

NDIA
AT THE HEART OF THE MISSION

2021 FUTURE FORCE CAPABILITIES

CONFERENCE & EXHIBITION

Armaments, Robotics, Munitions, and EOD

October 18 – 21 | Columbus, GA | NDIA.org/FutureForce21

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NDIA

WHO WE ARE

The National Defense Industrial Association is the trusted leader in defense and national security associations. As a 501(c)(3) corporate and individual membership association, NDIA engages thoughtful and innovative leaders to exchange ideas, information, and capabilities that lead to the development of the best policies, practices, products, and technologies to ensure the safety and security of our nation. NDIA's membership embodies the full spectrum of corporate, government, academic, and individual stakeholders who form a vigorous, responsive, and collaborative community in support of defense and national security. For more than 100 years, NDIA and its predecessor organizations have been at the heart of the mission by dedicating their time, expertise, and energy to ensuring our warfighters have the best training, equipment, and support. For more information, visit **NDIA.org**

GET INVOLVED
Learn more about NDIA's Divisions and how to join one at **NDIA.org/Divisions**



ARMAMENTS DIVISION

WHO WE ARE

The Armaments Division provides a forum for industry, military, and government personnel to address issues in order to ensure a superior armament system capability today and in the future. The Division addresses armament operational needs and requirements, approaches and concepts, system integration, weapons, munitions, fire control, and logistic support. Attention is given to total systems, technology application, and state-of-the-art advancements in technology.

LEADERSHIP AND COMMITTEES

Brian Berger
Division Chair

Bruce Webb
Division Vice Chair

Steve Faintich
Small Arms Committee Chair

Alan Kull
UEA Committee Chair

Matt Phillips
GARM Committee Chair



GLOBAL EXPLOSIVE ORDNANCE DISPOSAL COMMUNITY

WHO WE ARE

The Explosive Ordnance Disposal (EOD) committee brings together government, international partners, academia, and industry to address the needs of the EOD warfighter, the civilian Public Safety Bomb Squads, and non-governmental organizations. Through our partnership with the EOD Warrior Foundation, we provide a forum to address the most pressing problems of the EOD warfighters and their families.

LEADERSHIP AND COMMITTEES

COL Leo Bradley, USA (Ret)
Chair, EOD Symposium

Eugene Squires
EOD Committee Chair



MUNITIONS TECHNOLOGY DIVISION

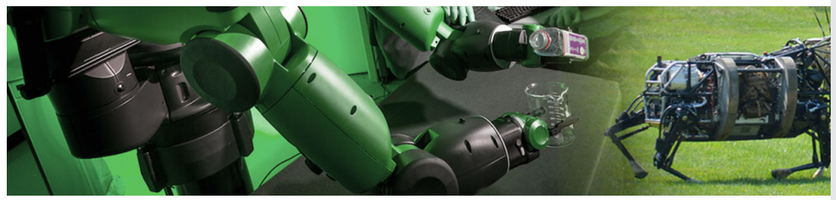
WHO WE ARE

The Munitions Technology Division works to maintain the open exchange of technical information among government and industry programs and technical managers. In addition, the Division identifies changes and trends in policy, guidance, and organizational functions that affect the development, production, maintenance, and demilitarization of munitions. The Division is comprised of two sections, Fuze and Insensitive Munitions & Energetic Materials, and one advisory group, the Industrial Committee of Ammunition Producers.

LEADERSHIP AND COMMITTEES

Nick Perry
Division Chair

COL Moises (MO) Gutierrez, USA (Ret)
Division Vice Chair



ROBOTICS DIVISION

WHO WE ARE

The Robotics Division focuses on security-related robotics technology, covering the development, acquisition, application, integration, and sustainment of unmanned ground systems to improve warfighters' capabilities and survivability. The Division sponsors the Ground Robotics Champion and Ground Robotics Technology Innovator Awards.

LEADERSHIP AND COMMITTEES

Matt Dooley
Division Chair

Howard Kent
Robotic Armament Payload Chairman

EVENT INFORMATION

LOCATION

Columbus Georgia Convention & Trade Center
801 Front Avenue
Columbus, GA 31901

WIFI

Network: FFCCE21
Password: PacSciEMC

REAL-TIME Q&A

Slido is an audience engagement platform that allows users to crowd-source top questions to drive meaningful conversations and increase crowd participation. Participants can up-vote the questions they would most like to hear discussed. Simply tap the thumbs-up button to up-vote a question. Top questions are displayed for the moderator and speaker to answer. Ask your question in sessions by going to Slido!

Event code: FFC2021

ATTIRE

Civilian: Business
Military: Uniform of the Day

SURVEY AND PARTICIPANT LIST

You will receive via email a survey and list of participants (name and organization) after the conference. Please complete the survey to make our event even more successful in the future.

EVENT CONTACTS

Meredith Mangas, CMP
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Program Manager, Divisionsr
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SPEAKER GIFTS

In lieu of speaker gifts, a donation is being made to the Fisher House Foundation.

HARASSMENT STATEMENT

NDIA is committed to providing a professional environment free from physical, psychological and verbal harassment. NDIA will not tolerate harassment of any kind, including but not limited to harassment based on ethnicity, religion, disability, physical appearance, gender, or sexual orientation. This policy applies to all participants and attendees at NDIA conferences, meetings and events. Harassment includes offensive gestures and verbal comments, deliberate intimidation, stalking, following, inappropriate photography and recording, sustained disruption of talks or other events, inappropriate physical contact, and unwelcome attention. Participants requested to cease harassing behavior are expected to comply immediately, and failure will serve as grounds for revoking access to the NDIA event.

EVENT CODE OF CONDUCT

NDIA's Event Code of Conduct applies to all National Defense Industrial Association (NDIA), National Training & Simulation Association (NTSA), and Women In Defense (WID) meeting-related events, whether in person at public or private facilities, online, or during virtual events. NDIA, NTSA, and WID are committed to providing a productive and welcoming environment for all participants. All participants are expected to abide by this code as well as NDIA's ethical principles and practices. Visit NDIA.org/CodeOfConduct to review the full policy.

AGENDA

MONDAY, OCTOBER 18

11:00 am – 7:00 pm

REGISTRATION
NORTH HALL LOBBY

1:50 – 2:00 pm

CAPABILITIES KICK-OFF
FOUNDRY ROOM

Brian Berger
President and Chief Executive Officer, GTDS America, LLC
Introducer

Donald Sando
Deputy to the Commanding General and Director of Capabilities Development & Integration, U.S. Army Maneuver Center of Excellence

2:00 – 3:00 pm

CONCEPTS DIVISION EMERGING TECHS
FOUNDRY ROOM

Donald Sando
Deputy to the Commanding General and Director of Capabilities Development & Integration, U.S. Army Maneuver Center of Excellence
Moderator

Jim Stone
Acting Director, Concept Development Division, Maneuver Capabilities Development and Integration Directorate

3:05 – 4:05 pm

ACM STRYKER AND EMERGING ARCTIC CONDITIONS
FOUNDRY ROOM

Donald Sando
Deputy to the Commanding General and Director of Capabilities Development & Integration, U.S. Army Maneuver Center of Excellence
Moderator

Dominick Edwards
Deputy Director, Army Capability Manager, Stryker Brigade Combat Team, Maneuver Center of Excellence

4:10 – 5:10 pm

MANEUVER BATTLE LAB/ACM'S
FOUNDRY ROOM

Donald Sando
Deputy to the Commanding General and Director of Capabilities Development & Integration, U.S. Army Maneuver Center of Excellence
Moderator

COL Christopher Budihas, USA
Director, Maneuver Battle Lab, Maneuver Capabilities Development and Integration Directorate

5:10 – 7:00 pm

RECEPTION
NATIONAL INFANTRY MUSEUM – TRANSPORTATION WILL BE PROVIDED

Donald Sando
Deputy to the Commanding General and Director of Capabilities Development & Integration, U.S. Army Maneuver Center of Excellence

TUESDAY, OCTOBER 19

7:00 am – 6:30 pm

REGISTRATION
NORTH HALL LOBBY

7:00 – 8:00 am

NETWORKING BREAKFAST
CENTER HALL

8:00 – 8:15 am

NDIA OPENING REMARKS
IRON WORKS BALLROOM

MG James Boozer, USA (Ret)
Executive Vice President, National Defense Industrial Association (NDIA)

8:20 – 8:35 am

WELCOME REMARKS
IRON WORKS BALLROOM

MG James Boozer, USA (Ret)
Executive Vice President, National Defense Industrial Association (NDIA)
Introducer

MG Patrick Donahoe, USA
Commanding General, U.S. Army Maneuver Center of Excellence

8:40 – 9:20 am

KEYNOTE SPEAKER
IRON WORKS BALLROOM

MG James Boozer, USA (Ret)
Executive Vice President, National Defense Industrial Association (NDIA)
Introducer

Brian Berger
President and Chief Executive Officer, GTDS America, LLC
Moderator

Honorable Ellen Lord
Former Under Secretary of Defense for Acquisition & Sustainment

9:00 am – 6:30 pm

EXHIBIT HALL OPEN
EXHIBIT NORTH AND SOUTH HALLS

9:20 – 10:30 am

NETWORKING BREAK
EXHIBIT NORTH AND SOUTH HALLS

10:30 – 11:00 am

BUDGET BRIEF
IRON WORKS BALLROOM

MG James Boozer, USA (Ret)
Executive Vice President, National Defense Industrial Association (NDIA)
Introducer

Nicholas Perry
Director, Strategy & Strategic Planning, Northrop Grumman Corporation
Moderator

Jay Brannam
Executive Director, Munitions Industrial Base Task Force

11:00 am – 12:30 pm

NETWORKING LUNCH
EXHIBIT NORTH AND SOUTH HALLS





TUESDAY CONCURRENT BREAKOUT SESSIONS

	ROBOTICS SYCAMORE ROOM	SMALL ARMS IRON WORKS BALLROOM AB	GARM ROOM 205	UEA ROOM 211	EOD IRON WORKS BALLROOM C	MES FOUNDRY ROOM B
12:30 – 12:55 pm	**An Army Robotics and Autonomous Systems Update** **Matt Dooley** Chief Executive Officer, Fidelium, LLC *Moderator* **Dr. Bob Sadowski** Senior Robotics Scientist, Research, Technology, & Integration Directorate, Ground Vehicle Systems Center, U.S. Army Combat Capabilities Development Command (DEVCOM) **MAJ Cory Wallace, USA** Robot Combat Vehicle Lead, Next Generation Combat Vehicle Cross-Functional Team **COL Rob Ryan, USA** Director, Robotics Requirements, Maneuver Capabilities Development Integration Directorate, Futures and Concepts Center, U.S. Army Futures Command **Stu Hatfield** Chief, Robotics Branch, HQDA G-8 FDD	**PM Soldier Lethality Panel** **COL Scott Madore, USA** Project Manager, Soldier Lethality, U.S. Army *Moderator* **David Oatley** Product Director, Crew Served Weapons **LTC Peter Stambersky, USA** Product Manager, Individual Weapons, Office of the Product Manager for Individual Weapons	23815 **Integrated Quality Management Reduces Risk for Armament, Robotic, and Munitions Manufacturers** **Mike Miller** Founder and Chief Executive Officer, TIP Technologies	24030 **Prism Demonstration** **Charles Douros** Performance Analysis Branch Chief, Armaments Center, U.S. Army DEVCOM	**DoD EOD Program Board Update** **Brig Gen William Kale III, USAF** Director, Civil Engineer, Deputy Chief of Staff, Logistics, Engineering and Force Protection, U.S. Air Force	**Ammunition Enterprise Cross-Service Update** **BG William Boruff, USA** Joint Program Executive Officer, Armaments & Ammunition *Moderator* **BG Gavin Gardner, USA** Commander, Joint Munitions Command **COL Lance Green, USA** Military Deputy, Armaments Center, U.S. Army DEVCOM
1:00 – 1:25 pm			23931 **MIM Frangible Energetic Projectiles for Medium-Caliber Weapons** **Howard Kent** Chief Executive Officer, Armor Development Group LLC	24041 **Human Autonomy Interactions for Intelligent Weapons Systems** **Andrew Tweedell** Research Kinesiologist, DEVCOM Army Research Laboratory, Human Research and Engineering Directorate	**Army Panel** **Leo Bradley** Founder, L.E. Bradley Consulting, LLC *Moderator* **COL Shawn Kadlec, USA** Director, Explosive Ordnance Disposal, Training & Doctrine Command Integration Office, U.S. Army Combined Arms Support Command **COL Russ Hoff, USA** Project Manager, Close Combat Systems, Joint Program Executive Office for Armaments & Ammunition	
1:30 – 1:55 pm	24083 **All-Domain Execution and Planning (ADEPT) Framework** **Camila Francolin** Leader, Autonomy, Guidance, Navigation, & Control Division, Draper		24017 **Modulation-Assisted Gun-Drilling** **Dr. James Mann** Chief Executive Officer, M4 Sciences LLC	24050 **The Development and Status of the Fire and Ordnance Control for Unmanned Systems (FOCUS)** **Thomas Spirock** Electrical Engineer, Armaments Center, U.S. Army DEVCOM		**PM Acquisition Panel** **Chris Grassano** Deputy Program Executive Officer, Joint Program Executive Office for Armaments & Ammunition *Moderator* **CAPT Brian Schorn, USN** Project Director, Joint Bombs, Joint Program Executive Office for Armaments & Ammunition **COL Russel Hoff, USA** Project Manager, Close Combat Systems, Joint Program Executive Office for Armaments & Ammunition **COL Anthony Gibbs, USA** Project Manager, Combat Ammunition Systems, Joint Program Executive Office for Armaments & Ammunition **COL Paul Alessio, USA** Project Manager, Maneuver Ammunition Systems, Joint Program Executive Office for Armaments & Ammunition **Melissa Markos** Acting Deputy, Project Director, Joint Services, Joint Program Executive Office for Armaments & Ammunition
2:00 – 2:25 pm	24064 **Autonomous Robotic Systems Act as Force Multipliers to Improve Warfighting Safety and Increase Operational Tempo** **Jonathan Brown** Manager, Business Development, RE2 Robotics	24005 **Long-Life Gun Barrel Tests** **George Kontis** Chief Executive Officer, Gun IQ International LLC	24032 **Modernizing the Energetics Manufacturing Industrial Base** **Chris Marlow** Project Manager, Franklin Engineering Group, Inc.	24073 **Range Extension for the Anti-Access Battlefield** **John Martins** Director, International Programs, MBDA, Inc.	24011 **Enabling Explosive Ordnance Disposal Operations in the Electromagnetic Spectrum** **Jerry Coburn** Senior Director, Business Development, Sierra Nevada Corporation **David Barnhard** Director, Business Development, Kutta Technologies, Inc.	
2:25 – 2:55 pm	**NETWORKING BREAK – EXHIBIT HALL** EXHIBIT NORTH AND SOUTH HALLS					

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TUESDAY CONCURRENT BREAKOUT SESSIONS

ROBOTICS — SYCAMORE ROOM

3:00 – 3:25 pm

23987
Considerations for Lethality Packages on Unmanned Ground Vehicle Platforms: Arming a Killer Robot
BG Phillip Coker, USA (Ret)
Chief Executive Officer, EOS Defense Systems USA, Inc.

3:30 – 3:55 pm

23747
Critical Scout – Repurposing Small Ground Robotic Vehicles TP Pinpoint Observers
Dr. Leo Volfson
President, Torrey Pines Logic, Inc.
Howard Kent
Chief Executive Officer, Armor Development Group LLC

4:00 – 4:25 pm

24035
FENRIS: Persistent Autonomous ISR in the Arctic and Beyond
James Crowell
Founder and Chief Executive Officer, Crow Industries

4:30 – 4:55 pm

24070
Gaining Decision-Making Advantage through Force Design and Mission Integration
Timothy Walton
Fellow, Center for Defense Concepts and Technology, Hudson Institute

4:55 – 5:00 pm

CLOSING REMARKS
Matt Dooley
President and Chief Executive Officer, Fidelium, LLC

SMALL ARMS — IRON WORKS BALLROOM AB

3:00 – 3:25 pm

Joint Service Small Arms Synchronization Team (JSSAST) Panel
Gus Funcasta
Chief, Joint Service Small Arms Program Office, Armaments Center, U.S. Army DEVCOM, U.S. Army Futures Command
Moderator
COL Lance Green, USA
Military Deputy, Armaments Center, U.S. Army DEVCOM
COL Rhett Thompson, USA
Director, Soldier Requirements Division, Maneuver Capabilities & Integration Directorate
Billy Epperson
Infantry Weapons and Optics Capabilities Integration Officer, Ground Combat Element Division, Fires & Maneuver, Capabilities Development Directorate, Combat Development and Integration, Headquarters, U.S. Marine Corps
Craig LaMudge
Program Manager, Combat Arms, HQ USAF/A4SF
Jason Rissler
Systems Engineering and Technical Assistance (SETA), Weapons

3:30 – 3:55 pm

Joint Service Small Arms Program (JSSAP) Office Session
Gus Funcasta
Chief, Joint Service Small Arms Program Office, Armaments Center, U.S. Army DEVCOM, U.S. Army Futures Command
Moderator
Mark McFadden
JSSARI Chairman, NATO Dismounted Soldier Systems, Weapons and Sensors Subgroup, U.S. Head of Delegation
Adam Jacob
Program Management Engineer, Joint Small Service Small Arms Program Office, U.S. Army Futures Command
Terence Rice
Armaments Center, Joint Small Service Small Arms Program Office, U.S. Army DEVCOM
Matthew Moeller
Lead, Soldier Lethality Cross-Functional Team, Armaments Center, Joint Service Small Arms Program Office, U.S. Army DEVCOM
Corey Hall
Manager, Joint Small Arms Small Business Innovation Research, Joint Service Small Arms Program Office

4:55 – 5:00 pm

CLOSING REMARKS
Brian Berger
President and Chief Executive Officer, GTDS America, LLC

GARM — ROOM 205

3:00 – 3:25 pm

24034
Data Science & ML-Enabled Terminal Effects Optimization
John Cilli
Computer Scientist, System Analyst, System Analysis Division, Picatinny Arsenal, U.S. Army

3:30 – 3:55 pm

24040
Analytical Evaluation and Redesign of the MK44 Rounds Positioner Spring Using Adam Multibody Dynamics Simulation Software
Jesse Behrens
Senior Principal Systems Engineer, Northrop Grumman Corporation

4:00 – 4:25 pm

24049
Multifunction Sealing, Quality Assurance, and Ammunition Marking Systems
Gustavo Domit
General Manager, Hernon Manufacturing, Inc.

4:30 – 4:55 pm

24009
Shaping the Future of Indirect Fires
Tiffany Winzell
Executive Director, Business Development, Elbit Systems of America

4:55 – 5:00 pm

CLOSING REMARKS
Matthew Phillips
Director, Business Development, General Dynamics Ordnance and Tactical Systems

UEA — ROOM 211

3:00 – 3:25 pm

23999
Modernizing the Army by Utilizing Design of Experiments Approaches to Determine System Effectiveness in a Stochastic Infantry Simulation
Thorsten Roberts
Military Operations Researcher, Armaments Center, U.S. Army DEVCOM

3:30 – 3:55 pm

24025
Decision Analytics for Threat Response
Charles Douros
Performance Analysis Branch Chief, Armaments Center, U.S. Army DEVCOM

4:00 – 4:25 pm

CLOSING REMARKS
Alan Kull
Senior Manager, Aerospace Systems Engineering, General Atomics

EOD — IRON WORKS BALLROOM C

3:00 – 3:25 pm

24007
Enhanced Situational Awareness for the Modern EOD Warrior
Dr. Aris Makris
Vice President, Research & Development, and Chief Technology Officer, Med-Eng

3:30 – 3:55 pm

24023
Searchable Ordnance Database
Anthony O'Shaughnassey
Chief Executive Officer and Managing Partner, FMF Technology, LLC
Mike Pate
Chief Operating Officer, FMF Technology, LLC
Vadim Bichutskiy
Chief Technology Officer, FMF Technology, LLC

4:00 – 4:25 pm

CLOSING REMARKS
Leo Bradley
Founder, L.E. Bradley Consulting, LLC

MES — FOUNDRY ROOM B

3:00 – 3:25 pm

PM Acquisition Panel Continued

3:30 – 3:55 pm

Energetics and Lethality: The Imperative to Reshape the U.S. Military Kill Chain
Dr. Theresa Mayer
Executive Vice President, Research & Partnerships, Purdue University
Moderator
Dr. Thomas Russell
Former Deputy Assistant Secretary of the Army for Research & Technology
James Thomsen
Former Principal Deputy Assistant Secretary of the Navy (Research, Development and Acquisition)
MG Bill Hix, USA (Ret)
Former Chief, Strategy Office, U.S. Army
Dr. Robert Wardle
Principal, Wardle Enterprises, Energetic Solutions and Technologies, Inc.

4:30 – 4:55 pm

CLOSING REMARKS
Nicholas Perry
Director, Strategy & Strategic Planning, Northrop Grumman Corporation

5:00 – 6:30 pm

NETWORKING RECEPTION
EXHIBIT NORTH AND SOUTH HALLS

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WEDNESDAY, OCTOBER 20

7:00 am – 5:00 pm

REGISTRATION
NORTH HALL LOBBY

7:00 – 8:00 am

NETWORKING BREAKFAST
CENTER HALL

8:00 – 8:15 am

OPENING REMARKS
IRON WORKS BALLROOM

MG James Boozer, USA (Ret)
Executive Vice President, National Defense Industrial Association (NDIA)
Introducer

B. H. "Skip" Henderson, III
Mayor of Columbus, Georgia

8:20 – 9:05 am

KEYNOTE SPEAKER
IRON WORKS BALLROOM

MG James Boozer, USA (Ret)
Executive Vice President, National Defense Industrial Association (NDIA)
Introducer

Brian Berger
President and Chief Executive Officer, GTDS America, LLC
Moderator

COL Wendell Leimbach, Jr., USA
Director, Joint Intermediate Force Capabilities Office, U.S. Department of Defense

9:00 – 3:00 pm

EXHIBIT HALL OPEN
EXHIBIT NORTH AND SOUTH HALLS

9:10 – 9:40 am

NETWORKING BREAK
EXHIBIT NORTH AND SOUTH HALLS

9:40 – 10:25 am

FOREIGN COMPARATIVE TESTING (FCT) PROGRAM OVERVIEW
IRON WORKS BALLROOM

MG James Boozer, USA (Ret)
Executive Vice President, National Defense Industrial Association (NDIA)
Introducer

COL Randy Everett, USA (Ret)
International Armaments Cooperation Staff Officer, U.S. Army Combat Capabilities Development Command

10:30 – 11:30 am

AWARDS PRESENTATION
IRON WORKS BALLROOM

Small Arms Committee Chinn Award
Ralph Mazeski

Small Arms Committee Hathcock Award
MSGT Kevin Owens, USA

Small Arms Committee James R. Ambrose Award
Vista Outdoor

Gun & Missile Systems Committee Robert Trifiletti Award
Ralph Campoli

Defense User Recognition for Excellence Award
Dan Deguire

Ground Robotics Champion
MAJ Cory Wallace, USA

Armaments Division Professional Service Award
COL Hector Gonzales, USA

Armaments Division Professional Service Award
COL Andrew Lunoff, USA

11:30 – 1:00 pm

NETWORKING LUNCH
EXHIBIT NORTH AND SOUTH HALLS

NDIA Connect

AN ONLINE COMMUNITY FOR DEFENSE PROFESSIONALS

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WEDNESDAY CONCURRENT BREAKOUT SESSIONS

	ROBOTICS SYCAMORE ROOM	SMALL ARMS IRON WORKS BALLROOM AB	GARM ROOM 205	UEA ROOM 211	EOD IRON WORKS BALLROOM C	MES FOUNDRY ROOM B
1:00 – 1:25 pm	24039 **Hardware-Enforced Data Separation Security on Autonomous Robotic Systems or: How I Learned to Stop Worrying and Trust the Robot** Matthew Dosmann Vice President, Strategy, InZero Technologies	**Suppressor Panel/Session** Adam Jacob Program Management Engineer, Joint Service Small Arms Program Office, U.S. Army Futures Command *Moderator* 24068 **STANREC 4785 Suppressor Testing** Dr. Leslie James Flemming Project Lead, Small Arms Signature Laboratory, Naval Surface Warfare Center – Crane Division Adam Jacob Program Management Engineer, Joint Service Small Arms Program Office, U.S. Army Futures Command 23988 **Modular Suppressor Test Bed Design of Experiments** Daniel Cler General Engineer, Armaments Center, U.S. Army DEVCOM 23964 **Suppressor Cleaning** Zachary Torigian Mechanical Engineer, Armaments Center, U.S. Army DEVCOM 24054 **Intermediate Caliber Virtual-Baffle Suppressor System** Dr. Phillip Burnside Mechanical Engineer, Naval Surface Warfare Center – Crane Division 23979 **Surefire's Advanced Suppressor Program - Blending Experience with Technology to Bring Next Generation Signature Suppression Technology to the Warfighter** Barry Dueck Vice President, Suppressor & Weapons Division, Surefire 24052 **7.62mm Belt-Fed Suppressor** Phillip Haag Director, Research & Development, Radical Firearms/Radical Defense 24061 **Maxim Defense M240 Suppressor** David Steinbech Director, Military & Law Enforcement Sales, Maxim Defense, Inc.	24008 **Modular Multi-Mode Seeker** Greg Newman Technical Director, Engineering, Elbit Systems of America	**Passive IR Projectile Tracking for RWS Closed-Loop Fire Control** Matt Robertson Weapons Systems, Naval Surface Warfare Center – Crane Division	**USAF Panel** Leo Bradley Founder, L.E. Bradley Consulting, LLC *Moderator* Dr. John Olive Deputy, EOD Division, Air Force EOD Subject Matter Expert SMSgt Cole Pasley, USAF Manager, Joint EOD Technology Division	**Industry Panel: Medium and Small Businesses** Scott McAnallen Program Manager, Azimuth Consulting *Moderator* David Siggers President, Spectra Technologies LLC Scott Selle President, Armtec Defense Technologies Nick Korinis President and Chief Executive Officer, SAVIT Corporation
1:30 – 1:55 pm	24004 **Mobile Minefield: How to Kill Modern Tanks That Have Advanced Protection with Small Robots** Dewey Akers Vice President, Sales, Spartan Armor Systems		24036 **MK52 Chain Gun (7.62 X 62mm) History, Capabilities, Reliability, and Platform Integration** Art O'Donnell Lead, Engineering, Northrop Grumman Defense Systems	23729 **Hydrone Multi-Domain (Marine, Ground, Air) Vehicle** Scott Kempshall President and Chief Executive Officer, HyALTA Aeronautics, Inc.		
2:00 – 2:25 pm	24058 **The Multi-Purpose Expeditionary Platform** Caleb Holt Chief Executive Officer, Tracks North America, LLC		24063 **Counter-Improvised Explosive Devises (CIED)** Dr. Benjamin Barrowes Senior Research Electrical Engineer, Cold Regions Research & Engineering Laboratory, U.S. Army Corps of Engineers	24006 **Armament Sustainment and Lethality Multipliers in Expeditionary Settings** Jonathan Ross Manager, Strategic Initiatives, Marvin Engineering Co., Inc. Todd McKinney Director, Technical Solutions, Marvin Engineering Comany, Inc.	24081 **The EOD Future Threat Landscape and Explosive Detection Technology Advancements** Sean Dennis President, United States Bombs Tech Association	**CLOSING REMARKS** Nicholas Perry Director, Strategy & Strategic Planning, Northrop Grumman Corporation
2:25 – 2:55 pm	**NETWORKING BREAK** EXHIBIT NORTH AND SOUTH HALLS					

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WEDNESDAY CONCURRENT BREAKOUT SESSIONS

	ROBOTICS SYCAMORE ROOM	SMALL ARMS IRON WORKS BALLROOM AB	GARM ROOM 205	UEA ROOM 211	EOD IRON WORKS BALLROOM C	MES FOUNDRY ROOM B
3:00 – 3:25 pm	24019 **AI-Enabled and UAS-Supported Terrain-Traversability Assessment for Off-Road Navigation of Robotic and Autonomous Systems (RAS)** Dr. Yoichiro Endo Director, Robotics & Electromechanical Systems, Intelligent Automation, Inc.	24028 **Artificial Intelligence-Enabled Small Arms for Networked Lethality** Ross Towers Lead, Future Fire Control Team, Small Arms, Armaments Center, U.S. Army DEVCOM	**USMC – APBI** Capt Howard Mill, USMC Chief Information Officer, Counter-UAS, Aviation Combat Element Division, Combat Development and Integration	24060 **TRAPS: Empowering FWS-I and Storm Systems** Leif Horton Vice President, Sales, TX-Tactical	24074 **Briefing on EOD Issues with Disposing of Insensitive Munitions** Willie Snell Specialist, Explosive Ordnance Disposal Equipment, U.S. Army EOD Technical Detachment	
3:30 – 3:55 pm	24079 **Emerging Technologies for Armed Unmanned Systems** Gus Taylor Chief Engineer, Weapons Systems, Naval Surface Warfare Center – Crane Division Ernesto Garcia-Lopez Special Programs Manager, Strategic Relationships Division, Business Interface Office, Enterprise & Systems Integration Center, Armaments Center, U.S. Army DEVCOM Michael Jones Lead Engineer, Scalable Effects R&D Group, Naval Surface Warfare Center – Crane Division	24029 **Semi-Autonomous Engagement Mechanisms and Effects for Small Arms** Ross Towers Lead, Future Fire Control Team, Small Arms, Armaments Center, U.S. Army DEVCOM	24045 **Xm914e2 Chain Gun – LW30 (30mm X 113mm) Capability on Light Tactical Vehicles** John Inman System Engineer, Northrop Grumman Corporation	24056 **Reinforced Concrete Wall Performance Prediction Using Deep Neural Network** David Holgado Senior Safety & Security Engineer, Stone Security Engineering	**CLOSING REMARKS** Leo Bradley Founder, L.E. Bradley Consulting, LLC	
4:00 – 4:25 pm	24038 **Optionally Manned Semi-Autonomous Howitzer** Michael Evans Program Manager, Fires Programs, AM General LLC	24048 **Mechanochemically Assisted Broaching of Refractory-Lined Gun Barrels** Dr. Jason Davis Mechanical Engineer, Naval Surface Warfare Center – Crane Division	**CLOSING REMARKS** Matthew Phillips Director, Business Development, General Dynamics Ordnance and Tactical Systems	24046 **Virtual Gunner** William Nuckols Program Director, Ground Combat Systems, Elbit Systems of America		
4:30 – 4:55 pm	24014 **Perception-Based Robotic Reconnaissance Team Coordination in a Hostile Environment** Dr. Hambisa Keno Principal Scientist, FAST Labs, BAE Systems, Inc.	**CLOSING REMARKS** Brian Berger President and Chief Executive Officer, GTDS America, LLC		24086 **Capability Integration: Considering for Delivering the Future** Tom Henthorn Capability Developer, USG CTR, Joint Service Small Arms Program		
4:55 – 5:00 pm	**CLOSING REMARKS** Matt Dooley President and Chief Executive Officer, Fidelium, LLC			**CLOSING REMARKS** Alan Kull Senior Manager, Aerospace Systems Engineering, General Atomics		

THURSDAY, OCTOBER 21

8:30 am — **TRANSPORTATION PICK-UP**
COLUMBUS, GA, CONVENTION AND TRADE CENTER

9:00 am — **ARMOR RESTORATION SHOP**
HARMONY CHURCH

11:00 am — **TRANSPORT TO SMALL ARMS LIVE-FIRE DEMONSTRATION**
PATTON RANGE

12:30 – 4:00 pm — **LIVE-FIRE DEMONSTRATION**
PATTON RANGE

2:00 pm — **EARLY BUS DEPARTS**
PATTON RANGE

NDIA has a policy of strict compliance with federal and state antitrust laws. The antitrust laws prohibit competitors from engaging in actions that could result in an unreasonable restraint of trade. Consequently, NDIA members must avoid discussing certain topics when they are together at formal association membership, board, committee, and other meetings and in informal contacts with other industry members: prices, fees, rates, profit margins, or other terms or conditions of sale (including allowances, credit terms, and warranties); allocation of markets or customers or division of territories; or refusals to deal with or boycotts of suppliers, customers or other third parties, or topics that may lead participants not to deal with a particular supplier, customer or third party.

LIVE-FIRE DEMONSTRATING COMPANIES

THURSDAY, OCTOBER 21

AERO PRECISION
AIMLOCK
B&T USA
KGM TECHNOLOGIES
LEIDOS INNOVATIONS CENTER
LMT DEFENSE
MARATHON TARGETS
MAXIM DEFENSE INDUSTRIES
NOVO USA
RADICAL DEFENSE
SECUBIT, INC. | WEAPONLOGIC
SIG SAUER, INC.
SUREFIRE, LLC
TRIJICON
UNIT SOLUTIONS

ABSTRACT SUMMARIES

ROBOTICS

24083

All-Domain Execution and Planning (ADEPT) Framework

Francolin, C.

The ADEPT framework is a design concept which addresses the challenges of adaptive behaviors and intelligent autonomy. ADEPT has had multiple instantiations in software architectures used on a wide variety of autonomous systems and applications including undersea, ground, air, and space vehicles.a

24064

Autonomous Robotic Systems Act as Force Multipliers to Improve Warfighting Safety and Increase Operational Tempo

Brown, J.

RE2 Robotics is developing multiple autonomous robotic systems for the DoD to serve as force multipliers, help decrease injuries experienced by warfighters, and increase operational tempo.

23987

Considering for Lethality Packages on Unmanned Ground Vehicle Platforms: Arming a Killer Robot

Coker, P.

To achieve maximum effectiveness, lethality payloads on UGV platforms must be precise, sufficiently powerful, reliable, easily resupplied, modular and intelligent.

23747

Critical Scout - Repurposing Small Ground Robotic Vehicles TP Pinpoint Observers

Kent, H.

A robotic payload that geolocates enemy optics.

24035

Fenris: Persistent Autonomous ISR in the Arctic and Beyond

Crowell, J.

Fenris is a small-scale ruggedized, intelligent unmanned ground vehicle (UGV) designed to provide persistent ISR in the Arctic and beyond. In this talk, CI's Founder & CEO James Crowell will discuss Fenris' current progress to date and its promise for the future.

24070

Gaining Decision-Making Advantage Through Force Design and Mission Integration

Walton, T.

This DARPA-sponsored study describes a new model for joint force design and integration, where elements of military capability are able to be composed and tailored by Combatant Commanders to the needs of specific operational challenges close to the time of use. Combined with appropriate command and control processes and systems, this model of mission integration has the potential to provide military advantage against capable adversaries through the surprise generated from force composition and recombination. Mission integration could also reduce the cost of operations and modernization by enabling aggregation of less-expensive weapons systems to realize capabilities provided today by large multimission platforms or formations.

24039

Hardware Enforced Data Seperation Security on Autonomous Robotic Systems Or: How I Learned to Stop Worrying and Trust the Robot

Dosmann, M.

As robots become more prevalent and powerful, their cybersecurity is crucial. Hardware enforced data separation closes critical gaps in their security.

24004

Mobile Minefield: How to Kill Modern Tanks That Have Advanced Protection with Small Robots

Akers, D.

They may have passive and active protection from direct fire, artillery fragment, rocket and missile threats, but even the latest battle tanks are vulnerable to the smallest robotic systems. Proposed are commercially developed scale off road racing vehicles used to create weapons which are armored, armed and equipped with surveillance systems to destroy armored vehicles and other targets.

24058

The Multi-Purpose Expeditionary Platform

Holt, C.

The Multi-Purpose Expeditionary Platform (MPEP) provides the Air Force an innovative, versatile platform for logistics, construction, disaster recovery, and more, along with multiple hydraulic attachment available today.

24019

AI-Enabled and UAS-Supported Terrain-Traverability Assessment for Off-Road Navigation of Robotic and Autonomous Systems (RAS)

Endo, Y.

A computational framework for a RAS that enables real-time construction of a traversability map was developed. Employing a set of customized deep neural networks, the traversability of the region perceivable through an onboard camera and/or a UAS-captured aerial image is automatically inferred and added to an active traversability map, so that the most efficient route can be computed. This computational framework was implemented within ROS-2, and integrated into a custom-made autonomy payload. The successful field-testing using this UGV-mounted autonomy payload paired with a sUAS demonstrated the utility of this AI-enabled computational framework for effective off-road navigation of future RAS.

24079

Emerging Technologies for Armed Unmanned Systems

Garcia-Lopez | E. Taylor, G.

Group (JTUAWG). The working group is a network of Army and Navy Laboratories that collaborate to develop small/miniature weapons for smaller Unmanned Systems in the land, air, and sea domains. This multi-domain capability will ultimately save friendly lives by giving small combat units the ability to conduct armed reconnaissance, and optionally engage the enemy with scalable effects, and without exposing Warfighters to enemy fire.

24038

Optionally Manned Semi-Autonomous Howitzer

Evans, M.

AM General with its partners Maren-go and Mandus Group LLC has developed a teleoperated Hawkeye mobile howitzer to demonstrate the feasibility of moving and positioning a 105mm howitzer using a remote device controlled by a distant operator. After a successful test, AM General expanded the capability to leader-follower of two howitzers, autonomous positioning and remote firing of the cannon.

24014

Perception-Based Robotic Reconnaissance Team Coordination in a Hostile Environment

Keno, H.

Our team at BAE Systems FAST Labs is working toward developing and transitioning Mission Intelligence for Tactical Systems (MITS), an autonomy and coordination system for a multi-robot reconnaissance team composed of unmanned ground vehicles (UGVs) and supporting unmanned aerial systems (UASs) that host a variety of sensor payloads. We will present the main challenges we addressed, our method, experimental results, plans for future work, and a transition plan to ground operations.

SMALL ARMS

24005

Long Life Barrel Tests

Kontis, G.

Test results show a major extension in gun barrel life is achievable with barrels made from new steel.

24068

STANREC 4785 Suppressor Testing

Dye, D. | Jacob, A.

An overview of the suppressor testing program at NSWC Crane will be presented including descriptions of test standards, procedures, and hardware used.

23964

Suppressor Cleaning

Torigian, Z.

The purpose of this brief is to present the challenges, trends, methodology and preliminary data from the US Army Suppressor Cleaning effort to the defense community. The presentation will illustrate the widespread problem of small arm suppressors becoming ineffective due a buildup of fouling deposits. The brief will contain technical content related to ongoing developments by both the USG and industry to extend the service life and performance of suppressors.

24054

Intermediate Caliber Virtual-Baffle Suppressor System

Burnside, P.

Using CFD to take advantage of shock waves to improve suppressor performance.

23979

Surefire's Advanced Suppressor Program - Blending Experience with Technology to the Warfighter

Dueck, B.

Surefire's Advanced Suppressor Program blends experience with Technology to bring Next Generation Signature Suppression to the Warfighter. The end results are a Next Generation, patent pending, low back pressure suppressor designed and optimized for the warfighter providing best in class, Audible and Visual characteristics.

24052

7.62 MM Belt Fed Suppressor

Haag, P.

Radical Firearms has produced fully functioning machine gun suppressors with audible, thermal, and flash signature reduction utilizing additive manufacturing from a high nickel and cobalt superalloy. This is to show the real-world viability of the proposed technologies on a proven platform. The technology has the ability to be adapted to multiple platforms.

24061

Maxim Defense M240 Suppressor

Steinbech, D.

This abstract provides the details on Maxim Defenses efforts to reduce/remove the visual and audible signature of the M240MG.

23988

Modular Suppressor Test Bed Design of Experiments

Cler, D.

A design of experiments was conducted using modular suppressor hardware to assess blast and flash.

24028

Artificial Intelligence Enabled Small Arms for Networked Lethality

Towers, R.

As availability of information on the battlefield increases, dismounted forces need tools to filter that information for relevancy, and convert it for immediate action. An artificial intelligence, embedded at the weapon system's fire control, maximizes the utilization of available information to increase dismounted squad lethality.

24029

Semi-Autonomous Engagement Mechanisms and Effects for Small Arms

Towers, R.

Lethality in small arms systems remains limited by Soldier accuracy. Leveraging advances in target detection and tracking enables a semi-autonomous fire control system to significantly reduce aim error, while allowing the Soldier to retain final control over target engagement.

24048

Mechanochemically Assisted Broaching of Refractory-Lined Gun Barrels

Davis, J.

A recent scientific discovery may be key to realizing the use of refractory linings in gun barrels. This discovered surface effect transitions the 'gummy' behavior of refractory metals when cut to one that is much more favorable, enabling conventional rifling of the liners - a task until now that has proven to be quite challenging.

GARM

23815

Integrated Quality Management Reduces Risk for Armaments, Robotic, and Munitions Manufacturers

Miller, M.

This presentation will discuss how an integrated electronic quality management solution can help armament, robotics, and munitions manufacturers improve operations, reduce risk, and meet industry regulations. We will discuss steps to achieving a comprehensive continuous improvement strategy to put companies on the path to improved productivity and profitability, while protecting customer safety.

23931

MIM Frangible Energetic Projecticles for Medium Caliber Weapons

Kent, H.

Introducing a medium caliber frangible energetic projectile for C-UAS, target marking and training.

24017

Modulation-Assisted Gun-Drilling

Mann, J.

Manufacturing productivity gains and quality improvements in deep-hole gun-drilling with modulation are reviewed. Applications in 4140 and 416R steel alloys are discussed.

24032

Modernizing the Energetics Manufacturing Industrial Base

Marlow, C.

A process to evaluate and modernize energetics manufacturing processes is described and detailed, including examples of successful projects.

24034

Data Science & ML-Enabled Terminal Effects Optimization

Eng, K. | Krogstad, Z. | Patel, R.

Warhead design and performance optimization is conducted utilizing technologies from data science, machine learning, distributed computing, and computational optimization.

24040

Analytical Evaluation and Redesign of the MK44 Rounds Positioner Spring Using Adam Multibody Dynamics Simulation Software

Behrens, J.

The Mk44 30mm cannon utilizes a custom shape spring to quickly translate rounds from its dual feed paths and into the bolt. The dynamic behavior of the spring when feeding rounds is difficult to characterize with classical analytically approaches. Optimization of the spring geometry using empirical methods may require multiple time consuming iterations. This presentation will describe how MSC Adams, a multi-body dynamics simulation software, was coupled with SmartUQ's DOE software was utilized to model the Mk44 feed system including gear train, linked rounds, and spring to optimize the Mk44 cannon's rounds positioner spring.

24049

Multifunction Sealing, Quality Assurance and Ammunition Marking Systems

Domit, G.

HERNON Manufacturing has developed a single enclosure which seals, weighs, performs 2-D dimensional profiling and bullet tip ID marking on 100% of post production ammunition passed through it.

24008

Modular Multi-Mode Seeker (Distro D)

Newman, G.

This presentation provides information on Elbit America's integrated seeker suite that address the multi-faceted problem of keeping pace with evolving threats and kill-chain closure in contested regions. This suite of integrated multi-mode sensors and effectors, on distributed platforms and across domains in a networked, configurable battlespace offers an affordable, flexible, WOSA compliant solution.

24009

Shaping the Future of Indirect Fires (Distro D)

Winzell, T.

This presentation provides an overview of the production-ready systems Elbit America offers to the warfighter. Leveraging combat proven systems developed and fielded by Elbit Land in Israel, the ATMOS (mobile howitzer), Sling and Spear (mobile mortars) and Cardom (turreted mortar) systems coupled with precision guided rounds and seeker technologies are re-shaping the future indirect fires. Bringing in laser and GPS guidance gives battlefield operators the ability to connect on target with the first round, providing increased survivability and inherent cost savings. Committed to expanding the U.S. Industrial Base footprint, Elbit America is moving toward U.S. production of these systems beginning in 2022.

24036

MK52 Chain Gun (7.62 X 62MM) History, Capabilities, Reliability, and Platform Integration (Distro D)

O'Donnell, A.

In response to the growing interest in small and medium caliber chain guns on various platforms including Remote Weapon Stations, this presentation will focus on the 7.62 x 51mm MK52 Gun System.

24063

Counter Improvised Explosive Devices (CIED) (Distro D)

Barrowes, B.

High-frequency electromagnetic induction (HFEMI) can detect and classify carbon rods, wires, and other improvised explosive device constituent parts.

24045

XM914E2 Chain Gun - LW30 (30MM X 113MM) Capability on Light Tactical Vehicles (Distro A)

Inman, J.

In response to the growing interest of medium caliber capability on lightweight platforms with focus in counter-UAS, DEVCOM and Northrop Grumman are in the process of maturing and optimizing the 30mm x 113mm XM914E2 Chain Gun. The focus of this abstract highlights the operator level maintainability improvements being implemented into the XM914E2.

UEA

24030

PRISM Demonstration

Douros, C.

Demonstration on the modularity of M&S using DEVCOM AC's PRISM framework.

24041

Human Autonomy Interactions for Intelligent Weapons Systems

Tweedell, A.

New research approaches by U.S. Army Research Laboratory are discussed for human-agent interaction for intelligent squad weapons.

24021

Winning the Gray Zone: The Importance of Intermediate Force Capabilities

Leimbach, W.

Winning in the Gray Zone means completing the "deterrence equation," that is, precluding adversary aggression in competition below armed conflict with intermediate force capabilities (IFCs) in a manner similar to equipping the U.S. military element of national power with overwhelming lethality as a deterrent to armed conflict.

IFCs, which include non-lethal weapons as well as other non-lethal tools, will bridge the gap that exists between a mission of mere presence and the use of lethal effects.

24050

The Developemnt and Status of the Fire and Ordnance Control for Unmanned Systems (Focus)

Spirock, T.

The development of the Fire and Ordinance Control for Unmanned Systems (FOCUS) by the Joint Tactical Unmanned Armaments Working Group (JTUAWG) will be discussed.

24073

Range Extension for the Anti-Access Battlefield

Martins, J.

The INDOPACOM theater requires U.S. forces to employ weapons with increasingly longer standoff ranges. This presentation will discuss the spectrum of modifications to significantly increase weapon employment ranges while preserving weapon mass properties. Specifically, it will discuss the long range ramjet powered Meteor air-to-air weapon, the turbojet powered SPEAR 3 air-to-surface weapon, and wing kit additions to unpowered munitions like the 155mm surface-to-surface guided artillery projectile. Discussions will include weapon kinematics as well as emerging seeker and data link requirements for long range employment on a network connected battlefield.

23999

Modernizing the Army by Utilizing Design of Experiments Approaches to Determine System Effectiveness in a Stochastic Infantry Simulation

Roberts, T.

This case study follows the novel design and analysis of computer experiments (DACE) approach taken for the operational analysis of the AFCT (Advanced Fire Control Technology) as a follow on project for the IVAS (Integrated Visual Augmentation System) for the dismounted combat infantry soldier.

24025

Decision Analytics for Threat Response

Sassaman, G.

Utilizing decision analytics methodologies to respond to threat advancements in technologies and capabilities while balancing system level competing objectives (Cost, Schedule, Performance).

23729

Hydrone Multi-Domain (Marine, Ground, Air) Vehicle

Kempshall, S.

HyDrone is the world's only fully multi-modal (air/land/maritime) UAS. This capability is provided with minimal parasitic elements.

24006

Armament Sustainment and Lethality Multipliers in Expeditionary Settings

McKinney, T. | Ross, J.

The presentation focuses on providing warfighters with the means to integrate and sustain armament systems to support various munitions, including air and surface launched missiles, as well as air dropped bombs, on both manned and unmanned platforms in austere, expeditionary settings. Utilizing mobile, partially containerized solutions, we will discuss how Air, Ground, and Maritime assets can benefit from having agile support capabilities delivered closer to the action, in highly mobile formats that can serve as force multipliers to support distributed operations.

24060

TRAPS: Empowering FWS-I and Storm Systems

Horton, L.

The military has implemented a standard rail interface systems, known as the Picatinny Smart Rail (PSR). This system provides a mounting platform for firearms accessories, including tactical lights or telescopic sights. The military can mount both the Family of Weapon Sights – Individual (FWS-I) (2) and Small Tactical Optical Rifle Mounted (STROM) (3,4,5) micro-laser rangefinder Program of Record hardware onto the current PSR. However, each solution has its own battery source and user interface, complicating decision-making and hindering operational efficiencies for the modern warfighter.

To solve this issue, new approaches are needed to integrate current FWS-I and STORM hardware to the standard PSR. Specifically, the adapters are required for current FWS-I and STORM systems to make these two systems compatible with its new PSR interface, operating system, and electrical supply source to minimize size and weight. The Tactical Rail Accessory Power System (TRAPS) by Axle Box Innovations, will solve these problems and provide the military with a unique solution for integrating FWS-I and STORM hardware onto the Pic rail while delivering a significant cost advantage. The TRAPS is a single-point power supply for electronic targeting enablers.

24056

Reinforced Concrete Wall Performance Predicted Using Deep Neural Network

Holgado, D.

Based on test data, two DNN Models are built to predict rc wall performance under contact and near-contact explosions. Obtained predictions shows higher accuracy compared with currently available models.

24046

Virtual Gunner

Nuckols, W.

Virtual Gunner reduces the cognitive load and enhances the combat effectiveness of a modern combat vehicle crew with multiple sensor and weapon systems employed in the current and future highly dynamic combat environment.

24086

Capability Integration: Considering for Delivering the Future

Henthorn, T.

Everyone seeks to add capability to the squads of the future, but as we try and expand the envelope of capability, we may need to reconsider what that squad looks like…what needs to be considered? How do we get there? What could it look like?

EOD

24011

Enabling Explosive Ordnance Disposal Operations in the Electromagnetic Spectrum

Barnhard, D. | Coburn, J.

Concepts for multi-domain combined arms operations define threats in the operating environment (OE) in 2025 and beyond as super-empowered through rapid access to information and significant advances in commercial electronics. Electronic support hardware and visualization tools that provide detection, localization and isolation of commercial wireless signals and devices will become necessary to enhance security and situational awareness to mitigate risk. The ability to quickly and safely locate SOIs can also be enhanced by the use of multiple, heterogeneous types of unmanned platforms (UGV, UAV, USV, etc.). This presentation will explore notional use cases that illustrate current and envision future technologies that serve to provide the EOD operator with additional sensing capabilities.

24007

Enhanced Situational Awareness for the Modern EOD Warrior

Makris, A.

There is an ever-increasing need to enhance the situational awareness of the modern EOD operator as threats expand and improvised explosive devices (IEDs) become increasingly sophisticated, with possible contamination of the target environment by CBRN agents. Additionally, there can be a need for night operations where visible lights are not permitted. To respond to such threats, EOD operators require equipment and detectors across a broad spectrum of threats, as well as a range of camera sensors, which must seamlessly integrate with their current protective ensembles through appropriate interfaces, displays and embedded heads-up-display (HUD). The current presentation introduces two current programs aimed at delivering integrated sensor and HUD capability to EOD operators, having the potential to significantly transform render safe operations and capability under a diversity of operating conditions and threats.

24023

Searchable Ordnance Database

Bichutskiy, V. | Shaughnassey, A. | Pate, M.

We present Searchable Ordnance Database (SOrD), a novel framework for ordnance and explosives identification, recognition and intelligence. SOrD provides a mobile-first platform---buttressed by a munitions and explosives data lake and an ordnance data warehouse with more than 100,000 items, and leveraging the latest advancements in AI/ML, AR/VR, LIDAR, and mobile technologies---consisting of a suite of tools that provide EOD personnel with actionable intelligence quickly, easily and efficiently.

24074

Briefing on EOD Issues with Disposing of Insensitive Munitions

Snell, W.

This brief covers a short history of munitions safety. It also covers insensitive munitions (IM) and EOD issues with disposing of IM. The reasons we have issues disposing of IM are discussed as are the ways we are currently achieving disposals.

24081

The EOD Future threat Landscape and Explosive Detection Technology Advancements

Dennis, S.

Analysis and solutions for future EOD explosive threat detection requirements with the USBTA and DetectaChem.

POSTER PRESENTERS

SMALL ARMS

Board 1

Coaxial OD Sensors - Enabling Crew Served Weapon Gunners to Eliminate Snipers and Other Optically Equipped Observers

Kent, H.
Armor Development Group, LLC

Board 2

Integration of Modern Suppression Technologies into Mass Production

Mudgett, C.
B&T USA

Board 3

Resiliency of Caliber .50 Projectiles in Barrels with Irregular Rifling

Gmyrek, T.
U.S. Department of Defense

Board 4

Inert Fill Replacement

Bell, J.
UDC USA, Inc.

Board 5

Replacing Tracers With Visible, Thermal and IR Signature on Target Projectile Technology

Kent, H.
Armor Development Group, LLC

Board 6

Modular Suppressor Test Bed Design of Experiments

Cler, D.
Armaments Center, U.S. Army DEVCOM

Board 7

Zinc Slug Feasibility

Holland, T.
Armaments Center, U.S. Army DEVCOM

Board 8

Lightweight Materials Houstings for GRIN Prototype Riflescopes

Dionisio, R.
CCDC Armaments Center, U.S. Army

Board 9

Cleaning Sealed Firearm Suppressors for Longer Service Life and Replacement Cost Savings

France, B.
TDA Research, Inc.

ROBOTICS

Board 10

Kinesis - Universal Robotic Control

Brodmerkel, C.
Tomahawk Robotics

Board 11

What's Your Backup Plan? Adapting Crew Served Robotic Weapons to Manual Firing

Kent, H.
Armor Development Group, LLC

Board 12

Combat Optimized Ballistic Remote Armament (COBRA)

Smith, A.
Armaments Center, U.S. Army DEVCOM

EOD

Board 13

Advanced Demolition Explosives are Needed to Dispose of Insensitive Munitions (IM) to Overcome the Tactical Disadvantage of Current Demolition Explosives

Wittkamper, B.
Booz Allen Hamilton

SPEAKER BIOGRAPHIES



BG WILLIAM BORUFF, USA

Joint Program Executive Officer
Armaments & Ammunition Commanding General

Brigadier General William M. Boruff became the Joint Program Executive Officer Armaments & Ammunition and the Commanding General, Picatinny Arsenal on July 23, 2021, leading the mission to develop and procure conventional and leap-ahead munitions to increase the warfighter's combat power. Prior to this, BG Boruff served as the Special Assistant to the Military Deputy/Director, Army Acquisition Corps, Office of the Assistant Secretary of the Army (Acquisition, Logistics and Technology) Washington, DC. Prior to arriving at the Pentagon, Brigadier General Boruff served as the Deputy Commanding General of the Combined Security Transition Command, Kabul Afghanistan.

Brigadier General Boruff was commissioned as a second lieutenant in Field Artillery from the ROTC program at the University of North Carolina at Pembroke, North Carolina, where he received a Bachelor of Science in Accounting as a distinguished military graduate. He joined the Army Acquisition Corps in 1995. His advanced education includes a Master of Science in Acquisition and Contract Management, Florida Institute of Technology, Melbourne, Florida. His military education includes a Master of Science in Strategic Studies from the U.S. Army War College; Air Command and Staff College; Transportation Corps Advance Course; Multiple Launch Rocket System Cadre Course; and Field Artillery Basic Course.

Brigadier General Boruff has held numerous command and staff positions. His assignments include contingency contracting officer, XVIII Airborne Corps, Fort Bragg, North Carolina; assignment officer, Acquisition Management Branch, U.S. Army Human Resources Command, Alexandria, Virginia; executive officer to the Director, U.S. Army Acquisition Support Center, Fort Belvoir, Virginia; proponency officer, Army Acquisition Executive Support Agency, Pentagon; commander, Defense Contract Management Agency-Northern Iraq; deputy director, USAASC; commander, Defense Contract Management Agency, Combat Vehicles BAE Systems, York, Pennsylvania; project manager, Transportation Systems; director, Contracting Enabler Cell, Combined Security Transition Command Afghanistan; and, Commanding General of the Mission and Installation Contracting Command, Fort Sam Houston, TX.

His awards and decorations include the Legion of Merit with one oak leaf cluster, Bronze Star with two oak leaf clusters, Defense Meritorious Service Medal, Meritorious Service Medal with four oak leaf clusters, Joint Service Commendation Medal, Southwest Asia Service Medal, Afghanistan and Iraq Campaign Medals, Global War on Terrorism Service Medal, NATO-International Security Assistance Force Medal (Afghanistan), Saudi Arabian Kuwaiti Liberation Medal, and Kuwaiti Liberation Medal. He is authorized to wear the Army Parachute Badge, Air Assault Badge and Joint & Army Staff Identification Badge. In fiscal 1997, he was awarded the Secretary of the Army Award for Excellence in Contracting-Outstanding Contingency Contracting Officer; and, in fiscal 2009 he was named the Secretary of the Army Acquisition Director of the Year.



MG PATRICK DONAHOE, USA

Commanding General
U.S. Army Maneuver Center of Excellence

Major General Patrick J. Donahoe, a native of New Jersey, was commissioned an Armor Officer through Villanova University in May 1989. He has served in numerous company grade and field grade Armor and Cavalry positions in the continental United States, Germany, Bosnia, Kuwait and the Republic of Korea.

He most recently served as the deputy commanding general for Operations, Eighth United States Army in the Republic of Korea. Prior to serving in the Republic of Korea, he was the deputy commanding general for Operations and acting senior commander, 10th Mountain Division, Fort Drum, New York. His other general officer assignment was as the CJ-5, director of Plans, Headquarters Operation Resolute Support in Afghanistan.

Other previous assignments include: commander, 1st Battalion, 67th Armor Regiment, 4th Infantry Division at Fort Hood, Texas. While in command, the unit deployed to Iraq where the battalion conducted counterinsurgency operations in Babil and Karbala provinces and earned the Valorous Unit Citation for actions against the enemy.

Following battalion command, he was assigned to the National Training Center at Fort Irwin, California where he served initially, as a battalion trainer leading the Scorpion Team, and then led the Bronco Team as the brigade trainer. He commanded the 4th Cavalry Brigade at Fort Knox, Kentucky. He also served in Afghanistan as the Senior Advisor to General Sher Mohammed Karimi, the chief of the General Staff of the Afghan National Army.

Following that assignment he served as the chief of staff, U.S. Army Maneuver Center of Excellence at Fort Benning, Georgia.

He is a graduate of the Armor Officer Basic and Advanced Courses, the United States Naval Command and General Staff College, and Senior Service College Fellowship at Harvard University. He holds a Bachelor of Arts in History, a Masters of Advanced Military Studies, and a Masters of National Security and Strategic Studies.



COL RANDY EVERETT, USA (RET)

International Armaments Cooperation Staff Officer
U.S. Army Combat Capabilities Development Command

Mr. William "Randy" Everett is currently employed with the Department of Defense as an Employee at the US Army Combat Capabilities Development Command (CCDC). His focus is on Global Technology Integration working on Foreign Comparative Testing (FCT) programs for the US Army as well as serving as a desk officer for Australia.

Previously, Mr. Everett has been an affiliate Instructor at Loyola University located in Baltimore, Maryland where he has taught International Management and Business courses along with Advanced Leadership Develop Courses and Business Policy (Strategy) and Executive Education Seminars.

Mr. Everett is a Retired Colonel after thirty-three years in the United States Military. His final military assignment was Chief, National Guard Bureau J-5, International Affairs Division.

Preceding his assignment to the International Affairs Division, COL (Ret) Everett was assigned to the Iraqi Assistance Group. His focus was training Border Security Forces in operations at the Division, Brigade and Battalion levels.

A qualified Infantry and Special Forces officer, COL (Ret) Everett's career focus has been primarily within the arena of international relations, education, training and operations. Previous assignments within Infantry and Special Forces units have enabled him to understand operations from the squad to Division level.

Assignments within the military have been Detachment Commander of a Special Forces A-Team, Training and Executive officer of an Infantry Battalion, Senior Instructor and Operations Officer of a Training Academy, and Commander of an Infantry Battalion.

Colonel (Ret) Everett joined the military in 1975, and was commissioned as a Second Lieutenant of Infantry in September 1978. Throughout his thirty-three years of active and traditional service he has visited many countries including, Estonia, Germany, Kuwait, Iraq, Israel, Bulgaria, Bosnia-Herzegovina and Croatia.

Colonel (Ret) Everett graduated from the Naval Postgraduate School in December 1998 with a Masters of Arts in International Security and Civil Military Relations. He maintains a Baccalaureate degree from Regents College of New York in Liberal Arts. He was accepted into Johns Hopkins SAIS Doctorate of International Affairs program and began courses in the Fall of 2020.

His awards include a Legion of Merit, Bronze Star, Defense Meritorious Service medal, several Meritorious Service medals, Joint Commendation medal, mutable Army Commendation medals, Special Forces Tab, Master Parachute Badge, Combat Action Badge and a host of other awards to include a Campaign medal from Iraq and several Foreign Awards to include the Ukrainian Badge of Honor and Polish Service medal. He was inducted into Ft. Benning's Officer Candidate School Hall of Fame in 2012 and was nominated and found worthy to be added to the Order of St. Maurice.

William Everett is married to the former Elva L. Bourchel RN and they reside in Harford Country, MD.



COL WENDELL LEIMBACH, JR., USA

Director, Joint Intermediate Force Capabilities Office
U.S. Department of Defense

Col Leimbach was born and raised in Baltimore, MD, and graduated from Baltimore's Friends High School in 1988. He graduated from the University of Delaware 1992 with a BS in Computer and Information Sciences and a minor in History. He was commissioned a second lieutenant in the U.S. Marine Corps in July 1992 after completing Officer Candidate School. He was assigned as a Tank Officer and attended the Armor Officer Basic Course at Ft. Knox, KY in 1993.

As a lieutenant he served as a Tank Officer with the 2nd Tank Battalion, 2nd Marine Division in Camp Lejeune, NC, from 1993-1997. While there he served as the 2nd Platoon Commander, C Company and subsequently as the TOW Platoon Commander, H&S Company.

In 1997, then Capt Leimbach was assigned to his first tour with Marine Corps Systems Command (MCSC) in Quantico, VA as a project officer for the Program Manager for Tank Systems. Subsequently, in 1999 Capt Leimbach was sent to the Army Armor Captain's Career Course (ACCC) at Ft. Knox, and then back to 2nd Tank Battalion at Camp Lejeune. While at 2nd Tank Battalion Capt Leimbach served as the D Company Commander and assistant operations officer, and as the H&S Company Commander.

From 2002-2004, Maj Leimbach was a student at the Naval Postgraduate School (NPS) in Monterey, CA where he received a Master's Degree in Business Administration with a focus in Systems Acquisition Management. Upon graduation he was reassigned to MCSC and took on responsibilities as the Individual Armor and Load Bearing Team Leader for the Program Manager for Infantry Combat Equipment. While serving in that billet Maj Leimbach was selected as an Acquisition Professional Officer (8061) in the first year that the MOS was competitively offered.

In 2006, Maj Leimbach was transferred to PM Tank Systems where he served as the M1A1 Project Officer and then as acting Program Manager. In 2007 he was selected to serve as the Program Manager for Tank Systems where he contributed to the fielding of the programmable 120mm Multi-Purpose High Explosive (MP-HE) main gun ammunition. In August of 2010, LtCol Leimbach was reassigned to the office of the

Program Manager, Advanced Amphibious Assault, Program Executive Officer Land Systems where he served as the Deputy Director for the Marine Personnel Carrier Program until June of 2012.

From June 2012 to June 2013, LtCol Leimbach served as a Secretary of Defense Corporate Fellow. During that time he worked as a member of industry with Accenture Federal Services in Washington, DC. In 2013 he was selected to be the DPM AAA, Stafford, VA where he served supporting the sustainment of the Marine Corps' legacy Assault Amphibious Vehicle (AAV) fleet and the ACAT IC Amphibious Combat Vehicle (ACV) program. Col Leimbach was promoted to his current rank in September 2014. From mid-2017 to June 2018 he served as the Program Manager for AAA where he led that organization through a successful MS C for the ACAT IC ACV 1.1 Program. In October 2018, Col Leimbach was assigned as the Director of the Joint Intermediate Force Capabilities Office, Quantico, VA where he continues to serve to this date.

Col Leimbach's personal awards include the Army Achievement Medal, Navy and Marine Corps Achievement Medal, Navy and Marine Corps Commendation Medal, Meritorious Service Medal with gold star, Andrew J. Higgins Award for Acquisition Innovation and Excellence and the United States Cavalry and Armor Association Order of Saint George Bronze Medallion. He resides in Fredericksburg, VA with his wife and two children.



HONORABLE ELLEN LORD

Former Under Secretary of Defense for Acquisition & Sustainment

Senate Confirmed in August 2017, the Honorable Ellen M. Lord formally served as the Under Secretary of Defense for Acquisition and Sustainment (A&S). In this capacity, she was responsible to the Secretary of Defense for all matters pertaining to acquisition; developmental testing; contract administration; logistics and material readiness; installations and environment; operational energy; chemical, biological, and nuclear weapons; the acquisition workforce; and the defense industrial base.

Prior to this appointment, from October 2012 – June 2017, Ms. Lord served as the President and Chief Executive Officer of Textron Systems Corporation, a subsidiary of Textron Inc. In this role, she led a multi-billion dollar business with a broad range of products and services supporting defense, homeland security, aerospace, infrastructure protection, and customers around the world.

Ms. Lord has more than 30 years of experience in the defense industry, serving in a variety of capacities, to include Senior Vice President and General Manager of Textron Defense Systems, now Weapon & Sensor Systems; and Senior Vice President and General Manager of AAI Corporation, now known as Textron Systems' Electronic Systems, Support Solutions, and Unmanned Systems businesses. Earlier in her career, Ms. Lord served as Vice President of Integration Management for Textron Systems and Vice President of Intelligent Battlefield Systems for Textron Defense Systems, in addition to other business and operations positions.

Ms. Lord is a former Vice Chairman of the National Defense Industrial Association, as well as a former Director of the U.S. – India Business Council. She has served on the industry steering committee for the Center for New American Security's (CNAS) task force on "Strategy, Technology and the Global Defense Industry," as well as CNAS's DoD-Industry collaborative project "Future Foundry: Forging New Industries for Defense," which was formed to examine key technological trends and challenges facing the global defense industry. Ms. Lord has also served on the Board of Trustees of the U.S. Naval Institute Foundation.

Ms. Lord earned a Master of Science degree in Chemistry from the University of New Hampshire, as well as a Bachelor of Science degree in Chemistry from Connecticut College.



DONALD SANDO

Deputy to the Commanding General and Director of Capabilities Development & Integration

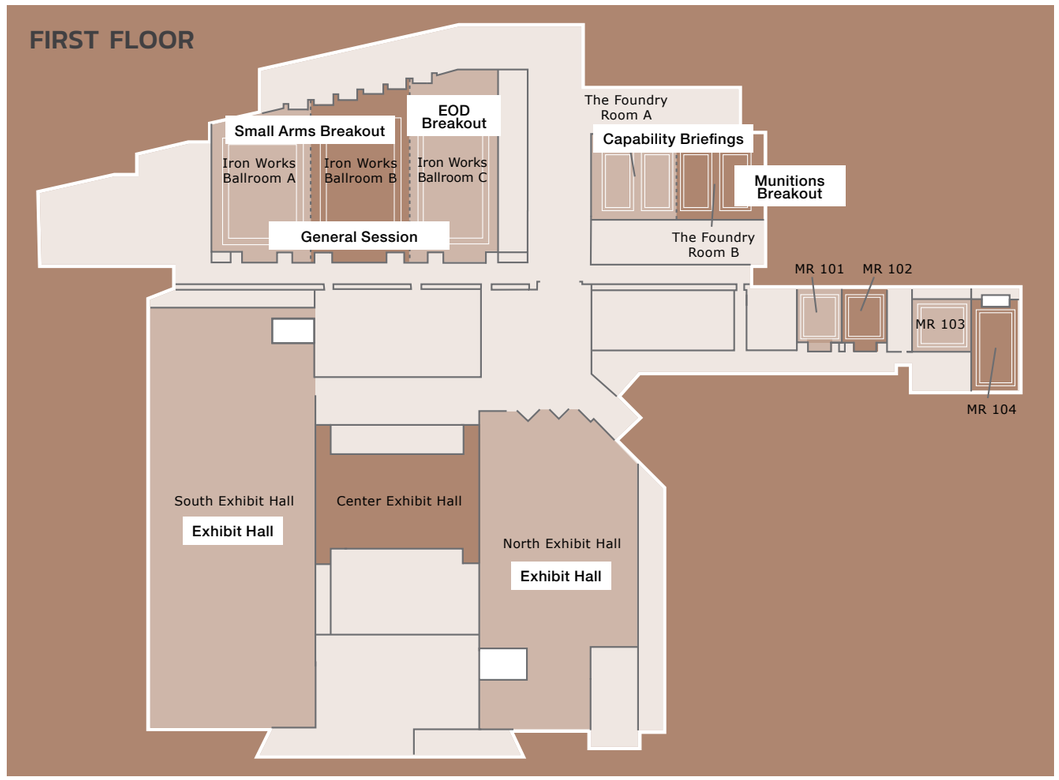
U.S. Army Maneuver Center of Excellence Company

Mr. Don Sando was selected to the Senior Executive Service in February 2008 and is currently assigned as the Deputy to the Commanding General and Director of Capabilities Development and Integration for the Maneuver Center of Excellence at Fort Benning, Georgia. As Director, Mr. Sando is responsible for conducting analysis and experimentation for the maneuver force, developing operational concepts and organizational designs, describing required materiel capabilities, and integrating solutions to support Army, joint, interagency, and multinational organizations.

Mr. Sando graduated from the United States Military Academy at West Point, New York, in 1981. He holds a Master of Science degree in Operations Research from the Air Force Institute of Technology, and a Master of Science degree in Strategic Studies from the Army War College.

Mr. Sando culminated over 26 years of active duty service as Director of the Infantry Futures Group, U.S. Army Infantry Center, Fort Benning, Georgia. His awards and decorations include the Distinguished Service Medal, the Legion of Merit, and the Combat Infantryman's Badge.

VENUE MAP



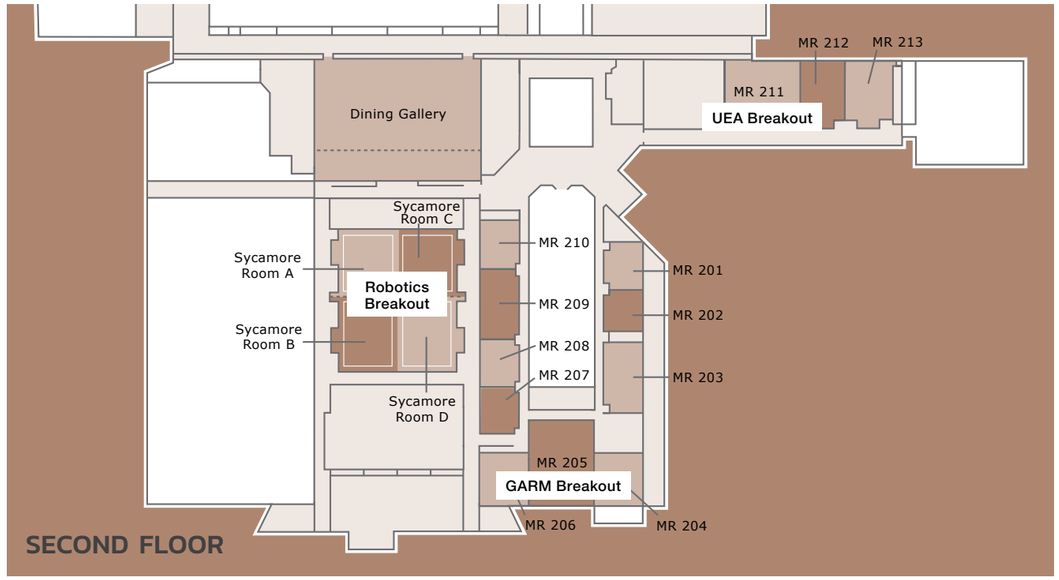


EXHIBIT HALL FLOORPLAN

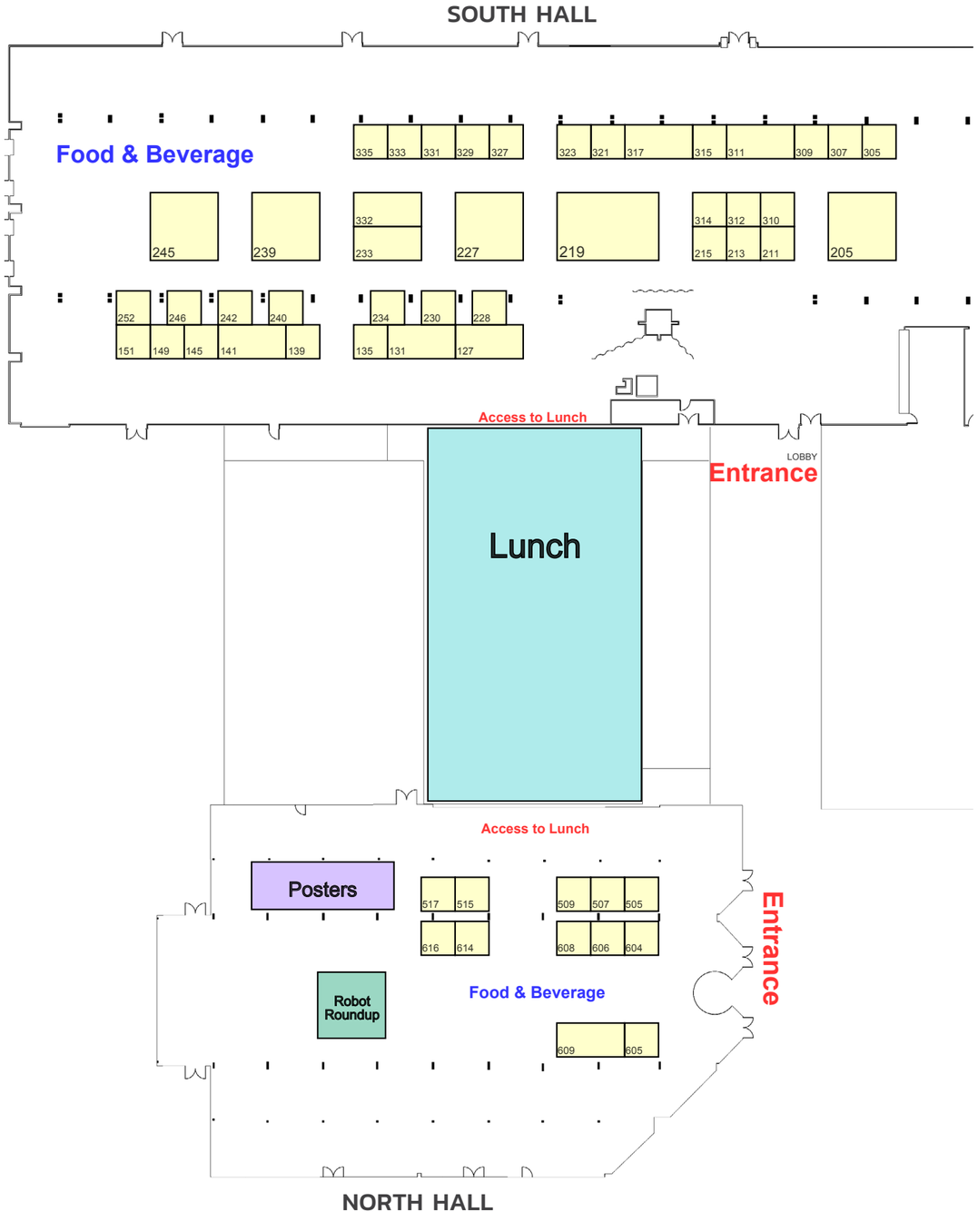


EXHIBIT HALL HOURS

TUESDAY, OCTOBER 19
9:00 am – 6:30 pm

WEDNESDAY, OC TOBER 20
9:00 am – 3:00 pm

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Applied Research Associates (ARA) 315
B&T USA 507
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Bren-Tronics, Inc. 234
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UDC USA 149
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Zero Point, Incorporated 252

EXHIBITOR DESCRIPTIONS

908 DEVICES 215

908 Devices is democratizing laboratory mass spectrometry with simple handheld and desktop devices. These devices are used at the point-of-need to interrogate unknown and invisible materials and provide quick, actionable answers to address some of the most critical problems in life sciences research, bioprocessing, pharma / biopharma, forensics and adjacent markets.

ADS, INC. 227

ADS, Inc. provides equipment, procurement, logistics, and supply chain solutions. We offer access to the largest product and service selection, the broadest array of procurement and contract options, and world-class expertise and support to assist you—every step of the way.

AERO PRECISION 307

Aero Precision is a leading manufacturer in the firearms industry. With roots in Aerospace, our quality and attention to detail are unmatched. When building something that flies, there is no margin for error. Aero always delivers extremely high-quality, American-manufactured rifles and components that your soldiers can count on.

AIMLOCK 317

Specializing in the development of organic autonomous precision strike weapon systems, AimLock enhances speed, accuracy, and reduced cognitive load for deployment of lethal fires from unmanned systems. AimLock's CORE engine offers decision accelerating autonomy in target detection, classification, identification, sensor fusion, and target prioritization, and shortened sensor-to-shooter times.

AIMPOINT INC. 505

For over 40 years, Aimpoint has been the world leader in design and manufacture of electronic red-dot sighting systems. Soldier tested and combat proven – don't settle for anything less.

APPLIED RESEARCH ASSOCIATES (ARA) 315

ARA is an international research and engineering company globally recognized for applying technically-excellent, in-depth and diversified research, engineering, and technical support services to provide answers to complex and challenging problems in the physical sciences. We have a broad range of technical expertise in defense technologies, civil engineering, computer software and simulation, systems analysis, environmental technologies, and blast testing and measurement.

B&T USA 507

B&T USA, a Florida-based firearms, silencer and accessories manufacturer operating under license of B&T AG SWITZERLAND, which was founded in 1991 as a designer and manufacturer of the industry's most advanced suppressors. Under the leadership of Karl Brügger, B&T AG has evolved into a world leader in the design, manufacture, and sale of the most technologically advanced, high performance weapons systems in the world. For more information on B&T USA, visit: www.bt-arms.com

BARRETT 240

Barrett Firearms Manufacturing, Inc. (Barrett) is the world leader in large-caliber and long-range rifle design and manufacturing. Our products are used by civilian sport shooters, law enforcement agencies, the United States military, and over 70 State Department approved countries. The Barrett Quality Management System has received the prestigious ISO 9001:2015 certification for the design and manufacture of firearms, ammunition, and accessories, and to provide training for those systems.

BREN-TRONICS, INC. 234

Supporting the Warfighter and EOD teams for 48+ years, all made in the US. Lithium-Ion batteries for every major military robot platform, small to large ground robots, air and sea. Chargers that get power from solar, vehicles, and other batteries in any climate between -40C / 80C. High power 24V Li-Ion batteries to start/power military vehicles (6T) + high energy power for mobile/fixed silent watch applications (>3 kWh). Winner: Conformal Wearable Battery (CWB) that also uses our ABC charger.

CEIA USA 242

CEIA Ground Search Metal Detectors provide overall superior performance in the areas of detection distance, soil compensation capability, and immunity to external interference. CEIA USA provides nationwide sales, service, and customer support to customers in North America. Dynamic solutions are the foundation of CEIA USA's commitment to customer satisfaction. For more information about CEIA USA, visit www.ceia-usa.com

DANIEL DEFENSE, INC. 614

Founded in 2000 by Marty Daniel, Daniel Defense, Inc. has grown to over 350 employees. Daniel specializes in the production of world class small arms to include complete weapons systems and best in class components- such as their Cold Hammer Forged Barrels provided to USSOCOM. Daniel has an unmatched production capability which is ISO 9001:2015 accredited and is located in Black Creek, GA near the port of Savannah.

DARLEY DEFENSE 239

Since 1908, W.S. Darley & Co. has been dedicated to serving the world's Fire and Emergency Services and Defense organizations. Darley remains a family owned and operated business. Our entire company is committed to customer satisfaction. Darley is dedicated to excellence and offers a diverse line of quality products and services through progressive design, manufacturing and worldwide distribution.

EOD GEAR 230

In order to achieve mission success you need the gear that performs to the level you operate. Focusing on your mission shouldn't include hoping your gear will perform as promised. It's wrong to compromise on gear which could cause mission failure. EOD Gear understands the consequences you face and can guide you to the best gear that works within your budget allowing you to focus on the target in front of you and win the fight.

EOS DEFENSE SYSTEMS USA, INC. 245

EOS is an industry leader in Remote Weapon Station (RWS) technology and manufacturing. Continuously investing to improve currently fielded and developing systems. We have built a strong reputation as a provider of weapon systems technology for over 25 years to not only the USA and Allied Countries.

FEDERAL RESOURCES 127

Federal Resources serves the vast global military and government markets facing critical defense developments and other challenges .Federal Resources excels in locating and delivering the exact tools teams require to proceed, quickly and efficiently. Awarded with multiple contract vehicles and trusted partner relationships, FR can assist you with the steps for a successful mission solution, on time and on budget.

GENERAL DYNAMICS – OTS 205

General Dynamics Ordnance and Tactical Systems manufactures large-, medium- and small-caliber direct and indirect-fire munitions; and is a leader in the development and production of lightweight tactical vehicles, weapons and armament systems. The company also produces propellants and non-lethal and force-protection products. More information about General Dynamics Ordnance and Tactical Systems is available online at www.gd-ots.com.

GHOST ROBOTICS 219

Ghost Robotics™ is revolutionizing legged robotics and the market for autonomous unmanned ground vehicles (Q-UGVs) used in unstructured terrain and harsh environments. Our Q-UGVs are rugged and unstoppable. Beyond all terrain operation, a core design principle for our legged robots is size-scalability, and reduced mechanical complexity with total software (SDK) control when compared to other legged and traditional wheeled and tracked UGVs on the market.

HDT GLOBAL 332

A provider of highly-engineered mobile military and emergency response solutions, HDT Global is widely recognized for its industry-leading production of state-of-the-art, fully integrated deployable solutions. With advanced systems currently being used by the U.S. and allied military units stationed worldwide, HDT's products include shelter systems, environmental control systems, generators, heaters, air filtration devices, parachutes, aerial delivery systems, and robotics.

IS4S 145

IS4S specializes in munition system design and development and brings the full spectrum of analysis, simulation, and testing resources to projects. We operate a series of ranges in Eastern Alabama in support of the Defense community. Our main areas of support are explosive testing (100+ lb. NEW), small and medium caliber testing, small-scale energetic synthesis and production, and test design and execution.

KGM TECHNOLOGIES 309

KGM Technologies is a U.S. based SDVOSB company, and a leader in the weapon suppressor industry with products that support .22LR to .50 BMG, bolt action, semi-auto, and full-auto weapons. KGM's innovative designs and cutting-edge manufacturing processes specialize in small arms suppressor technology, weapon enhancements, material science and high-level research and development. We are the largest most innovative suppressor technology company in the US.

L3 HARRIS 517

Next-generation robotic systems - going into harm's way so you don't have to. L3Harris develops cutting-edge robotic solutions for austere and harsh environments, drawing upon more than 20 years of research in advanced robotics. Driven by the continuous feedback of active duty operators, L3Harris builds powerful, versatile platforms that ensure mission success.

LEIDOS INNOVATIONS CENTER 327

The Leidos Xpose Portable X-Ray (Xpose XP) CR and DR Imaging System, provides a unique multi-function capability in a single kit. The Xpose XP is both a real-time imager and a flat-bed scanner for single and mosaic digital imaging panels. The Xpose XP can be used wired, wirelessly, or unwired/unpowered for operations in denied areas and environments where minimal electronic signature is desired. The Xpose XP is light weight, compact and IP67 rugged for use in any extreme environment.

LMT DEFENSE 305

Est. in 1980, Lewis Machine & Tool Company (LMT®) manufactures M4 type carbines, 7.62 x 51 rifles, and M203 40mm launchers. LMT is 100% US made and an ISO 9001:2015 registered US Govt. GSA contractor. Models include the MWS classified by the UK MOD as the L129A1 DMR and the 5.56 x 45 monolithic rifle with ambidextrous features, classified as the MARS-L, Modular Ambidextrous Rifle System, Light. Our products are currently in service with the US Govt., SOCOM, and 40 countries around the world.

MARATHON TARGETS 609

Marathon: COTS Autonomous Ground Robots since 2008. Our 6th Gen COTS Autonomous Robotic Target transforms live fire training from simple 'marksmanship practice,' into training against an Army of AI-driven robots. Lethality triples "in just one day" as ARTs react to fire by autonomously scattering for cover - or self-organizing a counterattack. Upgrading ranges to 'Robot-Capable Ranges' enables huge construction cost avoidance. Bulletproof ARTs go 30 miles/charge. Rental fleets on 4 continents.

MAXIM DEFENSE INDUSTRIES 606

MED-ENG 141

Med-Eng provides solutions for Explosive Ordnance Disposal (EOD) and related blast threats. Its Bomb Suits are trusted by the Army, Navy, Air Force and Marines for EOD, Unexploded Ordnance (UXO), Demining and Counter-IED. Med-Eng offers Hook And Line systems and specialized tools for EOD, UXO, Search and Tactical operations. Its Blast Sensors for the warfighter record detailed blast profiling data and forces impacting an individual, and improve operator safety through modified tactics.

