



U.S. Army Research, Development and Engineering Command



TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

*PACOM Operational S&T Conference
14-17 July 2008*

*MG Fred D Robinson, CG
RDECOM*



Strike
(Exploit FCS Netted Fires)

MISSION:

Get the right technology to the right place, at the right time, for the Warfighter (Current and Future)

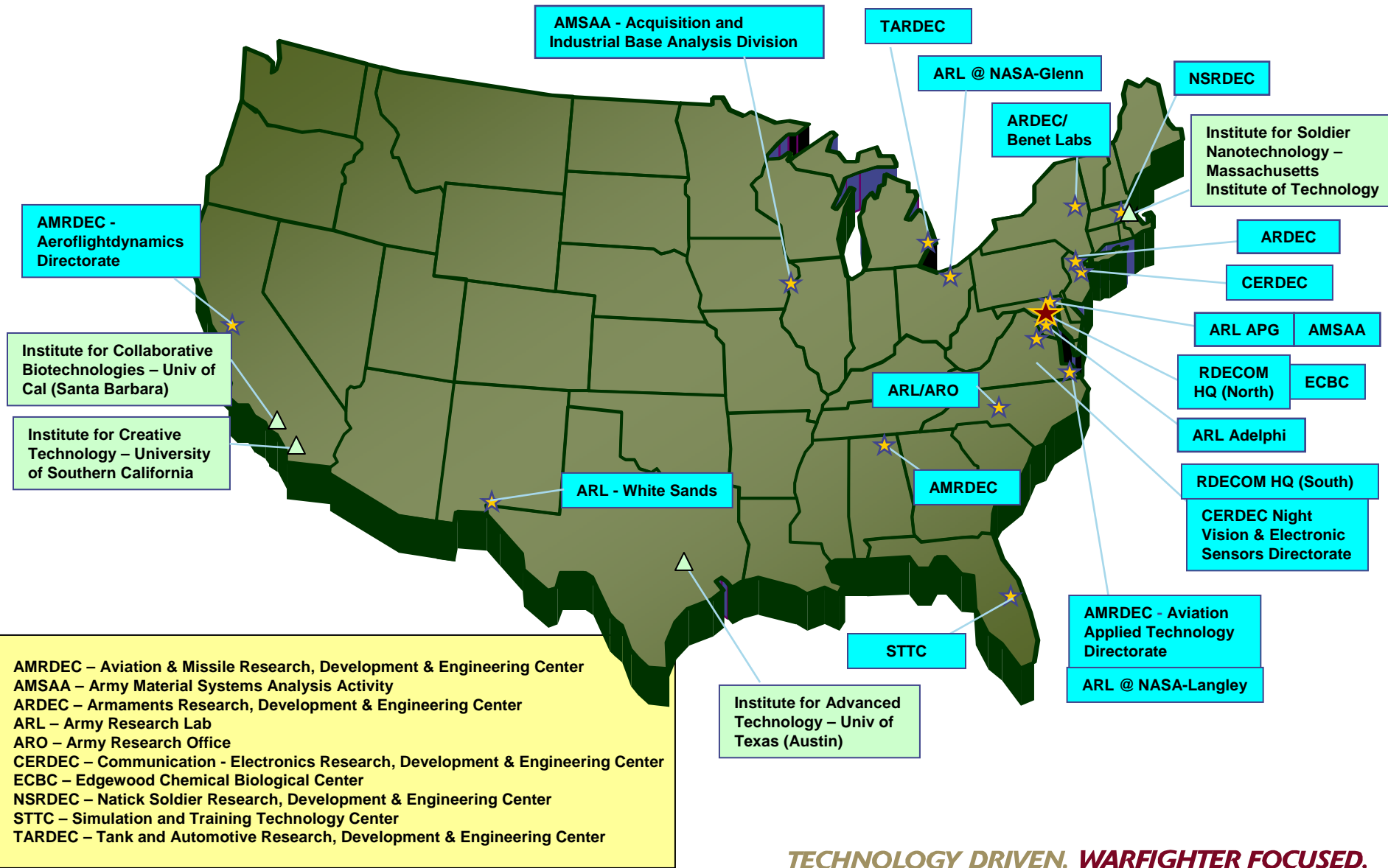
- ★ Technology Out of the Laboratories and into the Hands of Warfighters in the Shortest Time
- ★ Develop Materials and Technologies for Future Combat System (FCS) and Future Force
- ★ Manage Speed and Complexity of Technological Change to Operational Needs
- ★ Systems Engineering, Assessment, and Analysis
- ★ Engineering Support to Development and Sustainment
- ★ Identify Foreign Technologies for US Army Use



