engineering plans and data management strategies. The team establishes and manages engineering change proposal and deviation workflows, along with Configuration Control Boards. It releases product data through an Engineering Release Record, coordinates physical configuration audits, and supports Integrated Product Teams and the Product Data and Engineering Working Group for new or updated Army and DoD standards and policies. CM engineers use Windchill PDMLink as the product data management tool to build accurate product structures, record approved changes, manage user permissions and create reports for customers.

BENEFITS

- Establishes a high level of confidence in product information.
- Provides system configuration control.
- Establishes and maintains product baseline.
- Maintains data in appropriate product containers with access control for users based on customer requirements.
- Allows for competitive re-procurement of secondary items.
- Supports downstream use of reliable data for product improvements or engineering studies.

CORROSION ENGINEERING

TARDEC's Corrosion team provides expertise in vehicle design, manufacturing and sustainment for corrosion prevention and control. The team analyzes vehicle geometry, joint design, substrate material selection, coating selection and surface preparation/finishing. In addition, it provides ground vehicle storage solutions and support equipment to reduce corrosion impacts.

CAPABILITIES

The Corrosion team's engineering support spans the total system life cycle to include development of requirements for acquisition documents; upfront vehicle design evaluation to identify premature coating and corrosion failures; evaluation of full vehicle corrosion test data for defects; and guidance on various surface finishing technologies, such as phosphating, anodizing, powder coating, electrocoating, electroplating, CARC and pretreatments.

BENEFITS

- Reduces weapon system program life-cycle costs due to corrosion-related maintenance/component replacement.
- Improves life-cycle performance.
- Ensures compliance with DoD and Army corrosion policies.
- Assists with Environmental Management System compliance.

ENGINEERING COST REDUCTION TEAM (ECRT)

The ECRT provides a systematic approach to improving value in products, facilities, systems and services through the Value Engineering (VE) Methodology. ECRT also establishes VE criteria and provides guidance to TACOM LCMC organizations to meet annual VE goals.

CAPABILITIES

ECRT provides guidance to identify programs, projects, systems and processes that are most appropriate for VE studies. The purpose is to remove unnecessary costs while maintaining function and value in systems delivered to the warfighter. ECRT manages the TACOM LCMC VE Program and establishes VE goals for all TACOM LCMC organizations. ECRT can perform functional analysis on programs, projects, systems and processes, and is the VE point of contact for the AMC.

BENEFITS

- ECRT provides value to customers.
- Improves organizational culture in relation to managing cost.
- Provides communication across organizations.
- Offers guidance to help organizations understand complicated systems.
- Provides training in VE methodology.

ENVIRONMENTAL ENGINEERING

The Environmental Engineering team provides support to the TACOM LCMC community to ensure environmental compliance and weapon system conformance to various federal, state and local environmental regulations, as well as DoD policies.

CAPABILITIES

The Environmental team ensures that weapon systems meet DoD environmental requirements by participating in integrated product teams (IPTs). Support includes:

- Preparing programmatic environment, safety and health evaluations in support of milestone decisions.
- Hazardous materials (HAZMAT) management.
- Developing *National Environmental Policy Act* compliance documents.
- Developing environmental contractual requirements and general guidance on compliance with environmental policies and regulations.

The team also works with the Environmental Protection Agency to obtain National Security Exemptions for noncompliant engines, performs Class I Ozone Depleting Substance reviews, reviews specifications and system technical documents for environmental compliance, reviews upcoming environmental policies and regulations to minimize weapon system impact, and works with TACOM LCMC HAZMAT reduction depots.

BENEFITS

- Reduces weapon system program life-cycle cost due to environmental compliance and conformance.
- Reduces weapon system program schedule impacts due to participation in weapon system IPT.
- Reduces environmental contamination and disposal concerns due to HAZMAT management, reduction and elimination.

GROUND VEHICLE CABIN THERMAL SYSTEMS (GVCTS) LABORATORY

The GSPEL GVCTS Lab can test vehicle components, subsystems and systems in any natural environment and replicate induced conditions on vehicles. Seven environmental chambers in the lab, ranging from 30 cubic feet to 1,300 cubic feet, allow environment control from minus 90° F to more than 1,000° F, humidity control from 5–100 percent and solar load up to 1120 W/m2. The lab's layout allows multiple environment simulations simultaneously on any given system with close proximity for thermal shock testing of small to large components and systems. The lab contains air conditioning tool sets and equipment used in the field for vehicle systems.

CAPABILITIES

This lab provides complete life-cycle support for all ground vehicle climatic control, all auxiliary thermal systems and thermal aspects of components, ensuring Soldiers and equipment function safely in any region of the world. Environmental chambers evaluate component and subsystem integration and perform validation. Component and subsystem failures in the field are rapidly addressed by replicating controlled field-condition environments. Engineers use tools and equipment to evaluate counterfeit refrigerant, address issues and provide safe systems for Soldiers.

BENEFITS

- Simulated environments allow development, testing and troubleshooting throughout natural and induced environments on ground vehicle platforms.
- Field thermal issues can be addressed quickly with the ability to reconfigure different tests, given the lab's flexibility.
- Reduce and eliminate counterfeit refrigerants to increase ground vehicle safety, reduce required maintenance and mitigate potential environmental risks.
- The ability to run auxiliary thermal systems and vehicle components in controlled environmental conditions provides the Army complete life-cycle support for thermal systems.

GROUND VEHICLE POWER LABORATORY (GVPL)

The GVPL, located within the GSPEL, can test vehicle power generation systems up to 40kW, including multiple alternator/generator systems. Lab modularity allows configuration for up to three alternator/generator systems to run concurrently with electrical buses either separate or together. The lab can test a complete system installed in the vehicle, or on a test bench, under controlled conditions from minus 80° F to 250° F.

CAPABILITIES

The lab provides complete life-cycle support for ground vehicle onboard power generation and fielded electrical systems. Support includes development, testing, integration and troubleshooting for vehicle power generation and fielded electrical systems. Environmental conditions for each portion of an electrical system can be simulated simultaneously, up to four at a time. Electrical integration of the power generation system can be performed concurrently or prior to physical integration with the bench test area located adjacent to vehicle bays.