MICRO-X INC. 604

Micro-X is an ASX-listed hi-tech company developing and commercializing Cold Cathode Carbon Nano-Tube emitter technology operating across global health, defence and homeland security domains. The technology enables X-ray tubes to be manufactured with significant reductions in weight, size, and power requirements. Originating in the medical sector the technology has transferred into the Counter IED market providing the development of leading-edge, stand-off X-ray technology.

MISTRAL INC. 616

Mistral Inc. serves as a "bridge" between the User requirements and innovative, relevant and ready solutions for the challenges faced while out in the field. Continuous analysis of capability gaps and existing technologies enables Mistral to stay ahead of the problems faced by Users today, tomorrow and into the future.

MITHIX PRO 323

Mithix Pro is a SDVO Small Business USA owned Manufacturer specializing in EOD, Combat Engineer, Special Ops and Demining, Counter-UXO, IED and Booby-Trap tools/tool kits and solutions. Our strengths are working with end-users at DoD, federal, state and local levels to manufacture, integrate, develop and/or supply custom tools/kits to meet mission needs.

NATIONAL ARMAMENTS CONSORTIUM (NAC) 312

The National Armaments Consortium (NAC) serves as the industry partner for the Department of Defense Ordnance Technology Consortium's (DOTC) and the Aviation and Missile Technology Consortium (AMTC). Our robust, transparent, and unique collaboration approach, once considered a novel and unrealistic concept, has evolved into a well-established process through which our DoD stakeholders acquire the innovative Armament technologies needed to maintain U.S. technological superiority.

NATIONAL DEFENSE INDUSTRIAL ASSOCIATION (NDIA) 509

NDIA engages thoughtful and innovative leaders to promote the best policies, practices, products and technology for warfighters and others who ensure the safety and security of our nation. NDIA offers 25 chapters, 27 divisions for corporate involvement, award winning publications, and numerous conferences and trade shows annually. Corporate and individual memberships are available. US government and military are welcome to join free of charge.

NOVO USA 139

NOVO DR Ltd. offers the highest image quality in the portable digital radiography industry. The ruggedness and reliability of our systems combined with amazing X-Ray Images make them the best in the market. Our intuitive and easy to use products have been designed and engineered by our incredibly professional and highly experienced team! We put a strong emphasis on the following points: Highest image quality, Reliability, Easy to Use, Professional Support

OTIS TECHNOLOGY 333

Otis Technology is known for manufacturing the most advanced firearms maintenance systems. The superior Breech-to-Muzzle® design combined with unmatched quality has positioned Otis as the gun care system of choice with the US Military, Hunters, Shooters and Law Enforcement professionals worldwide. Made in the USA, Otis Technology is AMERICA'S GUN CARE.

PATRIOT PRODUCTS, LLC 608

We specialize in the design and manufacture of Range Equipment (RTADS/TADSS), and are known for delivering custom solutions for military applications, expert field services - including maintenance of legacy systems, and standing behind our work with a full warranty ensuring client satisfaction is guaranteed. We pride ourselves on our loyalty and commitment to our clients, and hope you will let us do what we do best. Our mission will not be complete until your mission is accomplished.

PENDAR TECHNOLOGIES 135

Pendar X10™ offers breakthrough, short-range standoff Raman chemical identification capabilities for EOD, HAZMAT, Narcotics, Forensics, and more. It can be used at a standoff distance of up to 6 feet (2 meters), mitigates fluorescence and has minimal ignition risk with black powder and sensitive primaries. Simple point-and-shoot technology requires little training and delivers results within seconds. Pendar X10™ can be mounted on a UGV to put further distance between the operator and threat.

POINT ONE USA, LLC 329

Point One provides advanced EOD training, highest quality kits, systems, and training aid products such as hostage, WMD, underwater devices, ordnance, and clandestine laboratories. Our decades of experience in the SOF and EOD communities within joint, multi-agency, and national level environments ensure we are the best choice to provide the services offered, to include exercise support and research and development. As an SDVOSB, we are dedicated to preparing operators and bomb technicians in advancing capability.

QINETIQ, INC. 233

QinetiQ, Inc. provides cutting-edge technology and revolutionary products to the defense, security and military markets. Our product offerings include tactical land vehicle and aircraft protection, sensors to protect soldiers, unmanned robots in a variety of sizes and with varying capabilities and power and control systems. Customers rely on our products to enhance security, aid in personal safety, streamline operations, increase situational awareness and improve efficiencies.

RADICAL FIREARMS/RADICAL DEFENSE 311

Radical Defense is dedicated to delivering cutting-edge capabilities into the hands of soldiers and Law Enforcement. They provide innovative solutions to battle major issues with modern weapons. The most common issues that we have tackled head on are: Heat, thermal signatures, end user serviceability, longevity and reliability. Radical Defense is a true manufacturer with modern CNC and Additive manufacturing. They are capable of true RND, engineering, manufacturing and full production.

RECONROBOTICS, INC. 228

ReconRobotics® is the world leader in tactical, throwable micro-robots. Worldwide, nearly 7,000 ReconRobotics® robots have been deployed to the U.S. military and international friendly forces, federal, state and local law enforcement agencies, bomb squads and fire/rescue teams. Each day, they use the company's mobile Recon Scout® and Throwbot® devices to protect their personnel, minimize collateral damage, and gain immediate reconnaissance within dangerous and hostile environments.

SIERRA NEVADA CORP 213

SNC is a trusted leader in best-of-breed, open architecture engineering in Space Systems, Commercial Solutions, and National Security and Defense. SNC is recognized among The Top 10 Most Innovative Companies in Space, as a Tier One Superior Supplier for the U.S. Air Force and is the only aerospace and defense firm selected as a 2020 US Best Managed Company.

SMALL ARMS DEFENSE JOURNAL 246

Distributed at defense trade shows worldwide, Small Arms Defense Journal is a bimonthly publication focused on small arms, accessories, soldier gear, new products, industry news, and defense trade show reviews. Small Arms Review is a 10 issue publication. Our aim is to provide a forum for all aspects of Class 3 interests and the military small arms industry. Semper Fi highlights the charitable works and fellowship of the Marine Corps League and covers league and chapter events across the U.S.A.

SMARTRAYVISION 314

SmartRayVision Portable EOD X-Ray is designed, developed and manufactured by SharpLogixx LLC. Made in the USA in Green Bay Wisconsin, the SmartRayVision system is the #1 selling EOD kit in the country. SharpLogixx LLC is a leading technology company focused on advanced research and development of X-Ray equipment and specialized software.

SOUTHERN MACHINE WORKS 335

SMW is a make-to-print contract CNC machining concern providing machined components to Aerospace, Defense, and Commercial industries for over half a century. We provide precision CNC machining, fabrication, and welding services in an AS9100D + ISO9001:2015 and an ITAR controlled environment. Our central USA location is logistically advantageous for short transit times to all USA location(s). We offer prototype assistance, and excel at low, medium, and high-volume production machining.

SUREFIRE, LLC 321

Located in Fountain Valley, California, SureFire LLC is the leading manufacturer of high-performance flashlights, weapon-mounted lights and other tactical equipment for those who go in harm's way, or anyone who demands the ultimate in quality, innovation and performance. SureFire illumination tools are used by more SWAT teams and elite special operations groups than any other brand. SureFire is an ISO 9001:2015-certified company.

TELEDYNE FLIR 131

Teledyne FLIR offers a diversified portfolio that serves a number of applications in government & defense, industrial, and commercial markets. Our products help first responders and military personnel protect and save lives, promote efficiency within the trades, and innovate consumer-facing technologies. Teledyne FLIR strives to strengthen public safety and well-being, increase energy and time efficiency, and contribute to healthy and intelligent communities. Learn more at teledyneflir.com

TIP TECHNOLOGIES 211

TIP Technologies' suite of integrated modules offer a complete range of quality and compliance functions, while supporting the complex business requirements facing manufacturers today. Companies use our solutions to achieve measurable improvements, while advancing customer service, productivity and profitability. With real-time visibility into the production process, users can accelerate their reaction to a shift in quality and become more proactive about improving operational efficiencies.

TOMAHAWK ROBOTICS 331

Tomahawk Robotics is the leading innovator of common control solutions that transform how humans and unmanned systems work together to make the world more safe and secure. From the battlefield to remote industrial sites, our technology safeguard users working under the most extreme and stressful conditions. Kinesis is the only multi-domain, cross-architecture, AI-enabled control system that unlocks intuitive interaction with remote environments from across the room or around the world.

TRIJICON 605

Backed by a limited-lifetime warranty, Trijicon's aiming systems are proven on the range and in the field. As a result, Trijicon has earned the trust of those who are most in need of aiming accuracy and dependability. Our customers include the United States Navy, Marine Corps, Army, Air Force, and United States Special Operations Forces; United States Government, as well as state and local Law Enforcement.

TSSI 151

For more than 40 years, TSSi has provided the highest quality equipment & solutions for military, law enforcement, and disaster response professionals worldwide. TSSi maintains an extensive inventory of best selling items and has established partnerships with the industry's leading suppliers. TSSi is known for having the highest standards of integrity & professionalism. Long-term and comprehensive contracts include: DLA Tailored Logistics Support (TLS) and GSA.

T-WORX HOLDINGS, LLC 515

T-Worx Holdings has developed the Intelligent Rail® platform (aka "Picatinny Smart Rail") - a patented platform technology that powers, connects, and communicates data from rifles and weapon-mounted accessories to the soldier, squad, and command centers on and off the battlefield. Developed under US Army SBIR funding and direction and selected as the NATO Powered Rail STANAG in 2015, the Smart Rail is mature and ready for insertion on all next generation weapons and legacy small arms platforms.

UDC USA 149

UDC produces small & medium caliber ammunition of several types, as well as support munitions and demolition products. UDC is headquartered in Tampa, Florida with offices and facilities in the Kansas City, Missouri, USA metro area. UDC specializes in munitions manufacturing, prototyping and testing, full rate production, modernization of legacy weapon systems, and training and equipping of foreign military or indigenous defense forces.

UNIT SOLUTIONS 310

UNIT Solutions is dedicated to being the pre-eminent non-lethal training solution for law enforcement and military worldwide. Based on direct feedback from military and law enforcement professionals, we have custom engineered an affordable solution to directly address existing training challenges, and provide the best training system on the market for realistic force-on-force and decision-making training.

ZERO POINT, INCORPORATED 252

Zero Point offers innovative EOD and C-WMD products, training, and services. Our products and in-house Engineering services enable effective identification, diagnostics, disablement, and disposal of threats in hazardous situations all manufactured to meet superior quality. Our goal is to provide total mission solutions designed to defeat today's evolving threats. When you use a Zero Point product or service, Defenders are better prepared helping them come home safely.

SPONSORS DESCRIPTIONS

GEISSELE

PREMIER

Geissele Automatics is an American firearms and firearms parts manufacturer located in North Wales, Pennsylvania. William Geissele founded Geissele Automatics in 2004. Geissele is comprised of a team of highly-trained and dedicated individuals, whose mission statement is short: We Manufacture Confidence.

The company first entered the civilian market by manufacturing trigger mechanisms for the AR15 rifle. Throughout the years, while we haven't lost touch with our humble beginnings, we have evolved from manufacturers of trigger mechanisms to manufacturers of rifles and pistols for sport shooting, hunting, and personal defense.

Beyond our civilian customers, Geissele is committed to servicing the U.S. Department of Defense, U.S. Federal Law Enforcement Agencies, and our allies around the world. In fact, while our first trigger, the Hi-Speed National Match, was originally designed for target shooting and the CMP and NRA Hi-Power Rifle competition, it was found to have U.S. Military applications in semi-automatic sniper weapons and, in 2005, we received a request from the Department of Defense to build a select-fire trigger like the Hi-Speed National Match trigger. Geissele then designed and built the Geissele Super Select-Fire trigger, which was eventually adopted by entities in the U.S. Special Operations community and then became their trigger of choice for M4 carbine-based weapons.

Using state of the art machine technology and the most modern materials, we engineer, develop, and produce solutions to meet the unique and complicated needs of the modern-day warfighter.

In short, We are Weaponmakers® and we are committed to excellence in everything we do.

SNC SIERRA NEVADA CORPORATION

ELITE

Owned by Chairwoman and President Eren Ozmen and CEO Fatih Ozmen, Sierra Nevada Corporation (SNC) is a trusted leader in solving the world's toughest challenges through best-of-breed, open architecture engineering in Space Systems, Commercial Solutions, and National Security and Defense. For nearly 60 years, SNC has delivered state-of-the-art civil, military and commercial solutions to customers worldwide, including more than 4,000 space systems, subsystems and components. SNC has participated in more than 450 missions to space, including to Mars, and is recognized among The Top 10 Most Innovative Companies in Space. SNC is also a Tier One Superior Supplier for the U.S. Air Force and is the only aerospace and defense firm selected as a 2020 US Best Managed Company.

From engineers and scientists to cybersecurity experts and software developers, SNC's workforce of more than 4,000 dreams, innovates, inspires and empowers the next generation to transform humanity through technology and imagination.

THANK YOU TO OUR SPONSORS

KGM TECHNOLOGIES

Live Fire Demonstration

National Defense Corp

Wednesday Lunch

NORTHROP GRUMMAN

Monday Reception at the
National Infantry Museum

TEXTRON Systems

PUSHING PAST POSSIBLE

Tuesday Breakfast

GENERAL DYNAMICS
Ordnance and Tactical Systems

Tuesday Reception

PACSCI EMC

WIFI

QINETIQ

Registration and Lanyards

RMII
REACTIVE METALS INTERNATIONAL, INC.

Patriot

GLOCK®
PERFECTION

Tuesday Lunch

DRAPER®

Draper Autonomy:
All Domain Execution & Planning Technology (ADEPT)

Camila Francolin

October 19, 2021

The Charles Stark Draper Laboratory, Inc.
555 Technology Square, Cambridge Mass. 02139-3563
CAGE Code: 51993

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Draper Overview

- Independent, not-for-profit lab
- Mission:
  - *Applied research and development*
  - *Technology transition: turning technologies into capabilities*
  - *Advanced technical education*
- Headquartered in Cambridge, Massachusetts
- >$660 million in fiscal 2020
  - *1,900 employees*
  - *1,200 technical*



Apollo Guidance Computer



Orion Reentry Guidance



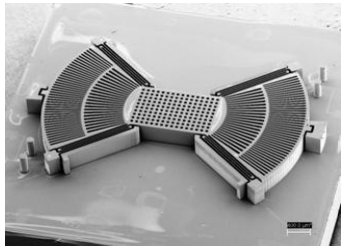
Digital Fly-by-Wire



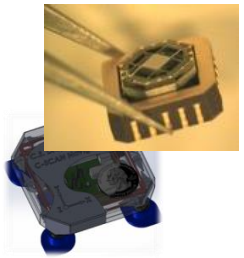
Unmanned System Autonomy



Strategic Guidance Systems



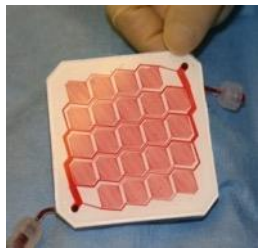
MEMS



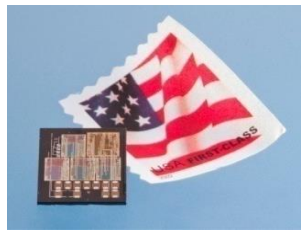
Cold Atom Sensors



RF-addressable Micro Neural Stimulator



Micro Fluidics



Ultra-High Density Electronics

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Draper's Autonomy Solutions Span the Air, Space, Undersea, and Terrestrial Domains



Autonomy for Low SWAP platforms



TRN & Hazard Avoidance for Lunar landing



Autonomous Resupply



Registered AR for Dismounted Operations



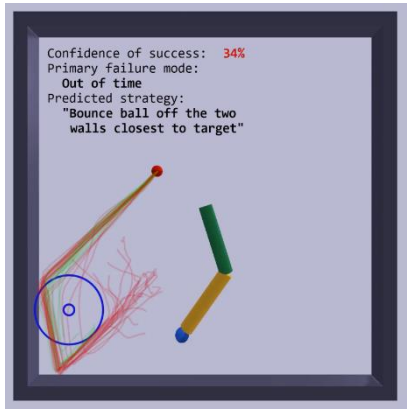
Autonomy for Group 1+ UAVs



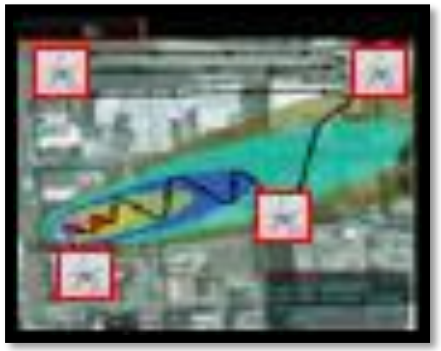
Autonomy for Unmanned Underwater Vehicles



Autonomy for Mobile Manipulators



Competency Aware Machine Learning for Autonomy



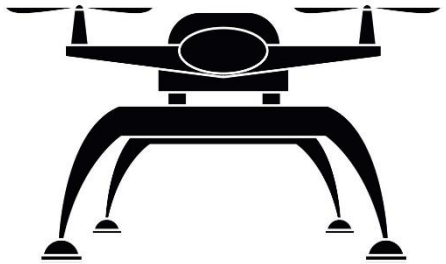
Aerial Autonomy for CBRN Missions

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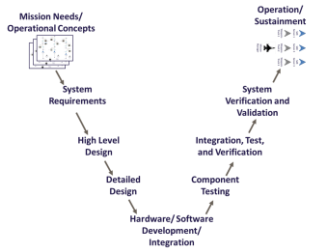
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Autonomy is a Confluence of Technologies

Platform



Development & Test Capabilities



Perception & Autonomy SW

Mission autonomy function: Target tracking

Mission perception function: Object recognition

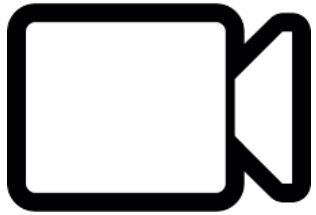
Core autonomy function: Motion Planning

Core Perception function: VIO

Mission manager

Autonomy Architecture

Sensors



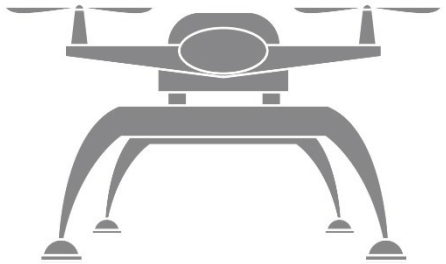
C2/User Interface



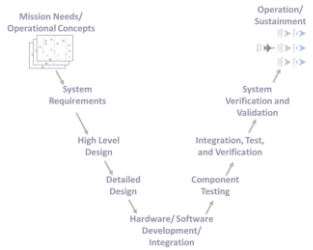
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ADEPT Mission manager

Autonomy Architecture

Sensors



C2/User Interface



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Autonomous Mission Management

Requirements

1. Ability to take high level operator mission definitions
2. Ability to plan complex missions in real-time
3. Ability to monitor mission execution and re-plan as necessary
4. Ability to integrate with various sensor modalities & platform types
5. Ability to quickly reconfigure to address various missions types

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ADEPT Mission Manager

- Missions are made up of functional blocks that abstract low-level autonomy functions
- Hierarchical mission decomposition enables fast planning times for even most complex & long-duration missions
- Closed-loop planning via OODA loop enables mission monitoring & re-planning
- Implementation separates autonomy function from sensor & platform interfaces
- Each autonomy functional block is reusable across missions, enabling fast reuse

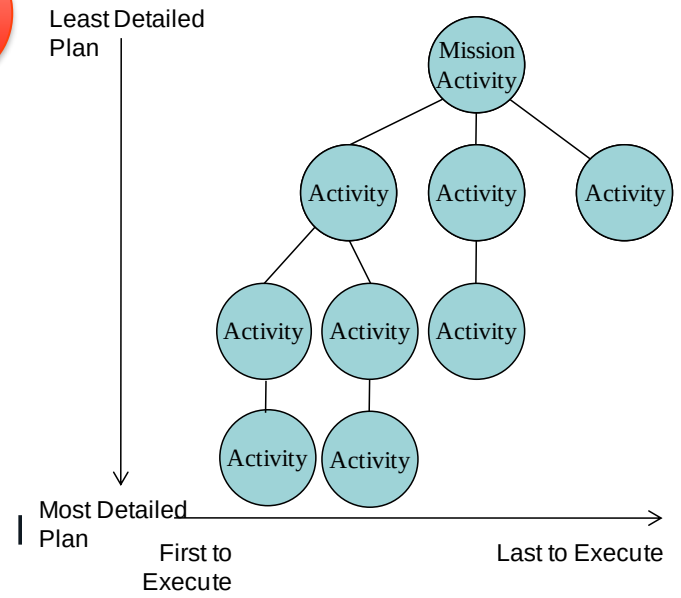
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Draper Autonomous Mission Management:

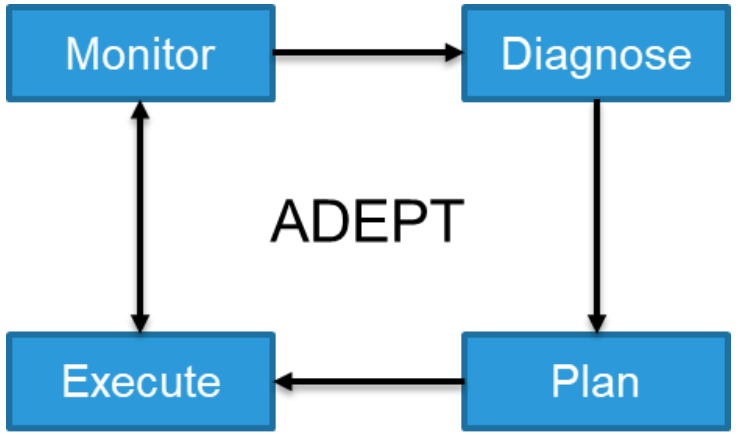
All Domain Execution & Planning Technology

1. Hierarchical task decomposition
   - Allows user to specify high level goals which are broken down into low level simple tasks the system can execute
   - Simple tasks facilitate re-use
2. Sense-reason-act paradigm of intelligence
   - Each functional block is implemented in a closed loop fashion, allowing for dynamic re-planning as needed
   - Plan/Execute/Monitor/Diagnose
3. Modular, re-usable object oriented software
   - Sensor and platform abstraction layers allow for easy re-use

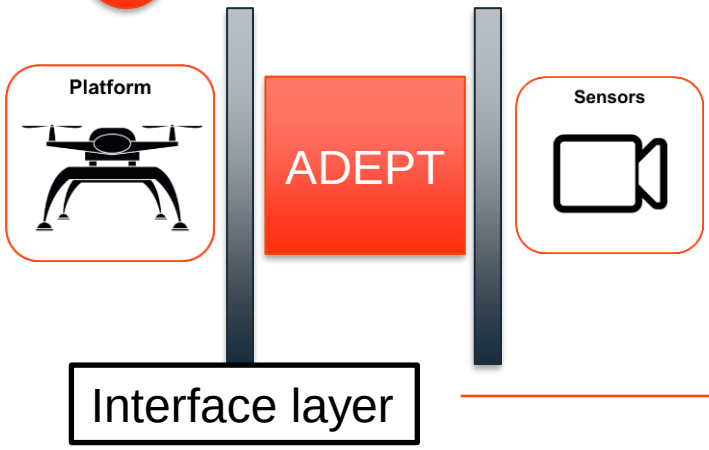
1



2



3



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ADEPT Mission Manager Codebase History

2019-2020 and Beyond



2014
Small autonomous UGV



2018
UGV for precise navigation of complex environments with no human intervention



2015 *UAV for precision emplacement*





2017
Counter drone interceptor

2015 Squad-X- *UAV & UGV Human-Machine Cooperation*



2018 Counter UAS
Counter drone interceptor with net launching system

Robotic Autonomy

2019 Robotic autonomy baseline code
For general use

UAS Program

2018
UAV for autonomous tracking and geolocation



CBRN UAV
Autonomous search and contour mapping of CBRN hazards



Counter UAS
Counter drone interceptor with onboard radar seeker



Low SWAP UAS
Indoor obstacle avoidance, GPS-denied localization, and 3D mapping



Legged Platform
Integrate mission manager onto legged UGV

UAV for precision landing and payload delivery

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ADEPT in Action

Transit to work area, do wide area search, notify me if red cars are found



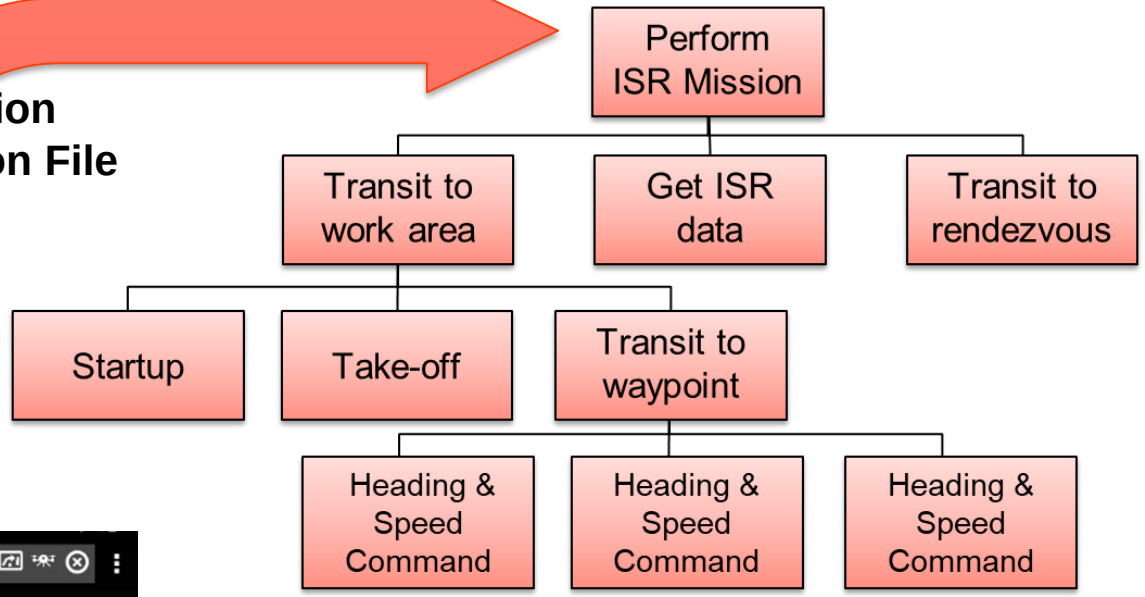
Parametrized Mission Data

1



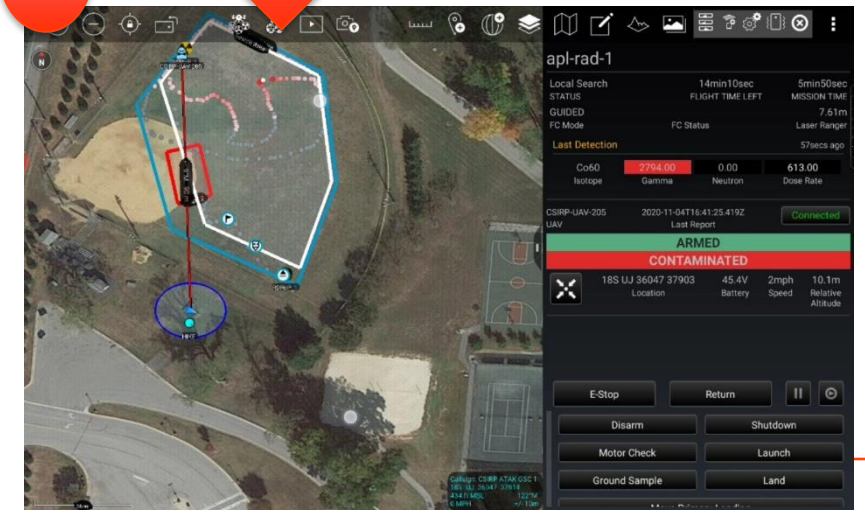
2

Mission Definition File



Mission Monitoring & Re-planning

3

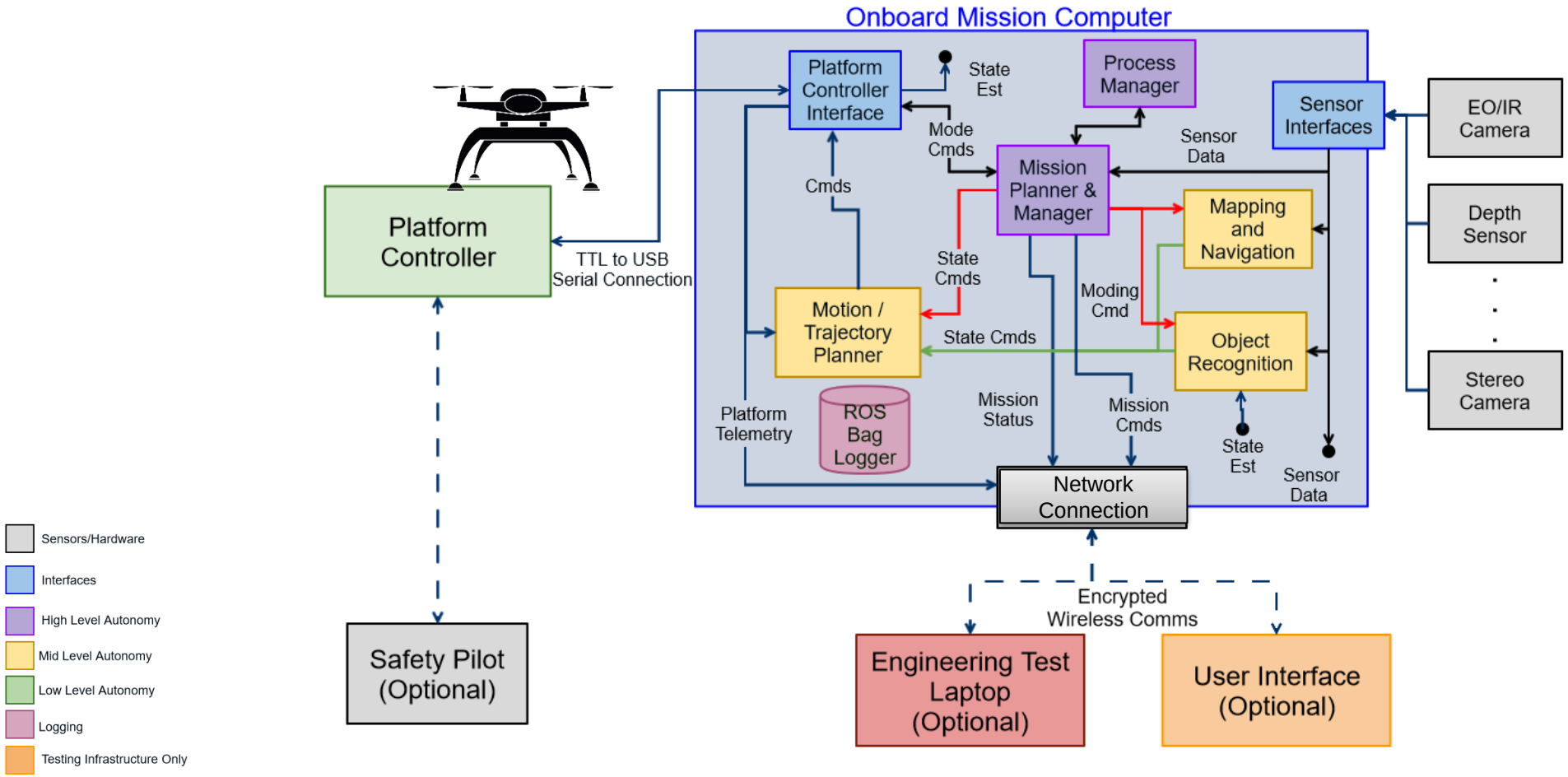


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Nominal ROS Architecture

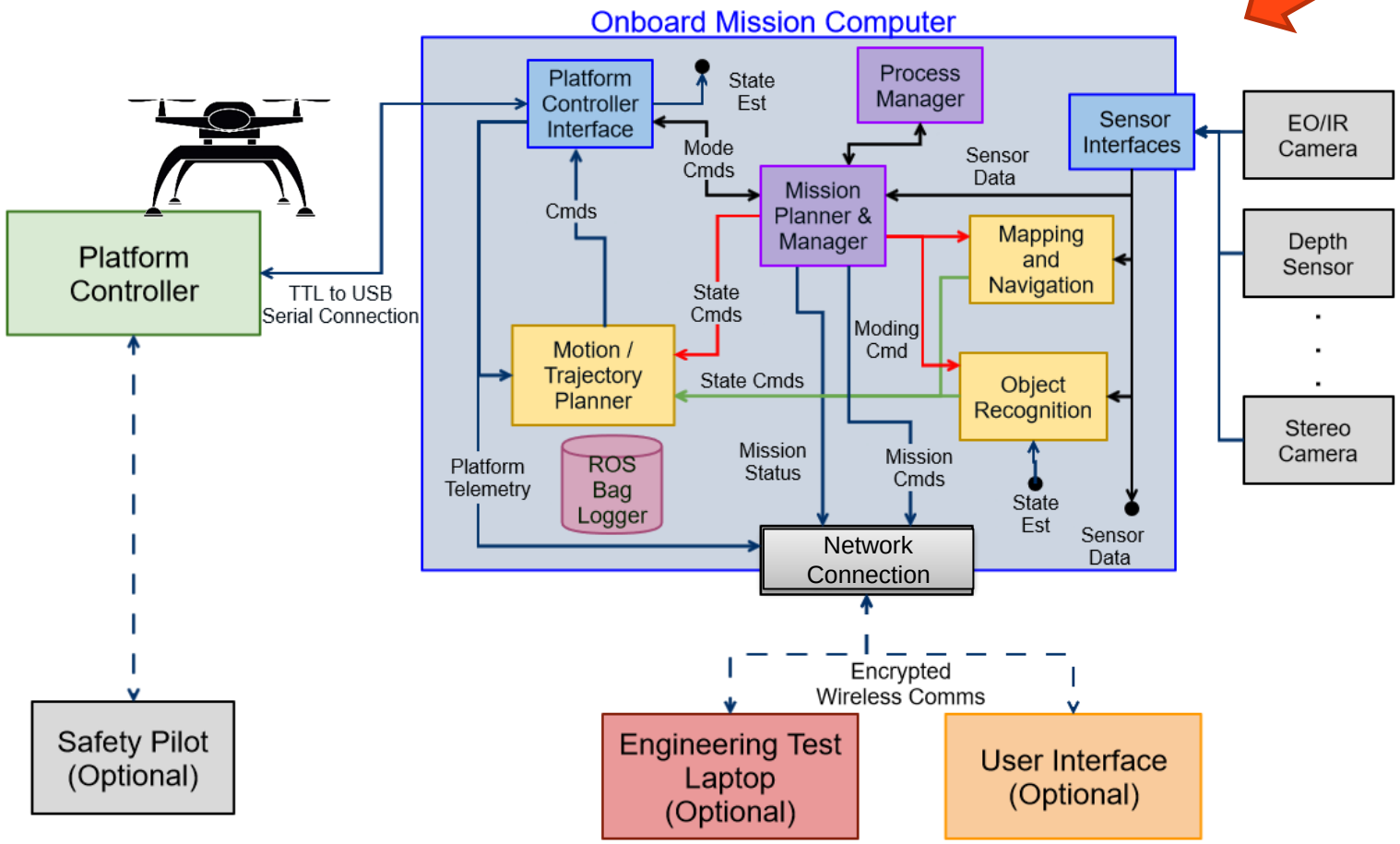
- Architecture flexible and dependent on platform and/or system requirements



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Nominal ROS Architecture

- Architecture flexible and dependent on platform and/or system requirements



Onboard mission computer with Ubuntu OS runs ROS.

- Functional blocks represent one or more ROS nodes

Examples:

- Intel NUC
- NVDIA Jetson TX2
- NVDIA Jetson Xavier
- Qualcomm Snapdragon
- ModalAI Voxl
- Odroid XU4
- Raspberry Pi 3B+





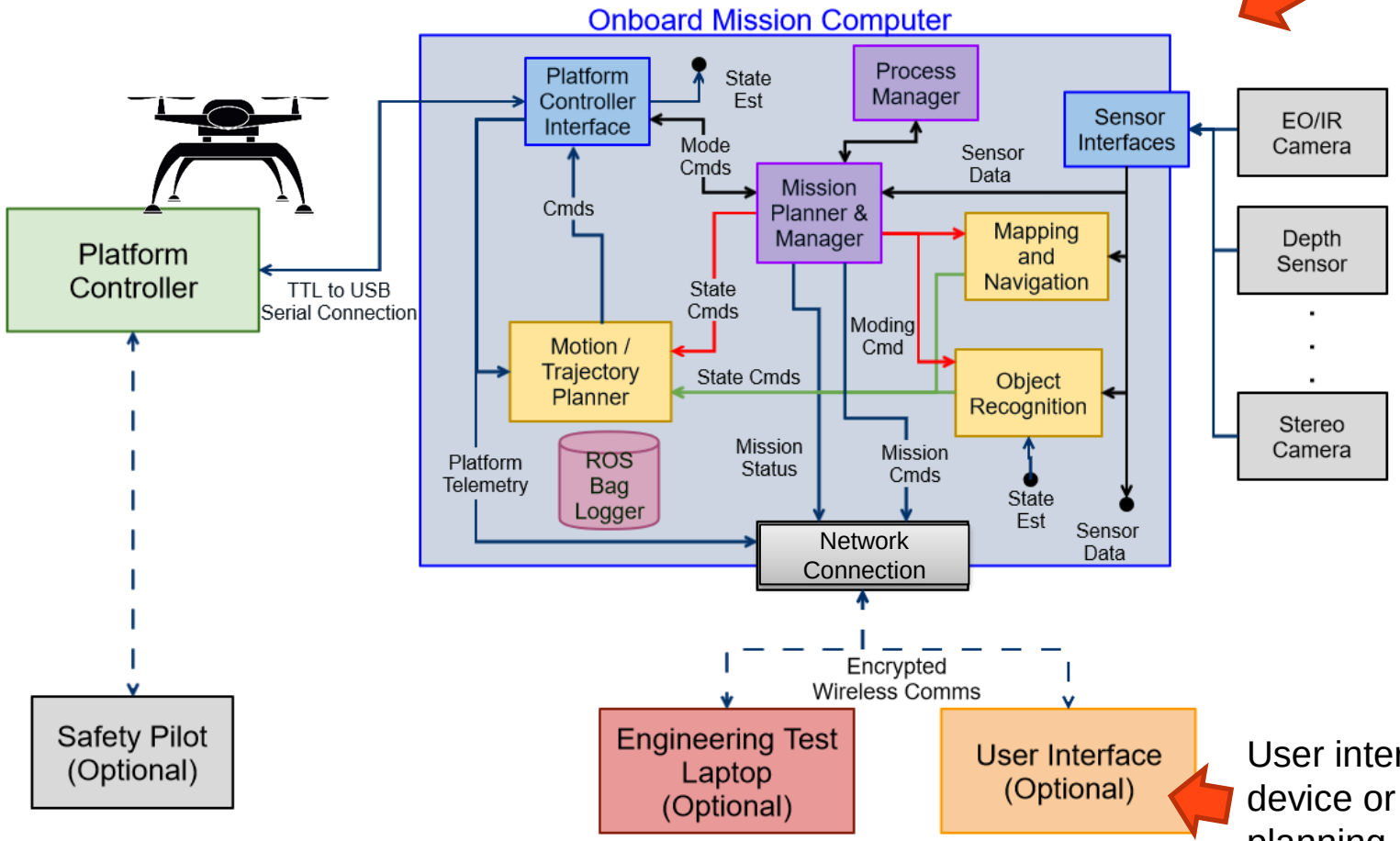




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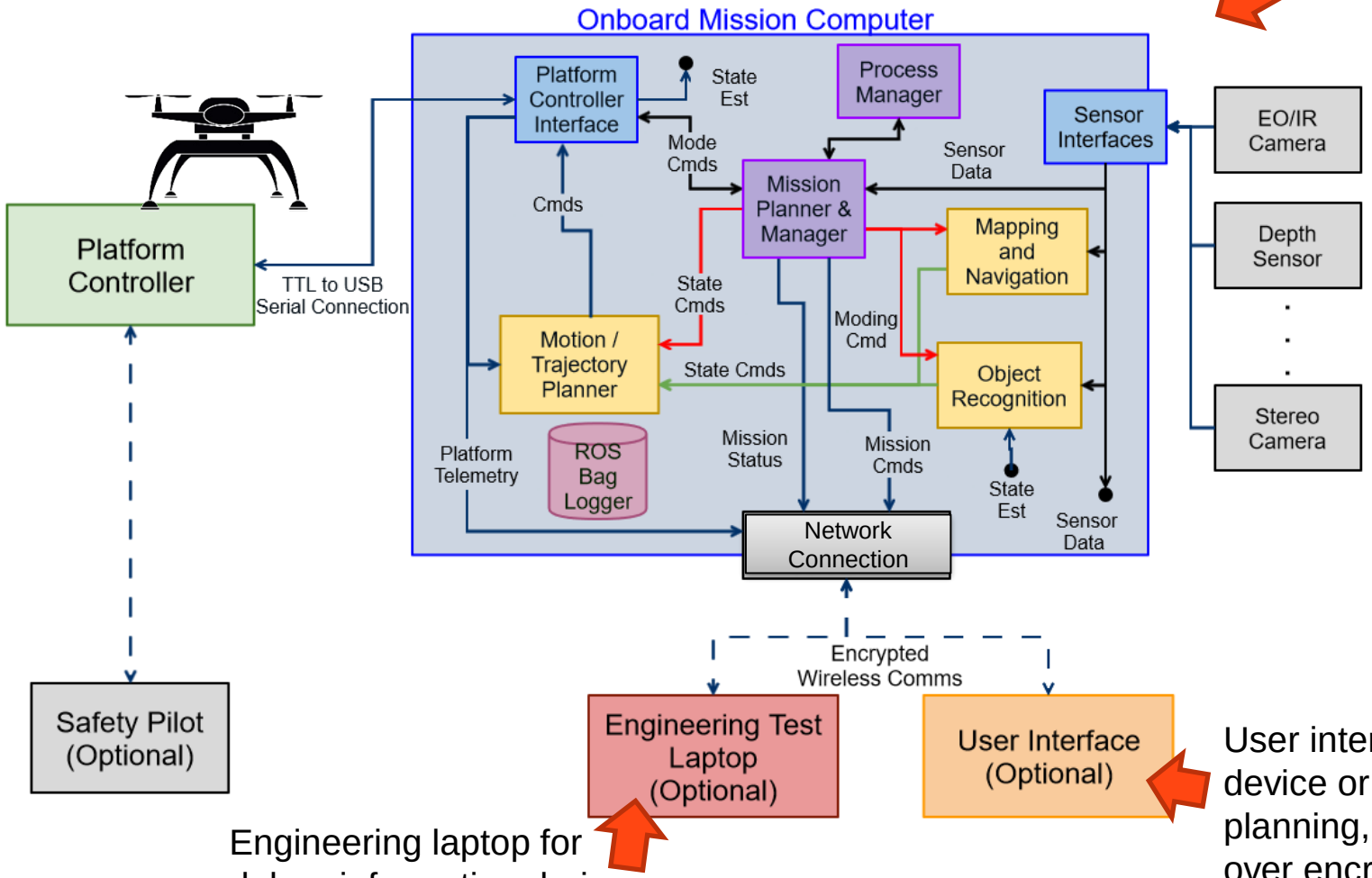
User interface running on ATAK device or laptop for mission planning, monitoring, and/or C2 over encrypted connection

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Engineering laptop for debug information during developmental testing

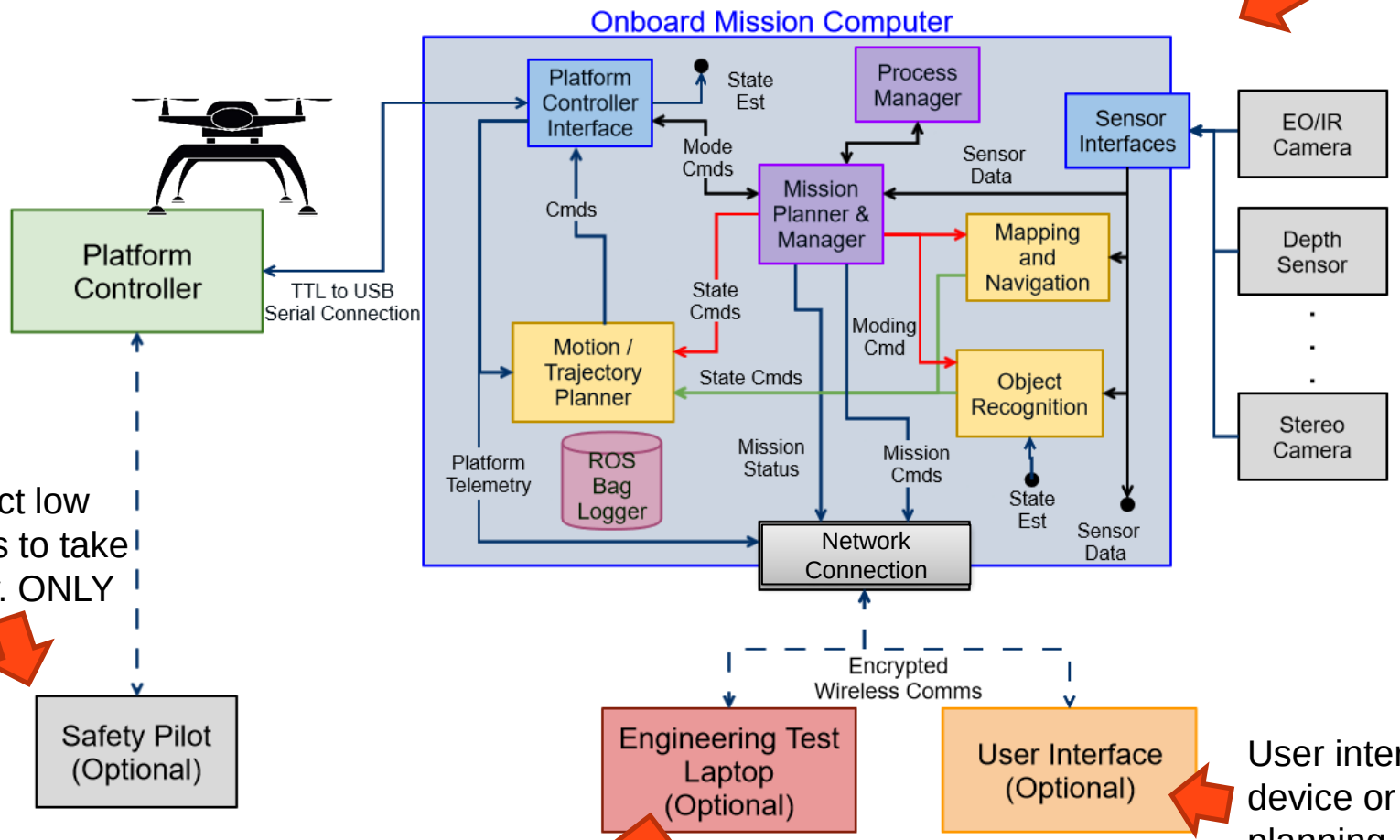
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Safety pilot has direct low level control if needs to take over from autonomy. ONLY FOR TESTING

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User interface running on ATAK device or laptop for mission planning, monitoring, and/or C2 over encrypted connection

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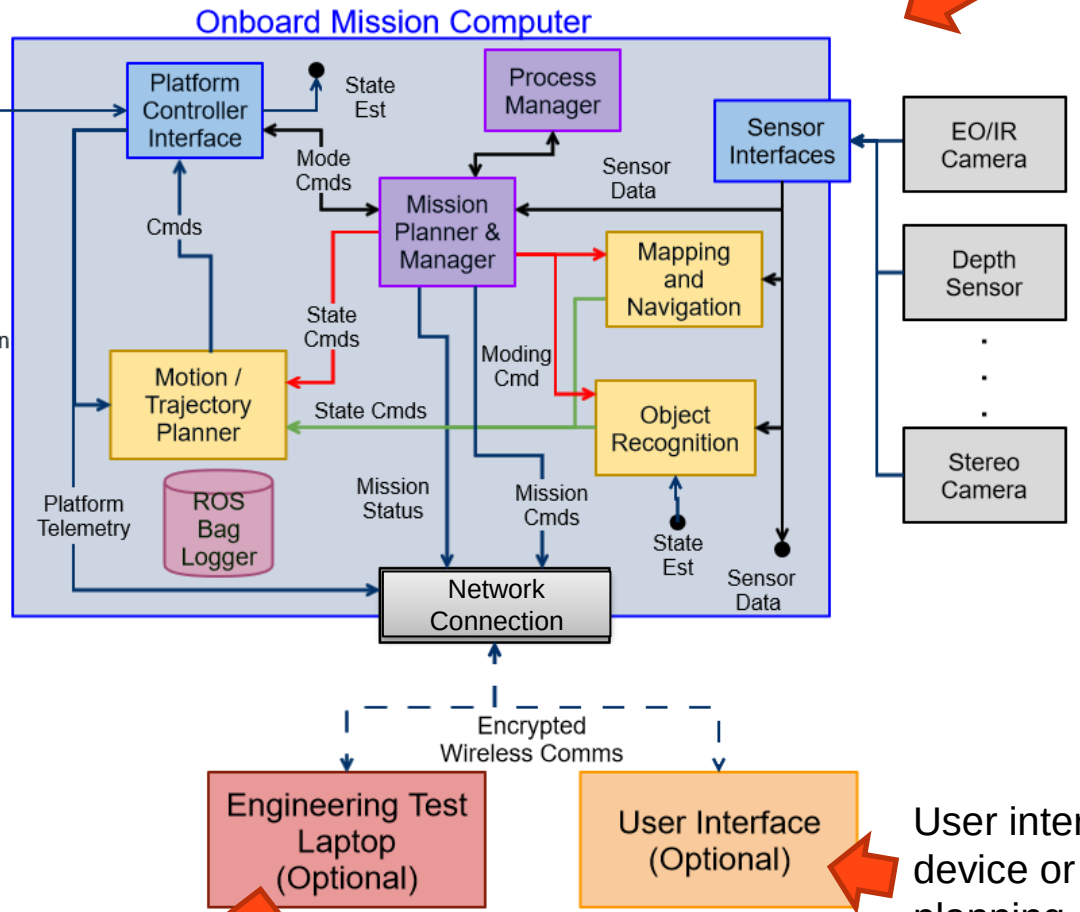
Nominal ROS Architecture

- Architecture flexible and dependent on platform and/or system requirements

Platform controller handles stabilization and low level control

Examples:
- Pixhawk 2.1
- CubeBlue
- mRo
- Custom UGV controllers





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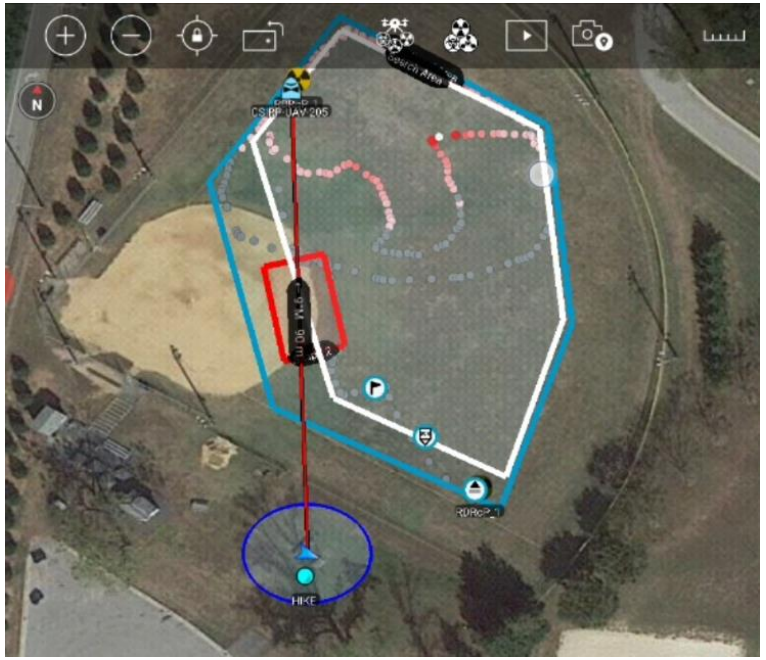




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Example Mission: CBRN Hazard Mapping

- Multirotor UAV for autonomous search for and mapping of chemical or radiological hazards to protect dismounted forces and fixed sites
- Integrated sensors:
  - *Chemical & Radiological sensors for CBRN mapping*
  - *EO camera for ISR*
  - *Anemometer for improved chemical searches*
- User defined search area drives generic lanes or “lawn mower” search until hazard is detected
- Intelligent smart search drives hazard contour mapping or source localization
- Custom ATAK Plugin provide rapid mission planning, monitoring, and semi-autonomous user control
- Extensive field testing with chemical and radiological sources



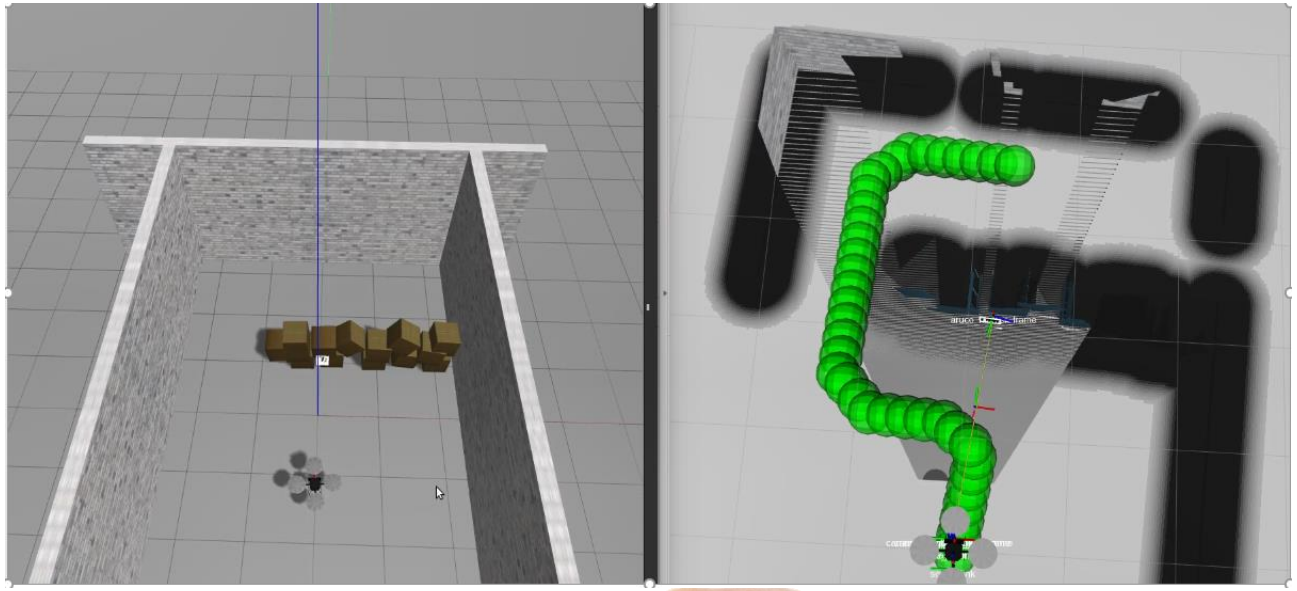


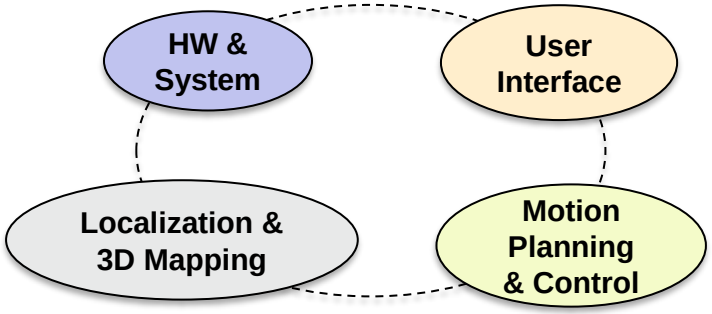


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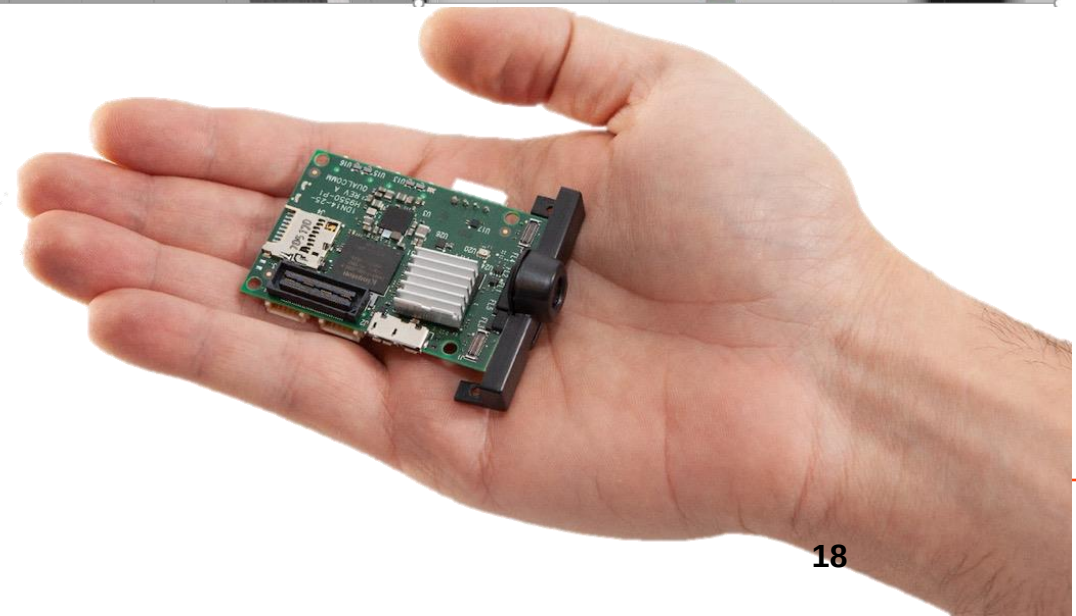
Example Mission: Low-SWAP ISR

- Advanced perception and navigation of low-SWAP UAS
- Outdoor and indoor operation
- **Included technologies:**
  - *GPS-denied localization in unknown environments*
  - *Depth perception to known/unknown obstacles*
  - *Reliable motion planning and safe avoidance*
- Ensure full on-board processing
- Intuitive Graphical User Interface (GUI)



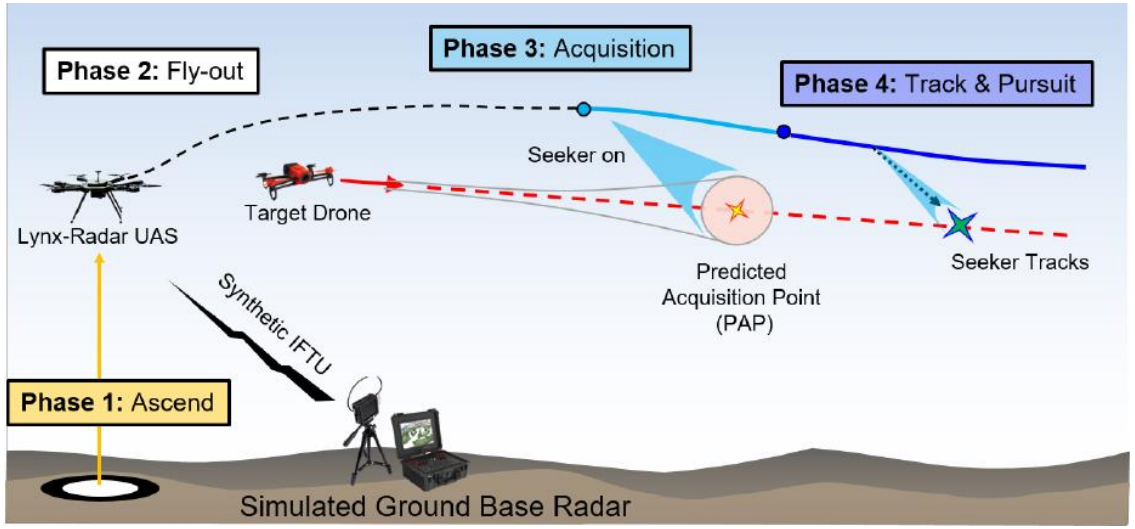


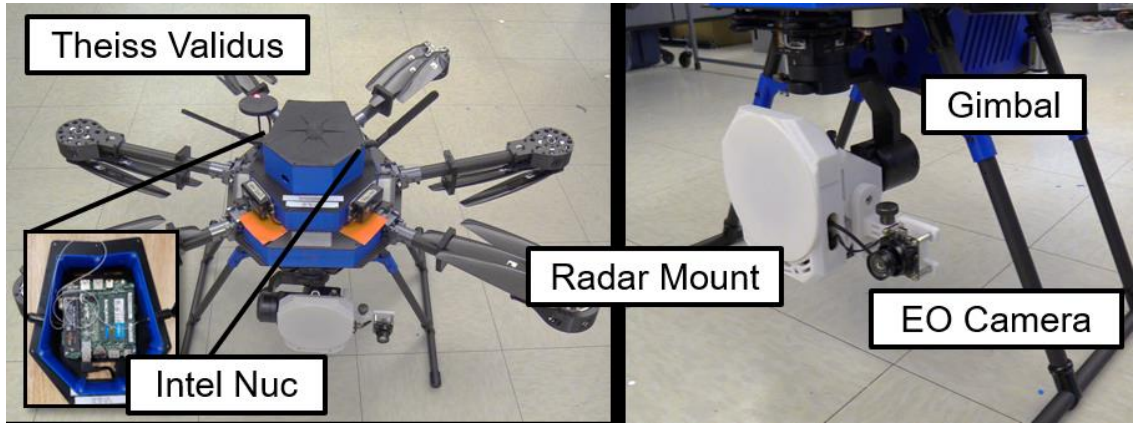


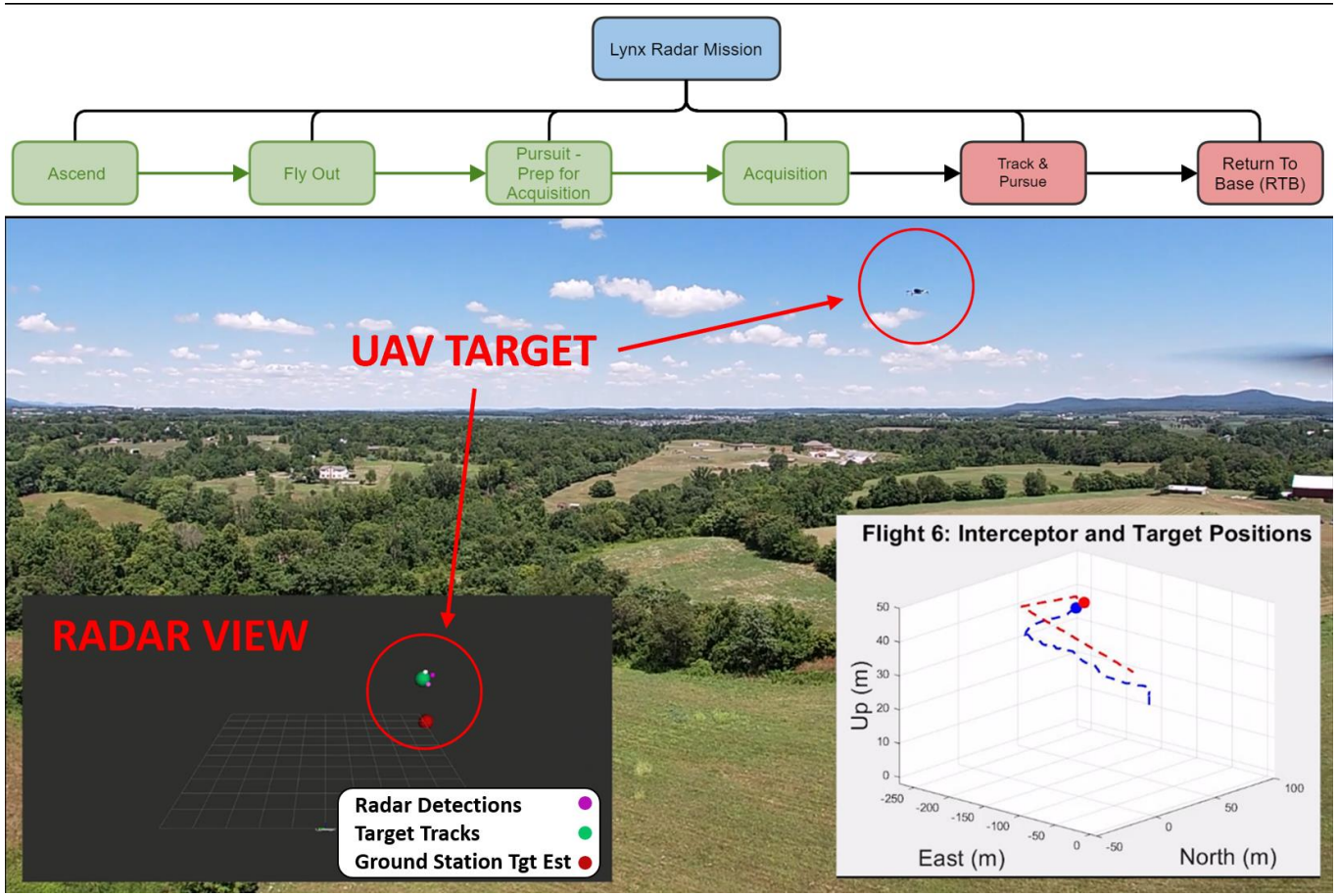


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Example Mission: Counter-UAS







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Draper's Mission-Level Autonomy Software Capabilities

- Technology
  - Suite of **autonomy modules** built upon a ROS architecture
  - Capabilities include ***GPS denied Nav, 3D Obstacle Avoidance, Dynamic Mission planning/management, Target recognition/tracking, 3D Mapping,*** *and* ***ATAK human-system interfaces***
  - Emphasis on modularity and reusability
- Technology Insertion
  - Integration/demonstration on a number of platforms: Snapdragon, Theiss Hex, Ascent Spirit
  - Tigershark, BlackHornet Nano, Vantage Vesper

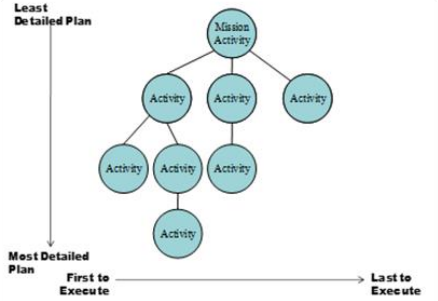






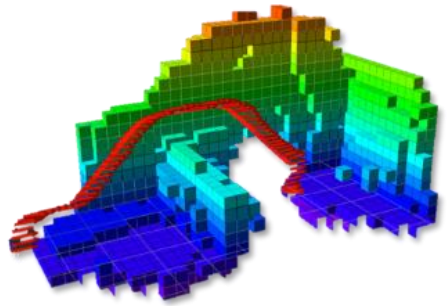
Mission Planning

Aims at decomposing high-level mission



Motion Planning

Aims at planning an obstacle-free path



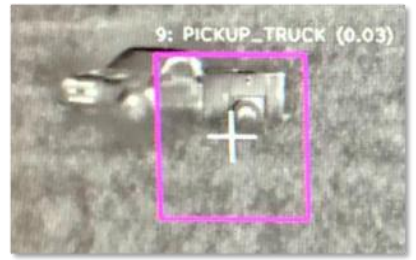
Dense Mapping

Aims at creating a dense tri-dimensional map of the explored environment



Automatic Tgt ID & Tracking

Aims at detecting, identifying and tracking tgt of interest



Explainability in AI

Aims at producing understandable AI solutions



GPS-denied Localization

Aims at estimating UAS location at frame rate



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Questions?

Camila Francolin
Email: cfrancolin@draper.com
Phone: 617-519-6938

Design Considerations for Lethality Packages on Unmanned Ground Vehicle Platforms:

(Making a Killer Robot)

Phil Coker

EOS Defense Systems USA, Inc.

19 OCT 2021

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What is a killer robot?

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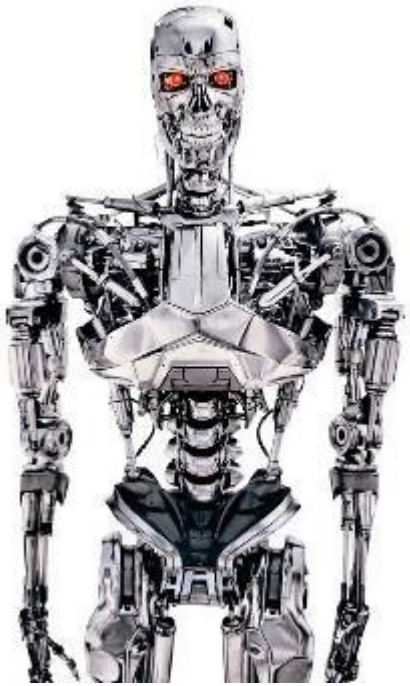












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What kind of killer robot?



- **<u>NOT OUR FOCUS</u>**:
  - Employed within view of the operator
  - Wire Controlled
  - Dumb
  - Explosive
  - Flying
  - Swimming
  - Kills Autonomously





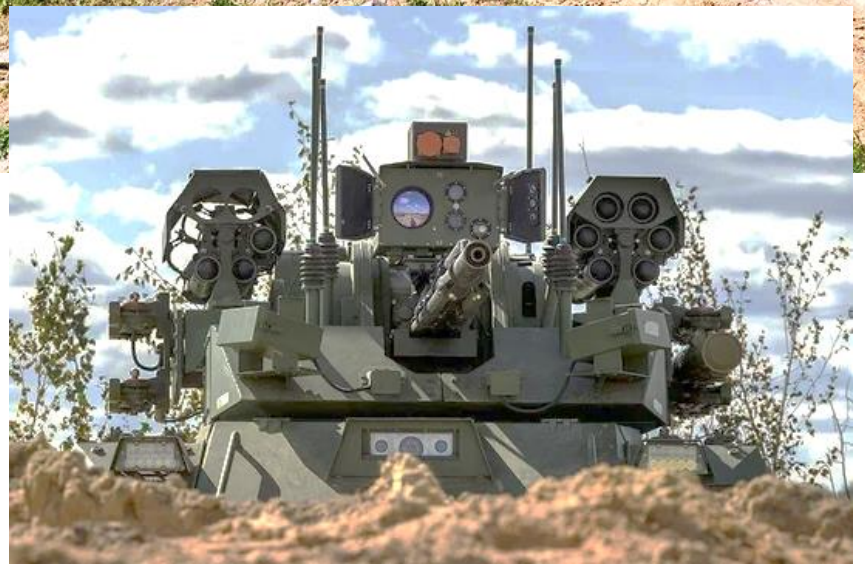


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What kind of killer robot?

- Propose to Discuss:
  - Ground based
  - Semi- or fully-autonomous
  - Carrying a lethality package
  - Includes sensor package for the lethality solution
  - Provides data to the lethality package
  - Employed as either wingman or semi-independent





Focus Today is on the Lethality Package

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What makes a good lethality package for an armed robot?

- Precise
- Lethal
- Smart
- Sustainable
- Modular
- Physical Properties
- Safe
- Secure
- Reliable

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Precise

Negate adversary advantages

- Shoot first, hit first, kill first
- Sensor suite is key
  - LRF Accuracy
  - Day/Night

Logistic benefits

- Fewer rounds per engagement
- More stowed kills
- Extend mission profile





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Lethal

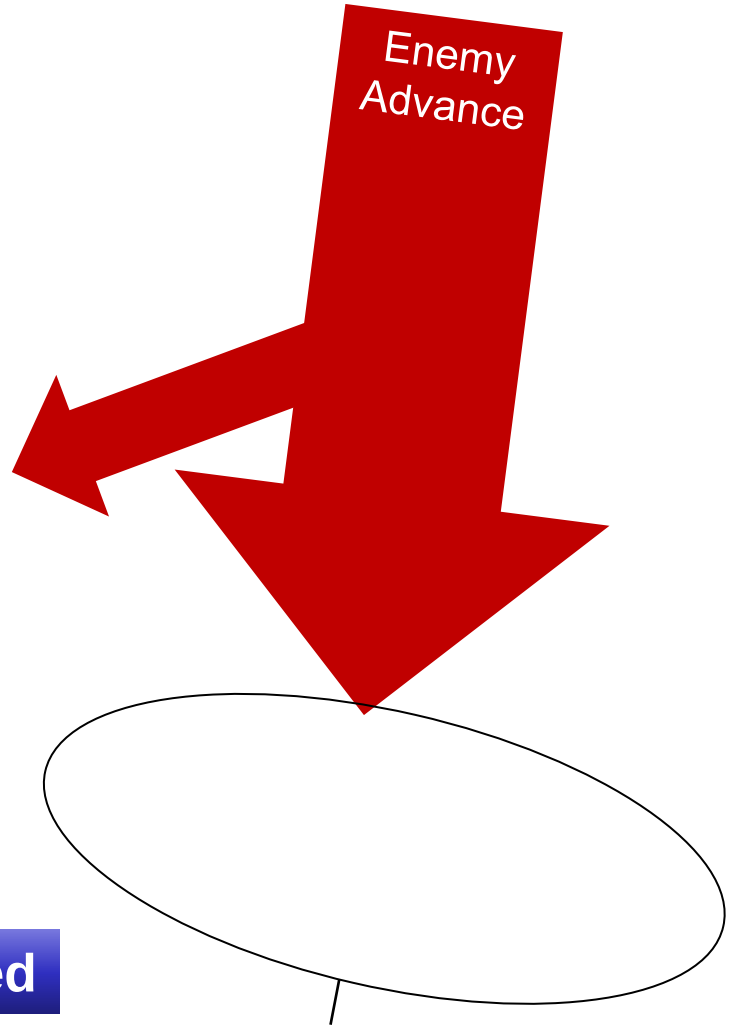
Force the Adversary to React

- Cannot bypass
- Cannot allow in rear areas
- Expendable vs. Attritable

Broad Spectrum Lethality



UGV w/30mm & Javelins



Too Deadly to be Ignored

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Smart

Aided Target Recognition

- Speed Engagements
- Reduce Fratricide

Sector Scan / Pixel Change

- Change Detection
- Reduce Soldier Load

Location-dependent TRPs



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Reliable

High Mean Time Between Failure

- Both weapon & mobility platform
- Built-in-Tests & self-diagnosis
- Chain gun consistency

Cyber hardened

- Communication link
- Internal software

Resilient

- Protect/Clean its own sights
- Powered immediate action



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Sustainable

Resupply

- Keep in the fight
- Magazine reload
- If not – at least 2x the number of robots



Robot to Robot

- Designed for the lethality package
- Magazine? Clip?



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Modular

Adaptable to Mission Set

- Multiple weapon configurations (gun / missile)
- Stationary or mobile
- Sensor suite

Capable of Expanding to support Heavy Data & Power Load

- Advanced power and data solutions
- Next generation battery performance



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Physical Properties

Weight

- Can impact trafficability

Height/CG

- Risk of tipping

Physical Configuration

- Risk of unintended impacts from main gun, side extensions



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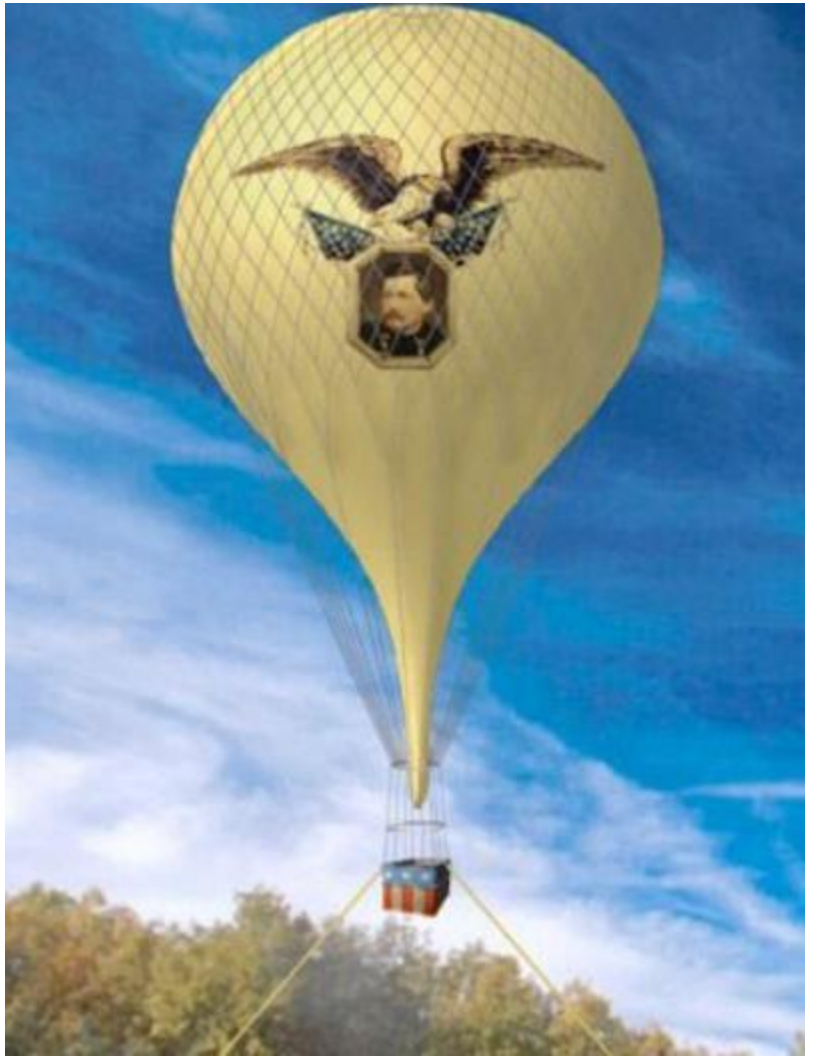
Safe

Tested, Proven

- Repetitive reliable performance
- Fielded
- Supported units have trained with this capability

Capable sensor suite

- Day/Night capable beyond max range of onboard weapons



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Secure

Armored

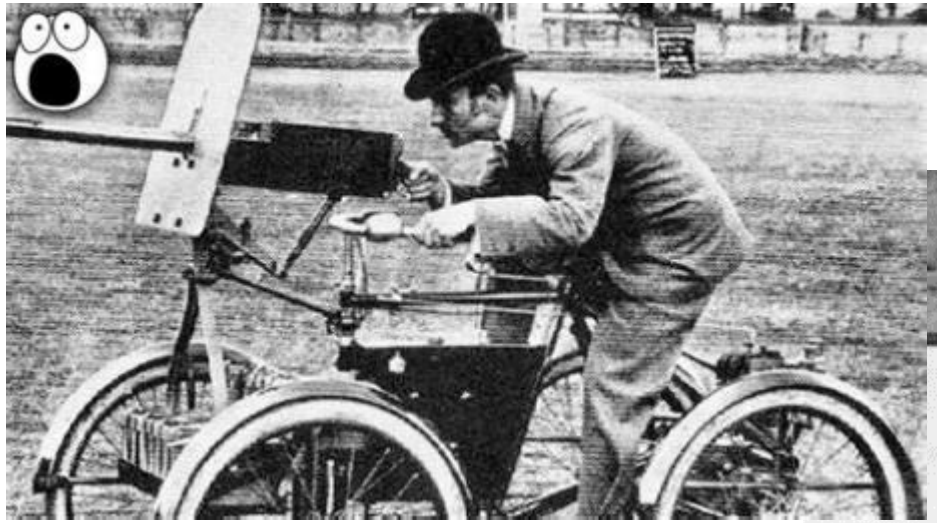
- At least STANAG Level 2

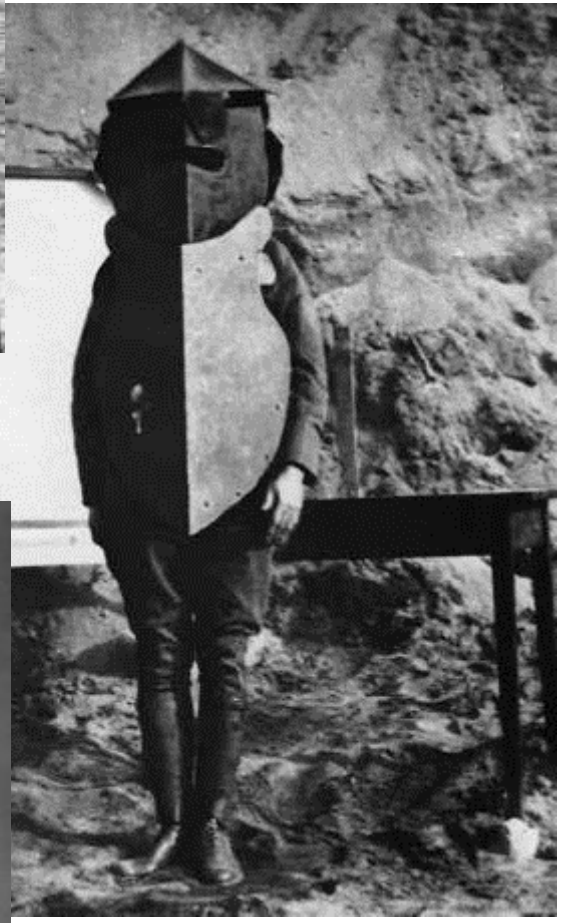
Resistant to tampering

- Weapons cannot be turned on supported units
- Difficult to re-purpose

Close In Non-Lethal

- 360° view and defend
- Taser?







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Conclusion

What we put on top of a robot is, at least, as important as the platform itself.



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Questions?

BG(R) Philip D. Coker
CEO, EOS Defense Systems USA, Inc
pcoker@eosdsusa.com

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CRITICAL SCOUT:

We May Not Own The Night, But We CAN Deny The Use Of It

By:

Howard D. Kent, ADG, LLC

&

Dr. Leo Volfson, TPL, Inc.

NOTE: Approved For Public Release

Contents:

3. Introduction
5. Problem: The Proliferation Of Battlefield Optics
7. Robotic Platforms: The Perfect Geolocation & Detection Tool
9. Optic Detection Principles
12. TPL BEAM: Modern Battlefield Optic Detection System Capability
16. Future Development Path Incorporating Robotic Autonomy
19. Conclusions
20. Recommendations
21. Credits

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Critical Scout:

Introduction…



AIMEE, Red Planet (2000)

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Critical Scout:

Introduction…

- Optics For Visible, IR And Thermal Imaging Devices On The Modern Battlefield Have Proliferated For Small Arms, Rockets And Missiles…
- Optics For Observation, Cameras And Remote Sensor Devices Pose A Threat To Friendly Forces Even When Not Mounted To A Weapon…
- There Is Therefore A Need To Detect These Threats And To Geolocate Them For Application Of Appropriate Fires Without Endangering Friendly Forces.

"If You Can No Longer Own The Night, You ***Can*** Deny Anyone The Use Of It"

NOTE: Approved For Public Release

Critical Scout:

Problem: The Proliferation Of Battlefield Optics



USMC 1903 Springfield / Unertl Scope Wikipedia

NOTE: Approved For Public Release

Critical Scout:

The Proliferation Of Battlefield Optics:

Binoculars, Scopes, Cameras, Rangefinders And Designators Everywhere…

















Above Clockwise From Upper Left: Chinese ATGM, RPG-7 With Optical Sight, US Army Sniper Team Photo, DPReview Blog Camera, Russian Tank, Russian BMP, Unusual Chinese Sniping Position Which One Hopes They All Use, Chinese Tank, SkySapience Tethered Drone, Chinese DLI Quadcopter, US Army Rifleman Photo, Bertin Instruments Remote Cameras, Israeli SPOTLIGHT System.