Human Performance & Embedded Training



Sensory Enhancement



Co-op Agreements, OTAs, TSAs, Contracts, Grants, CRADAs

Centers Of Excellence

High Performance Computing

- Stanford University
- New Mexico State University
- Morgan State University
- University of Texas, El Paso
- High Performance Tech, Inc
- NASA - Ames

Flexible Displays

- Arizona State University

Materials

- University of Delaware
- Johns Hopkins University
- Rutgers University
- Drexel University
- Virginia Tech

University Affiliated Research Centers



Biotechnology

- Biologically-derived:
- Sensors
 - Electronics
 - Information Processing



Soldier Survivability

- Protection
- Performance Enhancement
- Injury Intervention and Cure



Electromechanics & Hypervelocity Physics

- EM Launch
- Pulsed-power
- Electric Armaments



Immersive Environments

- Full Sensory Immersion
- 3-D Mobility
- Compelling Interactive Stories

Battlefield Capability Enhancement Centers

Human Centric C2 & Decision Making



Intelligent Sensor Fusion



Environmentally Stable Flexible Displays



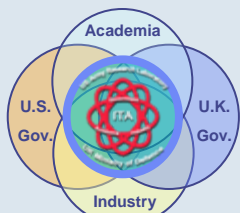
Flexible Extremities Protection:



Digital Battlefield Communication:



International Technology Alliance



Collaborative Technology Alliances

Advanced Sensors



Robotics



Power & Energy



Comms & Networks



Advanced Decision Architectures



Micro Autonomous Systems & Technology



297
Academic Partners
In 50 States + DC

1229
Single Investigator
Grants

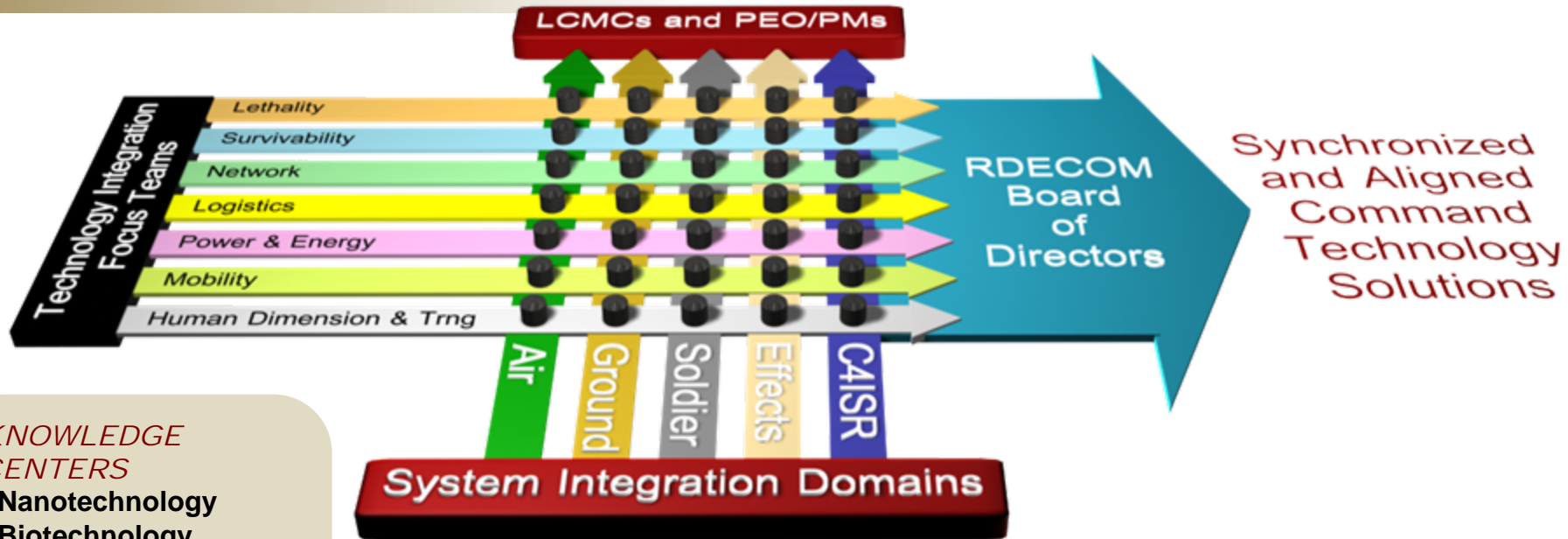
63 MURI

422
Active CRADAs

Over 300
International
Agreements



Technology Integration The Concept



KNOWLEDGE CENTERS

- Nanotechnology
- Biotechnology
- Cognitive & Neuroergonomics
- Electronics
- Advanced Computing
- Enterprise Integration

SYSTEM OF SYSTEMS OVERLAY

- Systems Engineering Across Domains
- RDECOM HQ
- AMSAA

- System Integration Domains ensure integrated capabilities for common systems.
- Technology Focus Teams ensure 6.1-6.3 S&T portfolio is optimized across all domains.
- Knowledge Centers provide coordination and serve as technology advocate to Focus Area leads on emerging technologies.
- Board of Directors provide RDECOM S&T strategic guidance, establish command priorities and adjudicate inter-RDEC/Lab issues. **TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.**



- **Survivability**
 - **Vehicles**
 - **Soldier**
- C4ISR
 - Fusion of Asymmetric Sensor Data / Intel
 - Information Assurance
 - Spectrum Usage / Management
- Power and Energy
 - Hybrid Electric Technologies
 - Improvements in Soldier Power
 - Alternative Energy Sources (Fuel Cells, Battery Chemistries, Solar)
- Robotics
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 - Manned / Unmanned Teaming



MRAP Family of Vehicles



Category I Urban Combat Operations

Concept of Operation:

Small unit combat operations in urban or confined areas - Mounted patrols, reconnaissance, communications, command and control, and direct interaction with civilian population.



Category II Multi-mission Operations

Concept of Operation:

Ground logistics support operations - Reconfigurable vehicle capable of convoy security, combat engineering, ambulance, troop & cargo transportation.



Category III Mine/IED Missions

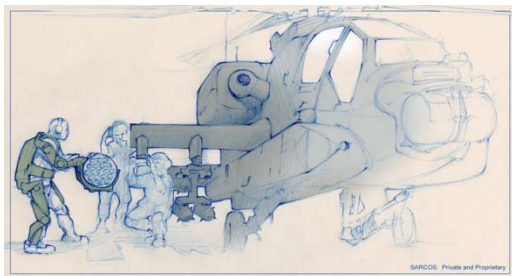
Navy and Marine Corps Only

Concept of Operation:

Explosive Ordnance Disposal - Route Clearing; detect and disarm or detonate IEDs, mines and other explosive devices.



Exoskeleton Logistic Variant



Purpose:

Develop a fully-powered wearable exoskeleton that increases the Logistic Support Soldiers' repetitive manual lifting/handling (holding, moving, lifting, pushing, pulling) capacity and maximal load carrying capacity

Products:

- **2 Prototypes that operate in austere environments while making the load feel lighter thru strength augmentation**
- **1 System will have a power tether**
- **1 System will have on board power**
- **Draft Operation & Maintenance plan**

Payoff:

- **Enhanced load bearing & manual lifting capability**
- **Reduced fatigue and injury potential**
- **Enhances Soldier effectiveness in combat support and combat service support**



- Survivability
 - Vehicles
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- **C4ISR**
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Asymmetric Data Fusion

The screenshot displays the DCOS-A Multi-Function Workstation (MFW) interface. The central window shows a map of Baghdad with various data overlays, including a network diagram and a list of entities. The interface includes a menu bar (System, Settings, View, Services, Help), a toolbar, and a 'Map View' section. A 'Drawing Palette' on the right side contains various symbols and tools for analysis. The interface is labeled 'UNCLASSIFIED'.

