

TARDEC 30-YEAR STRATEGY VALUE STREAM ANALYSIS

11 July 2014



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Lingo:

Lines of Effort Lines of Effort (LoE's) are strategic thrust areas within each value stream. Collectively the roadmaps for each LoE layout the path to achieve TARDEC's 30 Year Strategy.

VALUE STREAM 1 (VS1): Purposeful investments in leap-ahead technologies and integrated systems

VS1 Lines of Effort

- Autonomy-Enabled Systems
- Protected Mobility
- Ground System Architecture
- Power Density and Energy Efficiency

VALUE STREAM 2 (VS2): Purposeful investments in the development, integration and transition of technologies that address specific PM needs

VS 2 Lines of Effort (Evolving)

- Improve SWaP-C Margin Analysis
- Reduce Life Cycle Costs
- Develop New Capabilities for Current Systems

VALUE STREAM 3 (VS3): Purposeful investments in TARDEC's engineering enabling capabilities to provide world-class support to internal and external customers

Lines of Effort

- Engineering Services and Support for Ground Systems
- Field Support and Secondary Items

Capability Demonstration Capability Demonstrations (CD's) are high-level, cross-organizational, integrated demonstrations of new ground system capabilities, designed to influence the requirements of future Programs of Record and drive the study of future operational capability. **It is how we communicate with TRADOC in their terms.** Focus is on capability, not technology.

Capability Demonstrators Identified to date:

- CD 1 – Combat Vehicle Prototype activity (Next Gen Powertrain, Vehicle Architecture, APS/Active Survivability)

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- CD 2 – JOEI Modeling Tool, Black Water Treatment/Gray Water reuse, and water quality monitoring.
- CD 3 – Demonstrate an enduring, operationally relevant, air-droppable, mobile protected firepower (MPF) ground vehicle capability.
- CD 4 – Medium/Heavy Duty Tactical Truck Demonstrator, LW Modular Vehicle, ONR Modularity Study.
- CD 5 – Develop unmanned vehicles capable of maneuvering with mounted and dismounted units.
- CD 6 – Achieve ground system integrated 360° situational awareness capability at extended distances from the platform, in order to enhance Soldier safety and ease the Soldier's burden
- CD 7 – Develop robotic technologies and capabilities that expand the operational capabilities of a Brigade Combat Team (air/ground teaming)
- CD 8 – Demonstrate ground vehicle architectures and technologies designed to allow the vehicle to function "as a member of the squad."
- CD 9 – Demonstrate robust ground vehicle architectures and technologies designed to operate offensively and defensively in "dirty", complex and antagonistic electromagnetic and cyber environments (cyber and electronic warfare)
- CD 10 – Demonstrate ground vehicle architectures and technologies designed to assist in the detection, location, identification, compilation, threat assessment, prioritization and neutralization of enemy human, mobile, terrestrial and airborne C4ISR collection assets and sensors (counter C4ISR).
- CD 11 – Demonstrate ground vehicle technologies and architectures designed to provide novel, unconventional and multi-modal mobility applicable to a broad spectrum of environments.
- CD 12 – Develop robotic technologies and capabilities that enable unit resupply and sustainment operations using optionally-manned and unmanned vehicles.

Ground Vehicle Power and Mobility

Al Grein AD-GVPM

The Ground Vehicle Power and Mobility (GVPM) group develops solutions meeting customer needs for mission-capable combat and tactical vehicles that operate reliably in any environment. GVPM provides technical support to customers, other TARDEC teams and government agencies in many vehicle power and mobility systems.

Advanced Combat Engine - Design and develop a novel 1500 hp Military Engine to meet mobility needs for heavy combat vehicles. This engine will provide an order of magnitude in energy efficiency while increasing power density, improving vehicle mobility, reducing fuel consumption and thermal loads. Leap-ahead technology in the engine to buy-back vehicle mobility and performance lost due to increasing weights and on-board power demands.

EXISTING CONTRACT ACTIONS FY14-19:

- Three year Contract w/ two x 1 year contract options for integration and testing;
- Follow-on effort to design, develop, and test a leap-ahead engine technology to achieve a 1500 hp advanced combat engine at TRL 6 offering high power density, high efficiency and low heat rejection

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Advanced Combat Transmission - Research and develop an efficient, reliable transmission that will dramatically improve the energy productivity of existing military ground vehicles while increasing power density, improving vehicle mobility, reducing fuel consumption and thermal loads, targeting heavy combat vehicles.

OPPORTUNITIES FY15-19:

- Three year contact with two x 1 year contract options for test and integration;
- An Open Competition to design, develop, and test an advanced transmission offering high installed power density, high efficiency and low heat rejection at TRL6

Integrated Starter Generator - Address onboard electrical power needs of Army combat vehicles (Stryker/CVP). Current vehicle alternators provide 10-20kW; inline generators under will provide 100-160kW of high voltage electrical power. Buy back power margin, allow for future capability growth. Increase efficiency (save fuel), augment mobility, allow export power.

EXISTING CONTRACT ACTIONS

- **FY13** - APOP Stryker SIL Integration;
- **FY13 & FY14** - APOP Stryker Vehicle System Integration, Development Support & TEC-D 4A upgrades;

OPPORTUNITIES

- **FY14** - Competitive contract for 85 oC capable Inverter for risk mitigation of SiC CVP Inverter;
- **FY15** - ISG modifications for 105oC operation;
- **FY16** - Purchase of additional ISGs;
 - SIL Development;
- **FY17** - ISG modification based on results of component test;
 - Inverter upgrades based on results from environmental testing;
- **FY18** - ISG advanced powertrain integration;

Advanced Thermal Management System (ATMS) - Develop, mature and integrate advanced cooling technology components/sub-systems/controls to improve efficiency and reduce parasitic power consumption in all modes of vehicle operation to evaluate advanced components and optimize performance.