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Critical Scout:

Robotic Platforms; The Perfect Detection & Geolocation Tool

Find All Hostile Observers, Geolocate And Characterize Them For Targeting…

File Match:
RPG
Rifle/MGO







Sweep 70 Deg
Targets: 22



Wikipedia Small Arms, MartinVFXDeviantart Battle Scene, iRobot Warrior By Howard Kent, TPL Beam System

NOTE: Approved For Public Release

Critical Scout:

Send The Target Geolocation Scout Forward

Existing Robotic Platforms Can Provide Mobility For Force Multiplication Sensors…



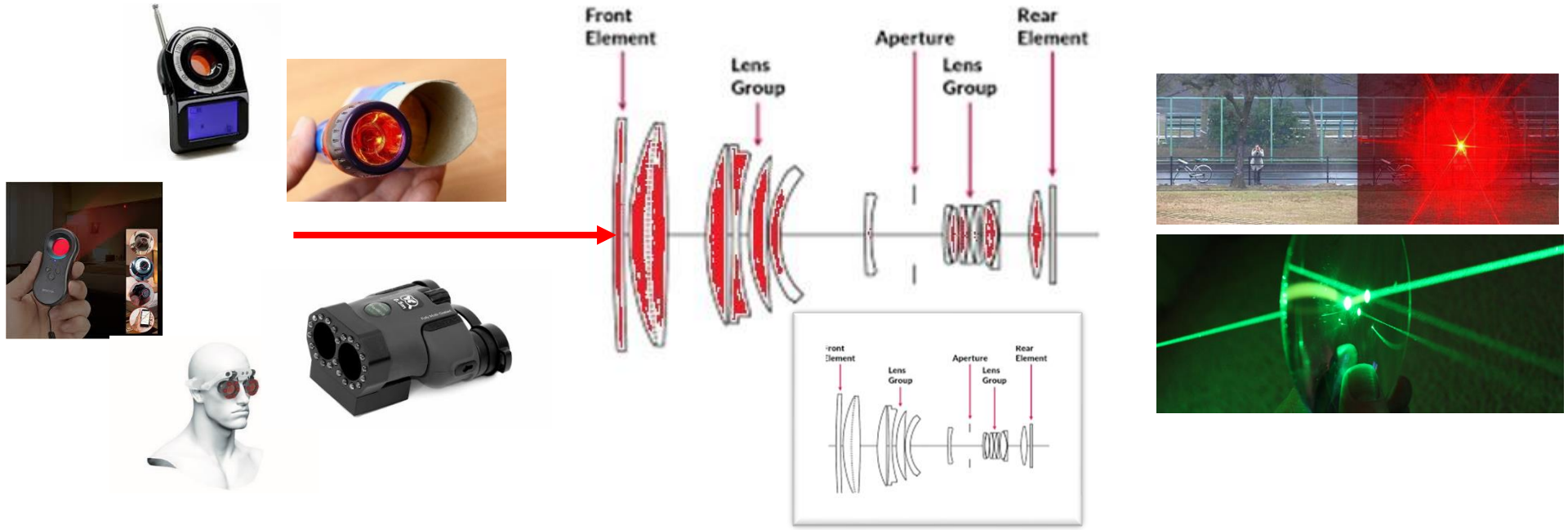
Clockwise From Upper Left: What Was In 2012 And Still Candidates; Former iRobot Robotic Systems Family, QinetiQ Armed Talon, NGIC EOD Robotics, Textron Howe & Howe Ripsaw Modified, GD SMSS, HDT Global Hunter, GD MUTT Ground Robotic System.

NOTE: Approved For Public Release

Critical Scout:

Optic Detection Principles: How It Works

Shine A Bright Light Into The Lens And Spot The Reflection…



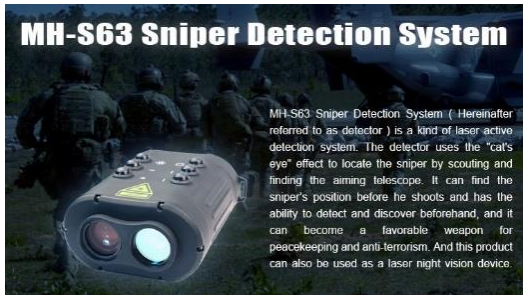
From Left To Right Above: Multiple Amazon "Pinhole Camera Detectors", Wikipedia Lens Graphic & Graphic Modified, Quora Laser On Lens, Michael Naimark Laser Photo.

NOTE: Approved For Public Release

Critical Scout:

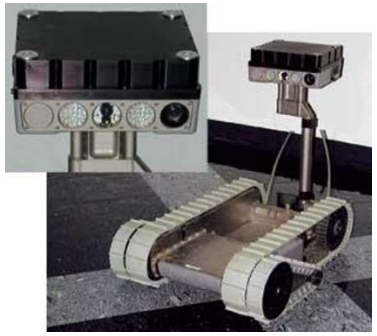
Optic Detection Principles: Early Battlefield Optical Detection Integration

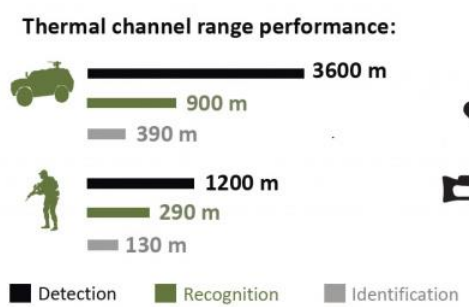
Hand-Held, Clamped On, No Turret Scanning, No Geolocation…

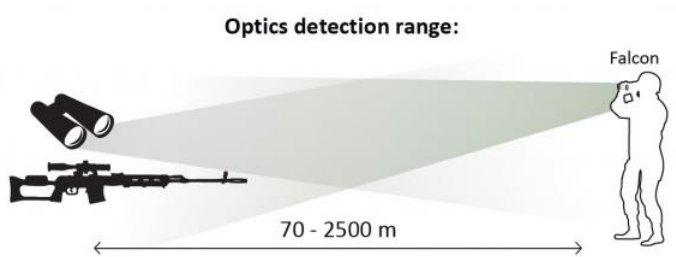












Clockwise From Top Left: Chinese Optic Detection System From Amazon, Jetprotect Counter-Sniper System, Popular Mechanics Russian Weapon Mount, FALCON Handheld Detector, iRobot + Photonics Center Photos

NOTE: Approved For Public Release

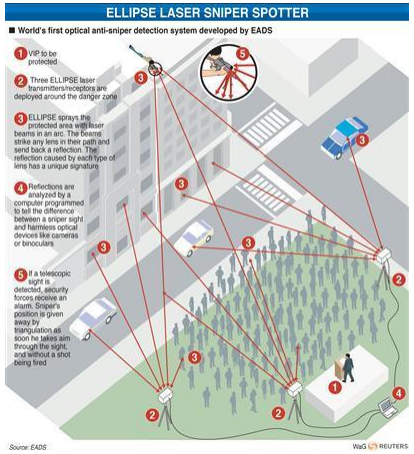
Critical Scout:

Optic Detection Principles: Early Battlefield Optic Detection Integration

Fixed Site Observation, Low Mobility, Narrow Field, Multiple Units Required…









Let To Right Above: AES Vision System, EADS Eclipse System, Israeli Elbit Counter Sniper System

NOTE: Approved For Public Release

Critical Scout:

TPL BEAM; Modern Battlefield Optic Detection System Capability:

Small, Lightweight, Scanning, Wide Area Coverage, Highly Mobile, Geolocation…



Horizontal





Vertical Over





[Beam™ 230 – Torrey Pines Logic (tplogic.com)]

[Campanile™ 233 – Torrey Pines Logic (tplogic.com)]

Torrey Pines Logic Photos Beam System

NOTE: Approved For Public Release

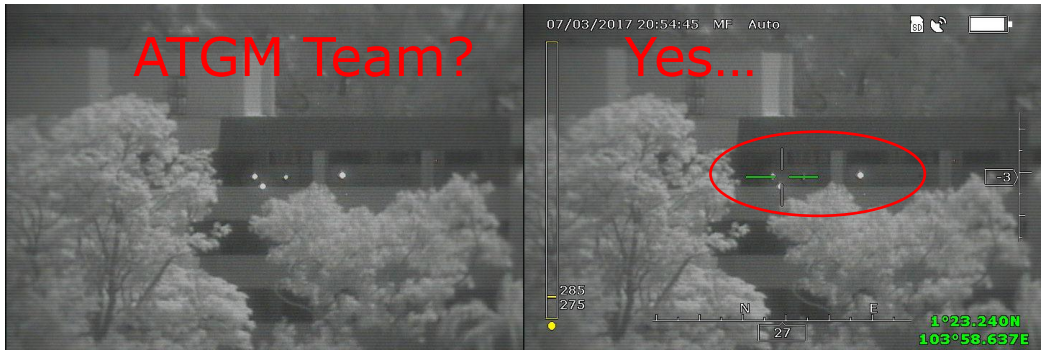
Critical Scout:

Torrey Pines Logic Optic Detector Technology In Action…











Torrey Pines Logic Photos BEAM System

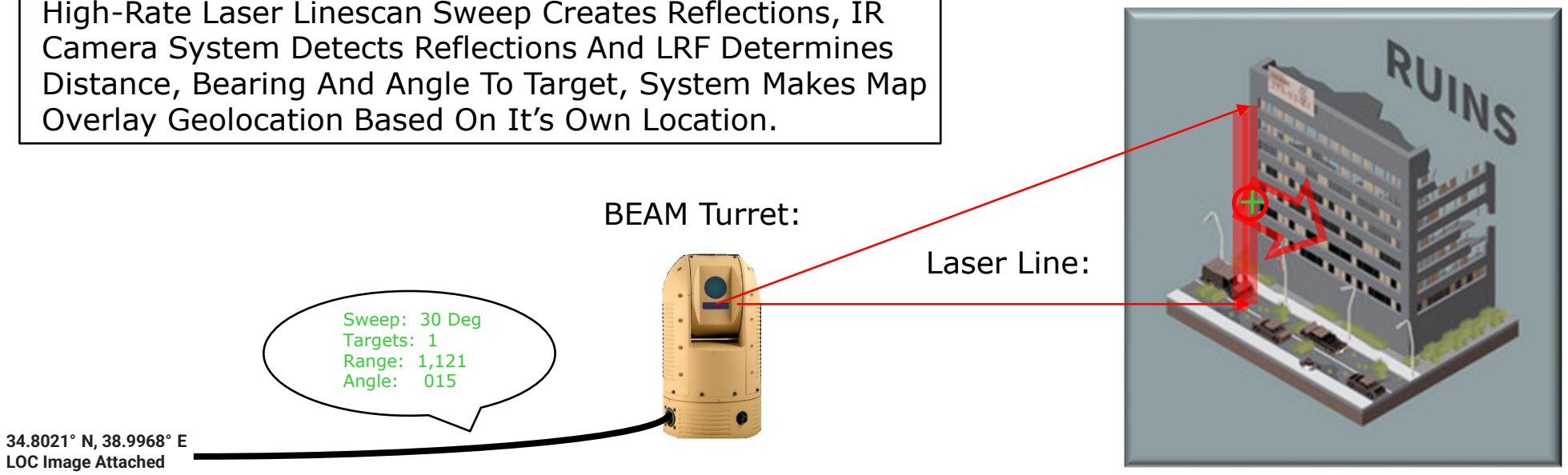
NOTE: Approved For Public Release

Critical Scout:

Torrey Pines Logic Optic Detector Technology Scenario…

"Small Robot Goes Forward With BEAM System And Locates Enemy Formation In Ruins"

High-Rate Laser Linescan Sweep Creates Reflections, IR Camera System Detects Reflections And LRF Determines Distance, Bearing And Angle To Target, System Makes Map Overlay Geolocation Based On It's Own Location.



Vectorstock Ruins

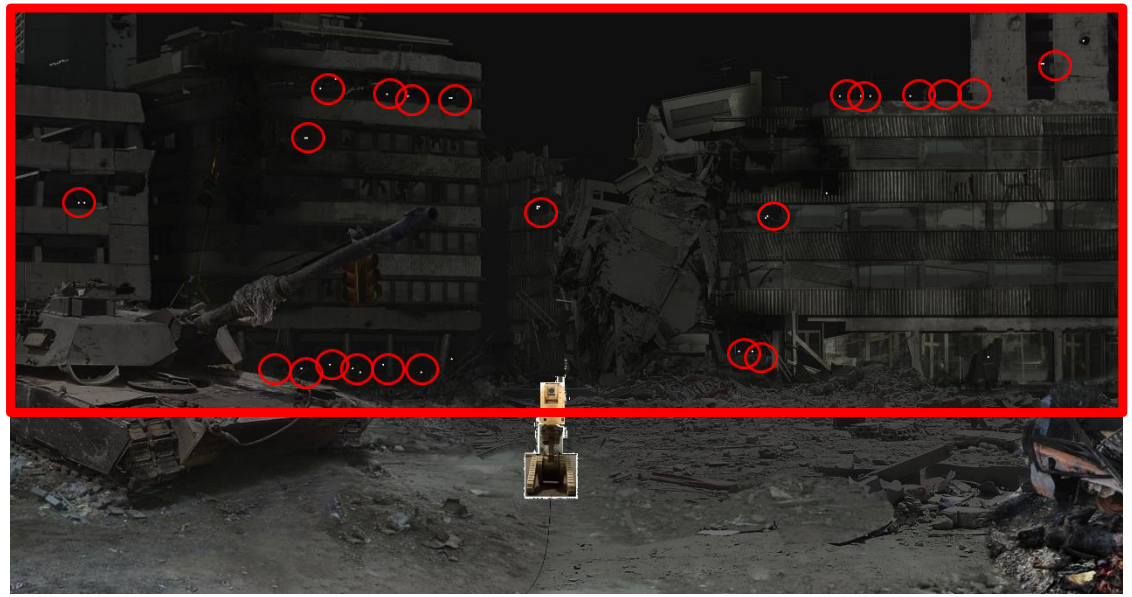
NOTE: Approved For Public Release

Critical Scout:

Torrey Pines Logic Optic Detector Technology Scenario…

"Small Robot Goes Forward With BEAM System And Locates Enemy Formation In Ruins"

BEAM Detects All Optical Devices: Scopes, RPGs, ATGM, Binoculars, Rangefinders, Designators, Etc.



MartinVFXDeviantart Battle Scene, iRobot Warrior By Howard Kent, TPL Beam System

May Not See All Enemy Troops, Just The Most Dangerous Ones With Optics On Their Weapons.

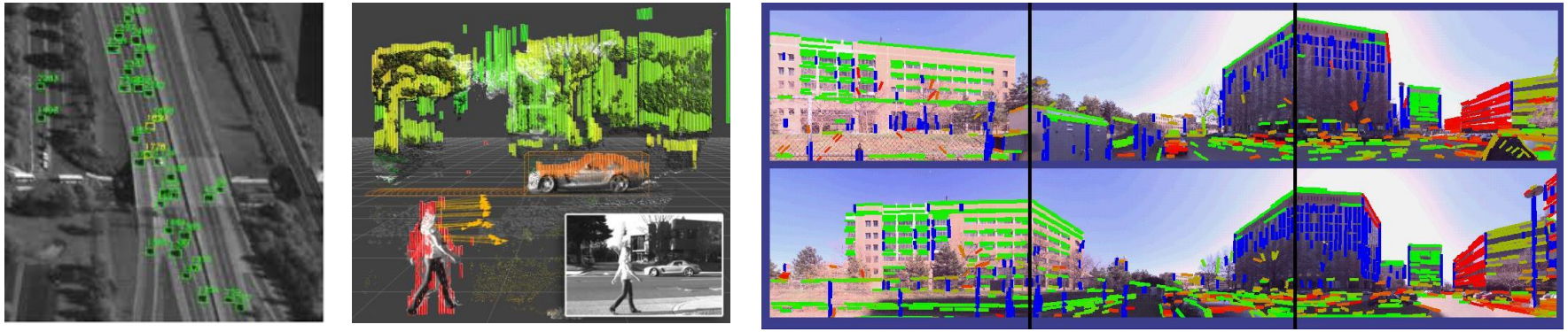
NOTE: Approved For Public Release

Critical Scout:

Torrey Pines Logic Optic Detector Future Development Path:

"Small Robot Goes Forward Autonomously With BEAM System And Locates Enemy Formations"

Future Developments: Incorporation Of Self-Driving Car Technology



From Left To Right Above: SightLine Applications MTI, Google Autonomous Vehicle Sensor Data, MIT LIDAR Digital Scene Matching Area Correlation

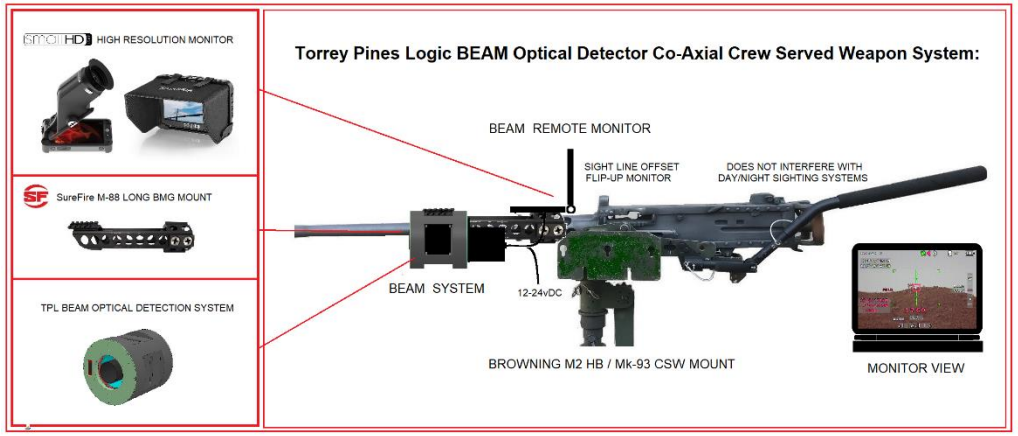
NOTE: Approved For Public Release

Critical Scout:

Torrey Pines Logic Optic Detector Future Development Path:

"Small Robot Goes Forward Autonomously With BEAM System And Locates Enemy Formations"

Future Developments: Coaxial Weapons Integration For BEAM System



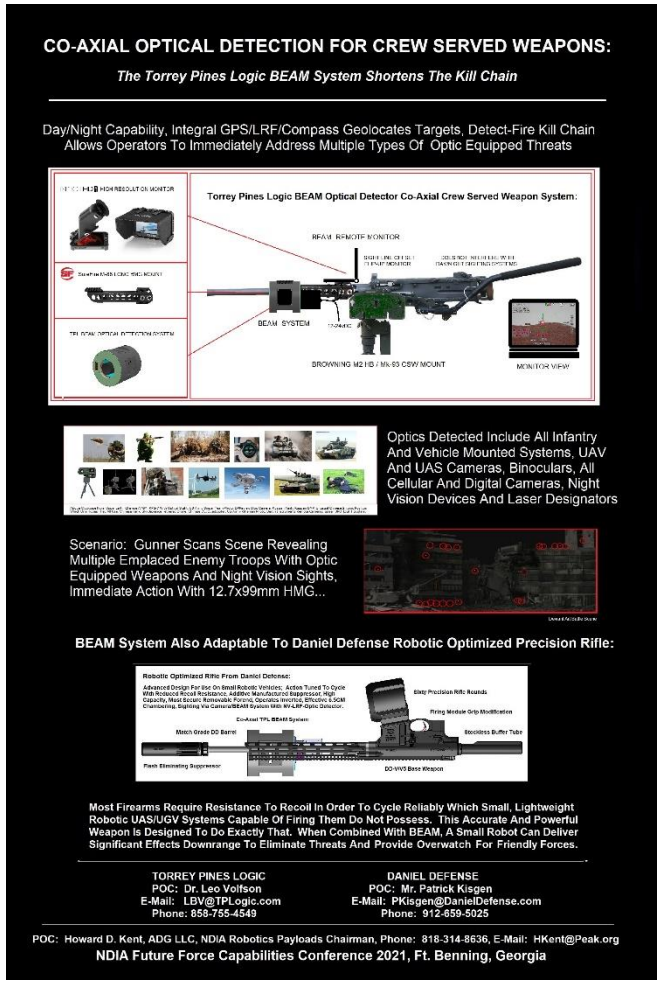


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Critical Scout:

See **Co-Axial Optical Detection For Crew Served Weapons** Poster

In The Exhibit Hall



Featuring **Torrey Pines Logic** & **Daniel Defense** Robotic Payloads For Future Unmanned Ground Combat Systems

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Conclusions:

- The Proliferation Of Optics On The Battlefield Creates Both A Threat And Opportunity.
- Locating Optic Equipped Observers And Weapons Is A Proven Military Technology.
- Enemy Forces Possess Optic Detection Capabilities Which Will Be Used Against Us.
- Placing The BEAM System With Geolocation On A Mobile Platform Is A Leap Ahead Enabling US Forces To Find Threats Without Endangering Friendly Forces.
- Once Identified And Located, Concealed Enemy Forces May Then Be Eliminated…

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Recommendations:

- Develop Robotic Applications Of The BEAM System, Including Stand Alone And Coaxial Mounting To Weapons Mounts For Immediate Response To Enemy Detection.

- Develop Tactics And Weapons For The Use Of Optic Detection In Robotic And Combined Manned-Robotic Operations Teaming To Reduce Friendly Casualties.

*"We May No Longer Own The Night, But We **CAN** Deny Others The Ability To Use It"*

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Credits:



POC: Howard D. Kent, CEO, ADG LLC, Phone: 818-314-8636, e-Mail: HKent@Peak.org

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Torrey Pines Logic – Welcome (tplogic.com)

POC: Dr. Leo Volfson, CEO, TPL Inc., Phone: 858-755-4549, e-Mail: LBV@tplogic.com

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Credits:

The Testing And Demonstration Facilities Of:

Mr. Joby Hawkins

LTC Steve Brown, USA-Ret.







Secure Confidential Research And Development Location
For Defense Applications In Laurens, South Carolina

nP TECHNOLOGY

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Hudson Institute

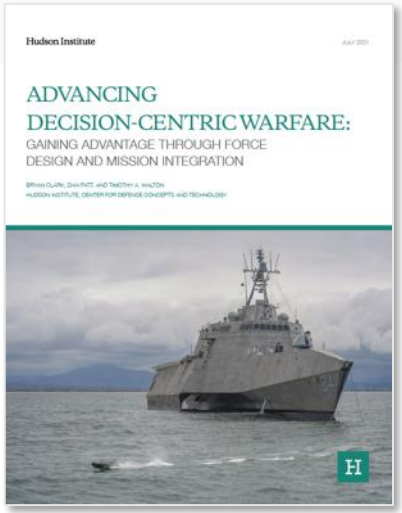
CENTER FOR DEFENSE CONCEPTS + TECHNOLOGY

Gaining Decision-Making Advantage through Force Design and Mission Integration

Timothy A. Walton

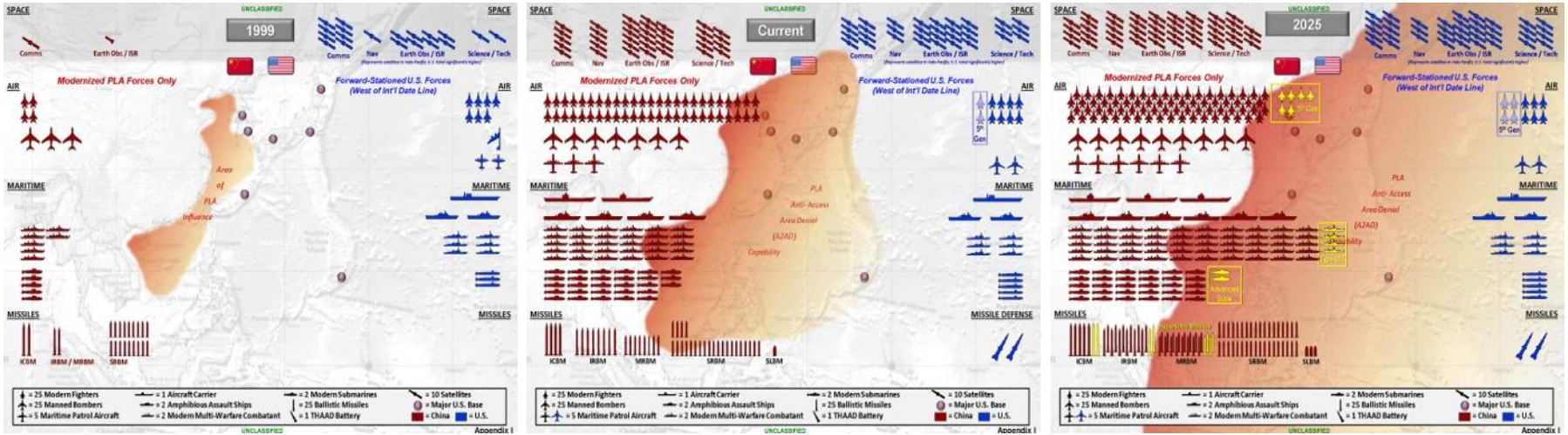
twalton@hudson.org





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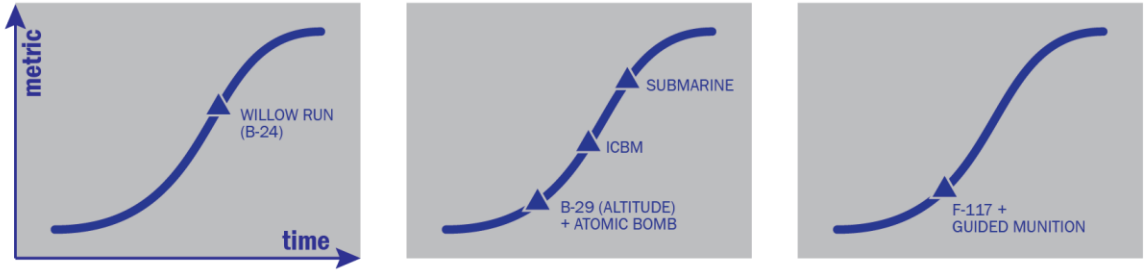
Challenge: More or better gear alone unlikely to yield durable advantages against China



- The threat from China will become increasingly severe during the 2020s
- Decades-long development programs are unlikely to arrive in time within realistic budgets
- China is a peer competitor fighting on their home territory
- **Flexible combinations of systems & concepts could more effectively create a decision-making advantage and impose losses on the enemy**

China's parity reflects culmination of the precision weapons/stealth competition

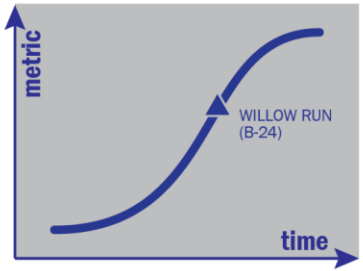
INNOVATIONS (S-CURVES) IN MODERN MILITARY HISTORY

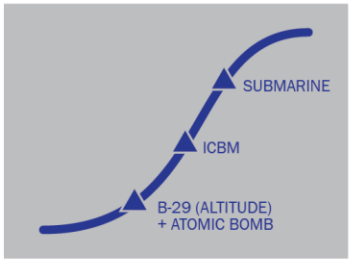


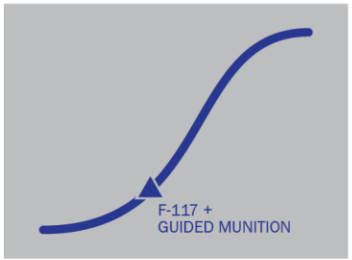
ERA	INDUSTRIAL CAPACITY	NUCLEAR WEAPONS	INVISIBILITY & PRECISION
exemplary metrics	• quantity produced	• yield • number of launch options • prosecutable targets	• signature / detectability • collateral effect size • navigation precision
key technologies	• mass production	• fission • delivery mechanisms	• radio frequency stealth • electronic warfare • computer control
DoD institutional innovation	• effective relations with private industry	• strategic decision making	• performance-driven product development
counters	• centralized state control of industry	• equivalent capability creates stasis	• multi-mode detection • basing denial

Next competition could center on decision-making, using AI & autonomous systems

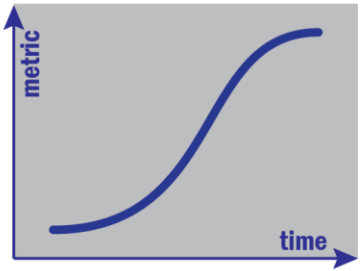
INNOVATIONS (S-CURVES) IN MODERN MILITARY HISTORY





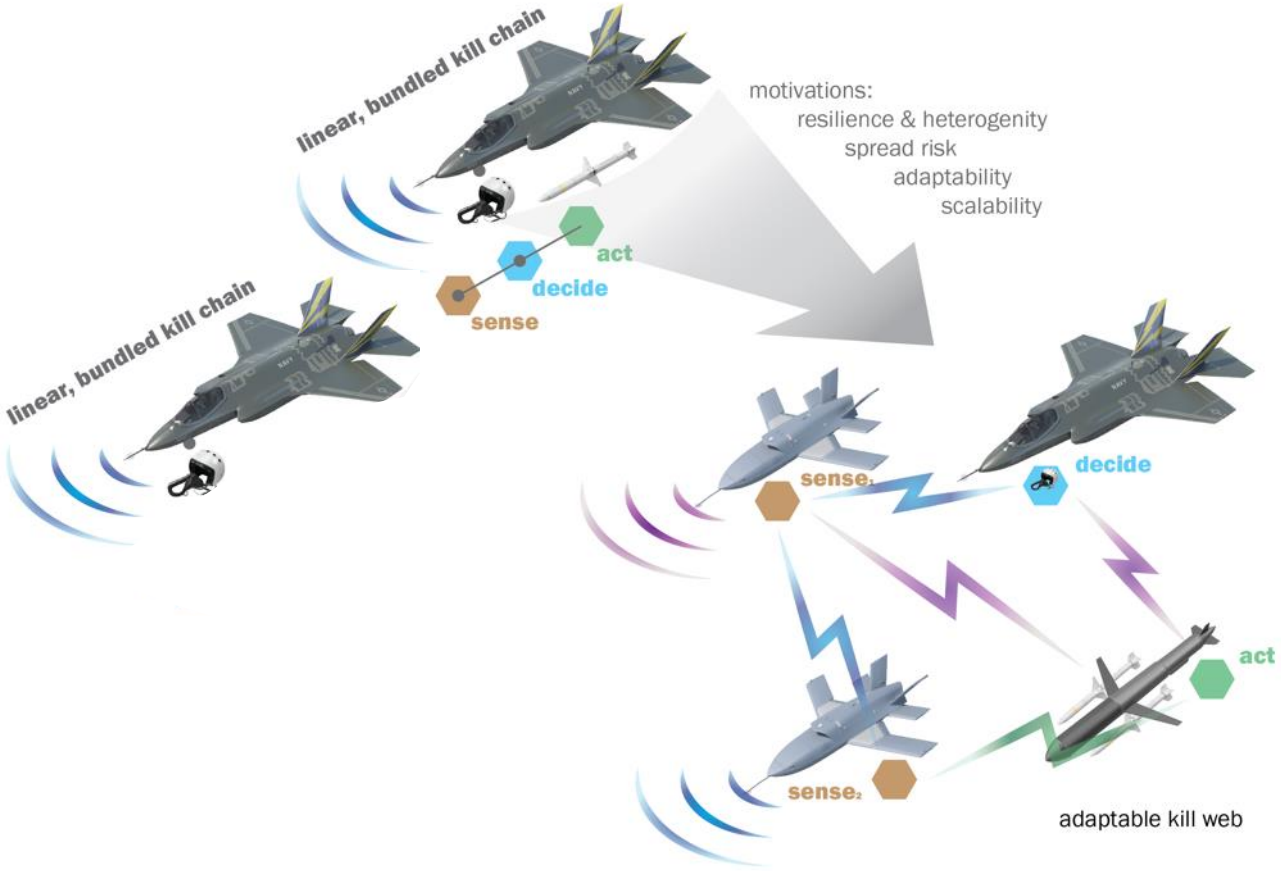


NEW ERA

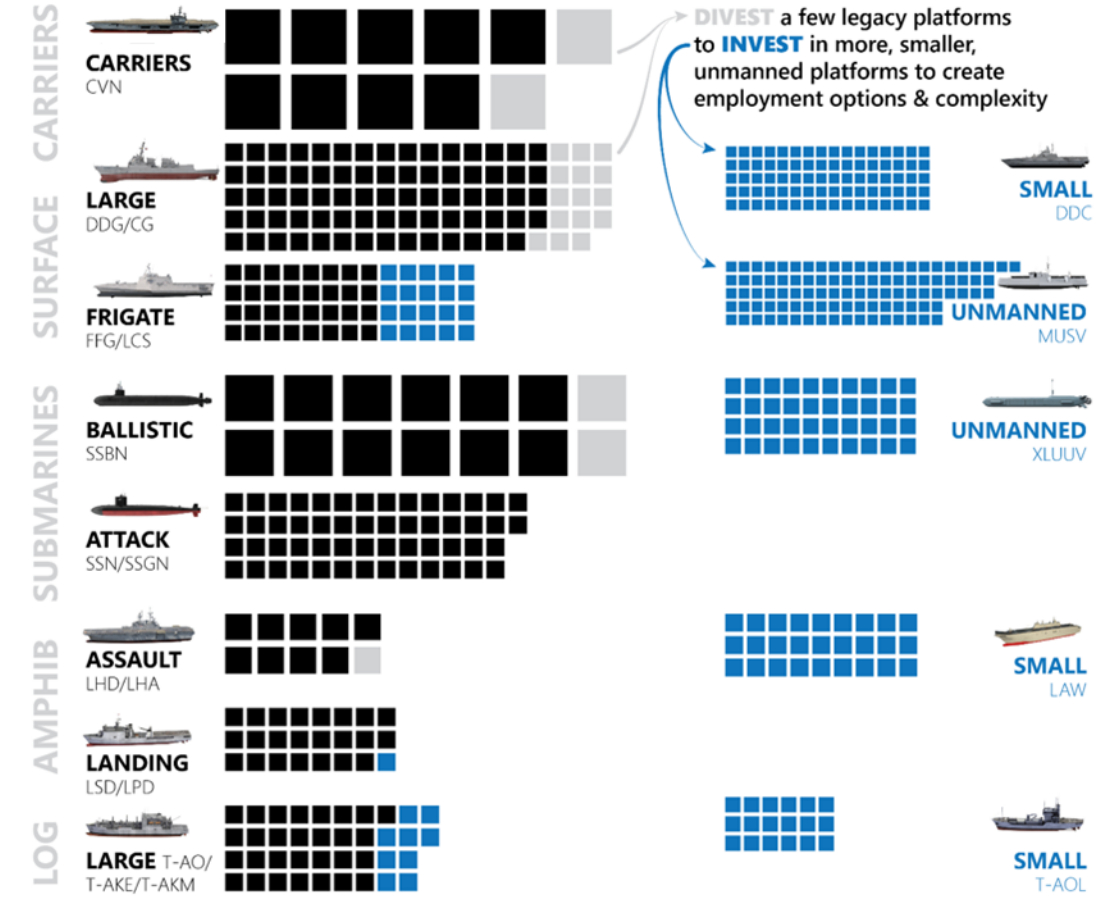


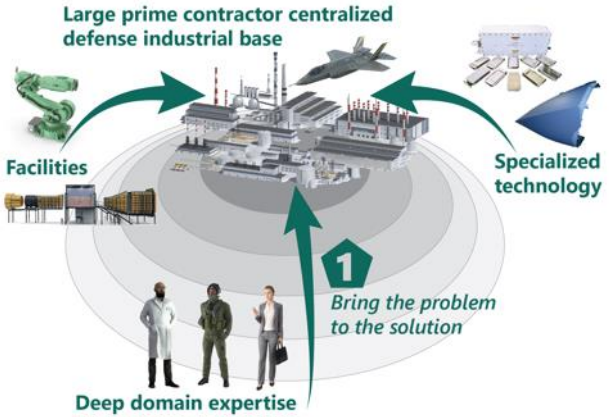
ERA	INDUSTRIAL CAPACITY	NUCLEAR WEAPONS	INVISIBILITY & PRECISION	DECISION-CENTRIC WARFARE
exemplary metrics	• quantity produced	• yield • number of launch options • prosecutable targets	• signature / detectability • collateral effect size • navigation precision	• scale (optionality) • pace • resilience
key technologies	• mass production	• fission • delivery mechanisms	• radio frequency stealth • electronic warfare • computer control	• context-centric C2 • interoperability • software building software
DoD institutional innovation	• effective relations with private industry	• strategic decision making	• performance-driven product development	• agility • mission-centrism
counters	• centralized state control of industry	• equivalent capability creates stasis	• multi-mode detection • basing denial	

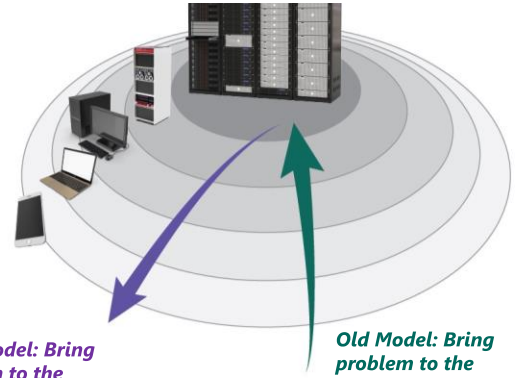
Disaggregating force w/unmanned systems and AI-enabled C2 increases adaptability



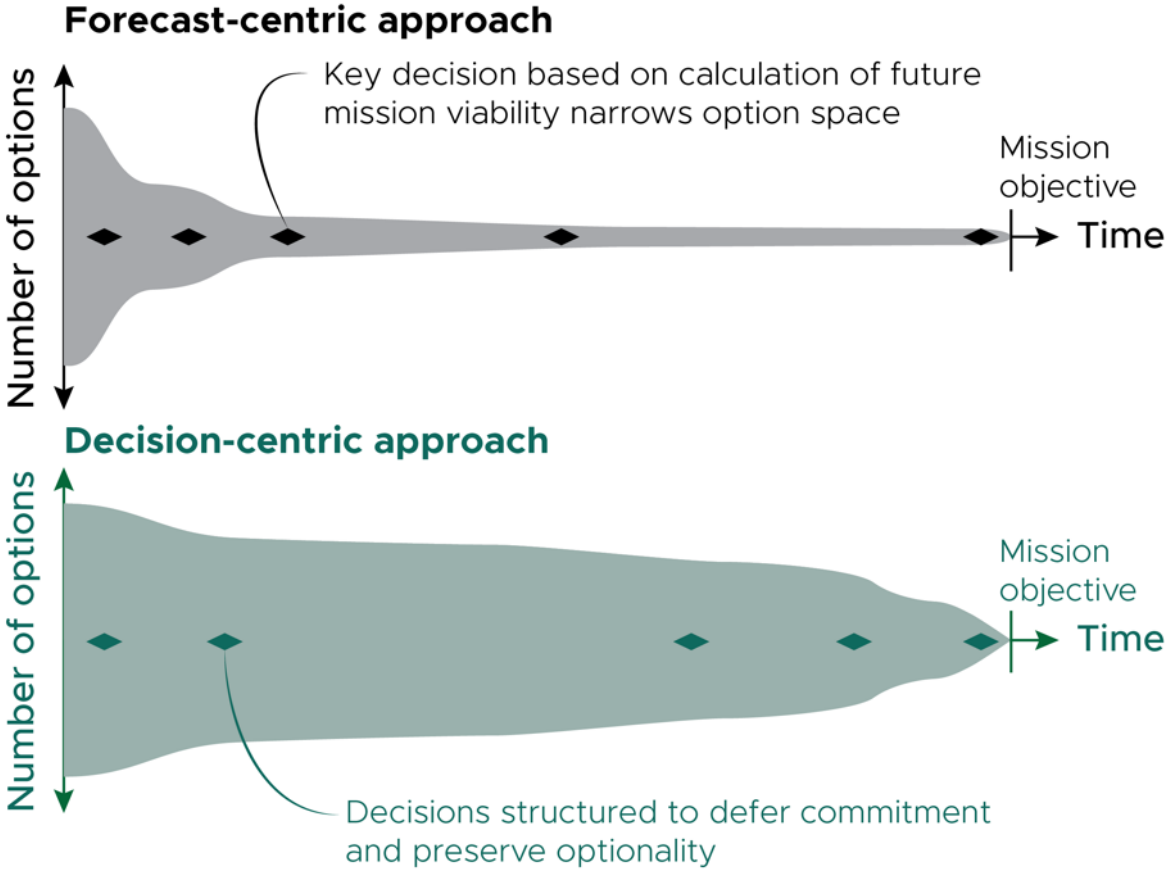
Disaggregation creates heterogeneity at scale that allows tailoring force packages







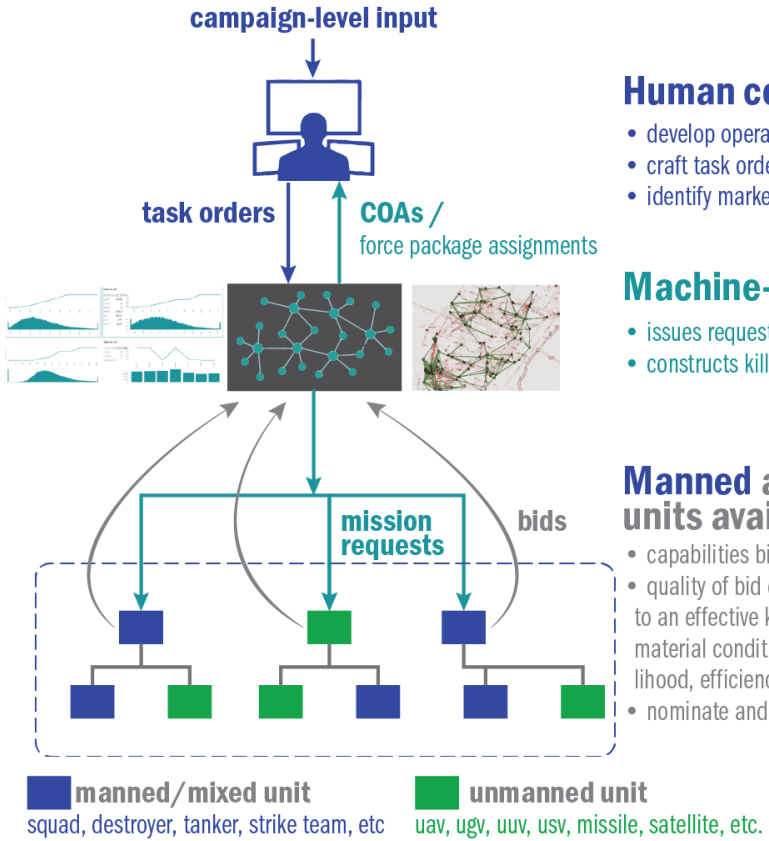
Disaggregated forces provide more options and imposes more complexity on enemy



- **Forecast-centric operations pursue efficiency**
  - Goal is defining narrowly-scoped solution for gaps
  - Relies on numerous assumptions
  - Does not prioritize adaptation; could center on ineffective solution

- **Decision-centric operations pursue resilience**
  - Trades efficiency to sustain more options later
  - Relies on fewer assumptions
  - May deliver less-precise capabilities, but better able to adapt as understanding improves
  - More options also acts to constrain choices for enemy

Harnessing heterogeneity at scale requires C2 scheme that assesses entire option space



Human command

- develop operational plans
- craft task orders
- identify marketplace of capabilities

Machine-assisted control

- issues request for bids to accomplish task orders
- constructs kill chain sets from available capabilities

Manned and unmanned units available for tasking

- capabilities bid on orders
- quality of bid depends on ability to contribute to an effective kill chain (i.e. proximity, speed, material condition, key functions, success likelihood, efficiency of capability)
- nominate and refine execution tactics

key principles

Mission command

- viable in contested communications environment where supervision and consultation may not be possible

Maximize optionality

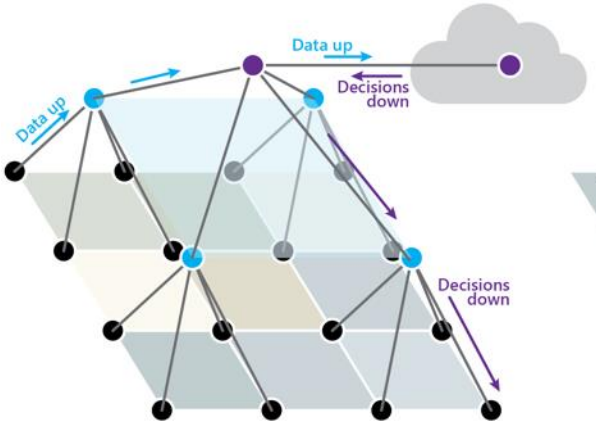
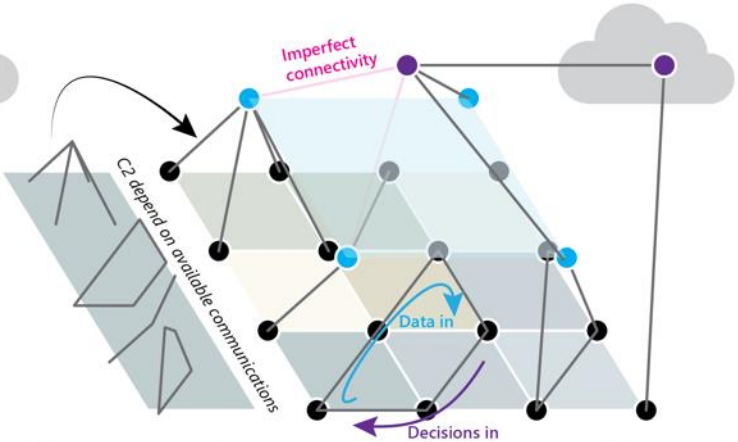
- manage vast distributed resources in an efficient manner
- set up multiple options to enable tactical success

Action with autonomy

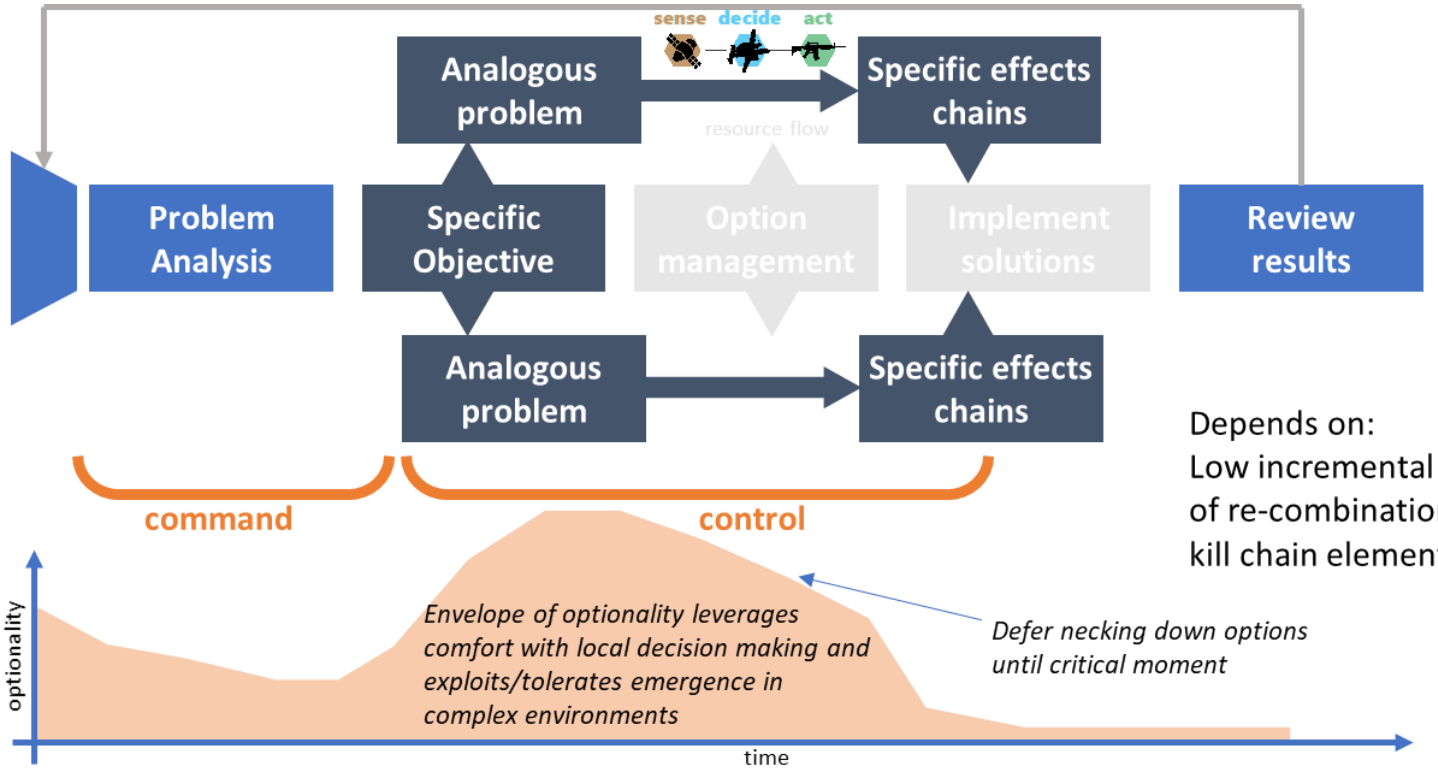
- lower echelon units act with autonomy according to mission-command style task orders

Figure based on Bryan Clark, Dan Patt, and Harrison Schramm, *Mosaic Warfare: Exploiting Artificial Intelligence and Autonomous Systems to Implement Decision-centric Operations*, (Washington, DC: CSBA, 2020), p. 36.

Machine control allows adapting C2 structure to communications availability

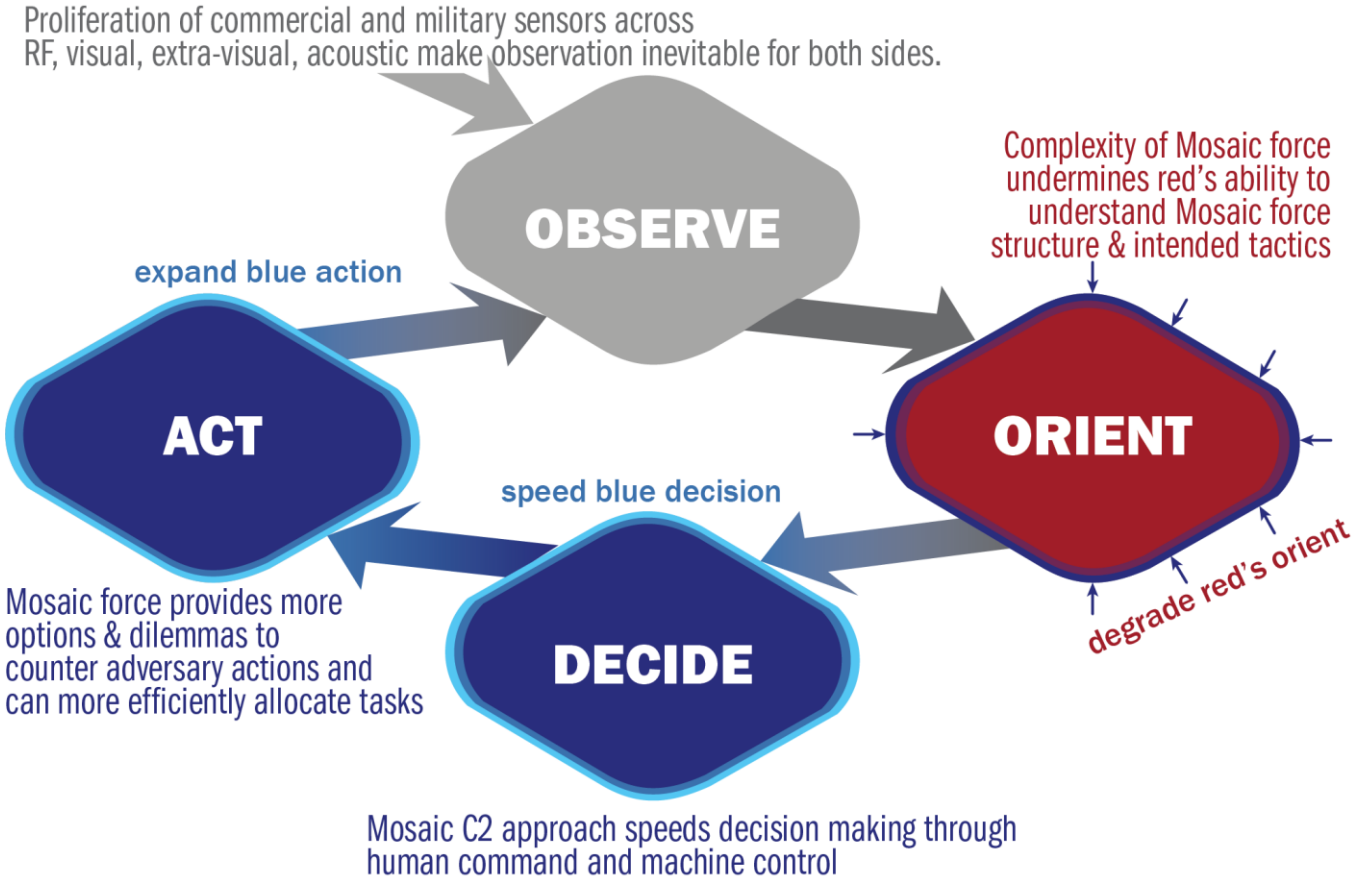
Network-centric battlespace architecture		Context-based battlespace architecture
		
Universal joint standard for communication, data	**Communications & Interoperability**	Diverse communications and on-demand interoperability
Forecast joint force & mission threads, enforce standards compliance	Design approach	Architectural principles, but evolutionary/emergent design
Optimized directive control based on global picture	**C2 approach**	Local decision making based on opportunity
Attrition-centric	Warfighting Concept	Decision-centric

Analogous problem-solving would enable AI C2 systems to rapidly build COAs

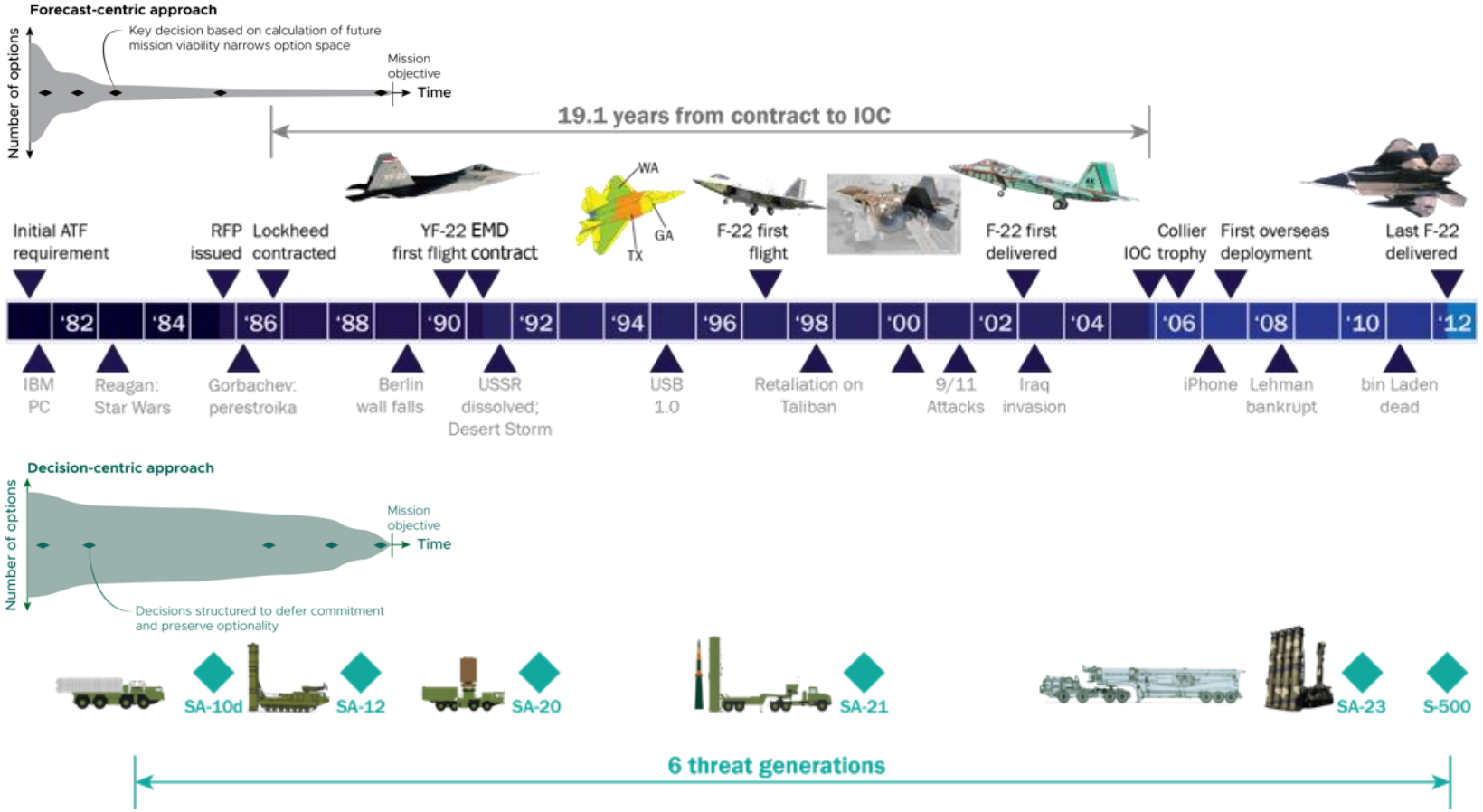


Depends on:
Low incremental cost of re-combination of kill chain elements

C2 tools + disaggregated force speed blue decisions and degrade enemy orientation



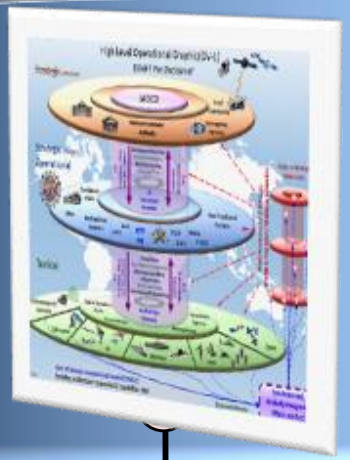
Adaptability also benefit in terms of acquisition



Mosaic Warfare is the 2nd and 3rd wave of an evolution started with JADC2

Wave 1

Manually engineer solutions



JADC2

Wave 2

Operator defined architectures as part of mission planning



Mosaic Warfare (operationally)

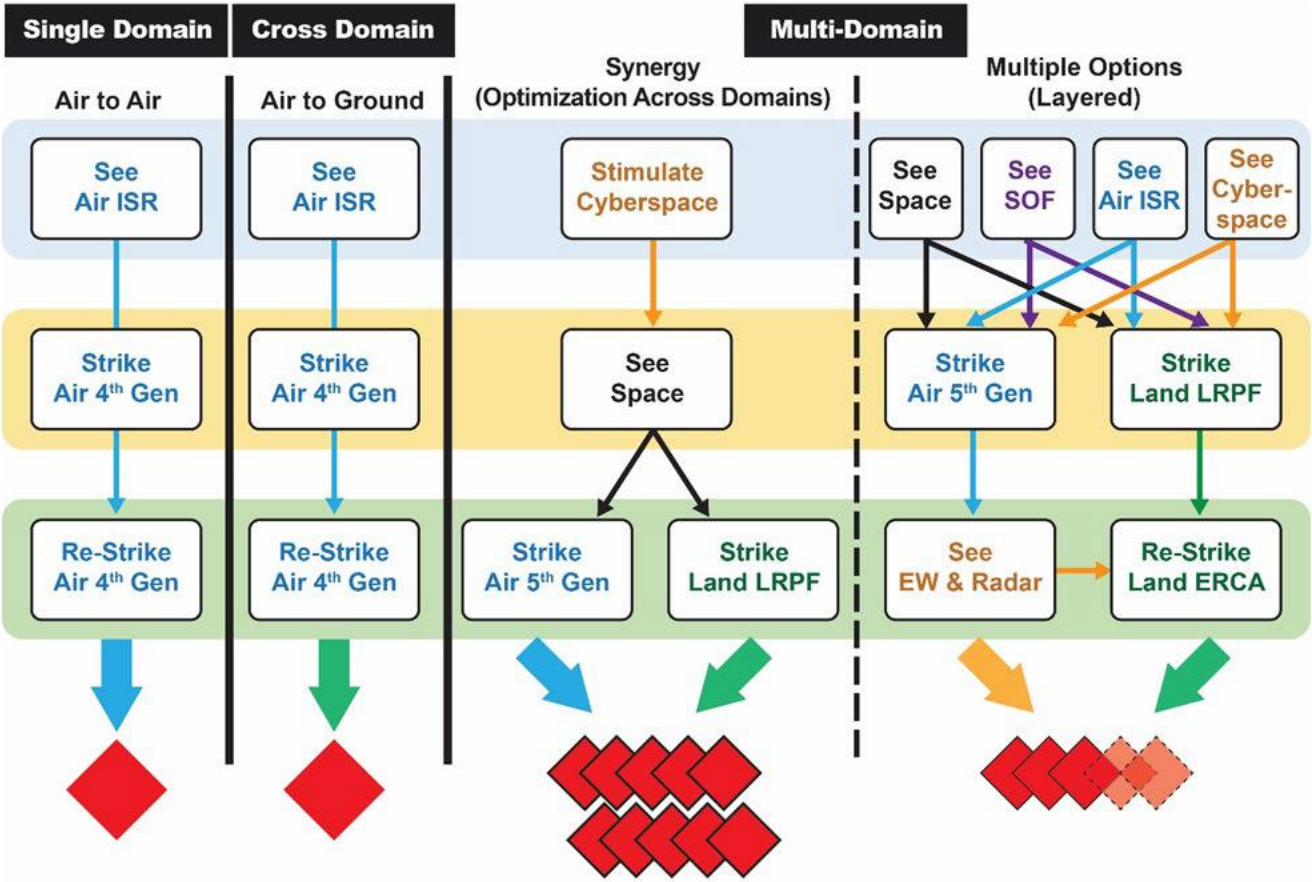
Wave 3

Adapted acquisition focus

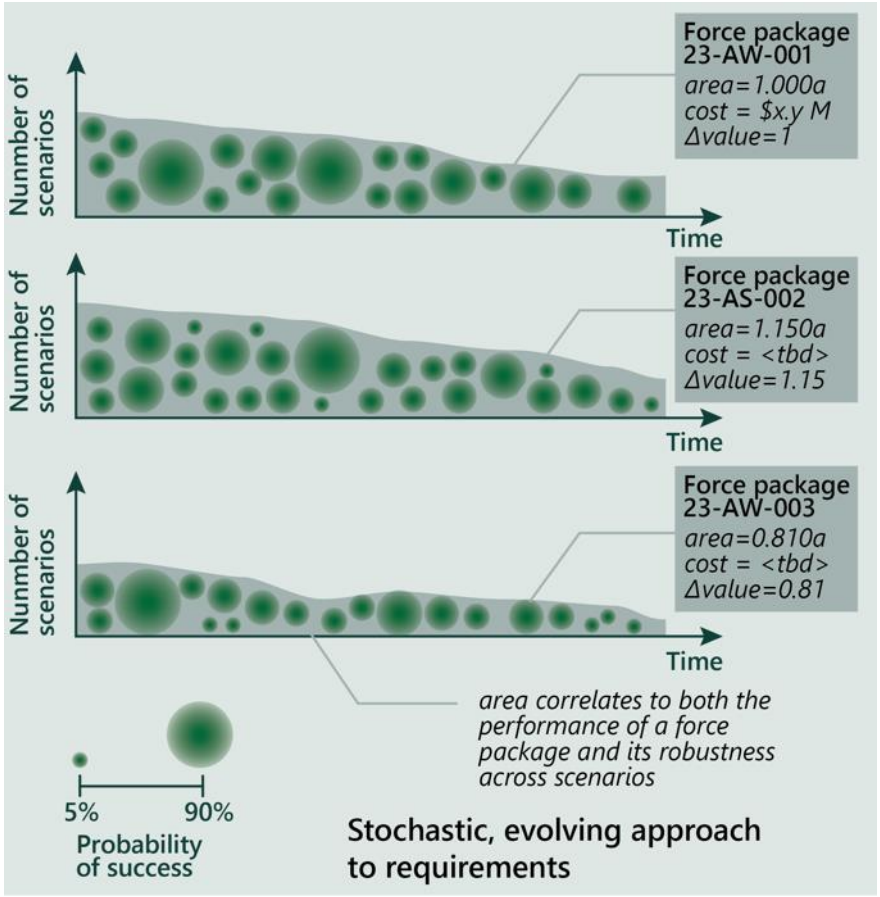


Mosaic Warfare (reqmts/acquisition)

Army MDO concept shares Mosaic's goal of recomposition, adaptability & complexity

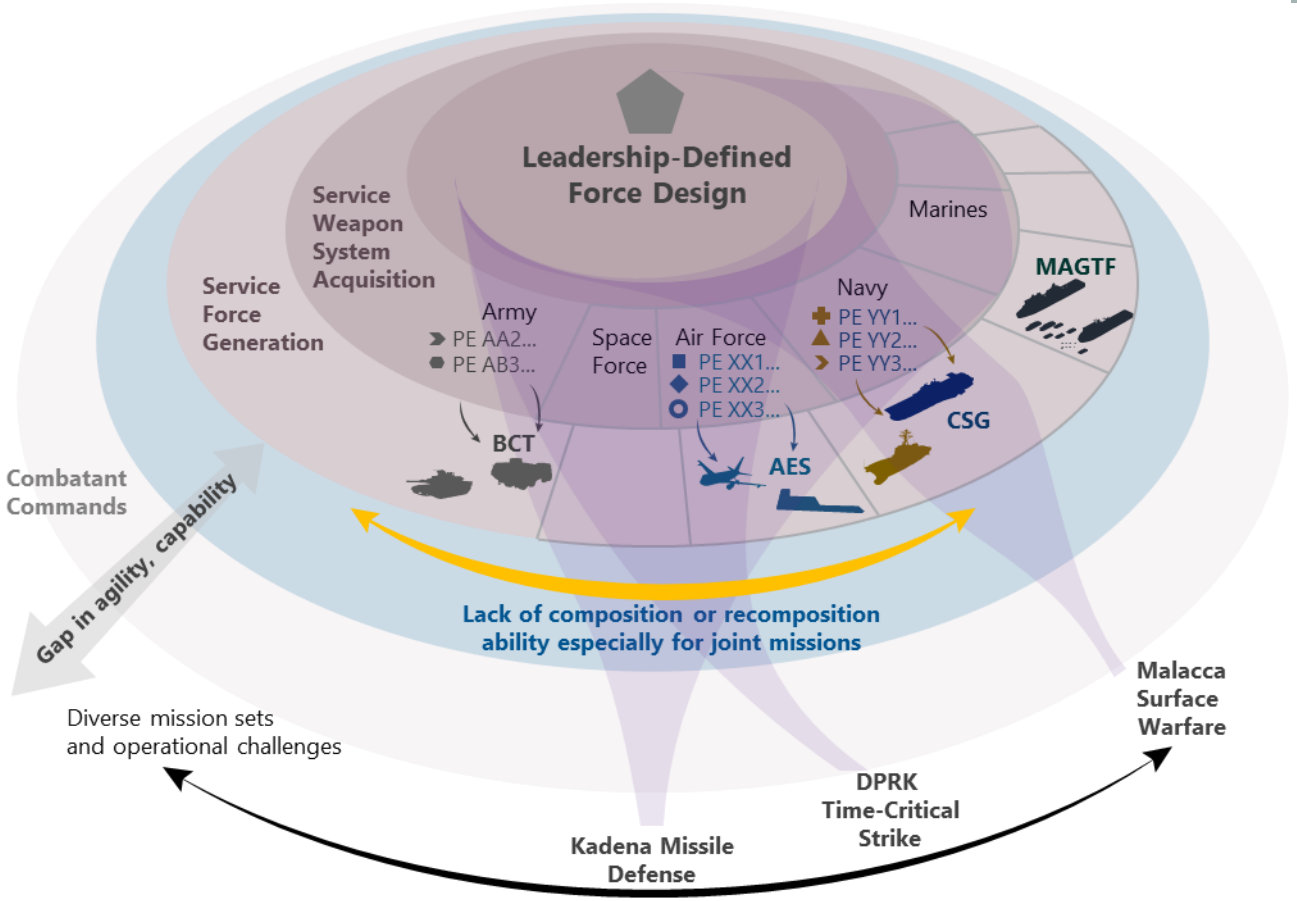


Recomposability implies new approaches to requirements and analysis

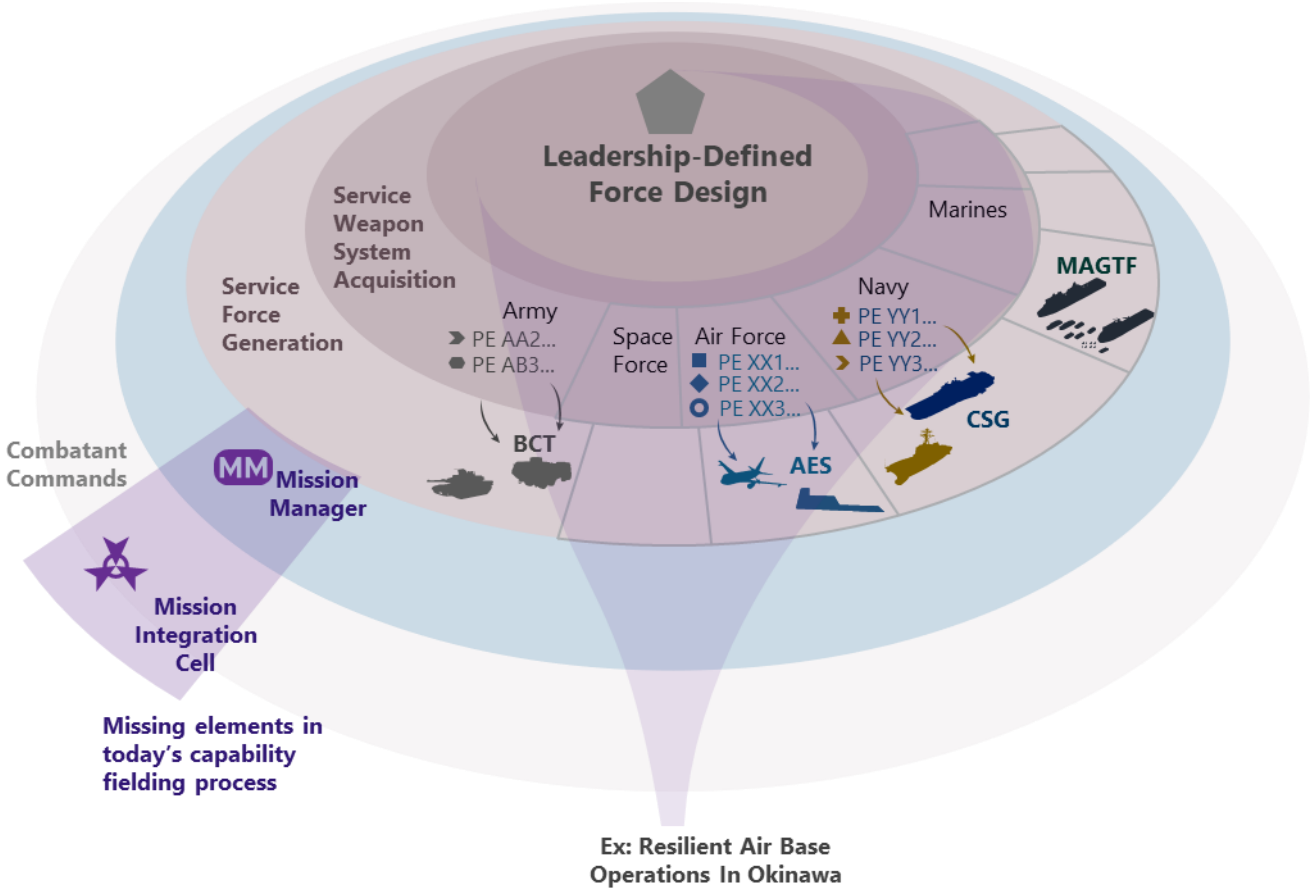


- **Performance of force packages, not individual systems, should be measured**
- **Force packages should be assessed a wide range of situations**
- **New systems can be evaluated by incorporating them into force packages and assessing the impact on performance**
- **Systems/force packages that offer better performance across range of relevant scenarios are preferred**

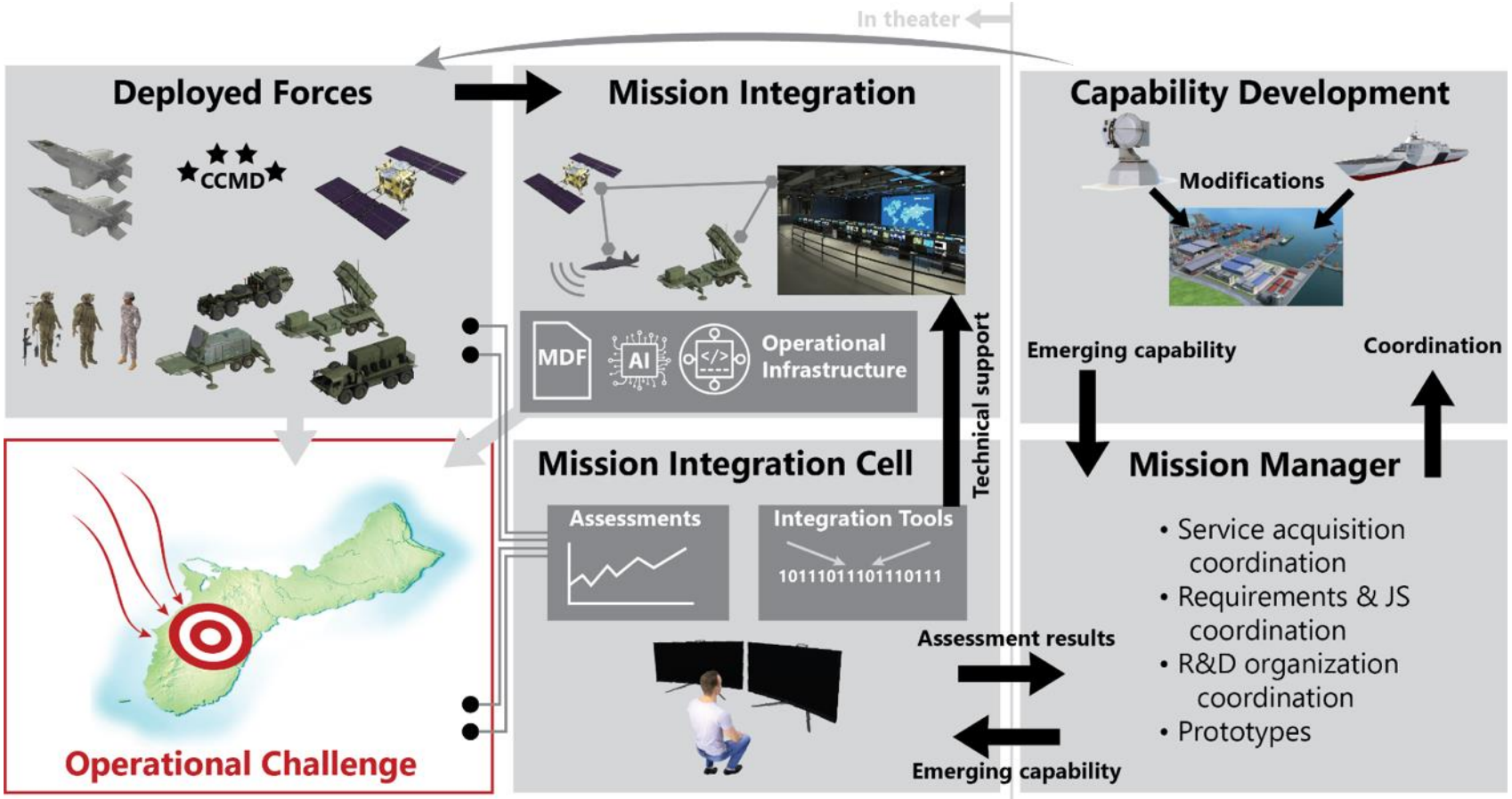
Organizational view highlights lack of joint integration in US force generation



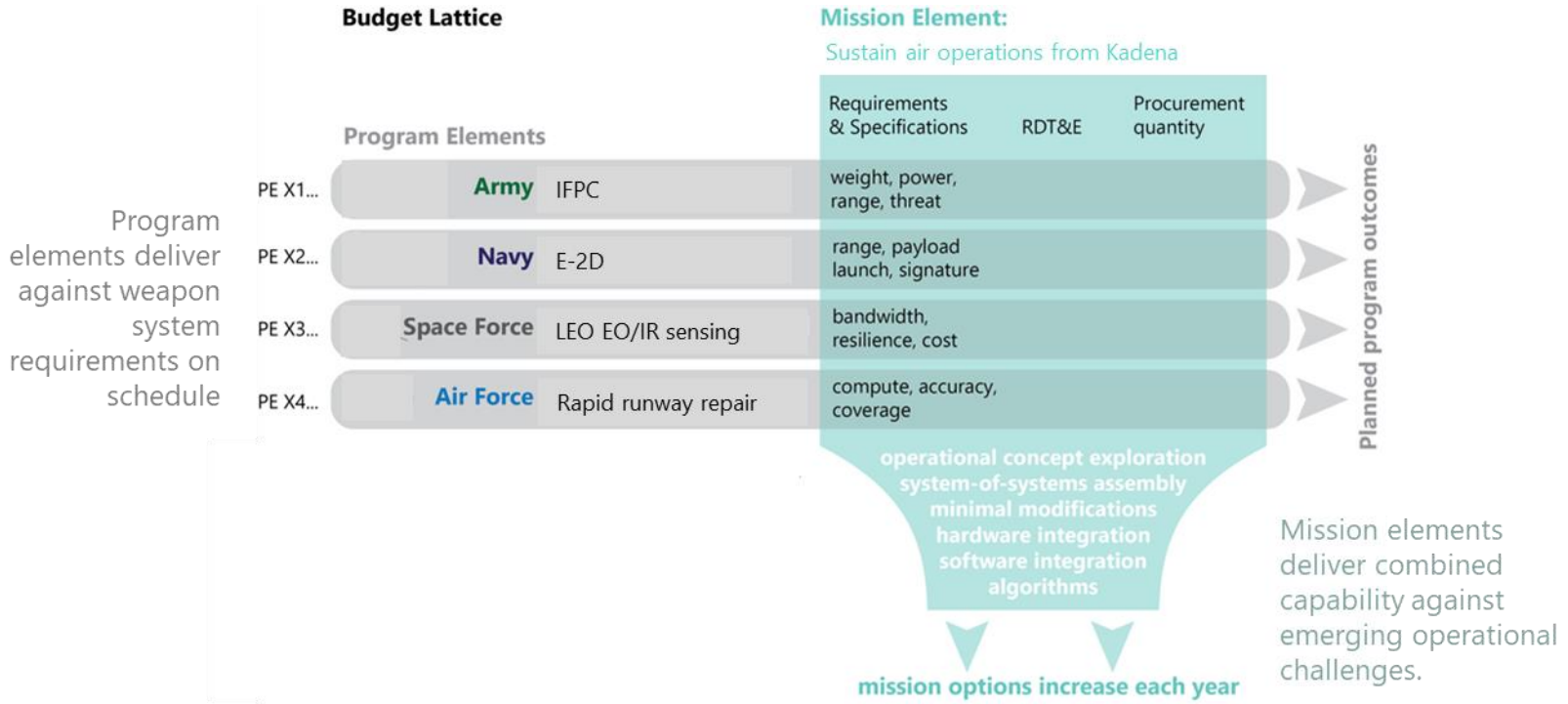
New organizations and processes needed for enable joint integration at tactical edge



Mission Integration Cells address top CCDR operational challenges; pilot in 2022 NDAA



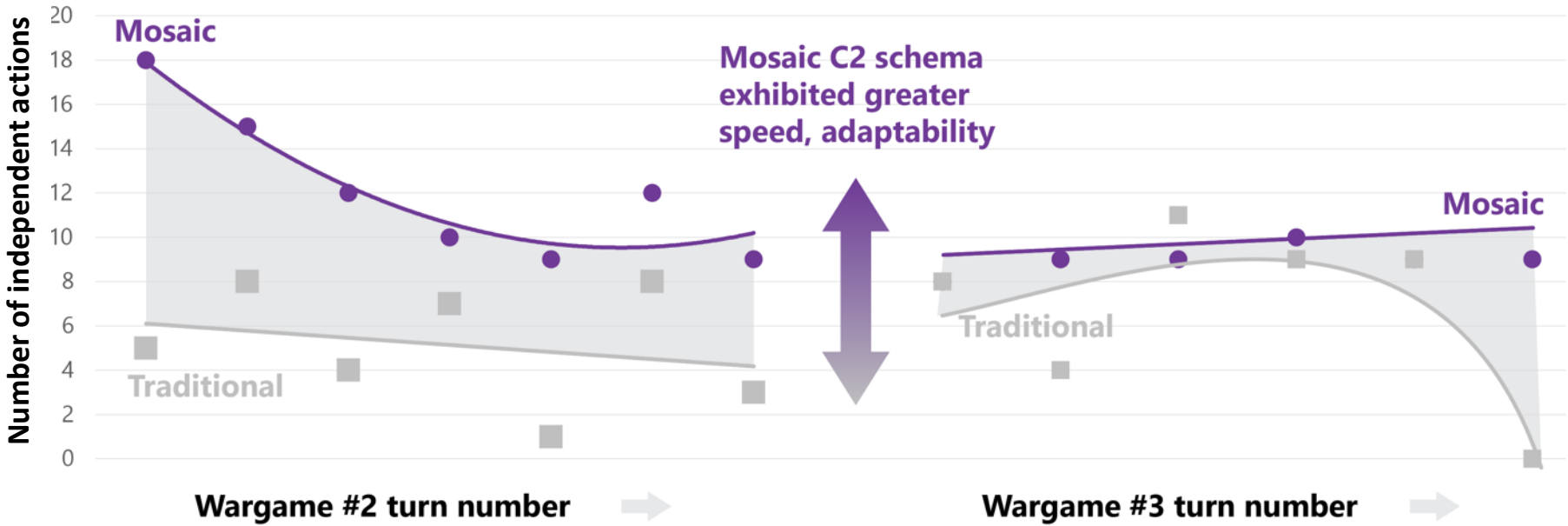
Integrating forces in theater requires funding for missions; pilot in 2022 NDAA



Discussion

twalton@hudson.org

Mosaic Warfare wargames revealed optionality improves pace of operations



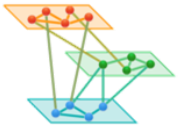
Implementation of Mosaic Warfare

- **DoD service concepts (MDO, EABO, DMO, etc.) reflect characteristics of Mosaic Warfare**
  - Emphasis on decision-making and information
  - Reliance on creating dilemmas for opponents
- **Joint Warfighting Concept incorporates elements of Mosaic Warfare**
- **Distributed force design being pursued by each military service**
  - Rebalancing in Navy and Air Force toward lager number of smaller ships and aircraft
  - Marine Force Design 2030
  - Distributed Army units
- **C3 and institutional reforms are the most important changes to implement Mosaic Warfare**

Mosaic C3 and institutional reforms can be viewed through five lenses



- **Stack view:** Technologies to enable communications, command, and control (C3) functions



- **Network view**: Concepts necessary to align communications with command and control (C2) in contested environments

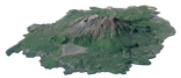


- **Problem solving view**: AI methodologies needed to formulate and assess courses of action in C2 decision aids



- **Time view**: Processes to improve and sustain optionality over a confrontation or competition



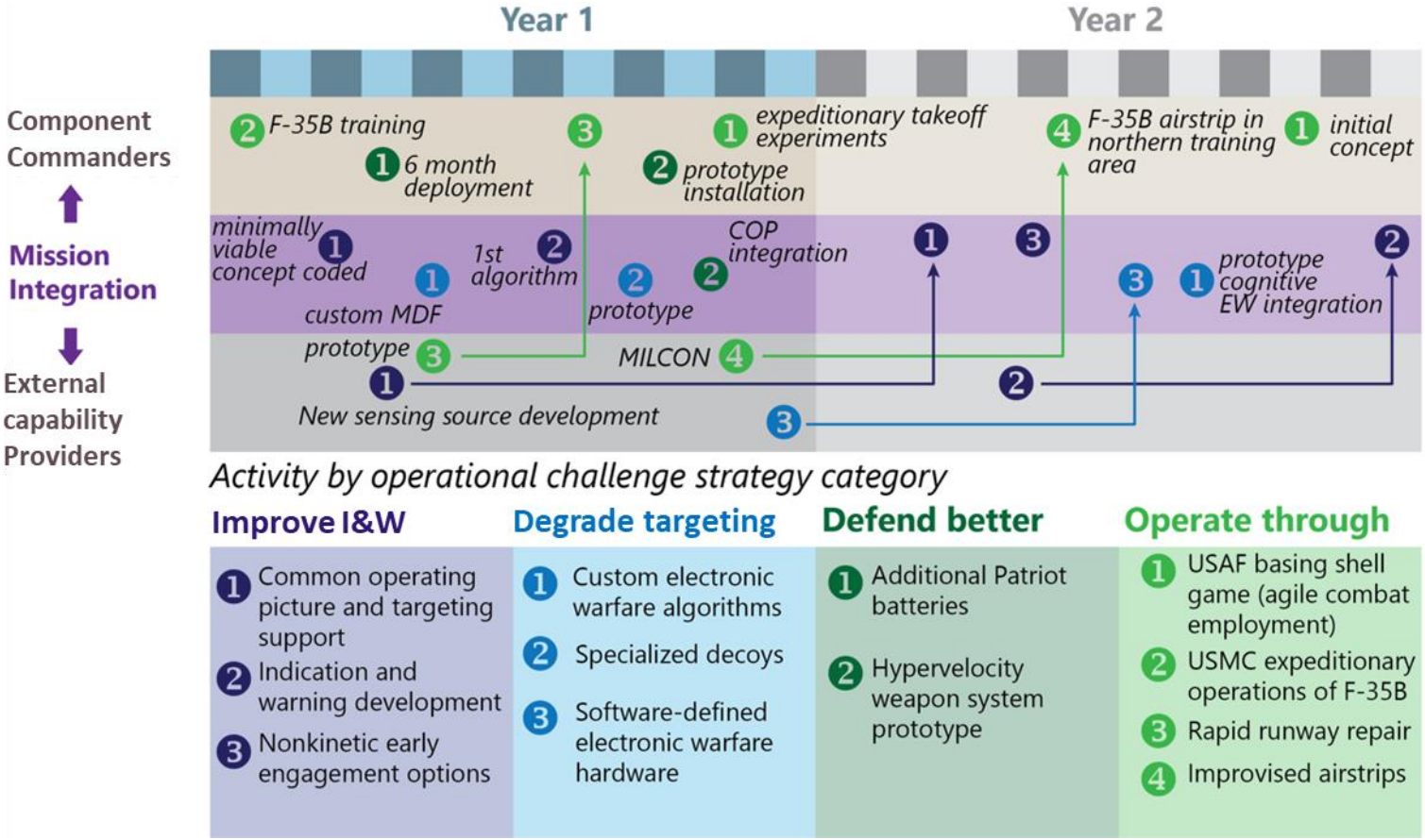


- **Organizational view**: Implications of new C3 technologies and force design for DoD requirements and budgeting

Stack view highlights DoD's efforts on communications technologies for Mosaic

Interoperability Stack Layer	Typical Interoperability Equipment	Managed Interoperability (Solution 101)	Intelligent Interoperability (Solution 201)
Application Use the bits for the mission	API	Published application programming interface (APIs)	Meta-API focused on needed information (e.g., GraphQL)
Information What do the bits mean?	Message	Open Standards (UCI)	Cross-standard, ad-hoc interoperability (STITCHES)
Network Where to send the bits	Router	Gateway / BACN Multiple networks with a router bridge	Adaptive software-defined routing (e.g., DYNAMO)
Physical How to send the bits	Radio	Software-defined radio cards (one card per waveform)	Software-defined signal processing (GNU radio) (per processing block)

Mission Managers support MICs by overseeing actions over next 1-2 years



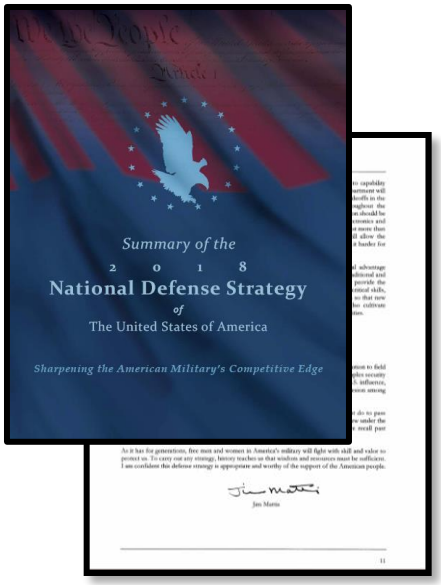


PM Soldier Lethality Panel

19 Oct 2021

Colonel Scott J. Madore
Project Manager Soldier Lethality
scott.j.madore.mil@army.mil

NDS Alignment - Strategic Approach



Build a More Lethal Force

- *Prioritize preparedness for war*
- *Modernize key capabilities (…include capabilities to enhance close combat lethality in complex terrain)*
- *Cultivate workforce talent*

Strengthen Alliances and Attract New Partners

- *Deepen interoperability*

Reform the Department for Greater Performance and Affordability

- *Deliver performance at the speed of relevance*
- *Organize for innovation*
- *Drive budget discipline and affordability to achieve solvency*
- *Streamline rapid, iterative approaches from development to fielding*
- *Harness and protect the National Security Innovation Base*

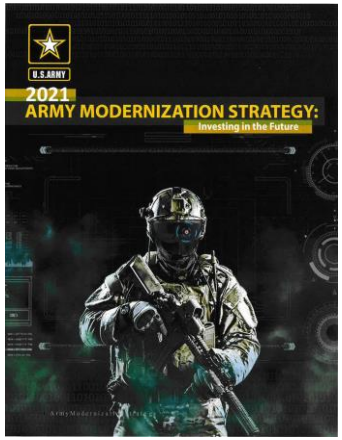
"We must use creative approaches, make sustained investment, and be disciplined in execution…"

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Army Modernization Strategy

End State

- *Modernized Army…MDO-capable by 2028…MDO-ready by 2035*



Means

- Realigned Army Modernized Enterprise
- Prioritized Resources
- Operational Feedback

Ways

- How We Fight [Concepts – Doctrine – Organizations – Training]
- **What We Fight With [Materiel – 6 Materiel Modernization Priorities]**
- Who We Are [Leader Development – Talent Management]

Enabled By

- Global Posture
- Facilities
- Policies

6 Modernization Priorities

- *Long Range Precision Fires*
- *Next Generation Combat Vehicles*
- *Future Vertical Lift*
- *Network*
- *Air and Missile Defense*
- ***Soldier Lethality***

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PM SOLDIER LETHALITY

Mission

Develop and Deliver Innovative and Relevant Small Arms Lethality to our Warfighters

Vision

Be the premier provider of integrated small arms weapon systems for our Warfighters, and our Allies and Partners

Priorities

1. Take Care of Our ***People***
2. ***Deliver Lethality*** at the Speed of Relevance
3. Foster a culture of ***Innovation*** for our processes and products

Principles

- Alignment
- Collaboration & Teamwork
- Transparency & Communication
- Empowerment

Every Soldier Armed – Every Formation Ready

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Project Manager Soldier Lethality

Enlisted Advisor
MSG Daniel Saucedo

PM Soldier Lethality
COL Scott Madore
Deputy
Mr. Angelo Scarlato

Director, Business Mgt.
Ms. Lora Sgroi

Director, Sys Engineering
Mr. Douglas Cohen

Director of Logistics/PSM
Mr. Michael Friedman

Director, Acquisition Operations
Mr. Mark Keck

Product Manager Individual Weapons
LTC P. Stambersky
Deputy
Ms. Barbara Muldowney

APMs
CPT D. Stephens
CPT T. Morgan

Product Director Crew Served Weapons
Mr. David Oatley
Deputy
Mr. Peter Errante

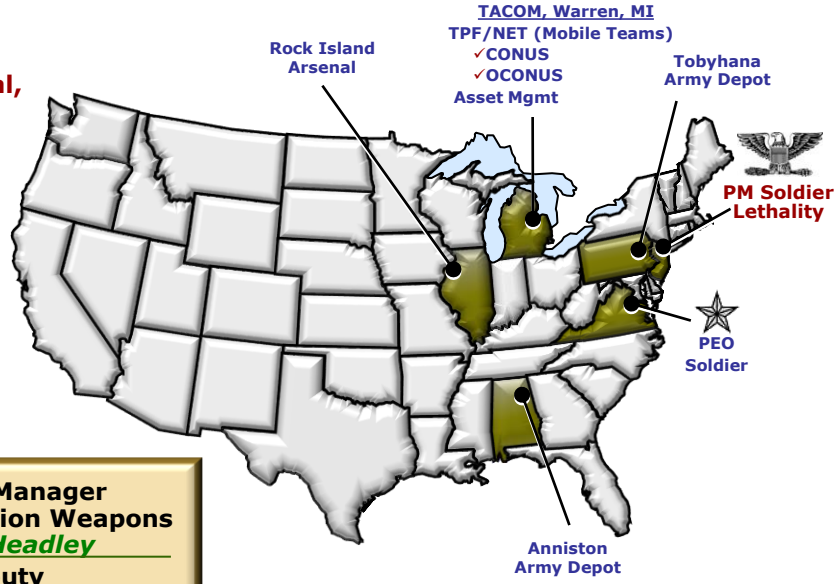
APMs
LTC H. Trudell
MAJ A. Kipetz

Product Manager Next Generation Weapons
LTC J. Headley
Deputy
Mr. Arthur Fiorellini

APMs
MAJ J. Williamson
MAJ M. Pekol-Evans

Picatinny Arsenal, New Jersey

Army and Other Services and Agencies



Kuwait



Iraq



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PM Soldier Lethality Portfolio

Operations & Support


M150
Rifle Combat Optic (RCO)


M68
Close Combat Optic (CCO)


M145
Machine Gun Optic


M24
Mini Binocular


M22
Binocular


M25
Binocular


M4 w/ M203
Grenade launcher


M1911
Pistol


M11
Pistol


M7
Bayonet


M9
Bayonet


M9
Pistol


M26
Modular Accessory Shotgun System (MASS)


M14
Enhanced Battle Rifle (EBR)


M16A2/M16A4
Rifle


M500/M590
Shotgun


M2010
Enhanced Sniper Rifle (ESR)


M107
Long Range Sniper Rifle


M240B
Medium Machine Gun


M110
Semi-Automatic Sniper System (SASS)


M240H
Medium Machine Gun


M249
Squad Automatic Weapon (SAW)


M192
Lightweight Tripod


M2
Machine Gun


MK19
Grenade Machine Gun

Production & Deployment


M4/M4A1
Carbine


M17/M18
Modular Handgun System


M320
40mm Grenade Launcher


Grenadier Sighting System


M25A1
Stabilized Binocular


Non-Standard Weapons


M3
Carl Gustaf (MAAWS)


APC9K
Sub Compact Weapon


Mk22
Precision Sniper Rifle (PSR)


M110E1
Squad Designated Marksman Rifle (SDMR)


M240L
Medium Machine Gun


M2A1
Machine Gun


M205
Lightweight Tripod


M153
Common Remotely Operated Weapon Station (CROWS)


Gunner Integrated Protection and Restraint System (GIPRS)


CROWS Low Profile

Development


M4/M4A1
Upgrades


Compact Semi-Automatic Sniper System (CSASS)

Notional


Mounted Machine Gun Optic - M2 Variant


Direct View Optic (DVO)


XM914

Directed Requirements


M3E1
Carl Gustaf (MAAWS)

Future

(Notional Images)

No Image Available
Next Gen MMG/HMG


Suppressors

No Image Available
Precision Grenadier System


Next Generation Squad Weapon-Automatic Rifle (NGSW-AR)


Next Generation Squad Weapon – Rifle (NGSW-R)


NGSW – Family of Ammunition


NGSW - Fire Control

Fire Control


Crew Weapons


Precision Weapons Fire Control

Provide premier Soldier weapons systems enabling battlefield dominance

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Adaptive Squad Architecture

Squad as an Integrated Weapons Platform

Need to go from this…



- 85+ items/components
- 122 lbs. of kit
- Redundant power sources
- Connected with cables

…to this!