BENEFITS

- Integration, physical and electrical, of vehicle power generation systems is performed concurrently in a rapid-fielding program.
- Field electrical issues are addressed quickly to reconfigure different tests.
- Vehicle electrical systems — including power generation — can be tested in relevant environmental conditions throughout the developmental cycle to ensure a system's technology readiness level will meet program requirements on schedule.
- The ability to run all portions of electrical systems on the vehicle, or on a test bench in controlled environmental conditions, provides a complete life-cycle support lab for vehicle power generation and electrical systems.

INDUSTRIAL BASE AND SUSTAINMENT ENGINEERING RISK MANAGEMENT

TARDEC's Industrial Base Engineering Team (IBET) provides support and strategy in resolving TACOM LCMC obsolescence and sustainment issues. The IBET collaborates with the PEOs and the Industrial Base Operations Directorate at the Integrated Logistics Support Center (ILSC). IBET investigates and resolves ground vehicle and equipment issues, works with the Diminishing Manufacturing Sources and Material Shortages (DMSMS) Team and interfaces with the commercial industrial base. IBET maintains the Visibility and Communication (VisCom) software tool to collect information on the TACOM industrial base, including TACOM National Stock Number (NSN) vendors and potential industrial supply base sources.

CAPABILITIES

Using VisCom and other data sources, IBET conducts Sustainment Engineering Risk Assessments on managed systems. These assessments identify emerging equipment obsolescence and supportability issues affecting readiness and operating costs, while providing equipment managers fact-based data to forecast resource requirements. After identifying an issue, IBET convenes a Risk Mitigation Board to consider potential strategies, select the path forward and engage TARDEC expertise. IBET strategically helps maintain a stable supply by identifying alternate sources, reclaim and refurbish opportunities and component redesign/reengineering. IBET can also reverse-engineer complex components to produce TDPs for future procurements.

BENEFITS

- Accurately forecasts industrial base risks.
- Reduces sustainment cost through proactive mitigation risks.
- Reduces downtime due to DMSMS issues.
- Stabilizes supply sources throughout sustainment.
- Reverse-engineered, government-owned, TDP reduces future sustainment risks.

METALLURGICAL LABORATORY (MET-LAB)

The MET-LAB can perform materials characterization for all types of metallic components and systems to any industry-specific or military standard.

CAPABILITIES

The MET-LAB contains instrumentation used in the characterization and analysis of materials at both the macro and micro levels. MET-LAB has the capabilities to measure mechanical properties, such as tensile strength and hardness, identify metallic particulates, and conduct chemical analysis for metallic materials at both the macro and micro levels. The MET-LAB can conduct both qualitative and quantitative micro-structural evaluation, such as microstructural phase analysis, grain size and grain texture. In addition, instrumentation can be used for manufacturing process development, characterization and process quality evaluation. The materials engineering staff can conduct failure analysis of components and characterization of welds to determine root cause of failures.

BENEFITS

- Reduce production cost by evaluating material and process quality, and offering recommendations for process improvement.
- Evaluate contractors' manufacturing process changes to assure product quality.
- Conduct failure analysis on all types of metallic components and systems, and offer design change recommendations; evaluate contractor design change recommendations.
- Support M&S efforts by determining material property data.

SECONDARY ITEM DATA MANAGEMENT

The Secondary Item Data Management Team provides technical procurement data support to the TACOM LCMC and the Defense Logistics Agency (DLA), and acts as engineering support liaison between TARDEC and the ILSC and DLA. The team also serves as the primary manager and coordinator for all technical procurement packages within TARDEC's functional areas. It develops and manages systems capabilities in the Tech Loop product data management process for TARDEC, Rock Island Arsenal, Edgewood Chemical Biological Center and Natick Soldier Systems Center.

CAPABILITIES

The Secondary Item Data Management Team uses the Tech Loop process workflow to develop and validate technical procurement packages and coordinate the package with other functional areas, such as packaging, quality, engineering, transportation and materials. As part of the Tech Loop process, engineering change proposals and other changes can be processed and implemented into the technical procurement package.

BENEFITS

- Ensures latest product data configuration is used to support spare parts procurement.
- Manages and controls workflow to ensure all functional areas provide input to procurement package.
- Provides a single focal point for engineering support.

STANDARDIZATION

The Standardization team is TARDEC's proponent for the Defense Standardization Program, ensuring that material requirements are effectively documented and communicated to support system acquisition and sustainment. The team promotes policies and procedures to implement parts management best practices, and helps qualify components that require long or complex evaluations that couldn't be completed during first-article inspection.

CAPABILITIES

The team specializes in helping to create product descriptions that define requirements and verification procedures. It can also facilitate and maintain other documents, such as defense standards. This team also conducts audits to verify that manufacturers requesting a qualified product approval have effective self-audit programs. Standardization associates also monitor and evaluate tests to determine whether a product or process meets qualification requirements. They also assist in identifying and selecting candidate parts to achieve parts commonality.

BENEFITS

- Develops specifications and standards to provide warfighters with interoperable systems, subsystems and components.
- Decreases logistics burden.
- Reduces total ownership costs and acquisition cycle times.
- Improves operational effectiveness for Current and Future Forces.
- Parts management programs improve interoperability, interchangeability, reliability, and availability of components and systems.

TIRE ENGINEERING GROUP

The Tire Engineering Group is DoD's center of expertise for ground vehicle tires. Tire Engineering provides technical support to various DoD customers regarding tires, wheels, run-flats, tire valves, tire tubes and flaps. The group also resolves field and obsolescence issues for a variety of components.

CAPABILITIES

The Tire Engineering Group investigates new technologies related to tires, wheels, run-flats and associated components. It manages and executes tire source approval and qualification process support for military and commercial tires, including test development and engineering support. The group worked with the tire and wheel industry to update the Military Tire Test Standard for qualification of additional tire sources for military vehicles.