Surrounding the main interface are several smaller images and diagrams illustrating the system's capabilities:

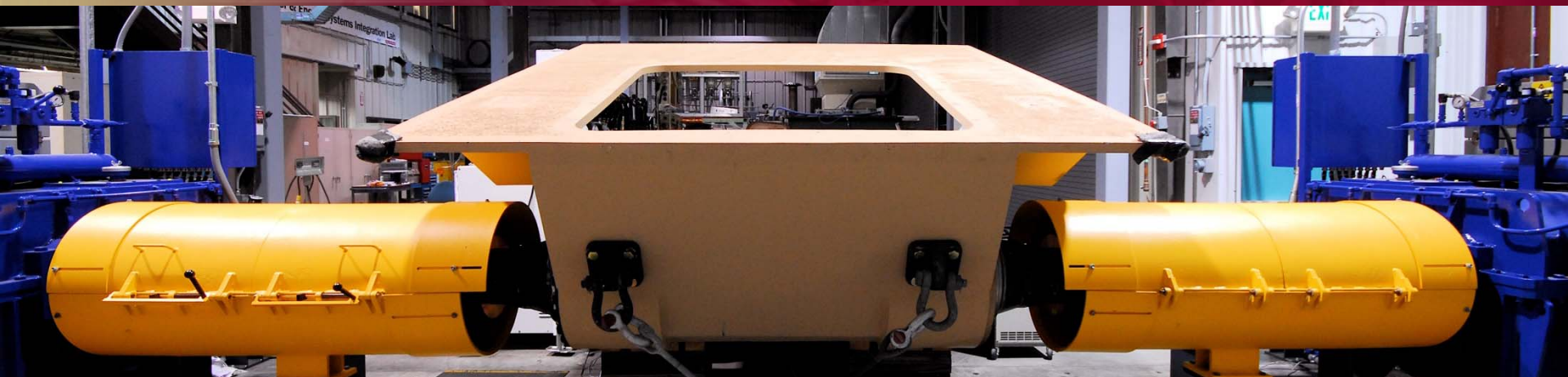
- A vertical list of categories: Political, Military, Economic, Social, Infrastructure, Information.
- A photograph of a person in a red shirt.
- A network diagram with nodes and connections, labeled 'Reverse Of Address Assignment', 'Entity Identification', and 'Network Determination'.
- A photograph of a building with smoke rising from it.
- A photograph of a person in a white shirt and a person in a white uniform.
- A photograph of a person in a white uniform.
- A photograph of a person in a white uniform.
- A photograph of a person in a white uniform.

Full Spectrum of Operations

Provides timely analysis, identification and tracing capability in contemporary & future operating environments, by fusing data from all sources.



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Design Attributes

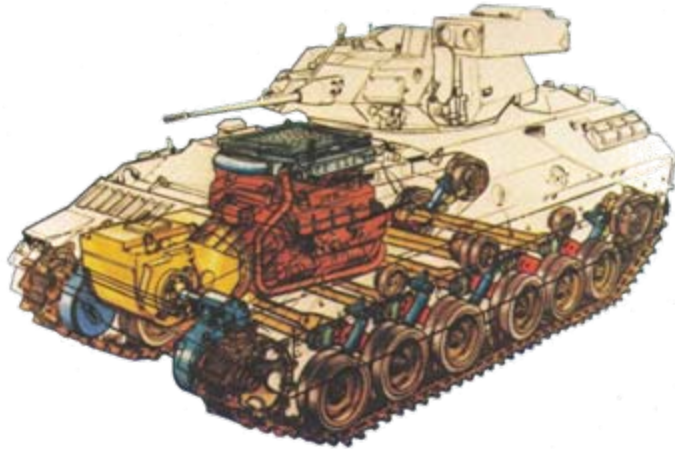
- More effective & responsive than current platforms at lesser weight
- Computer processing power equivalent to higher performance computers
- Capability to produce electrical power equivalent to 90 portable 5kW generators
- On-board storage capability of more than 500 full-length movie videos
- Increased diagnostic capability than a typical automobile repair shop