Adaptive Squad Architecture is government-owned, collaboratively developed architecture that documents all existing and future Soldier/Squad variations, including all interface controls between Soldier/Squad systems and external systems.

ASA enables systematic modernization and quantitative assessment of new capabilities on the overall effectiveness of Soldiers/ Squads

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Innovative Designs & Engineering Assessment (IDEA) Program

BLUF: Project Manager Soldier Lethality is conducting advanced market research by seeking information on new, innovative, enabling technologies that can generate new capabilities or provide enhanced capabilities to PM SL's portfolio.

The IDEA program is:

- An opportunity for Industry to submit innovative ideas and technologies for the USG to assess. Assessments may be conducted at vendor or government facilities.
- A one-on-one pitch to the USG showcasing their technology for a potential for non-competitive award under 10 U.S.C, § 2373 - Procurement for Experimental Purposes.
- Renewable on a quarterly basis.
- https://sam.gov/opp/ced1e1c4bcbc4e329b781c66cbd74d3e/view

The IDEA program is <u>NOT</u>:

- Intended to be a developmental program
- A USG in-house proposal
- A competitive contract

PM SL will leverage enabling IDEA technologies to quickly provide Soldier Capabilities and enhancements

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PM SL Technology Interest Areas

Current Interest Areas

- **Methods to improve system reliability**
- **Improved lethality/overall system effectiveness which includes**
  - **Weapon performance**
  - **Wind sensing**
  - **Reductions in shooter aim error**

Recent Award Examples

PM SL IDEA
- **Advanced Barrels:** Bonnie Blue Ballistics, PCP Tactical
- **Suppressor Cleaners:** OTIS, TDA Research
- **Weapon Part Coatings:** Geissele Automatics, Mustang Vacuum Systems

Soldier Enhancement Program
- **Sniper Tripod**
- **Slings & Buttstocks for M4A1**
- **Barricade Support Device**

PM SL Leverages Multiple Authorities to Evaluate Technologies

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FY21 PM Soldier FMS Highlights



<u>Standard and nonstandard weapons, optics and accessories</u>
FY21 Requirements Executed: 258 (Contract actions)
FY21 Weapons/Items Awarded ($): $112.4M
Current Open Requirements (Qty): 332
Current Open Requirements ($): $117.1M
Customers: 36 countries

- FY21 Top 3 Standard Weapons Sales ($): M16A4, M2A1, M240B
- FY21 Top 3 Nonstandard Weapons Sales ($): FMG762 Mexico S.D.N (medium machine gun), C1299 MEXICO S.D.N. KIT (chain gun), Commercial Colt M4 Rifle
- FY21 Top 3 Nonstandard Optics/Accessories Sales ($): Trijicon Commercial M150 RCO, Leupold Spotting Scope, Eotech EXPS Holographic weapon sight

- Strong annual demand for foreign designed/non-standard weapons
  - Finding domestic sources can mitigate supply chain risks and ensure greater oversight on quality control
  - Currently evaluating domestically produced AK style weapons

PM Soldier Lethality FMS Requirements continue to grow in FY21

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Key Points

- Diminishing Resources
  - Increase Buying Power
  - Efficiencies
- Modernization Priorities
  - Demonstrated Performance
  - Increasing Lethality
- FMS and Domestication of Non-Standard Weapons



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PdM Individual Weapons

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PdM Individual Weapons

- **Accomplishments:**
  - ✓ M4A1 Modernization Program concluded
  - ✓ First MK22 Precision Sniper Rifles were delivered
  - ✓ Over 190,000 M17/M18 Modular Handgun Systems (MHS) delivered to the Army and over 49,000 handguns to Other Services and other Government Agencies
  - ✓ Fielded over 1,200 M110E1 SDMRs

- **Upcoming Opportunities**
  - *Innovative Designs & Engineering Assessment (IDEA) Program*: Seeking information on new, innovative, enabling technologies
  - *Soldier Enhancement Program*: Identify and procure off-the-shelf items that have the potential to substantially improve weapons and support equipment









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PdD Crew Served Weapons

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Product Director
Crew Served Weapons Portfolio



Medium and Heavy Machineguns



MAAWS Recoilless Rifle



Accessories / Optics



Non-Standard Weapons



Medium Caliber Weapons



Remote Weapons Stations (RWS)

Technical Expertise

- Development of weapons
- Lethality
- Fire Control
- Software development
- Integration with RWS and vehicles
- Independent analysis

Efficient Management

- Existing contracts and funding
- Consolidate requirements for multiple customers
- Single procuring agent vs. multiple
- Economies of scale
- Life Cycle Weapon Management

CSW Services

- Program / IPT Management
- Platform Integration
- Logistics Management
- Configuration Management
- Testing / Qualification / Type Class
- Vendor validation

PdD CSW provides premier weapon system SOLUTIONS to meet customer needs

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PdD CSW Range Day

- **Concept:**
  - CSW provides range for industry
  - Attendees receive instant feedback
  - Informs Government about technology
  - Foster numerous discussions across the community
- **Held July 14-15, 2021**
  - 15 live fire lanes each day
  - 28 static displays
  - More than 200 attendees













Check beta.SAM.gov for FY22

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PdD CSW Opportunities

- **NextGen Medium MG**
  - **FY22-FY24 (Evaluate Key Technologies & Subsystems)**
    - **Recoil Management**
    - **Novel Materials (reduce weight / increase durability)**
    - **Suppressor Technologies**
    - **Fire Control**
    - **Mounting and Fire Control Interfaces**
  - **FY25-FY26 (Characterize System Capabilities)**
  - **FY27+ (System Development)**
- **RFP for Remote Weapon Station production open until 22 Nov**

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Questions and Answers

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JOINT SERVICE SMALL ARMS PROGRAM OFFICE (JSSAP)

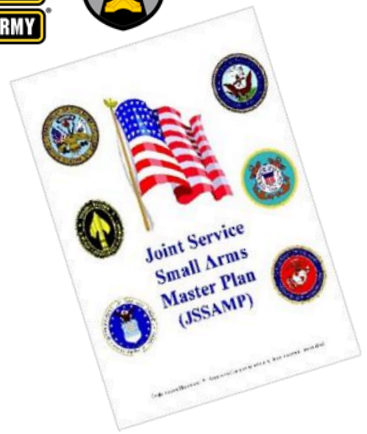
NDIA Future Force Capabilities Conference and Exhibition Small Arms Track

Columbus, Georgia

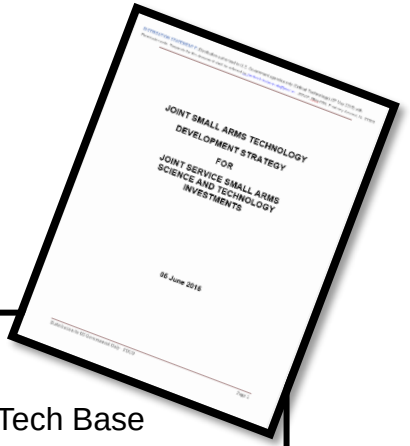
Gus Funcasta
Chief, Joint Service Small Arms Program Office
US Army AFC
DEVCOM Armaments Center
Picatinny Arsenal, NJ 07806
usarmy.pica.futures-cmd.mbx.jssap@army.mil

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JOINT SERVICE SMALL ARMS PROGAM OFFICE



An OSD chartered Joint-Centric activity harmonizing requirements & providing Small Arms Technology for all the Armed Services



JSSAP Background/History

1978: Under Secretary of Defense established JSSAP office and the Joint Service Management Committee (JSMC) with the Army as the Executive Agent.

- JSMC was composed of 4 principal voting members: USA, USN USMC, USAF
- Harmonize multi-service requirements
- Consolidate and coordinate development, reduce costs, and improve the efficiency of the material acquisition process.

1991: JSSAP transitions PM and lifecycle support, focusing exclusively on S&T

2004: Charter updated adding 2 more principal members: USCG, SOCOM

Mission Statement

- ❑ Intensive management of the DoD Small Arms Tech Base
- ❑ Coordinate and Harmonization of Requirements
- ❑ Transitions Technology to Program Managers for Engineering and Manufacturing Development
- ❑ Long Range Plans and Strategies
- ❑ Influence of International Small Arms Activities

… and fulfill Executive Agent responsibilities per Deputy Under Secretary of Defense (Research and Engineering) Memorandum, 10 May 1978

Joint

JSSAP AREA OF RESPONSIBILITY

JSSAST – Joint Services Small Arms Synchronization Team
- Approves Annual Updates of Joint Service Small Arms Capability Gaps
- Approves JSSAP S&T project portfolio on annual basis
- Promotes, coordinates, and manages the exchange of small arms technology, acquisition, and sustainment information across the Joint Services, Program/Product Managers, Labs, R&D Centers, and Industry

JSSARI – Joint Services Small Arms Requirements Integration
- Develop, review, report, and submit Joint, harmonized Small Arms Systems capability documents
- Harmonize service requirements, including concurrence, disposition, support, and staffing of Small Arms Systems Capability Based Developments.
- Routinely review Service threat statements and assessments.

JSTAC – Joint S&T Advisory Council
- Manage timely exchange of Science & Technology information
- Manage Technology Development Strategy (TDS)
- Maintain awareness of the small arms science & technology Joint portfolio
- Maintain awareness of domestic and foreign technology - identify areas of possible exploitation
- Recommend prioritized plans, programs and strategies to the Steering Committee

JSSAME – JSSAP Metrics & Evaluation Working Group
- Ensure that test and evaluation of small arms weapon systems is operationally relevant, and done in a consistent, repeatable, and standardized manner.
- Review, coordinate, and monitor test and evaluation activities within the JSSAP project proposals and the JSSAP portfolio.

INTERNATIONAL
- NATO Army Armaments Group (NAAG) / Dismounted Soldier Systems (DSS)
  - Weapons and Sensors Subgroup (WS SG) - Serve a US Head of Delegation
  - Suppressor Team of Experts Lead
  - Several DEA/IEA/PA with various foreign nations
  - NATO CUAS WG participation

SL-CFT Soldier Lethality Cross Functional Team
- CCDC Armaments Center Lethality Lead
- Lethality LOE - How do we increase lethality to achieve and maintain overmatch against a peer/ near peer adversary?

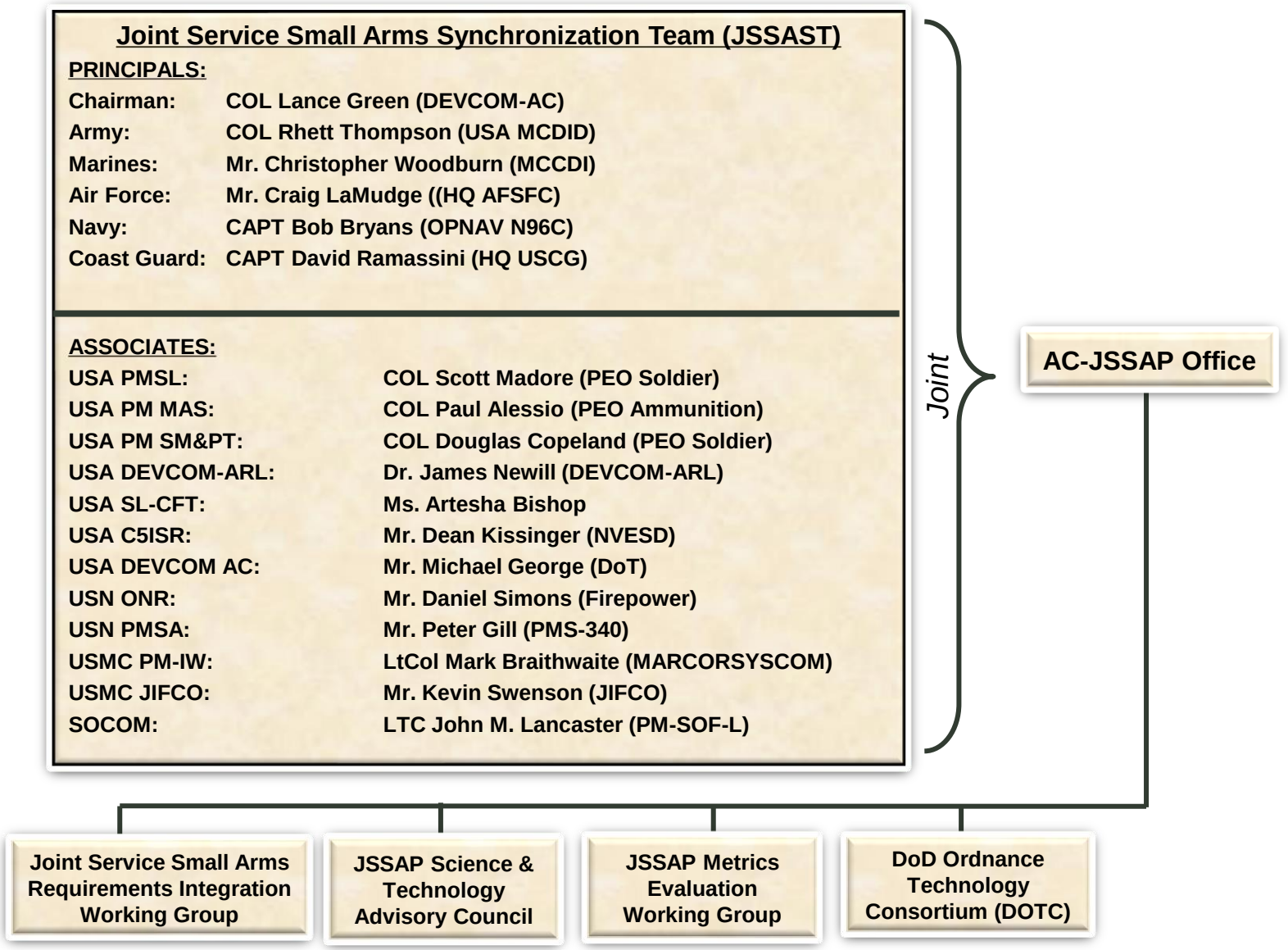
OSD-SBIR – Office of Secretary of Defense / Small Business Innovation Research
- Allows small, high-tech U.S. businesses and academia the opportunity to provide innovative research and development solutions in response to critical Army needs.
- To be the Army's premier source of innovative technology solutions, providing direct access to America's high-tech small business research and development community, enabling our Soldiers deployed around the world.

Industrial / OGA Base
- DOTC/NAC - Defense Ordnance Technology Consortium / National Armaments Consortium
- DARPA
- DOE-National Labs
- DOD-Research Labs

JS3 – Joint Service Signature Suppression IPT
- Develop harmonized understanding of signature suppression across the Joint Services
  - Test methods and standards
  - Requirements
  - S&T efforts

JSSAP Barrel Technology Development Strategy
- Generate a deliberate, organized approach to the development of small caliber barrel technologies
- Identify technical challenges, areas where improved knowledge is needed for small caliber barrels
- Transition barrel technologies to joint service PMs to improve performance in the field

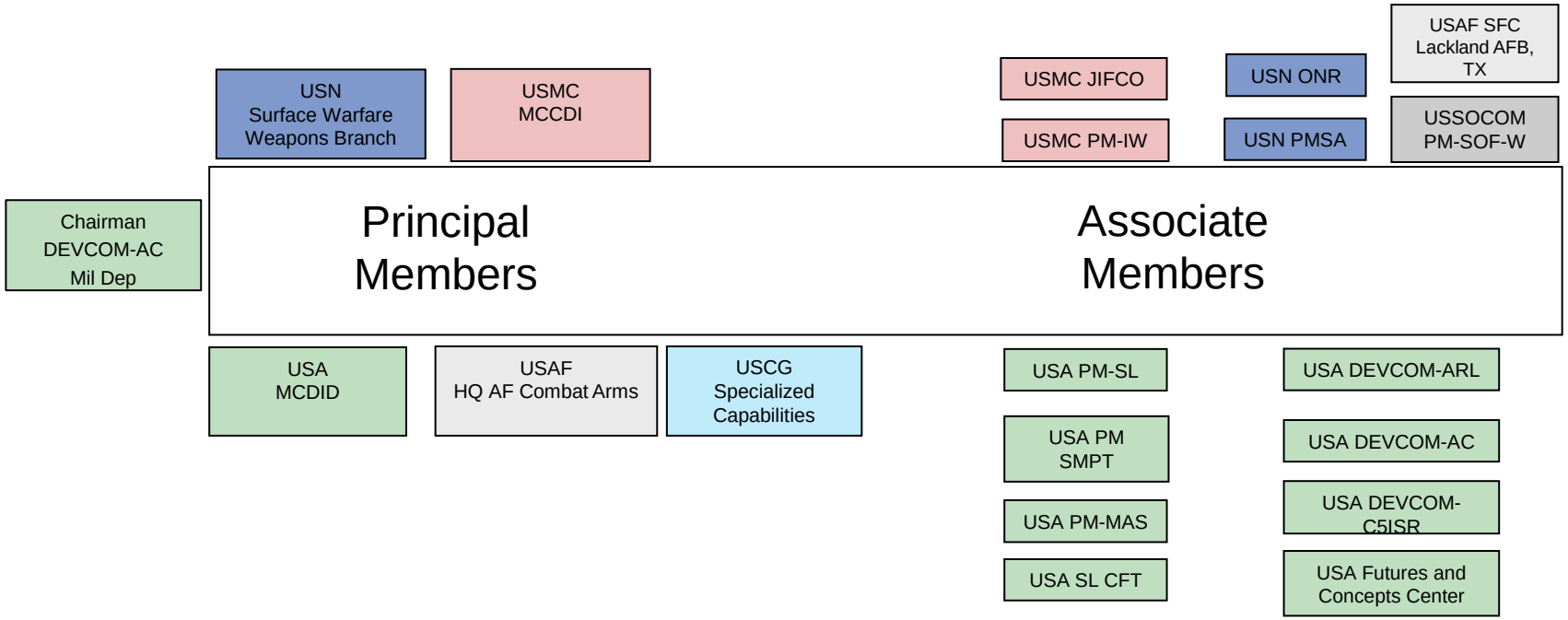
JOINT SERVICE SMALL ARMS PROGRAM OFFICE FRAMEWORK



JOINT SERVICE SMALL ARMS SYNCHRONIZATION TEAM (JSSAST)

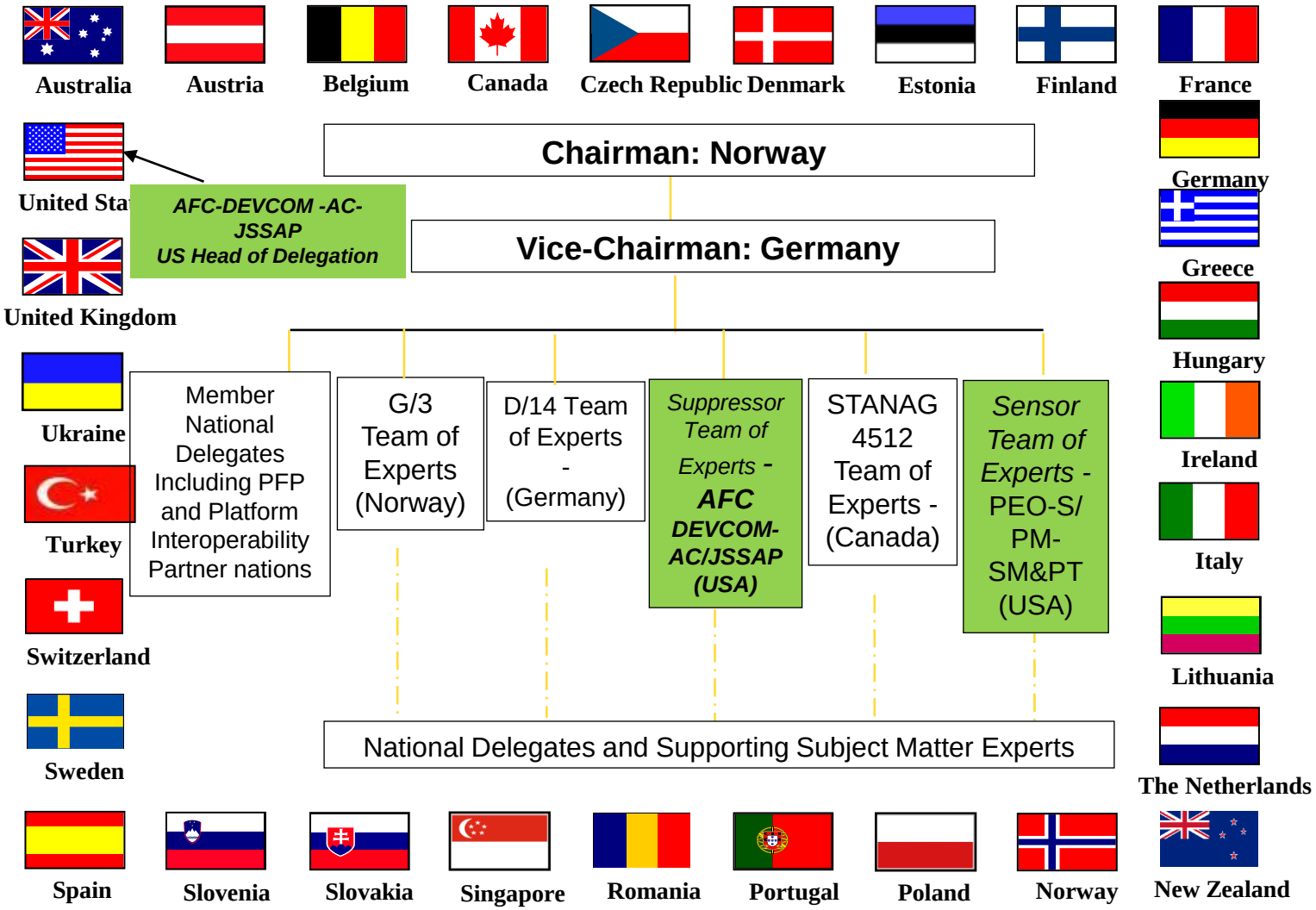
Areas of Responsibility:

- Approves Annual Updates of Joint Service Small Arms Capability Gaps
- Approves JSSAP S&T project portfolio on annual basis
- Identifies opportunities for potential joint programs
- Prepares and maintains a harmonized DoD wide Joint Service Small Arms Master Plan (JSSAMP) that integrates and harmonizes individual strategies of respective services



INTERNATIONAL SMALL ARMS ACTIVITIES

NATO ARMY ARMAMENT GROUP (NAAG)/DISMOUNTED SOLDIER SYSTEMS (DSS) WEAPONS and SENSORS SUBGROUP (WS SG)



Project Arrangement (PA):

- Defence Research and Development of Canada
- Focus on enabling technologies for future small arms systems.

Data Exchange Agreement (DEA):

- Defence Research and Development of Canada
- Small Caliber Weapons and Ammunition Data Exchange

Information Exchange Agreements (IEAs):

- Defence Science and Technology Laboratory (DSTL) of UK
- Infantry Weapons and Munitions Information Exchange Agreement

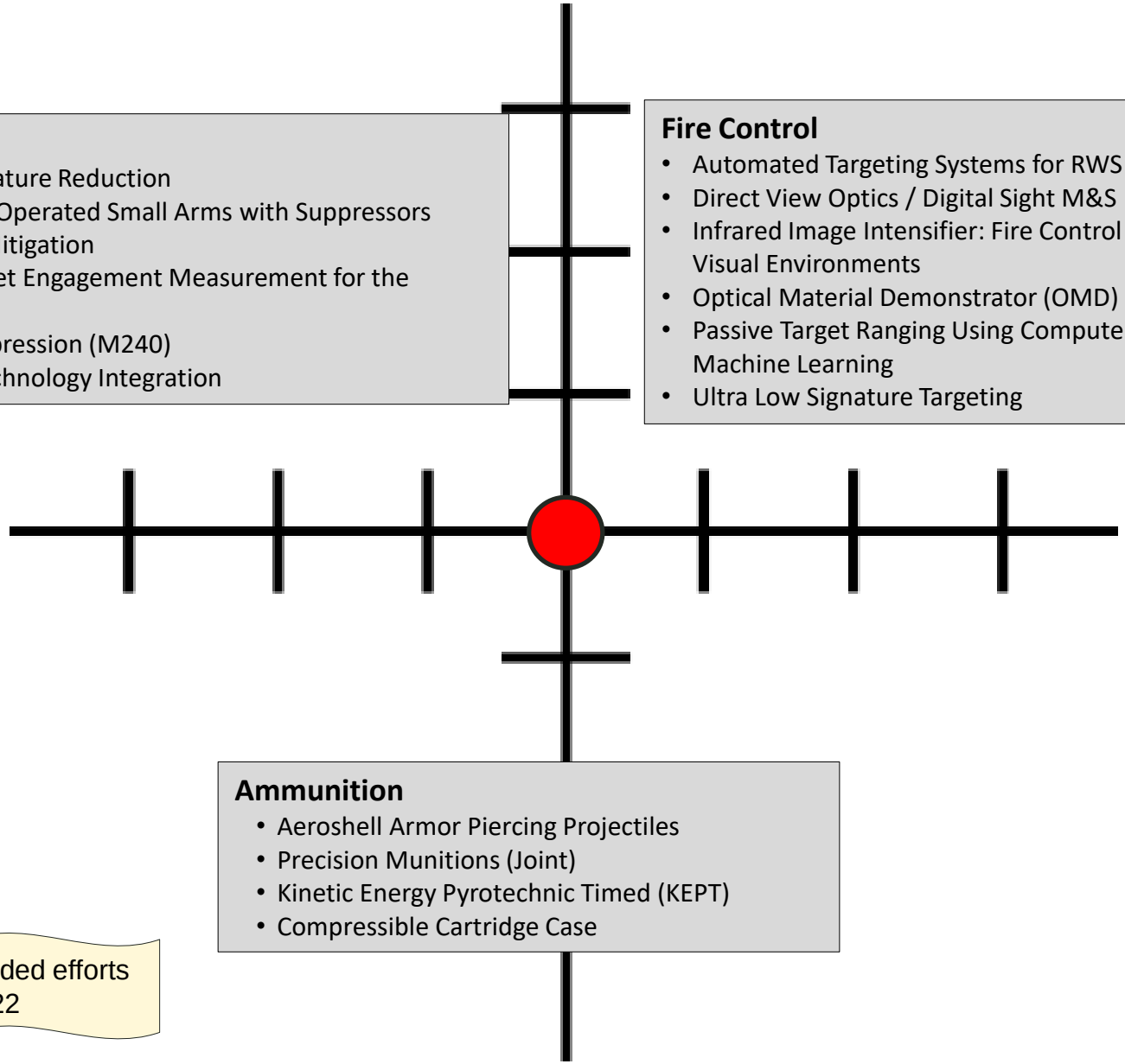
U.S. ARMY COMBAT CAPABILITIES DEVELOPMENT COMMAND

Joint Service Small Arms Program Office Portfolio

Update to the NDIA

Terence F. Rice (terence.f.rice.civ@army.mil)
Project Management Engineer
DEVCOM Armaments Center
Joint Service Small Arms Program (JSSAP) Office

JSSAP PORTFOLIO (FY22)



Weapons
- First Shot Signature Reduction
- Modeling Gas Operated Small Arms with Suppressors
- Novel Recoil Mitigation
- Objective Target Engagement Measurement for the LWMMG
- Signature Suppression (M240)
- Suppressor Technology Integration

Fire Control
- Automated Targeting Systems for RWS
- Direct View Optics / Digital Sight M&S
- Infrared Image Intensifier: Fire Control for Degraded Visual Environments
- Optical Material Demonstrator (OMD)
- Passive Target Ranging Using Computer Vision and Machine Learning
- Ultra Low Signature Targeting

Ammunition
- Aeroshell Armor Piercing Projectiles
- Precision Munitions (Joint)
- Kinetic Energy Pyrotechnic Timed (KEPT)
- Compressible Cartridge Case

Sixteen (16) funded efforts for FY22

FY22 PORTFOLIO (WHAT JSSAP IS TRACKING)

AMMUNITION	
Project	**Purpose**
Aeroshell Armor Piercing Projectiles	Provide Snipers and Advanced Marksmen with the capability of shooting low-cost armor-piercing projectiles that will safely pass through suppressors, muzzle brakes, and flash-hiders. Greatly reduce sniper-barrel wear. Provide all Warfighters with new ammunition that will extend barrel life and be environmentally-friendly.
Compressible Cartridge Case	Under the vast majority of material condition combinations of chamber headspace and case length, axial clearance exists between the base of the case head and the face of the breech bolt after chambering and locking are complete but prior to the shot. This clearance is an undesirable consequence of manufacturing tolerances as well as practical limits on the input peak force and energy to lock the breech bolt. The compressible cartridge case aims to increase the achievable levels of axial case crush for a given input force and energy in order to reduce or eliminate pre-shot axial clearance under all material condition combinations.
Kinetic Energy Pyrotechnic Timed	An understanding of the art of the possible on increasing incapacitation of Unmanned Aerial Systems. Provide user with “shotgun” capability at extended ranges utilizing existing, fielded weapon systems. Potential for Lower Collateral Damage Projectile for use in CONUS situations. Provide increased hit probability while maintaining sufficient kinetic energy to neutralize targets.
Precision Munitions (Joint)	Develop scalable precision munition technologies to increase Warfighter capability in anti-materiel, anti-personnel and other specialized missions.

FY22 PORTFOLIO (WHAT JSSAP IS TRACKING)

FIRE CONTROL	
Project	**Purpose**
Automated Targeting System for RWS	Enhance the mission effectiveness of existing Remote Weapons Stations (RWS) by extending current capability to include acting as an Automated Targeting System (ATS). Integrate with NSWCDD's Autonomous Remote Engagement System (ARES) enabled RWS as a new targeting node.
Direct View Optics / Digital Sight M&S	Updated Direct View Optic (DVO / Glass optics) & Digital Camera Modeling, Simulation and Test. Color cameras are rapidly improving due to commercial sector investment – "prosumer" (SLR & mirrorless) cameras and cell phone cameras. Updated modeling, simulation and test is needed to identify times and environments where digital or direct view perform best in order to provide the best capability to the Soldier.
Infrared Image Intensifier: Fire Control for Degraded Visual Environments	Add MWIR to VIS-NIR imaging capability of existing NVD tubes through photocathode modification. Enhances capability above traditional Image Intensifiers in degraded, sub-t and low moonlight environments Enables warfighters to target in degraded visual environments by integrating thermal band into Night Vision Scopes (NVS)
Optical Material Demonstrator	Leverage advances in manufacturing technology to demonstrate a 3-D printed optic. Provide optical performance commensurate with fielded optics, at significantly reduced weight and cost
Passive Target Ranging Using Computer Vision and Machine Learning	Accurate ranging is a difficult task. Investigate the use of a computer vision technique known as depth from defocus (DfD) to perform passive target ranging from 2-D imagery. Range information gained by passive means will allow COVERT units to determine various object distances and target those objects without emitting signals which can be detected by opposing forces. This method will provide ranges for the entire image, not just a single point.
Ultra Low Signature Targeting	Develop an ultra-low output light detection and ranging (LIDAR) system for range determination, target recognition, and wind sensing. This system will be capable of operating with significantly less output power than any prior laser based systems, thus minimizing probability of detection and/or interception

FY22 PORTFOLIO (WHAT JSSAP IS TRACKING)

WEAPONS	
Project	**Purpose**
First Shot Signature Reduction	Reduce 1st-shot weapon signature in low light to conduct operations without detection. First shots produces a brighter flash.
Modeling Gas Operated Small Arms with Suppressors	Develop numerical, physics based simulation tools that can be used to understand and predict the operation of gas operated, suppressed small arms systems and obtain more detailed information than can be found experimentally. Investigate methods to correlate gas species distributions and states to the radiation energy and flash that develops. Include the gas flow conditions, chemical reactions, particulates, heat transfer, and phase changing metal. Determine levels of model detail required to capture a given phenomena, flow condition, or performance measure.
Novel Recoil Motigation	Development of advanced recoil mitigation automatic weapon operating mechanism for NGSWT / NGCT. Unique combination of automatic operating methods
Objective Target Engagement Measurement for the LWMMG	To develop an objective, repeatable measurement approach for quantifying high-rate automatic firing performance for shooters, using the .338 Norma Magnum-chambered LMG-M as a test platform.
Signature Suppression (M240)	Develop an M240B/L signature suppressor that meets Joint Service requirements for flash, sound, durability, dispersion and point of impact, ease of use, weight, and size.
Suppressor Technology Integration	Integrate a variety of different suppressor technologies to develop a suppressor system that performs optimally in all areas.

PORTFOLIO UPDATES – TRANSITION

- **FY21 Transitions**
  - Lethal Limited Range Reduced (L2R2)
  - Active Stabilization
  - ARES Improved Machine Gun Barrel
  - Small Arms Ballistic Solver

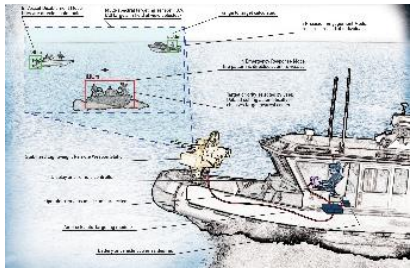
- **FY22 Planned Transitions**
  - Aeroshell Armor Piercing Projectiles
  - Compressible Cartridge Case
  - Kinetic Energy Pyrotechnic Timed
  - Precision Munitions (Joint)
  - Automated Targeting System for RWS
  - Direct View Optics / Digital Sight M&S
  - Infrared Image Intensifier: Fire Control for Degraded Visual Environments
  - Optical Material Demonstrator(OMD)
  - Passive Target Ranging Using Computer Vision and Machine Learning
  - Multispectral Dual Channel Crosstalk Reduction
  - Modeling Gas Operated Small Arms with Suppressors
  - Novel Recoil Mitigation
  - Suppressor Technology Integration

ACTIVE STABILIZATION TECHNOLOGIES

(U) Auto-Targeting Remote Operated Weapons









(U) Schedule & Funding

MILESTONES	FY16	FY17	FY18	FY19	FY20
Remote Weapon Status					
Requirements	3				
Sytem Development					
Test1 - Crane					
Test2 - Aimlock					
Live-Fire Test & Evaluation					6
Foundational Development					

Transition to Joint Services

(U) Purpose:

- (U) Develop and demonstrate applicability of active stabilized concepts for mounted operations (Vehicle, Boat, Airborne).

(U) Products:

- (U) Full Auto Analysis – Observe and measure unique environmental factors in full automatic fire conditions
- (U) Sensor Analysis – Perform market survey of single spectrum and multi-spectrum weapon sights; culminates in a target detection experiment in realistic environments
- (U) Fabricate Surrogate Systems - Design and fabricate a technology demonstrator
- (U) Development of machine gun mounted prototype solution
- (U) Target detector integration for boat/engine and other non-standard high-value targets
- (U) High Precision Long Range Application Modification

(U) Payoff

Foundational Development

- (U) Automatic Target Recognition
- (U) Active Stabilization Techniques

Technologies/Techniques for improvements in Aim Error

- (U) Reduce engagement time for increased lethality and improved survivability.
- (U) Fire Control ==> 4th Gen/Level 5+
- (U) Can Active Stabilization techniques be applied to FVL concepts?

(U) Future Events

- (U) CY19 – Maritime Testing, USCG,/USN, Location: TBD
- (U) CY19 – Test Readiness Review (TRR) – Final Life Fire Test prior to project transition.

POC: Terence F. Rice, terence.f.rice.civ@army.mil

US ARMY SUPPORT OF USCG LETHAL REDUCED RANGE AMMUNITION





M80 SC18 LW3 P6?

Schedule

Tasks FY(19)	2QTR	3QTR	4QTR
Current RRTA design review; analysis, selection			
Engineering Support			
Ballistic Testing			
Ballistic Analysis			
Program Reviews			
		TRL5	TRL6

Purpose:

- Provide program support and comprehensive ballistic testing with analysis for the USCG Lethal Reduced Range Ammunition

Product:

- Lethal Reduced Range meeting USCG needs
- Approximate TRL 6 TDP & Demonstration

Payoff:

- Provide support and analysis to USCG that will provide understanding of their product, leveraging Army experience and techniques being applied to the US Army RRTA programs
- Flight and terminal ballistic performance characterized as a function of range.
- Evaluation of JSSAP provided contractor M240 test data

Partners:

US ARMY CCDC-AC; USCG

Transition:

JSSAP-to-USCG

Capability Gap / Opportunity Area(s) Focus:

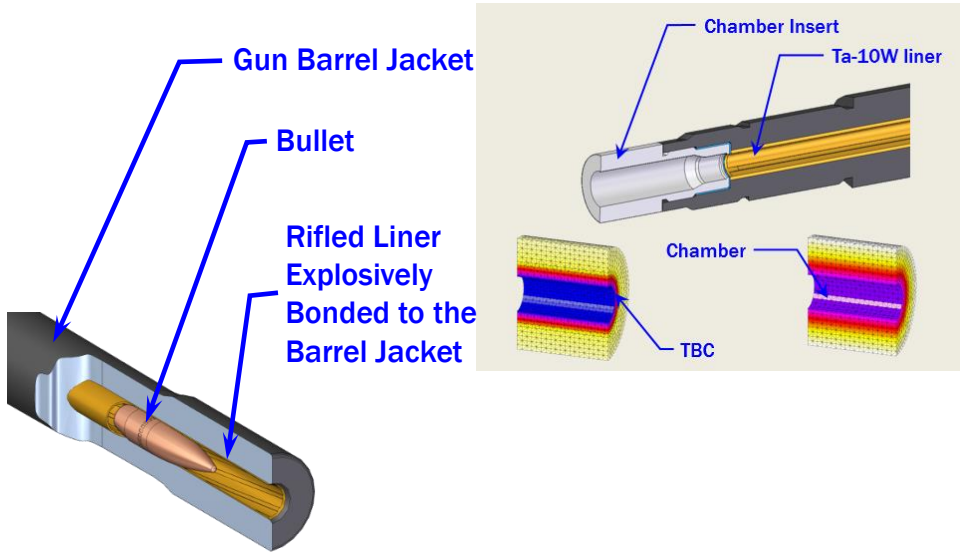
Lethal Limited Range ammunition to limit collateral damage

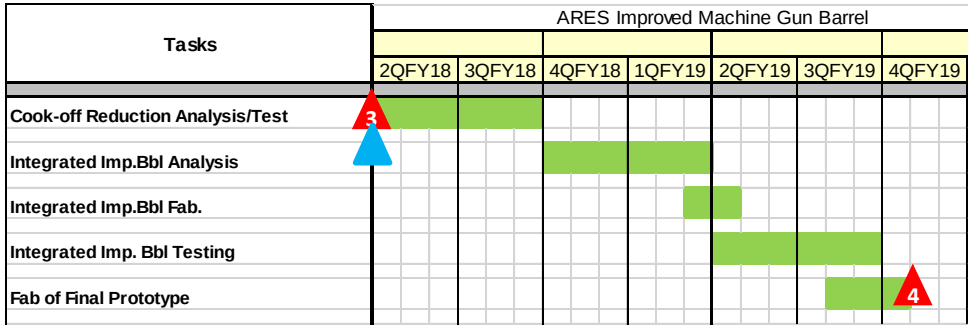
Key Upcoming Events:

- Requirements review with CCDC-AC / USCG
- RRTA design Review
- Contractor Support Kickoff

POC: Mark Minisi (x4326)
Shawn Spickert-Fulton (x6088)

ARES IMPROVED MACHINE GUN BARREL





TRL

Contract Award

POC: Alexander Smith,
973-724-9642,
Alexander.p.smith28.civ@mail.mil

Purpose:

- Develop, fabricate, and test a superalloy lined, jacketed barrel with an isolated chamber.

Product:

- Development and analysis of cook-off reduction through thermal isolation of chamber.
- Development and analysis of superalloy lined barrels for improved wear.
- Results of modeling and simulation, testing.
- Barrel prototype.

Payoff:

- Demonstration of chamber isolation technology and improved cook-off potential. Potential for hotter barrel with reduced cook-off.
- Demonstration of rifling technologies for superalloy liners. Superalloy liners have a variety of advantages but traditionally suffer from difficulty to rifle.
- Feeds PM SW barrel improvement product improvements.
- Demonstration of wear performance in various superalloy liners. Potential to meet wear requirements for advanced projectiles in support of Next Gen. Squad Weapons (NGSW).

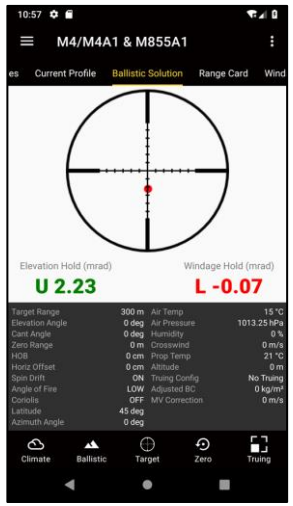
Transition:

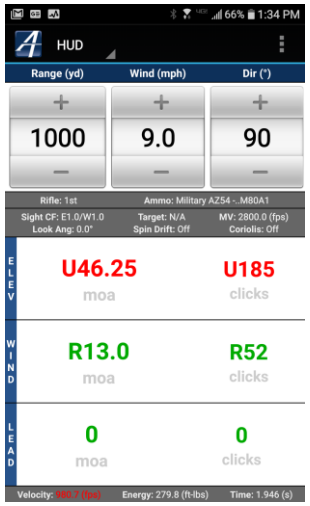
- PM-CSW

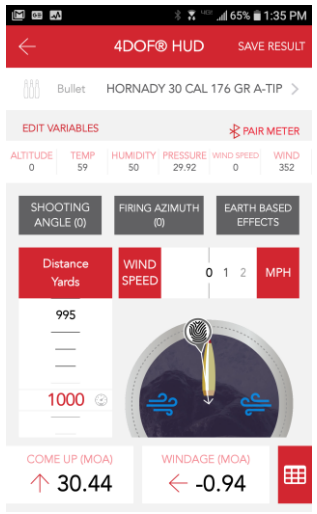
Capability Gap / Opportunity Area(s) Focus:

- Potential elimination of spare barrel – soldier load
- Extending barrel life – lifecycle cost savings

JSSAP HANDHELD BALLISTIC CALCULATOR COMPARISON PROPOSAL







Schedule

MILESTONES	FY20	FY21	FY22
Task 1		5	
Task 2			6
Task 3			
Task 4			
Task 5			
Task 6			

Purpose:

- Compare, verify, and validate effectiveness and accuracy of Army Advanced Small Arms Ballistic Solver (ASABS), Applied Ballistics (version ABX), and Hornady 4DOF direct fire control systems

Product(s):

- Ballistic calculator comparison study (completed, paper due April)
- Live Fire test report of fire control vs holes on target

(U//FOUO) Payoffs:

- Soldier buy-in
- Government maintained library of ballistics data
- Common fire control solutions and software re-use across different direct fire weapon systems

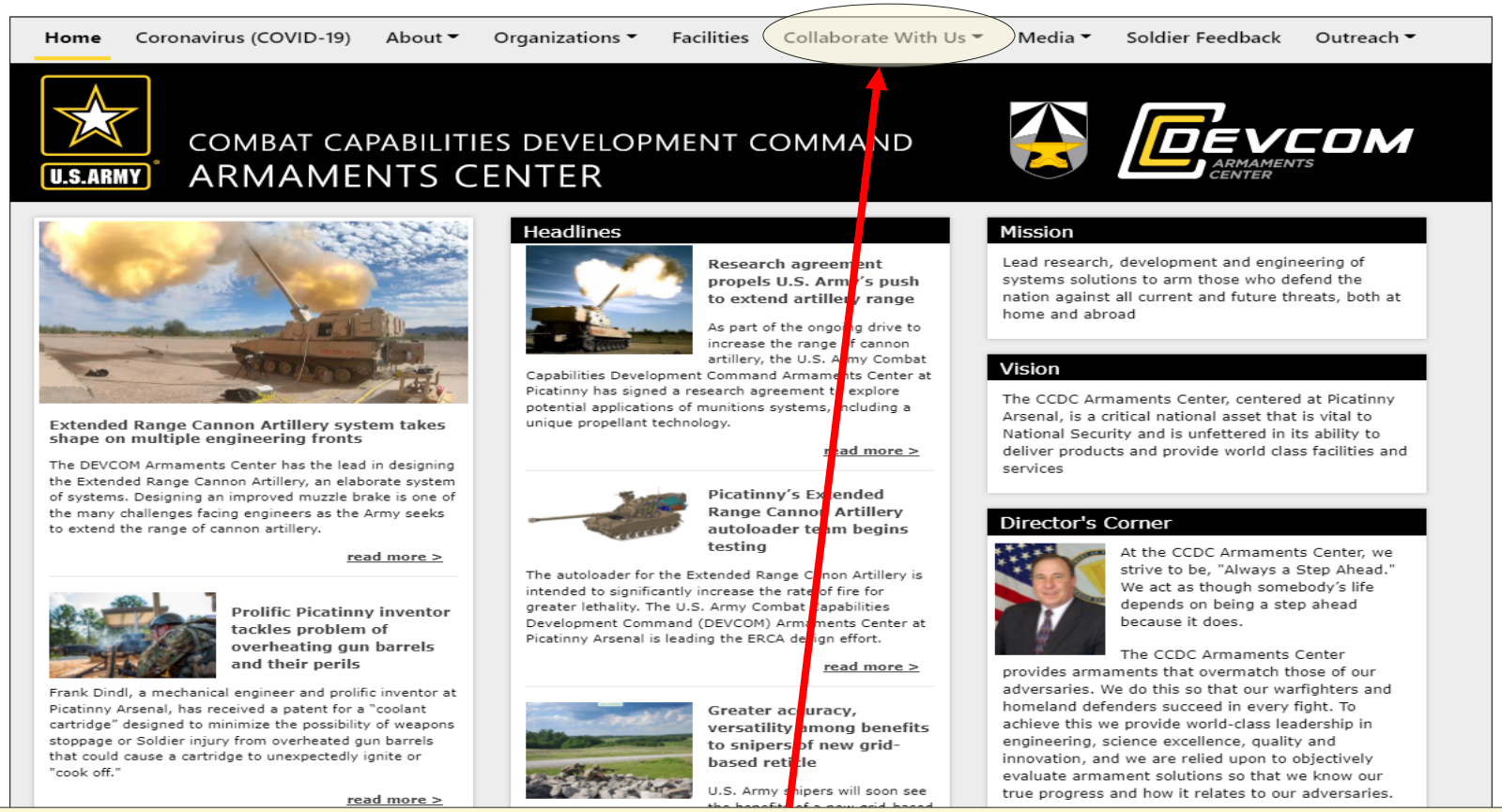
(U//FOUO) Transition:

- ASABS is in beta form on android systems for soldier testing, Applied Ballistics and Hornady 4DOF are commercial systems
- ASABS will be used in the Next Gen Fire Control program
- Also ASABS software and is already being used in Small Tactical Optical Rifle Mounted (STORM) II

POC: Christopher James, CCDC AC FTaB
4102783880, christopher.p.james12.civ@mail.mil

TRANSITIONS OPPORTUNITIES PATH FORWARD

Combat Capabilities Development Command (CCDC) Armaments Center (https://ac.ccdc.army.mil/)



JSSAP team working(in progress) with DEVCOM Armaments Center Business Interface Office (BIO) on Technology Transfer Opportunities for:

- Lethal Limited Range Reduced (L2R2)
- Active Stabilization
- ARES Improved Machine Gun Barrel
- Small Arms Ballistic Solver

CCDC-AC CONTACT:
https://www.pica.army.mil/SBP/Contacts.aspx
mailto:usarmy.pica.ccdc-ac.mbx.domestic-tech-transfer@mail.mil

Joint Service Small Arms Program Office - Office of the Secretary of Defense (OSD) Small Business Innovation Research (SBIR) Update to the NDIA

Corey D. Hall

Program Management Engineer

JSSAP

19 OCT 2021

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OSD SBIRS FOR JSSAP

- OSD SBIR Cycle is 3x per year
- Plan is to initiate topic generation 2 months prior to due date
  - Current Cycle SBIR 21.3 is open for proposal submissions
- Guiding Principles for Topics
  - Further Exploration of Existing Opportunity Areas
  - Unfunded Opportunity Areas
  - Previous Opportunity Areas that have become lower priority
  - Service Specific Needs
  - Concepts Which require Tech Push vs. Pull Model
- Potential Future topics of interest
  - Aim Augmentation
  - Assured Position/Navigation/Timing for small caliber weapon fire control in a denied environment
  - Coatings/Materials for higher pressure cartridge cases

Joint Service Small Arms Requirements Integration (JSSARI) Working Group Update to the NDIA

Mark J. McFadden

JSSARI WG CHAIRMAN

US ARMY AFC/DEVCOM-AC

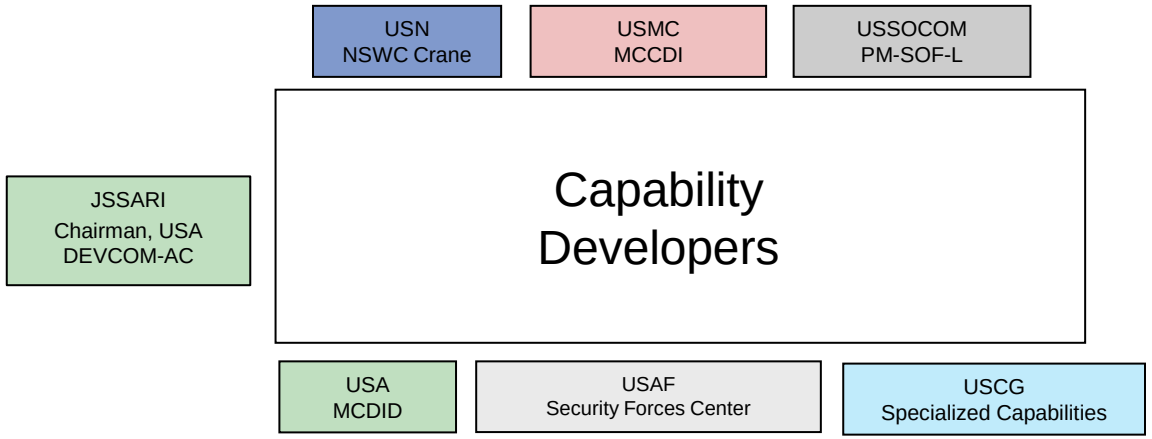
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JOINT SERVICE SMALL ARMS REQUIREMENTS INTEGRATION (JSSARI)

Areas of Responsibility:

- Develop, review, report, and submit Joint, harmonized Small Arms Systems capability documents
- Harmonize service requirements, including concurrence, disposition, support, and staffing of Small Arms Systems Capability Based Developments.
- Prepare, update and coordinate harmonized Department of Defense Small Arms Capability Roadmap on a two year basis to reflect the latest and emerging trends in small arms systems threats, capabilities and capabilities gaps.



JSSARI WG – INTEGRATION WITH JSSAME WG, JSTAC



Opportunity Areas (O/As)	S&T Investment Areas	Portfolio (Results)
Derived from service capability gaps	JTACS SMEs further break down O/As into S&T Investment Areas needed to 'close' O/A	16 efforts 14 continuations from FY20 2 New Starts
JSSARI ranked	Duplicate S&T Investment Areas can emerge across multiple O/As	Portfolio alignment at O/A level
22 approved O/As	S&T Investment Areas used to build portfolio for FY per POM planning	
	Metrics: 76 unique S&T Investment Areas 179 total S&T Investment Areas across 22 O/As	

SMALL ARMS TASKS

- Engage threat personnel with SA fire
- Engage threat personnel that are in defilade
- Engage threats with precise SA fire
- Engage threats with SA volume fire
- Acquire personnel and vehicle targets
- Determine range to target
- Mark or tag targets
- Breach existing entry points
- Avoid detection caused by weapon signature
- Operate and maintain weapons.

U.S. ARMY COMBAT CAPABILITIES DEVELOPMENT COMMAND

Joint Service Small Arms Metrics and Evaluation Working Group (JSSAME WG) Update to the NDIA

Adam M. Jacob

Project Management Engineer

Joint Service Small Arms Program

19 Oct 2021

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JOINT SERVICE SMALL ARMS METRICS AND EVALUATION WG



Improve the delivery of small arms capability to Warfighters by synchronizing ***small arms metrics*** around ***operationally relevant capabilities*** that have a ***common translation*** to the technical communities in both ***development and evaluation***.

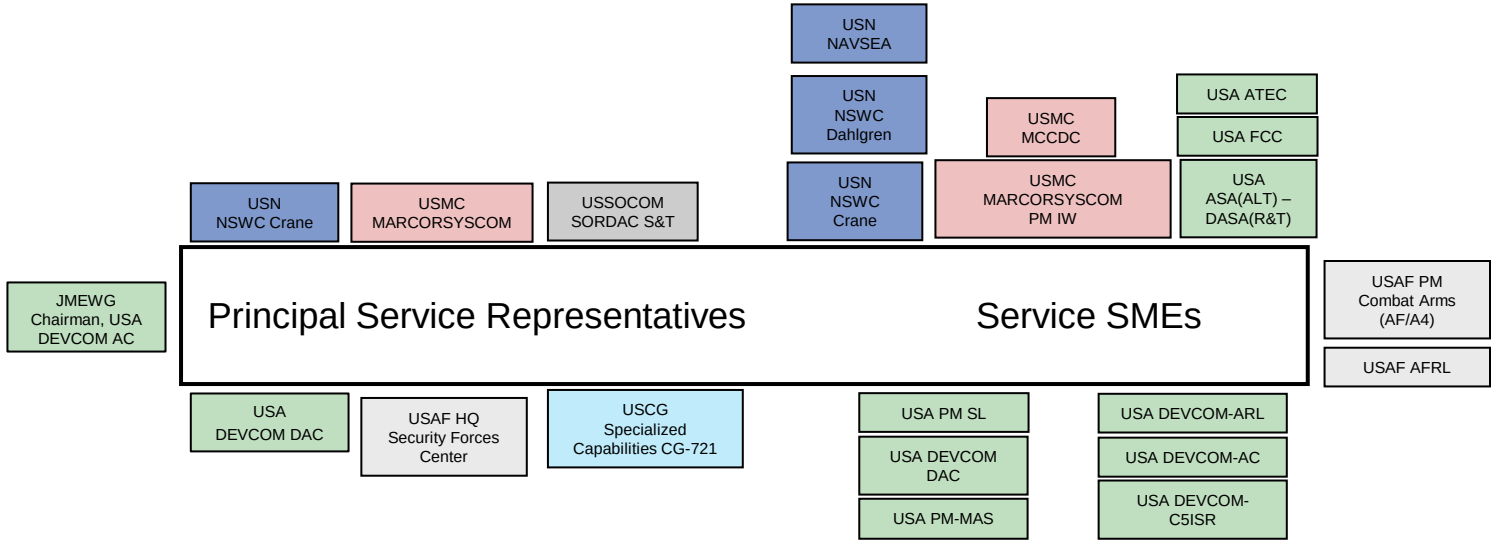
JOINT SERVICE SMALL ARMS METRIC EVALUATION (JSSAME) WORKING GROUP

Areas of Responsibility:

- Develop and maintain a common understanding of small arms performance across the user community, program offices, operational and evaluation community, and industry in order to generate a common language for small arms performance characterization.

- Identify, develop, and validate small arms evaluation standards, metrics, and modeling tools across the Joint Services.

- Coordinate with the JSTAC and JSSARI to provide recommendations on JSSAP portfolio to the JSSAST, including new start recommendations and ongoing project review and redirection as necessary, with focus on S&T programs' ability to close capability gaps.



JSSAME WG – INTEGRATION WITH JSSARI, JSTAC

JSSAME

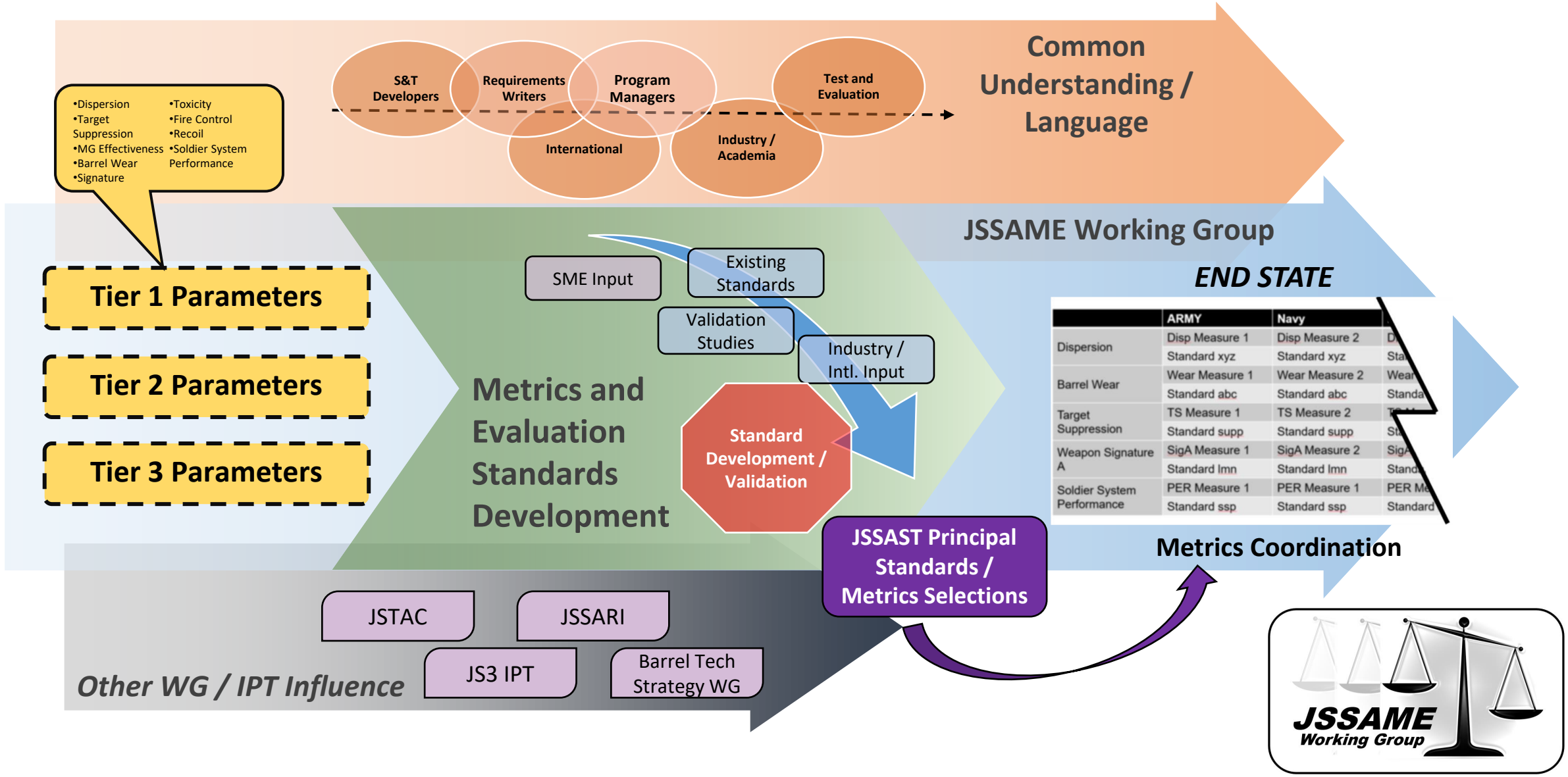
JSSARI O/As → JSTAC S&T Investment Areas → JSSAP Portfolio

Ensure that test and evaluation of small arms weapon systems is operationally relevant, and done in a consistent, repeatable, and standardized manner.

Opportunity Areas (O/As)	S&T Investment Areas	Portfolio (Results)
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JSSAME Working Group

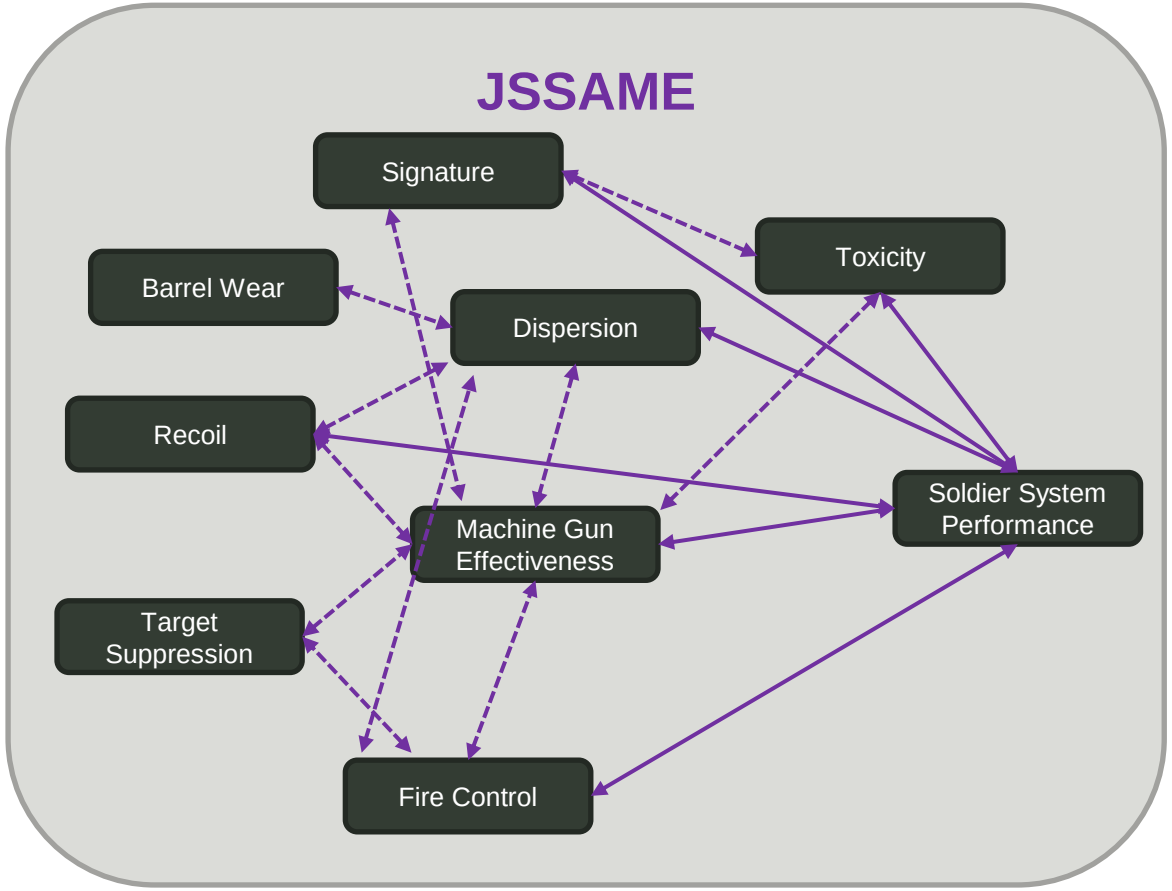
JSSAME WG – FLOW CHART



TIER 1 PARAMETER RELATIONSHIPS

WHY?

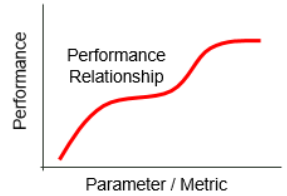
TO DEFINE THE DESIRED PERFORMANCE, WE FIRST NEED TO KNOW HOW TO QUANTIFY EACH OF THESE PARAMETERS (TEST PROCEDURE, METRIC).

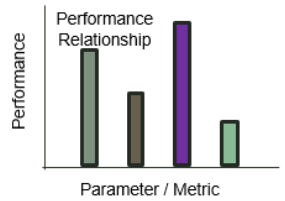


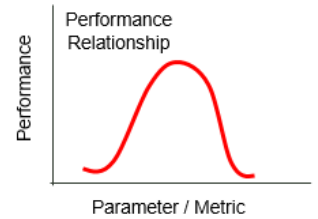
DESIRED PERFORMANCE

Define the performance relationship – Now that we know how to measure performance, what does "right" look like? Depends on mission, range, environment, etc.

Future Studies

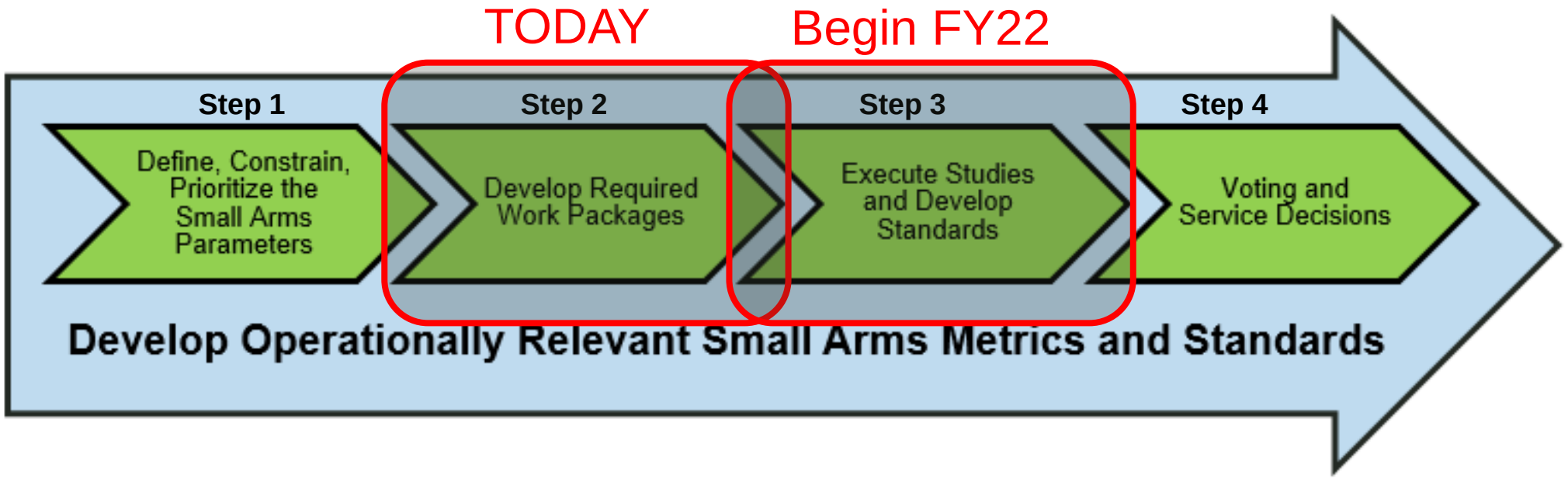






JSSAME Working Group

JSSAME WG – STANDARDIZATION APPROACH



Early in the process – Opportunities for Industry, Academia, and Government to collaborate.

JSSAME Working Group

JSSAP S&T CHALLENGE STATEMENTS TO INDUSTRY

2 examples of 17

Remainder in Backup

CHALLENGE STATEMENT

Small Arms Task(s) Addressed: ENGAGE THREATS WITH SMALL ARMS VOLUME FIRE

Technology Investment Area: MACHINE GUN AUTOMATIC BALLISTIC CORRECTION

Background/Problem Statement:

- The Joint Service Small Arms Program (JSSAP) Office is seeking information on Machine Gun Automatic Ballistic Correction prototype solutions.

- This refers to technologies that automatically correct and/or optimize aimpoint/shot. Placement/dispersion to minimize operator aim error and increase probability of hit using machine guns.

- Technologies may be similar to other applications of Automatic Ballistic Correction for weapon systems, however, since volume fire consists of extended bursts, the automatic ballistic correction may need to be quicker reacting, longer duration, or may need to optimize and control unique weapon system parameters in order to be effective in a machine gun.

- These considerations should be addressed in any proposed solutions.

JSSAP CONTACT INFO:
usarmy.pica.futures-cmd.mbx.jssap@army.mil

CHALLENGE STATEMENT

Small Arms Task(s) Addressed: ENGAGE THREATS WITH SMALL ARMS VOLUME FIRE

Technology Investment Area: SYSTEM THERMAL CHARACTERIZATION AND MANAGEMENT

Background/Problem Statement:

- The Joint Service Small Arms Program (JSSAP) Office is seeking information that addresses the development of advanced barrel cooling techniques that eliminate cook off, enable the use of caseless ammunition, and enable the use of low cost high strength heat treatable steels.

- The Government is looking for novel designs that offer practical and effective methods for cooling barrels.

- The requested information will demonstrate the offeror's basic understanding of the problem, provide a discussion of how the offeror would attack the problem, and include recent advances in technology that address the requirement. No offers or responses to this RFI should be expected by the offeror and is only for internal information to the government in program planning.

JSSAP CONTACT INFO:
usarmy.pica.futures-cmd.mbx.jssap@army.mil

QUESTIONS



BACKUP

CHALLENGE STATEMENT

Small Arms Task(s) Addressed: AVOID DETECTION CAUSED BY WEAPON SIGNATURE

Technology Investment Area: HOLISTIC/INTEGRAL SIGNATURE SUPPRESSION DEVELOPMENT

Background/Problem Statement:

- Recent advances in commercial suppressor technology have reduced sound and flash.
- Attempts have been made to reduce toxic fume blowback but it is not sufficient for military grade weapons with higher duty cycles and rates of fire.
- An integrated weapon system technology is necessary whereby the suppressor is not just an add-on, but is integrated and the weapon operating characteristics are in tune with the suppressor including heat, signature and blowback management utilizing a system approach.
- Integrally suppressed weapons have been tried in the past but have not dealt with all of the deleterious issues of suppressors in a balanced system approach including sound signature, flash signature, thermal signature; blowback, durability, fouling, etc. to build a durable military grade suppressed weapon system.
- Good measurement techniques are needed to evaluate all of the system performance measures in order to ensure deleterious effects, including toxic fumes, thermal signature and heat, weapon cycling, sound, and flash are necessary.
- Advances in how to modify weapon operating speeds may be necessary to deal with some of these issues.

JSSAP CONTACT INFO:
usarmy.pica.futures-cmd.mbx.jssap@army.mil

CHALLENGE STATEMENT

Small Arms Task(s) Addressed: ACQUIRE PERSONNEL AND VEHICLE TARGETS

Technology Investment Area: NIGHT TIME DIGIITAL IMAGE DATA FUSION

Background/Problem Statement:

- The Joint Service Small Arms Program (JSSAP) office is seeking information on multi-camera Digital Image Data Fusion techniques and technology for small arms applications.
- JSSAP is interested in information technologies in Digital Image Data Fusion, focusing on S&T Activity in the fusion of cameras with various modalities.
- This can include camera at different locations, with various levels of resolution, focal length, field-of–view, and spectral response.
- By extension this includes nighttime images, such as those from light image intensifier (I2) devices, ShortWave InfraRed (SWIR) devices, thermal Imagers and more.
- Latency, frame rate and other parameters known to directly affect human movement and cognitive processing should be considered.
- Both Daytime and nighttime images can be enhanced using multiple cameras and spectral fusion.
- Artificial Intelligence and Machine Learning could be used to determine and transmit the best synthesized image to display to Operators for any proposed solution.
- The request for information response will demonstrate the offeror's basic understanding of the problem, provide a discussion of how the offeror would attack the problem, and include recent advances in technology that address how any Daytime, or Nighttime Digital Image Data Fusion would be accomplished.
- A rough schedule and cost is for information only. No offers or responses to this RFI should be expected by the offeror and is only for internal information to the government in program planning.

JSSAP CONTACT INFO:
usarmy.pica.futures-cmd.mbx.jssap@army.mil

CHALLENGE STATEMENT

Small Arms Task(s) Addressed: ACQUIRE PERSONNEL AND VEHICLE TARGETS, DETERMINE RANGE TO TARGET, MARK OR TAG TARGET

Technology Investment Area: ULTRA LOW SIGNATURE LIDAR

Background/Problem Statement:

- The Joint Service Small Arms Program (JSSAP) Office is seeking information to improve personnel target detection, classification, recognition and identification (DCRI) involves the development of an extremely sensitive, i.e. high signal to noise ratio LIDAR systems for near covert operation while providing high resolution three dimensional imaging with single photon sensitivity.
- There is also interest in LIDAR technologies that employ integrated photonics allowing for a system with a very attractive size, weight, and power profile.
- A rough schedule and cost is for information only.
- No offers or responses to this RFI should be expected by the offeror and is only for internal information to the government in program planning.

JSSAP CONTACT INFO:
usarmy.pica.futures-cmd.mbx.jssap@army.mil

CHALLENGE STATEMENT

Small Arms Task(s) Addressed: ACQUIRE PERSONNEL AND VEHICLE TARGETS, MARK OR TAG TARGETS

Technology Investment Area: PHOTONICS BASED NEURAL NETWORK COMPUTING

Background/Problem Statement:

- The Joint Service Small Arms Program (JSSAP) Office is seeking information on Photonic based Neural Network computing technology development to further enable personnel and vehicle target identification in lowlight or long range situations.
- Optical computing, discussed in the scientific literature for several decades, has been a field in search of a viable hardware approach.
- Advances in integrated photonics have made an optically based neural network a near reality.
- These “circuits” can adjust couplings between “fibers” thus emulating weights in neural nets.
- They can also combine beams which have suffered differential delays; optically they are interferometers.
- Both these mechanisms provide the full panoply of functionality that implements highly capable neural nets.
- Advances in active optical waveguides have provided access to a new set of approaches, the viability of which have yet to be established.
- An optically based photonic chip for specialized AI processing could be more than one hundred times faster than similar specialized AI chips based on conventional electronics and use less electrical power.
- The neural nets can be used for target identification and tracking and low light or degrading imaging exploitation.
- They can also implement a wide array of linear algebra operations, including optimization, regression and convolutions.
- It is essential that any such identification or tracking system be validated early in the development cycle.
- Neural nets can also help realize image reconstruction and target identification for images collected using compressive sensing methods.
- The request for information response will demonstrate the offeror's basic understanding of the problem, provide a discussion of how the offeror would attack the problem, and include recent advances in technology that address how Photonics Based Neural Network Computing would be accomplished. A rough schedule and cost is for information only.
- No offers or responses to this RFI should be expected by the offeror and is only for internal information to the government in program planning.

