TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

2009 NDIA Combat Vehicles Conference

U.S. Tank Automotive Research, Development and Engineering Center
Dr. Grace M. Bochenek, Director

Tank Automotive Research, Development & Engineering Center (TARDEC)

- Provides ***full life-cycle engineering*** support and is provider-of-first-choice for ***all DOD*** ground combat and combat support vehicle systems.
- Develops and integrates ***the right technology solutions*** to improve Current Force effectiveness and provide superior capabilities for the Future Force.

Ground Systems Integrator for the Department of Defense

Responsible for Research, Development and Engineering Support to *2,800* Army systems and many of the Army's and DOD's Top Joint Warfighter Development Programs

Portfolio

PORTFOLIO

Combat Vehicles

- Heavy Brigade Combat Teams
- Strykers
- MRAPs
- Ground Combat Vehicles (Future)

Force Projection

- Fuel & Water Distribution
- Force Sustainment
- Construction Equipment
- Bridging
- Assured Mobility Systems

Tactical Vehicles

- HMMWVs
- Trailers
- Heavy, Medium and Light Tactical Vehicles

Robotics

- Technology Components
- Demonstrators
- Military Relevant Test & Experimentation
- Transition and Requirements Development

TARDEC Engineers Provide Cradle-To-Grave Engineering Support

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Technology Thrust Areas

Ground Vehicle Power & Mobility

- Prime Power (Powertrain)
- Non Primary Power
- Power & Thermal Management
- Energy Storage
- Track & Suspension
- Alternative Energy

Ground Systems Survivability

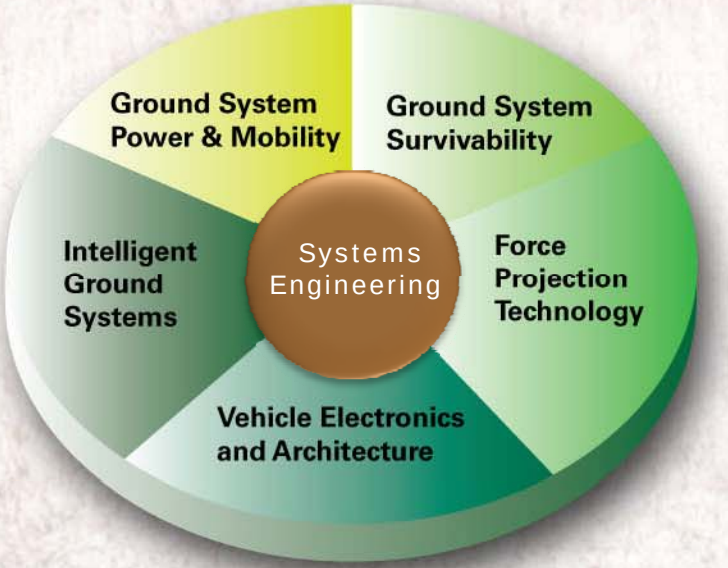
- Integrated Vehicle Protection Systems
- Active Defense
- Signature Management
- Laser Vision Protection
- Ballistic Protection
- Crew Survivability

Force Projection Technology

- Water Generation, Purification, Storage, Distribution & Quality Surveillance (QS)
- Petroleum Storage, Distribution & QS
- Material Handling Equipment
- Petroleum, Oils & Lubricants Technology
- Mechanical Countermine Equipment
- Tactical Bridging
- Alternative Fuels

Intelligent Ground Systems

- Autonomous Robotics Systems
- Safe Operations Technologies
- Indirect Vision Technologies
- Unmanned Systems Technology Development
- 360°Situational Awareness Technologies
- Soldier Machine Interfaces
- Connected Vehicles



Vehicle Electronics & Architecture

- Electronics Integration
- Data Architecture
- Condition-Based Maintenance (CBM+)
- Power Architecture/Management

Challenges, Facts & Goals

- **<u>Balance</u> Long-term technology investments & Short term Quick Reaction Solutions**
  - Think Incremental
  - Drive Innovation

- **Build the technology, but don't forget to build the business case**
  - Develop supporting physics-based models, analytical tools to support analysis, and system level studies……..Support the Army's DECISION MAKING process.
  - It's also about building a community of technical competence, both Industry & Government
  - Infuse LSS into Technology Management efforts

- **R&D Dollars are precious….use them wisely**

- **TARDEC leverages and aligns academia, industry, and government R&D to collectively meet Army's and our Nations needs**