BENEFITS

- Provides engineering support for tires, wheels, runflats, tire tubes and flaps.
- Provides tire source qualification testing management and execution.
- Manages tire lists of approved commercial tires for military applications and support qualifications for more than 160 NSNs.
- Manages lists of off-road tires for construction, material handling and earthmover applications.
- Resolves field and obsolescence issues for tires, wheels and associated components.

CREW STATION/TURRET MOTION BASED SIMULATOR (CS/TMBS)

The CS/TMBS is a high-capacity six-degrees-of-freedom test device. The simulation framework enables engineers to quickly obtain key data and information on vehicle/Soldier performance with high quality. The simulator employs a virtual environment with computer-generated imagery and displays, a digital audio system, crew station controls, real-time computational dynamics and a network for synthetic battlefield operations.

CAPABILITIES

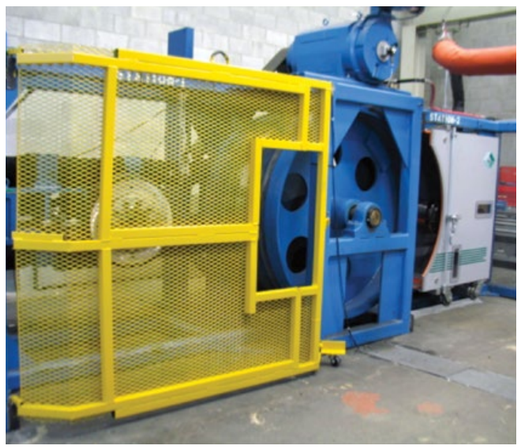
This simulator is capable of reproducing dynamic conditions encountered by combat vehicle crew stations and turret systems traveling on secondary roads and cross-country terrain. Battlefield environments are reproduced to study Soldier and vehicle-in-the-loop issues in an operational setting well before developmental testing.

BENEFITS

- Offers repeatability and control over variables difficult to manage at test centers and proving grounds.
- Provides gun turret drive characterization and control system algorithm development in a laboratory setting.
- Provides Soldier- and hardware-in-the-loop experimentation, plus power and energy management work for risk reduction.
- Provides studies of baseline versus modified in a quantitative fashion.

GROUND VEHICLE TIRE LAB (GVTL)

The GVTL consists of two tire test machines and software necessary to process experimental results. The lab features a walk-in environmental chamber capable of controlling temperatures of minus 60° F to 185° F and humidity of 20 to 95 percent.



CAPABILITIES

GVTL performs tire durability, run-flat device and road wheel experiments and determines physical characteristics without modification or disassembly to a degree of unparalleled accuracy. The GVTL can accommodate tires from trucks, trailers and road wheels to support M&S efforts for both military and industrial applications.

BENEFITS

- Conducts comprehensive tests of tire characteristics under a wide range of duty-cycle and environmental conditions, providing the most accurate simulation of real-world usage available in North America.
- Captures the resulting data for later use in computer M&S studies.
- To match GVTL's testing capabilities, a manufacturer would need to drive from Texas in August to Alaska in January, and back. Even then, the data captured would not be as comprehensive.

MISSION EQUIPMENT VIBRATION TABLE (MEVT)

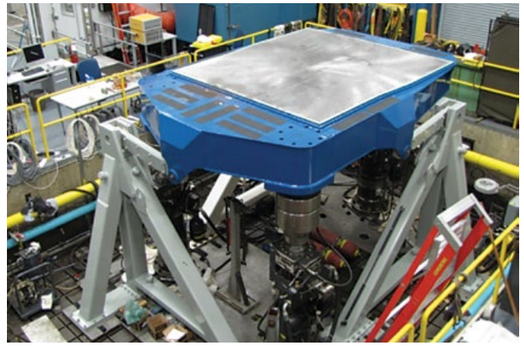
The MEVT is a powerful test rig capable of reproducing the most challenging terrains military vehicles would encounter in the field. The MEVT is designed to test components and subassemblies weighing up to 27,000 lbs. The MEVT helps reduce development costs, increase system reliability and durability and perform accelerated life-cycle tests.

CAPABILITIES

The MEVT features an advanced design capable of simultaneously applying force and motion in three degrees of freedom. The system is driven by voice coil servos that model correlations of frequencies up to 200 Hertz (Hz) with a maximum payload of 27,000 lbs. MEVT testing focuses on identifying failure modes early in the design process and applying design changes to prototypes prior to field testing. In the end, the field testing events serve as verification of the final design rather than failure mode discovery.

BENEFITS

- Dynamic qualifications of vehicle subsystems by applying single or multiaxial base excitation and identifying modal properties.



- Extensive range of application design to integrate early stage development with flexibility to provide meaningful information that will minimize cost, accelerate subsystem development and compress test schedules.
- Ability to induce high-frequency content for heavy subassemblies.

MULTI-AXIAL SIMULATION TABLE (MAST)

The MAST delivers an extensive array of testing applications providing rapid, flexible and reliable analysis for ground vehicle components and subassemblies. Using cutting-edge software, engineers work to reduce development costs, compress test schedules and perform accelerated life-cycle tests.

CAPABILITIES

MAST is an advanced hexapod design capable of providing simultaneous application of force and motion in all six degrees of freedom. MAST allows subsystem modal evaluations, design validation and optimization. The test stand can combine vibration testing with environmental effects by applying extreme temperatures of minus 70° F to 185° F and frequencies up to 500 Hz with a maximum payload of up to 500 kg.

BENEFITS

- Dynamic qualifications of vehicle subsystems by applying single or multi-axial base excitation to identify modal properties.
- Extensive range of applications designed to integrate early stage development with flexibility to provide meaningful information that will minimize cost and accelerate subsystem development.
- MIL-STD-810G Vibration Testing.

PINTLE MOTION BASE SIMULATOR (PMBS)

The PMBS is used to conduct durability and performance tests on lunette trailers. It provides motion and force inputs to the test trailer's tires and lunette to reproduce dynamic conditions experienced at proving grounds. The PMBS fatigues the trailer the way a field test would, but under controlled laboratory conditions.