JSSAP CONTACT INFO:
usarmy.pica.futures-cmd.mbx.jssap@army.mil

CHALLENGE STATEMENT

Small Arms Task(s) Addressed: ACQUIRE PERSONNEL AND VEHICLE TARGETS, MARK OR TAG TARGETS

Technology Investment Area: TECHNIQUES FOR REMOVAL OF ATMOSPHERIC INDUCED IMAGE DEGRADATION

Background/Problem Statement:

- The Joint Service Small Arms Program (JSSAP) Office is seeking information on techniques to remove atmospheric induced image and targeting degradation.
- JSSAP is interested in ideas to development digital signal processing algorithms that would be able to characterize image distortion due to atmospheric effects such of turbulence, refraction, mirage and haze.
- There are known algorithms to remove atmospheric aberrations and distortions from frame sequences.
- These software solutions may provide solutions that are more practical than those afforded by active wave-front compensation.
- Advances in processor speed continue to be achieved, and this S&T Activity is intended to take advantage of those increased capabilities.
- There is also an opportunity to use the atmospheric modeling to provide spectral band selection and sensor capability assessments and requirements definitions for future force battlespaces that are still under evaluated.
- Atmospheric correction in the VNIR will also allow for the estimation of cross-range wind an important aid in finding ballistic solutions.
- The request for information response will demonstrate the offeror's basic understanding of the problem, provide a discussion of how the offeror would attack the problem, and include recent advances in technology that address how Technologies for Removal of Atmospheric Induced Image Degradation would be accomplished.
- A rough schedule and cost is for information only. No offers or responses to this RFI should be expected by the offeror and is only for internal information to the government in program planning.

JSSAP CONTACT INFO:
usarmy.pica.futures-cmd.mbx.jssap@army.mil

CHALLENGE STATEMENT

Small Arms Task(s) Addressed: ACQUIRE PERSONNEL AND VEHICLE TARGETS, MARK OR TAG TARGETS

Technology Investment Area: NOVEL DIGITAL IMAGING

Background/Problem Statement:

- The Joint Service Small Arms Program (JSSAP) Office is seeking information on the development of Novel Digital Imaging techniques for the development of technologies and systems that facilitate digital target recognition, identification and tracking in novel ways for small arms applications. This could include super resolution, in-scene LADAR, Flat Diffractive optics, and Artificial Intelligence /machine Learning (AI/ML) supplemented targeting.
- This S&T Activity would require the development of advanced digital signal processing algorithms such as high quality spatial (in-frame) upscaling and/or motion compensation for finding corresponding areas in neighbor frames.
- Efficiencies in processing would be examined, including foveated imaging and Flat diffractive optics processing and imaging. Recovering high resolution images from optical systems that are aperture-limited could improve situational awareness, and allow for novel passive depth finding, where doing so would require the injection of surmised information.
- Smart imagers are known to reduce power requirements particularly for low level functions such as optical flow and registration, or autonomous pixel binning decision processing.
- Other opportunities lie in the application of light field methods, particularly in situations where 3D scene reconstructions are needed.
- The need for synthetic generation of super-resolved imagery is more important in the VNIR, SWIR and MWIR than in the visible.
- The SWIR band could take advantage of airglow in night time conditions.
- Foreground, background and image segmentation can be performed in multiple bands and the results cross-correlated to aid target identification and tracking.
- VNIR processing will eventually require atmospheric correction.
- The request for information response will demonstrate the offeror's basic understanding of the problem, provide a discussion of how the offeror would attack the problem, and include recent advances in technology that address how Novel Digital Imaging would be accomplished.
- A rough schedule and cost is for information only.
- No offers or responses to this RFI should be expected by the offeror and is only for internal information to the government in program planning.

JSSAP CONTACT INFO:
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CHALLENGE STATEMENT

Small Arms Task(s) Addressed: ACQUIRE PERSONNEL AND VEHICLE TARGETS

Technology Investment Area: INTEGRATION OF HIGH QUANTUM EFFICIENCY DETECTORS FOR DAY, NIGHT, AND DEGRADED CONDITIONS

Background/Problem Statement:

- The Joint Service Small Arms Program (JSSAP) Office is seeking information on the development of High Quantum Efficiency Detectors for Day, Night, and Degraded Condition battlespace imaging for small arms applications.
- The JSSAP office is looking for S&T technologies to further extend the material, physical and electrical designs of the detector, ROIC and FPA components to further improve the collection efficiency and responsivity of ultra-low SWaP battle field sensors for targeting and ISR applications in any proposed solution.
- The request for information response will demonstrate the offeror's basic understanding of the problem, provide a discussion of how the offeror would attack the problem, and include recent advances in technology that address how Integration of High Quantum Efficiency Detectors for Day, Night, and Degraded Conditions would be accomplished.
- A rough schedule and cost is for information only.
- No offers or responses to this RFI should be expected by the offeror and is only for internal information to the government in program planning.

JSSAP CONTACT INFO:
usarmy.pica.futures-cmd.mbx.jssap@army.mil

CHALLENGE STATEMENT

Small Arms Task(s) Addressed: ENGAGE THREATS WITH SMALL ARMS VOLUME FIRE, ENGAGE THREAT PERSONNEL WITH PRECIS SMALL ARMS FIRE

Technology Investment Area: RECOIL REDUCTION

Background/Problem Statement:

- The Joint Service Small Arms Program (JSSAP) Office is seeking information on advanced recoil mitigation technologies that reduce the firing specific impulse (i.e. force over time) for future squad and platoon level weapons.
- Technologies in this area include those of which reduce felt recoil and/or improve weapon controllability in the hands of a
- User to reduce Soldier aim error when shoulder firing and/or firing from a bipod.
- Proposals may also address the development of improved muzzle brake/compensator effectiveness while minimizing adverse effects, and should combine recoil impulse reduction with the various aspects of signature suppression.
- Technologies that address the relationship between recoil, rate of fire, integration of weapon systems with body armor and various other parameters are also required.
- The request for information will demonstrate the offeror's basic understanding of the problem, provide a discussion of how the offeror would attack the problem, and include recent advances in technology that address the requirement.

JSSAP CONTACT INFO:
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CHALLENGE STATEMENT

Small Arms Task(s) Addressed: ENGAGE THREATS WITH SMALL ARMS VOLUME FIRE, OPERATE AND MAINTAIN WEAPONS

Technology Investment Area: SYSTEM THERMAL CHARACTERIZATION AND MANAGEMENT

Background/Problem Statement:

- The Joint Service Small Arms Program (JSSAP) Office is seeking proposals for the development of advanced system thermal characterization methods (non-contact thermometry) and thermal management concepts for small caliber weapon systems.
- Management of thermal characteristics (impact on weapons system reliability, cook-off, sustained rate of fire rating, etc.) and thermal signature management (heat dissipation, thermal barriers, thermal wraps, etc.) are critical to system performance and soldier effectiveness.
- Traditional thermal characterization methods for predicting things like bore surface temperatures can be sensitive to installation techniques, may be limited to locations and depths of measurement, can be limited in dynamic response behavior, and can typically only provide pin point measurements making it almost impossible to determine real time temperature gradient fluctuations.
- The request for information will demonstrate the offeror's basic understanding of the problem, provide a discussion of how the offeror would attack the problem, and include recent advances in technology that address the requirement.

JSSAP CONTACT INFO:
usarmy.pica.futures-cmd.mbx.jssap@army.mil

CHALLENGE STATEMENT

Small Arms Task(s) Addressed: ENGAGE THREATS WITH SMALL ARMS VOLUME FIRE, ENGAGE THREAT PERSONNEL WITH PRECISE SMALL ARMS FIRE, OPERATE AND MAINTAIN WEAPONS

Technology Investment Area: ADVANCED RIFLING, MATERIALS, COATINGS, AND PROCESSING FOR BARRELS

Background/Problem Statement:

- The Joint Service Small Arms Program (JSSAP) Office is seeking information on advanced barrel technologies including advanced rifling techniques, novel materials and coatings (ferrous/non-ferrous / chrome alternatives), and/or unique manufacturing processing methods with direct application to legacy and future weapon systems.
- Proposal shall identify unique attributes that will improve accuracy and dispersion, inhibit the erosion of the bore surface, and extend overall barrel life.
- Proposals shall include discussion of past-experience with the barrel manufacturing.
- Whitepaper proposal should indicate scalability towards future 6.8mm weapons that push the current bounds of pressures, temperatures, and muzzle velocities.
- The request for information will demonstrate the offeror's basic understanding of the problem, provide a discussion of how the offeror would attack the problem, and include recent advances in technology that address the requirement.

JSSAP CONTACT INFO:
usarmy.pica.futures-cmd.mbx.jssap@army.mil

CHALLENGE STATEMENT

Small Arms Task(s) Addressed: OPERATE AND MAINTAIN WEAPONS

Technology Investment Area: ADVANCED SURFACE TREATMENTS

Background/Problem Statement:

- The Joint Service Small Arms Program (JSSAP) Office is seeking information on advanced surface treatment technologies applicable to legacy and future small arms weapons systems.
- The objective of this proposed investigation is to identify permanent surface treatments with the ability to maximize weapon system Operational Availability (Ao). Successful technologies (and supporting processes) shall concurrently advance weapon systems reliability, availability and lessen required maintenance and repairs.
- Efforts should include all technologies, materials, surface treatments and supporting processes capable of enhancing operational system performance.
- Successful surface treatment technologies shall eliminate the need for conventional liquid lubricants.
- In parallel, candidate technologies should prevent corrosion and other negative effects of water and salt-spray on the weapon and ammunition systems (including ancillary equipment) when systems are deployed in wet environments or aboard ships and boats.
- Prototype technology threshold requirements shall include provisions that the candidate treatment be capable of permanent application on metal substrates and that application processes can be optimized for performance and concurrently demonstrated as feasible with respect to treatment processing costs.
- Objective requirements demonstrate the ability to operate at temperatures above 400 °C.
- The request for information will demonstrate the offeror's basic understanding of the problem, provide a discussion of how the offeror would attack the problem, and include recent advances in technology that address the requirement.

JSSAP CONTACT INFO:
usarmy.pica.futures-cmd.mbx.jssap@army.mil

CHALLENGE STATEMENT

Small Arms Task(s) Addressed: ENGAGE THREAT PRESONNEL WITH PRECISE SMALL ARMS FIRE

Technology Investment Area: BARREL BORE CHARACTERIZATION AND PERFORMANCE CORRELATION

Background/Problem Statement:

- Existing barrel wear testing is too basic to understand the complex wear mechanics.
- Advanced in barrel wear material analysis and characterization has just started making its way into small caliber barrel testing.
- Barrel wear analysis tools developed for large caliber are too complex and time consuming for rapid turn small caliber systems.
- Thermo-chemical experimentation on barrel samples involves measuring material properties, analyzing effects of maximum surface temperature and propellant chemical interactions.
- Modeling involves understanding interior ballistics and thermal-mechanical interaction with the barrel.
- Full scale barrel testing does not identify and characterize wear mechanisms.
- State of the art advancement of this technology will demonstrate the development of tools and processes that better characterize wear mechanisms with simpler methodology than has existed in the past for large caliber systems.

JSSAP CONTACT INFO:
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CHALLENGE STATEMENT

Small Arms Task(s) Addressed: AVOID DETECTION CAUSED BY WEAPON SIGNATURE

Technology Investment Area: SUPPRESSOR THERMAL MANAGEMENT

Background/Problem Statement:

- Suppressors absorb tremendous amounts of heat from the propellant gases due to their high surface area, gas velocity and turbulent flow.
- Managing or mitigating this high heat load is important because it can affect structural integrity, weapon operation and cycling rates, mirage, and increase thermal signature.
- Having effective ways to manage and/or reduce the overall heat load is critical to improving suppressor operation and signatures.
- Methods to cool suppressors and dissipate heat loads have been tried in the past with some success.
- Ways of masking the heat load and managing the thermal signature have also been tried.
- Reducing the heat transfer from the propellant gases to the suppressor has also been tried by attempting to reduce turbulence levels and reducing overall surface area inside the suppressor. Unfortunately this is typically at the expense of increases in sound and flash.
- Innovations in how to better manage thermal effects will take into account how to balance overall system performance while reducing deleterious effects thermal load.

JSSAP CONTACT INFO:
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CHALLENGE STATEMENT

Small Arms Task(s) Addressed: ENGAGE THREAT PRESONNEL WITH PRECISE SMALL ARMS FIRE

Technology Investment Area: BARREL BORE CHARACTERIZATION AND PERFORMANCE CORRELATION

Background/Problem Statement:

- The Joint Service Small Arms Program (JSSAP) Office is seeking information on small caliber barrel inspection equipment to verify manufacturing capability and to ensure items are created to the required specification.
- Requested equipment should provide high resolution inspection capabilities for assessment of gun barrel conditions (bore erosion profiling, dimensional measurements, optical images, surface roughness, etc) and should include advanced analysis and reporting features.
- The request for information will demonstrate the offeror's basic understanding of the problem, provide a discussion of how the offeror would attack the problem, and include recent advances in technology that address the requirement.

JSSAP CONTACT INFO:
usarmy.pica.futures-cmd.mbx.jssap@army.mil

CHALLENGE STATEMENT

Small Arms Task(s) Addressed: OPERATE AND MAINTAIN WEAPONS

Technology Investment Area: WEAR INDICATOR EMBEDDED SENSORS

Background/Problem Statement:

- The Joint Service Small Arms Program (JSSAP) Office is seeking information for the development of sensor hardware for the purposes of tracking weapon life due to barrel and component wear.
- Currently weapon life is based on visual inspection, testing of weapon performance, and/or estimates of how many rounds have been fired. Sensors embedded into the weapon, barrel, or components can change these qualitative analyses to quantitative.
- The information should demonstrate knowledge of capabilities and limitations of employed sensors due to extreme operating conditions.
- Technology should be able to be incorporated in legacy and future weapon systems, but shall focus on embedded sensors for future weapon systems for incorporation during production.
- Sensors shall capture data while weapon is being utilized for predictive analysis on weapon performance and failure modes needed for maintainability and sustainability.
- The request for information response will demonstrate the offeror's basic understanding of the problem, provide a discussion of how the offeror would attack the problem, and include recent advances in technology that address how sensors embedded in weapon systems would be accomplished. A rough schedule and cost is for information only.
- No offers or responses to this RFI should be expected by the offeror and is only for internal information to the government in program planning.

JSSAP CONTACT INFO:
usarmy.pica.futures-cmd.mbx.jssap@army.mil

GUN IQ

International LLC

LONG LIFE GUN BARREL TESTS



George E. Kontis
October 19, 2021

Approved for public release by Gun IQ International LLC

GUN IQ

International LLC

HISTORY

* 2018 PAPER –SUPERIOR GUN BARREL MATERIALS
  * METALLURGICAL DATA/ LAB TESTING
  * GKH & ARMAD—PRODUCED BY AUBERT & DUVAL
* 2020/2021--LIVE FIRE TESTING—60 K rounds
  * CONTROL SAMPLE—Mil-B-11595 (41V45)
* TEST RESULTS

AUBERT&DUVAL

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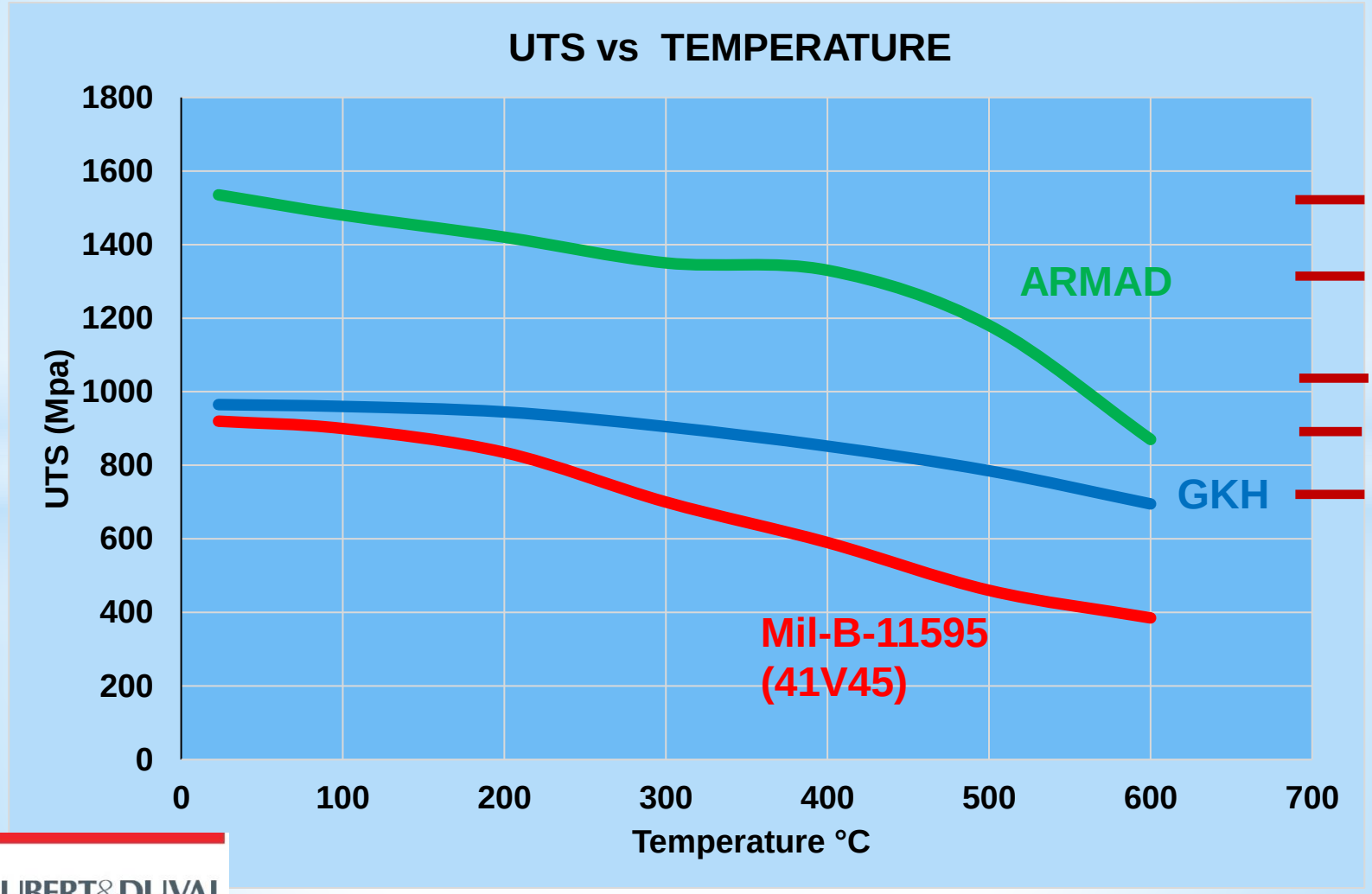
CHEMICAL COMPOSITION

Analysis	C	Cr	Mo	S	P	Si	Mn	V	Ni
GKH	0.325	3.00	1.00	0.007	0.008	0.300	0.550	0.300	0.080
ARMAD	0.325	3.00	1.00	0.001	0.005	0.169	0.217	0.300	0.080
CrMoV Mil-B-11595	0.450	0.970	0.350	0.040	0.040	0.270	0.700	0.250	---

AUBERT&DUVAL

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HOT HARDNESS



AUBERT&DUVAL

Approved for public release by Gun IQ International LLC

Capt. Robert W. Landies III, USMCR
Vice President of Manufact

GUN IQ International LLC

TEST EQUIPMENT

M240—7.62mm Machine Gun

Ohio Ordnance Works

- ✓ **ESTABLISHED BACKGROUND IN M240 PRODUCTION**
- ✓ **MIL-SPEC TEST PROCEDURES:**

TEST BARRELS:

ARMAD: HRC 40

GKH: HRC 28

Mil-B-11595: HRC 30

BUTTON RIFLED
BORES: HARD CHROME



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TEST PARAMETERS

Endurance firing schedule: MIL-DTL-63314

* 250 rds./barrel—air cool
* Measurements/Data at 1250 rds.
* Fixed mount
* Ball ammunition



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FAILURE CRITERIA

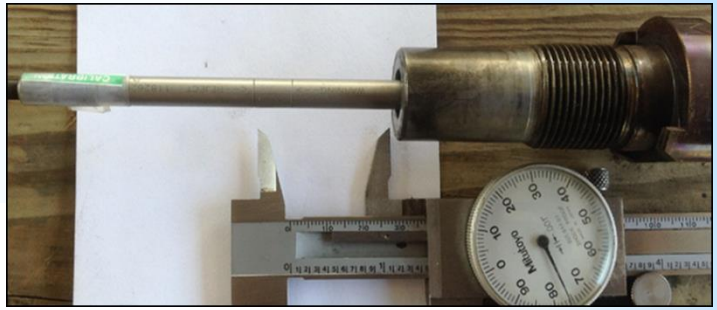
If one of the following occur- barrel has failed:

1. Muzzle Velocity: Drop below 200 ft./sec from new barrel measurements
2. Stability: 20 % of rounds with yaw of 15˚or more
3. Extreme spread exceeds 30 cm



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GAGES





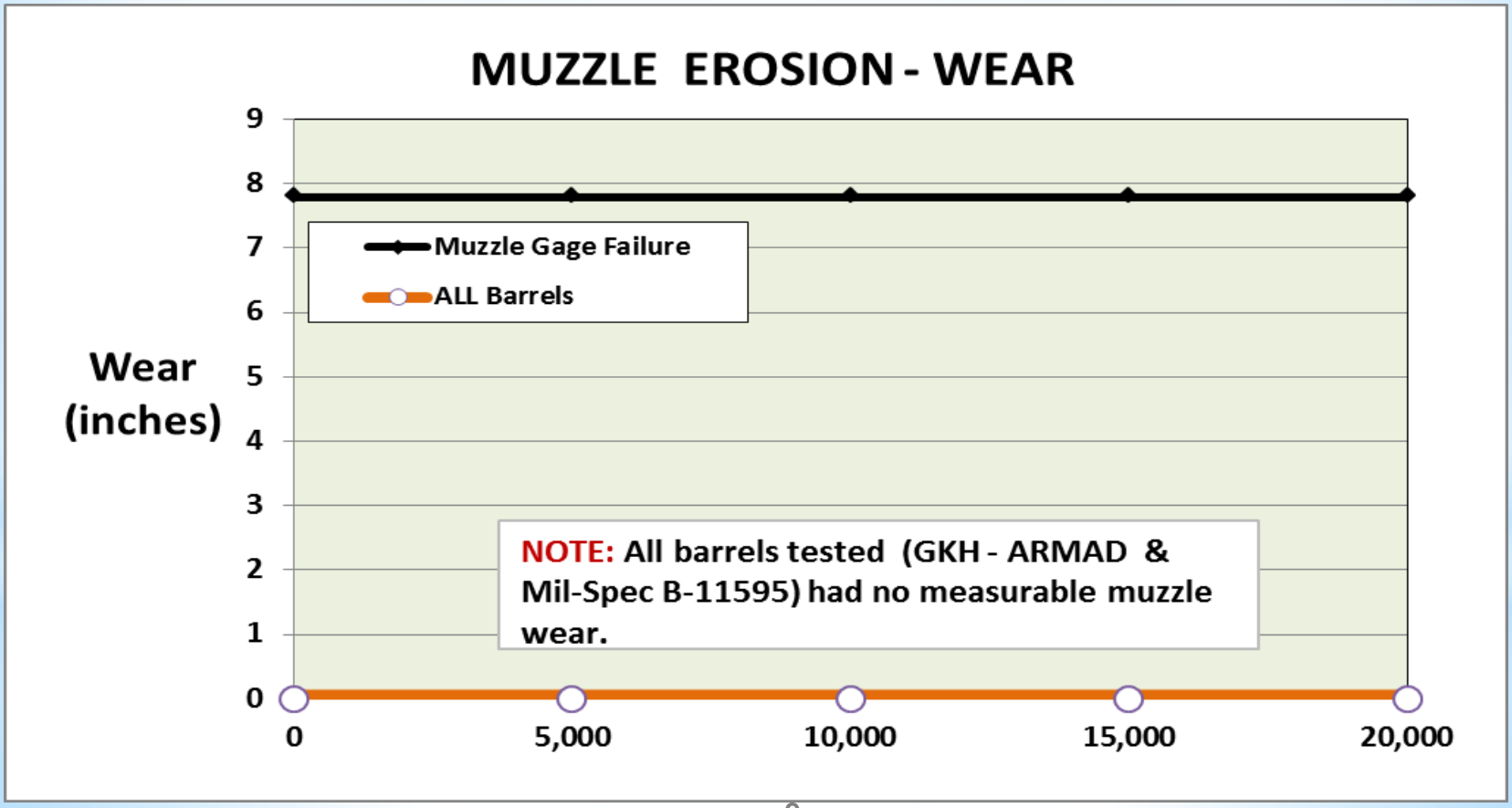
THROAT EROSION GAGE P/N 11816276

BORE EROSION GAGE P/N 11816298

MUZZLE EROSION GAGE P/N 11816276

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MUZZLE WEAR

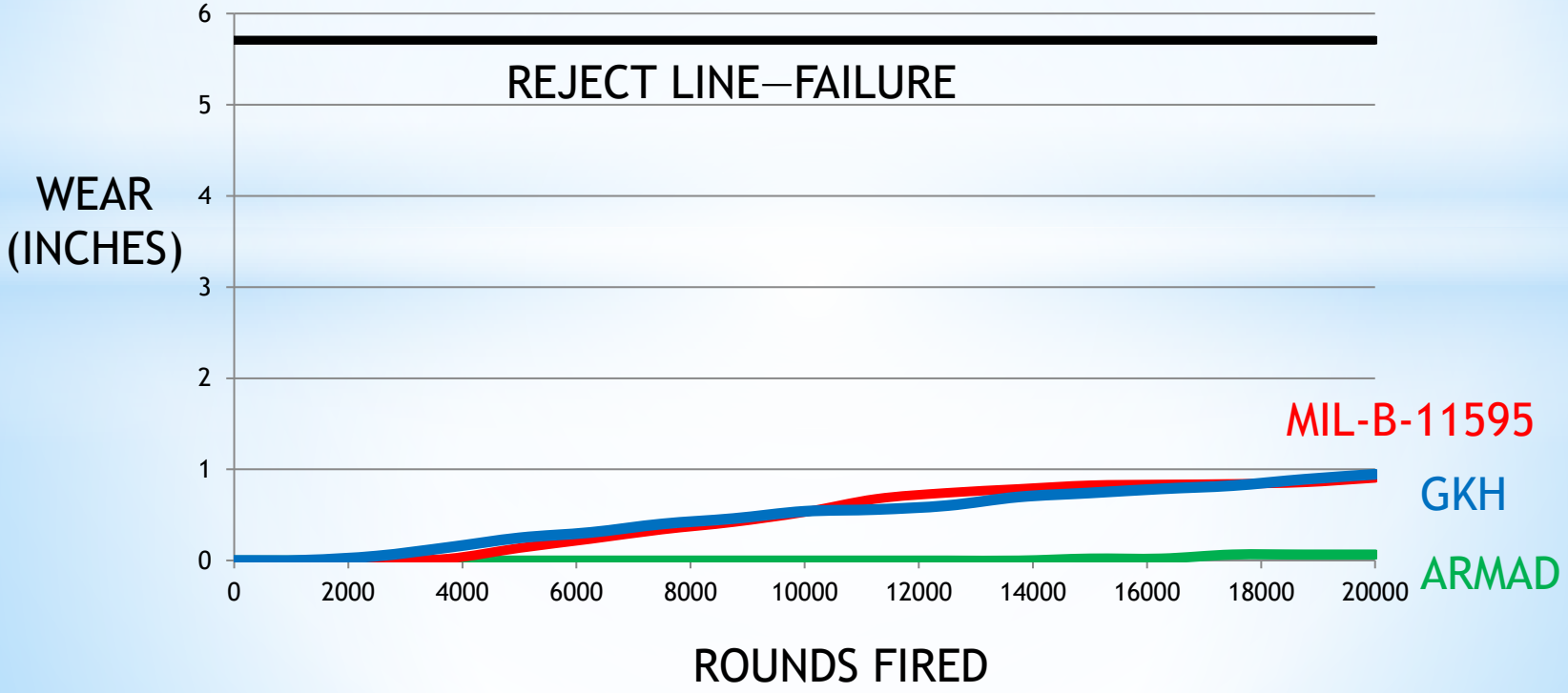


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THROAT WEAR

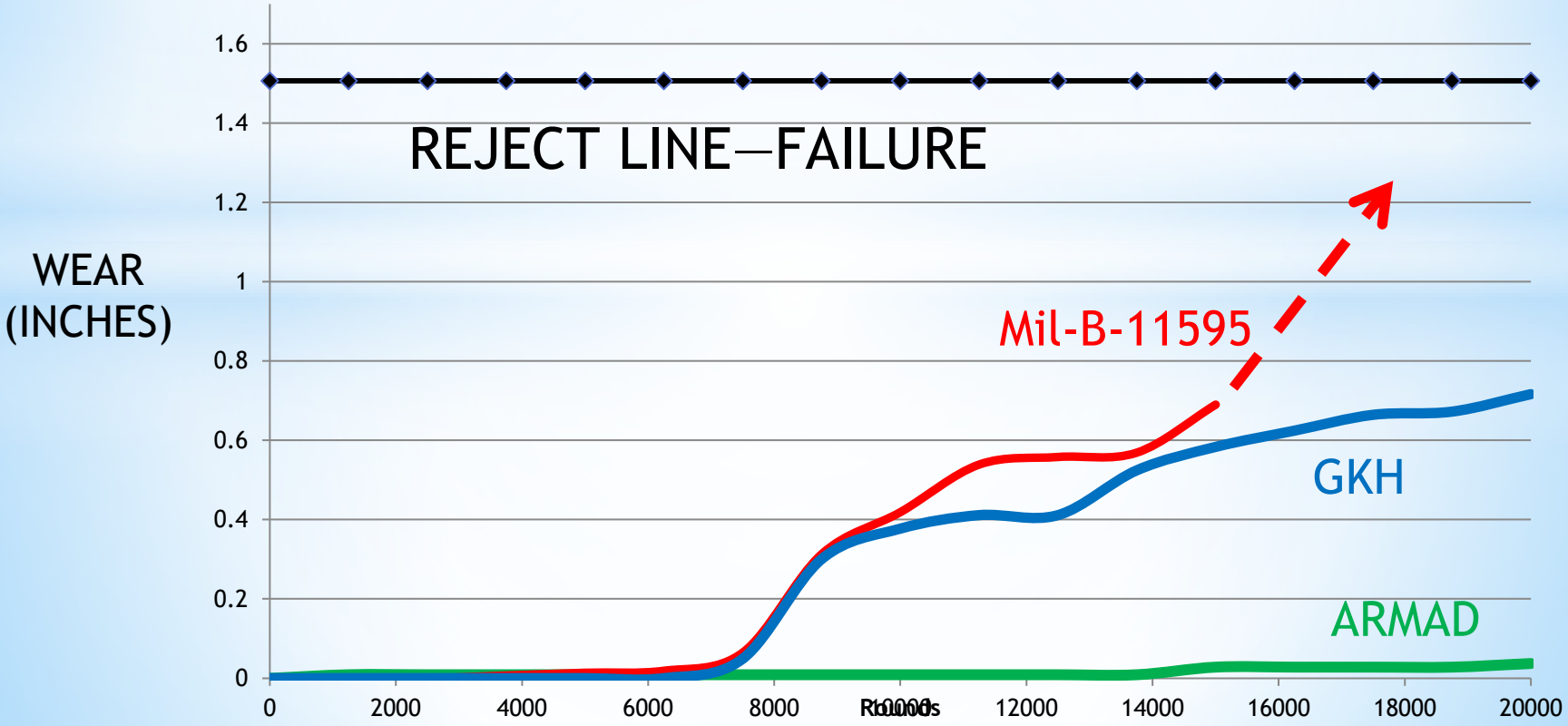


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BREECH WEAR





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MIL-DTL-6331 CRITERIA

AT 15K ROUNDS:
ALL BARRELS WITHIN SPEC
⚠ YAW— 10% >15° MIL-B-11595

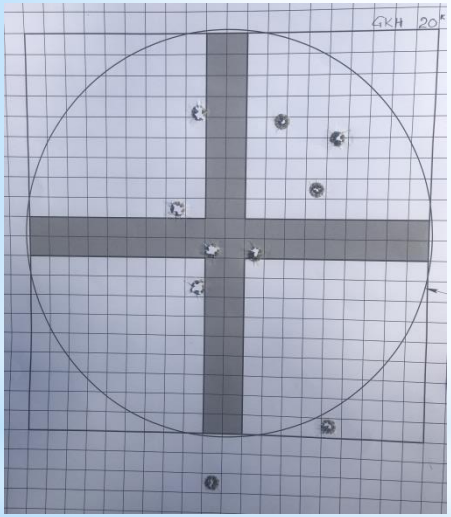
AT 20K ROUNDS:
ARMAD and GKH WITHIN SPEC
YAW— 20% >15° MIL-B-11595—FAILURE

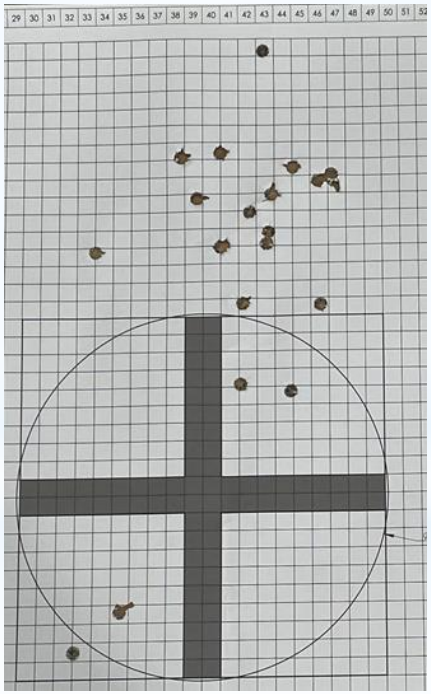
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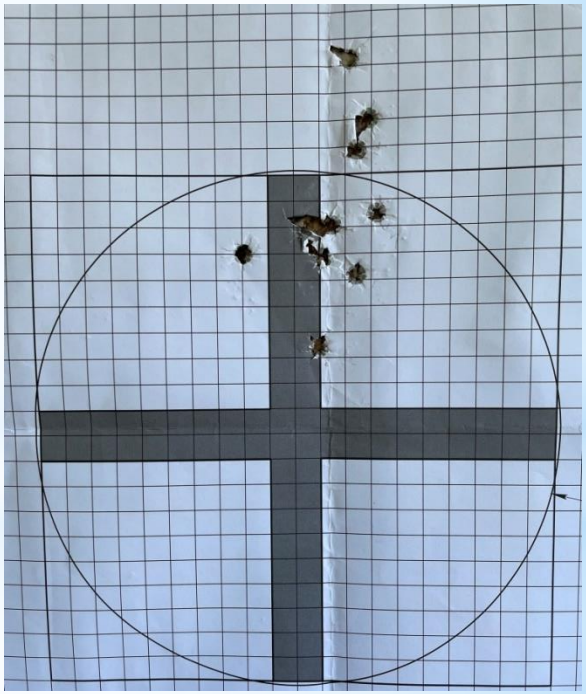
TARGETS

GKH—20K



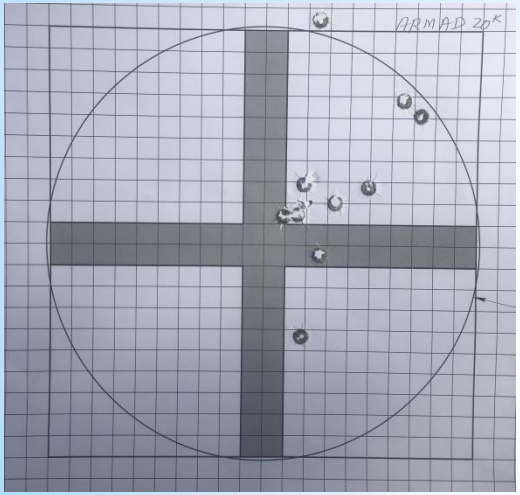


15K



20K

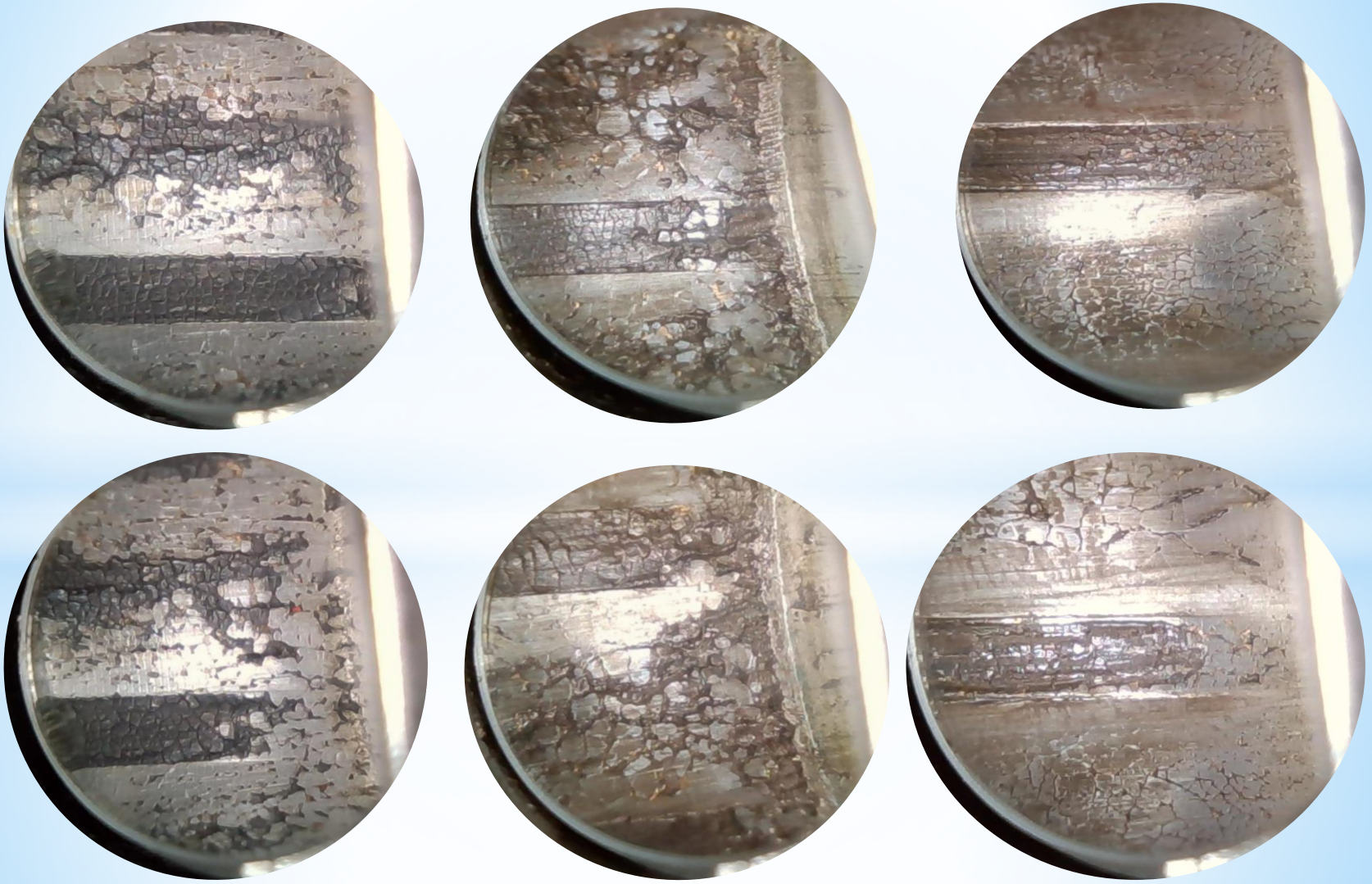
MIL-B-11595



ARMAD—20K

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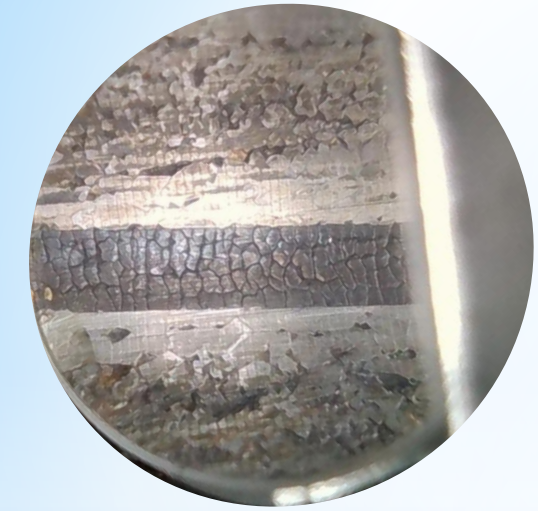
THROAT

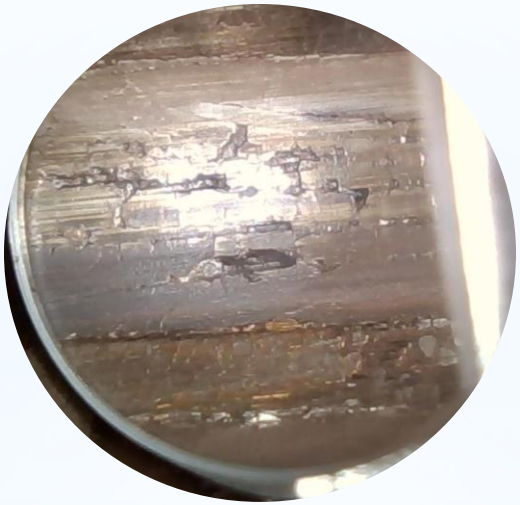


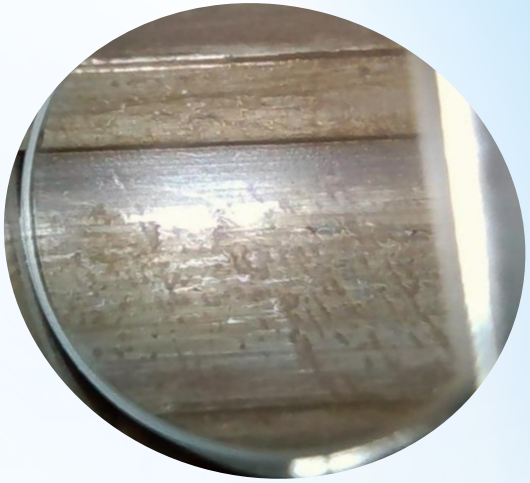
Mil-B-11595 GKH ARMAD

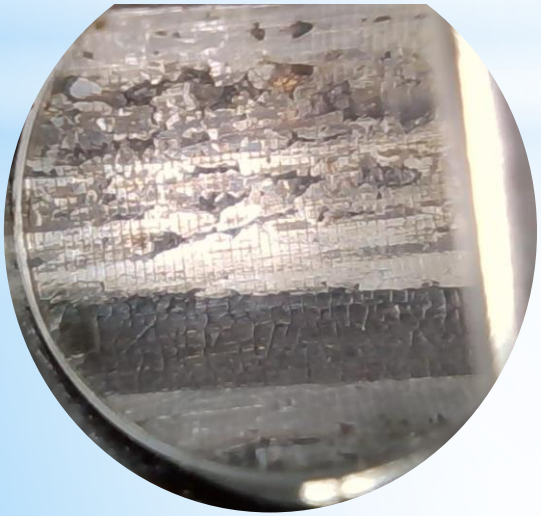
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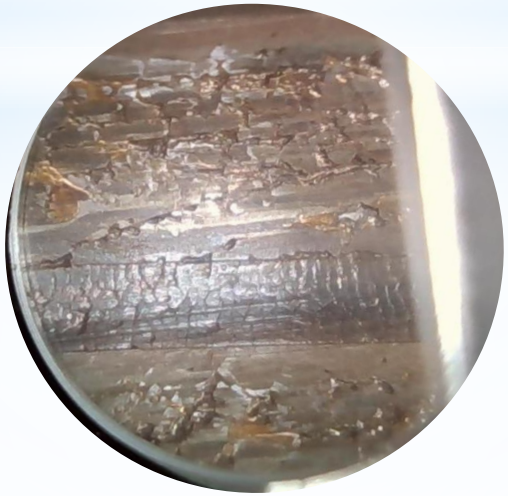
THROAT + 25mm

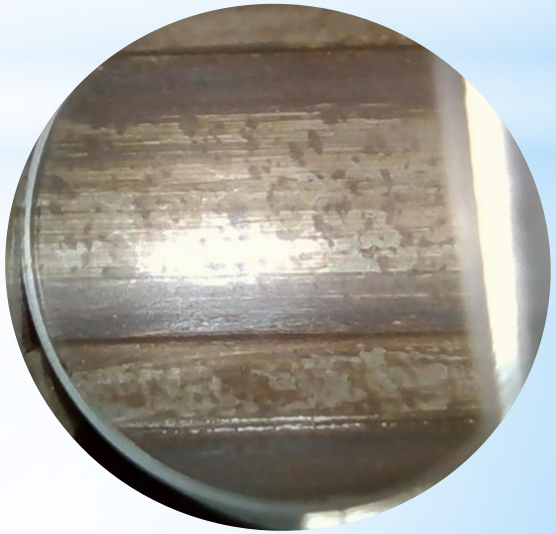












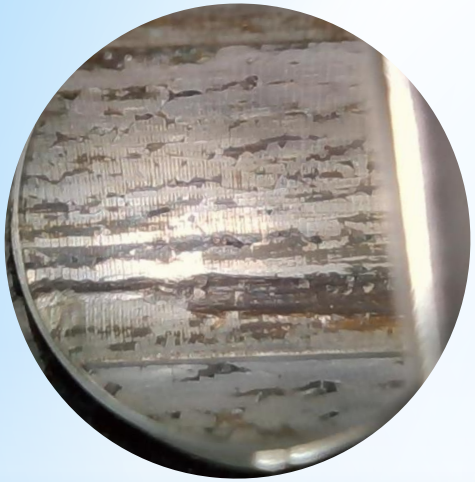
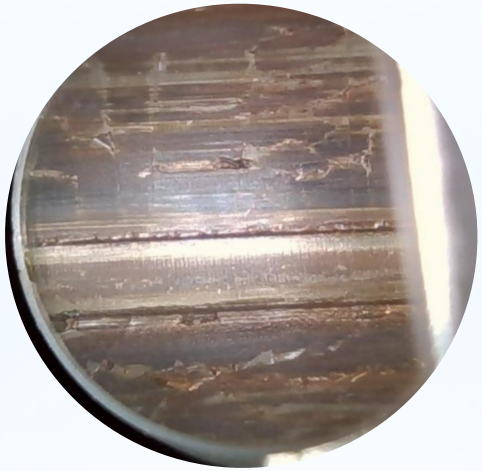
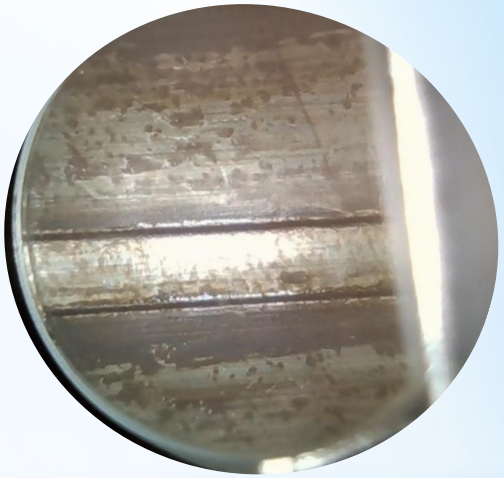
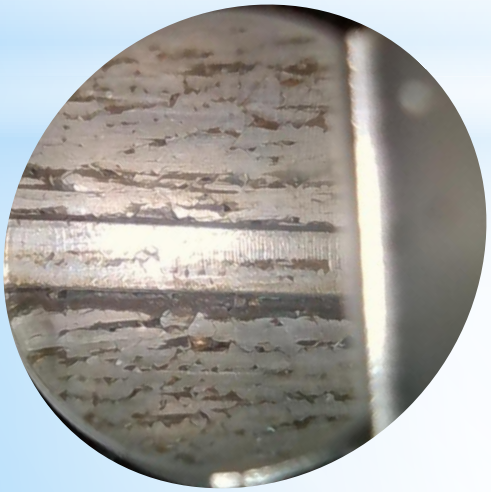
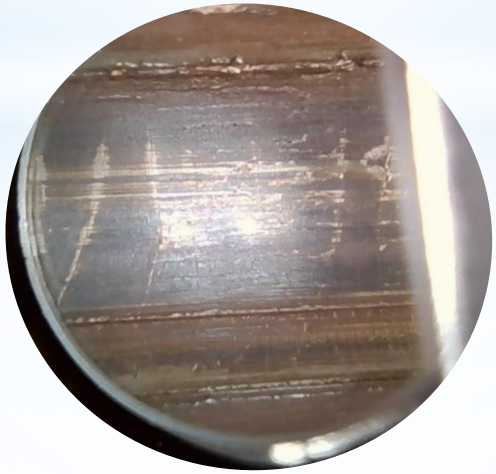
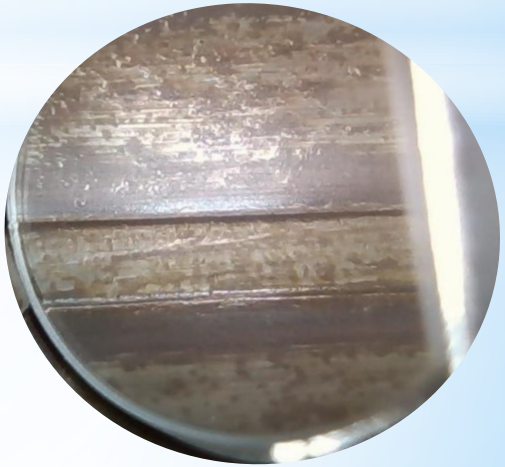
Mil-B-11595

GKH

ARMAD

Approved for public release by Gun IQ International LLC

THROAT + 50 mm

Mil-B-11595 GKH ARMAD

Approved for public release by Gun IQ International LLC

GUN IQ
International LLC

CONCLUSIONS

1. ARMAD GIVES SUBSTANTIAL INCREASE IN BARREL LIFE
2. BARREL MANUFACTURE ROCKWELL C—40'S BY BUTTON, CUT
3. AMEND MIL SPEC TO INCLUDE BETTER MATERIALS
4. BORE GAGES NOT PRACTICAL FOR FIELD BARREL LIFE DETERMINATION

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GUN IQ
International LLC



CREDITS

- OHIO ORDNANCE WORKS
- US NAVY
- FCIP



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GUN IQ International LLC

BORE CONDITIONS



Chamber pressure 50,000-60,000 psi.

Projectile velocity 3,000 f/s

Gas velocity 4100 f/s

Gases: H_2S, NH_3, Methane

H_2O, CO_2 , CO

Gas Temperature: 3000 °-4600°F

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GUN IQ

International LLC



October 1948

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International LLC

FURTHER STUDY

- ACCURATE BORE MEASUREMENTS—BEMIS
- ADDITIONAL TESTING—ARMAD & GKH
- BARREL LIFE WITH TRACERS INCLUDED
- HOT FIRING SCHEDULE
- NITRIDED vs CHROME vs UNCHROMED
- NEXT GENERATION ARMAD

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International LLC

QUESTIONS?

George E. Kontis
Gun IQ International LLC

321-607-2965
GunIQinternational@gmail.com



Damascus barrel Study --1955



Gun IQ International: Providing engineering, testing and marketing services to the firearms industry since 1948

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TIP Technologies, Inc.
The difference between surviving and thriving

Presented by:
Mike Miller, Founder & CEO

Future Force Capabilities Conference

Integrated Quality Management Reduces Risk for Armament, Robotic, and Munitions Manufacturers





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The Benefits of an Integrated QMS

- Real-time Access to Quality and Manufacturing Data
- Control Over User Access
- Automate Critical Quality Processes
- Gain Visibility into Costs
- Effectively Collaborate with Suppliers
- Ensure Operational Excellence throughout Product Lifecycle
- Create a controlled environment where performance is repeatable and reliable.

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Facilitate Industry Compliance

- Compliance Auditing to Regulatory Standards
  - Facilitate compliance with many regulatory requirements including ISO, ITAR, DFARS, FAA, AS9100D, MIL Standard.
  - Measure against your established processes and procedures
  - Using **a** QMS with supplier management capabilities**,** customers can effectively demonstrate compliance

AS9100D CERTIFIED ISO 9001

DEPARTMENT OF DEFENSE DFARS Compliant UNITED STATES OF AMERICA

FEDERAL AVIATION ADMINISTRATION

MIL-SPEC

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Streamline Quality Inspections

- Source Inspection
  - Validate compliance with engineering drawings
  - Test castings and forgings before firearm or robotic production begins
- First Article Inspection
  - Test components against industry regulations
- Receiving Inspection
  - Inspection steps can be revised and approved at the part number, part group, and commodity level
  - Skip lot processing can be completed at the part/operation level

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Supply Chain Challenges

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Supplier Ratings Address these Challenges

- Inadequate or Totally Lacking Supplier Rating System
- Adversarial Relationship with Suppliers
- Non-Objective Supplier Evaluation/Rating
- Paper-based Supplier Report Cards
- Inclusion of Supplier Caused Production Assembly Failures into Supplier's Rating
- Inclusion of PO Delivery concepts prior to actual delivery
- Sub-tier Supplier Management
- Uncovers performance trends & helps Identify Root Cause

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Calculating Supplier Rating

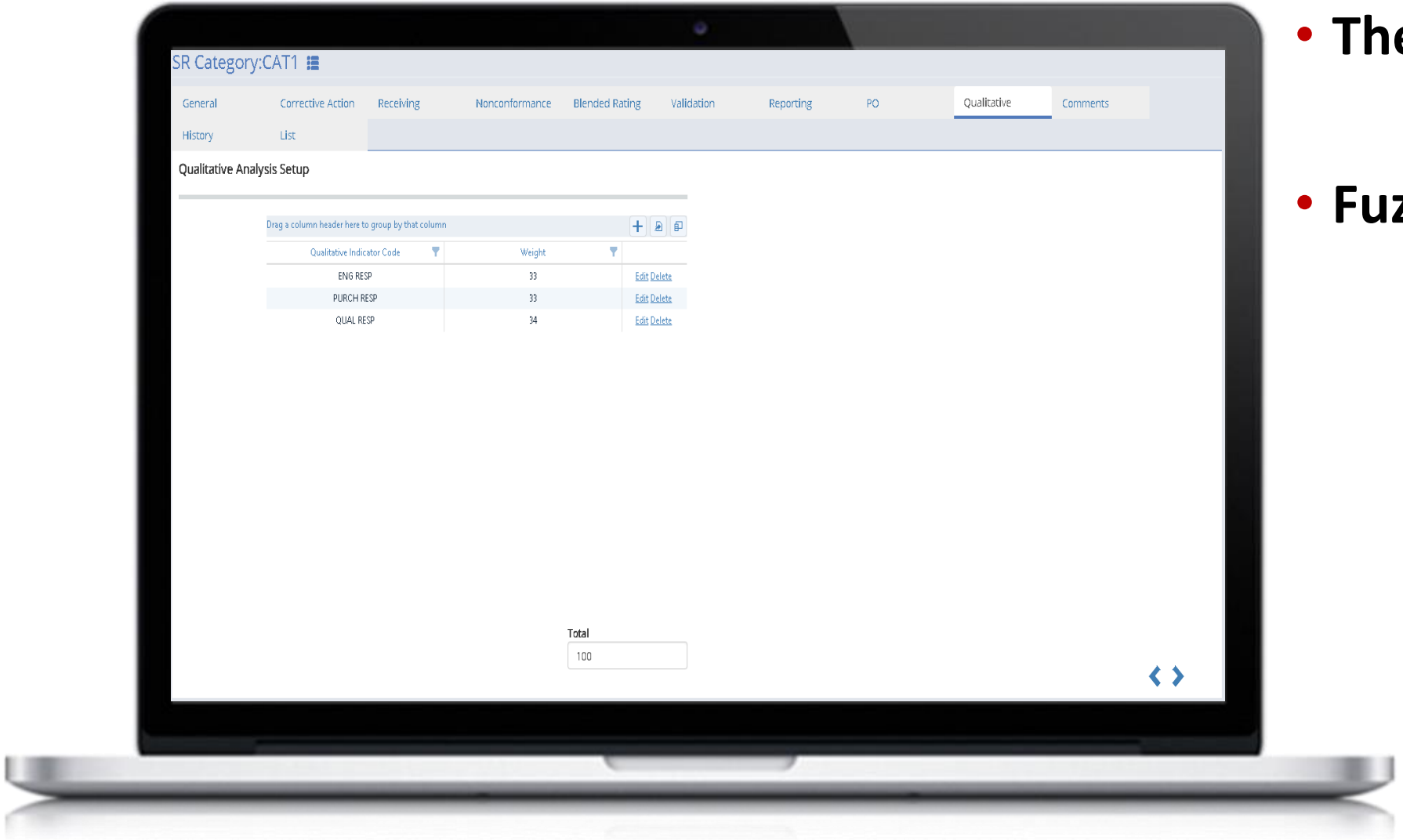
Understanding the individual components, how they are calculated, and how they can potentially impact the blended ratings is critical to effective supplier quality management.

The following ratings can be considered and blended into a unified rating which can communicate the overall health of the supplier both internally and externally, as desired.

- Delivery Rating
- Receiving Inspection Quality Rating
- Nonconformance Rating
- Corrective Action Rating

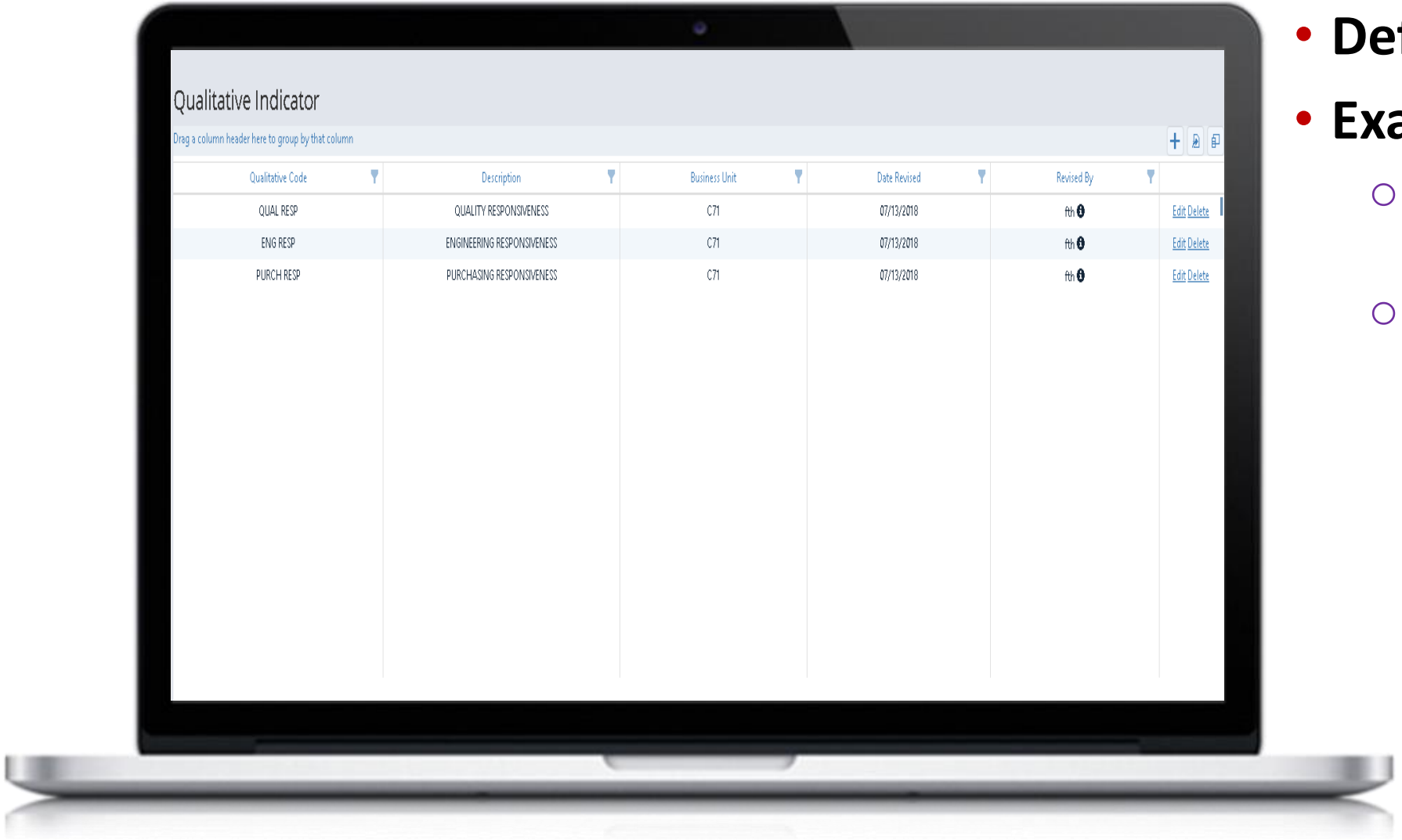
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Qualitative Ratings



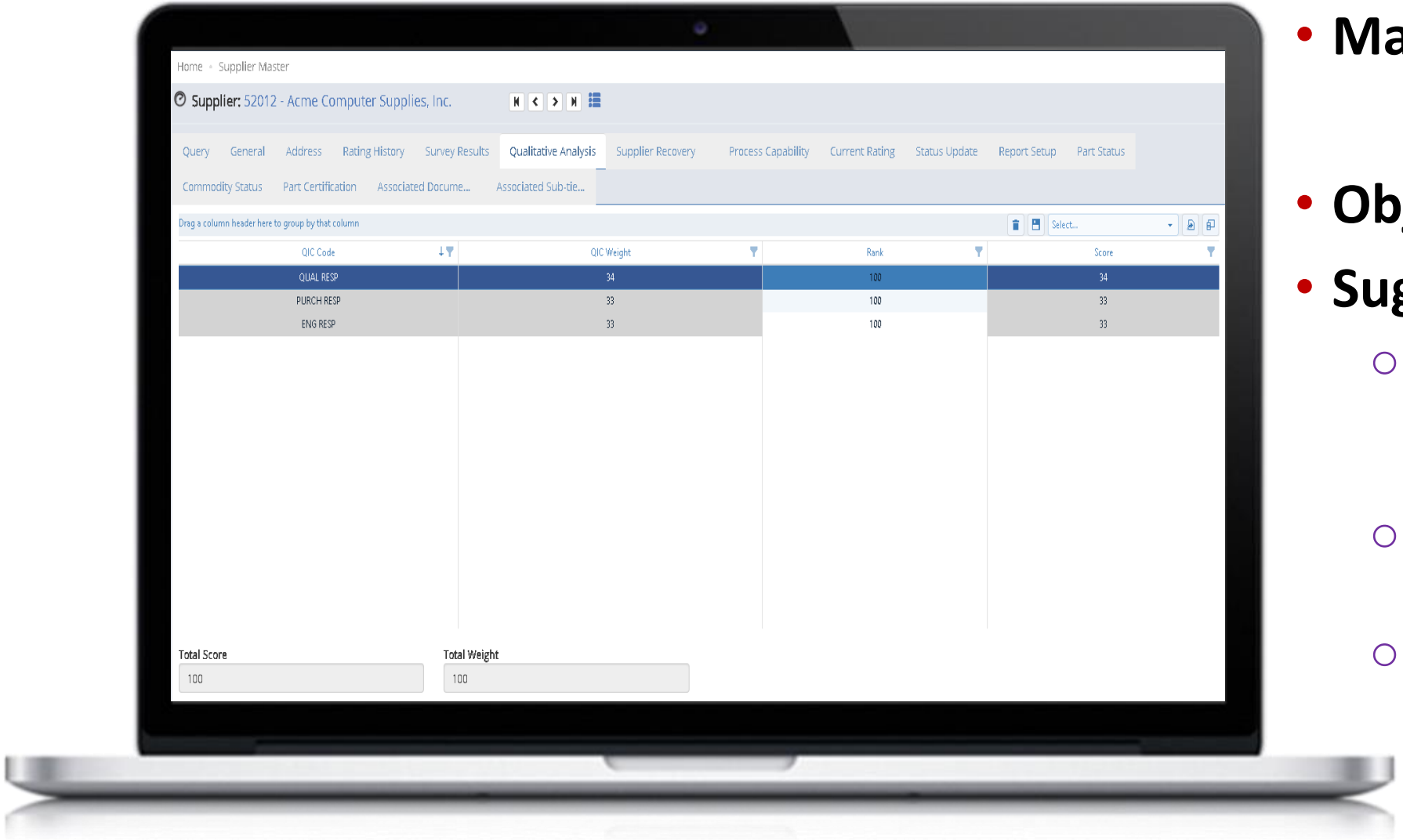
- The “feel good” metrics
- Fuzzy logic

Qualitative Indicators



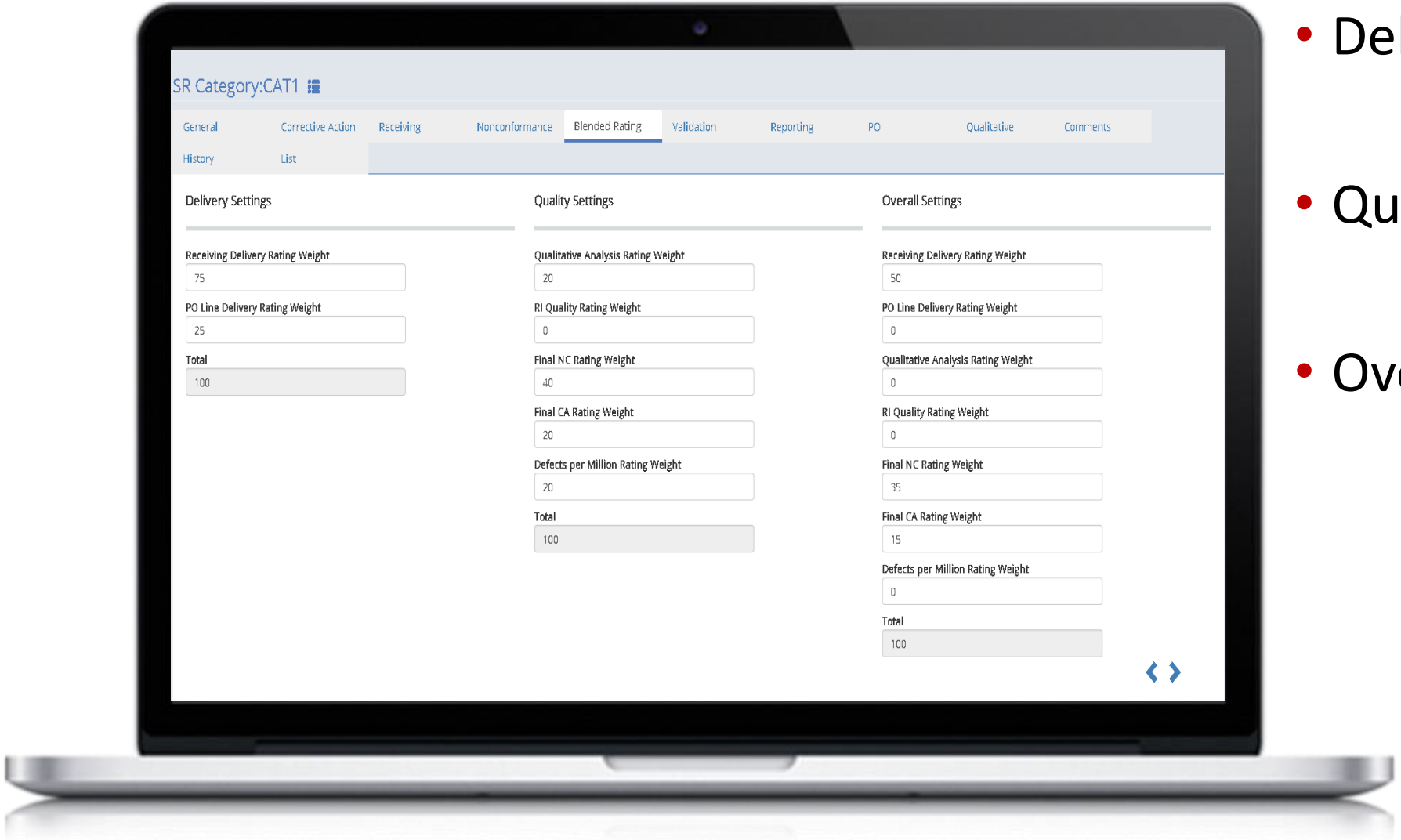
- Defined by you
- Examples:
  - Engineering Responsiveness
  - RFQ Responsiveness

Qualitative Analysis



- Manual process
- Objective evidence?
- Suggestion
  - Utilize AM with a type linked to each of your Qualitative Indicators
  - Leverage the score as your input here.
  - Maybe average several?

Blended Ratings



- Delivery Blending
- Quality Blending
- Overall Blending

Genealogy/Configuration Management

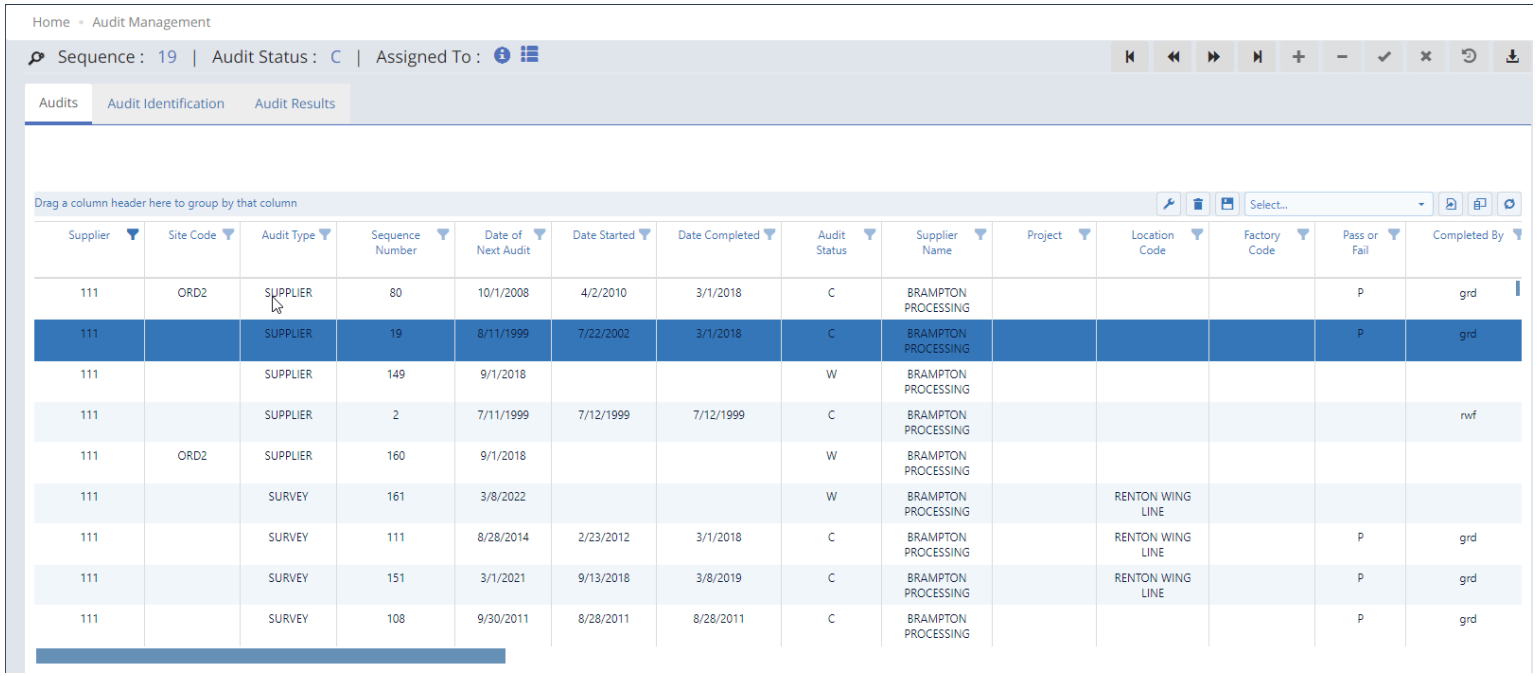
- Enforcement of Requirements
  (Serial Number, Lot Code, UID, etc.)
- Ensure All Issues are Resolved Before Product Release
  - All inspections completed
  - All Nonconformances resolved
  - All deviations approved
- Ability to Rapidly Identify Suspect Material for Recalls



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Audit Management

- Enables electronic supplier self audits and surveys
- Displays audit list and results for supplier audits completed internally and by the supplier
- Only audits pertinent to the specific supplier are displayed



Supplier	Site Code	Audit Type	Sequence Number	Date of Next Audit	Date Started	Date Completed	Audit Status	Supplier Name	Project	Location Code	Factory Code	Pass or Fail	Completed By
111	ORD2	SUPPLIER	80	10/1/2008	4/2/2010	3/1/2018	C	BRAMPTON PROCESSING				P	grd
111		SUPPLIER	19	8/11/1999	7/22/2002	3/1/2018	C	BRAMPTON PROCESSING				P	grd
111		SUPPLIER	149	9/1/2018			W	BRAMPTON PROCESSING					
111		SUPPLIER	2	7/11/1999	7/12/1999	7/12/1999	C	BRAMPTON PROCESSING					rwf
111	ORD2	SUPPLIER	160	9/1/2018			W	BRAMPTON PROCESSING					
111		SURVEY	161	3/8/2022			W	BRAMPTON PROCESSING		RENTON WING LINE			
111		SURVEY	111	8/28/2014	2/23/2012	3/1/2018	C	BRAMPTON PROCESSING		RENTON WING LINE		P	grd
111		SURVEY	151	3/1/2021	9/13/2018	3/8/2019	C	BRAMPTON PROCESSING		RENTON WING LINE		P	grd
111		SURVEY	108	9/30/2011	8/28/2011	8/28/2011	C	BRAMPTON PROCESSING				P	grd

Manage Your Supply Chain

An effective QMS will allow you to map your supply chain by giving you the ability to indicate primary and sub-tier supplier relations.

This provides the ability to build a standardized approach to managing supplier information.

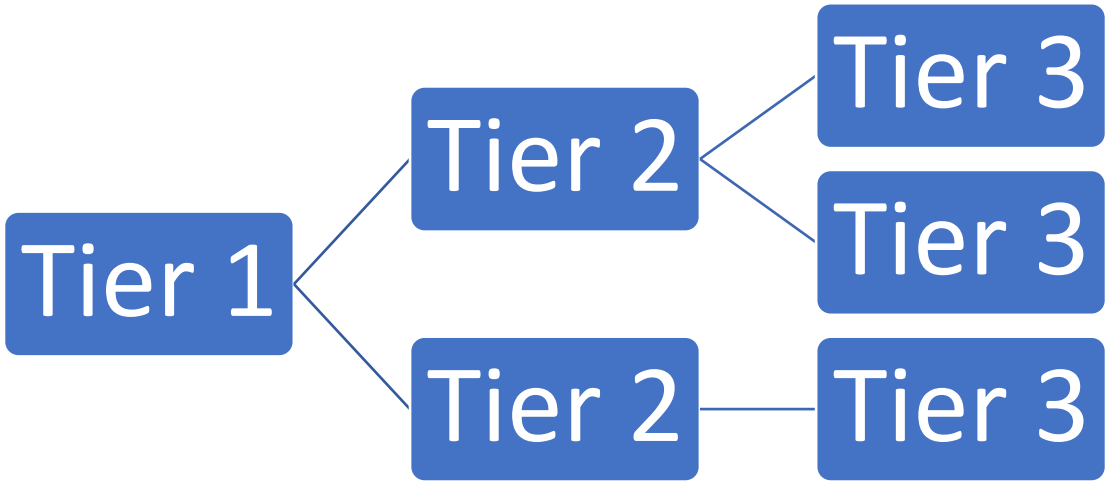


Easily Identify and Categorize Suppliers
Authorized Distributor
Franchised Distributor
Independent Distributor
Open Market
OCM/OEM

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Effective Supply Chain Quality

- Manage the Entire Supply Chain
  - Delivery
  - Price
  - Quality
- All Levels
  - Tier 1 Suppliers
    - Suppliers to Tier 1 "N" Tier
  - Tier 2 Suppliers
    - Supplier to Tier 1
    - Suppliers to Tier 2 "N" Tier
  - Tier 3 Suppliers
    - Suppliers to Tier 2
    - Suppliers to Tier 3 "N" Tier
  - And next level and beyond….



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Supplier Approvals & Certifications

- Supplier and N-Tier Capabilities
  - Approval Management
    - Supplier, Part, Commodity, Process Capability
    - Special Processes
  - Supplier Approval and Certification Supported by Audit Results
  - Supplier and Part Level Certification
  - Comprehensive ASL Approved Supplier List with Host Integration
  - Certified Parts management including automation
  - Inspection Planning

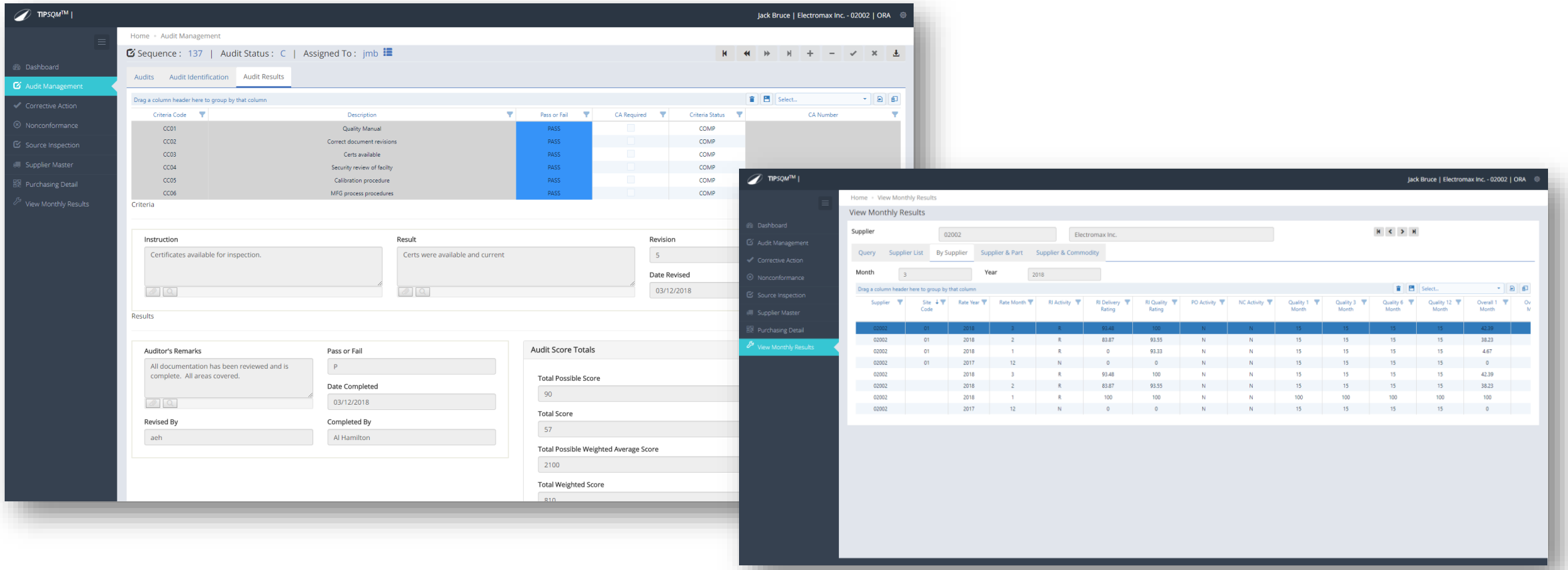
ERP Integration:

- Supplier Approval Status
- Part Certifications
- ASL Part Status
- Process Capabilities

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Benefits for Supplier

Interact/collaborate with supporting data and documentation



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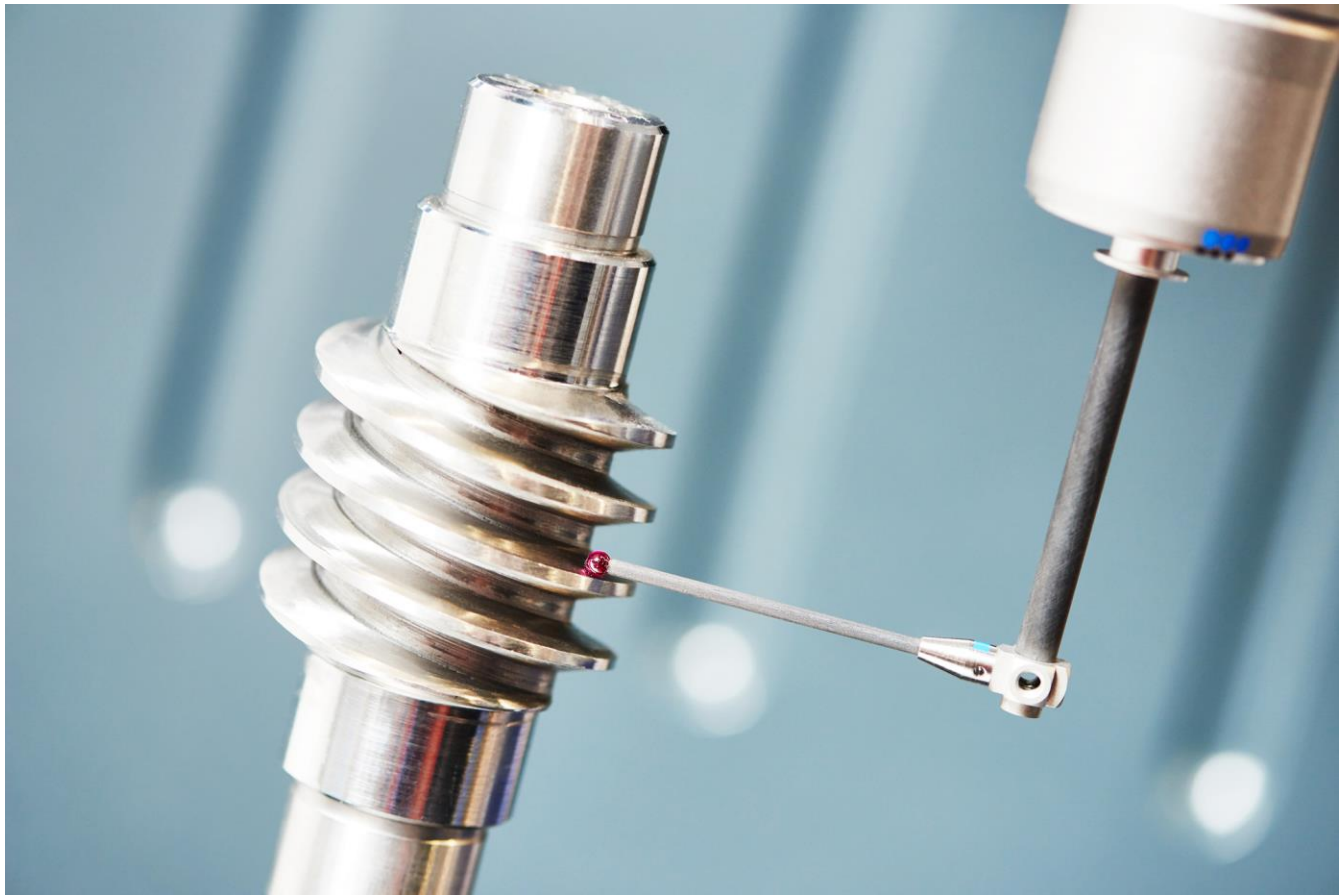
Standardize Workflow

- Statistical Process Control (SPC)
  - Categorize issues using measurable codes
  - Instantly react to variations
  - Identify Trends
- Eliminate Paper-based records
- Reduce scrap and rework

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Manage Tool Usage

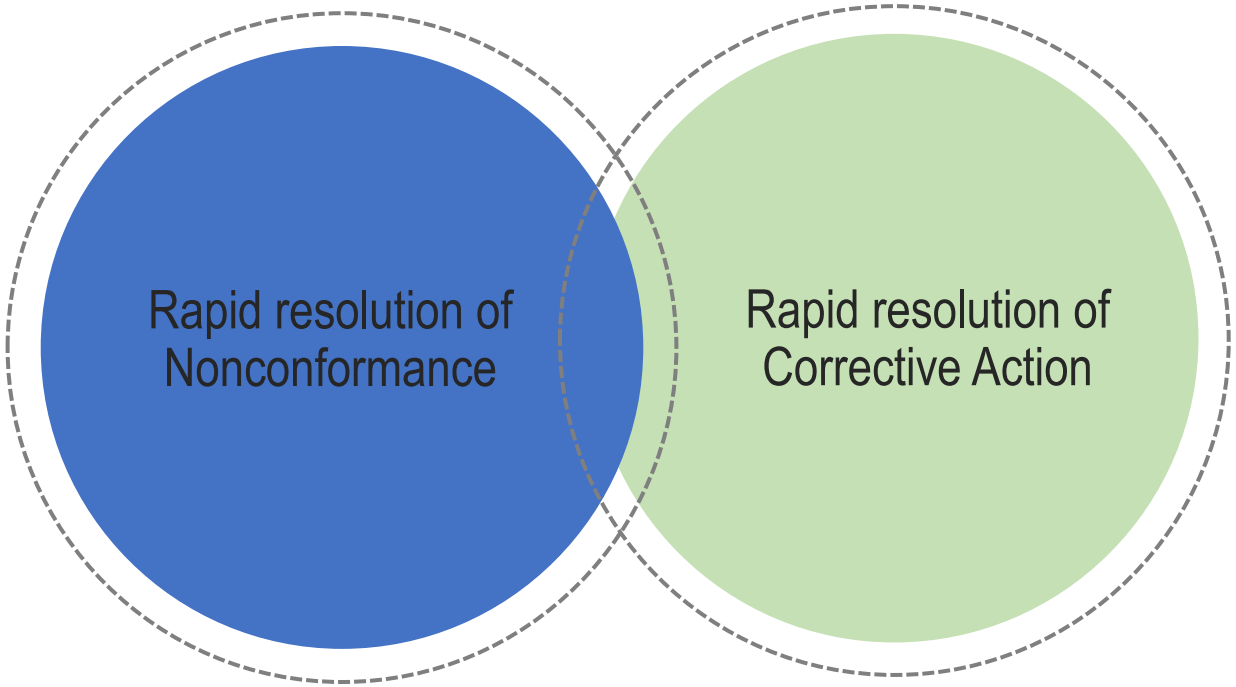
- Alert users about tools due for calibration
- Track possession of tools
- Automate calibration recall
- Reproducibility analysis
- Complete audit trail



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Achieve Real-time Collaboration Throughout the Supply Chain





Closed-loop CAPA process tracks issues from initiation through disposition and corrective action.