- **TARDEC is committed to supporting the warfighter**

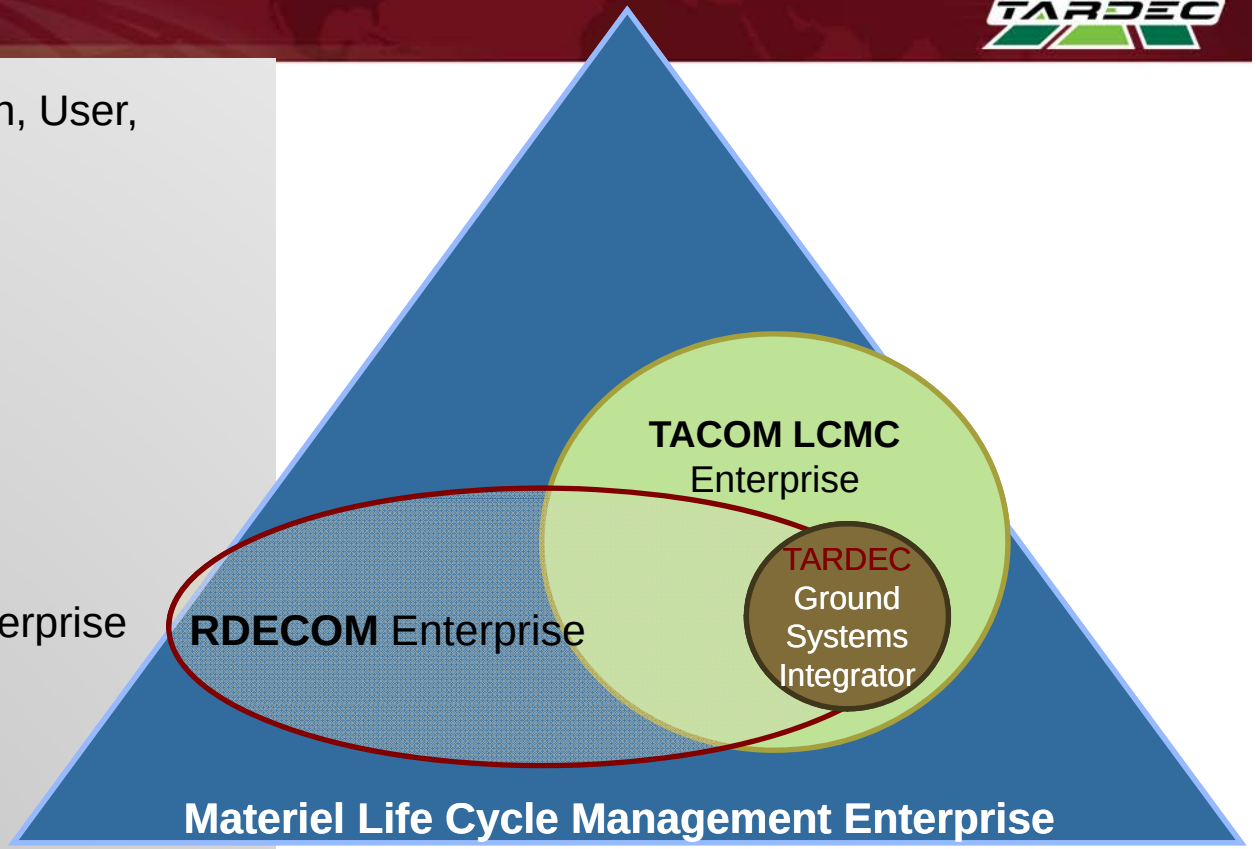
Army Materiel Enterprise

- Align Ground Systems Acquisition, User, S&T and Logistics communities.
  - Stakeholders include:
    - PEOs
    - PMs
    - TACOM ILSC
    - Marine Corps
    - TRADOC
    - RDECOM

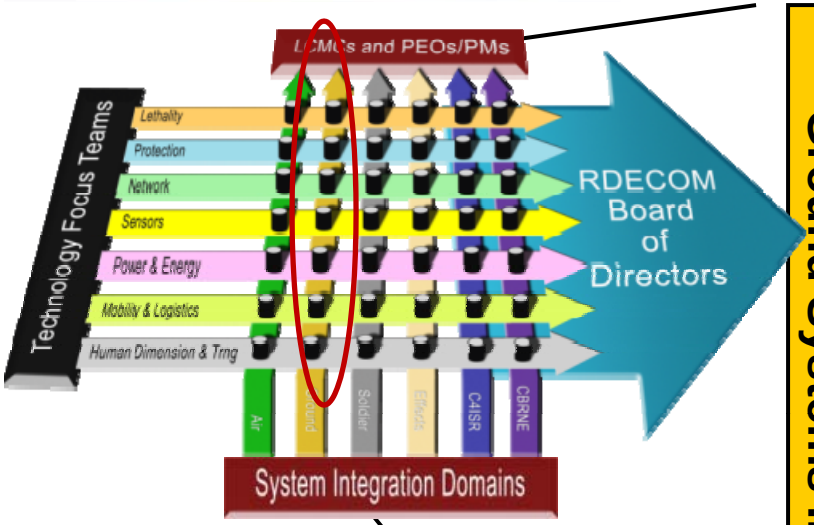
- Facilitate across the Materiel Enterprise
  - technology *planning*,
  - *development*,
  - *transition*

- Integrate S&T and acquisition program cost, schedule and performance parameters.

- Manage capability development strategies that links 6.1, 6.2 and 6.3 technology programs into cohesive integrated plans



RDECOM Ground Systems Integration Domain



Ground Systems Integration Domain

Mission Tasks:

- Data Refinement with TRADOC and LCMC Partners
- Translation of data into actionable research
- Understand & manage portfolios with TFTs/SIDs
- Shape POM with LCMC Partners
- Facilitate integration and transition of S&T to soldier

Ground Systems Portfolio:

- Combat Vehicles
  - Heavy Brigade
  - Stryker
  - Robotic Systems
  - MRAP
- Tactical Vehicles
  - HMMWVs
  - Trailers
  - FMTV
  - HTV
- Ground Combat Vehicle
- Joint Combat Support Systems
  - JLTV
  - Test/Measurement/Tools Equipment
- Force Projection
  - Fuel & Water Distribution
  - Force Sustainment
  - Construction Equipment
  - Bridging
  - Assured Mobility Systems