OPPORTUNITIES

- **FY14:** - CRADA: Partner with Industry to test and evaluate advanced cooling components; Industry Partner TBD (12 months)
- **FY15 – FY19:**
 - Mature ATMS design; (FY15-FY16);
 - Three year contact with two x 1 year contract options for test and integration. Design, build, test and integrate fan system;

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Advanced Li-Ion Modular Batteries (Gen 2) - Apply recent advances in Lithium-ion based anode, cathode, electrolyte and separator battery materials to electrode, cell, and pack designs to:

- Double the energy density for the Gen 1 6T Lithium- Ion Battery from 80Whr/kg to >160Whr/kg AND
- Increase power density for Gen1 6T Li-ion battery by 50%.

EXISTING CONTRACT ACTIONS FY14:

- Development of prototype Gen 2 6T battery cells to demonstrate material performance;
- Development of prototype Gen 2 6T battery packs for demonstration material performance;

OPPORTUNITIES FY16-19:

- 1 year base effort for cell development with multiple options used for pack, TRL, and safety testing (SOW developed in FY15);

Advanced Auxiliary Power - Provide electrical power for ground vehicle main engine off operations. Develop a compact, scalable Auxiliary Power Unit (APU) to provide sufficient power while meeting space and weight requirements

EXISTING CONTRACT ACTIONS FY14:

- B-Series Engine Component Development, Oil Performance Testing, Engine Controls Development;
- Phase II SBIR to develop a high pressure fuel injector designed specifically for direct injection rotary engine use;
- C Series Engine design, oil system optimization, integrated engine control unit development, and engine hardware procurement;
- Procure Engine-Generator Test stand;
- Develop and test engine hardware procured in FY13 (22 months);
- FY15 – FY19 Contract Award - (1 year with four x 1 year contract options):
- FY15 - 18 month effort to mature engine design based on FY14 contract test results and increase TRL, begin APU design;
- FY16 - Option #2 - 24 month effort to build second APU, complete thermal analysis, developmental testing;
- FY17 - Option #3 - 24 month effort to retrofit two Gen. 2 APUs, complete TRL 5 testing;
- FY18 - Option #4 - 18 month effort to retrofit two Gen. 3 APUs, complete final shakedown;
- FY19 - Option #5 -12 month effort to support TRL 6 and integrated vehicle test;

External Suspension Unit (ESU) System - Develop a completely External Suspension system and alleviate effects of increasing GVW, such as degraded mobility and reduced ground clearance while providing for weight growth and optional height mngt with adaptive damping.

EXISTING CONTRACT ACTIONS FY14:

- Solicitation in process – no discussion allowed at this time.

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OPPORTUNITIES FY18:

- Fabrication of 2 x production sets of ESUs for Qualification on-vehicle system suspension test at YPG;

High Capacity Lightweight Truck - Reduce system weight through improved designs' Increase track system durability through advanced elastomer materials, Reduce rolling resistance to increase fuel efficiency, Augment track survivability through fire resistant elastomers.

OPPORTUNITIES

- **FY14:**
 - 1 year contract w/ 4 x Options;
 - Development of advanced elastomer compounds capable of increased durability
- **FY15:**
 - Option #1 (12 months);
 - Elastomer compound development & lab testing
 - Metal and elastomer component fabrication for testing
 - Rubberization and assembly of components
- **FY16:**
 - Option #2 (12 months);
 - Fabrication of prototypes for Track Trailer test
- **FY17:**
 - Option #3 (12 months);
 - Fabrication of prototypes for Limited Durability (Proof of Principle) testing
- **FY18:**
 - Option #4 (12 months);
 - Fabrication of production representative components for Qualification testing – (2 Sets)

Identified Technology Gaps

- **Powertrain System Integrator**
 - Existing contracts in place address technological solutions separately; integrated solution necessary to meet the CVP requirement.
 - Award a contract to a single Powertrain Systems Integrator by the end of 1st QTR FY15 with technical depth in the optimization and integration of the separate CVP powertrain technologies.
- **Lighter Weight Systems**
 - 30% reduction in component and sub-system weights.
- **Heavy Combat Transmission (ACT)**
 - Transmission selection to interface with 1500 hp heavy combat engine is not definitively identified.
- **Power electronics (APU & ISG)**
 - Advanced silicon power electronics that can operate with coolant temperatures greater than 95OC would reduce risk and improve system power density greatly
- **Turbocharger (APU)**

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- Engine design requires high pressure ratio (2.1 to 3.0) at relatively low flow rate (less than 10 lbs/min)
- **Compliant Track Tensioner (ESU)**
 - Height management capability of ESU system will allow for adjustable road wheel height, causing variable track tension
 - Track Tensioner with a considerable amount of compliance needed to account for the track tension variation

Ground System Survivability

Jeff Koshko AD GSS

Design, develop and demonstrate state-of-the-art Ballistic Protection, Blast Mitigation, and Advanced Material Technologies to influence the next-generation of Infantry Fighting Vehicles.

Modular Active Protection System (MAPS)

Suzanne Culkin Deputy AD

Modular APS will allow commonality across the vehicle fleet, tailoring of systems to meet PM needs and platform constraints, provide growth capability to address emerging threats and facilitate transition

Products:

- Modular APS Framework (MAF) and interface standards
- Modular APS Controller (MAC) implementing the framework and designed with safety requirements
- Modular software to integrate subsystems for a specific platform capability
- MAF compliant sensor / countermeasure subsystem specifications
- End-to-End simulations of specific configurations for risk reduction analysis

Payoff:

- “Best of Breed” component flexibility
- Avenue for technology insertion of Industry and S&T subsystems
- Designed for safety / shorter transition times
- Potential component commonality between vehicles
- Subsystem competition and associated cost savings

FY14-FY19: Modular APS Framework - Development and refinement of the Modular APS Framework (MAF), Multiple Requests for Information (RFI) and execution of regular and event driven industry forums for coordination

Purpose:

1. Compile information on APS Architectures and Subsystems to develop MAF objective requirements that will enable future growth
2. Capture data on existing Subsystems to populate databases and inform data driven decisions for Soft-Kill and Soft-Kill/Hard-Kill Demonstration Efforts