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Seamless ERP Integration

- Real-time access to quality and manufacturing data
- Supports real-time process control
- Provides the flexibility to respond quickly to changes in inventory levels, production status, and regulatory updates
- Reduces the complexity of multi-site infrastructure
- Actionable data and enhanced operational visibility allows better decisions across the enterprise

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Thank You!

For More Information Contact:

TIP Technologies

(262) 544-1211

www.tiptech.com

sales@tiptech.com

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MIM Frangible Energetic Projectiles For Medium Caliber Weapons

By:

Howard D. Kent, ADG, LLC

&

Robert Folaron, nP Technology, LLC

NOTE: Approved For Public Release

Contents:

3. Introduction
8. nP Technology Injection Molded Frangible Projectiles
9. Training, Target Marking And Special Purpose Applications
x. Molded Projectile Pathway Into The Future
x. Conclusions
x. Recommendations
x. Credits

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Introduction:

Advancing Training And Special Purpose Projectiles With Molded Projectile Technology

From

nP Technology, LLC

There Is A Better And More Versatile Way To Make These Than This…



(Fired And Unfired Traditional Target Practice Projectiles For Sale On The Internet)

NOTE: Approved For Public Release

Introduction:

Advancing Training And Special Purpose Projectiles With Molded Projectile Technology

From

nP Technology, LLC



Features: Molded In Al Windscreen, MIM Brass Base Cup & Integral Drive Band, nP Nano-Frangible Projectile Body With Solid, Energetic Or "Special" Fillers…

Benefits: Reduced Surface Danger Area, Low Ricochet Risk, Improved Accuracy, Lower Molded Technology Production Cost Per Round, Energetic Provides (4) Impact Effect; Auditory, Visual, Thermal, IR…



nP TECHNOLOGY

NOTE: Approved For Public Release

Introduction:

Colorado Springs, CO

Made In The USA



nP Technology LLC develops and manufactures small caliber projectiles in support of military, law enforcement, other government agencies, and commercial needs. **nP** specializes in rapid projectile R&D, developed and built on process-matched high volume molding systems, delivered ready-to-load.

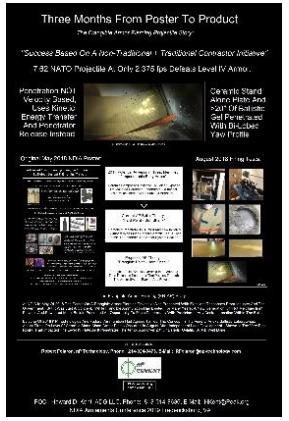
"Supporting Our Warfighters With Projectile Technology"

NOTE: Approved For Public Release

Introduction:



https://np-technology.com/



National Armaments Consortium Member: www.nptrf.com

US Army CCDC ARDEC ARL CRADA: Molded Projectile Technology
Armor Defeating FR-AP, Training, Energetic SOT, SRTA, Marking

NDIA Armaments, Small Arms, Guns & Missiles Committee Presenters

NOTE: Approved For Public Release

Introduction:

Questions:

Does The Medium Caliber Community Need Performance Enhancement Of Existing Target Practice And Special Purpose Ammunition?

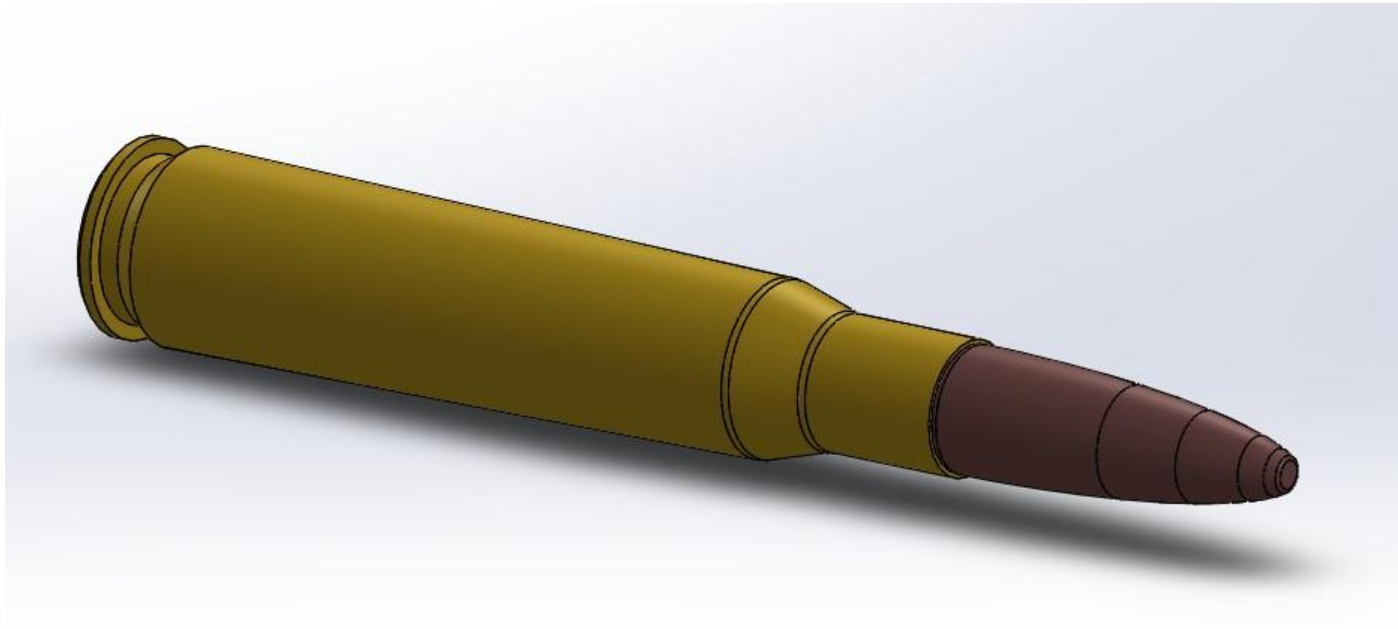
Is There Also A Need To Reduce Surface Danger Areas, To Produce Marking And Low Collateral Damage Projectiles?

nP TECHNOLOGY

NOTE: Approved For Public Release

nP Technology Injection Molded Frangible Projectiles:

Consistent And Accurate Polymerized Nano-Particle Construction



NOTE: Approved For Public Release

nP Technology Injection Molded Frangible Projectiles:

Consistent And Accurate Polymerized Nano-Particle Construction













Copper Or Brass Nano-Particles

Tungsten Nano-Particles

Iron Or Steel Nano-Particles

Metallic Powders May Be Blended To Achieve The Desired Cost, Weight And Performance

nP TECHNOLOGY

NOTE: Approved For Public Release

nP Technology Injection Molded Frangible Projectiles:

With Molded-In Features For Aerodynamics And On-Target Effects












Ballistic And Penetrative Tips, Tracer Cups, Gas Checks And Semi-Jackets

Clockwise From Top Left: Winchester Silvertip, Benjamin Nosler Pellets, ALCO Bullets, Barnes TSX, CVDS Windscreens, US M80A1 Projectile, US 0.50 Spotting Round, Corbin Bullet Cups, Corbin Gas Checks, Swagedies.com Bullet Jackets

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nP Technology Injection Molded Frangible Projectiles:

The nP Technology "Cargo Round" Development:

Virtually Anything Can Be Inserted Into Molded In Cavities…

Molded Features May Include:

- Aerodynamic/Penetrative Tips
- Tracing Compound Inserts
- Brass Drive Band Base Cups
- Impact Fired Shaped Charges
- Solid Or Hollow Cavities
- Other…



Internal Payloads May Include:

- Chemical Or Metallic Powders
- Crystalline Incendiary Materials
- Solid Cores Of Any Material
- Target Marking Compounds
- Preformed Fragments
- Other…

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Training, Target Marking And Special Purpose Applications:

nP Technology *SOT: Visible 20mm Hits Without A Trace…*



Imgur Album F-16 Strafing Modified

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Training, Target Marking And Special Purpose Applications:

Existing 20mm TP Projectile Ricochet Or Long Surface Danger Hazard Resulted In This Projectile Being Found Off Base And Sold On The Internet.

Fired 20mm TP Projectile Analysis:

"High Potential For Frangible SOT Update Of Steel Body Projectiles"



Summary: Steel Body Is A Land Riding Projectile With No Visible Rifling Marks Indicating No Compression In Firing. Base And Tip Features Are Added In Additional Steps. High Potential For Frangible Molded Projectile Bodies With Molded In Base And Tip Features, SOT Effects.

Aluminum Tip Flash And Projectile Dust Impact Signatures Can Be Exceeded With Frangible Body SOT For Day/Night Firing Practice With Low Ricochet Potential.

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Training, Target Marking And Special Purpose Applications:



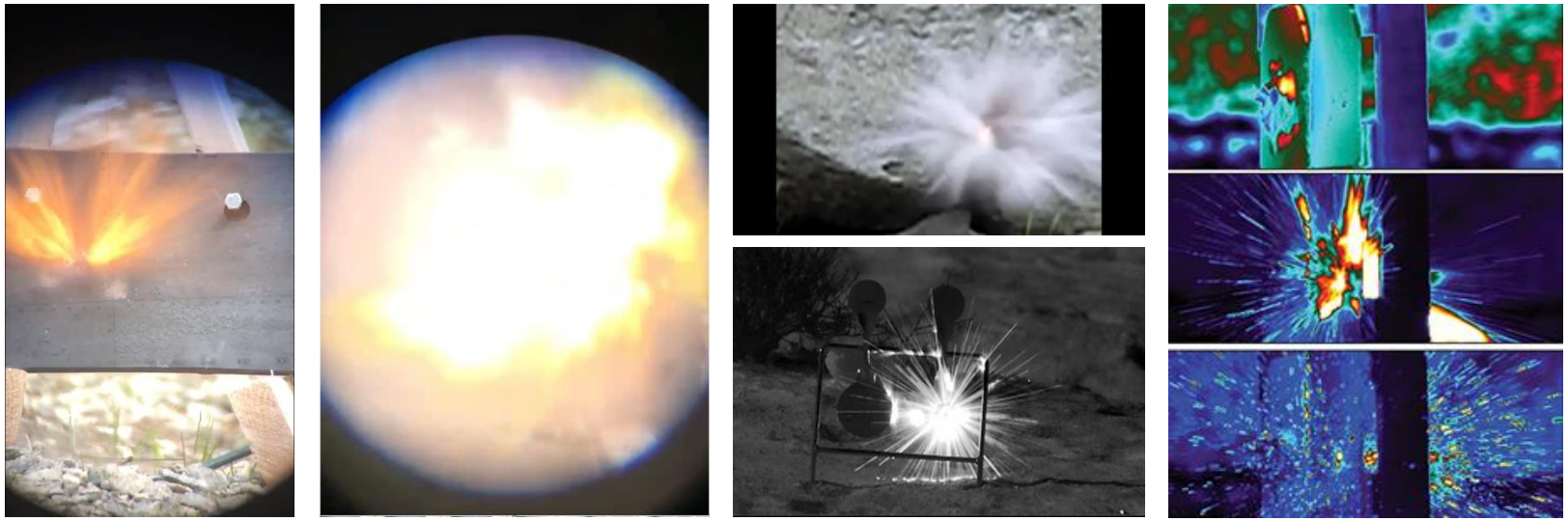
Worthpoint 20mm Cutaway, Worthpoint Cutaway Modified

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Training, Target Marking And Special Purpose Applications:

Impact Initiated Signature On Target Projectile:

Creating Four Significant Signature Effects Without A Fuse Or Primer…



Left To Right: 7.62x51mm SOT, 12.7x99mm SOT, 7.62x51mm SOT Stone, Frangible Thermal & Photonics Spectra IR

https://www.np-technology.com/50-cal-sot-demonstration/

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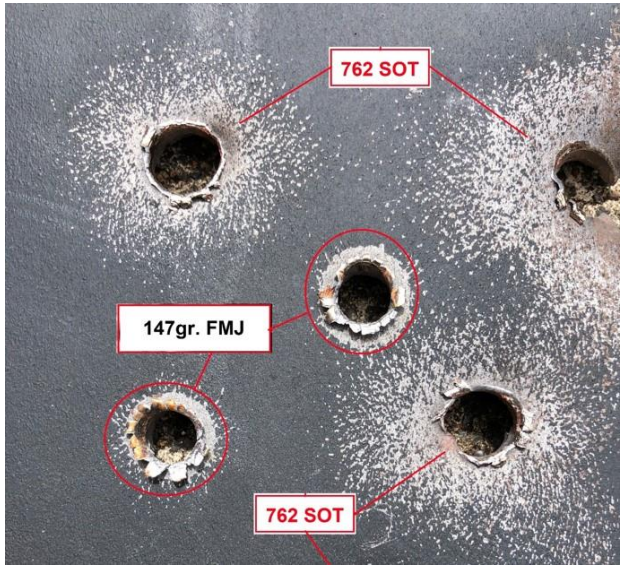
Training, Target Marking And Special Purpose Applications:

Impact Initiated Signature On Target Projectile:

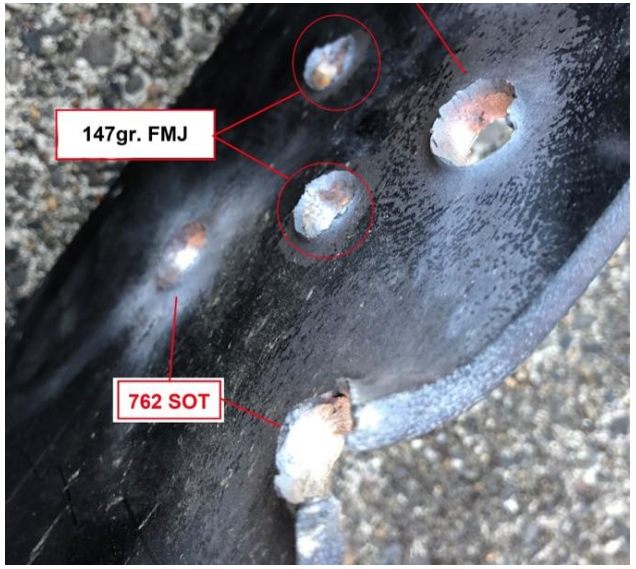
And Greater Effect On Mild Steel Than Ball Ammunition…











Left To Right Above: 20% Larger Holes In ½" Mild Steel With Fragmenting SOT Projectile, Melted Steel And Blast Residue Around Penetrations vs. Bullet Jacket Material Shed From Core With FMJ, 7.62x51mm SOT, Blast And Spall Damage While Producing Four Impact Signatures Which Are Clearly Visible Day Or Night.

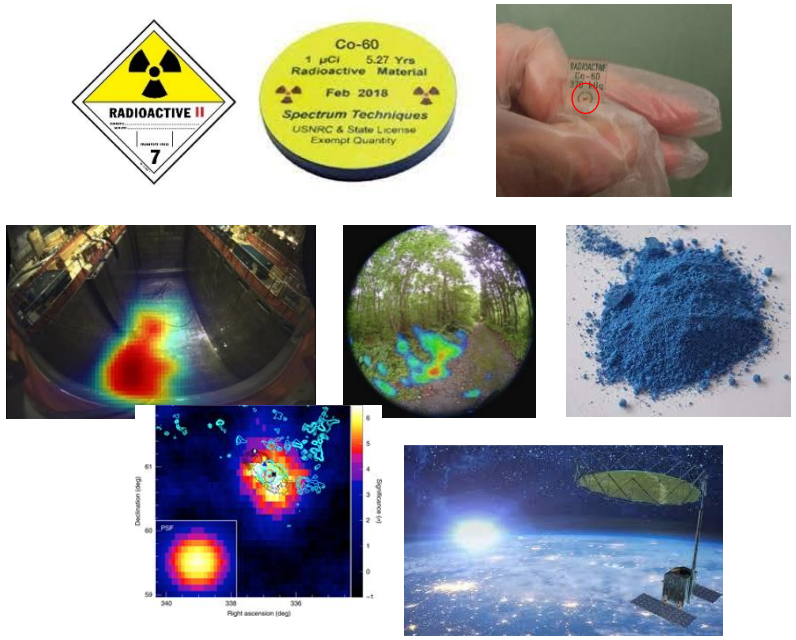
nP TECHNOLOGY

NOTE: Approved For Public Release

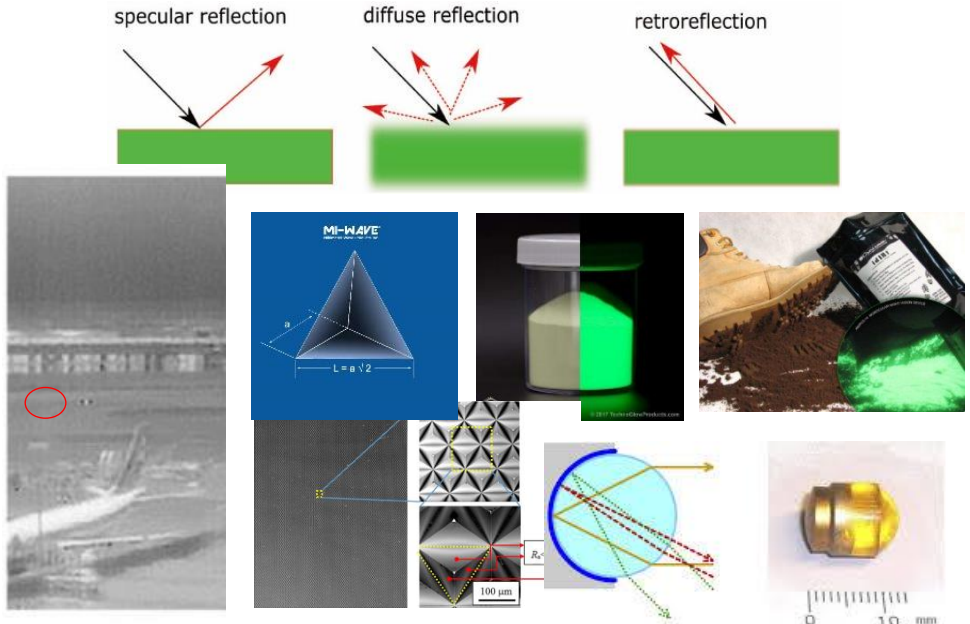
Training, Target Marking And Special Purpose Applications:

Virtually Anything Can Be Inserted Into Molded In Cavities:

Examples Of Radiological, Radar Reflective And Luminescent Payloads…



Clockwise From Upper Left: Spectrum Technologies Markers, Cobalt Powder, L-3 Satellite, Nature Gamma, PhysOrg, H3D Gamma Ray Camera Overlays.



Clockwise From Top: Wikipedia Light Behavior, Technoglow Powder, Cyalume Dirt, The Diva Dash Portal Retroreflectors, Researchgate Reflective Films, Mi-Wave Tetrahedral mm Wave Micro Radar Reflector, Heathrow Airport Radar Reflective Marking Image Journal Of Science.

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nP Technology Molded Projectile Pathway Into The Future:



Molded **nP Technology** Projectiles

NOTE: Approved For Public Release

nP Technology Molded Projectile Pathway Into The Future:

Question: Which Process Seems (And Is) More Accurate And Affordable?

Small Arms Projectile Example:

Single Operation vs. Many Steps

Projectiles Drop From The Mold Ready To Load



Nosler Ballistic Tip Process Steps Outdoor Hub

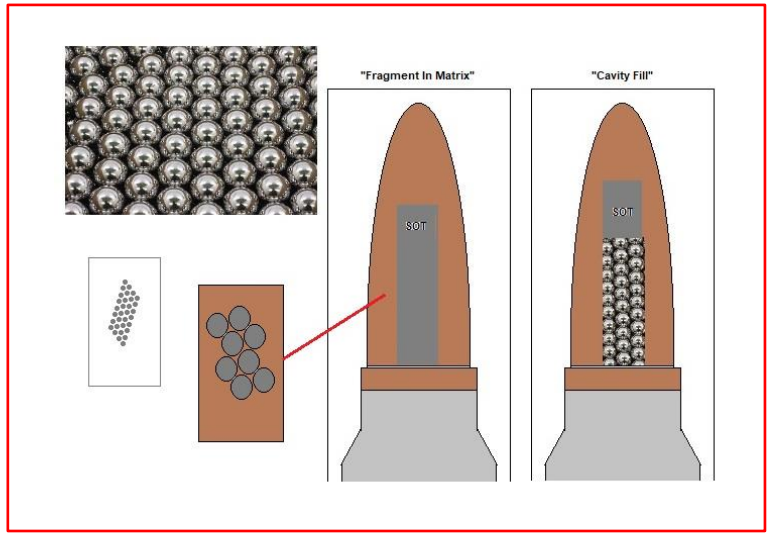
nP TECHNOLOGY

NOTE: Approved For Public Release

nP Technology Molded Projectile Pathway Into The Future:

Molded In Matrix Fragmenting & Fragmenting SOT Concepts:

Spherical Or Cylindrical Fragments Molded Into Central Cavities Or Directly Into The Projectile Body, With Or Without Energetics





AMR Capable: NDIA Presentation: 20mm AMR By David Armstrong NSWC Crane

https://ndiastorage.blob.core.usgovcloudapi.net/ndia/2009/infantrysmallarms/thursdaysessionxi8503.pdf

nP TECHNOLOGY

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nP Technology Molded Projectile Pathway Into The Future:

SOT-AP Special Combat Round:



IMAGES REMOVED: NOT FOR PUBLIC RELEASE

nP TECHNOLOGY

Conclusions:

- Molded Projectiles For Medium Caliber Are As Valid A Concept As Those For Small Arms
- Molding Is A Lower Cost Alternative To Machining And Traditional Assembly Methods
- The 20mm Target Practice Projectile May Be Directly Replaced By A Molded Frangible Version With Very Low Ricochet Potential To Reduce Surface Danger Ranges
- The Potential Of Cargo Round Variants Based On **nP Technology** Patents Is Large…

Recommendations:

- Develop Molded Projectile Analogs To Target Practice And Special Purpose Rounds

Because They Can Be Made More Accurately And Economically By This Method…

- Develop Combat Rounds Which Are Enhanced By Molded And/Or Frangible Design

Imagine Projectiles Where The Body Isn't Just A Steel Tube, But Participates In The Action…

And Low Collateral Damage, Non-Fragmenting Explosive Or Frangible Solid Rounds…

"Molding Projectiles Gives Designers Freedom To Expand Their Concepts Beyond Machined Bodies And Drawn Jackets"

-Robert Folaron, CEO, nP Technology, ARL CRADA Participant

nP TECHNOLOGY

NOTE: Approved For Public Release

Credits:



POC: Howard D. Kent, CEO, Phone: 818-314-8636, e-Mail: HKent@Peak.org

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POC: Robert Folaron, President, Phone: 214-924-9473, e-Mail: rfolaron@np-technology.com

Credits:

With Special Thanks To:

Mr. Jeff Hoffman

Mr. Stephen Faintich

Mr. Patrick Kisgen

Mr. Scott Koller

TMI50BMG
Tactical Manufacturing, Inc.

Mr. Harry Arnon

HERNON®
MANUFACTURING, INC.
High Performance Adhesives, Sealants and Precision Processing Solutions

nP TECHNOLOGY

NOTE: Approved For Public Release

Credits:

The Testing And Demonstration Facilities Of:

Mr. Joby Hawkins

LTC Steve Brown, USA-Ret.











Secure Confidential Research And Development Location
For Defense Applications In Laurens, South Carolina

nP TECHNOLOGY

NOTE: Approved For Public Release

Gun-drilling with Modulation-Assisted Machining

2021 NDIA Future Force Capabilities Conference
18 October 2021

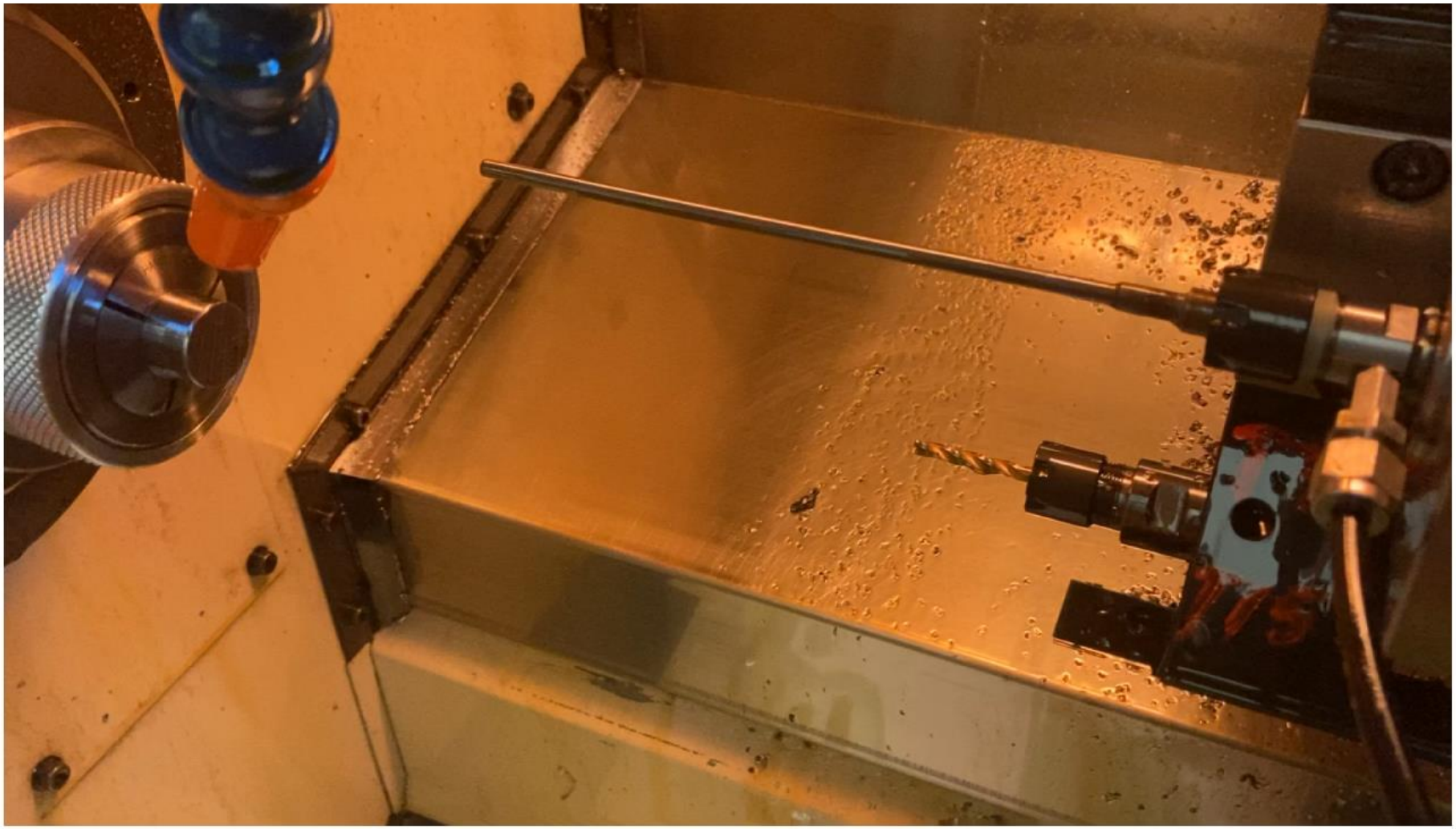
J B Mann, CEO
M4 Sciences LLC
jbmann@m4sciences.com
www.M4sciences.com

Approved for Public Release – M4 Sciences

Modulation-Assisted Machining (MAM)

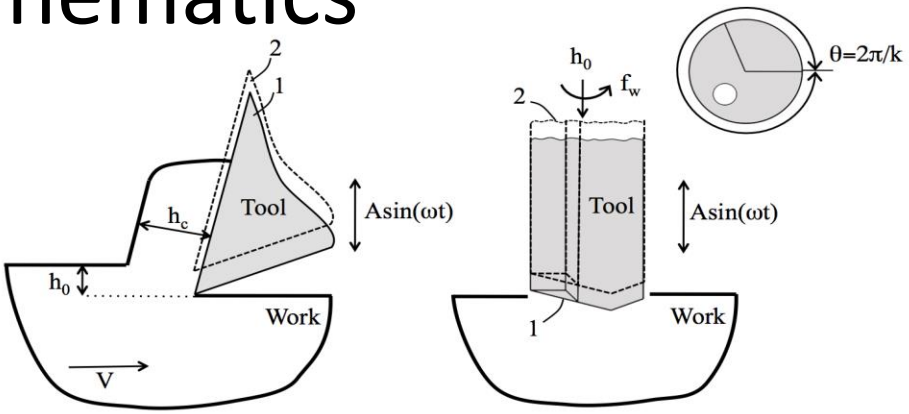
- Application of controlled oscillation during machining
  - Low-frequency (~<1000Hz)
  - Disrupt severe contact conditions (reduced contact time)
  - Improve effectiveness of cutting fluids (reduces temperatures)
  - Discrete chip formation (chip evacuation)
- Effects of MAM on surface texture
  - Surfaces generated by geometric tool path
  - Opportunities for additional development
  - Commercial impact

Gun-drilling with MAM

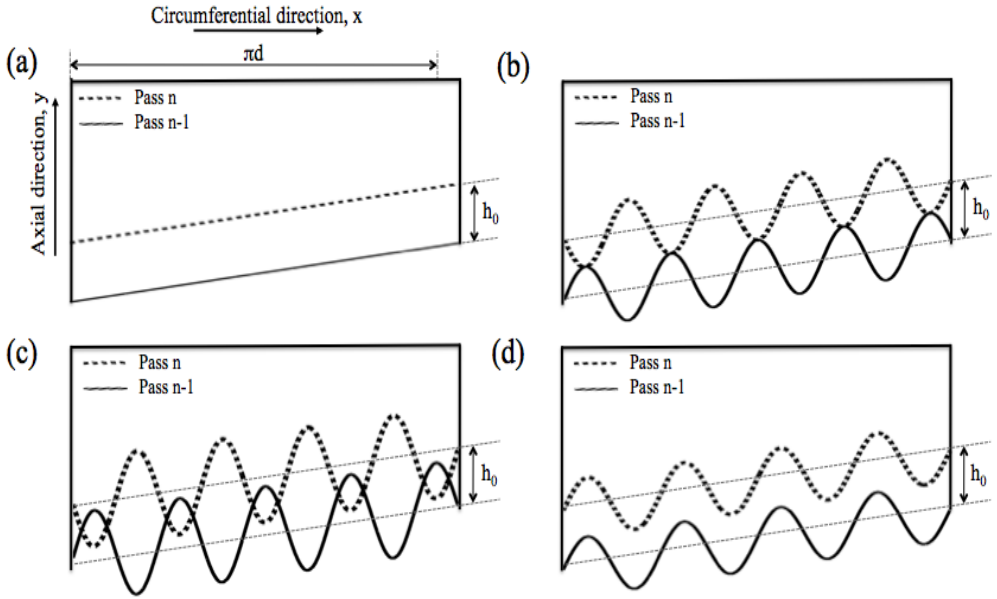


MAM Kinematics

- Geometric tool paths
  - 2-D cutting and drilling models



Critical conditions
$fm=k/2*fw*(2N+1)$, $2A>h_o$



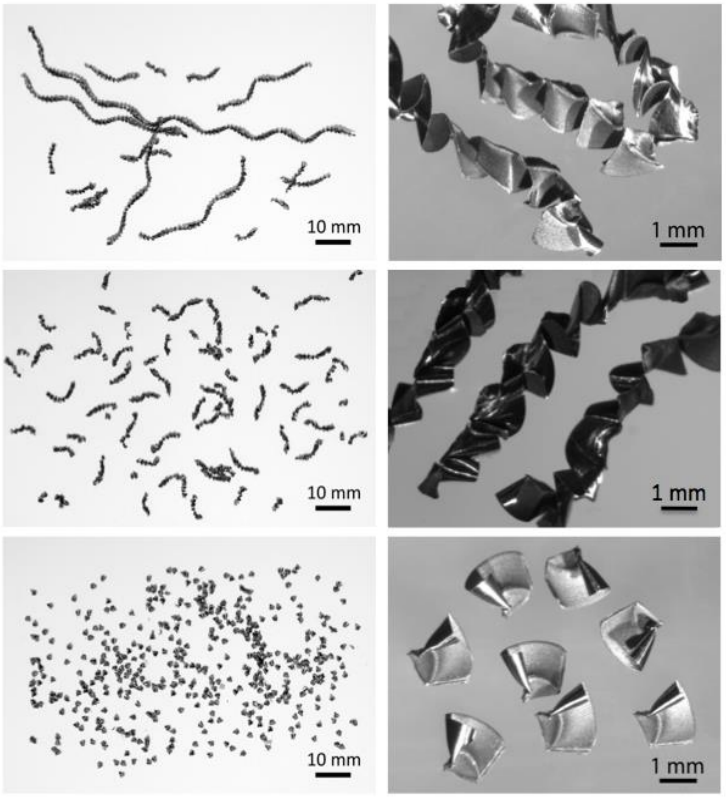
Drilling with MAM

- Chip control
  - Increased drilling productivity

Conventional gun-drilling (a)

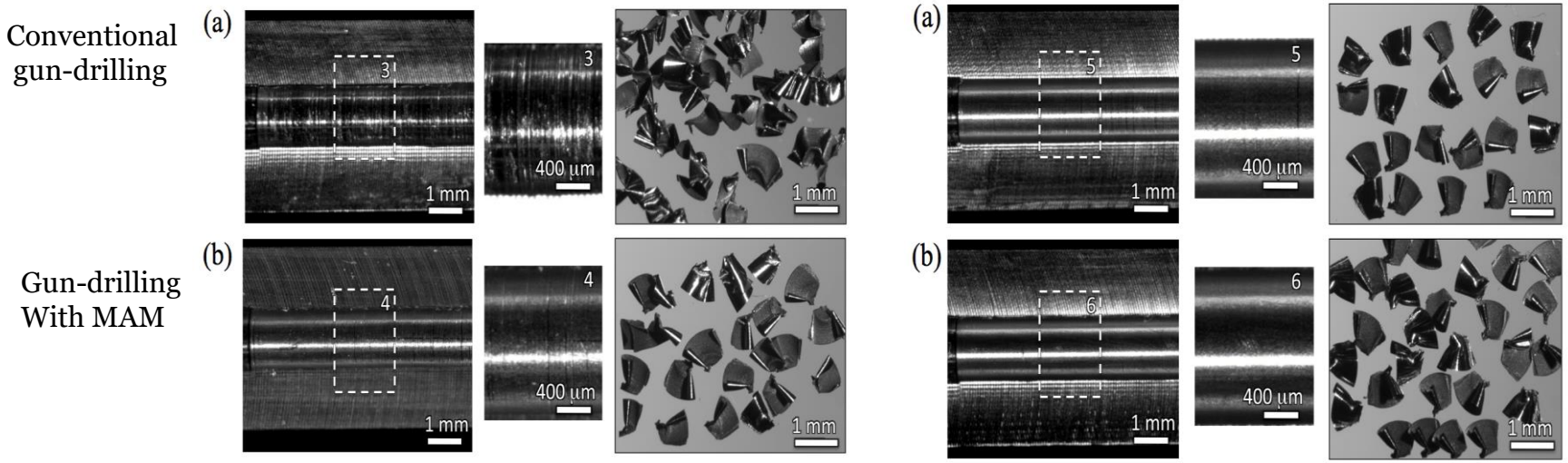
Gun-drilling with MAM – incorrect frequency (b)

Gun-drilling with MAM – correct freqency (c)



MAM surface textures

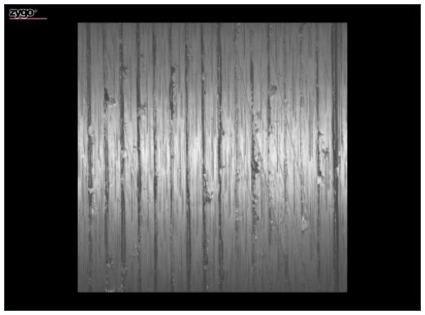
- Deep hole gun-drilling Ti alloys
  - Increased productivity (feedrate, tool life)
  - Reduction in surface finish
  - Commercial impact across orthopedic sector

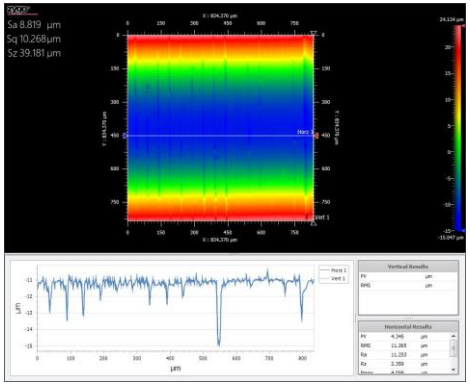


MAM surface textures

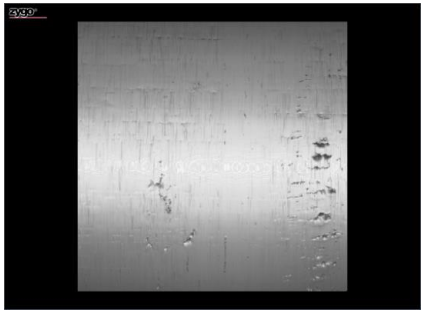
- Deep hole gun-drilling in 4140
  - Improved surface finish
  - Characteristics observed in drilling of Ti6Al4V

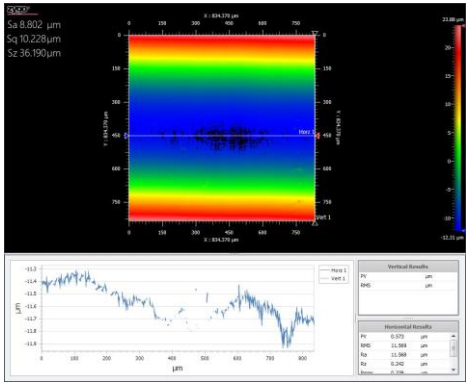
Conventional gun-drilling





Gun-drilling With MAM



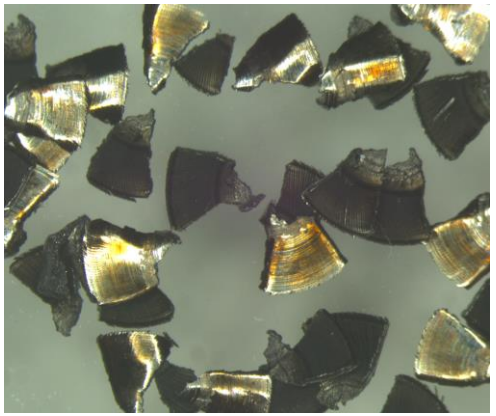


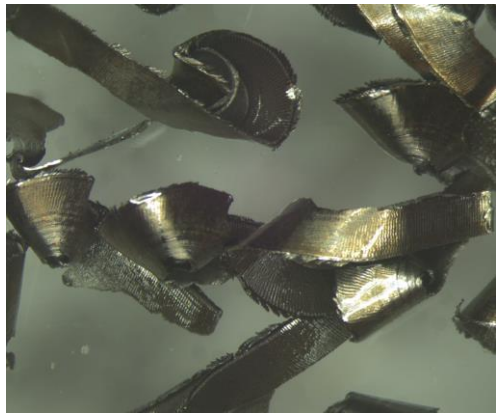
MAM chip control

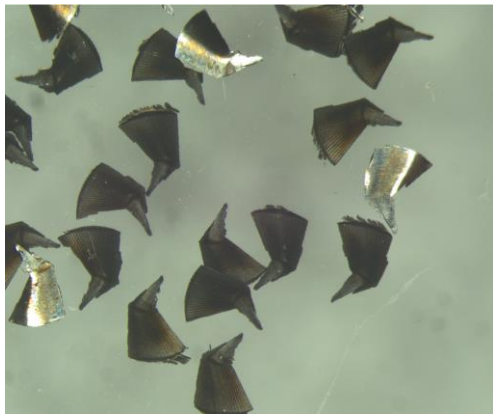
- Deep hole gun-drilling in 4140 and 304L

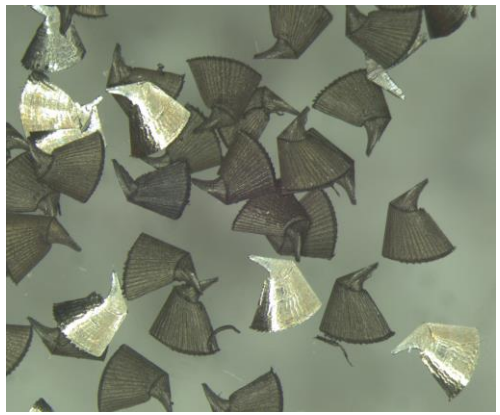
Conventional gun-drilling

Gun-drilling with MAM









4140 steel

304L steel

Conclusions

- Gun-drilling with MAM
  - Improved productivity – ability to drill range of alloys
  - Improved quality (size control, surface finish)
  - Successful industrial application (>10 yrs, up to 500mm length)
  - Pathway to implementation of difficult to machine alloys
- Results demonstrate effectiveness of MAM
  - Significant opportunities in the gun-manufacturing industry
  - Future investigation of MAM on hardened steel alloys

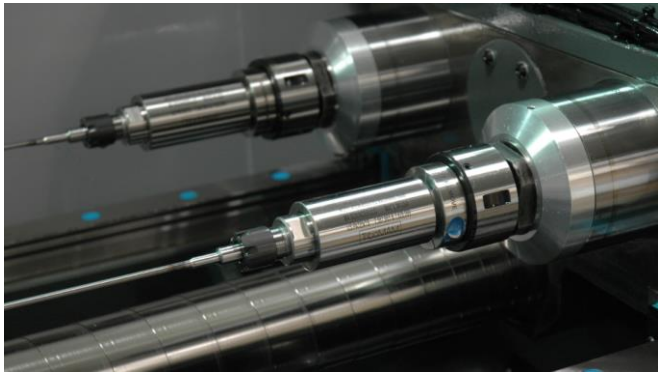
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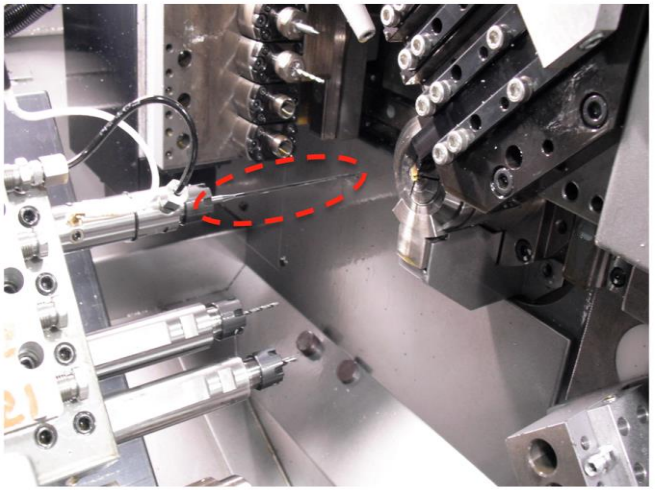
- NSF STTR program IIP- 0822879 (M4 Sciences)
- Crane Division, NSWC

Thank you! Questions?

- Commercial TriboMAM systems
- www.m4sciences.com







2021 NDIA Future Force Capabilities Conference

Modernizing the Energetics Manufacturing Industrial Base

Chris Marlow
Energetics and Specialty Materials Handling Program Manager

FRANKLIN
engineering group, inc.







Approved for Public Release

Presentation Overview

- Franklin Engineering Group Introduction
- Modernization Process
- Modernization Challenges
- Lessons Learned
- Success Stories
- Conclusion

Franklin Engineering Overview

- Multi-disciplinary engineering services company
  - Chemical
  - Mechanical/Structural
  - Electrical, Instrumentation and Controls
  - Environmental
- Office located in Franklin, TN (Nashville)
- 20 plus years of executing projects for energetics and munitions production processes
- Small Business





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Franklin Clients

Government	
Radford RFAAP	Indian Head NSWC
McAlester AAP	Picatinny Arsenal
Crane NSWC	Lake City AAP

Commercial	
Eastman Chemical	Pacific-Scientific
Solvay	Tesla
Mitsubishi	Nissan

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Hazardous Materials Experience

- Munitions, Ammunition, and Primers
- Propellants: Single, double, triple–based
- Explosives
  - TNT
  - PAX
  - PBX
  - Lead azide
  - Lead styphnate
  - MIC
  - HMX
  - PETN
  - KDNBF
  - DDNP
  - ZPP
- Magnesium and aluminum powders
- MTV flare composition
- Elemental phosphorus, white and red
- Phosphine gas
- Lithium and sodium metal
- Ammonium Perchlorate

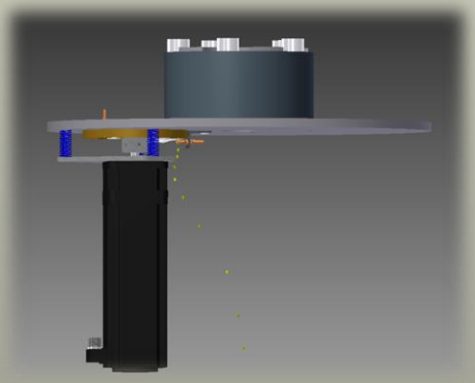




Energetics Processing Experience

- Mixing/blending
- Granulating
- Slurry handling
- Drying and filtration
- Net-shape pressing
- Cast-cure filling
- Extrusion
- High speed cutting
- Pick and place handling
- Gravimetric and volumetric filling
- Abrasive jet cutting and high-pressure water washout
- Waste incineration
- Solvent/vapor recovery and distillation
- Render-safe and demil systems





Modernization – What?

- Efforts to update current energetics manufacturing facilities
- Facilities and processes designed and constructed during WWII era (1940/50's) compared to current design and construction.

- 1950's Technology



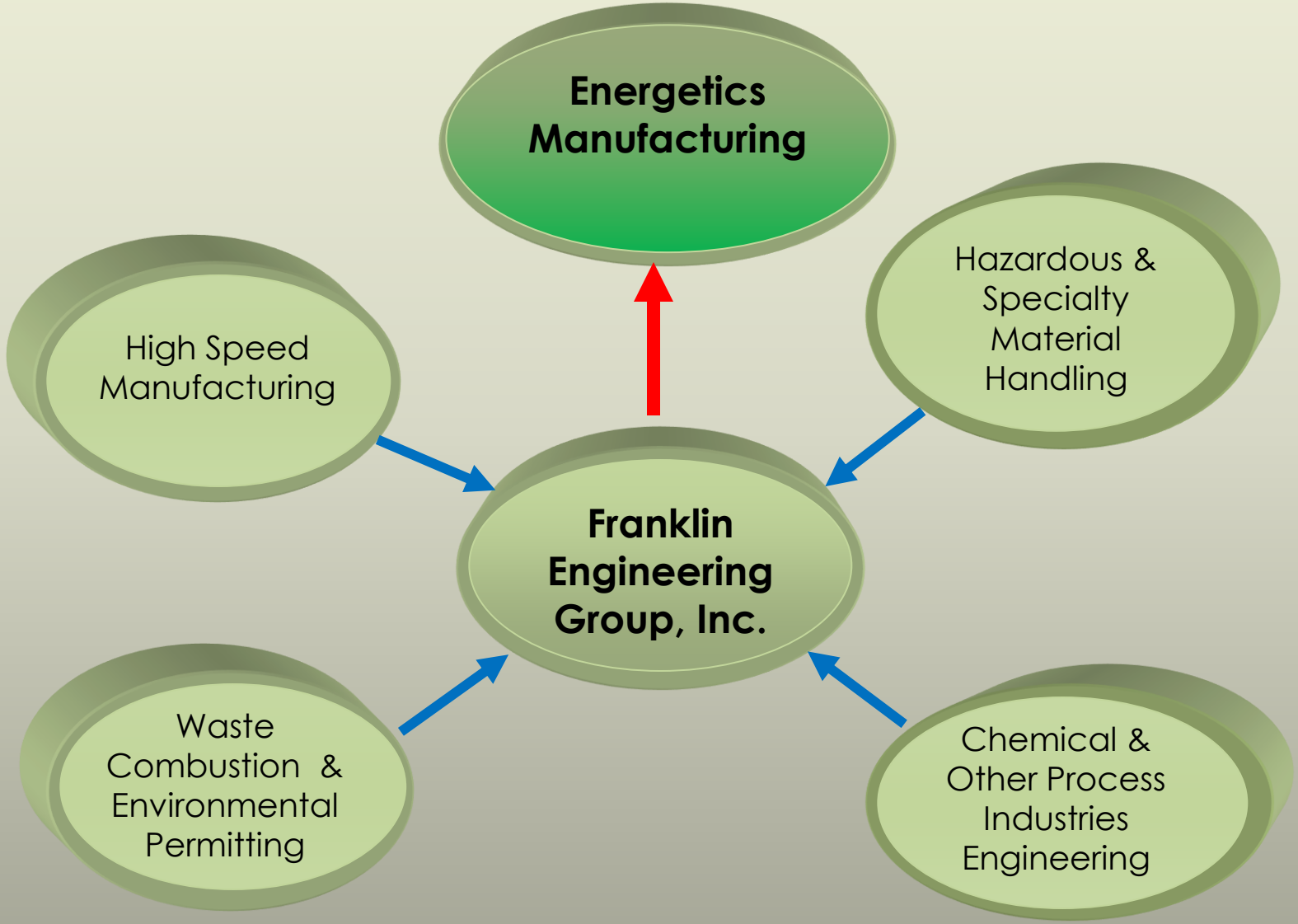


- Modern Technology





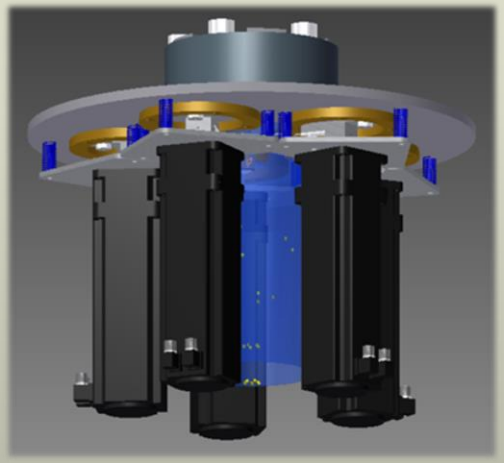

Industries



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Modernization – Why?

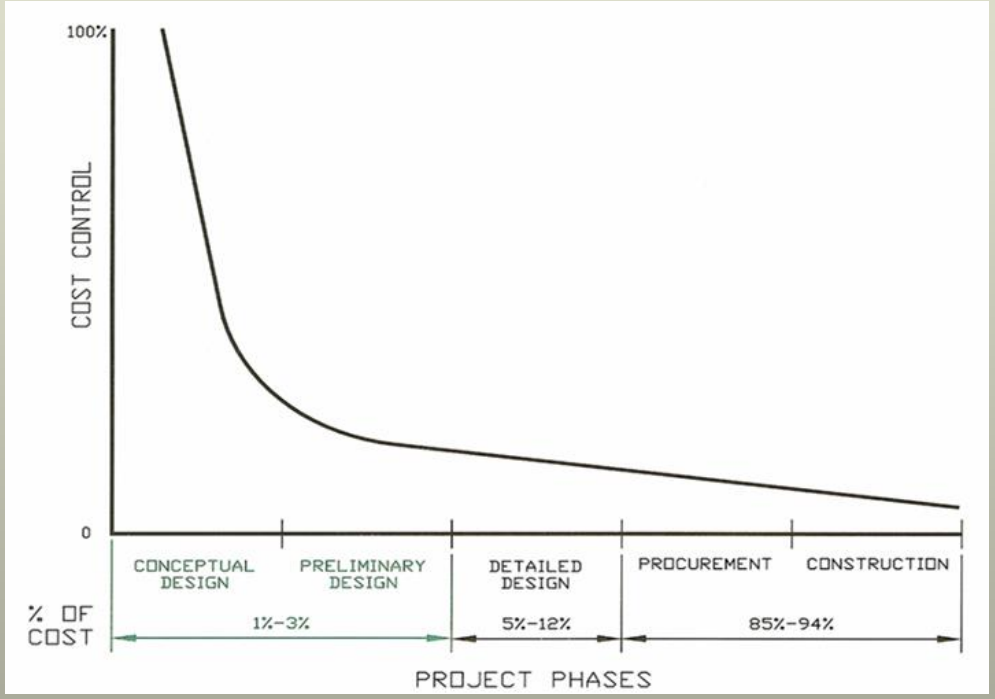
- Safety
  - Remove operators from dangerous activities
- Quality
  - Increase consistency and improve inspections
- Production capacity and reliability
  - Improved rates with automation
- Cost
  - Reduced operating costs
- Environmental Benefits
  - Reduced emissions
- Sustainability
  - Long term viability
- Competitive
  - Remain competitive in the global market



Modernization – How?

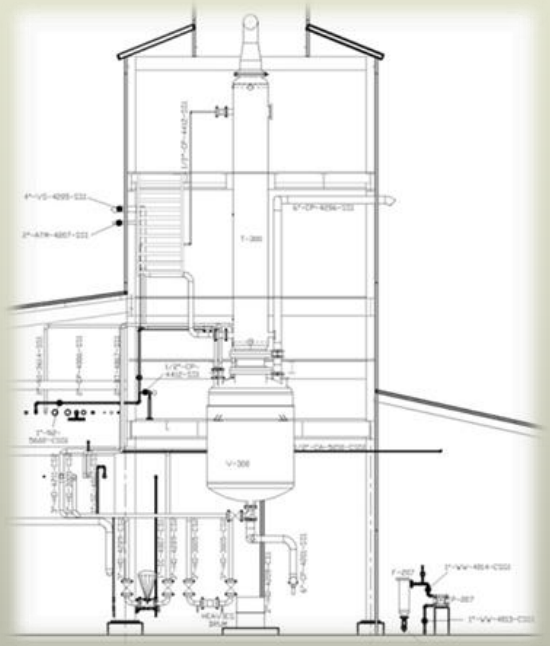
- Phase 1: Conceptual Design
- Phase 2: Development and Testing
- Phase 3: Detailed Design
- Phase 4: Construction and Installation
- Phase 5: Commissioning

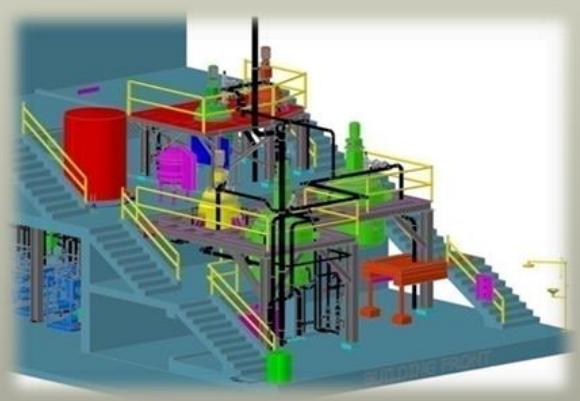




Phase 1 – Conceptual Design

- Project definition and scope
- Define production and flexibility requirements
- Determine overall throughput
- Clearly define project requirements
- Survey modernization technology
- Evaluate custom solutions
- Select best viable technology solutions
- Identify facility, utility, environmental, and infrastructure constraints





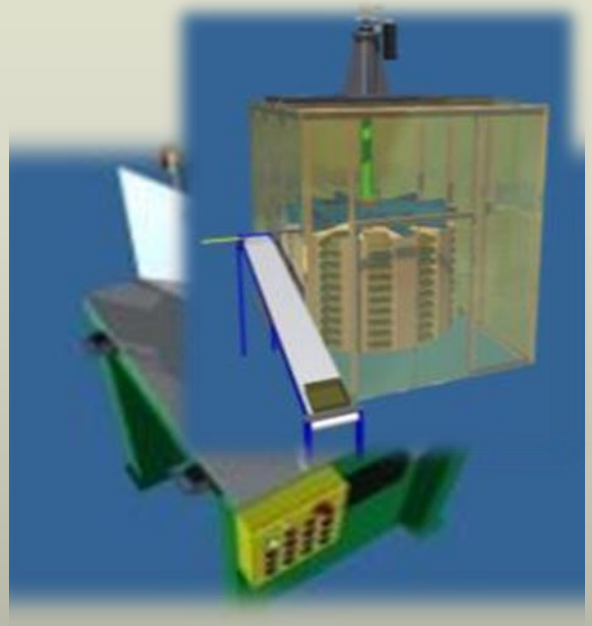
Phase 2 – Development and Testing

Objective:

Identify and validate technologies to replace aged production processes

Approach:

1. Research
2. Screening
3. Testing
4. Selection





Phase 3 - Detailed Design

- Mechanical and electrical design
- Facility design
- Safety approvals (Local, USACE, DDESB, etc)
- Generate construction drawings

Phase 4 – Construction & Installation

- Construct facilities (modify existing facilities)
- Fabricate custom equipment
- Purchase COTS equipment
- Install building equipment and process equipment

Phase 5 – Commissioning

- Equipment check-out
- Testing (inert batches)
- Start-up

Modernization – Challenges

- Safety
  - Electrical classifications
  - Change from traditional processes
- Justification
  - Cost / Funding
- Facilities
  - Older buildings
  - Infrastructure
- Schedule
  - Development time
  - Safety approvals
  - Product qualifications
  - Building upgrades or new construction

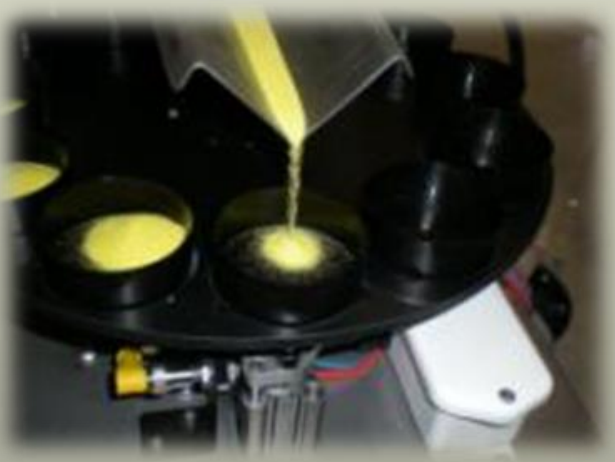


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Modernization – Lessons Learned

- Safety – Always the Top Priority
- Think outside the box
- Leverage other industries
- Correctly identify problem
  - Proper scope development
  - Don't rush FEL engineering
- Funding
- Approval cycles

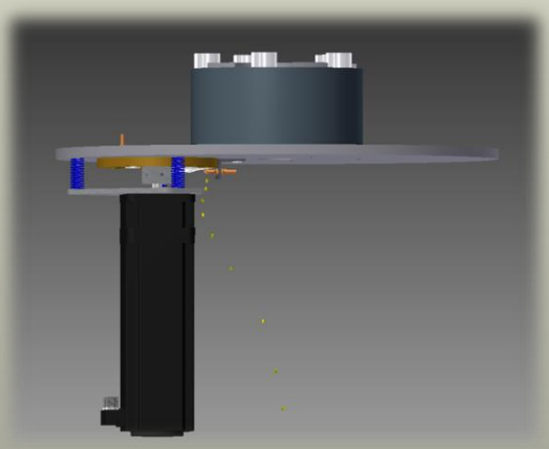




Successful Projects

- MTV Manufacturing
- Explosives Mixing
- Drying and filtration
- Pressing & extrusion
- Cast-cure filling
- High speed cutting
- Pick and place handling
- Primer assembly
- Abrasive jet cutting
- Waste incineration
- Solvent/vapor recovery
- Render-safe and demil systems

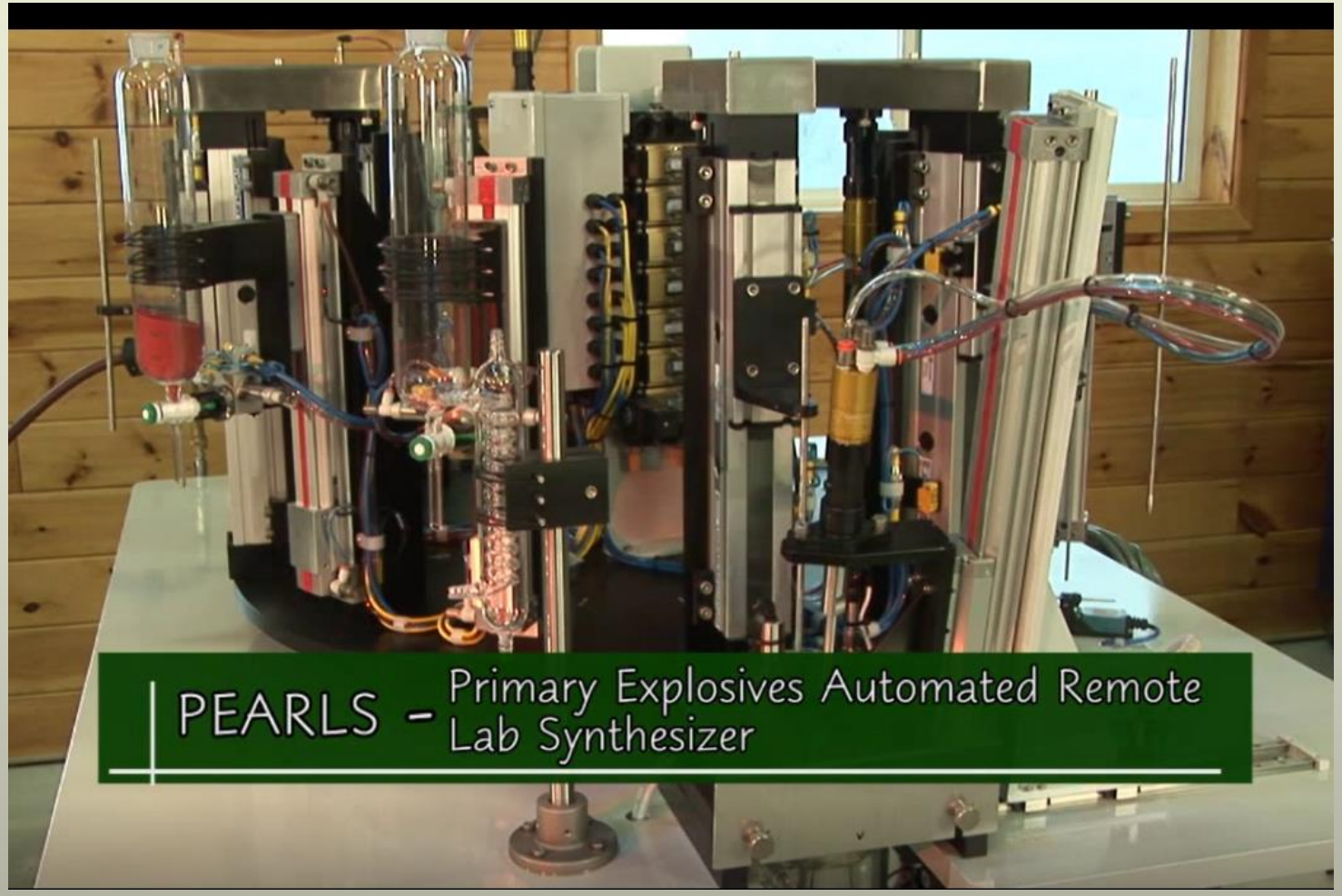




Automated mixing – Various Energetics



Primary Explosives



Modernization - Summary

- What?
  - Bringing the energetics manufacturing process into the 21st century



- Why?
  - Safety, quality, cost, sustainability
- How?
  - Follow a proven modernization process and leverage technologies from the chemical, pharmaceutical, automotive industries
- When?
  - NOW, before falling further behind
- Questions?

PM CCS
PROJECT MANAGER CLOSE COMBAT SYSTEMS

ON EVERY MISSION

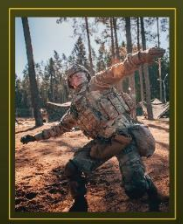
EOD Army Panel

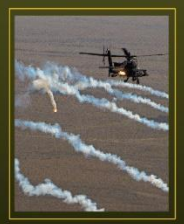
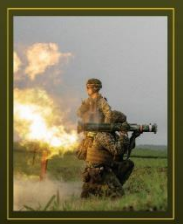
19 October 2021
Future Forces Capabilities Conference

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60 YEARS OF ACQUISITION EXCELLENCE 1961 2021
PROJECT MANAGER CLOSE COMBAT SYSTEMS





DISTRIBUTION STATEMENT A. Approved for public release: distribution unlimited. PAO# 368-21

Agenda

- PM CCS Overview
- Explosive Hazard Detection Programs
  - AN/PSS-14C Mine Detecting Set
- EOD Programs
  - EOD Tools and Equipment Kit (ETEK)
  - Enhanced Robotic Program Render Safe (ERP RS)
- Demolition Programs
  - RF-RAMS Receivers M17A1/M85A1
  - Anti-Personnel Obstacle Breaching System (APOBS)
  - Mine Clearing Line Charge (MICLIC)
  - Breaching Capability Development - Mounted



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Team PM CCS

ON EVERY MISSION

60 YEARS of ACQUISITION EXCELLENCE

- ***Manage 44% of the Army's conventional munition lethality***
- ***384 products: 316 Class V, 59 Class VII & 9 RDT&E***
- ***Average 79 Contracting Actions/Year***
- ***Oldest PMO in the US Army, 1961 "PM-Selected Ammunition"***



Mission

Provide dominant and innovative lethal and protective capabilities for the Joint Warfighter through acquisition excellence

Vision

Skilled innovative team, empowered to deliver dominating close combat capabilities

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Team PM CCS

ON EVERY MISSION

60 YEARS of ACQUISITION EXCELLENCE

Provide dominant and innovative lethal and protective capabilities for the Joint Warfighter through acquisition excellence

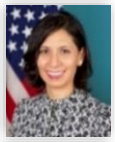
ON EVERY MISSION



Project Manager
COL Russell Hoff



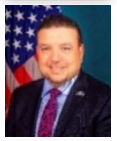
Deputy PM
Joe Pelino



Business Division Manager
Anita Polesky



Chief, Product Support
Fred Willecke



Director, Program Integration & International Division
Michael O'Grady (Actg)



Manager, Technology Management Division
John Esposito

Product Manager Terrain Shaping Obstacles



Product Manager
LTC Isaac Cuthbertson

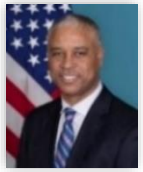


Deputy PdM
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Asst Product Manager(s)
CPT (P) Macias (Inbound)

Branch Chiefs
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TSO: Eli Vainchenker

Product Director Combat Armaments & Protection Systems



Product Director
David Millette



Deputy PD
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Asst Product Manager
MAJ Pfromm (Inbound)

G&PS Branch Chief
Tinesha Nicholas

Team Leads
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Grenades: Anthony Sacco (Actg)
Protection Systems: Derek DeReiter

Product Director Demolitions & Countermeasures



Product Director
Michael Burke (Actg)



Deputy PD
Hugh MacMillan (Actg)

Asst Product Manager
CPT Fite (Inbound)

Branch Chiefs
Pyrotechnics: Harvard Yuen
Demolitions: Tim Healy

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PM CCS Portfolio

ON EVERY MISSION

60 YEARS of ACQUISITION EXCELLENCE

Grenades



M67 Fragmentation Hand Grenade



M106 SOD-V_R



M228 Practice Fuze



Smoke Grenades

Terrain Shaping Obstacle



Close Terrain Shaping Obstacle



Standoff Activated Volcano Obstacle (SAVO)



Spider

Protection Systems



AN/PSS-14C Hand Held Mine Detector





SNS-RDD

Intermediate Force Capabilities



SS-ADT



Acoustic Hailing Device

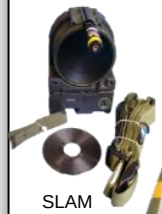


Taser



Munitions

Demolitions



SLAM



Claymore



RF-Remote Activation Munition System



Shaped Charge



Sheet Explosive

Det Cord



C-4 Block

Shoulder Launched Munitions

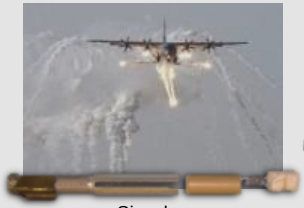


Bunker Defeat Munition



AT4 & AT4CS

Pyrotechnics



Signals



Simulators



Countermeasure Flares

EOD



Explosive Ordnance Response Kit



Smart Ray Vision (SRV)

Breaching Systems



APOBS



MICLIC

DISTRIBUTION STATEMENT A. Approved for public release: distribution unlimited. PAO# 368-21

AN/PSS-14C Mine Detecting Set

Program Description

- Lightweight self-contained handheld mine detector system that is operated by a single Soldier
- The AN/PSS-14B/C is an enabler for Soldier Lethality as it enables soldier maneuver by enhancing the probability and speed of detection of buried landmines and IEDs allowing for increased speed of dismounted operations making the unit more efficient and lethal.
- Vendor: L3Harris



Performance Capabilities

- AN/PSS-14B consists of a Coupled Ground Penetrating Radar (GPR) and Metal Detector (MD)that provides detection of traditional conventional mines
- AN/PSS-14C consists of a Decoupled GPR and MD, that provides enhanced detection of hard to find, low/no metal IED components, along with traditional conventional mines

AN/PSS-14C hand-held detector is the final configuration for the program of record, providing a more comprehensive capability

DISTRIBUTION STATEMENT A. Approved for public release: distribution unlimited. PAO# 368-21

EOD Tool and Equipment Kit (ETEK)

ON EVERY MISSION
60 YEARS of ACQUISITION EXCELLENCE

Program Description

- Approved requirement
- Funding in FY20 and FY21
- The ETEK will provide enduring, sustainable, lightweight, counter-Explosive Hazard (EH) and Weapons of Mass Destruction (WMD) reconnaissance, detection, identification, diagnostics, render safe/neutralization, incident evaluation and control, and enhanced mission support capabilities to increase an EOD Team's endurance, force protection and mission success while primarily supporting dismounted operations in complex and austere environments.

Capability Overview



X-Ray Imager, *COTS*



X-Ray Generator, *COTS*



Dismounted Operations Protection, *GOTS*



Trace Detection, *COTS*



Low Light Visual Augmentation System, *COTS*



Subsurface Explosive & Hazard Detection , *COTS*



Render Safe Initiation, *COTS*



* Gamma and Neutron Search and Detection, *COTS- TBD*



Power Management, *COTS*



* Unmanned Aerial System (UAS), *COTS- TBD*



* Localized Incident Site Protection, *Development*

DISTRIBUTION STATEMENT A. Approved for public release: distribution unlimited. PAO# 001-22

* Denotes Representative Technology Image

Enhanced Robotic Payloads Render Safe (ERP RS)

Program Description

- Approved requirement
- Suite of modular capabilities designed with common interfaces to provide increased standoff, situational awareness, disruption capability and dexterity to respond to current and emergent EOD, CBRN and Engineer requirements. Utilizes open architecture for integration with MTRS Inc. II and CRS-H platforms to form the Army's next generation platform adaptable robotics systems.

Overview

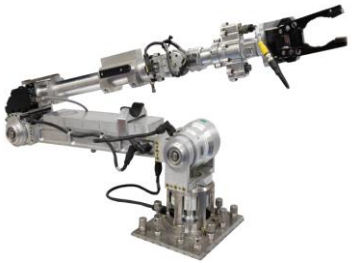
- **Highly Dexterous Manipulation System (HDMS)-** Provides the ability to remotely manipulate objects with natural human motions and stability in a highly dexterous manner within a defined work area.
- **Multi-shot Disruptor (MSD)-** Standoff disruption tool, compatible with all types of Percussion Actuated Non-electric (PAN) ammunition- including water shot, that enables EOD technicians to remotely select appropriate disruption ammunition to mitigate threat of multiple explosive hazards.
- **Precision Aiming Module (PAM)-** Enables fine adjustments for positioning of multi-shot disruptor into position for disruption and/or render safe of explosive hazards.



Highly Dexterous Manipulation System



Multi-shot Disruptor



Precision Aim Module

DISTRIBUTION STATEMENT A. Approved for public release: distribution unlimited. PAO# 001-22

RF-RAMS M17A1 / M85A1

ON EVERY MISSION
60 YEARS of ACQUISITION EXCELLENCE

Program Description

- The Radio Frequency (RF) Remote Activation Munition System kit is a Demolition Firing Device system that provides dismounted soldier wireless initiation capability of explosives, demolition charges and munitions. The M17A1 is an explosive RF receiver which, after receipt of a wireless coded signal from the MK26 Transmitter (supplied in the M152/MK152 Mod 0 kit), is capable of detonating its own explosive lead/non-electric blasting cap and the attached demolition charge(s)
- Fielding ongoing to Engineer Clearance Companies
- CASCOM to do a close-out brief to the AMRCoC in FY21
- Vendor: Mnemonics Inc. Melbourne FL



RF-RAMS MK152 Mod 0 (Class VII)

Performance Capabilities

- Packed 6 Expendable Receivers in PA108 container
- M17A1 Rec Field Programmable by M/MK26 Transmitter
- Uses Standard CR123 Battery
- Less Time on Target & reduce exposure to enemy fires
- M85A1 is the inert functional training device for the M17A1



6 Each M17A1 Tactical Per PA108 Container



2 Each M85A1 Trainers Per PA108 Container

DISTRIBUTION STATEMENT A. Approved for public release: distribution unlimited. PAO# 368-21

Anti-Personnel Obstacle Breaching System (APOBS) MK 7 Mod 2

ON EVERY MISSION

60 YEARS of ACQUISITION EXCELLENCE

Program Description

- The APOBS is a self contained, one shot breaching system. It uses a rocket to deploy a linear demolition charge consisting of 108 grenades spaced on a length of det cord encased in a protective sleeve over a target obstacle.
- APOBS is in the production and sustainment life cycle phase
- Configuration management is owned by the USMC.
- Vendors: Nammo Perry, Inc., Perry FL; Ensign Bickford Aerospace & Defense, Graham, KY





Performance Capabilities

- Two (2) man portable; 125 pound total tactical weight
- Time delay and command firing modes
- Breaches a footpath 0.6 meter wide, 45 meter long through antipersonnel land mine fields and complex wire obstacles

DISTRIBUTION STATEMENT A. Approved for public release: distribution unlimited. PAO# 368-21

APOBS Launchable Reusable Trainer (ALRT) Update

ON EVERY MISSION
60 YEARS of ACQUISITION EXCELLENCE

Program Description

- The APOBS Launchable Reusable Trainer (ALRT) is DEVCOM developed kit that can be used by Soldiers to deploy an inert line charge using the actual APOBS system allowing them to duplicate actual APOBS operations.
- System has obtained a Safety Confirmation and is being tested in Soldier Evaluations
- DEVCOM/PM CCS is working with User Proponent to generate requirements

Performance Capabilities

- Allows Soldiers to cost effectively train with the APOBS system without the need to deploy the energetic line charge
- Improve training to fill in the current learning gap to duplicate and launch the system in different tactical and environmental situations without firing tactical system.
- High potential for cost savings due to reusability of the inert line charge



DISTRIBUTION STATEMENT A. Approved for public release: distribution unlimited. PAO# 368-21

Mine Clearing Line Charge (MICLIC)

Program Description

- The MICLIC is a mounted breaching system. It uses an MK22 rocket to deploy an M58 linear demolition charge consisting of 1800 pounds of C4 explosive over a target obstacle. The rocket is launched from a MK155 launcher mounted to an M200A1 trailer. The M68 is a reusable trainer for the M58.
- MICLIC is in the production and sustainment life cycle phase
- Configuration management is owned by the USMC for class V and Army or USMC depending on variant for class VII
- Vendors: American Ordnance, Middletown IA (M58); NSWC Indian Head, MD (MK22)



Performance Capabilities

- M58 breaches a vehicle wide, 100 meter long path through mine fields
- M68 trainer can be used up to 3 times
- Ammo also employed from Assault Breacher Vehicle and Amphibious Assault Vehicle (M59 variant)



DISTRIBUTION STATEMENT A. Approved for public release: distribution unlimited. PAO# 368-21

Breaching Capability Development Mounted

ON EVERY MISSION
60 YEARS of ACQUISITION EXCELLENCE

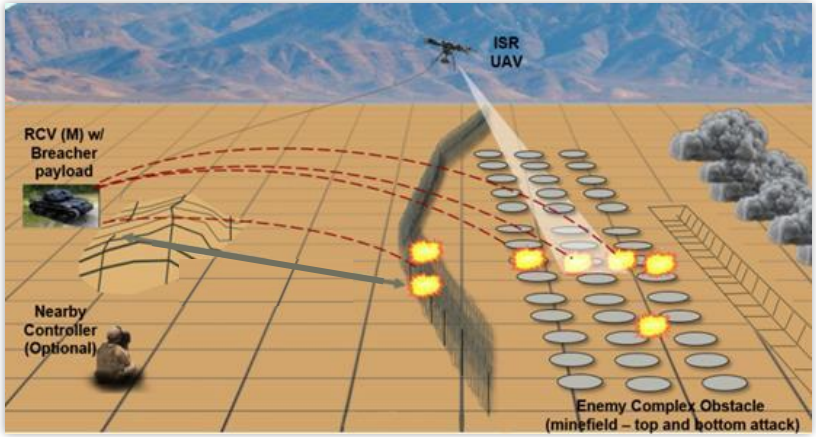
Program Description

- The Explosive Breacher concept is as a modular mission breaching payload.
- Technologies matured through the Next Generation Breaching Technologies S&T effort will be fully developed for fielding and integration initially onto the RCV-M.
- Establishment of a POR is anticipated in FY23.
- The target for fielding is currently matched to the projected fielding date for the RCV-M.

Performance Capabilities

- High reliability neutralization of modern threat obstacles within a vehicle width, 150 meter long path
- 1-3 km employment standoff from obstacle removes Soldiers from breach
- Scalable/precision effects to customize breach lane dimensions





DISTRIBUTION STATEMENT A. Approved for public release: distribution unlimited. PAO# 368-21

FY22 Competitive Opportunities

ON EVERY MISSION
60 YEARS of ACQUISITION EXCELLENCE

FY22				
Program/ Item/ Description	Planned FY22 Dollars ($M)	Planned Strategy	Contract Type	Anticipated Final RFP Release Date (QtrFY)
Close Terrain Shaping Obstacle (CTSO)- Inc 1 – Top Attack	$10.3	C	Stand Alone OTA	1QFY22
M18A1 Claymore	$9.9	C	IDIQ/FFP	1QFY22
DWEN MK160 & DWEL MK158 Delay Detonator	$0.50	C	IDIQ/FFP	1QFY22
M456 Detonating Cord	$ 4.70	C	IDIQ/FFP	1QFY22
Family of Sheet Explosives	$7.00	C	IDIQ/FFP	1QFY22
M81 Igniter MN08	$2.40	SBSA	IDIQ/FFP	1QFY22
M88 Volcano Canister	$8.73	C	IDIQ/FFP	1QFY22
M34/M35 Simulators	$1.70	C	IDIQ/FFP	2QFY22
XM919 Individual Assault Munition (IAM)	$23M	C	IDIQ/FFP	2Q/FY22

Contract Strategy:
C- Competitive
SBSA - Small Bus Set-Aside
NTIB - National Technology & Industrial Base

Contract Type:
DLA- Defense Logistics Agency
FFP -Firm Fixed Price
IDIQ - Indefinite Delivery/ Indefinite Quantitiy
DOTC - DoD Ordnance Technology Consortium
CPFF - Cost-Plus-Fixed-Fee

DISTRIBUTION STATEMENT A. Approved for public release: distribution unlimited. PAO# 542-21

Summary

- Continuing to produce, deliver, and field capabilities to warfighter and accelerating when possible: AN/PSS14-C, ETEK, RF RAMS M17A1, MICLIC

- Emerging Technologies: ERP RS Dual Army Dexterity System, MICLIC alternate explosive formulations

- Explosive Breacher – High-TRL solutions for payload delivery system and mine detection sensors are needed in FY22 for evaluation and system integration

DISTRIBUTION STATEMENT A. Approved for public release: distribution unlimited. PAO# 368-21

Questions?