Partners

- **PEO GCS**
- **PEO CS/CSS**
- **PEO Integration**
- **TACOM ILSC**
- **TRADOC**
- **Marine Corps**

Technology Integration Across Ground Domain

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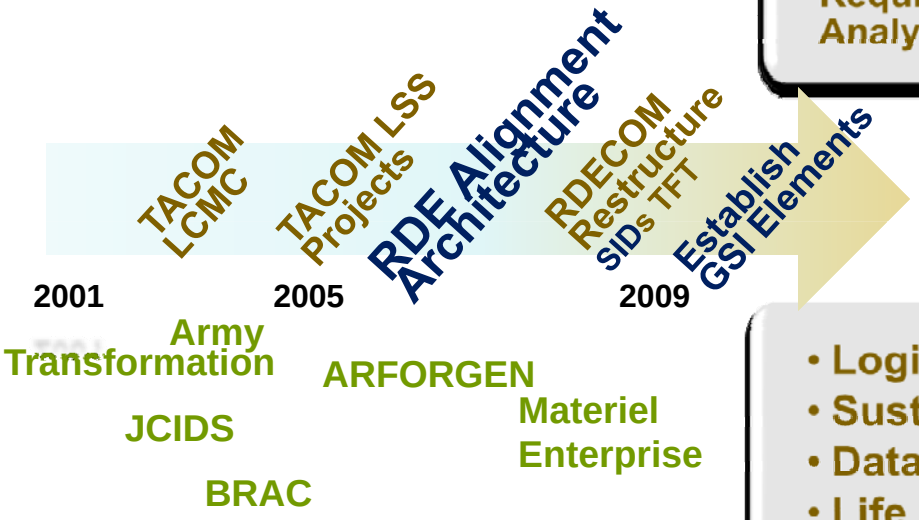
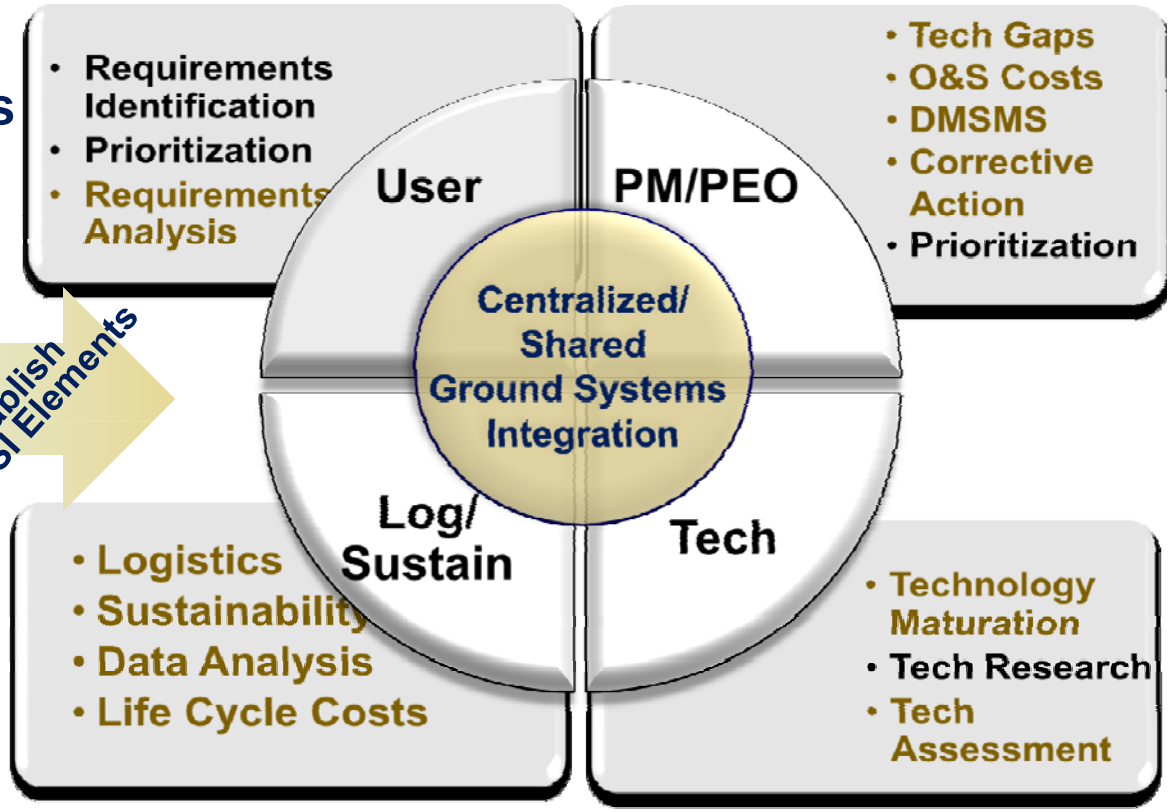
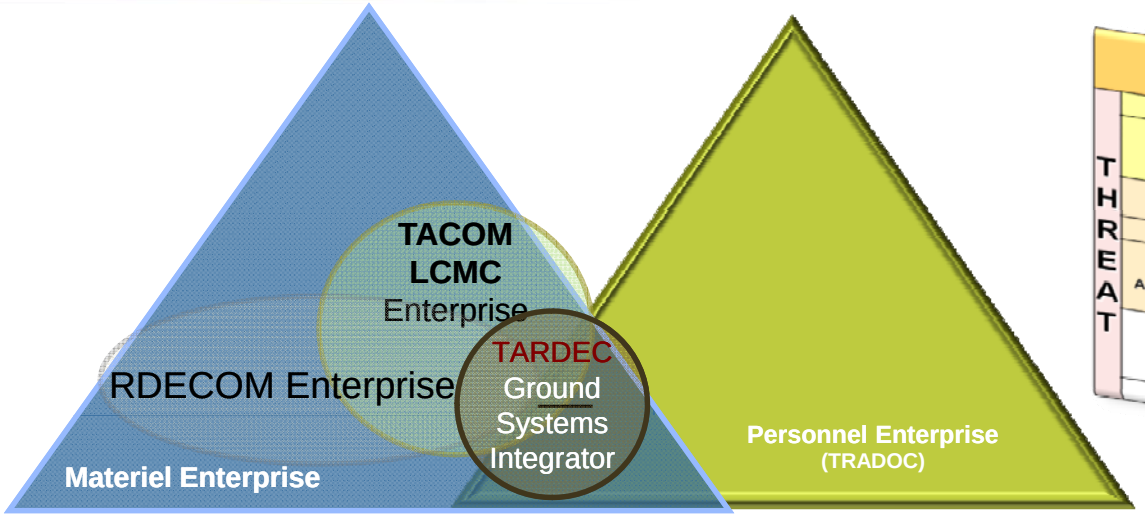
Building the Ground Systems Enterprise