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OPPORTUNITIES:

- **FY14: Modular APS Controller** -*Request for Proposal (RFP)* for Requirements Analysis and Design Trade Studies supporting Modular APS Controller (MAC) development
- **FY15: Soft-Kill Demonstration** - Subsystem IPTs release *competitive RFPs (Sensor and Countermeasure)* for Soft-Kill demonstration of MAF/MAC
- **FY16: Soft-Kill/Hard-Kill Demonstration** - Subsystem IPTs release *competitive RFPs (Sensor and Countermeasure)* for Hard-Kill demonstration of MAF/MAC
- **FY19 and Beyond:**
 - Government will maintain configuration control of MAF and MAC
 - MAC TDP available to vehicle PMs as a possible foundation to an APS
 - TARDEC MAPS SIL established to provide assessments of vehicle system integration of MAPS configurations through Verification and Validation (V&V) of Sensor and Countermeasure subsystems

Industry IR&D and Government S&T continue to advance the state-of-the-art in subsystem capability that can be evaluated, integrated and transitioned via the framework and controller

Sensors

Passive Technology

- Mid-wave IR sensor array development, uncooled PbSe Focal Plane Array (FPA)
- Band Notch exploitation development
- Wide angle optical lens development (decrease number of sensors to meet requirement)

Active Technology

- Active Electronically Scanned Array (AESA) cost reduction development
- APS concept development to leverage strengths of staring radar technology

Countermeasures Maturation, miniaturization, effectiveness

- Improve probability of defeat for expanded angles and elevations
- Reduce and understand “crush-up” phenomenon
- Reduce cost (complexity) / Operational Issues (environmental)

Army Vehicle Light Weighting Campaign

Lynne Kogsgrud Dep. AD

Demonstrate best practices in affordable, multi-material design structures, reduce ground vehicle weight, utilize & evaluate advanced materials, manufacturing, and assembly technologies to develop a lightweight structure. Demonstrate weight savings >10% over GCV baseline. Evaluate current technical capability of material supply chain.

Products: Affordable Lightweight demonstration structure, able to support ballistic and blast requirements. Updated production cost models providing; lighter weight vehicles, increased fuel economy, increase reliability, and increased Space-Weight-Performance-Cost metrics

Key Component: Materials & Manufacturing processes (incl. Joining) - Lightweight materials cost prohibitive due to production costs and/or replacement costs (if vehicle is damaged). Joining multiple materials into a structural joint can also be difficult.

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- Plan to Approach: Identify commercially available, cost effective, lightweight materials, and joining processes to enable utilization of multiple materials throughout the structure. RFI release in FY14 will cover ALL material/mfg aspects.
- Anticipated to Contract: FY14-17

Key Component: Upper Hull & Turret - Reduce structure weight by at least 10% from current baseline at current performance levels. Components must integrate armor packages and additional vehicle system components including main armament, crew safety equipment, etc. which could require localized reinforcements.

- Plan to Approach: Identify and collaborate w/industrial partners to maximize use of proven assembly and integration hardware; tailor design to meet robust ballistic & blast requirements.
- Anticipated to Contract: FY15-19

Key Component: Lower Hull - Reduce weight by 10% over baseline and provide elevated blast performance. Lower hull must integrate w/suspension components, upper hull, and additional crew safety equipment; may require localized reinforcements.

- Plan to Approach: Leverage lessons learned from “Heavy Combat” Blast project and collaborate w/industrial partners to maximize use of proven manf. and joining methods.
- Anticipated to Contract: FY15-18

Key Component: Vehicle Components Light-weighting - Estimated 3-5% weight savings can be achieved by lightening miscellaneous vehicle components such as torsion bars, light fixtures, fasteners etc. MORE savings expected from larger components.

- Plan to Approach: Utilize internal and external analysis to identify component weight removal opportunities.
- Anticipated to Contract: TBD. Significant Opportunity For Industry to Help Solve this Complex Issue

OPPORTUNITIES:

- FY 14: Release RFI to gather information on materials, manufacturing technologies, modeling & simulation analysis methods/tools for high strain rate and complex load path analysis, design options for structures.
- FY15-19 Modeling & Simulation Development for ballistic loading (incl. structure/joints)
 - Provide advanced material research and M&S software enhancements, engineering support services
 - Material / Hardware Purchases
 - Metals and composite material purchase and fabrication
 - Test & Evaluation Services
 - Provide physical test capability (MIL-810) coupon and sub-system level, environmental testing
 - Sub Component / Structure Fabrication (test elements)
 - Structural joints, load beam test elements
 - Vehicle analysis to identify high-payoff component level weight opportunities

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Existing Contracts / Mechanism:

- University of Delaware Center for Composite Materials (Multi-year contract)
- Michigan State University Composite Vehicle Research Center (Multi-year/ Coop Agree)
- Lightweight Modern Metals Manufacturing Innovation (LM3I) Institute. Government / Industry cost share (www.manufacturing.gov)

CVP Affordable & Lightweight Vehicle Structure RFI due in 2014

- o Utilize commercial and academic resources; novel manufacturing techniques
- o Materials and hardware purchases will be competitively bid and awarded
- o Full scale structure fabrication for the lower hull, upper hull and turret will be competitively bid and awarded
- o M&S support for the entire structure will be competitively bid and awarded

Ballistic Protection - Leverage current investments in combat vehicle armor to develop, mature and integrate lightweight base, add-on, electrified, and adaptable armors. Mature and test Pulse Power system to enable electrified armors. Mature advanced armors into integrated armor solutions while maintaining performance, decreasing weight, and maintaining cost.