Design Solutions

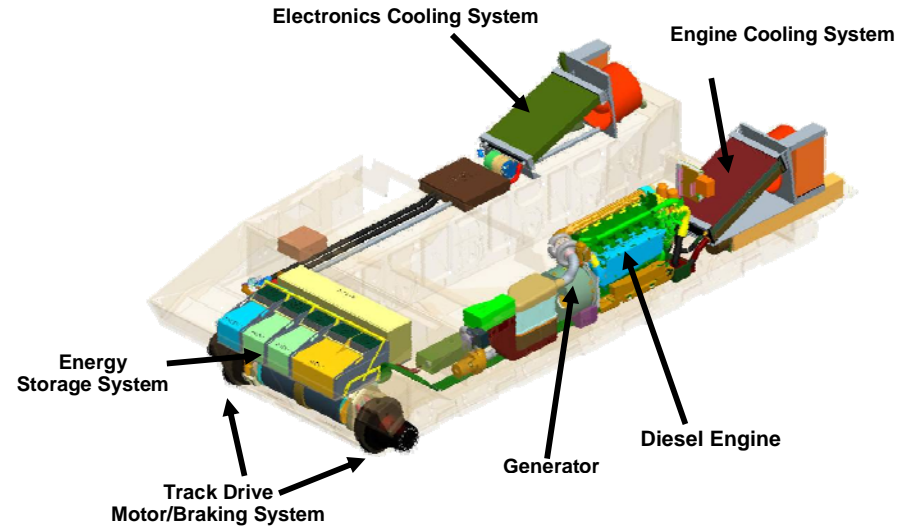
- Electrically Based Architecture is Fundamental to FCS MGV
- High Power Density Diesel Engine with Advanced Technology Generator Supporting FCS MGV
 - **Improved efficiency for more available power**
 - **Improved reliability to increase system availability**
- Advanced Power Management and Energy Storage System
 - **Monitoring and controlling loads maximizing available power**
 - **Improved batteries to increase Silent Watch/Mobility capability**
- Cross Drive System for Track System
 - **Improved efficiencies reduces:**
 - Radiator size**
 - Density reduces weight**

The FCS MGV Has an Unprecedented Need for Electrical Power

Electric Architecture Benefits Comparison



Conventional Drive Train



Electric Drive Train

Design Benefits

- No Mechanical Link
- No Drive Shaft
- Design Flexibility
- Improved Maintainability
- Lower Silhouette



Battery Requirements



AN/PVS 14 (Night Vision)
(2) AA
.1 lbs



Melios
(1) BB 516
.59 lbs



HTWS (Night)
(6) AA
.3 lbs



M68 CCO (Day)
(1) DL 1/3N
.04 lbs



Sure Fire Light
(2) CR-123A
.12 lbs



Mag Lite
(2) AA
.1 lbs



Head Set
(2) AA
.1 lbs



PEQ-2A
(2) AA
.1 lbs



MBITR
(1) BB 521,
.88 lbs



DAGR
(4) AA & (1) 1/2
.22 lbs



ICOM F43
(1) BP 196
.35 lbs



P-Beacon
(1) 9V
.1 lbs



Battery Requirements for the Platoon Leader

Total: 8 types of batteries, 34 batteries, 3 lbs

- Infantry Platoon battery requirements

- 8 types of batteries
- 2,587 total batteries
- Weight: 364 lbs.
- Cost: \$10,103.80



- Current costs are approximately \$1.5 M for 5 day supply of batteries for an Air Assault Infantry Brigade.

ULTRACELL XX25 DEVELOPMENT

Objective

Provide a portable fuel cell power source which can extend mission runtimes through improved energy density while decreasing overall mission equipment weight

Benefits for Military Applications

The XX25 will allow the military to have increased runtimes of electronics equipment while lowering the overall mission weight. The military will be able to power communication devices, man-wearable electronics (LW/FFW programs), as well as provide emergency power and serve as a remote field recharging unit.

CERDEC POC: Beth Ferry, 410-278-1319
elizabeth.ferry@us.army.mil

Project Status

The XX25 is a 25 Watt portable Reformed Methanol Fuel Cell (RMFC) system – quieter and more efficient than electric generators, and smaller and lighter than long runtime battery solutions. Developed by UltraCell with funding from the U.S. Army CERDEC, the XX25 is a field ready fuel cell system available today.

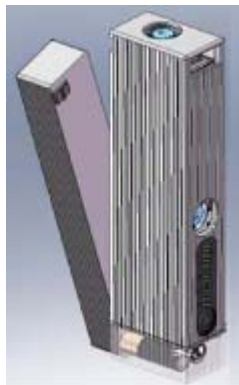
In 2007, UltraCell achieved milestones including MIL-STD 810F testing which validated system ruggedness and reliability and beta system field testing confirming usability.

The UltraCell Gen.II, being developed in 2008, will further increase energy density, benefiting the soldier by saving weight.