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MED-ENG®

A BRAND OF THE SAFARILAND GROUP

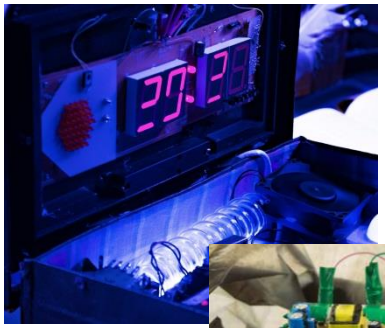
ENHANCED SITUATIONAL AWARENESS FOR THE MODERN EOD WARRIOR

ARIS MAKRIS, PH.D., V-P RD&E, CHIEF TECHNOLOGY OFFICER

2021 FUTURE FORCE CAPABILITIES CONFERENCE AND EXHIBITION – OCTOBER 19, 2021

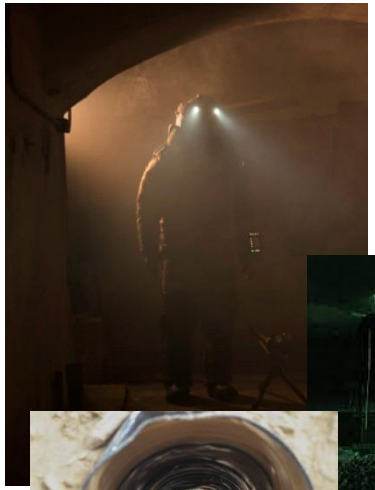
MORE COMPLEX ENVIRONMENTS FOR IEDD

Increasingly sophisticated IEDs

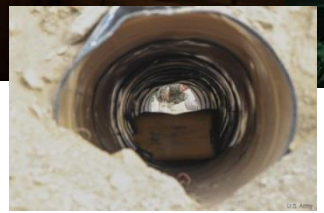




Operations in the dark / culverts







Non-permissive & Asymmetric Warfare





CBRN Contamination









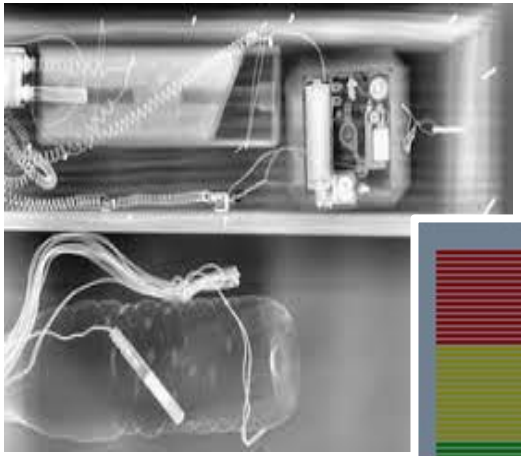
NEED FOR ENHANCED SITUATIONAL AWARENESS



Operations in tunnels & low-light environments



Night warfare/ IEDD in the dark



Access to Real-Time Data, IED x-ray, intel



SITUATIONAL AWARENESS FOR EOD TEAM

- Ever-increasing need to enhance situational awareness
- Access to information & intel in real-time
- Share information with command post & other EOD assets
- Enable operations in all environments
- Integral element of bomb tech safety and effectiveness

Live Video / Camcorder



Radio comms



Various cameras
- *Visible*
- *Low Light*
- *Thermal...*



MAPS, FLOOR PLANS USEFUL FOR RSP, PLANNING



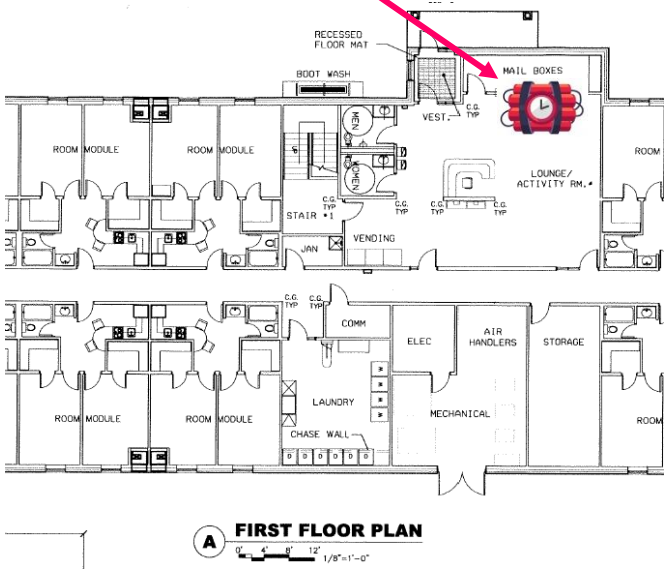
Enemy location





Escape route

Threat Location

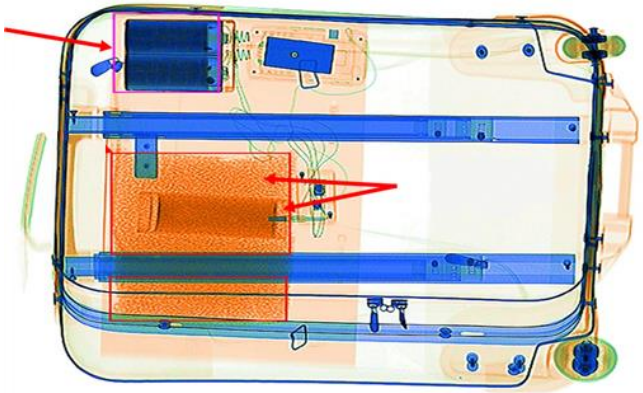


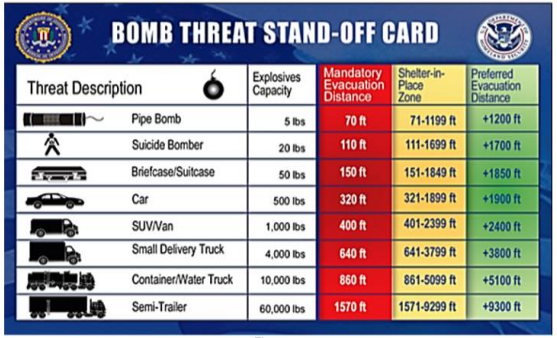
INFO ON EXPLOSIVE DEVICES, CHARTS, DATA



Access to render safe procedures that apply to current circumstances

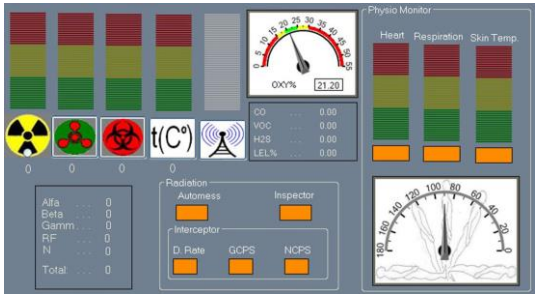
Access to x-rays on device or similar devices





Threat Description	Explosives Capacity	Mandatory Evacuation Distance	Shelter-in-Place Zone	Preferred Evacuation Distance
Pipe Bomb	5 lbs	70 ft	71-1199 ft	+1200 ft
Suicide Bomber	20 lbs	110 ft	111-1699 ft	+1700 ft
Briefcase/Suitcase	50 lbs	150 ft	151-1849 ft	+1850 ft
Car	500 lbs	320 ft	321-1899 ft	+1900 ft
SUV/Van	1,000 lbs	400 ft	401-2399 ft	+2400 ft
Small Delivery Truck	4,000 lbs	640 ft	641-3799 ft	+3800 ft
Container/Water Truck	10,000 lbs	860 ft	861-5099 ft	+5100 ft
Semi-Trailer	60,000 lbs	1570 ft	1571-9299 ft	+9300 ft

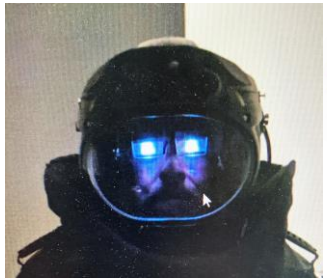
Reference to explosive threat data, charts, intel



NEED FOR SAFE/SECURE COMMUNICATION

Operator







Drone



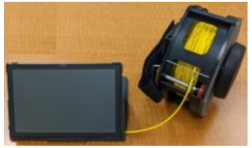


Command Post





ROV
- Sensors
- Video



Audio

Visual

Wireless

Wired

EOD OPERATIONS WITH LIGHTING OPTIONS

Distribution Statement A. Approved for public release. Distribution is unlimited

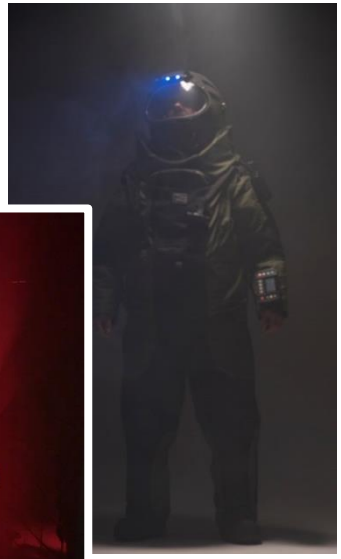
White LEDs



Red LEDs



Blue LEDs



- Must maintain situational awareness throughout
- Minimize chances of triggering light-sensitive IEDs
- Permit for local low lighting
- Reduce detection from afar

SOLDIER ENHANCED NIGHT VISION ENVG-B – L3 HARRIS

BINOCULAR GOGGLE

- White phosphor tubes and thermal imaging for dismounted soldier
- Mil Spec goggles for combat helmet

Key Features:

- Fusion technology
- Augmented technology
- Rapid target acquisition



SENSOR FUSION –VISIBLE, LOW LIGHT, THERMAL



Object edges from raw image (image segmentation algorithm)

All colors here are from thermal data

Real-time fusion of thermal camera and daylight camera data



Source: Liteye & ISTEC ICE Sign

INTEGRATED VISUAL AUGMENTATION SYSTEM (IVAS)

Provide Infantry with mixed reality headset:

- Night vision
- Thermal and day optics
- Map overlays
- Weapon sights
- Training

U.S.ARMY

Uses Microsoft Hololens technology

- Developed in 2016
- High resolution widescreen
- Head mounted display
- Accelerometer, gyroscope, magnetometer



SIGNIFICANT ADVANCES IN TECHNOLOGY FOR WARFIGHTERS & SPECIAL OPS TEAMS

Provide Infantry with mixed reality headset:

- N
- T
- N
- V
- T

U

- D
- 2.3-megapixel widescreen
- Head mounted display
- Accelerometer, gyroscope, magnetometer



What about EOD!

- EOD is not primary focus of technology for most defense companies (small market size)
- EOD is often lagging in adopting technological advances
- Enhance Situational Awareness through visual display(s) of EOD technician – Augmented Reality (AR)

NEED FOR INTEGRATED DISPLAY IN EOD HELMET

Communicate sensor outputs (visual, video, data readings)

In real-time

Enable more informed decisions

While minimizing distraction

Maximizing safety

Need integration into EOD Helmet



SOLUTION: HEADS-UP DISPLAY (HUD)

Heads-Up Displays

Transparent



Opaque



Single-Eye

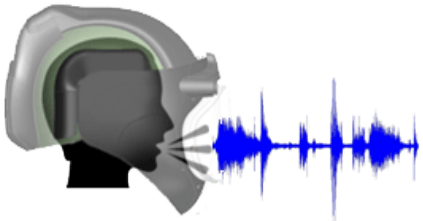


Dual-Eye



REQUIREMENTS FOR EOD:

- Image projection to an embedded HUD
  - Fit within tight space beneath EOD visor
  - Avoid ergonomic & mission interference
  - Customize technology to unique constraints
- Navigate display options / Select images:
  - Visible menus & controls
  - Voice commands
  - Audible alarms



DATA CONVERGENCE TO HEADS-UP DISPLAY

CBRN sensors

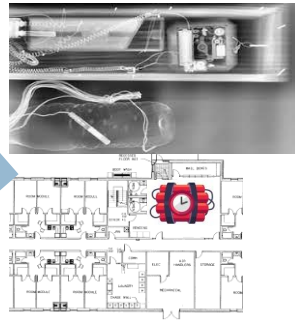




Physiological Monitoring



Plug & Play



X-rays, plans

Bomb Suit status



Multi-Spectral Image sources

Blast sensor



EOD SPECIFIC PROGRAMS SINCE 9/11

For enhanced situational awareness

CRTI
Sensor Fusion
2007-09

CBRN Research and Technology Initiative

CTTSO/IWTSD
Bomb Suit HUD
2017-22

US Army
Next-Generation
Advanced Bomb Suit
2019-22

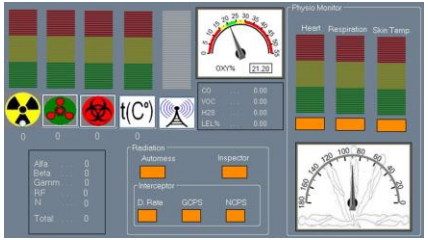
NGABS

CRTI – SENSOR FUSION FOR EOD RESPONDER





CBRNe Research & Technology Initiative 2007-09



IWTSD BOMB SUIT “HELMET MOUNTED” HUD

Distribution Statement A. Approved for public release. Distribution is unlimited

Requirements derived from evolving requirements of Military and Law Enforcement EOD











CA

LU

Dual-eye transparent HUDs

IWTSD HUD SENSORS – INTEGRATED ON HELMET

Distribution Statement A. Approved for public release. Distribution is unlimited

Multi-Spectral Camera
(Visible + Low light)

IR Illuminator

LWIR (Thermal) Camera



White LEDs

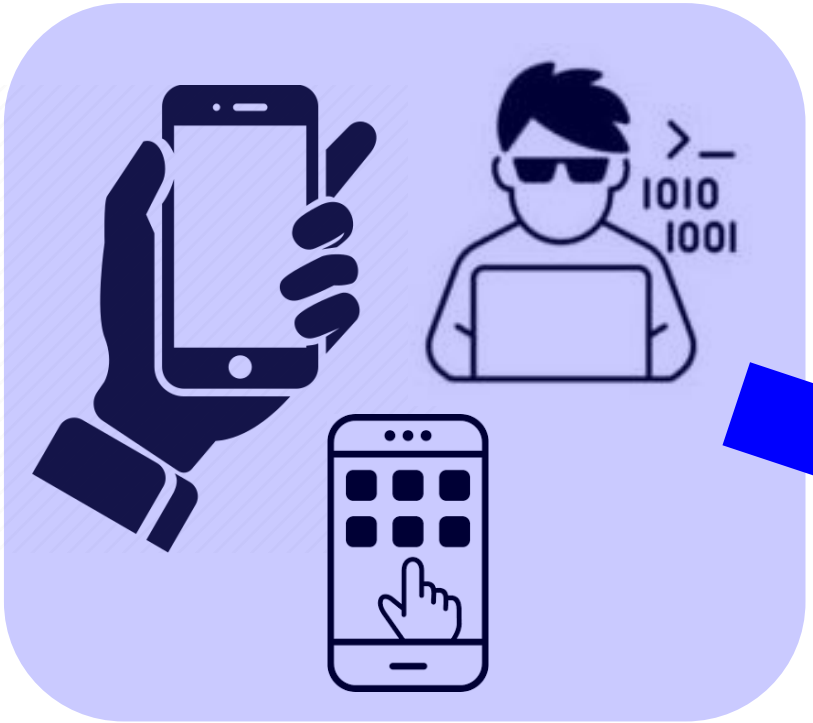




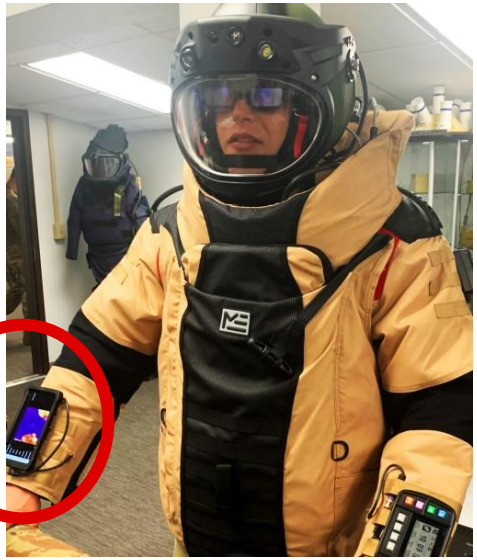
Displays:

- Camera images
- Sensor data
- Bomb suit status
- Smart Phone Images

LEVERAGE APP AND SMARTPHONE TECHNOLOGY

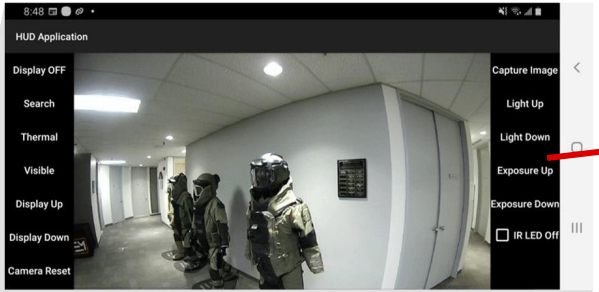


- Scalable approach
- Modest cost



IWTSD HUD – APP AND SMARTPHONE

Same image displayed on both HUD & wrist display



Voice Command Options displayed on HUD screen

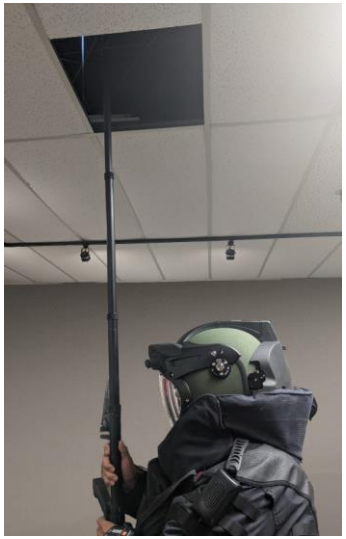
Galaxy Android with custom APP (wrist-mounted)

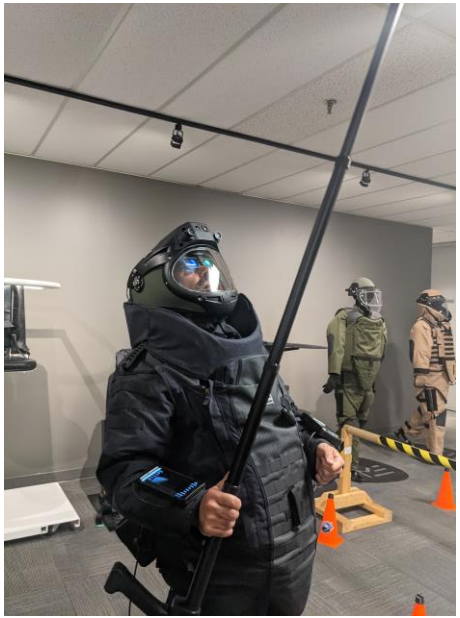


Touch-button Command Options displayed on wrist screen

REMOTE IMAGES DISPLAYED IN EOD HUD

Distribution Statement A. Approved for public release. Distribution is unlimited









HUMAN FACTORS TRIALS WITH HUD

Distribution Statement A. Approved for public release. Distribution is unlimited

Obstacle Course



Low light



Visor shade





NGABS HEADS-UP DISPLAY AND SENSOR SUITE

Distribution Statement A. Approved for public release. Distribution is unlimited



Med-Eng / QinetiQ

NGABS

***N**ext*
***G**eneration*
***A**dvanced*
***B**omb **S**uit*

U.S.ARMY



Visor Up



Visor Down



Visor Covered Augmented Reality

NGABS HEADS-UP DISPLAY – AR FOR EOD

Distribution Statement A. Approved for public release. Distribution is unlimited



- Modular & Scalable Bomb suit protection
- Multi-Sensor Suite (MSS)
- Heads-Up Display (HUD)
  - MSS sensor outputs display on HUD with user controls
- MSS & HUD mounted on combat helmet



Photo By Frederick Shear | Human Factors Evaluation with the 52nd Ordnance Group at Fort Campbell, KY

ESSENTIAL FINDINGS FOR USER ACCEPTANCE





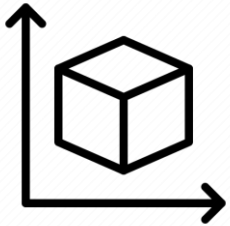
- Seamless Integration in Helmet
- Easy to don/doff
- Respect C of G
- Avoid tangling
- Avoid duplication
  - Rely on suit power
- All controls integrated
  - *No patchwork*
  - *Central control*
- Adjustability to head/eyes
- Reliable operation

CHALLENGES EXPERIENCED FOR EOD SENSORS & HUD INTEGRATION

Weight



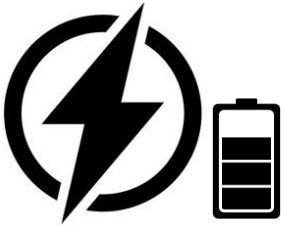
Bulk



C of G



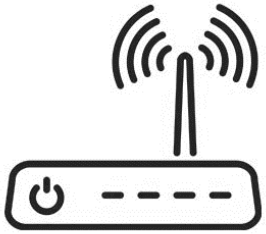
Power



Cost



EMI



Reliability & Maintenance

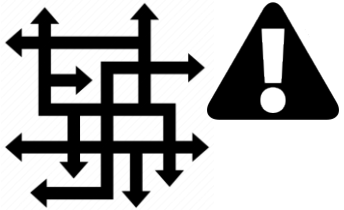


Info overload/Training



Integration Complexity

System Failure

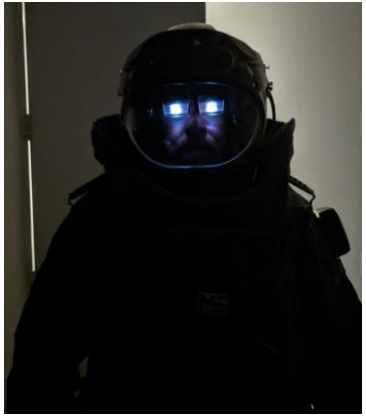


SUMMARY FINDINGS – SITUATIONAL AWARENESS

Technology will enhance safety, versatility & performance in Operations



Lighting for Smoke/Dark







Night vision & sensor fusion - Non Permissive

SUMMARY FINDINGS – CONT'D

- Better information, many sources
- Available downrange in real time, hands-free and heads-up
- Enables more efficient decision making
- Provides a real advantage for the modern EOD operator
    - Augmented Reality



SUMMARY FINDINGS – CONT'D

EOD tech will be more enabled with Augmented Reality

- Display info on HUD to avoid diverting attention from the task



- Threat sensor data
- Camera images (visible, night, thermal, fusion)
- Communication exchange
  - Reach back to data base
  - Access ROV and UAV inputs
- Interoperability with other render safe equipment
  - X-Rays on HUD
- Layout of building
- Suit status (battery, air) physiological status

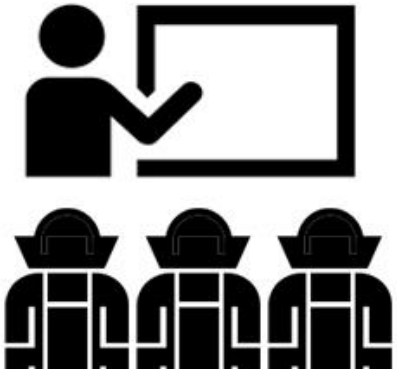
SUMMARY FINDINGS – CONT'D

But there are costs…

More expensive



More training



Higher Technology Platform needed



THE FUTURE…

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- EOD will be beneficiary from “Big Army” technological investments & advances
- EOD operators taking over the night
- Technology is rapidly advancing for EOD



Use EOD visor as the display

-Full Augmented Reality

Not there yet!!

ACKNOWLEDGMENTS



IWTSD – Explosive Ordnance Disposal and Explosive Operations (EOD/EXO)

Contract 1: N4175617C4749 – 2017
Bomb Suit Heads Up Display (HUD)

Contract 2: N4175619C3063 – 2019
Glasses-less Heads-Up Display (HUD) in Bomb Suit Helmet



US Army NGABS Program – PM SPIE or PM SPE, PEO Soldier

Collaboration with QNA: W909MY-18-9-001 / SCEC-PLA-0023
Next Generation Advanced Bomb Suit (NGABS)

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JOINT PROGRAM EXECUTIVE OFFICE
ARMAMENTS & AMMUNITION

Presented to:

Munitions Executive Summit
Acquisition Panel

Presented by:

Mr. Chris Grassano
Deputy Program Executive Officer
Armaments & Ammunition

20 October 2021







DISTRIBUTION STATEMENT A: Approved for public release; distribution unlimited. PAO Log #021-22, 13 Oct 2021.

Joint Program Executive Office Armaments & Ammunition



COL Anthony Gibbs

Project Manager
Combat Ammunition Systems
Indirect Fire Munitions and Mortar Weapon Systems
- Long Range Precision Fires
- Cannon Delivered Area Effects Munitions
- Mortar Weapon Systems



COL Russell Hoff

Project Manager
Close Combat Systems
Terrain Shaping Obstacles, Close Combat Munitions, Protection and Support Systems
- Interim Top Attack Munition
- Individual Shoulder Launched Munition
- Countermeasure Flares/Decoys



COL Paul Alessio

Project Manager
Maneuver Ammunition Systems
Direct Fire Munitions
- Small, Medium and Large Caliber
- Special Ammo & Weapon Systems



Mr. Matthew Zimmerman

Project Director
Joint Services
- Ammunition Industrial Base
- SMCA Integration
- Demilitarization
- Ammunition Logistics R&D
- Technology and Prototyping



JPEO A&A
BG Bill Boruff



DJPEO A&A
Mr. Chris Grassano SES



APEO International
Mr. Thomas Coradeschi



Dir Talent Management
Mr. Keith Gooding

Mission:
Develop, procure and field lethal armaments and ammunition providing Joint Warfighters and Allied Partners overmatch capabilities.

US Army
US Navy



Mr. John Curran

Chief of Staff
- Human Resources
- Security / Foreign Disclosure
- Acquisition Processes
- Audit Readiness
- Business Management
- Information Technology



Mr. Chris Hatch

Acting Program Manager
Towed Artillery Systems
Joint Artillery & Survey
- M777A2 Lightweight 155mm Howitzer
- M119A3 105mm Howitzer
- Target Acquisition
- Mobile Howitzer



CAPT Brian Schorn USN

Project Director
Joint Bombs
- Air Force and Navy Bombs
- Navy Deck Gun Ammo
- Energetics / Cartridge Actuated Device / Propellant Actuated Device



Mr. Eugene Conner

Director for Integration
- Science and Technology
- Systems Integration
- Architectures and Standards

Single Manager for Conventional Ammunition

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Key Development Thrusts

- Critical armaments and ammunition proactively "pulling" lethal technologies and system-of-systems capabilities from Army S&T developers like CCDC-AC, including …
  - **Extended Range Cannon Artillery** (Munitions, Weapons, Super Charge, Extended Range alternatives, Precision)
  - **Cannon-Delivered Area Effect** Munitions (anti-armor and DPICM Replacement)
  - **Mobile Wheeled Howitzer**
  - **6.8mm Ammunition for the Next Generation Squad Weapon**
  - **Terrain Shaping Obstacles**

- Leading effort to ensure Assured Position, Navigation, and Timing (A-PNT) Precision and Conventional Fires in GPS Degraded/Denied environments
  - **Assured Precision Weapons and Munitions** (including A-PNT, M-Code GPS, Network Assisted A-PNT (NA2), AltNav and non-GPS solutions)

JPEO A&A is fully engaged to develop, deliver, and ensure Combat Overmatch

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JPEO A&A's Digital Engineering Transformation

Transformation Drivers

- NDAA, DoD & Army DE Guidance
- Rapid Delivery/Upgrade of Disruptive Capabilities
- Industrial Base Modernization
- Supply Chain Resiliency
- SoS Complexity
- Big Data, AI and ML
- Remote-Work Culture

PRESENT STATE:

"**Excepted**" use of 3D Models & MBSE tools (i.e. "Islands of Excellence")

2D TDPs used in CTR solicitations/evals

Build/Test/Build Prototypes - **$$$$**

Time/labor intensive methods to address user reqmt changes & CTR RFDs/waivers

"Hi-Touch" **Industrial-Age** Mfg processes & Ammo Surveillance methods

Disparate/isolated data mgt systems & repositories

New Policies
Culture
Training
Infrastructure
Pilots/Demos

FUTURE STATE:

"**Accepted**" use of 3D Models & MBSE tools across all phases of the L/C

3D TDPs: Enables "As-Designed" vs "As-Built" CTR proposal evals & improved "clean-sheeting"

Virtual Testing of Digital Models **-$$**

"**Digital Thread**" enables faster & more complete eval of reqmt changes & waivers

Digital Mfg & **Predictive** Ammo Surveillance enabled by **AI/ML/IoT**

Cloud computing & collaborative work env based on **Authoritative Source of Truth** (ASOT)

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Eight Cross Functional Teams (CFTs) Support Army Modernization Priorities

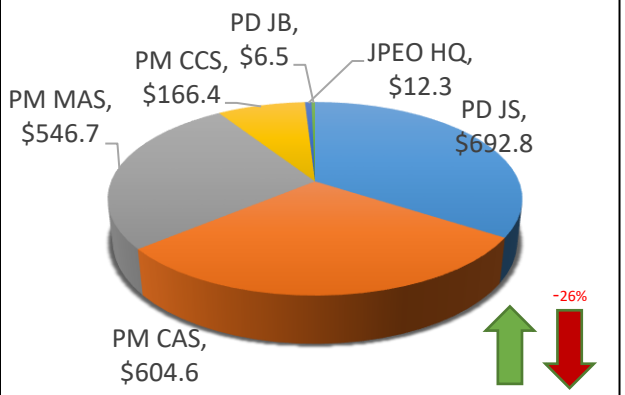


The JPEO Directly Supports Six of Eight CFTs

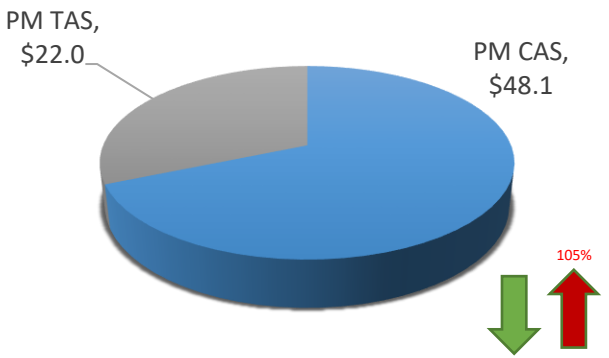
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JPEO Armaments & Ammunition
FY22 President's Budget

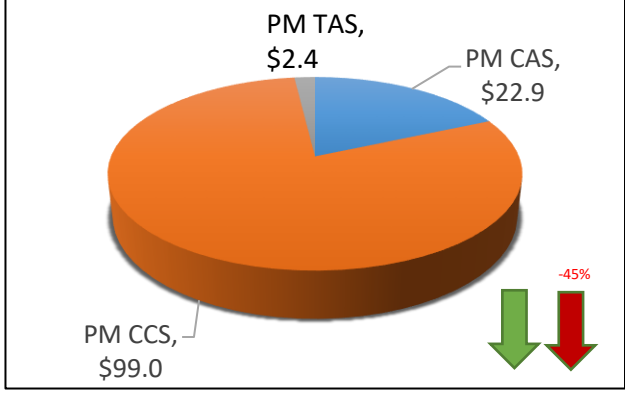
PAA $2,029.3M



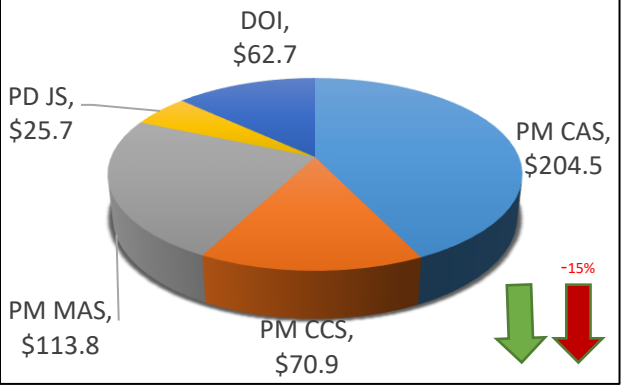
WTCV $70.1M



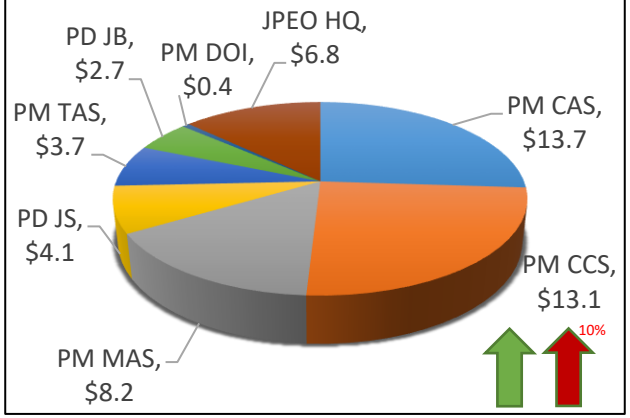
OPA $124.3M



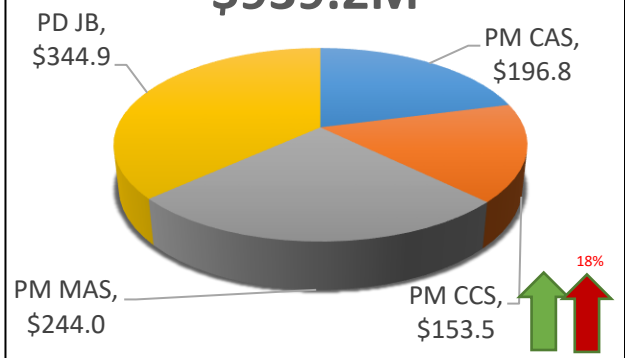
RDTE $477.6M



OMA $52.7M



Other Services $939.2M



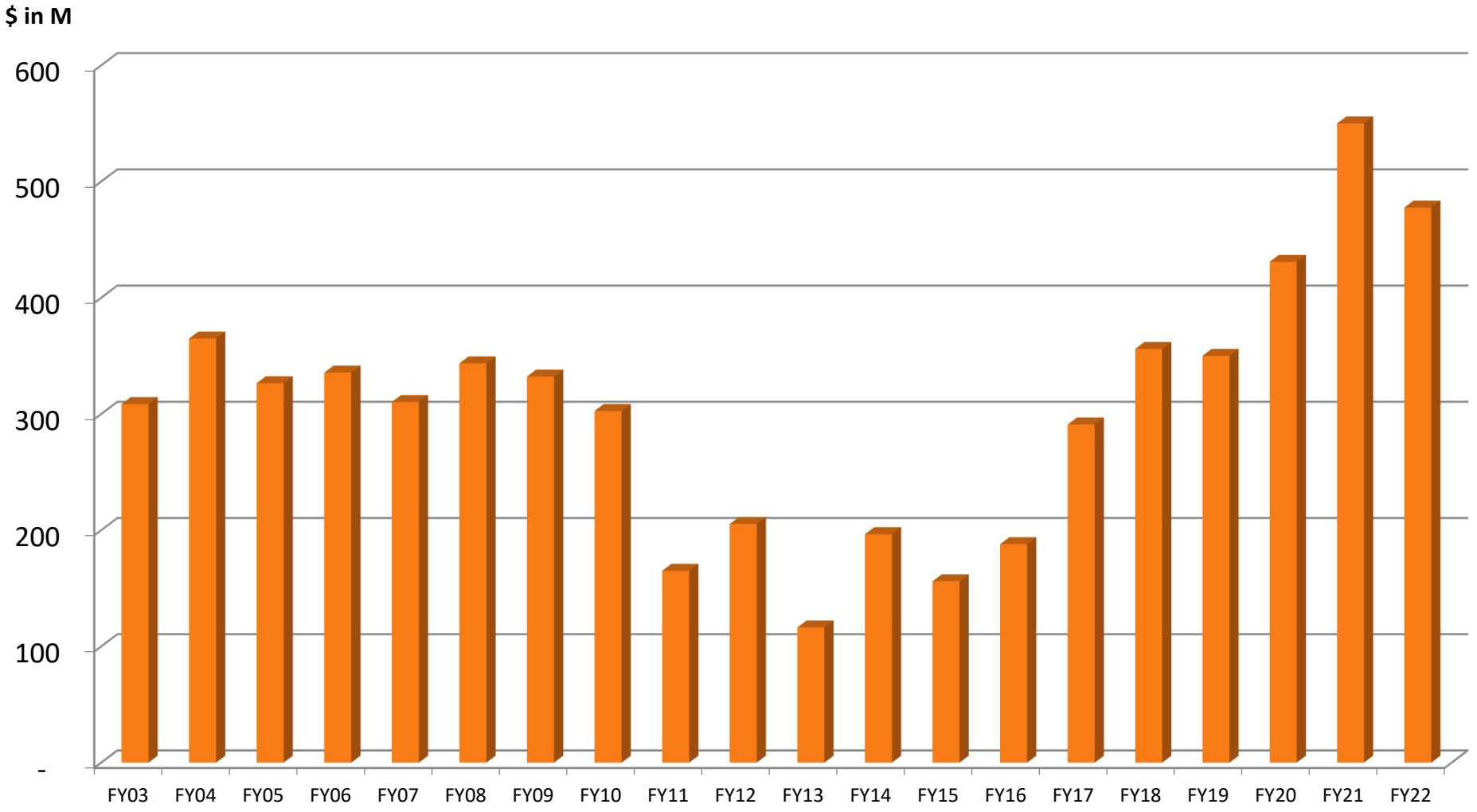
Future Trend

Total FY 22 Budget ~$3.7B

Trend from FY21 (%)

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RDTE Appropriation



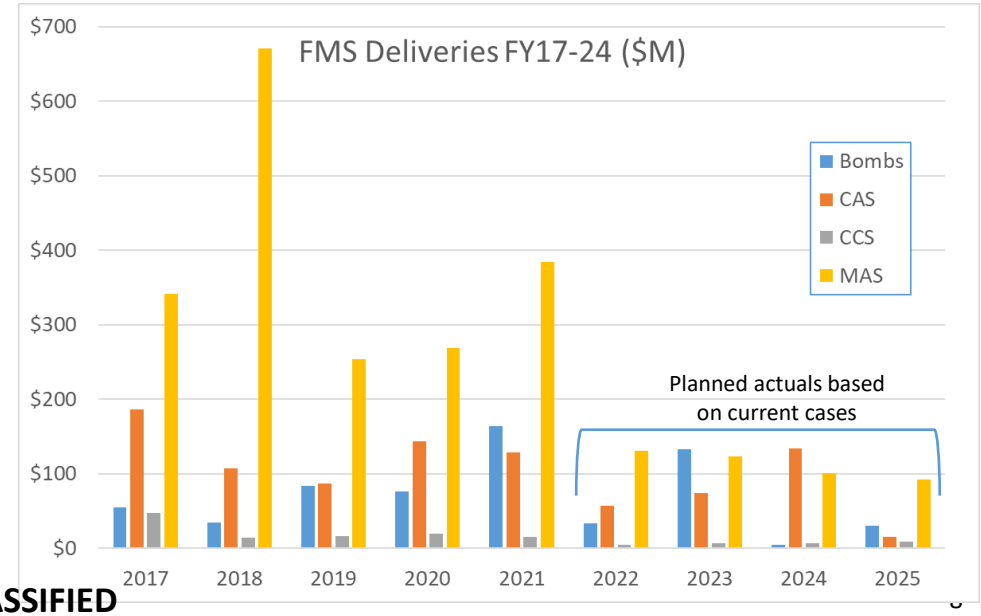
Sources: FY03-20 (Actual $'s Received)
FY21 Appropriated
FY22 (PB22LOCK)

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Developing & Maintaining Strategic Partnerships

- DoD Strategy is to encourage and enable partner nation security goals consistent with our national security objectives
- Key elements:
  - Foreign Military Sales
  - Cooperative R&D/Production
  - Foreign Comparative Test
  - Direct Commercial Sales

FMS – 66 countries
MOU – 12 countries
FCT – 5 countries



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Message to Industry

- We will continue the use of OTA where appropriate
- Focus on affordability
- Need for timely and compliant proposals
- Decline in ammunition budget – it's coming
- Move to more products / services made in America
- Thank you for your continued support

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Joint Program Executive Office
Armaments & Ammunition

Project Director Joint Bombs
2021 Munitions Executive Summit

PM Acquisition Panel
20 October 2021

CAPT Brian Schorn, USN
Project Director Joint Bombs
973-724-6487
brian.g.schorn.mil@army.mil







DISTRIBUTION A: Approved for public release, distribution unlimited (09/29/2021) PAO Log #543-21

Project Director Joint Bombs

Production | 0 – 5 Years FUE | 5 + Years FUE

Current Products



General Purpose Bombs



Penetrator Bombs



Cast Ductile Iron Bombs



Small Practice Bombs



Energetics
(Bulk High Explosives)



Bomb Fins



DSU-33
Proximity Sensor
(GP Bombs)



Army Aviation
CAD PAD

New Products

- Improved General Purpose and Penetrator Bombs

BLU-129



BLU-134
500 lb. CDI Live





BLU-137
Penetrator
Bomb

BLU-136



BLU-140
500 lb. Penetrator Bomb



~40 Active Programs

FY20 = $344.1M
FY21 = $224.8M

Total Products
Delivered in FY20:
307,000 End Items

Future Products

- Other Services retain configuration management of items



MK187 5' 54 Cal
With Multi
Function Fuze
(MFF)



MK 200
Propelling
Charge

Source: Actual $ Received

Manage SMCA acquisition of other Military Service configured munitions

Main Priorities

- Award new contracts for:
  - Nose Cone/Support Cup
  - Small Practice Bombs (BDU-33 & MK76)
  - Signal Cartridge (MK4-3)

- Complete First Article Testing and enter into production of:
  - MK 82 Tritonal LAP at MCAAP
  - MK 81 Tritonal bomb bodies at GD and LAP at MCAAP
  - M70 Series Cables

- Continue production of:
  - Tritonal filled MK84 2,000 lb General Purpose Bombs
  - General Purpose Bombs (all variants)
  - BLU-109 2,000 lb Penetrator Bombs
  - BDU-50 500 lb Cast Ductile Iron Bombs
  - MK 76 Small Practice Bombs
  - BSU-33 Conical Bomb Fins
  - MK84 Conical Bomb Fins
  - Bomb Suspension Lugs
  - MK3 & MK12 Pallets







Industrial Base Challenges

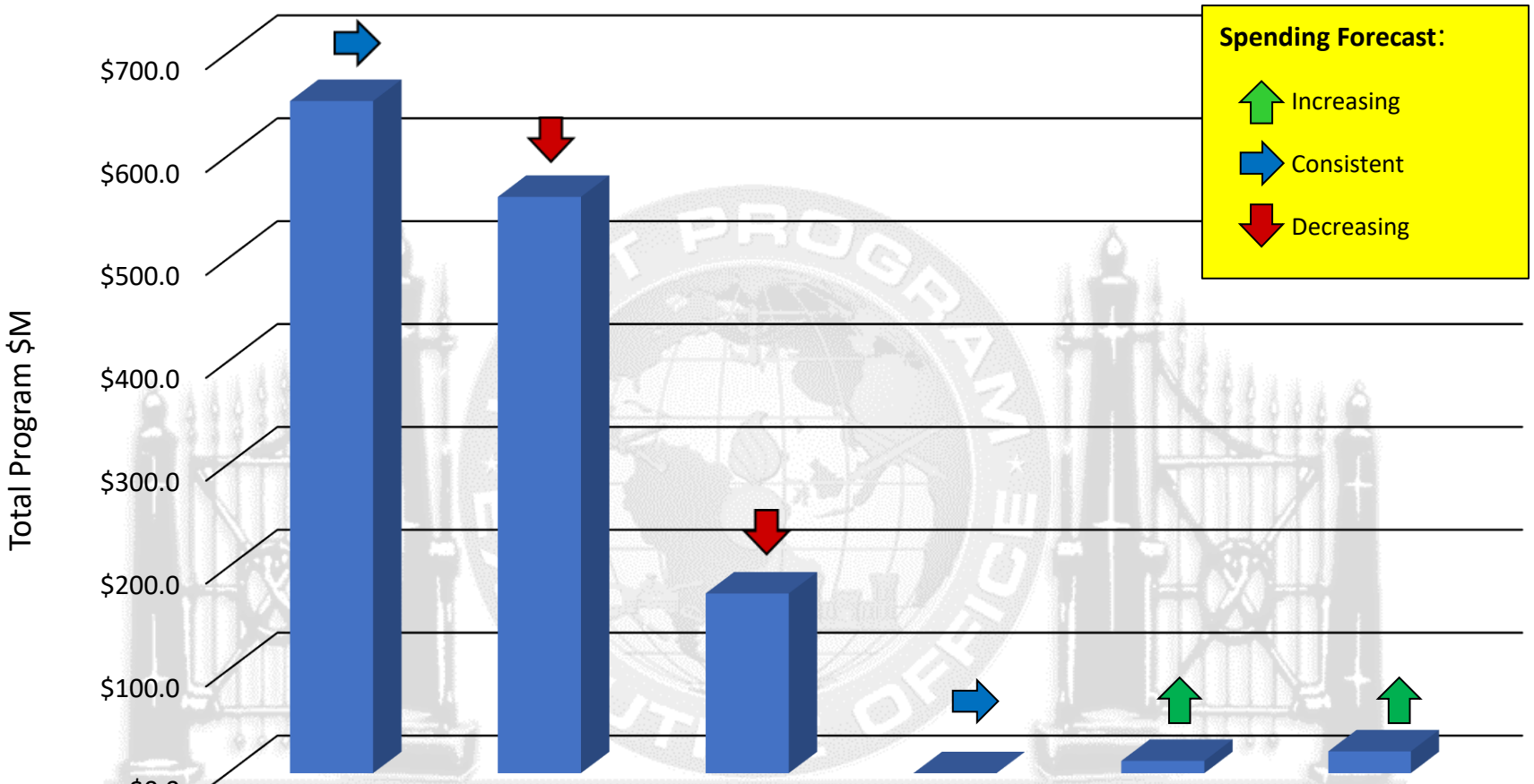
- Bombs requirements have declined after unprecedented highs; need to continue close collaboration with industry and requiring Services to maintain commercial industrial base viability
- Still need flexibility in both contracts and production facilities to absorb fluctuations in customer funding and continue to ask for your support as appropriate
- Maintain Industrial Base capabilities by keeping commercial facilities warm when requirements decrease with reduced production rates
- Government & contractors fully assess our supply chains (i.e., Single Point Failures and foreign sources of supply)
- Lead times for certain RDX-based explosives are still long but significantly shorter than before

Current Explosive Environment

- Community is still concerned about HSAAP capacity – valid concern
- The SMCA does not allocate or apportion capacity to meet any specific Service need
- Requirements placed on contract are scheduled as first-come, first-served
- Explosives prioritization process implemented as of 11 Apr 18, fbo.gov solicitation number: EXPLOSIVESPRIORITYHSAAP

For Explosive Prioritization Concerns:
usarmy.pica.peo-ammo.mbx.hsaap-prioritization@mail.mil
usarmy.pica.peo-ammo.mbx.hsaap-prioritization@army.mil
(email migration ongoing, "@mail.mil" obsolete after March 2022)

Funding Outlook



	GENERAL PURPOSE BOMBS	PENETRATOR BOMBS	PRACTICE BOMBS	FUZE/PROX SENS	SUPPORT PARTS	FINS PROGRAMS
PBD22 (FY22-26)	$653.3	$560.1	$174.7	$0.0	$12.0	$21.2

Represents Other Service Funding (Air Force and Navy) $M

PBD22: Total Portfolio ~$1.4B

Competitive Opportunities

Product	Projected RFP Release	Projected Award Date	Dollar Amount	Contract Strategy	Contract Type
CXU-3 Cold Signal Cartridge for Small Practice Bombs	4QFY21	3QFY22	$6.2M	SBSA	5 Year IDIQ
BSU-33 Fin Assembly	2QFY22	1QFY23	TBD	SBSA	5 Year IDIQ
MK84 Fin Assembly	2QFY22	1QFY23	TBD	SBSA	5 Year IDIQ
BLU-129 500lb Low Collateral Bomb	2QFY22	2QFY23	$85.3M	Competitive	5 Year IDIQ
BLU-109 A/B Penetrator Bomb	2QFY22	2QFY23	$27.0M	Competitive	5 Year IDIQ
TNT/Aluminum Powder	2QFY22	2QFY23	TBD	TBD	5 Year IDIQ
MS3314 & MK3 Bomb Suspension Lugs	3QFY22	2QFY23	TBD	SBSA	5 Year IDIQ

Closing Message to Industry

- Thank you for your sustained commitment and support to the Ammunition Enterprise and the Joint Warfighter

- General Purpose and Penetrator bomb requirements have come down from a high; the government/industry team need to work together to effectively negotiate the downturn

- Energetics consumers - please plan early and make no assumptions

  Prioritize, Plan, Prepare:

  - ✓ Prioritize internal requirements through active coordination with your PM customers and subcontractors
  - ✓ Plan for award of explosive requirements and provide funding in support of those awards as early as practical
  - ✓ Prepare for extended explosive lead times

PM CCS
PROJECT MANAGER CLOSE COMBAT SYSTEMS

ON EVERY MISSION

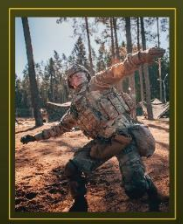
2021 Munitions Executive Summit
PM Acquisition Panel

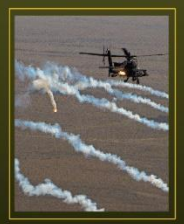
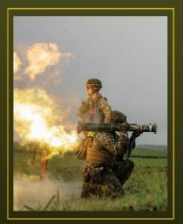
20 October 2021

COL Russell Hoff
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(973) 724-7041
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Mr. Joseph Pelino
Deputy Project Manager
(973) 724-3457
joseph.pelino.civ@mail.mil

60 YEARS OF ACQUISITION EXCELLENCE 1961 2021
PROJECT MANAGER CLOSE COMBAT SYSTEMS





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PM CCS Portfolio

ON EVERY MISSION

Protection System



AN/PSS-14C Hand Held Mine Detector



SS-ADT



Taser



Acoustic Hailing Device

Grenades



M67 Fragmentation Hand Grenade



M111 Offensive Hand Grenade



M228 Practice Fuze



M106 SOD-V_R



Smoke Grenades

Terrain Shaping Obstacle



XM204 Top Attack







XM343Standoff Activated Volcano Obstacle (SAVO)

Close Terrain Shaping Obstacle Inc 1



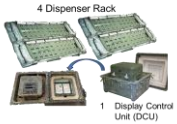
Remote Control System

Next Gen. TA Munition System



Obstacle Planning Tool

Volcano Recapitalization





Demolitions



SLAM



Claymore



RF-Remote Activation System



Shaped Charge



Sheet Explosive

Det Cord



C-4 Block

Pyrotechnics



Signals



Simulators



Countermeasure Flares

Shoulder Launched Munitions



Bunker Defeat Munition



AT4 & AT4CS



XM919 Individual Assault Munition

EOD



Explosive Ordnance Response Kit



Smart Ray Vision (SRV)



Render Safe – Sets, Kits and Outfits (RS-SKO

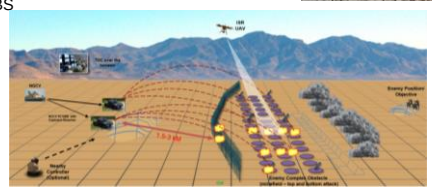
Breaching Systems



APOBS



MICLIC



Next Generation Explosive Breacher

60 YEARS of ACQUISITION EXCELLENCE

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(CUI) Team PM CCS

ON EVERY MISSION

Provide dominant and innovative lethal and protective capabilities for the Joint Warfighter through acquisition excellence

ON EVERY MISSION



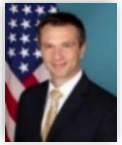
Project Manager
COL Russell Hoff



Deputy PM
Joe Pelino



Business Division Manager
Anita Polesky



Chief, Product Support
Fred Willecke



Director, Program Integration & International Division
Michael O'Grady (Actg)



Manager, Technology Management Division
John Esposito

Product Manager Terrain Shaping Obstacles



Product Manager
LTC Isaac Cuthbertson

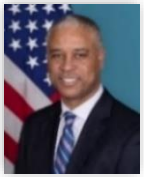


Deputy PdM
Ken Heider

Asst Product Manager(s)
CPT (P) Macias (Inbound)

Branch Chiefs
Spider & SAVO: Sean Stevens
TSO: Eli Vainchenker

Product Director Combat Armaments & Protection Systems



Product Director
David Millette



Deputy PD
Don Palathinkal

Asst Product Manager
MAJ Pfromm (Inbound)

G&PS Branch Chief
Tinesha Nicholas

Team Leads
Shoulder Launched: Phillyp Lawson
Grenades: Anthony Sacco (Actg)
Protection Systems: Derek DeReiter

Product Director Demolitions & Countermeasures



Product Director
Michael Burke (Actg)



Deputy PD
Hugh MacMillan (Actg)

Asst Product Manager
CPT Fite (Inbound)

Branch Chiefs
Pyrotechnics: Harvard Yuen
Demolitions: Tim Healy

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Team CCS Priorities

ON EVERY MISSION

- **Readiness, support to the Joint Warfighter & deliver improved capabilities**
- **Extreme Cold Weather Operations**
- **Cross Functional Team Alignment**
- **Sustain technological superiority through a quality workforce & innovation**
- **Enhance industry to government relationship**
- **Stewardship in everything we do**
- **Increase international program participation**





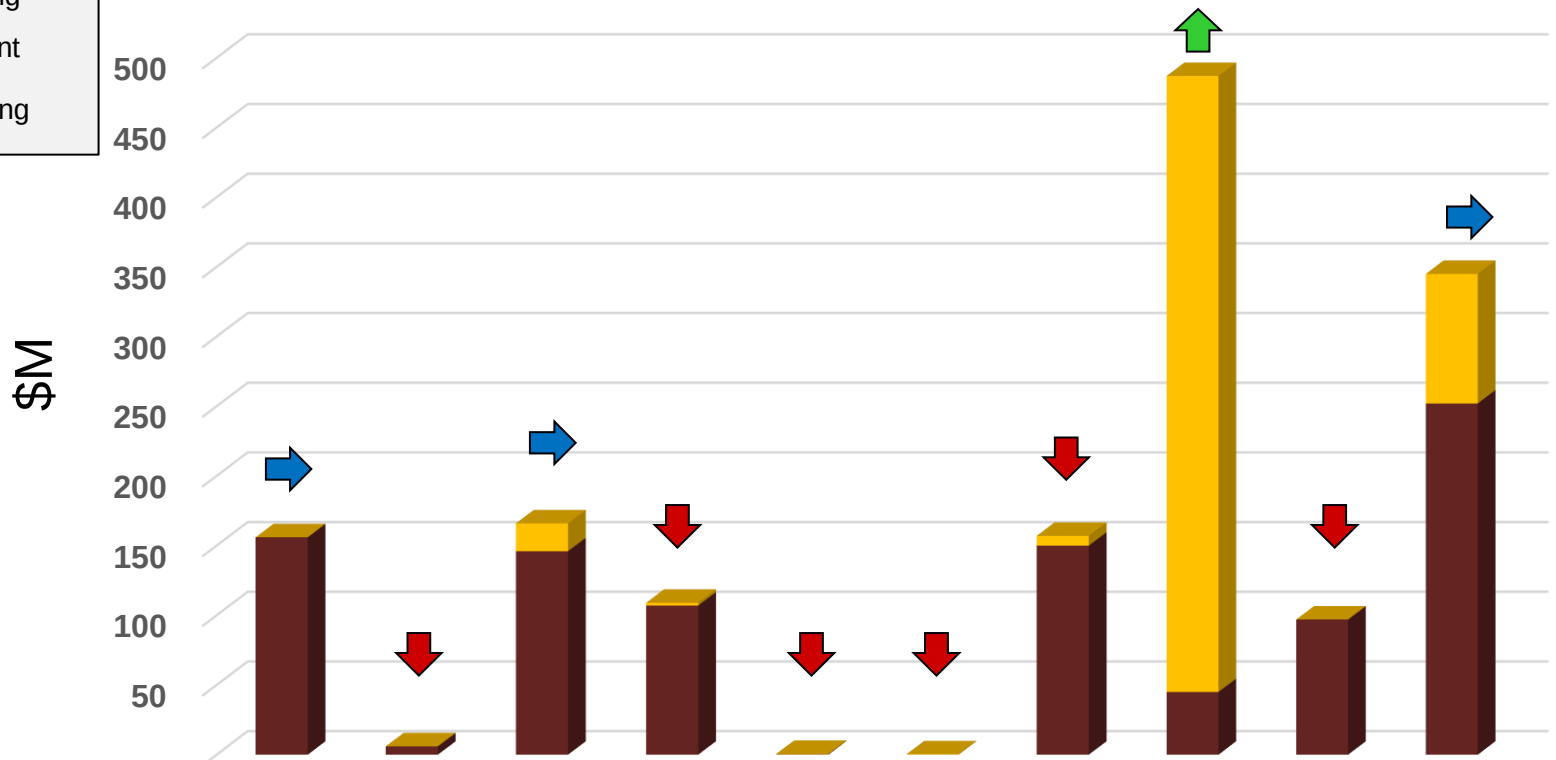


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PM CCS PB22 Budget Outlook (FY22-FY26)

ON EVERY MISSION

Spending Forecast:
- Increasing
- Consistent
- Decreasing



	TSO	Counter Explosive Hazard	Demo-litions	Pyro-technics	Non-Lethal Ammo	Non-Lethal Systems	Grenades	Shoulder Launched Munitions	EOD Equipment	Mines & Mine Clearing
PB22 (FY22-FY26) - Other Services $M	0	0	20	2	0	0	7	442	0	93
PB22 (FY22-FY26) - ARMY $M	156	6	146	107	0	-	150	45	97	252

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FY22 Competitive Opportunities

ON EVERY MISSION
60 YEARS of ACQUISITION EXCELLENCE

FY22				
Program/ Item/ Description	Planned FY22 Dollars ($M)	Planned Strategy	Contract Type	Anticipated Final RFP Release Date (QtrFY)
Close Terrain Shaping Obstacle (CTSO)- Inc 1 – Top Attack	$10.3	C	Stand Alone OTA	1QFY22
M18A1 Claymore	$9.9	C	IDIQ/FFP	1QFY22
DWEN MK160 & DWEL MK158 Delay Detonator	$0.50	C	IDIQ/FFP	1QFY22
M456 Detonating Cord	$ 4.70	C	IDIQ/FFP	1QFY22
Family of Sheet Explosives	$7.00	C	IDIQ/FFP	1QFY22
M81 Igniter MN08	$2.40	SBSA	IDIQ/FFP	1QFY22
M88 Volcano Canister	$8.73	C	IDIQ/FFP	1QFY22
M34/M35 Simulators	$1.70	C	IDIQ/FFP	2QFY22
XM919 Individual Assault Munition (IAM)	$23M	C	IDIQ/FFP	2Q/FY22

Contract Strategy:
C- Competitive
SBSA - Small Bus Set-Aside
NTIB - National Technology & Industrial Base

Contract Type:
DLA- Defense Logistics Agency
FFP -Firm Fixed Price
IDIQ - Indefinite Delivery/ Indefinite Quantitiy
DOTC - DoD Ordnance Technology Consortium
CPFF - Cost-Plus-Fixed-Fee

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Challenges Requiring Industry Partner Help

ON EVERY MISSION

Industrial Base

- Assured Munitions
  - Supply Chain Risk Management (Constituent level)
  - Electronic Component Obsolescence
- Facility Cybersecurity Requirements
- Modernize Production Methods
- Automated Non-Destructive Inspection (i.e., X-Ray) and Required Certified Personnel

Technology Base

- Novel Surface-to-Air Missile Countermeasure solutions
- Breaching Technologies
- Novel Energetic Formulations
- Advanced Fuze Design
- Improved Munition Power Sources
- Advanced Manufacturing
- Warheads

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Closing Message to Industry

ON EVERY MISSION

- **Number of RDT&E efforts transitioning to production in the FY22-24 timeframe**
- **We need to do better at modernizing legacy designs**
  - Role for both Contractor and PM
  - Leveraging other resources to modernize portfolio
- **Budgets appear to be lean - Opportunity still exists across the portfolio**
- **We can help you invest your IRAD**
- **Know your supply chain & remain vigilant in keeping them healthy**
- **Push, Push, Push, FMS & DCS – PM CCS support**

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PROJECT MANAGER COMBAT AMMUNITION SYSTEMS

Munitions Executive Summit

20-21 October 2021

Presented by:
COL Anthony R. Gibbs
Project Manager for Combat Ammunition Systems
anthony.r.gibbs6.mil@mail.mil
973 724-2003



FORGING THE FUTURE OF INDIRECT FIRE

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Sept 2021

PM CAS Family of Products

ARTILLERY


Canister Projectile


155mm ERAP


MOFA II w Next Gen Prox

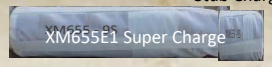

EPIAFS Modernization


M82E3 Primer


LR-PGK M1171/M1172


XM659 Stub Charge


XM660 Stub Charge


XM655E1 Super Charge

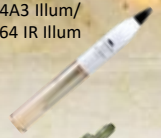

XM1208 HTK C-DAEM SMArtER

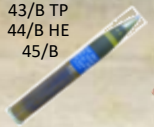

155mm XM1128 BB HE


155mm XM1113 RAP HE


M1156 PGK


105mm M1 HE


105mm M314A3 Illum/ M1064 IR Illum


Projectile Gun Unit 105mm PGU 43/B TP 44/B HE 45/B


105mm M1130


155mm BONUS


M767A1 ET

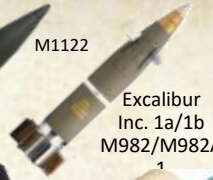

Smoke M1121 WP


155mm M110A2 SMK


155mm M485A2 Illum/ M1066 IR Illum


M1123IR/ M1124 VL


M1122


Excalibur Inc. 1a/1b M982/M982A1


EPIAFS M1155A1

155mm M107 HE


155mm M549A1 RAP


155mm M795 HE


M762A1 ET


M782 MOFA


155mm MACS M232A1/M231


M1155 PIAFS

Concept Development Production/Sustainment

MORTARS


120mm FERA


M32A2 LHMBC (Nett Warrior)


XM395 APMI


81mm HE IM M821A4


Lightweight 60 & 81mm Mortar Systems



M150 MFCS Dismounted


M326 Mortar Stowage Kit


M32/M32A1 LHMBC




M224 60mm Mortar


M120/M121 120mm Mortar


M772


M776 MT Fuze


MOFM M734A1/ M783 Fuze

Smoke
60mm – M722A1
81mm – M819
120mm – M929



High Explosive
60mm – M720A1/M888/M768/M1061
81mm – M821A4/M889
120mm – M933A1M934A1



IR Illum
60mm – M767
81mm – M816
120mm – M983



VL Illum
60mm – M721
81mm – M853A1
120mm – M930



Training
60mm – M769
81mm – M879
120mm – M931

Concept Development Production/Sustainment

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PM CAS Priorities



- Deliver Ammunition & Weapon Systems to meet or exceed Customer Required Delivery Dates
  - ✓ Execute increased deliveries of critical munitions
  - ✓ Continued emphasis on Safety and Quality
  - ✓ Field Excalibur Shaped Trajectory capability and BONUS
- Develop Long Range Precision Effects
  - ✓ Build/Test/Qualify XM1113 and XM1128 with Precision Guidance Kit (PGK)
  - ✓ Build/Test/Qualify XM1113ER (XM1210) with LR-PGK and PGK-ER
  - ✓ Design/Build/Test new family of 155mm propellant for ERCA
  - ✓ Qualify/Deliver Cannon-Delivered Area Effects Munition (C-DAEM) Armor solution
  - ✓ Extended Range Cannon (ERCA) Excalibur qualification
- Enable and Fulfill International Requirements to Strengthen Partnerships and Alliances
  - ✓ Interoperability demonstrations on foreign platforms (Caesar, K9, AS90, PzH2000)
  - ✓ 155mm Joint Ballistics Memorandum of Understanding
  - ✓ Foreign Military Sales/Direct Commercial Sales
  - ✓ Execute Co-development Project Agreements to meet shared objectives



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Industrial Base Feedback

- **COVID 19 Impacts**
  - ✓ Supply chain disruptions world wide, keep communicating risks/issues as you see them
  - ✓ Army leadership kept appraised on a weekly basis
  - ✓ Working with Army Contracting Command to review/mitigate impacts

- **Assured Munitions initiative**
  - ✓ Identifying raw material sources and assessing risks/issues
  - ✓ Looking to expand Industry involvement on risk identification/assessments/solutions
  - ✓ Assessing supply chain impacts of Buy American policy

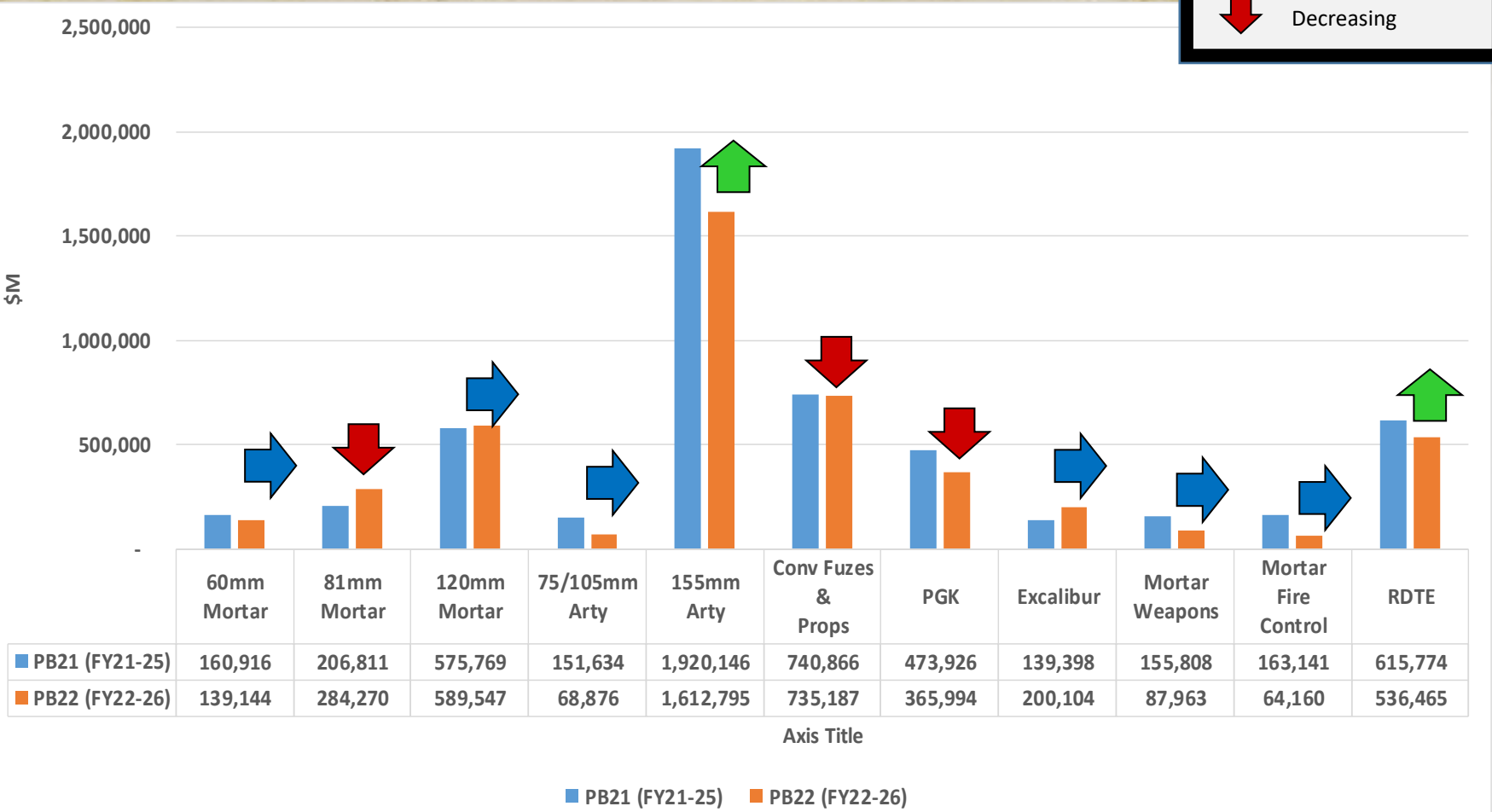
- **Quality and Production Trends**
  - ✓ X-ray and UT expertise continues to be a watch item
  - ✓ Measurement System Evaluation (MSE) clause needs proper planning
    - Tailoring of requirements (which greatly affects equipment qualification efforts) is allowed/encouraged but needs to coordinated within IPT
  - ✓ Need to achieve smart balance between development and production work
  - ✓ YPG is an acknowledged constraint that needs to be planned for effectively
    - PM CAS continues to work on prioritization of testing and potential alternative test locations

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President's Budget Comparison & Future Outlook for FY23

Future PB23 Forecast:

- Increasing
- Consistent
- Decreasing



	60mm Mortar	81mm Mortar	120mm Mortar	75/105mm Arty	155mm Arty	Conv Fuzes & Props	PGK	Excalibur	Mortar Weapons	Mortar Fire Control	RDTE
PB21 (FY21-25)	160,916	206,811	575,769	151,634	1,920,146	740,866	473,926	139,398	155,808	163,141	615,774
PB22 (FY22-26)	139,144	284,270	589,547	68,876	1,612,795	735,187	365,994	200,104	87,963	64,160	536,465

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FY22/23 Business Opportunities

Item	Acq Strategy	Projected Award	Total Value	Request for Proposal (RFP) Date/Remarks
120mm Mortar Weapon Systems (M120A1-Towed, M121-Mounted, M326-Mortar Stowage Kit)	F&OC	3QFY22	$49.2M	RFP Released 30 Jul 21
Main and Drogue Parachutes (Mortars & Artillery)	Small Business Set Aside	3QFY22	$31M	RFP Projected 1QFY22
60/81mm/120mm Mortar HE LAP	US & Canada	3QFY22	$370M	RFP Projected 1QFY22
155mm, XM1128 High Explosive Metal Part Assembly	US & Canada	1QFY23	$344.2M	RFP Projected 1QFY22
M67 Propelling Charges	US & Canada	3QFY22	$78.7M	RFP Projected 1QFY22

F&OC: Full and Open Competition

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FY22/23 Business Opportunities

Item	Acq Strategy	Projected Award	Total Value	Request for Proposal (RFP) Date/Remarks
M734/M783 Mortar Fuzes	US & Canada	4QFY22	$413M	RFP Projected 1QFY22
155mm, XM1128 High Explosive, Load, Assemble & Pack	US & Canada	4QFY22	$412M	RFP Projected 1QFY22
Mortar Fire Control System (FIRECON-Pro)	F&OC	1QFY23	$49.1M	RFP Projected 2QFY22
155mm, XM1113ER Production	SS	4QFY22	TBD	RFP Projected 1QFY22
60/81mm/120mm Mortar FRPC LAP	US & Canada	1QFY23	$130M	RFP Projected 1QFY22
M28B2 Primer	US & Canada	4QFY22	$20.1M	RFP Projected 1QFY22
Projectile Gun Unit (PGU) 43B/44B/45B, M1 Cartridge	US & Canada	1QFY23	$213.8M	RFP Projected 2QFY22

F&OC: Full and Open Competition
SS: Sole Source

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FY22/23 Business Opportunities

Item	Acq Strategy	Projected Award	Total Value	Request for Proposal (RFP) Date/Remarks
105mm Smoke M84A1 Smoke Artillery Projectile/120mm HC Smoke Training Cartridge and 81mm Flash Bang Mortar Cartridge	TBD	TBD	TBD	Market Survey Released August 2021; Assessment Ongoing
M772/M776 Fuze	SS	1QFY23	$49.8M	RFP Projected 2QFY22
60mm/81mm Body Tube and Tail Cones	Small Business Set Aside	2QFY23	$29.8M	RFP Projected 2QFY22
60mm/81mm Mortar Tail Fins	Small Business Set Aside	2QFY23	$49M	RFP Projected 3QFY22
60mm/81mm Shell Bodies	US & Canada	2QFY23	$170.9M	RFP Projected 4QFY22

TBD: To Be Determined
SS: Sole Source

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FY22/23 Business Opportunities

Item	Acq Strategy	Projected Award	Total Value	Request for Proposal (RFP) Date/Remarks
M751/M775/M781 Practice Fuzes	US & Canada	1QFY23	$74.7M	RFP Projected 3QFY22
60mm/81mm/120mm Mortar Propelling Charges	US & Canada	4QFY23	$499M	RFP Projected 1QFY23
155mm, XM1113 Production	SS	2QFY23	TBD	RFP Projected 2QFY22
60mm/81mm/120mm Ignition Cartridges	TBD	TBD	TBD	Market Survey Posted 4QFY21
Artillery Fiber Containers	TBD	TBD	TBD	Market Survey Posted 4QFY21
Mortar Fiber Containers	TBD	TBD	TBD	Market Survey Posted 4QFY21

SS: Sole Source
TBD: To Be Determined

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FY22/23 Business Opportunities

Item	Acq Strategy	Projected Award	Total Value	Request for Proposal (RFP) Date/Remarks
155mm Burster Tube Assembly, 105mm/155mm Expulsion Charge Assemblies/Booster Case	TBD	TBD	TBD	Market Survey 1QFY22
Excalibur Engineering Services	TBD	TBD	TBD	Market Survey 1QFY22

TBD: To Be Determined

TBD: To Be Determined

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Additional PM-CAS Priorities

- Automated inspection and classification of explosive melt-pour, pressed, or cast cure defects using X-Ray or other Non-Destructive methods.
  - ✓ Develop scientific understanding of probability and consequence of explosive defects causing system level hazards including in-bore detonation (i.e. cracks, low density, uncoated grains, etc.)
  - ✓ Large number of new/unique explosive fills and need for very quick fielding (UMR) schedules requires an improved understanding and inspection method.
- Higher performing, and affordable, post launch propulsion to include rocket motors and base bleeds
- System level development of higher muzzle velocity producing propulsion systems, including:
  - ✓ Surface coated multi-base (SCMB) type propellants to flatten temperature/velocity curve
  - ✓ Investment in ignition system and case optimization to maximize Muzzle Velocity to Peak Pressure Ratio
  - ✓ Improved tube materials/liners to enable hotter burning propellant
  - ✓ Improved muzzle brakes, recoil systems, etc. to enable higher impulse to the gun

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Additional PM-CAS Priorities *(cont.)*

- Projectile systems that can survive higher pressures and set-back/set-forward loads to take advantage of ERCA 100ksi capability
  - ✓ Improved obturator/rotating bands for both spinning and non-spinning projectiles
  - ✓ Improved strength/weight structures for warheads, projectile joints, etc
  - ✓ Improved electronic and optical mounting and damping systems to lessen load transfer, particularly set forward, to sensitive components
  - ✓ Investment in hardening hollow cavity devices and optics to higher set-back/set-forward loads
  - ✓ Decreased sensitivity (or better scientific understanding) of warhead, rocket motor and other energetics to higher pressure and setback acceleration environment
- Fuze Setting to Support Higher Power and Data Requirements and Autoloader Integration
- Manufacturing and test methods to allow for rapid technology insertion
- Mortar technologies – Range, lethality, mobility, advanced lightweight pointing devices and fire control

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Industry Takeaways

- Clear understanding of what the Product Costs is Important to the PM and PCO
  - ✓Affordability Remains Critical
- Agility needed to meet Army Futures Command requirements
  - ✓USG: Acquisition approaches
  - ✓Industry: Ability to respond for more rapid fielding
- Industry/Government Partnership is key to mission success
  - ✓New development programs moving toward Urgent Material Releases
  - ✓New production opportunities
- Cyber threat is real and a new warfighting function
- Continued support of FMS and DCS opportunities



Shifted from a model where USG learns and then asks industry to produce…
To a model where USG and industry learn at the same time,
enabling faster transition to Production and Delivery

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Mobile Minefield:
How To Kill Modern Tanks Without Tanks

By:

Howard D. Kent, ADG, LLC

&

Dewey Akers, Akers Innovations, LLC

NOTE: Approved For Public Release

Contents:

3. Introduction
5. Modern Tank Passive, Reactive And Active Armor
13. Low Cost Mobile Minefield Concept
23. Conclusions
24. Recommendations
25. Credits

NOTE: Approved For Public Release

Introduction:

Questions?

How Can You Destroy, Not Just Disable, Modern Tanks With Advanced Protection When You Have No Tanks Of Your Own?

What Weakness Do All These Tanks With Advanced Protection Possess?

NOTE: Approved For Public Release

Introduction:

Answer?

Proposed Is The Use Of “Bottom Attack” Techniques

And

Rapid Integration Of Commercial Products Into A Weapon

NOTE: Approved For Public Release

Modern Tank Passive, Reactive And Active Armor:



Israeli Trophy System

NOTE: Approved For Public Release

Modern Tank Passive, Reactive And Active Armor:

Composite, Spaced, And/Or Explosive Armor Plus Radar Guided Interceptors?



Clockwise From Above Left: Daily Mail UK Russian Armata, Wikipedia Chinese Tanks, Russian Tanks, Weapons & Warfare Photo Close Up Tank Turret

NOTE: Approved For Public Release

Modern Tank Passive, Reactive And Active Armor:

Armor Combinations Infantry HEAT Rounds Have Difficulty Getting Through?





Above Left To Right: Military Today M60 Reactive Armor, Quora Reactive Armor Hit Kontakt 5 or Arat

NOTE: Approved For Public Release

Modern Tank Passive, Reactive And Active Armor:

Plus Plows, Blades And Roller Systems To Defeat Buried And Surface Laid Mines?







Above Left To Right: Pinterest Mine Roller Abrams, Mike's Research Plow Abrams, Army Technology Leopard 1 Dozer Blade

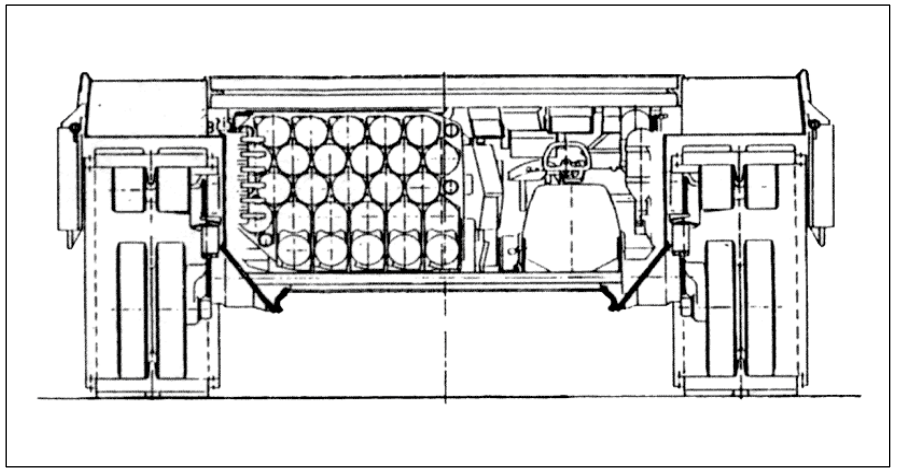
NOTE: Approved For Public Release

Modern Tank Passive, Reactive And Active Armor:

But Belly Armor Elements Of Most Battle Tanks Are Comparatively Thin…



Рис. 3.8. Схема броневой защиты танка Т-72

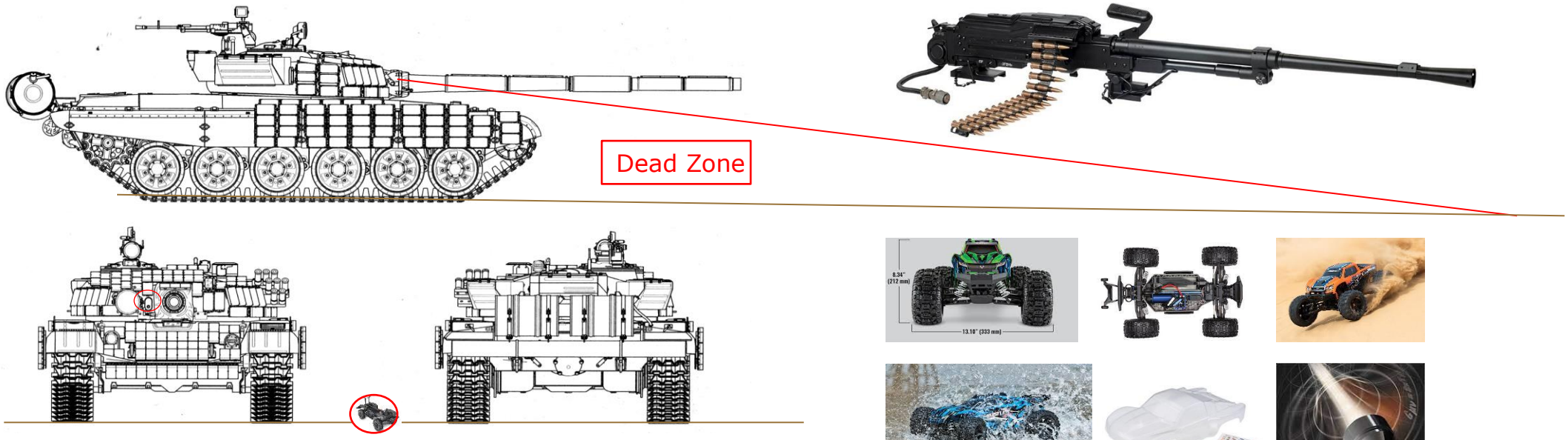


Above Left To Right: T-72 Belly Armor 20mm, Leopard 2 Belly Armor 19mm

NOTE: Approved For Public Release

Modern Tank Passive, Reactive And Active Armor:

And The Tank Coaxial Weapon Has A Minimum Engagement Range Even If Manned…



Above Left To Right: FAS.org T-90, ROE.ru Photo PKT Machine Gun, TRAXXAS Vehicles, Hunting Titan Energetics Shaped Charge

NOTE: Approved For Public Release

Modern Tank Passive, Reactive And Active Armor:

Plus Even Small Tanks Have Plenty Of Ground Clearance For Bottom Attack Methods…











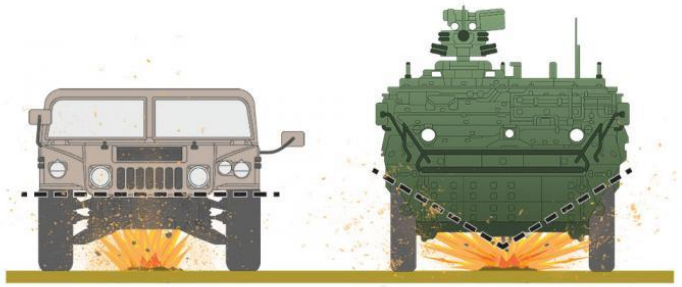
Clockwise From Top: Sturgeon's House Tank Comparison, Chinesew Norinco Tank, National Interest Chinese Tank, The Global Times Chinese Light Tank, Weapons And Warfare Russian T Series Tank.

NOTE: Approved For Public Release

Modern Tank Passive, Reactive And Active Armor:

If You Can Defeat Tanks, Fixed Targets Or Other Less Well Armored Vehicles With Lighter Armor Are Vulnerable To UGV Munitions





Blast Weapon: Not Even With Penetrating Shaped Charge Jet



Above Left To Right: VOA Car Landmine Photo, DSIAC JLTV Underbody Explosion Study, US Army Photo Destroyed Transport Vehicle

NOTE: Approved For Public Release

Low Cost Mobile Mine System:



UK MOD Robotic Carrier Concept

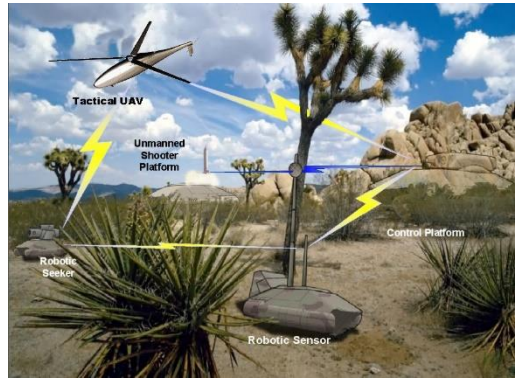
NOTE: Approved For Public Release

Low Cost Mobile Mine System:

The Future Is Ground Drone Munitions Deployed From Larger Robotic Platforms:







Smaller Robots May Be Deployed Manually, Or By "Carrier UGV Systems" To Enable Covert Reconnaissance And High-Risk Strikes Against Asymmetrical Targets…

Above Left To Right: BBC Textron Ripsaw Photo Carrier Vehicle, ADS Groundcraft Carrier, FAS Networked Forward Deployed Robotics.

NOTE: Approved For Public Release

Low Cost Mobile Mine System:

Example: Modified **TRAXXAS** 4x4 Off Road RC Vehicle As Basis Of Munition…

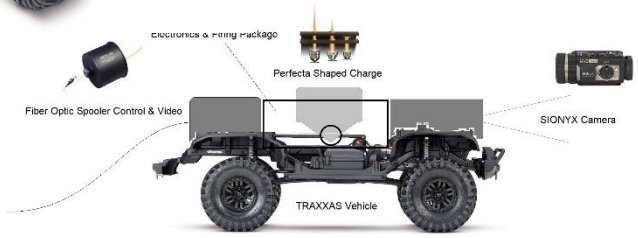
- Unjammable **SEDI-ATI** Fiber Optic Spool Control And High Resolution Day/Night **SIONYX** Video
- Highly Capable Off Road Racing Vehicle Chassis With Camouflageable Ballistic UDHDPE Body
- Two (2) **Hunting Titan 2**" OD Tungsten Lined Shaped Charges With Blast Fragmentation Rings
- Over 5' Penetration In Concrete, 12" Penetration Of Steel, Over 5 Million Commercial Charges/Year











NOTE: Approved For Public Release

Low Cost Mobile Mine System

What **TRAXXAS** 4x4 Off Road RC Vehicles Are Capable Of:

Fast, Powerful, Not A Child's Toy And Coincidentally Made On Taiwan…

















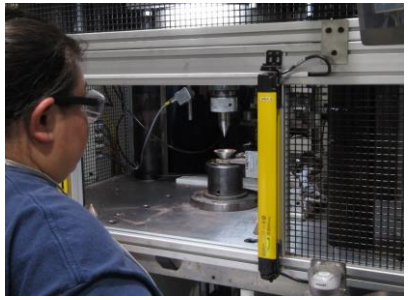


Above: TRAXXAS Photos

NOTE: Approved For Public Release

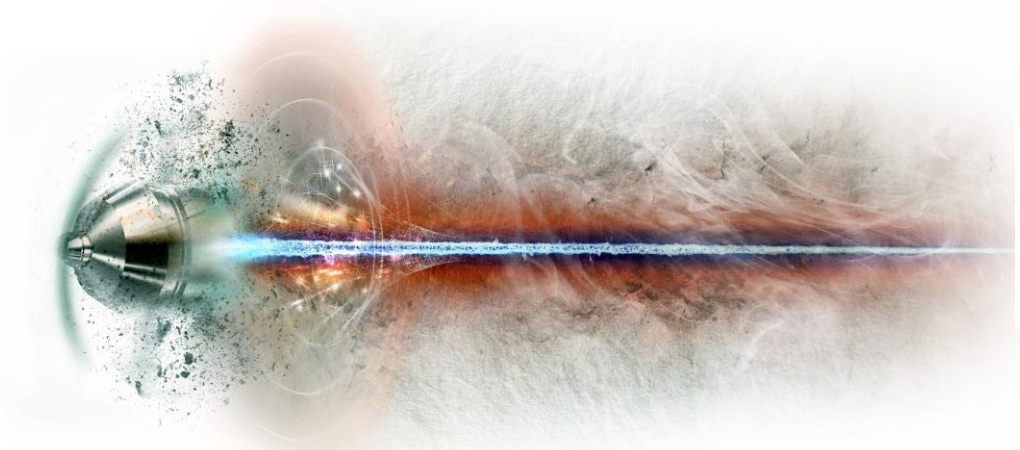
Low Cost Mobile Mine System

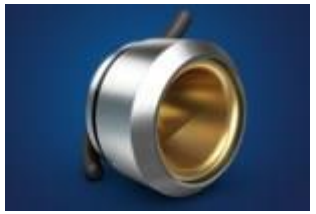
The Key To Effectiveness And Affordability Is **Hunting Titan's Energetics Group**



High Volume, Low Cost Manufacturing







Shaped Charges



Detonating Cord



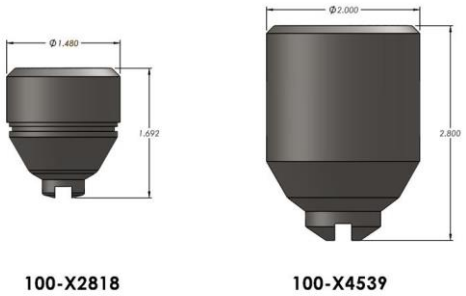
RF Safe Firing Switch
99.999% Reliability over 5 million runs

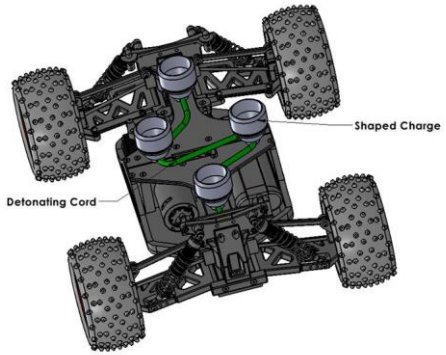
Hunting Titan Energetics Produces Millions Of EQUAfrac And Perfecta Charges Capable Of Penetrating Heavy Wall Well Casings And Up To 5 Feet Of Concrete-For Petroleum Recovery

NOTE: Approved For Public Release

Low Cost Mobile Mine System

The Key To Effectiveness And Affordability Is **Hunting Titan's Energetics Group**





HUNTING





Hunting Titan Energetics Shaped Charge Performance On Steel And Concrete In Field Testing Under Actual Petroleum Recovery Conditions With Millions Produced.