Foundational Ballistic Protection Program - Leverage current armor mechanisms, with new materials and design approaches to achieve a 10% weight reduction in integrated vehicle armor protection. Develop, mature, integrate, and transition TRL 6 modular armor systems to combat vehicle PMs and OEMs

Advanced Ballistic Protection Program - Advance state of the art armor defeat mechanisms to achieve a 15-20% weight reduction in integrated vehicle armor weight. Drive the development and maturity of non-traditional armor systems that take advantage of multiple defeat mechanisms. Develop, mature, integrate, and transition TRL 6 advanced armor technology systems to combat vehicle PMs and OEMs

EXISTING CONTRACT ACTIONS FY14:

- Multi-year contract with University of Delaware Center for Composite Materials, Development and fabrication of pilot scale automated armor manufacturing line;
- Pulse power supply component integration with BAE Systems;
- Ballistic Modeling & Simulation (M&S) code development with Southwest Research Institute
- Materials for prototype armor fabrication with various vendors

OPPORTUNITIES (FY15-19 NEW COMPETITIVE CONTRACT(S))

- o Armor Material Purchases
- o Electronic Component Fabrication and Design
- o Modeling and Simulation Development
- o Test and Evaluation Services

Advanced Materials Development - Improved ballistic performance against both direct fire and fragmentation threats, increased damage tolerance, Development of high strain rate material properties, improved impact and damage resistance.

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Improved Manufacturing Processes - Significant cost reductions and improved manufacturing methods (e.g. polishing, grinding) of advanced ceramics, Methods that address seams, corners and other vulnerable areas.

Opaque and Transparent Armor for Tactical Vehicles- Significant cost reductions without performance loss, Decrease in haze; improved luminous transmission, Improved interlayer material for wide temperature range.

Blast Mitigation/Protection - Mature blast mitigation technologies through product development, integration and validation. Fully understand blast load paths through vehicle platforms by decomposing the load paths through each subsystem and subsystem interface.

Exterior Blast Mitigation

- Prevent catastrophic deformations in the vehicle hull that generate high floor loads resulting in occupant injuries;
- Reduce peak flooring accelerations;
- Determine evaluation technique;s
- Improve ground vehicle blast survivability while reducing cost and weight;
- Control the transfer of momentum to the vehicle cab under various threat loads;
- Determine system timeline for detecting/reacting to threat loads;
- Provide an electric signal to various blast mitigation measures (technologies) in an effort to reduce injuries to the Soldier;
- Reduce lower extremity injuries by controlling loads between vehicle cab and floor;

Interior Blast Mitigation

- Develop integrated interior system (seats, restraints, airbags, cargo retention and protective trim) to maximize Warfighter survivability.
- Design the interior space from the occupant outward for a system capable of minimizing injuries against underbody threats.
- Leverage knowledge gained from previous programs, industry, and emerging technologies.
- Inform the future requirements process through data accumulated during the maturation of these IBMT projects.
- Develop data to improve Modeling and Simulation of the effects of blast on interior occupants.

Blast Mitigation Blast Bucks

- Demonstrate integration and performance of blast mitigating technologies;
- Demonstrate Technical Readiness Level (TRL) 6 of Blast Mitigation technologies;
- Prevent occupant injuries and accommodate the central 90% of the 2015 Soldier population;
- Active Blast Mitigation Technologies: Event triggering for active hull, flooring, and seating systems;
- Smart Integration to ensure simplicity and performance;
- Solutions to minimize user error or interaction and maximize ease of use when necessary;
- Focus is to minimize physical testing using M&S where possible;

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EXISTING CONTRACT ACTIONS FY14:

- CAMEL demonstrator design and development;
- Exterior Blast and Hull seat testing;
- Floor instruments development;
- Airbag contract;

OPPORTUNITIES (FY15-19 NEW COMPETITIVE CONTRACT(S))

- o Exterior Blast Mitigation Technologies;
- o Advanced (active) and foundational blast mitigating underbody and flooring solutions to achieve a system TRL 6 for a combat vehicle platform;
- o Interior Blast Mitigation Technologies;
- o Blast mitigating seats to provide an energy management system against a range of sizes;
- o Utilization of airbags in traditional and non-traditional applications and develop military environment airbag test and evaluation methods;
- o Blast Bucks;
- o Demonstrate integration/performance of advanced technologies into sub-system/system level blast bucks to prevent injuries and accommodate 90% of the Soldier Population;

Blast Mitigation / Protection Identified Technology Gaps

Blast/Rollover/Crash Mitigation Technologies for Tactical Vehicles

- o Low profile underbody protection solutions for blast events;
- o Flooring solutions to mitigate lower extremity injuries and prevent binding of energy absorbing seat mechanism;
- o Development of energy absorption and robust steering columns to protect the occupant and accommodate an airbag;

Improved Manufacturing Processes for Hulls

- o Cost effective means to produce high performing hulls to protect against blast threats;

Lightweight Materials for Hulls

- o Development of lightweight metallic and composite materials or alternative innovative lightweight concepts that are cost effective;

Impact Abatement for Secondary Effects of Blast

- o Mechanism and technology development to control or protect against extremity injuries caused by flail of the occupant(s);
- o Development of easy to use solutions for containing gear/cargo/ammo, so they do not become flying projectiles during a blast event and cause harm to the occupants;

Blast Retrofit Solutions

- o Development and characterization of blast mats, floor tubs, energy absorbing resettable seats that accommodate 90% of population, hands-free restraint systems, energy absorbing flame retardant material to line vehicle interior to protect head and extremity injuries, decoupled underbody and flooring solutions;

Central Point Triggering

- o Development of universal triggering system to trigger all active systems on the vehicle;

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Force Projection Technology

Fred Balling AD

The Force Projection Technology area is the DoD's program for ground fuels and lubricants, and the lead DoD Lab for water supply and wastewater treatment. FPT provides the research, development and engineering support for all ground fuels and lubricants, water purification and handling, military bridging, material handling, mechanical countermine and counter-IED equipment.