CAPABILITIES

The PMBS is designed to impart motion to an attached lunette trailer with the ability to conduct durability and performance tests on whole trailer systems. It moves the trailer lunette in three independent directions (vertical, longitudinal and lateral) while simultaneously providing vertical input to the trailer tires. The PMBS can accommodate trailers up to a gross vehicle weight of 20,000 lbs. and impart forces to the testing specimen via a bellcrank and strut arrangement.

BENEFITS

- Laboratory trailer testing offers the repeatability of dynamic events, and can eliminate performance variables such as weather conditions, driver variability and course maintenance.
- Extensive range of application design to integrate early stage development with flexibility to provide meaningful information that will minimize costs, accelerate development and compress test schedules.
- Provides a high-fidelity, multiaxial simulator that provides experimental test conditions for finite element analysis.

PROFILOMETER

TARDEC's profilometer is a laser scanning system mounted on an M1097A2 HMMWV to measure terrain height, versus distance. Measurement is made using a scanning laser, sampling a 4.4 m-wide swath in front of the HMMWV with a resolution of 940 data points at 1,000 Hz. By driving the profilometer at 10 mph, a forward sampling rate of 1 scan line (940 points comprising 4.4 m) per 5 mm is obtained.

CAPABILITIES

The profilometer is capable of a 4.4 m-wide scan with accuracies at 10 mm global and 1 mm local resolution. It can measure baseline test courses and off-road terrain, and enable course maintenance. It can produce output in root-mean-square, wave number spectra and graphical plot fashion.

BENEFITS

- Use of test course fidelity in laboratory tests.
- Categorization of test courses to meet program manager testing needs (primary and secondary roads, trails, cross-country).
- Allows standardization between various test centers in course characterization.
- Verification, validation and accreditation of software models, leading to improved accuracy.

RECONFIGURABLE N-POST MOTION BASED SIMULATOR (RNPS)

The RNPS conducts durability and performance tests on whole vehicle systems and fifth-wheel trailers. Vertical motion and force inputs are provided to reproduce dynamic conditions experienced at proving grounds. This allows for fatigue testing equivalent to a field test, but under controlled laboratory conditions.

CAPABILITIES

The simulator's analytical capabilities include fatigue damage estimation, statistical time history editing and cycle counting analysis. It can also subject full vehicle systems to temperature ranges of minus 60° F to 185° F, with humidity levels up to 95 percent. The control methods allow the matching of simulator output to displacements and accelerations measured from the field.

BENEFITS

- Observation of test specimens in motion allows the test engineer to evaluate the vehicle negotiating difficult or problem-causing terrain.

- Controlled environment for repeatability of previous test conditions, eliminating changes in motion due to time, the driver and weather or other test parameters.
- Reduces duration by removing non-damaging portions of a test schedule. Time and cost can be minimized while maintaining the severity of the test.

RIDE MOTION SIMULATOR (RMS)

The RMS is a simulator designed for crew station and man-in-the-loop experimentation. The simulator immerses users in a synthetic battlefield to experience realistic ground vehicle dynamics. It has integrated motion, audio and visual systems for high-fidelity real-time simulation. Simulation framework enables the Ground Vehicle Simulation Laboratory to obtain key data and high-quality information on Soldier/vehicle performance.

CAPABILITIES

The RMS is capable of reproducing combat, tactical and commercial automotive vehicle motion with high precision using one of two reconfigurable crew station cabs. This environment allows researchers to customize the cab driver or gunner controls, rugged display monitors or vision blocks, seats, sighting devices and other cab scenario components.

BENEFITS

- Provides Soldier performance investigations of driver, commander and troop transport to improve their performance.
- Defines Soldier/vehicle use history during operations for power and energy trade studies.
- Conducts Soldier bio-dynamic response, plus seat and posture research.

ROBOTIC INTELLIGENCE DEVELOPMENT ENVIRONMENT

Robotic Intelligence Development Environment provides government and contract engineers a virtual environment to test algorithms for human detection, avoidance and autonomous behaviors. The tool began as a transition from the Future Combat Systems robotics program's M&S tool – MODSIM – developed to simulate the Autonomous Navigation System. The MODSIM tool was modified to allow for different autonomy systems to be integrated into the virtual environment. The virtual environment provides ground terrain, vegetation models, lifeform models, vehicle dynamics and various sensor simulations to stimulate the algorithms that determine robotic vehicle control and behaviors.

CAPABILITIES

- Real-time vehicle dynamics, capable of modeling both tracked and wheeled configurations.
- Configurable laser radar (LADAR) model.
- Stereo disparity sensor model.
- Global positioning satellite/inertial navigation system model.
- Millimeter wave radar sensor model.
- Scenario editor for configuring and starting simulations.
- Scripted entities, humans and traffic vehicles.
- High-level architecture interface available.

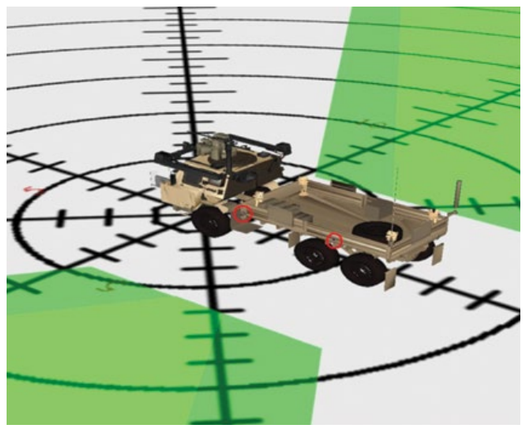
BENEFITS

- Support early testing of autonomous algorithms before target hardware is available.
- Eliminate testing variability with repeatable scenarios.
- Hundreds of virtual test runs help perfect autonomous system performance prior to field testing, allowing physical testing to focus on particularly problematic scenarios.
- Virtual tests decrease the need for extensive (and expensive) field testing, reducing overall program cost.
- Enable trade studies by varying sensor models and characteristics.

SENSOR VISUALIZATION TOOL (SVT)

The SVT is a camera vision coverage simulator used to determine the optimal placement of cameras to improve ground intercept, reduce overlap and increase local situational awareness. It has the capability to model video cameras, thermal imagers, infrared cameras and 360-degree cameras. As part of the vision coverage, the SVT identifies occluding objects such as antennas, armor panels and cargo.