UltraCell XX25



UltraCell Gen.II



Funding

FY 06, FY 07(Joint DARPA/CERDEC)

Total UltraCell Cost: FY 06 >\$2M, CERDEC cost \$1.1M

Total UltraCell Cost : FY07 >\$3.8M, CERDEC/DARPA Cost \$1.75M (ends May 2008)

FY08 Next Gen Effort (Start May 2008)

Total UltraCell projected Cost : FY08 \$>2.8M, CERDEC Cost \$1.4M (ends May 2009)

- Joint CERDEC/DARPA Funding

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- Deployable tactical system which converts military field waste (paper, plastic, scrap-wood, packaging and food waste) into biofuels (ethanol and fuel-gas)
- Biofuels used to fuel onboard 60Kw generator set and provide thermal utilities from excess thermal energy (e.g. hot water)
- Conserves approximately 100 gallons of diesel fuel per day and reduces waste disposal cost and overhead
- “Hybrid system” integrating thermochemical and biocatalytic technologies
- Outputs are carbon dioxide and ash. With the exception of conversion of petroleum based plastics the system is “carbon neutral”

Future

New biocatalysts R&D

Supply chain R&D for “green” plastics and polymers

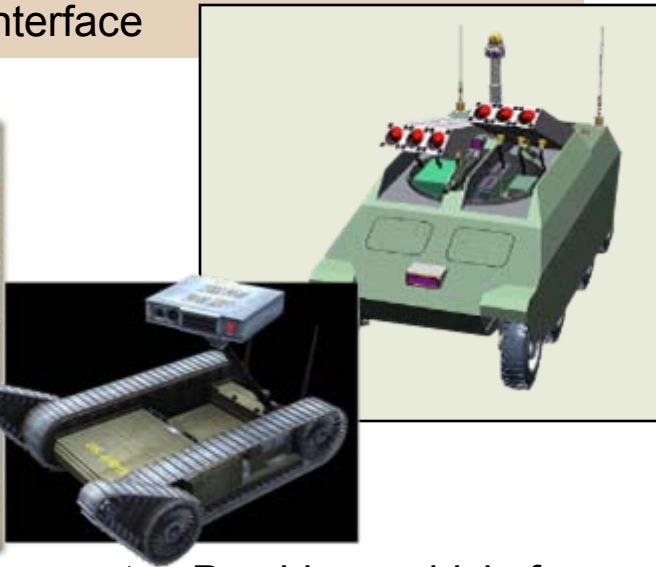
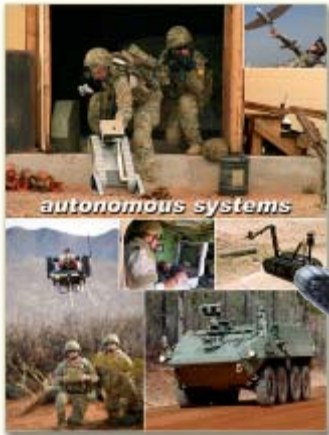


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Corporate Agreement established to advance science in three areas:

- Advanced Perception for Autonomous Mobility
- Intelligent Control Architectures and Tactical Behaviors
- Human-Machine Interface



- Cooperative Agreements: Provide a vehicle for collaboration with industry and academia to rapidly transition innovative research into the hands of the Soldier
- Impact: Safe operation of unmanned vehicles in populated environments

Industry Members

- General Dynamics Robotic Systems
- Alion Science and Technology
- Applied Systems Intelligence
- BAE Systems
- Jet Propulsion Lab
- Sarnoff Corporation
- SRI International
- PercepTek, Robotic Research
- Signal Systems Corporation
- SkEyes, Inc

Academia Partners

- Carnegie Mellon University
- University of Maryland
- Florida A&M University
- Howard University
- North Carolina A&T University
- University of Pennsylvania



- **Chem-Bio Detection and Decontamination**
 - **Standoff Detection**
 - **CB Agent Decontamination**
- **Training**
 - Immersive / Synthetic Environments
 - Personal Learning Assistance
- **Human Dimension**
 - Human-Network Interaction
 - Human Cognition / Performance Modeling
- **Lethality**
 - Increased / improved Soldier lethality
 - Tailorable Effects



- Traditional military application of explosives detection applied to finding mines.
 - Magnetometry, Ground Penetrating Radar
- DHS/TSA focused on detection of explosives prior to an event in a relatively “clean” environment (i.e. airports...)
- Law Enforcement focused on post blast analysis of residue for attribution, prosecution.
- Current military environment involves all three. Required to detect an explosive threat prior to detonation in a complex, dirty environment.