EXISTING CONTRACT ACTIONS FY13-14:

- Work directive Southwest Research Institute (SwRI), TARDEC Fuels & Lubricants Research Facility (TFLRF);

OPPORTUNITIES FY15-16:

- o Work directive to TFLRF;
- o Complete development of axle efficiency and durability test.
- o Evaluate candidate products.
- o FY16 field demo of candidate products
- o Provide qualified products for procurement by DLA under revised performance specification (SAE J2360)

Black Water Treatment / Gray Water Reuse – (CD 2) Develop and integrate multiple technologies to produce compact, mobile, energy-efficient systems capable of rapid start-up that can treat black water to discharge standards and treat gray water to non-potable reuse standards

EXISTING CONTRACT ACTIONS FY14-FY16

- Blackwater treatment system based on modified activated sludge technology;
- Blackwater treatment system based on electrochemical technology;
- Blackwater treatment system based on bioelectric & fuel cell technology;
- Gray water treatment based on forward osmosis technology;
- Gray water treatment system based on ultrafiltration technology;

OPPORTUNITIES FY15-19

- o TECD4a Small Base Logistics Comparative Industry Demo (NSRDEC will announce FY15, demo FY16);

Water Quality Monitoring - Enable rapid contaminant detection and process verification for mobile water treatment and supply systems;

EXISTING CONTRACT ACTIONS FY14-17:

- SBIR, Phase II, Syntrotek Corporation, (Inline multi-parameter lab-on-a-chip);
- SBIR, Phase I, Award Pending, (Real-time inline wastewater monitoring);
- ARO Grant, University of California, Los Angeles, (Cell-phone cyst assay);
- Purchase Order, Award Pending, (Commercial autonomous water monitoring stations with telemetry).

OPPORTUNITIES FY 15-19:

- o Technology Enhanced Capability Demonstration (TECD) 4a Sustainability/Logistics-Basing;
- o Comparative Industry Demo (NSRDEC will announce FY15, demo FY16);
- o Man Portable Water Purification – Develop a system to produce 30 gallons an hour;

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OPPORTUNITIES FY16-19

- Advanced pretreatment process – Contract;
- High pressure pump with energy recovery – Contract;
- Design system in-house with advanced components;

Fuel Quality Surveillance - Develop technologies to enable fuels quality surveillance in minutes. Investigate: Light obscuration, light scattering, and ultrasound for contaminate detection; Infrared and visible spectrometry for CI/LI detection, and Near Infrared or Raman Spectrometry for the portable fuel analyzer.

EXISTING CONTRACT ACTIONS

- Portable Fuel Analyzer: Collaboration with DLA-E and Navy Research Laboratory, Phase III SBIR effort to Real Time Analyzers;
- Inline water and particulate test method & instrument evaluation: Southwest Research Institute (SwRI), TARDEC Fuels & Lubricants Research Facility (TFLRF);

OPPORTUNITIES

- Continuation of existing contractual efforts;
- Inline water and particulate prototype development;
- Inline Fuel Property Monitor;
- Planned SBIR for Fuel Additive Detection instrument;
- Transitions to PM PAWS in FY16 for potential procurement;

Multi Functional Bridging Technologies - Develop a single bridge system which can be reconfigured for use in all Bridging missions; enable User to adapt to any condition encountered at a gap site.

OPPORTUNITIES

- FY15 - Possible contract for small/scaled composite components for evaluation;
- FY16 - Contract(s) for component demonstrators;
- FY17 - Test support for demonstrators;

Force Projection Technology Gaps

- High pressure (740 psi) collapsible hose + coupling assembly;
- Real time measurement of all water quality parameters in EPA primary and secondary drinking water standards;
- For reverse osmosis systems, raw water pre-treatment that will produce a feed water of equivalent quality as membrane systems, but with the simplicity and robustness of media and cartridge filtration;
- For composite materials in bridging structures, understand repair-ability & long-term effects of the environment;
- Affordable composite material manufacturing techniques;
- Technology to enable rapid load engagement for MHE;
- Highly energy-efficient, specialized lubricants and surfaces that enable service-free components;
- Accurate volumetric fluid measurement for collapsible fabric storage tanks;
- Long-life, lightweight materials for collapsible fabric storage tanks;

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Ground Vehicle Robotics

James Parker AD

Ground Vehicle Robotics develops robotic technologies and robotic systems for manned and unmanned ground vehicles. GVR engineers work with the Robotic Systems Joint Project Office (RS JPO) to provide robotic technologies and engineering support for the joint service programs managed by the JPO. TARDEC works with RS JPO to develop Robotics Interoperability Profiles (IOPs), which define standards for modularity and common interfaces.

Dismounted Soldier Autonomy Tools (DSAT) - Develop a suite of autonomy tools to enable dismounted soldiers to operate unmanned vehicles. Develop an open and extensible kernel for ground vehicle autonomy ICW AMAS and IOP.

Opportunities: Capability Demonstrations (CD)

- CD 5 - Develop unmanned vehicles capable of maneuvering with mounted and dismounted units;

AMAS Joint Cooperative Technology Development (JCTD) – Will provide today’s military vehicles with an optionally manned capability to increase safety and added flexibility to meet mission requirements. AMAS will consist of:

- Vehicle kit to control the physical actuation of a vehicle called the By Wire Active Safety Kit.
- Common, appliqué autonomy kit that will contain the primary intelligence and autonomous decision making. The autonomy kit will be common across all vehicle platforms, and designed to function and inter-operate regardless of type of vehicle platform.
 - CD 6 - Achieve ground system integrated 360°situational awareness capability at extended distances from the platform, in order to enhance Soldier safety and ease the Soldier’s burden;
 - CD 7 - Develop robotic technologies and capabilities that expand the operational capabilities of a Brigade Combat Team (air/ground teaming);
 - CD 12 - Develop robotic technologies and capabilities that enable unit resupply and sustainment operations using optionally-manned and unmanned vehicles;

Areas of Investment:

- Common Interfaces and Architecture
- Military Robotics Software Library

Gaps That Industry Can Help Fill:

- Autonomous Testing Methodologies and Procedures
- Participate in the RS JPO Appliqué WIPT to define future IOP versions
- Intra-vehicle and Inter-vehicle interoperability
- Developing stable large vehicle formation control techniques across undulating terrains
- Long duration operations for small to mid-size UGVs
- Mobility to match dismounted squad
- High speed operation
- C-Kit (mission payload) development & interfaces
- ARIBO

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TARDEC Office of the Chief Scientist

Dr. David Gorsich, SES

The OCS exists to set the research direction for TARDEC, to leverage research through other Government agencies, industry and academia, and to nurture and develop TARDEC's scientific and engineering talent.