Working in real-time, a designer can reposition and reorient cameras to find the optimal coverage as well as exchange cameras with different models for an A-B comparison. Instead of being manually controlled, the SVT links to simulations showing an external view of what the cameras see. It also has a demo mode to show a vehicle driving through a city.



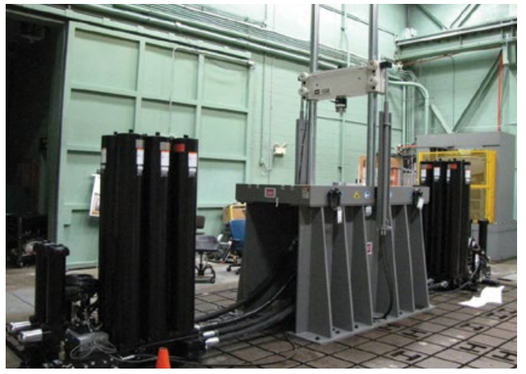
CAPABILITIES

- Analysis.
- Determine occlusions.
- Optimal placement.
- Ground intercept.
- Vertical intercept.
- Coverage gaps.
- Coverage overlaps.
- Dynamic viewing station for simulation experiments.
- Dynamic capabilities include: drive via waypoint,Distributed Interactive Simulation (DIS) interface and urban terrain.
- Specifications include: CAD Pro E, Open Flight and Open Scene Graph and others via conversion and desktop simulation.

BENEFITS

- Quickly determine situational awareness footprint.
- At run-time, reposition cameras to determine improved coverage and mounting locations.
- Calculate total viewable ground intercept area for a band "X" meters from the vehicle.
- Low cost, rapid turn-around capability.

SHOCK TEST EVALUATION MACHINE (STEM)



The STEM uses both durability and performance modes to determine the ability of shock absorbers or struts to withstand dynamic stress produced by transient waveforms. A key STEM characteristic, which exemplifies its one-of-a-kind nature, is its ability to achieve a minimum velocity of 5 meters per second at 20,000 lbs.

CAPABILITIES

The STEM was engineered to provide ultra-high force performance with accuracy and repeatability. It integrates the ability to provide damping characteristics or perform million-cycle durability tests on current heavy-duty vehicle shock absorbers and struts. STEM uses a sophisticated testing software suite to accommodate static or dynamic specimen side-loading, conduct friction force testing and measure seal friction and gas charge. It can also measure energy absorption mechanism properties for blast seats.

BENEFITS

- Accepts all forms of dampener systems used in the Army's ground vehicle fleet today.
- Conducts extreme velocity and force tests and evaluations on a fully integrated vehicle corner suspension system.
- Provides a flexible platform designed to accept special testing applications.

SUSPENSION PARAMETER IDENTIFICATION EVALUATION RIG (SPIDER)

The SPIdER accurately characterizes vehicle suspension systems without modifying or disassembling most vehicles, and can apply both static and dynamic inputs to accurately measure multiaxle vehicle systems.

CAPABILITIES

The SPIdER, which can accommodate military vehicles with track widths up to 110 inches and weights of 100,000 pounds per axle, is capable of performing three types of tests including bounce, roll and steering ratio. During each test, more than 70 transducers are used to monitor displacement, angles, forces and pressures.

BENEFITS

- Measures key vehicle suspension parameters to assist in predicting vehicle dynamic behavior so systems are less prone to rollover and offer better handling stability and performance on rough terrain.
- Provides necessary look-up tables and suspension characteristics curves for vehicle dynamic modelers.
- Performs trade-off studies that lead to better understanding of suspension performance.

TEST & EVALUATION (T&E) ENGINEERING SUPPORT

The T&E Engineering Support team provides engineering assistance to manage, develop and support integrated life-cycle T&E services at all stages of development, acquisition and deployment of assigned DoD ground systems.

CAPABILITIES

T&E engineers provide critical strategy to manage ground system test programs, including live fire, performance and reliability. The team mitigates risks associated with successful deployment of vehicles and weapon systems, while ensuring timely focus on user requirements.

BENEFITS

- Efficient and effective test programs (schedule and budget).
- Oversight approval of the T&E Master Plan.
- Testable and achievable requirements.
- Mature and interoperable systems and components.
- Operationally tested and approved systems.
- Coordination of the user, evaluator and contractor.

VEHICLE INERTIAL PROPERTIES EVALUATION RIG (VIPER)

The VIPER accurately measures system and subsystem inertial characteristics and center of gravity (COG) for trucks, trailers and turrets, generally without modification or disassembly. It consists of a configurable platform capable of rotating in roll, pitch and yaw, as well as the software necessary to post-process the results.

CAPABILITIES

The VIPER is capable of determining various parameters including vehicle COG, mass moments of inertia, total vehicle weight and roll/yaw mass product of inertia. The COG measurements are accurate to ±1 percent, the moment of inertia measurements to ±3 percent, and the weight and axle loads to ±0.5 percent. The VIPER is capable of measuring vehicles weighing between 1,500 and 100,000 lbs, and can accommodate vehicles up to 155 inches wide and 430 inches in length. Setup and test execution takes approximately three to five days.

BENEFITS

- Mass property measurements are an essential component for developing realistic dynamics models when solid modeling is not an option due to cost or availability.
- The VIPER directly impacts vehicle rollover analysis/prediction, vehicle stability/handling/ride, turret drive/control, transportability assessments, suspension tuning/design, vehicle data plate information, design trade-off analysis, durability and failure analysis, accident reconstruction and vehicle configuration change management.

VIRTUAL SYSTEMS INTEGRATION LABORATORY (VSIL)

The VSIL is designed as an environment that ensures the correct integration and intended functionality of vehicle electronics. It provides for complete system verification and validation of multiple vehicle configurations. The lab also serves as an avenue for post-production support, regression testing, man-machine interface/human factors development, training, future technology demonstration and rapid prototyping of proposed subsystems.