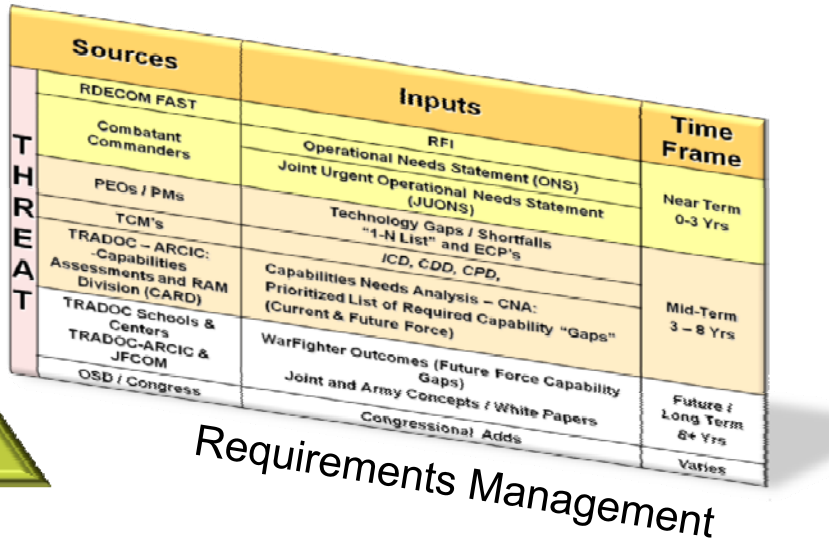




Not part of Systems Integration
Requires Systems Integration

Warfighter Integration





Recent TRADOC Activities Supported by Ground Systems Integration (GSI)

- GCV
  - 120 Day GCV CDD
  - Technology Assessment of the requirements
  - Analysis of Alternatives support
  - Specification development
  - Concept excursions
- EM Gun
- III Corp
- Robotics Innovation Workshop
- Power & Energy Workshop
- Robotics Rodeo

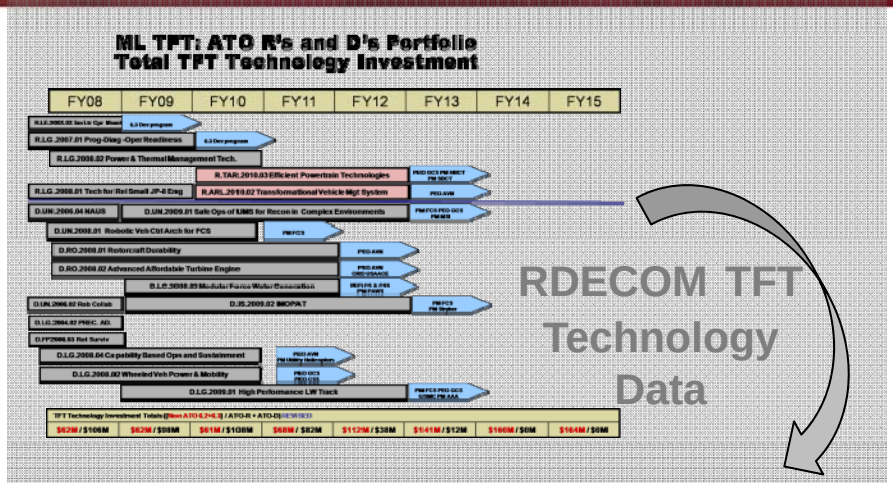
Long Term Goal

- Establish Robust GSI Requirements-Materiel development Process between Enterprises