Army Center of Excellence for Ground Vehicle M&S Research

Automotive Research Center (ARC) – Collaborative research program, located at the University of Michigan, and including TARDEC, industry, and academia (UM, Wayne State U., Oakland U., Clemson U., Virginia Tech U., and University of Iowa)

Research Thrust Areas:

- Dynamics and Control of Vehicles
- Human Centered Modeling and Simulation
- High Performance Structures and Materials
- Advanced and Hybrid Powertrains
- Vehicle System Integration, Optimization, and Robustness

EXISTING CONTRACT ACTIONS

- M&S Research - ARC (Automotive Research Center);
- Academic Research Centers – CVRC (MSU), SIMBRS (Miss State), FAJRI (Oakland);
- Contractor support (Technical Writers, Researchers);
- Innovation Grants (Oakland, MIT, CDI, VSDC);
- FY14 SBIR/STTR contracts managed by TARDEC;

OPPORTUNITIES

- Access to past research products, and participation in setting new research directions;
- Industry Access to DoD High Performance Computing (HPC) resources for collaboration projects with TARDEC;
- Industry and TARDEC Joint proposal submissions to National Network for Manufacturing Innovation (NNMI), American Lightweight Materials Manufacturing Innovation Institute (ALMMII), Composites NNMI hub (DOE), MANTECH, etc.;
- Focused Advanced Technology Demonstration seed projects;
- Innovation Grants (TARDEC associates partnered with Industry);
- FY15 SBIR/STTR Contracts for Phase 1 and Phase 2;
- SBIR/STTR Topics will be posted in Nov-Dec 2014

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Analytics

Sudhakar Arepally, AD

The Analytics group provides system-level ground systems performance assessments to generate significant value for DoD using specialized computational M&S expertise, tools and processes.

Leverage Opportunities”

- High Strain Rate Material Testing, Modeling & ISV model development for steel, aluminum alloys
- Soil Charge Characterization
- Gen 1&2, PPE, and Vertical Drop models
- OCP-TECD M&S Modeling Products
- Vehicle Dynamics (Chassis/Suspension)
- Thermal Analysis
- Off Road Mobility (Track/Tire/soil modeling, Vehicle Dynamics, Powertrain M&S)
- Need for in-house technical services: (Structural analysts, Occupant Protection analyst, CAD modeler, CFD M&S analyst, Controls & sensor algorithm developer)

EXISTING CONTRACT ACTIONS (SBIR/STTR/RIF/BAA)

- Material Testing & Characterization
- Crew Protection Assessment tools
- Off-Road Mobility R&D
- Operations/Sustainment/Logistics

OPPORTUNITIES:

- Stochastic terrain & mobility;
- Particle method for underbody blast evaluation;
- Intelligent mobility (onboard/driver assist – steering/braking/etc);
- Operations/Sustainment/Logistics;

Projected future new CRADA opportunities:

- Light-weight structures Modeling & Simulation (FY15-FY19)
 - Composites, Light-weight alloys;
 - Weld/Fasteners/Joints (dissimilar material joining);
- End-to-End Mobility Modeling & Simulation (FY15-FY18)
 - Tire/Track and soil contact modeling;
 - Power-train/Chassis coupling modeling;
 - Advanced dynamics (sensors/controls driven) modeling;
- Computational Behavior Modeling & Simulation (FY15-F19)
 - Trade-space analysis tools;
 - Operational Assessment/Effectiveness M&S;
 - Stochastic HPC-based computational behavior M&S;

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Physical Simulation and Test

Mark J. Brudnak, Ph.D. AD

Key mission areas: System characterization, Virtual environment simulation, System, subsystem & component durability testing, Test management & planning, Vehicle Testing, Terrain Measurement, Mass Properties, Heavy/Light Vibration, Cab and Payload Testing, Suspension Properties, Damper Properties, Turret Eval., Tire/Wheel test, Four Person Simulator, Seat Assessment, Motion Capture, Driving Simulator.

Applications: System performance modeling, Early soldier evaluations, juries & use cases, Validation of system designs, Efficient & timely discovery and mitigation of failure modes

Program Support: Test Planning (TEMP), Performance, RAM & Live Fire Testing, Risk Mitigation, Testability, DT/OT, TRL Assessment, T&E Efficiencies

EXISTING CONTRACT ACTIONS

- New controller for tire test machine;
- Suspension characterization improvement;
- Hydraulic distribution for VCL;
- Hydraulic oil cleaning;
- Test Consulting, work directive based;
- Simulation Integration, WD based;

OPPORTUNITIES:

- o IDIQ for Test Surge Support
 - o MIL-STD-810, proving ground, safety testing, data acq.
 - o TSAs - Industry can use Army unique capabilities

STRATEGY GAPS:

- o Virtual Proving Ground - Establish a M&S based Robotics Virtual Proving Ground;
- o System Characterization - Tire force & moment characterization, rolling resistance;
- o Durability Testing - Medium-capacity shaker table, Electro-dynamic shaker (1 or 3 axis);
- o Man-in-the-loop Simulation - Operational effectiveness analysis. Virtual environment development & composition;
- o Laboratory Operations & Management - Laboratory Maintenance, Tech. Services;

Integrated System Engineering Framework (ISEF)

Lisa Graf Deputy AD SE&I

ISEF provides the means to manage SE knowledge in an integrated manner throughout the system lifecycle. It is both an SE framework and a common environment that provides an integrated traceable systems engineering analysis capability throughout the life cycle of a program. It enables an iterative collaborative environment for all stakeholders to proactively engage in and facilitate decision making.