Currently, the SIL's M&S environment consists of a Semi-Automated Force (SAF) capability that allows for scenario generation as well as the population of simulated entities on a virtual battlefield. The environment also provides real-time vehicle dynamics for both the Mine-Resistant Ambush-Protected All-Terrain Vehicle (M-ATV) and Caiman virtual vehicles. The simulation protocols currently used in the SIL M&S environment are High Level Architecture (HLA) using the MATREX Federation Object Model and Distributed Interactive Simulation (DIS).

CAPABILITIES

- Real-time vehicle dynamics.
- Force feedback steering.
- Reconfigurable instrument panels.
- DIS/HLA compatible.
- Vehicular Integration for C4ISR/EW Interoperability (VICTORY) architecture compliant.
- MRAP visual and SAF.
- Populate SAF (red and blue) on Force XXI Battle Command Brigade and Below map.
- Controller area network data simulation.
- Sensor simulation including Remote Weapon Station Video Simulation and Sensor Control; Long-Range Advance Scout Surveillance System Video Simulation and Sensor Control; Driver's Video Enhancer Video Simulation; Check6 Video Simulation; and driver's out-the-window video simulation.

BENEFITS

- Test hardware/software interfaces in a repeatable laboratory environment.
- Work new technology integration issues and feasibility.

MANUFACTURING ENGINEERING

The Manufacturing Engineering Team (MET) works to reduce program risk by providing expert guidance and manufacturing technical support for TARDEC and TACOM LCMC programs. MET enables the development of novel manufacturing research technologies (MRL-2 to MRL-7) to facilitate the transition of the technologies to the PM or OEM. MET has strategic partnerships with industry, academia, OEMs and the organic government manufacturing base to define and develop manufacturing technologies that help the ground vehicle community support the warfighter.

CAPABILITIES

MET engages industry, academia and scans DoD to identify novel, best practice manufacturing processes and technologies. This knowledge is then disseminated by:

- Providing manufacturing support including design analysis review to PMs and for internal TARDEC programs.
- Providing manufacturing support to the arsenals and depots.
- Additive manufacturing research and engineering subject matter expert, including a powder/laser additive manufacturing cell.
- Contracting and project management expertise.

BENEFITS

- Reduces project manufacturing risk.
- Improves performance over the vehicle life cycle.
- Reduces cost through innovative technologies.

MANUFACTURING TECHNOLOGY (MANTECH) PROGRAM LEAD

The MET is the U.S. Army ManTech Program lead for TARDEC. The ManTech Program provides affordable and timely solutions by identifying and mitigating manufacturing risks within current and future technologies, systems and processes for the Army's ground vehicle domain.

CAPABILITIES

The ManTech Program develops technologies and processes for affordable production and sustainment of defense systems. Specific focus areas include:

- Reducing total ownership costs.
- Developing, maturing and transitioning key manufacturing technologies.
- Performing Manufacturing Risk Assessments (MRAs).
- Establishing existing MRLs.

BENEFITS

- Reduces manufacturing and project risk.
- Improves manufacturing efficiency and reduces life-cycle costs.
- Value Engineering (VE) support includes reverse engineering and manufacturing cost reductions.
- Enables TARDEC technology transitions through affordability improvements for targeted product builds.

PROGRAM SUPPORT AND ARCHITECTURE TEAM

The mission of the Program Support and Architecture team is to provide life-cycle SE support and guidance for DoD Ground Domain programs and architecture support to DoD programs as well as S&T projects. The team leads the planning, development, execution, and commonality of SE activities and products by leveraging SE expertise and best practices. This team supports numerous PEOs and PMs in the Army with matrix SE support personnel and the PMs, as well as TARDEC S&T projects, with architecture and modeling support.

CAPABILITIES/SPECIFICATIONS

The range of services and capabilities provided by the TARDEC Program Support team include knowledge and oversight of SE competencies involved with the PM, such as:

- Lead development, implementation and training of SE processes, such as: requirements, risk, configuration, data and decision management activities, including the implementation and use of applicable SE tools, such as:
  - Dynamic Object Oriented Requirements System
  - Project Recon
  - Integrated Systems Engineering Framework
- Lead Systems Engineering Plans (SEPs) documentation development activities between and during milestone gate decision points. Coordinate and align the SEP with other milestone documents and PM processes.
- Lead or assist with technical review event planning and execution. Ensure conformance to the SEP and Defense Acquisition Guide (DAG) guidelines. Coordinate assessments of these reviews with outside DoD agencies.
- Assist the PM with risk management processes by submitting technical risks as observed along with mitigations.
- Assist the PM's requirements development process as an active member of the Requirements IPT (or similar). Coordinate and assist with early TRADOC and Joint Capability Integrated Development process activities, support trade studies and add-on-armor (AoA) analysis, and assist in development of performance requirements refinement and output document development.
- Assist in defining program Critical Technology Elements and analysis of appropriate TRLs for the applicable stages of the program.
- Brief TRL achievement to Independent Review Teams involved in Office of the Assistant Secretary of the Army for Acquisition, Logistics and Technology (ASA(ALT)) assessments of TRL levels.
- Milestone documentation preparation and coordination activities.
- Contract Data Requirements List (CDRL) requirements definition and reviews.
- Source Selection Evaluation Board activities.
- Requirements, risk, configuration, data and decision management.
- Serve as IPT leads.

The range of architecture services, capabilities and support to PM programs and S&T projects include:

- Guide, facilitate and execute architecture development principles for PM programs and S&T projects, including the development of viewpoints and views that frame stakeholder concerns and commonality principles associated with the Ground System Architecture Framework (GSAF) Standard Product Classification Hierarchy (SPCH).
- Develop architecture models and abstractions in the systems modeling language environment that support S&T and PM program needs.
- Model and generate interface views and Interface description documents pertaining to key elements depicted in project and program system architecture models.
- Develop, model and/or check consistency of enterprise architecture and integration (including DoD Architectural Framework (DoDAF), Ministry of Defence Architectural Framework (MODAF) (Unitied Kingdom), and Unified Profile for DoDAF/MODAF (UPDM)) architecture descriptions and viewpoints for projects and programs.
- Provide consistent statement of work and CDRL contracting language relative to architecture contract requirements and deliverables. Interact with OEMs that are providing GSAF/SPCH deliverables to PM programs.
- Proliferate methods, tools and guidance among and between projects and PM programs so that architecture consistency is achieved.