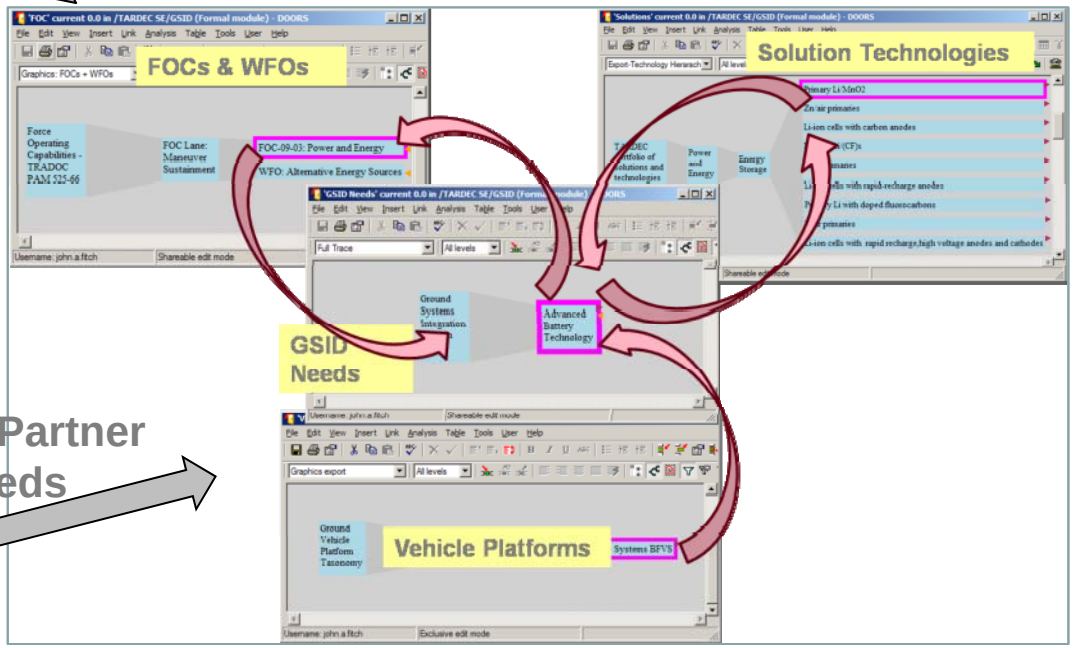
Linking Warfighter and Technology through Systems Engineering

- The GSID is Steward of 30 FY10 WFOs (129 Total)