ISEF features:

- Supports integrated SE knowledge from cradle-to-grave with continuous traceability throughout the lifecycle;
- Increase the level of knowledge integration, quality and enterprise collaboration;
- Preserve and reuse knowledge and provides efficiency;
- Enables Portfolio SE needs, Cross Cutting Processes and System of Systems Engineering;
- Consistent, seamless user experience across all tools;

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- Tie Science & Technology to Programs Of Record for Improved Investment Planning, Integration and Transition;

Opportunities FY 2014:

- Publish/Validate ISEF API Library;
- Open framework for third party development;
- Readiness Assessments Tool Build;
- Readiness Levels - TRL, MRL, IRL;
- Compliance Evaluation Tool Build;
- Requirements compliance evaluation and allocation;
- Decision Management Tool Enhancement;
- Advanced Roadmaps – Technology states;
- Project Recon Tool Build;
- Project Recon Integration into ISEF;
- ISEF-WSTAT Integration;
- Front-end Integration with ISEF;

Opportunities FY 2015 – FY 2016:

- Sustainment Engineering Risk Assessment activity and integration;
- FMEA/FMCEA Build;
- Failure Modes Effects Analysis;
- Capability Needs Analysis Integration;
- Integration with TRADOC's Needs database;
- M&S Data and Project Integration;
- Program Knowledge Point Dashboards;
- Integrated System Lifecycle Data rollup dashboards;
- Integration with Federated Databases;

Opportunities FY 2017 – FY 2020

- Knowledge Management across all disciplines;
- Commonality & Modularity Tools;
- Executive Composite Dashboards;
- M&S Data Integration;
- Integration with Federated Databases;
- COTS/GOTS Tool Integrations;

Systems Engineering & Integration

Lisa Graf Deputy AD SE&I

SEI is a customer driven effort (PMs/PEO) supporting the 30 year strategy through service support contracts.

•Key areas of focus:

- Advanced ISEF – Tools, DB Design, Infrastructure & Application;
- Project/Risk Recon advancement, application & sustainment;
- Requirements/functional modeling, operational research system analysis (ORSA), trade space integration, operational and system functional integration;
- Sys. architecture framework/patterns & SysML modeling/interoperability (e.g. CAD I/F);
- Effective systems engineering for S&T;
- Constraints on industry engagement:

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- PM support role requires evenhandedness among all potential vehicle ACAT competitors
- Open source for tools or interface with widely available vendor licenses
- Funding forecast challenging based on customer reimbursable model

OPPORTUNITIES:

- FY14 includes late FY13 allocation and projects
- Approach is to leverage available service contracts as they evolve
- 30 Year Strategy expected to yield significant additional work years in FY14/15
- CVP SE cuts across all areas and is FY14

EXISTING CONTRACT ACTIONS

- FY14 - Advanced ISEF;
- FY14 – Architecture;
- FY14 - Risk Management & Analysis;
- FY14 - Requirements Engineering;
- FY14 - PEO/PM General SE Support;
- FY14 - S&T General SE Support;

OPPORTUNITIES

Year	FY15	FY 16	FY 17	FY18
ISEF Support #	18 Developers	18 Developers	18 Developers	15 Developers
SE Support	34 work years	49 work years	55 work years	55 work years

RAM Engineering

Harsha Desai, AD, RAM and Quality

RAM Engineering is a semi automated capability to mine & analyze reliability and maintainability data. It manages usage, failure, maintenance, test and trend and pattern analysis for R&M metrics. It provides information to make data driven decisions for Programs.

EXISTING CONTRACT ACTIONS

- FY13 –Ground System Advanced Reliability Capability (GSARC);
- FY14 –GSARC – In Process;
- FY14 & FY15 – 1 workyear –Reliability engineering workyears;
- FY14 & FY15 – 3 workyears –Reliability engineering workyears – In Process;

OPPORTUNITIES

- FY16 – 4 workyears – Reliability engineering (Design for Reliability (DFR), reliability allocation, FMEA, R&M data analysis);
- FY17 – 6 workyears – Reliability Engineering;
- FY18+ – 6 workyears – Reliability Engineering;

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Center for Systems Integration

Luis A. Hinojosa AD

Mission is to develop, fabricate and integrate advanced solutions into current and future ground systems. Customer reimbursable (PEOs and program pay for service);

Key Capabilities: Project Management, ProE/CAD 3D Modeling, Finite Element Analysis (FEA), Mechanical & Electronic Eng. Design, Technical Data Package Development, 112,000 sf. Facility w/16 Integration Bays, Robotic Welding, Laser Cutting, Water Jets with chamfering capability, Turn Mill, Circuit Board Design & Mfg.

EXISTING CONTRACTS:

- “Blue Collar” Contract for welders, painters, machinists, and heavy vehicle mechanics.
- Technical Writer Contract for technical writers and illustrators.
- “White Collar” Contract for mechanical automotive design engineers and non-degreed, experienced CAD operators.
- “White Collar” Contract for electrical automotive design engineers and non-degreed, experienced CAD operators.

OPPORTUNITIES:

- o “Blue Collar” Contract for welders, painters, machinists, and heavy vehicle mechanics.
 - o Competitive Small Business (8a) Awards for FY14/15
 - o Base year + 2 option years – desired award no later than 30 May 2014.
 - o Man Year Equivalent = 13
- o “White Collar” Contract for mechanical automotive design engineers and non-degreed, experienced CAD operators.
 - o Competitive Small Business (8a) Awards for FY14/15
 - o Base year + 2 options years, desired award no later than 30 September 2014
 - o Man Year Equivalent = 8 - 13.
- o “White Collar” Contract for electrical automotive design engineers and non-degreed, experienced CAD operators.
 - o Competitive Small Business (8a) Awards for FY14/15
 - o Base year + 2 options years, desired award no later than 30 September 2014.
 - o Man Year Equivalent = 2 – 4

Future Modular Med/Hvy Tactical Truck Demonstrator

Dan Hefel Project Engineer

Aid future acquisition programs and requirement development activity for medium and heavy tactical fleets, by developing concepts that improve commonality and reduce redundancy in mission roles.