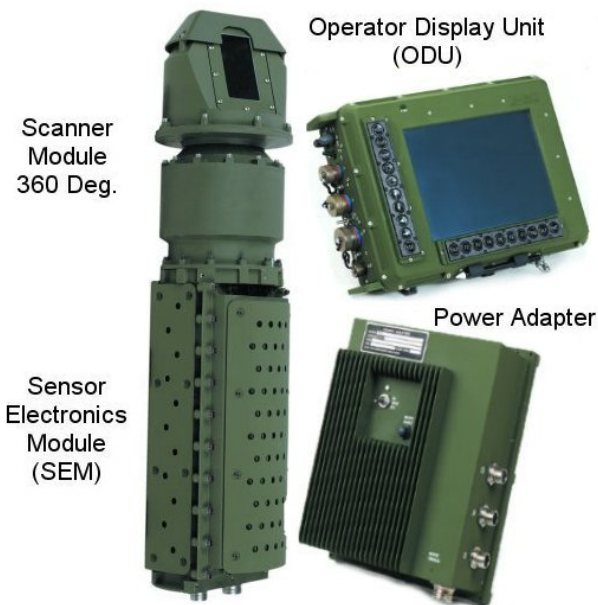
The IED Threat





Chemical to HME Detection

- Joint Services Lightweight Standoff Chemical Agent Detector (JSLSCAD)
- JSLSCAD Block I - integrated into the Stryker-NBC Reconnaissance Vehicle
- General Dynamics Armament and Technical Products/Honeywell currently under contract through JPM-CA
- Conducting a feasibility study on using a JSLSCAD to detect Nitric Acid
- Algorithm development and software only modification required



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Bi-lateral Negotiation (BiLAT) Simulation



PC-based, cognitive training tool used by Soldiers in both institutional and operational training environments to increase knowledge and develop skills in how to plan for and conduct bi-lateral meetings or negotiations in different cultural settings (current scenarios are focused on Iraq)



Game-Based Technology for Coalition Training



Massively Multiplayer On-line Game (MMOG) technology used to provide a flexible and scalable simulation environment that would support training for a wide range of Coalition Warfare operations. Allows training among US and Coalition ground forces on a wide variety of tasks, such as working with local authorities and first responders after an IED/terrorist attack.



The Stand Alone Patient Simulator (SAPS) is the world's first wireless, rugged, physiologically-based patient simulator. SAPS introduces the capability for medical care providers to train as they fight. The provider must assess and treat the patient in difficult terrain while extricating and evacuating him to higher levels of care.