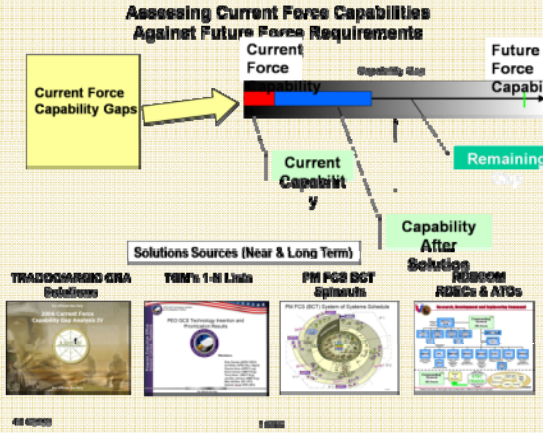
TRADOC ARCIC



RDECOM TFT Technology Data

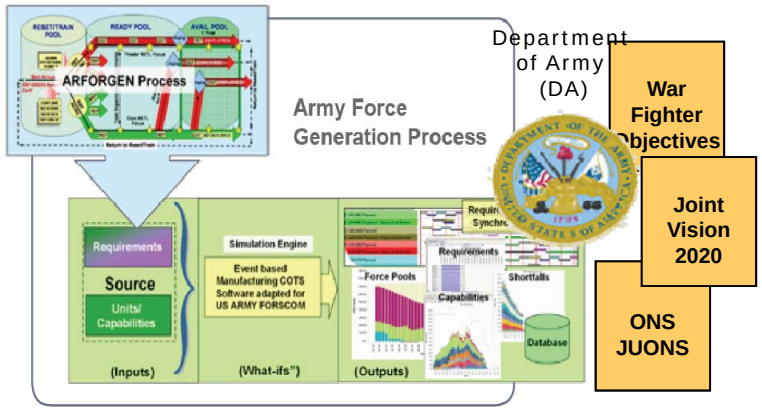


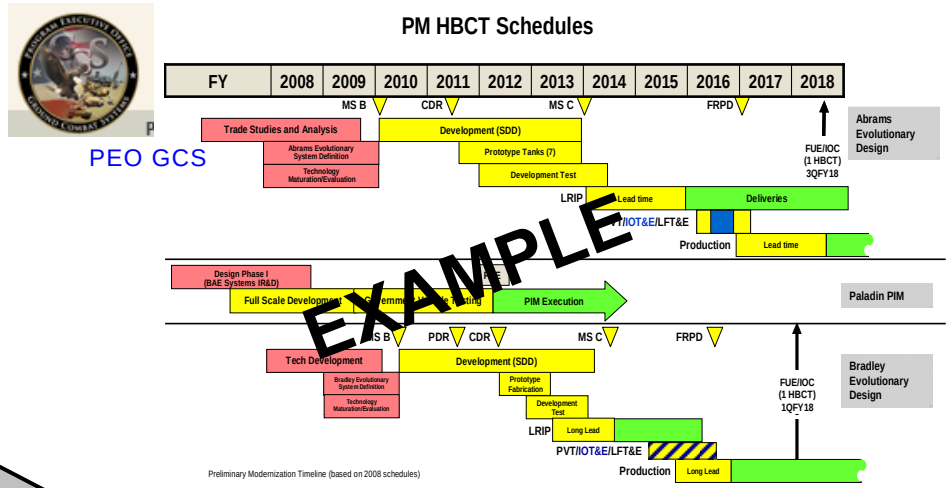
Example – PEO GCS

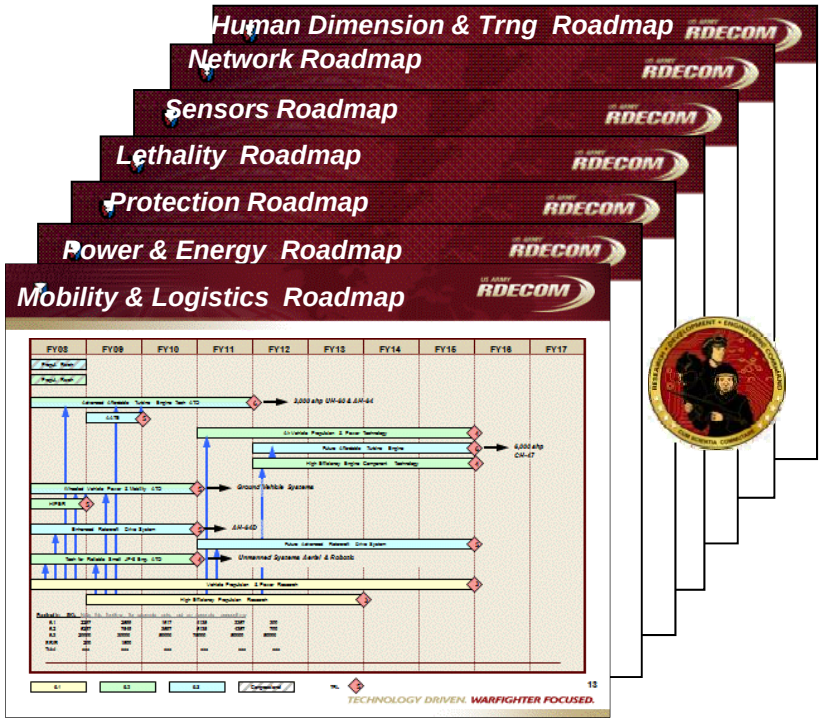


LCMC Partner Needs

Ground Systems Integration
Synchronization of Data







Ground Systems Integration Domain
Synchronized Views
- Capability Based
- Time Opportunity Based
- Resource Based

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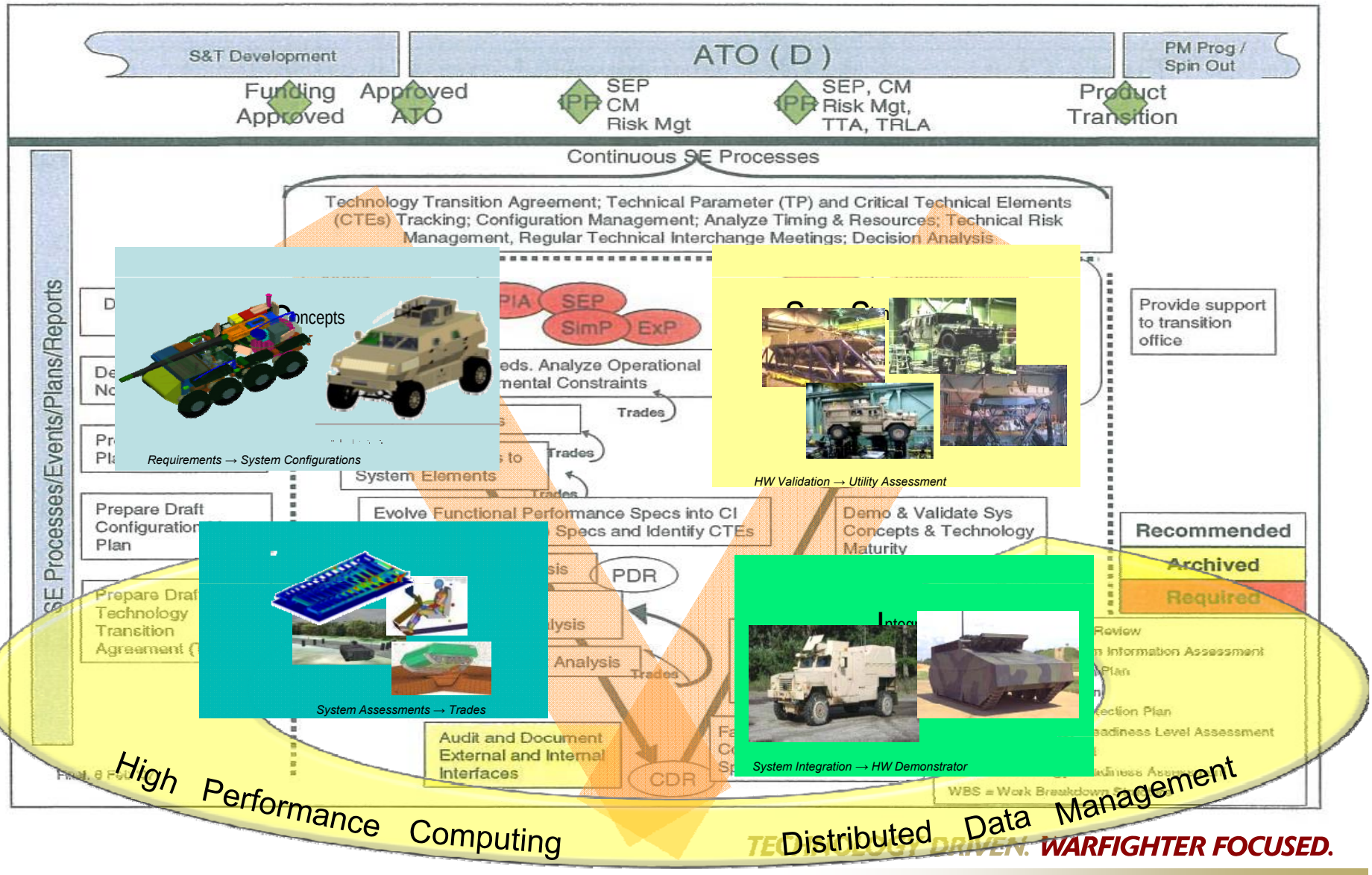
Concepts, Analysis, Systems Simulation, Integration (CASSI)