BENEFITS

- Stay connected with technical planning for use of SE lessons learned, best practices, consistency initiatives, new processes and tools, and overall collaboration.
- Foster communication among and between PM or Joint Program offices and departments, such as engineering, test & evaluation, logistics, quality, etc., to ensure SE processes are implemented consistently.
- Collaborate and coordinate SE activities with outside program offices and DoD agencies.
- Stay up to date with new or changing DoD, DAG, ASA(ALT), Office of Secretary of Defense and Research Development and Engineering Command (RDECOM) SE-related policy and guidance. Consult with the PM on potential implications to the program.
- Help the PM office in day-to-day technical and operational activities as requested, keeping mindful of SE as these tasks are executed.
- Foster incorporation of SE competencies into the program.
- Foster communication among PM engineering offices or S&T project partners on matters pertaining to architecture and interfaces.
- Help establish interfaces among and between large S&T projects or demonstrators and smaller supporting S&T technical project capabilities.
- Provide a bridge between project requirements traceability and physical design.
- Provide high-level and lower-level analysis of derived and allocated requirements through use-cases and behavior modeling.
- Provide parametric analysis capabilities to inform AoA or trade space analysis.
- Facilitate PEO portfolio commonality analysis among PM platforms.

PROJECT MANAGEMENT

The Project Management team provides engineering support to TARDEC and matrixed support to multiple external customers. The team significantly advances the level of project management and team effectiveness within TARDEC and with customers through coaching, mentoring, skills training and demonstrated practices.

CAPABILITIES

The team provides qualified project management practitioners and SMEs for short- and long-term matrix support roles. Engineers conduct Kaizen and other types of problem-solving workshops to help customers solve specific team effectiveness-related problems and process issues.

Team members serve in advisory roles to individuals or teams looking to gain or improve project management skills.

BENEFITS

- Efficient and effective project management.
- Customer workforce trained and skilled in project management.
- Successful project execution through appropriate management tools and processes.

RELIABILITY ENGINEERING SERVICES

The Reliability Engineering Services group provides expert guidance and technical support in Reliability, Availability and Maintainability (RAM) program implementation throughout the acquisition life cycle for all ground systems and TARDEC S&T projects. The group serves as the TACOM LCMC focal point for RAM policy, guidance and methodology implementation.

CAPABILITIES

- Technical feasibility and affordability study of RAM requirements.
- Development of Reliability, Availability, Maintainability and Cost Rationale Report.
- RAM input to milestone documentations, includes TEMP, SEP and Acquisition Strategy.
- RAM input to scope of work, specifications and contract evaluations.
- Development and implementation of Reliability Growth Program.
- Contract Management of RAM design analysis activities.
- Design for reliability activities, including RAM allocation/predictions; reliability block diagram; failure mode and effects analysis (FMEA); failure mode, effects and criticality analysis; and fault tree.
- RAM testing, evaluation and assessment.
- RAM data mining and analytics.

BENEFITS

- RAM technical services support acquisition PMs in delivering an operationally effective and suitable system to warfighters. RAM engineering is an essential element to the overall systems engineering approach.
- RAM data mining and analytic capabilities inform Operations and Support cost reduction efforts for fielded systems through RAM improvement program.

REQUIREMENTS ENGINEERING AND ORSA

The Requirements Engineering and Operations Research/Systems Analysis (ORSA) Team enables better decision making through requirements analysis, traceability and verification. By building robust, scalable and adaptable solutions, the team responds to evolving needs and technologies.

CAPABILITIES

The Requirements Engineering and ORSA team assists with requirements development, management, analysis and decomposition, management tool infrastructure and training, and traceability and compliance reporting. The team excels in transforming requirements data into contracting required Performance Specification (P-Spec) documents, and is also available to provide co-located, full-time requirements managers or task-based services/support for the execution life cycle.

BENEFITS

- Elicits program/project requirements to clearly specify system needs.
- Provides requirements change impact analysis to trade assessments.
- Verifies/validates requirements compliance used to perform program gap analysis.
- Captures requirements baseline to trace program history.
- Provides concise requirements specifications delivered to system suppliers for successful acquisition.
- Shows compliance of acquired system-to-system needs traced to test results.
- Achieves commonality analysis by comparing requirements across multiple vehicle platforms within requirements management infrastructure.
- Reuses vehicle capability and requirements models and patterns for faster system acquisition specifications for future programs.

RISK MANAGEMENT TEAM (RMT)

The RMT provides and continuously improves life-cycle risk management capabilities, support, guidance and expertise for the DoD Ground Domain.

CAPABILITIES

Services include S&T programs and program of record support for risk identification, assessment, mitigation and monitoring, with the focus on implementing plans for prioritized program risks.

Risk managers advise and mentor program staff in policies, processes and best practices. They also lead the development of risk management plans, chair risk working groups, as well as facilitate risk review board meetings and support reporting.

Risk managers support the management of issues and work with program team members developing action plans. They also support the management of positive risks (opportunities) to improve programs.

Tools, process guidance and training provided by the RMT include: How to execute risk management; Project Recon; FMEA; and Technology Readiness and Technical Risk Assessment.

BENEFITS

- Help stakeholders understand risks and implement preventive measures.
- Maximize resource use.
- Minimize or prevent cost overruns, schedule delays and performance problems.
- Improve product and design quality.
- Promote teamwork and SE.
- Implement mitigation plans for risks and corrective action plans for issues.

S&T PROJECT SUPPORT TEAM (PST)

The S&T PST provides life-cycle SE support and guidance for DoD Ground Domain S&T projects. By leveraging SE expertise and best practices, the team conducts the planning, development, execution and commonality of SE activities.