Goals:

- Maximize commonality between heavy and medium fleets;
- Achieve modularity with kit-able solutions;
- Reduce redundancy in mission roles;
- Enable tradeoffs between affordability and performance in each addressed capability area;

Opportunities FY15-19: (Possible demo build after FY15)

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- Collaboration/CRADAs in Key Technology Areas;
- Modularity (kit-able solutions);
- Fuel efficient technologies;
- Autonomous operations;
- Open system architecture;
- Survivability enhancements;

Software Engineering Center

Mark Slominski AD, SEC

Key Functions/Capabilities: Software Development, Integration and Test, Information Systems Security Engineering (ISSE), acquisition and lifecycle support.

Software Skills required to support the TARDEC 30-Year Strategy: Software Project Engineering, Architecture, Process Improvement. Software Developers, Test Engineers, Product & Process Quality Assurance (PPQA) Engineers, and Lab Tool Support. Software Assurance, Safety, and Configuration Management (CM) Engineering.

Vehicle Electronics Architecture (VEA)

Chris Ostrowski AD

The Army faces considerable challenges when integrating electronics on ground vehicles, compounded by the need to reduce cost and redundancy across multiple platforms. The VEA Research SIL (VRS) project will create a complete reference architecture to address the power, Vetronics, and C4ISR integration challenges facing the modernization of the ground vehicle domain. This architecture and the associated will support experimentation with future architectural concepts and implementations. This effort also includes the Power Management Technologies for the VRS project.

EXISTING CONTRACT ACTIONS

- DCS Work Directive

OPPORTUNITIES

- 15 kW SiC DC to DC converter; Quantity 3;
 - 600V to 28 VDC
- 35kW SiC Fan Inverter w/Electric Fan; Quantity 2;
 - 105C Coolant, 121C Ambient
- 30kW SiC Import/Export Inverter; Quantity 2;
 - 105C Coolant, 70C Ambient
- Low voltage (28 VDC) distribution hardware capable of distributing 45 kW; Quantity 1 system;
- Utilization and rugged packaging of ARM processors; leverage commercial industry tablets and cell phones, Quantity 10-20;
- Multiple Independent Levels of Security via a secure separation kernel on an ARM; Quantity 10-20;

VECTOR (Victory Enabled Company TransfORMation) - Transition and Demonstrate TARDEC's Vehicle Integration for C4ISR/EW Interoperability (VICTORY) investment from its current TRL 4 Lab Components to TRL 6 vehicle systems. This will reduce the risks for PMs by providing an accredited Information Assurance (IA) solution.

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VICTORY Standards Maturation - Maintain, develop, and adopt future capabilities to continue to enhance the Vehicular Integration for C4ISR/EW Interoperability (VICTORY) Specifications. Enhance existing Systems Integration Lab (SIL) capabilities to perform Validation and Verification for the updated Standards. Continue to provide new capabilities that can be added to Military Ground Vehicle platforms as a part of ARFORGEN block upgrades or Modernizations. <http://victory-standards.org/>

OPPORTUNITIES

- Varying software, hardware and power management. See charts for details.
- Test Service Agreements to test VICTORY Components
- Use of Govt software for FREE
- HR needs: 125-250 Contractors (Primarily Electrical and Computer Engineers)

National Automotive Center

Dave Thomas, Director, NAC

The NAC seeks solutions to close TARDEC's Technology gaps by reaching out to academia, other Government agencies and non-military industry partners.

NAC Engagement Examples:

- Other Government Agencies Academia Industry;
- Joint solicitations with Department of Energy in energy efficient vehicle technologies;
- Joint collaboration with Department of Transportation in advanced safety and autonomous solutions;
- Facilitate National Guard technology evaluations;
- Scouting solutions in DoD research laboratories;
- Find and foster R&D technologies and approaches;
- Connecting research and small business;
- Soldier Innovations Workshops;
- Sponsor vehicle specific user forums;
- Co-development of technology for commercial and military applications;

Industry association partnerships:

- 21st Century Truck Program - DOE Led effort, identifying high potential solutions in:
 - Vehicle Electrification & Autonomous Vehicles;
 - Powertrains, Fuels/Lubricants, & Open Architectures;
 - Operational Energy, Fuel Efficiency, Light-Weighting & Vehicle System Design;
- High-Efficiency Truck Users Forum (HTUF)
 - Commercial Truck Action Group;
 - Military Truck Action Group;
- Advanced Vehicle Power Technology Alliance
 - Advanced Combustion Engines and Transmissions;
 - Lightweight Structures and Materials;
 - Energy Recovery and Thermal Management;
 - Alternative Fuels and Lubricants;
 - Hybrid Propulsion Systems & Energy Storage

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Cooperative Research and Development Agreement (CRADA) - Established between federal labs and commercial, academic or nonprofit partners to facilitate technology transfer between the parties for mutual benefit.

Test Service Agreement (TSA) - A technology transfer mechanism that enables federal laboratories to perform work for hire.

Small Business Technology Transfer (STTR) - Program that expands funding opportunities in the federal innovation research and development (R&D) arena.

Pathways to TARDEC

- TARDEC Online - <http://tardec.army.mil/default.aspx>
- Automation Alley - <http://www.automationalley.com>
- Michigan Economic Development Corporation (MEDC)
<http://www.michiganbusiness.org>
- Michigan Defense Center (MEDC) - <http://michigandefensecenter.com/>
- Procurement Technical Assistance Center (PTAC) - <http://www.ptacsofmichigan.org/>
- 21st Century Truck Program
http://www1.eere.energy.gov/vehiclesandfuels/pdfs/program/21ctp_roadmap_white_papers_2013.pdf
- Automotive Research Center - <http://arc.engin.umich.edu/>
- Society of Automotive Engineers (SAE) - <http://www.sae.org>
- North American International Auto Show - <http://www.naias.com/>
- Center for Automotive Research - <http://www.cargroup.org>
- TARDEC Ground Vehicle Gateway - <https://tardec.groundvehiclegateway.com>

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