- Chem-Bio Detection and Decontamination
 - Standoff Detection
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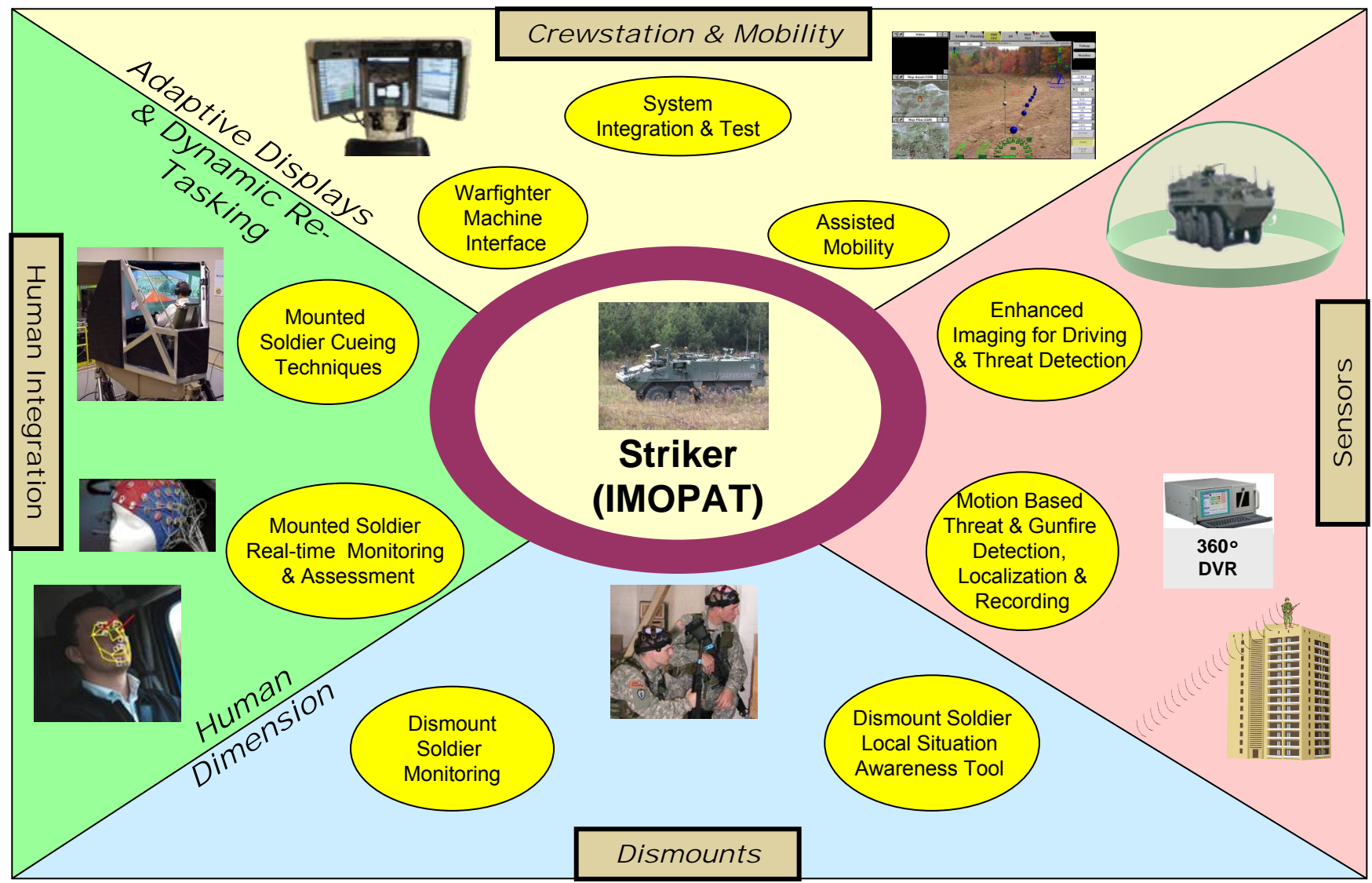
- Training
 - Immersive / Synthetic Environments
 - Personal Learning Assistance

- **Human Dimension**
 - **Human-Network Interaction**
 - **Human Cognition / Performance Modeling**

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- **Human Dimension:** That which encompasses the cognitive, physical, and moral components of Soldier, leader, and organizational development and performance essential to raise, prepare, and employ the Army in full spectrum operations.
 - Cognitive Component: Within the human dimension, what a Soldier must know, process and understand in order to perform essential intellectual tasks and functions.
 - Physical Component: Traditional aspects of physical fitness such as strength, endurance, tolerance, flexibility, and coordination, along with holistic fitness, an approach that considers mental and medical contributions to physical performance
 - Moral Component: In relation to the human dimension, it consists of three elements; warrior spirit element, moral-ethical development, and socio-cultural awareness





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Warfighter Payoffs:



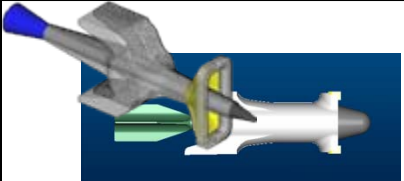
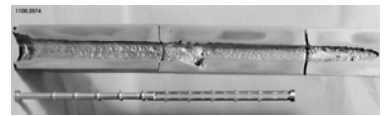
- Increased lethality and robust defeat of future threats
- Improved survivability (reduced launch signature & elimination of chemical propellants)
- Lower sustainment burden (reduced weight/volume rounds)

Approach:

- Separately demonstrate key components - pulsed power, launcher, and projectile
- Provide supporting analyses that establishes substantial benefits on the battlefield



Key Accomplishments:

<p>Built and proof tested key pulsed power components</p>	<p>Built and tested practical launcher prototypes</p>	<p>Demonstrated highly efficient KE and HE projectiles</p>	<p>Demonstrated novel hypervelocity penetrators</p>
			

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