CAPABILITIES

Knowledge and oversight of SE competencies involved within S&T projects include:

- SE processes development, implementation and training.
- Overarching requirements, risk, configuration, data and decision management guidance.
- Expertise in early needs analysis process activities.
- Technical review planning and execution.
- Project plan documentation development.
- TARDEC Gated Evaluation Track (TARGET) guidance and coordination on SE activities.

BENEFITS

- Knowledgeable of best practices, consistency initiatives, new processes and overall collaboration.
- Fosters communication between departments for S&T projects.
- Remains up-to-date with new or changing policies and guidance.
- Assists with S&T projects in technical and operational activities.
- Fosters the incorporation of SE competencies into S&T projects.

QUALITY ASSURANCE (QA) SERVICES

QA provides expert guidance and technical support in program implementation for all ground systems throughout the acquisition life cycle, and for S&T projects. This area serves as the Detroit Arsenal's focal point for QA policy, guidance and methodology implementation.

CAPABILITIES

- Facilitates corrective action for quality deficiencies in the field via the Product Quality Deficiency Report (PQDR) process.
- Provides quality management support to PMs.
- Provides QA support to the spare parts acquisition process.
- Works with the National Maintenance Program to monitor Source of Repair sites.
- Provides QA support to depot recap/reset programs.

BENEFITS

- QA technical services support the Acquisition PMs and ILSC Item Managers procuring spares. The group ensures products and services conform to performance and technical requirements, and satisfy the customer's life-cycle needs.
- The PQDR system is the Army's recognized feedback loop for products in the operations and support life-cycle phase.
- The system requires deficiency reports on new or newly reworked government-owned products that do not fulfill their expected purpose, operation or service.
- PQDRs can be submitted by depots, contractors (government-furnished equipment), field units and other services, and lead to corrective action.
- QA review of Procurement Work Directives for spares provides critical warfighter support, ensuring system readiness and operational effectiveness.
- Policy and methodology implementation leads to consistent practices across the TACOM LCMC and leverages lessons learned in training.

ENGAGE WITH TARDEC

The U.S. Army Tank Automotive Research, Development and Engineering Center (TARDEC) develops and integrates the right technology solutions to improve Current Force effectiveness and provide superior capabilities for the Future Force. Our technical staff leads research in ground systems survivability, power and mobility, intelligent ground systems, force projection and vehicle electronics architecture.

TARDEC employs several key mechanisms to leverage investments in technology research and development (R&D) and initiate shared technology programs. The organization is keen to partner with industry, academia and other government agencies to harness new technologies for emerging systems, integrate new energy and propulsion alternatives, reduce operating and maintenance costs of fielded systems and ensure that our Soldiers have the best performing, most reliable and easiest to maintain ground vehicles in the world.

In order to solve TARDEC design, development, manufacturing and product technology gaps, as identified in our 30-Year Strategy, TARDEC offers a variety of opportunities to create partnerships to accelerate the delivery of new capabilities and avoid unnecessary capability development costs.

COLLABORATE WITH TARDEC

Advanced Vehicle Power Technology Alliance (AVPTA) is a joint technology R&D partnership between the Department of the Army and the Department of Energy (DoE). The AVPTA welcomes concept papers and proposals in energy efficient vehicle technology. Submit your concept papers and proposals through the DoE Vehicle Technologies Office or Incubator Funding Opportunities Announcements online at the Federal Business Opportunities (FedBizOpps) website.

Michigan Army National Guard (MIARNG) and TARDEC have a Memorandum of Understanding (MOU) that provides a forum where issues related to the development and improvement of military and commercial equipment are discussed and acted upon. Additionally, this forum was created to support the coordinated and collaborative development and improvement of U.S. Army military and commercial equipment for potential use by all military services.

High-Efficiency Truck Users Forum (HTUF) is a TARDEC National Automotive Center funded program that brings truck original equipment manufacturers (OEMs), suppliers, fleets and other industry stakeholders together to ensure commercial product offerings are capable of meeting high-efficiency military requirements. Two working groups within HTUF are focused on military OEMs and suppliers interested in working more effectively with Army technology planning and procurement staff. The **Military Truck Action Group (MTAG)** and **Commercial Truck Action Group (CTAG)** allow maximum industry engagement by keeping members informed and updated on key industry issues and providing opportunities to weigh in on direction and priority.

Automotive Research Center (ARC) is a university-based, U.S. Army Center of Excellence in Modeling and Simulation. TARDEC manages the center in partnership with the University of Michigan, Clemson University, Oakland University, University of Iowa, Virginia Tech University and Wayne State University. The ARC Executive Committee, composed of government and university principals, selects basic and applied research projects each academic year based on current Army and TARDEC needs. Bi-monthly research seminars and an annual program review are conducted to peer-review projects, provide feedback to researchers, and ensure research projects meet cost and performance objects and align with TARDEC's 30-Year Strategy.

Small Business Innovation Research (SBIR) is a competitive awards-based program that taps small business innovation and creativity to help meet TARDEC's R&D objectives and develop technologies, products and software that can be commercialized.

Cooperative Research and Development Agreements (CRADAs) are established between federal laboratories and commercial, academic or nonprofit partners to facilitate technology transfers between the parties for mutual benefit.

Education Partnership Agreements (EPAs) encourage institutions to enhance study in scientific disciplines at all levels of education.

Patent License Agreements (PLAs) between federal labs and non-federal organizations allow for the use of government-owned or assigned patent applications, patents or other intellectual property.

Test Service Agreements (TSAs) allow federal laboratories to perform work for hire.

COMMUNICATE WITH TARDEC FOR PURPOSEFUL ENGAGEMENTS

Ground Vehicle Gateway (GVG) invites industry, academia and other government agencies to share ideas that can help TARDEC to develop, integrate and sustain advanced manned and autonomy-enabled ground system capabilities for the Current and Future Force in accordance with TARDEC's 30-Year Strategy. Full details about the 30-Year Strategy, along with a link to GVG submission forms, can be found on the TARDEC homepage at: *http://www.army.mil/tardec*

TARDEC Website: http://army.mil/tardec

Connect with TARDEC -- Industry, academia and government agencies can submit ideas and inquiries through the Ground Vehicle Gateway on the TARDEC website.

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