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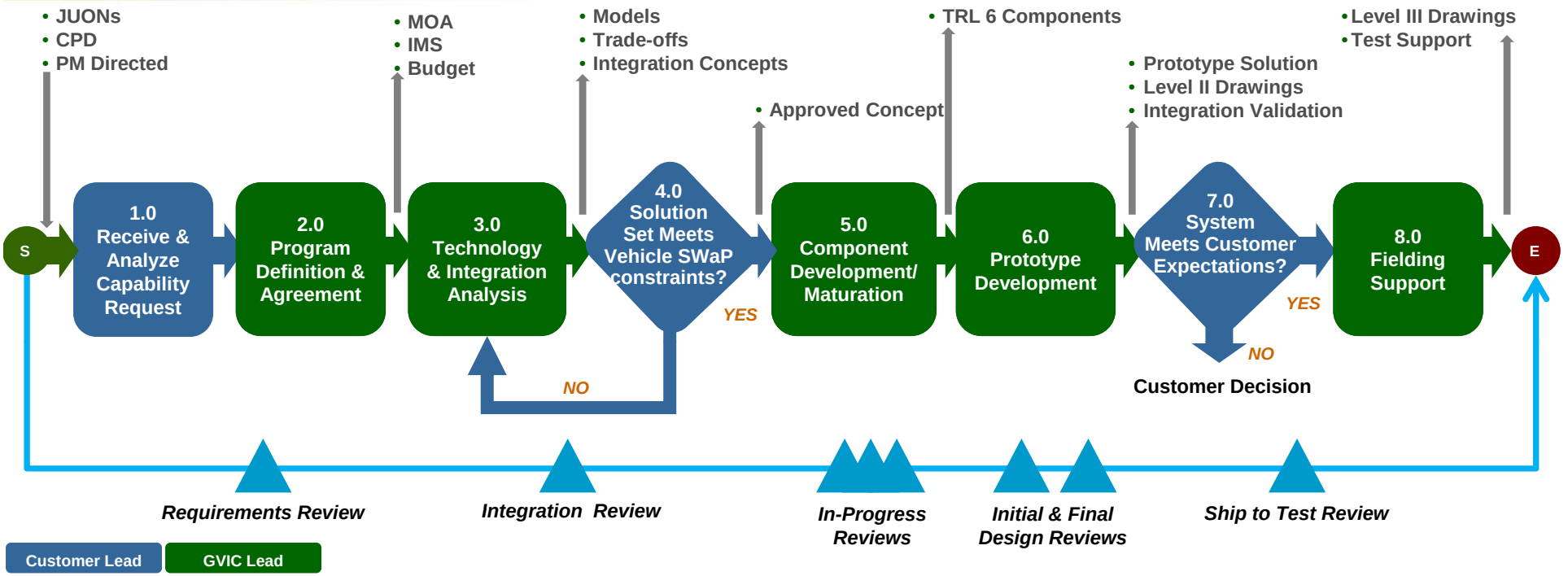
Systems Engineering Excellence



Systems Engineering PEOPLE

- Ground Vehicle Integration Center (GVIC)
- Systems Engineering Team
- Concepts, Analysis, Systems Simulation and Integration (CASSI)
- Subject Matter Experts

Systems Engineering PROCESSES

- Life Cycle Data Management
- Quality Assurance
- Testing
- Planning and Portfolio Management
- Project development and Execution

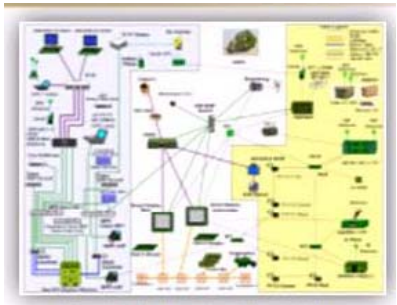
Systems Engineering PRODUCTS

- Proof of Concept
- Scope of Work
- Risk Reductions
- Technology Solutions
- Corrective Actions
- Decision Data

Ground Vehicle Integration Center

Description

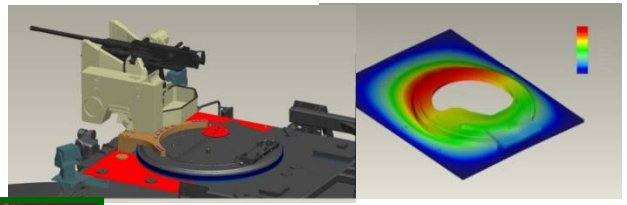
- Leverages RDECOM and DoD capabilities in a repeatable process to apply rigorous systems engineering to ground systems integration
- Provides customer partners a single entry point for cost, schedule, performance and risk management of system integration projects



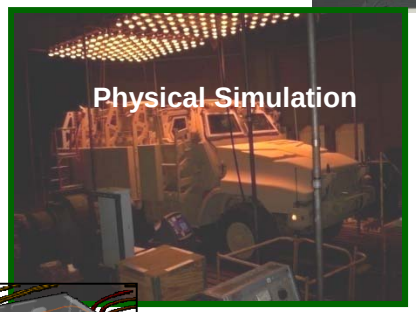
Updated Architecture

2009 Top Accomplishments

- Accelerated Remote Weapon Station Integration with ARDEC for the Caiman, MaxxPro and RG-33 systems
- Completed Full Capability Insertion Integration for Caiman Systems



Employs TARDEC organic Concepts, Analysis, Systems Simulation and Integration (CASSI), System Engineering (SE), Prototype Integration Facility and significant contributions from other RDECs and Organizations



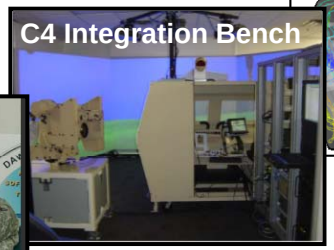
Physical Simulation

GVIC Projects (active):

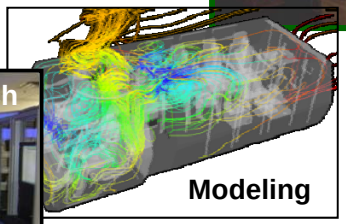
- *MRAP Capability Insertion*
- *C2OTM* – MRAP*
- *C2OTM* – Stryker*
- *LAV-R Upgrade*
- *RS-JPO*

*Command & Control On The Move

User Jury



C4 Integration Bench



Modeling

MRAP Capability Insertion

- **Vanguard** (ARDEC)
  - —CROWS II RWS (ARDEC)
  - —Boomerang **(**ARDEC)
  - —Double Shot **(**ARDEC)
- **OGPK Overhead Protection** (ARDEC effort)
- **LRAS3**
- **Check 6 Camera**
- **Overhead Wire Mitigation**
- **IBIS TEK Lights**
- **RPG Protection**
- ***Power Upgrade (derived requirement)***
- ***C4I Architecture (derived requirement)***
- **Thrown Object Protection System**

GVIC is the System Integration Lead for the MRAP Joint Program Management Office

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Systems Integration Applied in Survivability Technology Development

It's about balancing integration, mission, threat & technology

Requirements

Industry

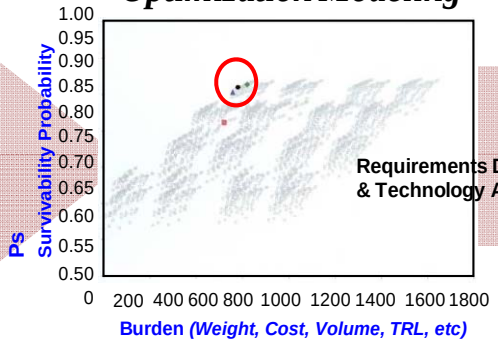
Labs

RDECs

OGAs

Survivability Technology Pallet

Optimization Modeling



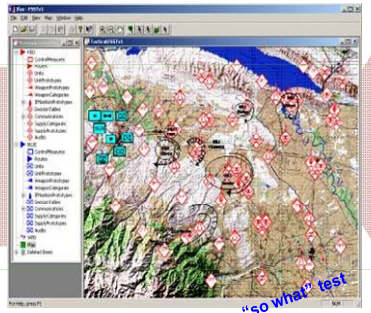
Requirements Definition/Decomposition & Technology Assessment

Vehicle Integration & Design Studies (SWAP-C)

Performance, Payload & Protection

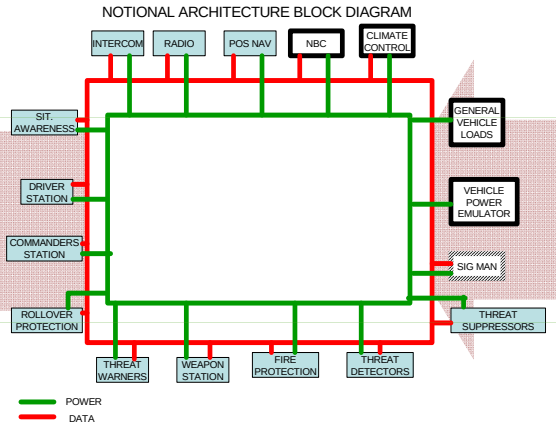
- Armor
- Weight
- Mobility (Veh Dynamics)
- Powertrain
- Thermal (HVAC)
- Safety (Crashworthiness)
- Cost
- Op. Effectiveness
- Mine Blast
- Sig Man
- Vulnerability
- Criticality

1st Order OE



The "so what" test

Integrated Product



System Integration Lab (SIL)

Technology Challenges

- Enduring Technology Challenges
  - Size
  - Weight
  - Power & Energy
  - Cooling

- Today's Challenges
  - Balance Long-term technology investments & Short term Quick Reaction Solutions
  - Threat is escalating and evolving
  - Incremental approach – Good enough but needs to have capability grow to meet full requirement
  - System interdependency (Armor, Power, C4I, weight)

Summary

Ground Systems Integration

- Creates a large opportunity to be a “game-changer” in the alignment of S&T, Acquisition and Logistics
- Is a complex and interdependent effort and continues to receive commitment from all stakeholders
- Requires a deliberate approach, utilizing collaborative planning, to execute successfully
- Faces Technical and Process Challenges