NOTE: Approved For Public Release

Low Cost Mobile Mine System

The Key To Affordable HD Video In High And Low Light Conditions is **SIONYX**:

The Most Advanced Full Color Night Vision Technology: Light Weight, Self Contained, Mountable, Water Resistant, GPS, WiFi

SIONYX



Color Vision Will Aid Discrimination In Red vs. Blue Engagements, Cost Is Less Than 1/3 Of PVS-14 Systems, Superior Image Resolution.







Above Left To Right: SIONYX PRO, USCMCORPS Photo, SIONYX Photos Helmet Mounting For Scale, Four Modes Of Display For Varying Mission Descriptions, Low Light CMOS Technology.

NOTE: Approved For Public Release

Low Cost Mobile Mine System

The Key To HD Video And Jam Proof Communication Is Fiber Optic Control:

AOC

TEMPEST
EMSEC





SEDI-ATI
fibres optiques

OFS Optics USA





Above: SEDI-ATI Fiber Optic Reusable And Disposable Spoolers In 300m And 500m Lengths, OFS USA Fiber Optic Solutions Catalog Including Aramid Armored Micro Fiber

NOTE: Approved For Public Release

Low Cost Mobile Mine System

The Key To Stealth And All-Weather Endurance Is **Kennon Covers**

Effective Camouflage, Protection From The Elements & **DisapIR** Non-Reflective Coating For Multi-Mode Stealth

AOC

TEMPEST
EMSEC



Protects **Sionyx** Camera, **Hunting Titan** Charges & Firing Train, And Vehicle Systems

NOTE: Approved For Public Release

Low Cost Mobile Mine System

The Key To Stealth And All-Weather Endurance Is **Kennon Covers**



NOTE: Approved For Public Release

Conclusions:

- Even Well Protected Tanks Will Not Withstand Shaped Charge Bottom Attack…
- Tanks And Other Armored Vehicles Have Limited Defenses Against Fast UGVs…
- Small UGV Munitions Can Also Provide Covert Forward Reconnaissance…
- Due To Low Cost, Thousands Can Be Made For The Price Of A Single Tank…

NOTE: Approved For Public Release

Recommendations:

- Develop: COTs Or Militarized Commercial Vehicles And Accessories

  If The UGV Is Only Going To Be Used Once…Make Sure You Can Afford Many

- Deploy: Hundreds Along Landing Beaches And Choke Points To Deter Invaders

  Effectively Creating A Moving Minefield Which Does Not Merely Disable Vehicles:

  It Kills Them…

Armor Development Group

"Contra Hostis Humanii Generalis"

Against The Enemies Of Humanity Everywhere…

NOTE: Approved For Public Release

Credits:



POC: Howard D. Kent, CEO, Phone: 818-314-8636, e-Mail: HKent@Peak.org

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Defense POC: Howard D. Kent
Armor Development Group LLC
Email: hkent@peak.org
Phone: 818-314-8636
&
Christopher Sokolove, GM
Hunting Titan Energetics

NOTE: Approved For Public Release

Credits:

With Special Thanks To:



SIONYX Digital Night Vision

Mr. Nathan Lombard, VP, SIONYX
Email: nlombard@sionyx.com
Phone: 503-953-0964

Mr. Clay Foulk, SIONYX Military
Email: cfoulk@sionyx.com
Phone: 503-329-0780

KENNON™

ISO 9001:2008 CERTIFIED

KENNON Protective Covers
With
Transhield Technology

Mr. Jim McLaughlin, Kennon Military
Email: jim@kennoncovers.com
Phone: 610-348-9879

NOTE: Approved For Public Release

Credits:

The Testing And Demonstration Facilities Of:

Mr. Joby Hawkins

LTC Steve Brown, USA-Ret.







Secure Confidential Research And Development Location
For Defense Applications In Laurens, South Carolina

nP TECHNOLOGY

NOTE: Approved For Public Release







U.S. ARMY COMBAT CAPABILITIES DEVELOPMENT COMMAND

Suppressor Session
20 OCT 2021

Adam M. Jacob

Project Management Engineer

Joint Service Small Arms Program

UNCLASSIFIED
DISTRIBUTION STATEMENT A. Approved for public release: distribution unlimited.

JS3 IPT



Harmonize Signature Suppression Community

- Test methods and standards
- Service-specific requirements
- S&T efforts
- Data sharing – past and current

Collaborate Across the Joint Services

- Joint S&T requirement development
- Joint S&T project execution
- Collaboration on suppressor efforts across Services

Engage with Industry, Academia, International

- Annual Suppressor Summit
- Participation in NATO WGs
- Site visits
- Participation in conferences and shows
- DOTC, SBIR, etc.

GOAL / VISION

To delivery capability to the Warfighter by collaboratively and efficiently developing **advanced signature suppression technologies, measurement methods,** and **fundamental understanding** of scientific phenomenon behind small arms signature.

AGENDA

Time	Title	Briefer(s)
1305-1315	**STANREC 4785 Suppressor Test Methods**	Dr. Les Flemming (NSWC Crane) and Mr. Adam Jacob (JSSAP)
1315-1325	**Modular Suppressor Test Bed Design of Experiments**	Mr. Dan Cler (DEVCOM AC)
1325-1335	**Suppressor Cleaning**	Mr. Zachary Torigian (DEVCOM AC)
1335-1345	**Intermediate Caliber Virtual-Baffle Suppressor System**	Dr. Phillip Burnside (NSWC Crane)
1345-1355	**Surefire's Advanced Suppressor Program – Blending Experience with Technology to Bring Next Generation Signature Suppression Technology to the Warfighter**	Mr. Barry Dueck (Surefire)
1355-1405	**7.62mm Belt-Fed Suppressor**	Mr. Phillip Haag (Radical Firearms/Radical Defense)
1405-1415	**Maxim Defense M240 Suppressor**	Mr. David Steinbach (Maxim Defense)

U.S. ARMY COMBAT CAPABILITIES DEVELOPMENT COMMAND
ARMAMENTS CENTER

Modular Suppressor Test Bed Design of Experiments

2021 Future Force Capability Conference and Expo, Columbus, GA

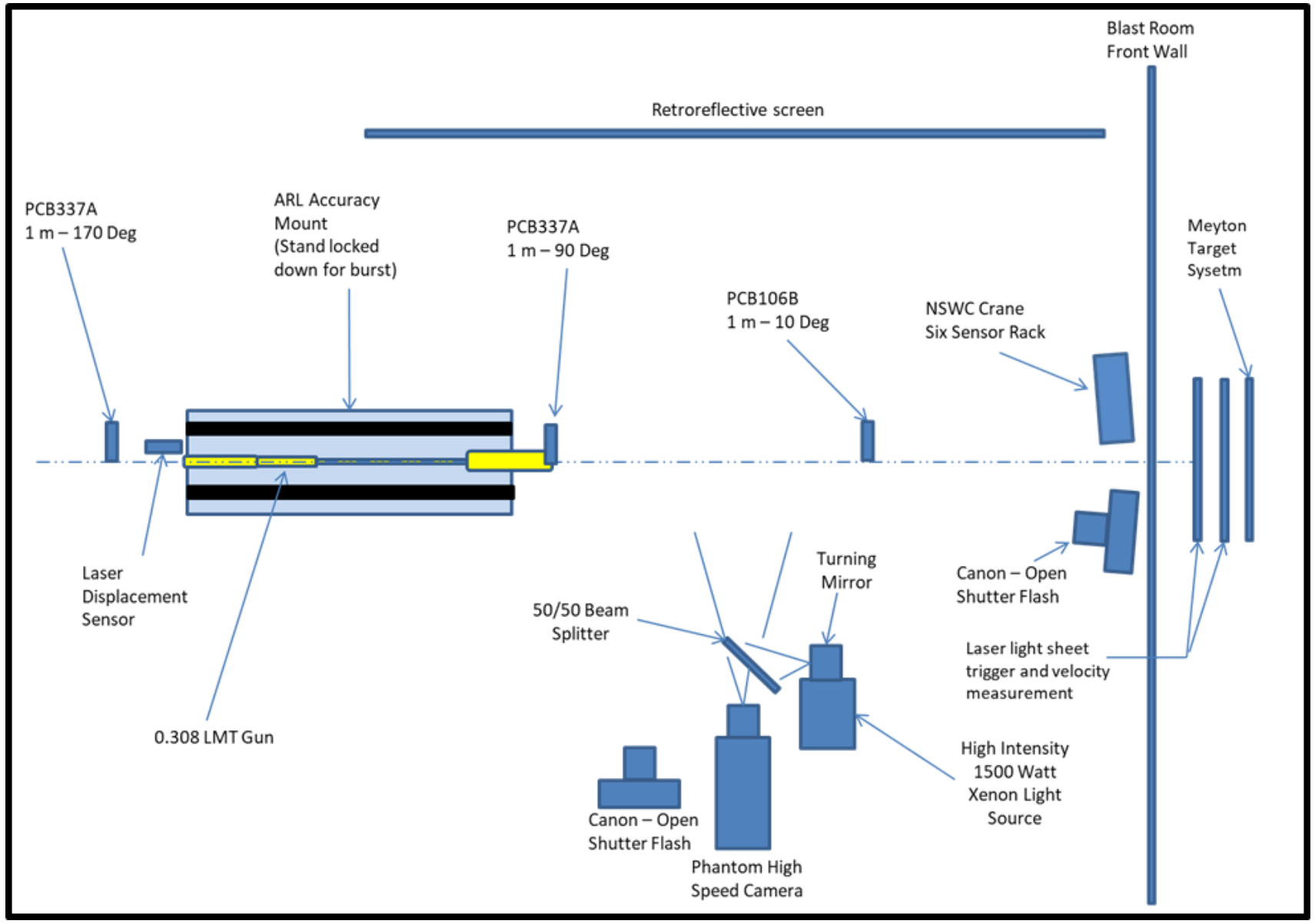
Daniel L. Cler, Gregory Oberlin, Eric Binter & Timothy C. Cler

DEVCOM – Armaments Center / DEVCOM – Army Research Lab

18-21 October 2021

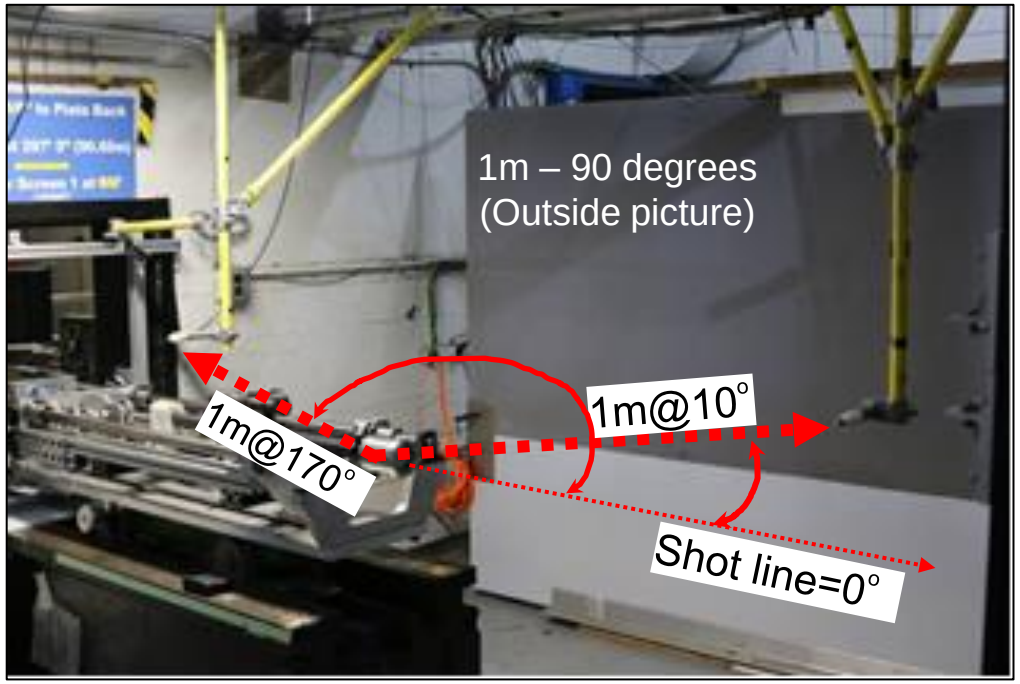
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TEST SETUP LAYOUT



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TEST SETUP EQUIPMENT



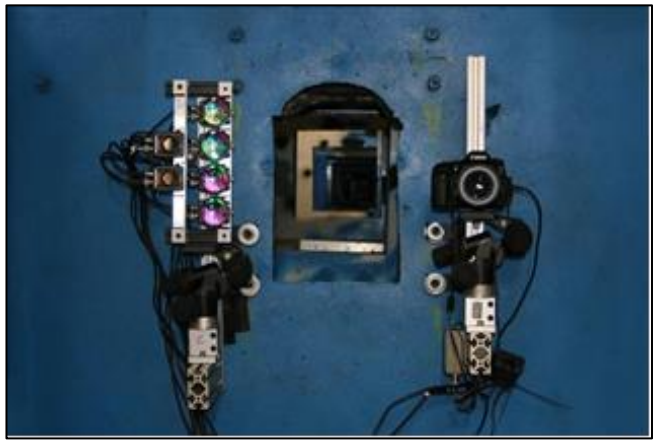
Sound Gage Layout



Shadowgraph Light Source (L) and Camera (R)



Recoil Mount

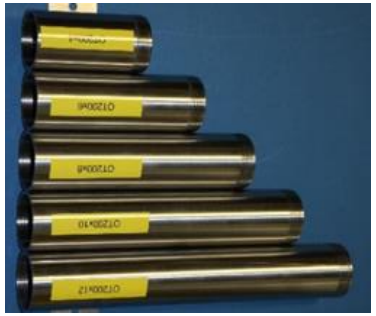


Downrange Flash Detectors (L) and Camera (R)

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MODULAR SUPPRESSOR TESTBED (MST)

Outer Tubes

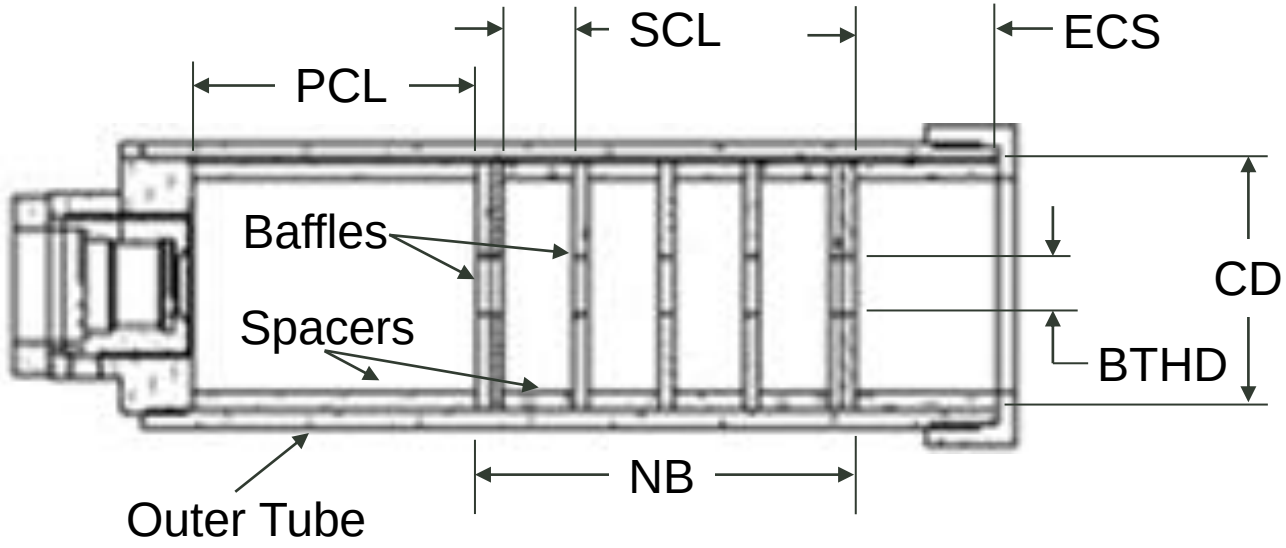


Spacers



Baffles



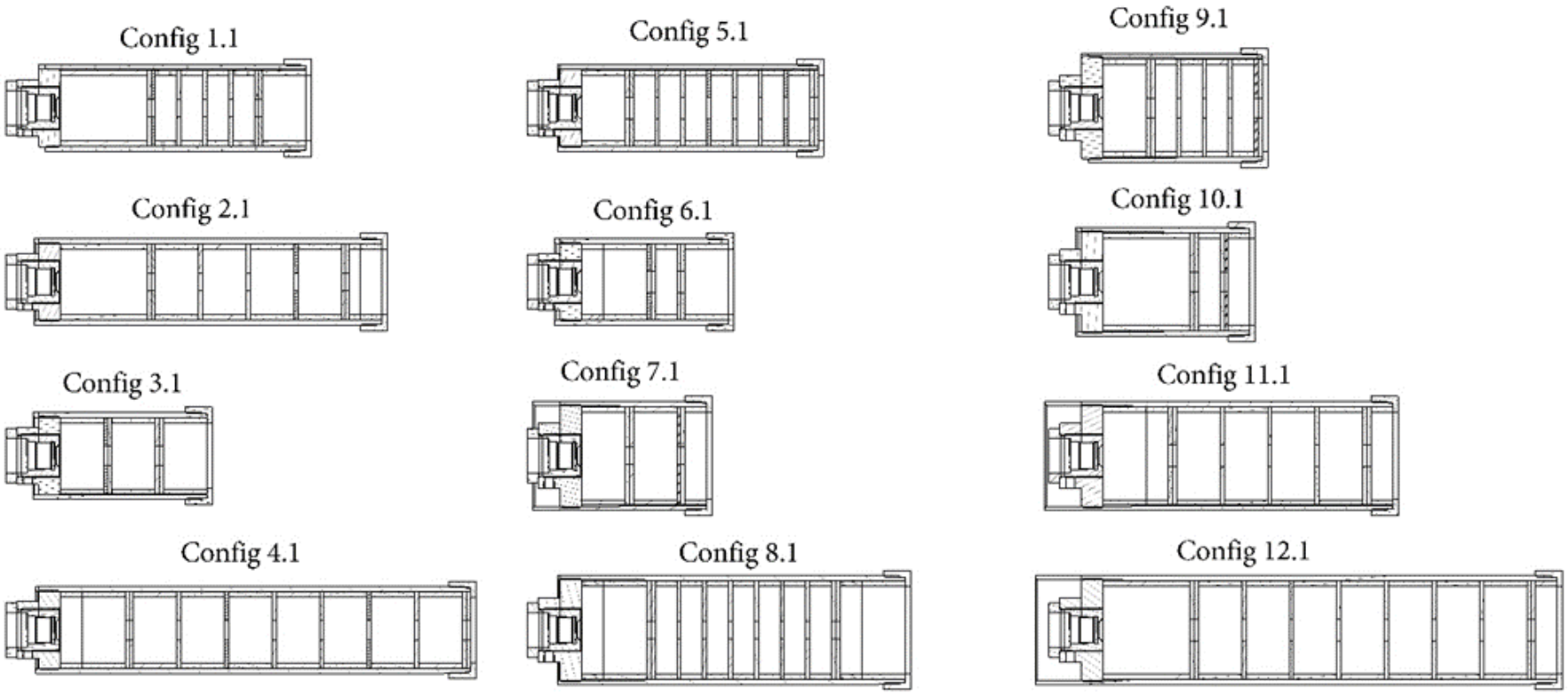


PCL = Primary Chamber Length
SCL = Secondary Chamber Length
ECS = End Cap Spacer Length
BTHD = Baffle Through Hole Diameter
CD = Can Diameter
NB = Number of Baffles

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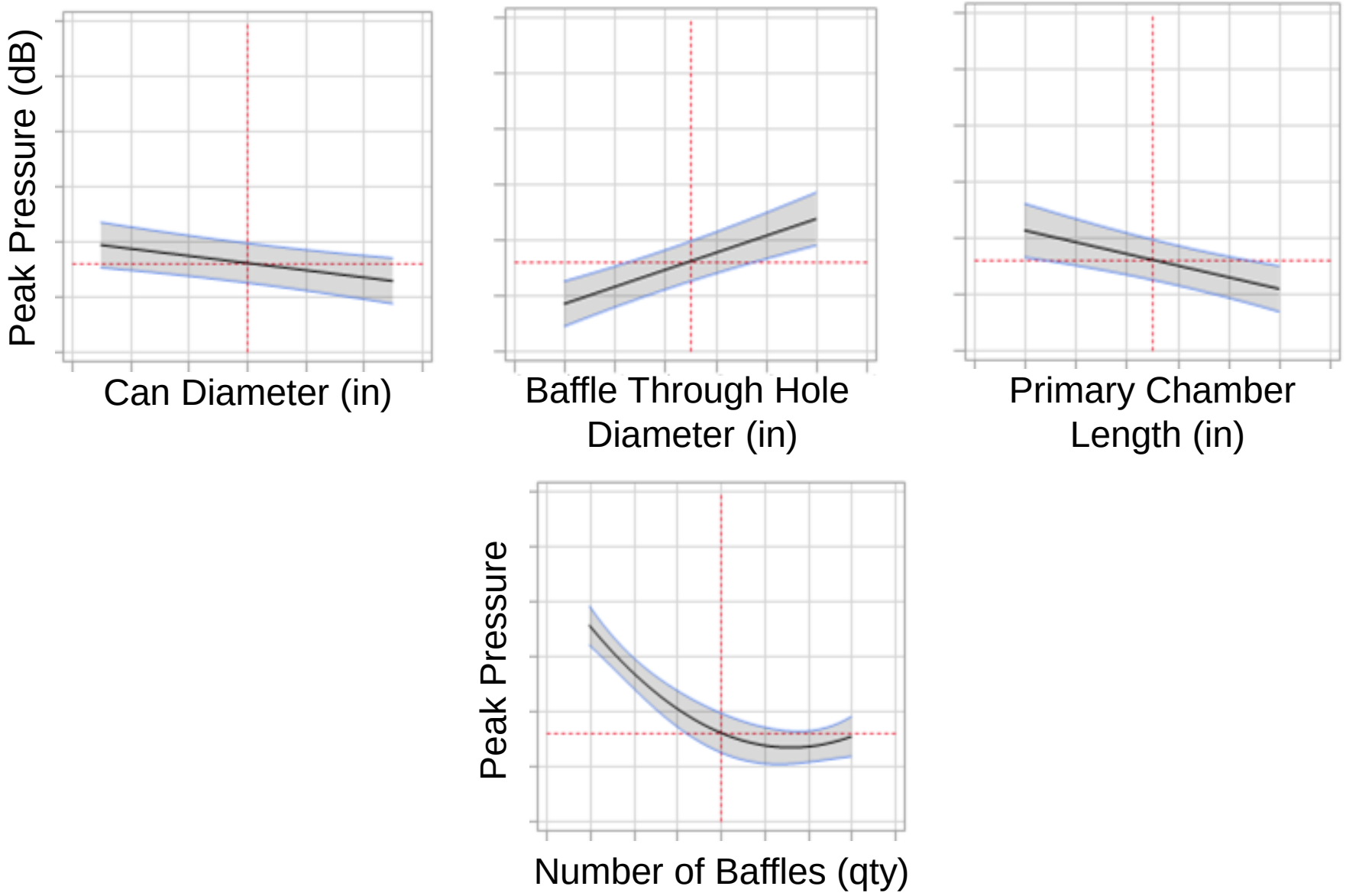
DOE SUPPRESSOR CONFIGURATIONS

Twelve Design of Experiments (DOE) modular suppressor configurations selected based on D-Optimality criteria for fit of a 2nd order least squares fit model with a maximum of 9-10 terms in the model.



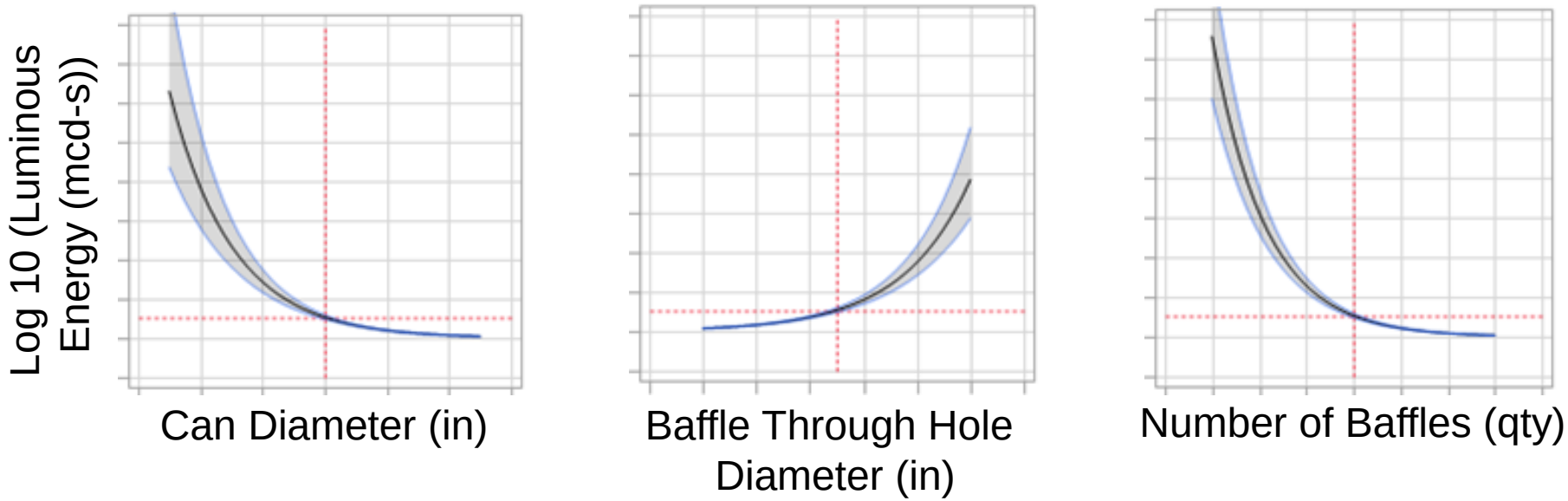
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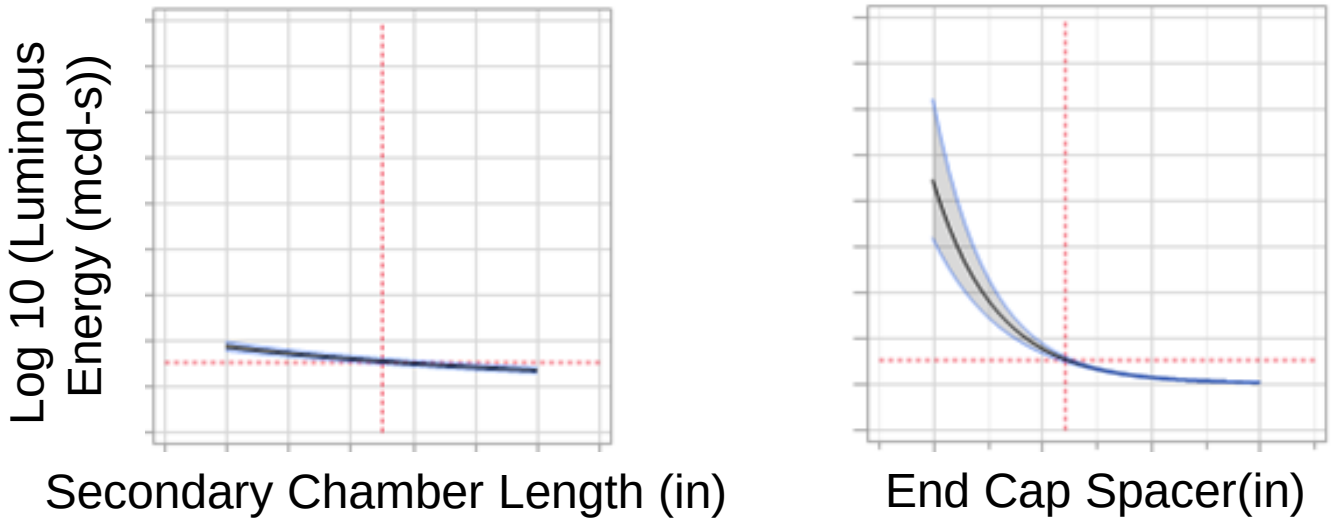
LEAST SQUARES FIT OF DOE RESULTS
PRESSURE @ 1M-170 DEG VS DOE DESIGN PARAMETERS



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LEAST SQUARES FIT OF DOE RESULTS
LUMINOUS ENERGY VS DOE DESIGN PARAMETERS





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SHADOWGRAPH – CONFIG 1.1

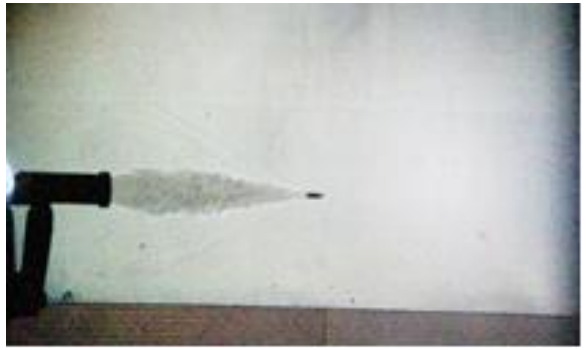
T=0 μs



T=200 μs



T=400 μs



T=600 μs



T=800 μs



T=1000 μs



CONCLUSIONS

- The Modular Suppressor Testbed (MST):
  - Utilizes 6 unique design variables
  - Provides an endless amount of different configurations for testing
  - Can verify simulated performances by testing simple suppressor geometries

- The MST was used to create high quality least squares fit models of sound, flash and impulse responses across a limited design space using only twelve suppressor configurations.

- The least squares fit models can be used to design suppressors and optimize performance with simple least square fit models.

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CONCLUSIONS

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SUPPRESSOR CLEANING STUDY

Project Problem / Background

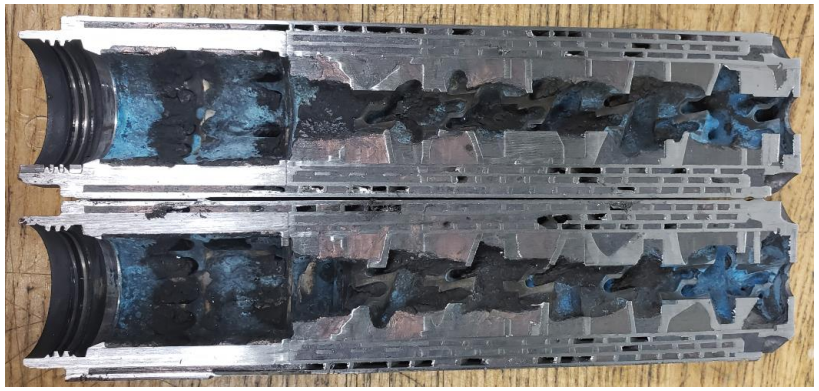
- Built up fouling deposits are decreasing performance and causing premature replacement of suppressors.
- No current process / procedure is established to effectively clean suppressors and restore performance.

The accumulation of fouling in the form of carbon, copper and lead results in:

- Significant Weight Increase
- Degradation of Sound Reduction
- Degradation of Flash Suppression
- Degradation in Dispersion/ Point of Impact Shift
- Difficulty of install/ removal
- Misalignment promoting Baffle Strikes
- Increased exposer to Toxic Vapor



M110 Suppressor



Fouled M110 Suppressor Cross Section

SUPPRESSOR CLEANING STUDY

Project Problem / Background Cont.

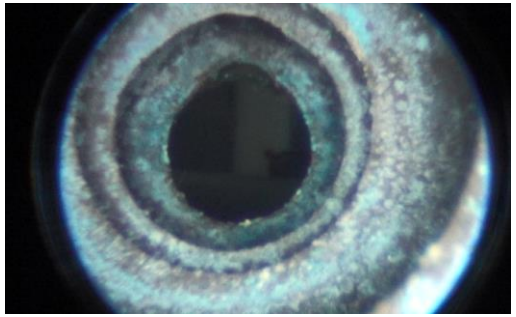
- Current cleaning efforts (Brushes, soaking, ultrasonic bath) prove to be costly, time consuming and ultimately ineffective due to the variety and complexity of modern sealed suppressors







- These factors have caused the DOD to prematurely classify suppressors as unserviceable, costing the US Government $$.
- Suppressors are expensive and often times are equally or more expensive than the weapon they are mounted too.





US ARMY SUPPRESSOR PREVALENCE



Next Generation Squad Weapon (NGSW) Suppressed Weapons

The NGSW is still under competition



M2010 ESR



M110 SASS



M110A1 CSASS

SUPPRESSOR CLEANING STUDY

Objective:

Research, develop and test processes to remove the buildup of carbon and metal oxides that are deposited on internal suppressor surfaces. Analyze commercially available systems to enhance development and knowledge in search of a field-able solution that will efficiently clean a wide variety of suppressors to maintain peak capabilities and maximize service life.

Warfighter Benefits / Operational Payoff:

- Eliminates Premature Replacement = Saves $$
- Extends Service Life of Suppressor
- Maintains Peak Capabilities and Performance
- Decreased weight on end of muzzle
- Maintainable signature reduction
- Decrease exposure to Toxic vapors



Need for Solution:

- Demand for a cleaning procedure will increase as suppressed weapons become more prevalent. Ex. (Army, Marine Corp, Special Ops, etc.)

Project Manager Soldier Lethality (PM SL) Innovative Designs & Engineering Assessment (IDEA) Program

BLUF: PM SL, is seeking information on new, innovative, enabling technologies that can generate new capabilities or provide enhanced capabilities to the Army's portfolio of small and medium caliber weapons, optics, binoculars, remote weapons stations, suppressors, powered rails, barrel life enhancements, externally powered systems, recoilless rifles, Next Generation Squad Weapons (NGSW) weapons, fire control, and ammunition.

The IDEA program is:

- An opportunity for Industry to submit innovative ideas and technologies for the USG to assess. Assessments may be conducted at vendor or government facilities.
- A one-on-one pitch to the USG showcasing their technology for a potential for non-competitive award under 10 U.S.C, § 2373 - Procurement for Experimental Purposes.
- Renewable on a quarterly basis.

The IDEA program is <u>NOT</u>:

- Intended to be a developmental program
- A USG in-house proposal
- A competitive contract

https://sam.gov/opp/ced1e1c4bcbc4e329b781c66cbd74d3e/view

PMSL will leverage enabling IDEA technologies to quickly provide Soldier capabilities and enhancements.

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COMMERCIAL MACHINES

1. OTIS Technology - OSCR (Otis Suppressor Cleaner and Reclaimer)

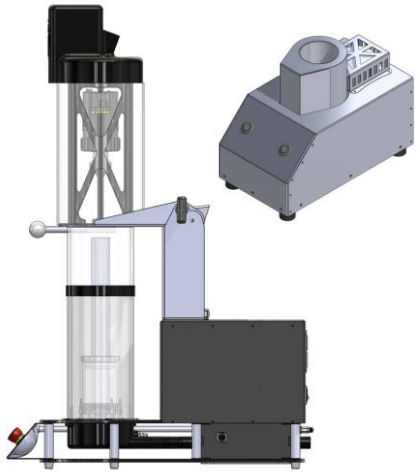


OSCR-6

The cleaner operates by circulating a proprietary cleaning solution through the suppressor at a high temperature and pressure. Available as a single or six suppressor machine

The OSCR, according to OTIS, consistently removes up to 95% of fouling buildup.

2. TDA Research – Sealed Suppressor Cleaner and Drier



TDA SSC&D

The dual system utilizes an ultrasonic horn that enters inside the suppressor to mechanically break up and release carbon and metal fouling and then dries the suppressor. Currently a single suppressor machine with a six suppressor attachment.

According to TDA, the system will cut accumulation rate by a third, reduce premature failures, ‘carbon welding’ and baffle strikes, improving service life.

Development was funded by the USMC SBIR program (M67854-18-C-6514).

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OTIS TECHNOLOGIES

OTIS TECHNOLOGY

OSCR | OSCR-6 OSCR-1

OTIS SUPPRESSOR CLEANER AND RECLAIMER

The OSCR is available in large unit that will clean 6 suppressors simultaneously, and a single, table top, unit that can clean one suppressor at a time.







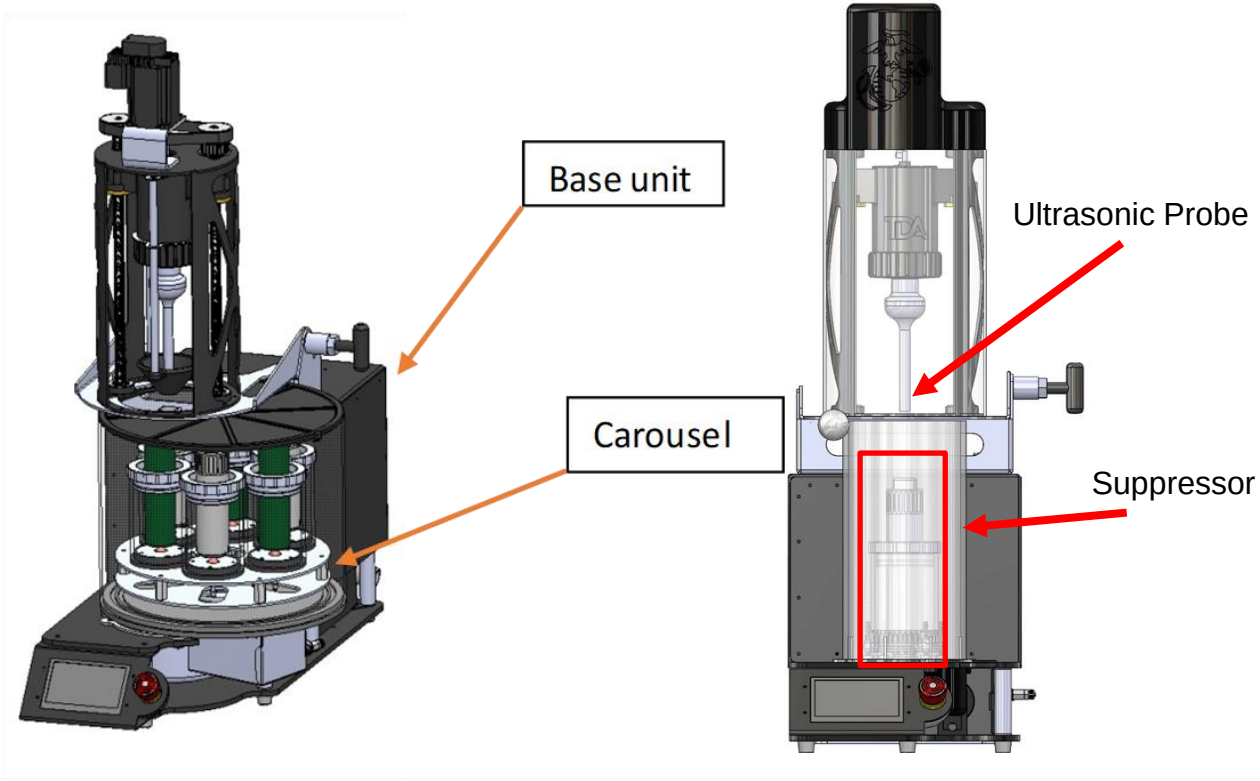
Primary Cleaning Method:

- Circulation of High Temperature and High Pressure proprietary cleaning solution.
- Suppressors are directly threaded onto cleaning nozzles.

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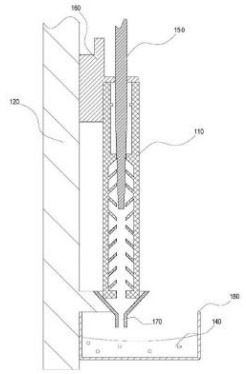
TDA RESEARCH



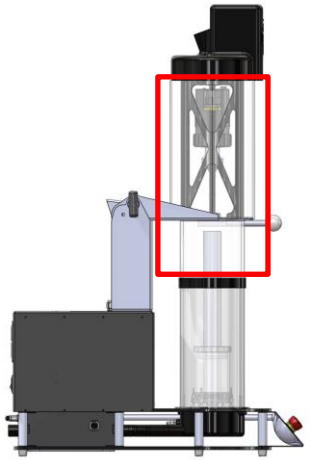


Primary Cleaning Method:

- Ultrasonic probe that utilized high frequency pressure (sound) waves to agitate liquid and create cavitation bubbles to mechanically remove “scrub” contaminates.
- Proprietary cleaning solution primarily consisting of water. This prevents solubilizing of deposited metals leading to hazardous waste (Cu and Pb Oxides)
- Corrosion inhibitors prevent oxidation



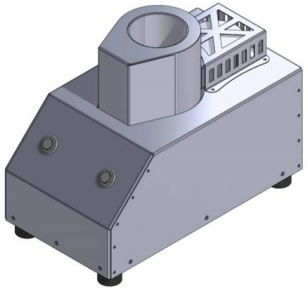
TDA RESEARCH ADDITIONAL COMPONENTS



Height Extension:

- Allows up to a 14” Suppressor

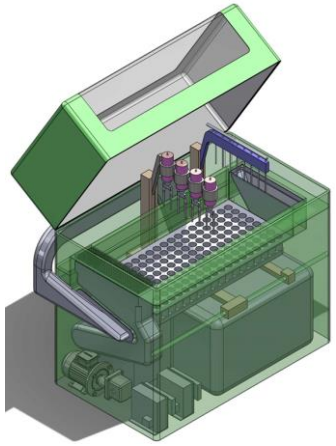
Dryer:



Features:

- Recirculating air flow means external contact surfaces are always cool to the touch
- Automated heat up and cool down cycle times
- Hot air temperature up to ~500°F during dry out portion
- Suppressor emerges dry and cool to the touch within 10 minutes of cycle start (suppressor is ~100°F when complete)

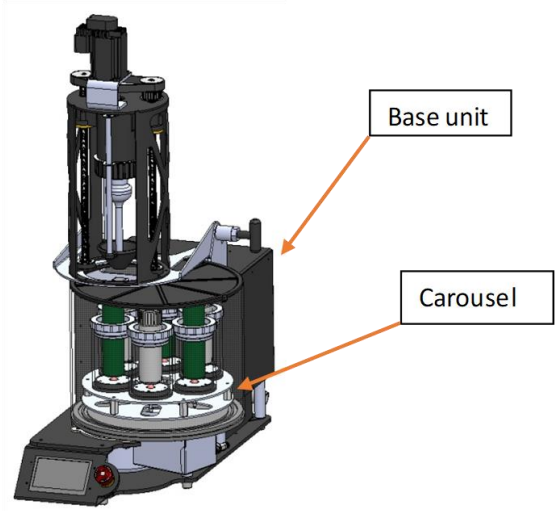
Unit Level Cleaner Concept:



Features:

- Larger floor based unit can clean up to 144 suppressors in a single run
- Integrated wash, rinse and drying cycles within the same unit
- Multiple ultrasonic tips can clean a full row of suppressor at one time (up to 8 per row)
- Self contained and sealed unit prevents contamination from exiting the unit
- Automated robotic arms used to wash and rinse all suppressors
- Wash basin automatically drained and then dried with integrated resistive blower

Multi-Suppressor Cleaner Attachment :





Features:

- Completely encapsulated cleaning cylinder prevents splash out and cuts down on noise from cleaning process
- 2 Quick connects to enable the accessory (1 fill line and power to the motor drive)
- 6 cylinder automated rotating drive to clean 6 suppressors without swapping
- Swap out of the accessory only requires 4 bolts on the main platform
- Alignment of each cylinder is automated with a lever switch within the motor housing
- Cylinders can be adapted with different size holders to clean various suppressor in the same run

Patents Pending



PERFORMANCE EVALUATION

An engineering evaluation will be conducted on each machine. 12 suppressors with identical round counts and firing cadence will be cleaned to determine system performance.

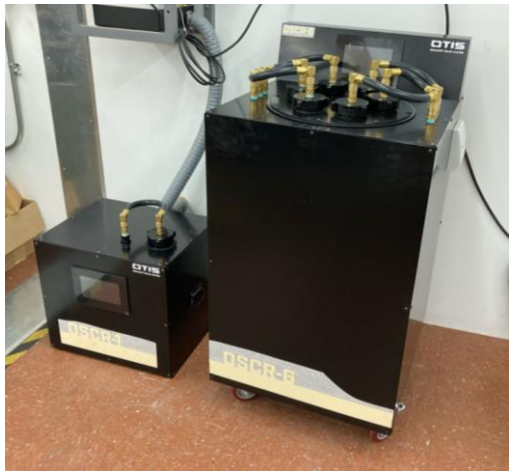
The machines will be utilized for specialized testing/ modifications for further data collection and suggested improvements.

Additional suppressor cleaning experiments will aid in determining the most efficient, and cost effective method of cleaning.



Fired vs Cleaned Suppressor TDA







Suppressor Cleaning Machines

The machines will be tested for durability and simulated operational use to obtain further data while supporting other programs such as NGSW.

Data obtained will reflect machines reliability and performance under repeated use.

Fired, unfired weights, makes, models, caliber etc. will be logged for each suppressor cleaned.

SUMMARY

Maintenance is a critical aspect to preservation of a well performing weapon system. The US Military is rapidly incorporating suppressors to increase operational capabilities. An effective and efficient suppressor cleaning method will benefit the war fighter and the DoD as a whole.

Should cleaning suppressors prove to reduce cost over replacing, the Army would pursue a cleaning strategy through full and open competition.



Suppressed Carbine

DISTRIBUTION STATEMENT A. Approved for public release: distribution unlimited.

NSWC Crane Division – Suppressor D.O.E.

Presented by: Phillip Burnside, PhD

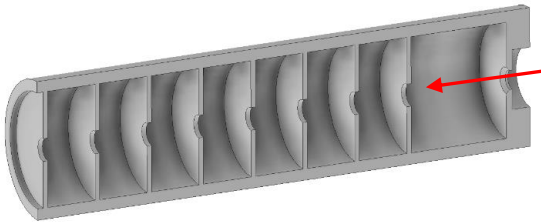


NAVSEA
WARFARE CENTERS
CRANE

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Simple Compressor D.O.E.

Simple Suppressor from ARL





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Taking Black Art to Science

- Currently suppressors are designed using the trial and error process
- With the development of the ALE3D4i Computational Fluid Dynamics (CFD) by Lawrence Livermore National Labs, a new and validated tool can be used to simulate the affects of firing a round through a suppressor which allows multiple designs to be evaluated each day
- We can now use applied science to optimize a suppressor based on predicted performance for the given weapon system

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Design of Experiments: Simple Suppressor

Inputs

- Can diameter
- Primary chamber length
- Secondary chamber length
- Number of chambers
- Baffle hole size

Key Performance Parameters

- Gas temperature in front of suppressor
- Pressure at bolt
- Sound
- Gas temperature inside the suppressor

case	Can Diameter (in)	Baffle Hole Diameter (in)	Primary Chamber Length (in)	Number of Baffles	Secondary Chamber Length (in)	Overall Length (in)	Microphone Position in X (cm)	Inside Suppressor Supy2 (cm)
Baseline								
1	1.75	0.35	1	2	0.5	1.800	3.62	1.60
2	1.75	0.35	1	5	0.5	3.300	7.43	1.60
3	1.75	0.35	1	8	0.5	4.800	11.24	1.60
4	1.75	0.35	1	2	1	2.300	4.89	1.60
5	1.75	0.35	1	5	1	5.300	12.51	1.60
6	1.75	0.35	1	8	1	8.300	20.13	1.60
7	1.75	0.4	1	2	0.5	1.800	3.62	1.60
8	1.75	0.4	1	5	0.5	3.300	7.43	1.60
⋮								
161	2.75	0.45	2	5	1	6.300	15.05	2.87
162	2.75	0.45	2	8	1	9.300	22.67	2.87

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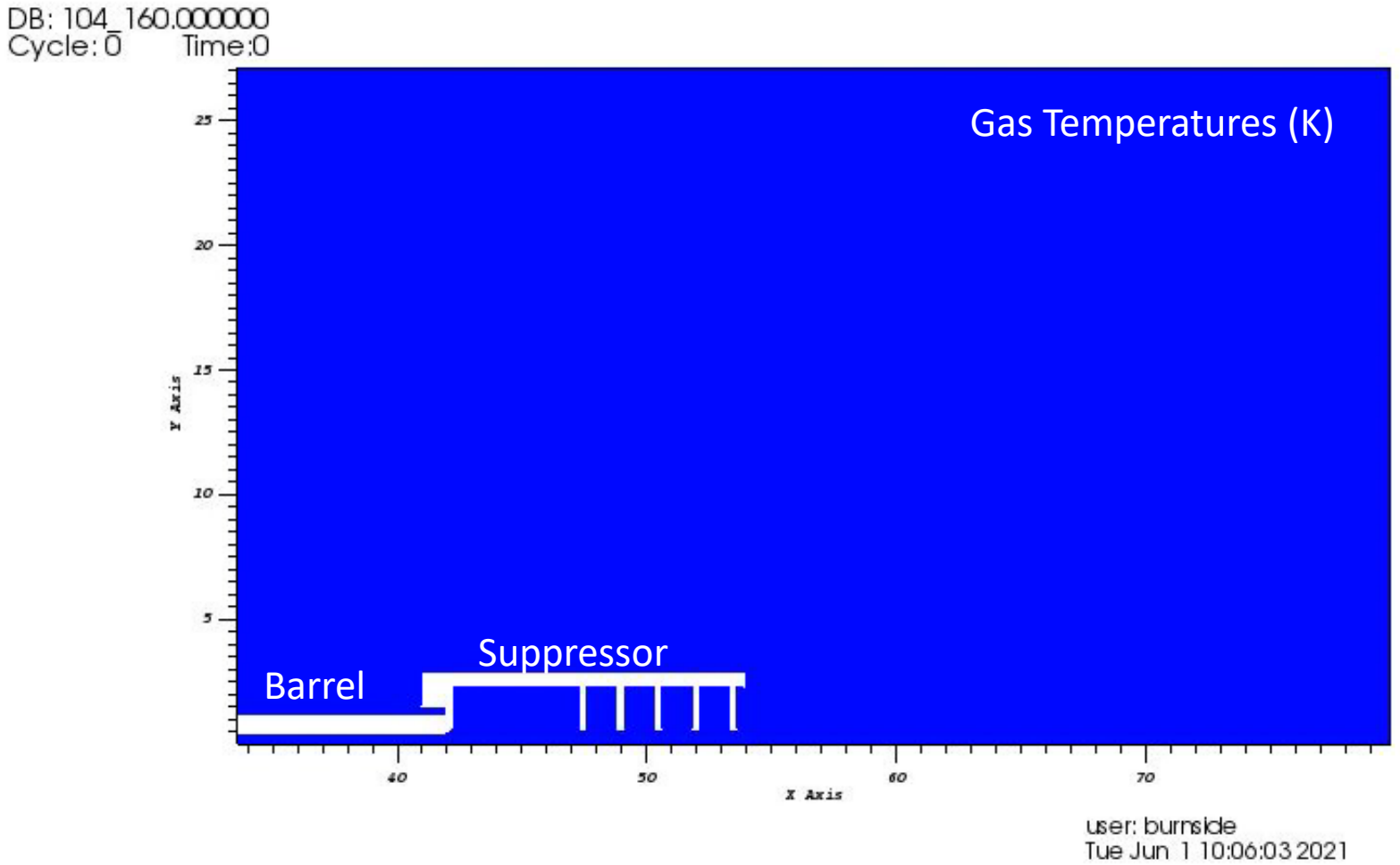
Requirements for an MK48 Suppressor

Key Performance Parameters in order of importance to the warfighter:

1. Flash in front of suppressor
2. Blow-back at bolt on opening
3. Sound level at one meter to side of weapon

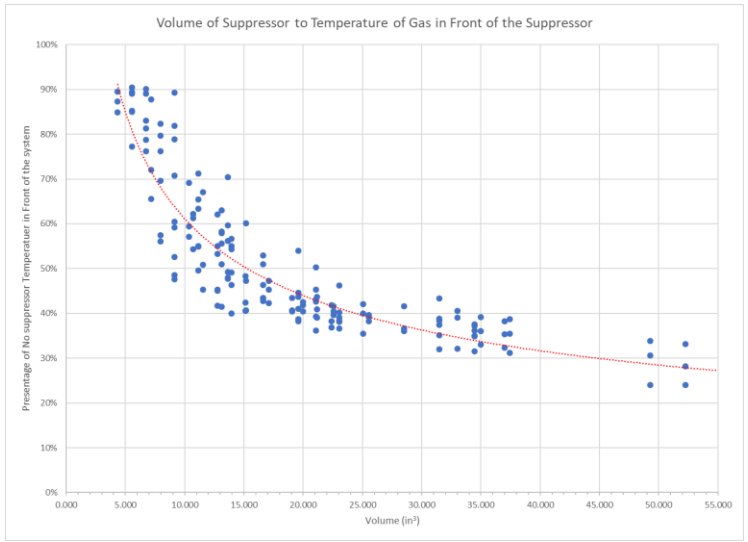
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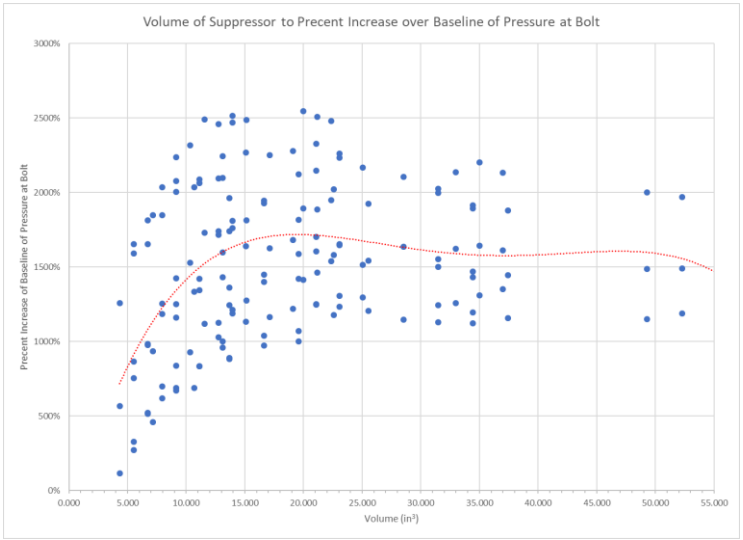
Example of Design of Experiments Simulation



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Design of Experiments Results



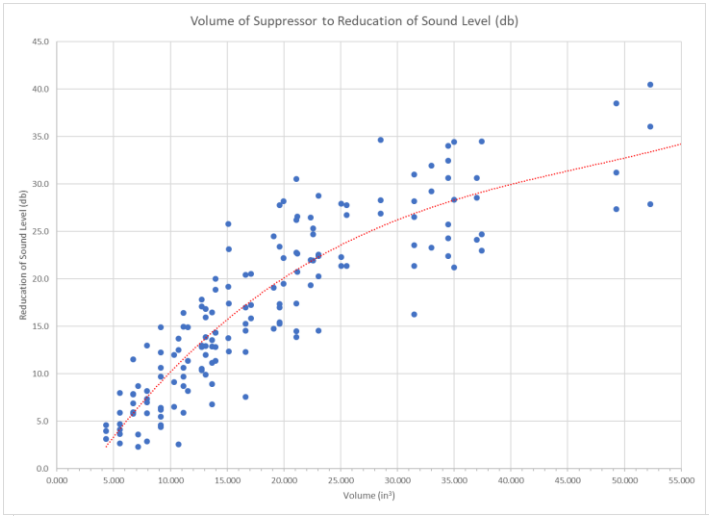


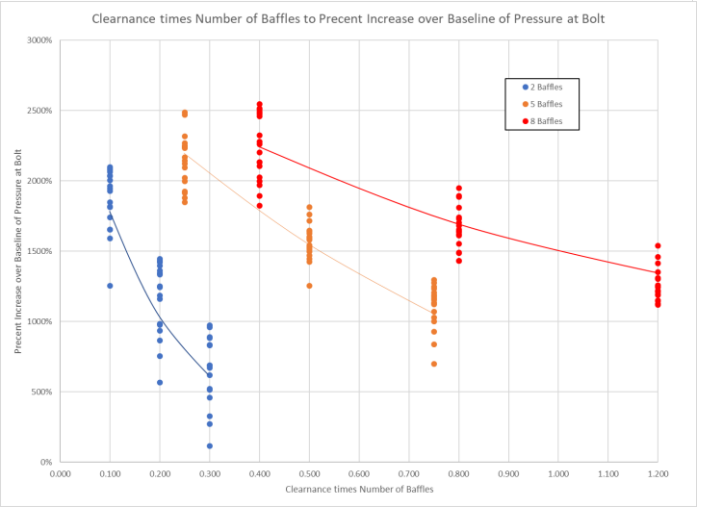
- Utilizing temperature in front of the suppressor allows comparison of flash vs the volume:
  - the relationship is nonlinear; and
  - the relationship is also significantly affected by other features of the suppressor.
- The relationship with volume to back pressure at the bolt also has these same two factors.

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Design of Experiments Results

- The relationship of volume to peak sound also exhibits a nonlinear relationship.
- The data can be sliced many different ways, but the relationships between the various features of the suppressor are always interacting in a nonlinear manner.
- This means optimization is based on a ranked set of Key Performance Parameters (KPP)





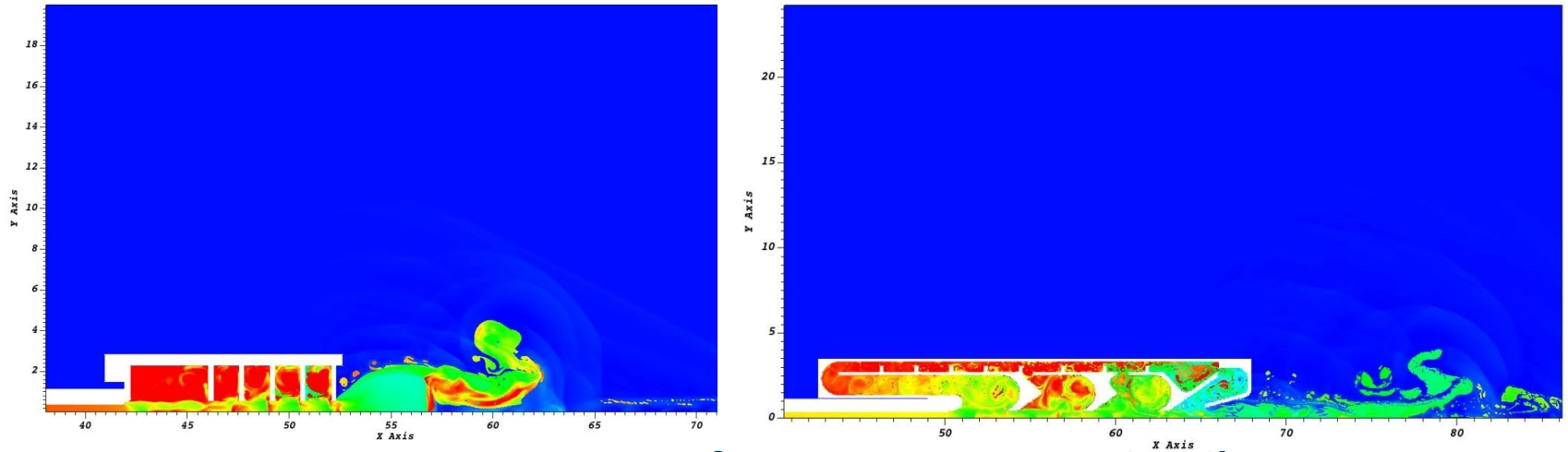
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Comparison of Suppressors

- CFD ALE3D4I code was used to test concepts to come to an optimized design.
- By looking at small changes, a new, more efficient NSWC Crane design was developed.

Simple Design

Crane Optimized Design



Gas Temperature from a 7.62mm Projectile

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Results Summary

	Priority 1	Priority 2	Priority 3
CASE	**Percent of Peak Mean Temperature in Front of Suppressor (F)**	**Percent Increase over Baseline of Pressure at Bolt**	**Reduction of the Peak DB Sound @ 1m**
Baseline	**N/A**	**N/A**	**N/A**
Simple Case 12 (tested)	**39%**	**1156%**	**15.2**
LLNL Bypass Design	**30%**	**418%**	**18.7**
Crane Optimized Design	**19%**	**54%**	**31.0**

Lower value = reduced gas temperature and thereby reduce flash

Lower value = minimize blow-back

Higher value = more reduction in the sound level

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CAGE: 8RC72 DUNS: 043893696

M240 fvs machine gun suppressor



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CAGE: 8RC72 DUNS: 043893696

Background

- Stated need for a suppressor to handle sustained fire on belt fed machine gun
- Largest challenges are controlling heat and back pressure
- Utilized technology developed during SURG program (Suppressed Upper Receiver Group)
- Applied knowledge of superalloy use in firearms
- Employed additive manufacturing for non-traditional geometries and structural integrity

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Your Current Problems

- Suppressors overheat to the point of catastrophic failure
- Use of common commercial materials such as titanium, 17-4, cobalt, or Inconel, are not durable enough for the subjected environment
- Use of standard manufacturing and assembly, such as welding and threading or press fitting, creates structural weak points
- High temperatures for long durations increase signature and interfere with Thermal/IR optics functionality
- Backpressure created by common suppressor designs causes cyclic rate issues and increases MRBS (Mean Rounds Between Stoppages)

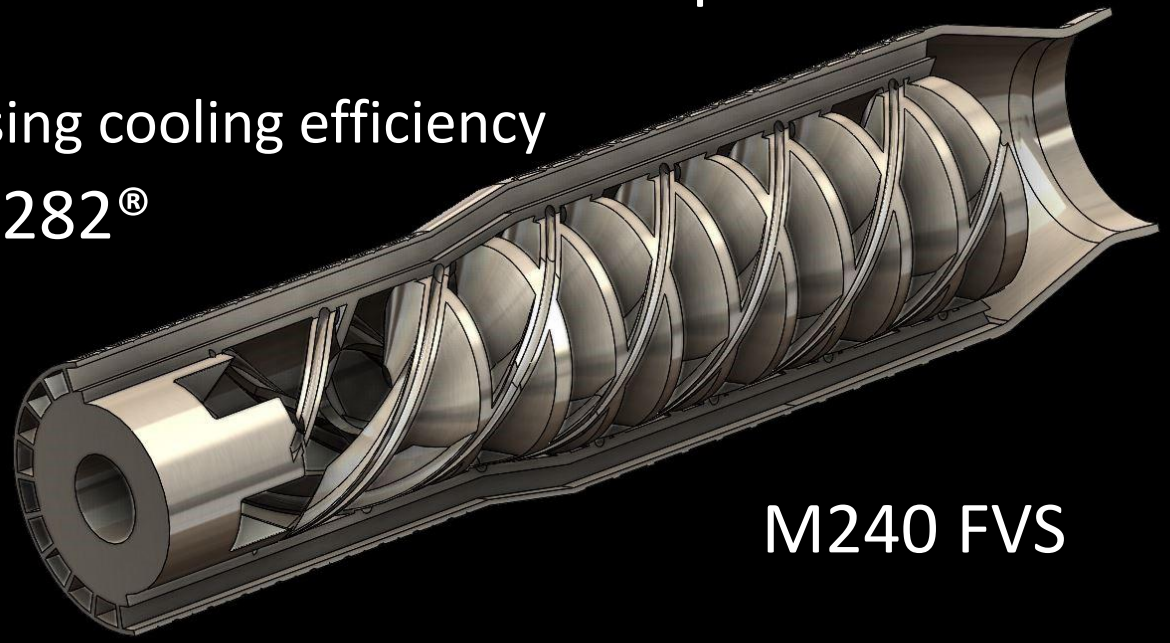
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The Radical Solution

- Venturi-based cooling
- Heat sink cooling channels
- Backpressure reduction from Venturi assist nozzles and spiral baffle design
  - Reduces backpressure while increasing cooling efficiency
- Nickel based super alloy - Haynes 282®
- 3D-printed monolithic structure
- Alpha-shield Elite coating
  - Reduces Thermal and IR signatures
  - Withstands extreme temperatures



M240 FVS

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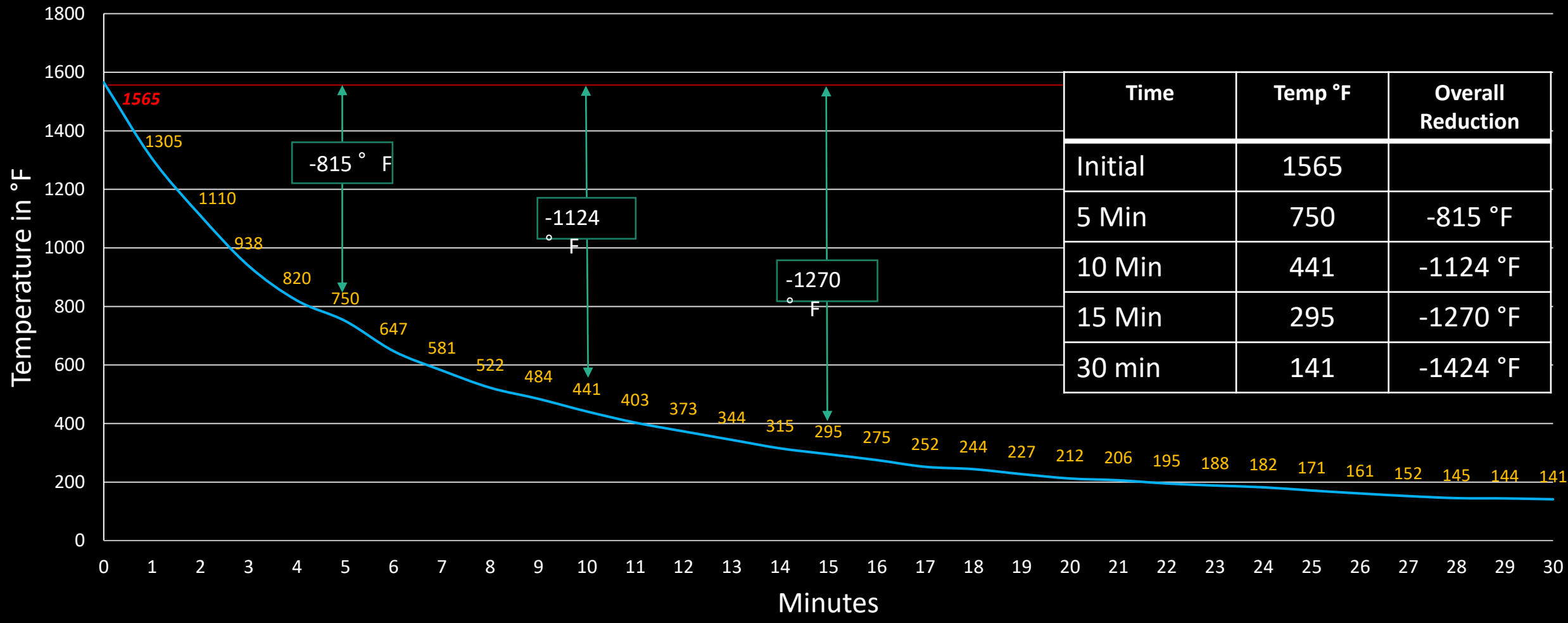
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Technical Data

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Thermal Test Data 240 FVS
Post 600rd "Mad Minute"



Time	Temp °F	Overall Reduction
Initial	1565	
5 Min	750	-815 °F
10 Min	441	-1124 °F
15 Min	295	-1270 °F
30 min	141	-1424 °F

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Points of Performance

- Rapid cooling
- Reduces 28 dB over an unsuppressed weapon
- Coating does not degrade under extreme heat
- Decreases ground signature disturbance
- Improves accuracy
- Moderates flash
- Monolithic super structure does not deform under heavy rates of fire
- Mitigates Thermal/IR signature
- Controls negative effect of backpressure

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Contact Information

- Available in 5.56x45 mm for M249 SAW and.338 Norma Magnum for LMMG
- POC: Phillip Haag, Dir. Research & Development

phil@radicaldefense.us

www.radicaldefense.us

281.207.8788

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Mechanochemically-Assisted Broaching of Refractory-Lined Gun Barrels

Presented by: Dr. Jason M. Davis



CAPT Duncan McKay, USN
Commanding Officer

NAVSEA
WARFARE CENTERS
CRANE

Dr. Angela Lewis, SES
Technical Director

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Problem Statement

- The use of refractory metals as gun barrel liners has great potential to reduce barrel wear and permit higher rate of fire weapons, increasing reliability and sustainability.
- Machining and rifling of refractory-lined barrels has proven difficult due to the 'gumminess' of refractory metals, particularly for small caliber weapons – resulting in thick chip formation, large cutting forces, poor surface finish, and ultimately premature tool breakage.

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Background

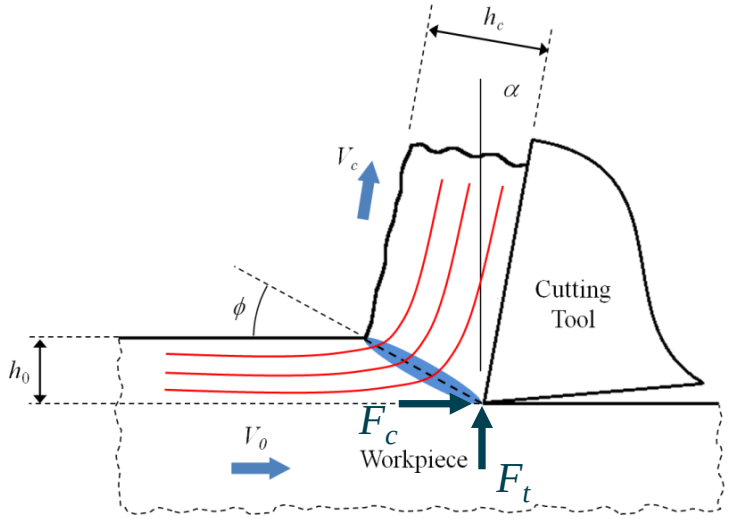
Explosively Bonded Gun Tube Liner Development, Apr 2015 (ARL-CR-0771) – William de Rosset

- Report recounts refractory liner development efforts – Ta10W-lined M242 barrels (25mm)
- Crown broach cutters: 60 individual cutting heads, each containing 9 pairs of teeth; each pass increases the depth of the groove by approximately 0.0004” (~ 10 µm)
  - When rifling, tooth broke on crown broach for two different barrels
  - Galling led to build-up of Ta10W on broken tooth
    - Possible causes:
      - Dull or chipped tooth
      - Inadequate cooling at tooth location
      - Chip interference with the cutting process
      - Broach moving off axis
      - Radial misalignment of the broach

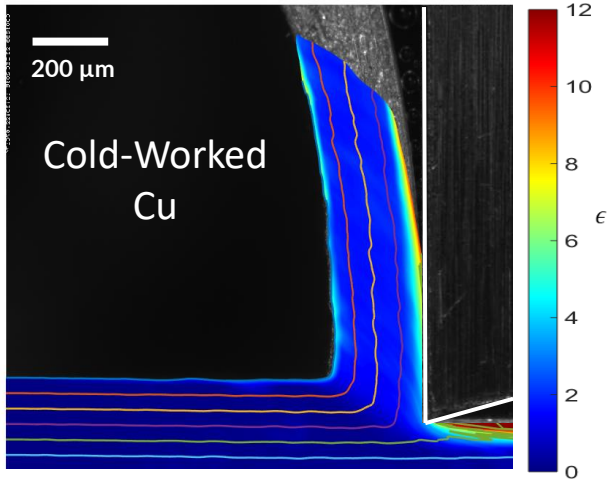
      - Maybe something else…

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Laminar Plastic Flow – "Well-Behaved" Flow



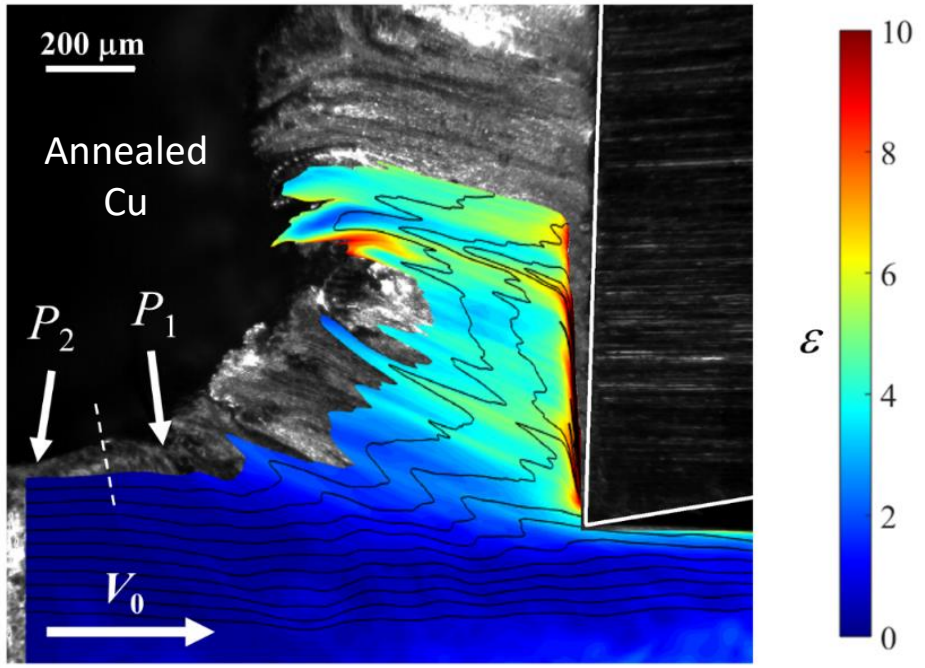
- Merchant model (1940s)
- Plane-strain orthogonal cutting
- Predicts laminar flow



- Moderately pre-hardened Cu (cold-worked)
- Homogeneous strain
- Follows shear plane/zone model

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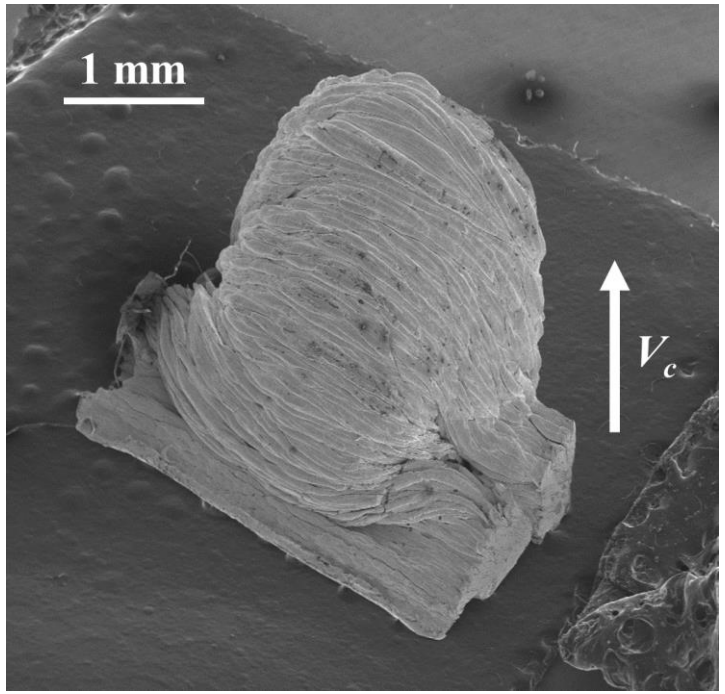
Sinuous Flow Explains Gumminess



- Unsteady, highly redundant (mesoscale) mode of large-strain plastic deformation
- Plastic buckling and large-amplitude folding
- Heterogeneous strain distribution in the chip

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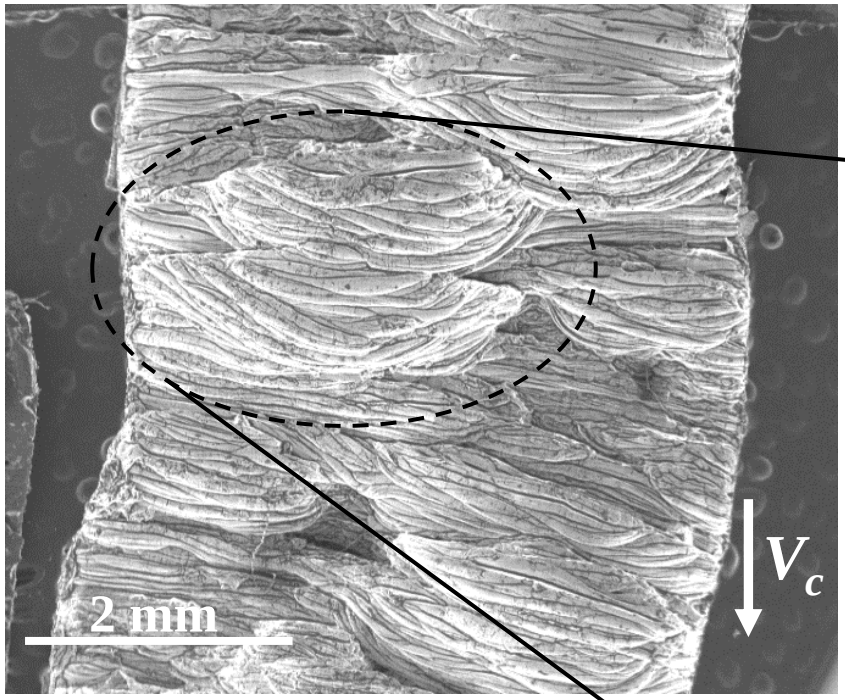
Tantalum Chip Morphology



$\alpha = 10°$
$V_0 = 2$ mm/s
$h_0 = 40$ μm

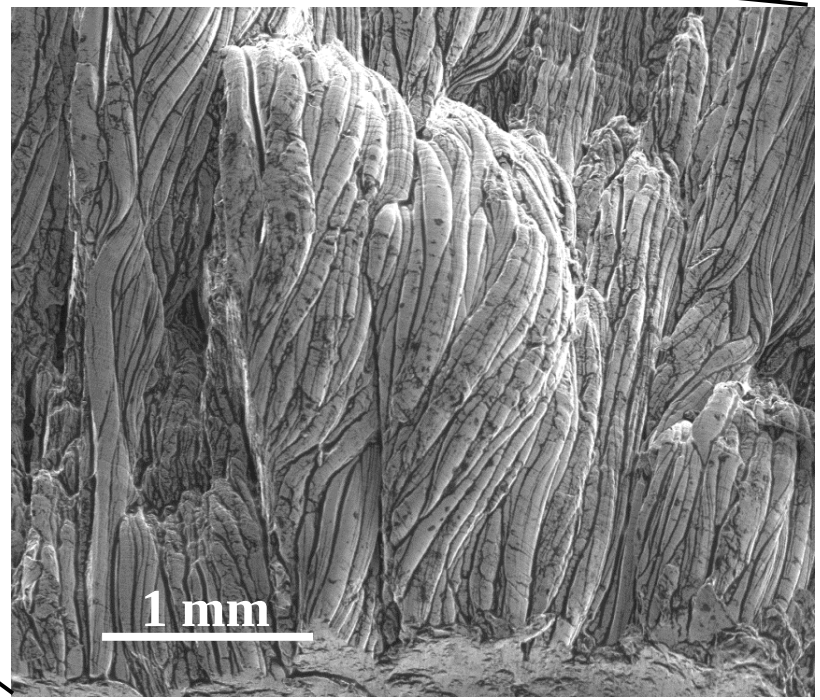
Low Speed Cutting

Top view of chip free-surface



"High" Speed Cutting

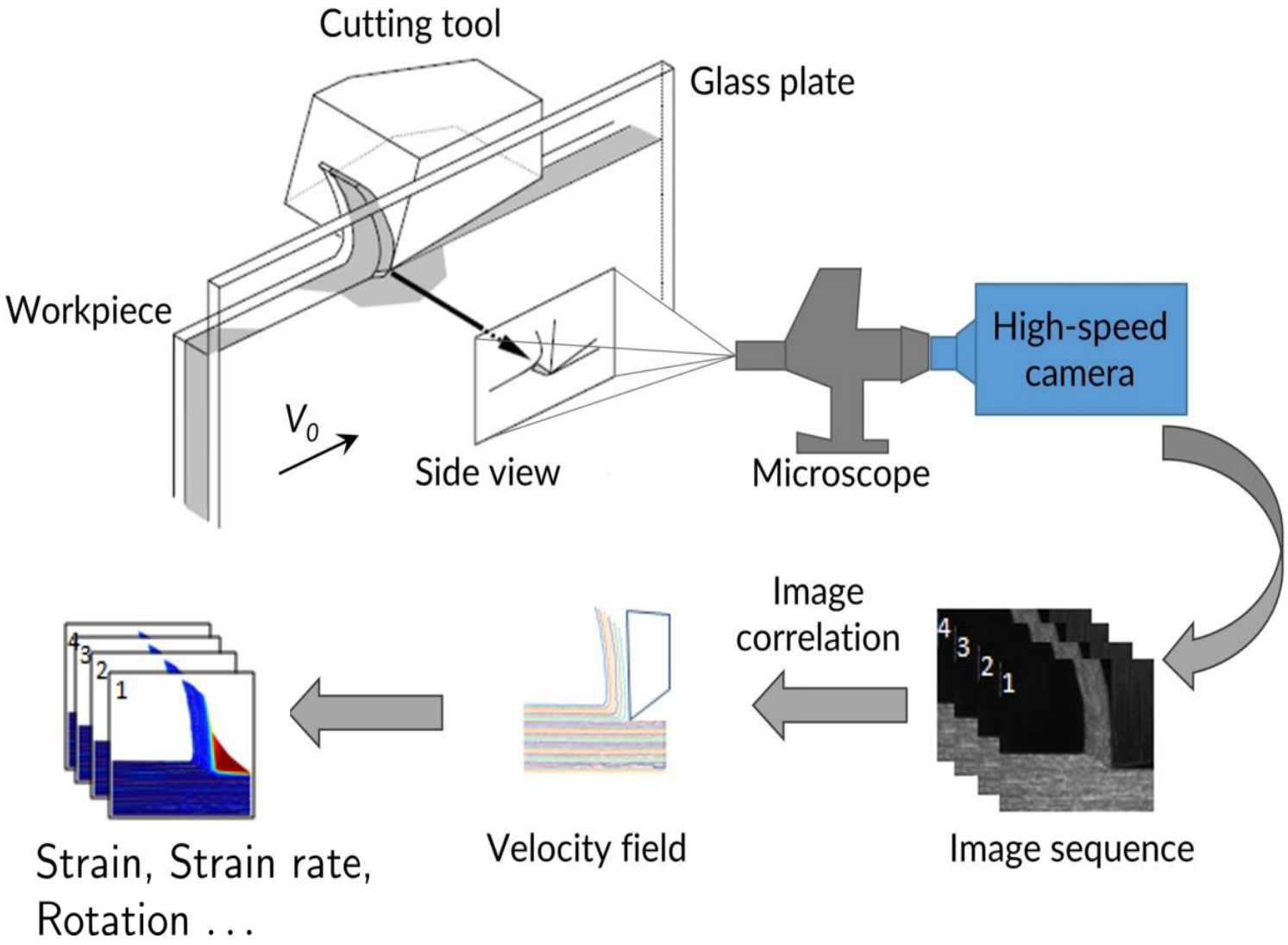
$\alpha = 0°$
$V_0 = 625$ mm/s
$h_0 = 50$ μm



Side view of chip free-surface

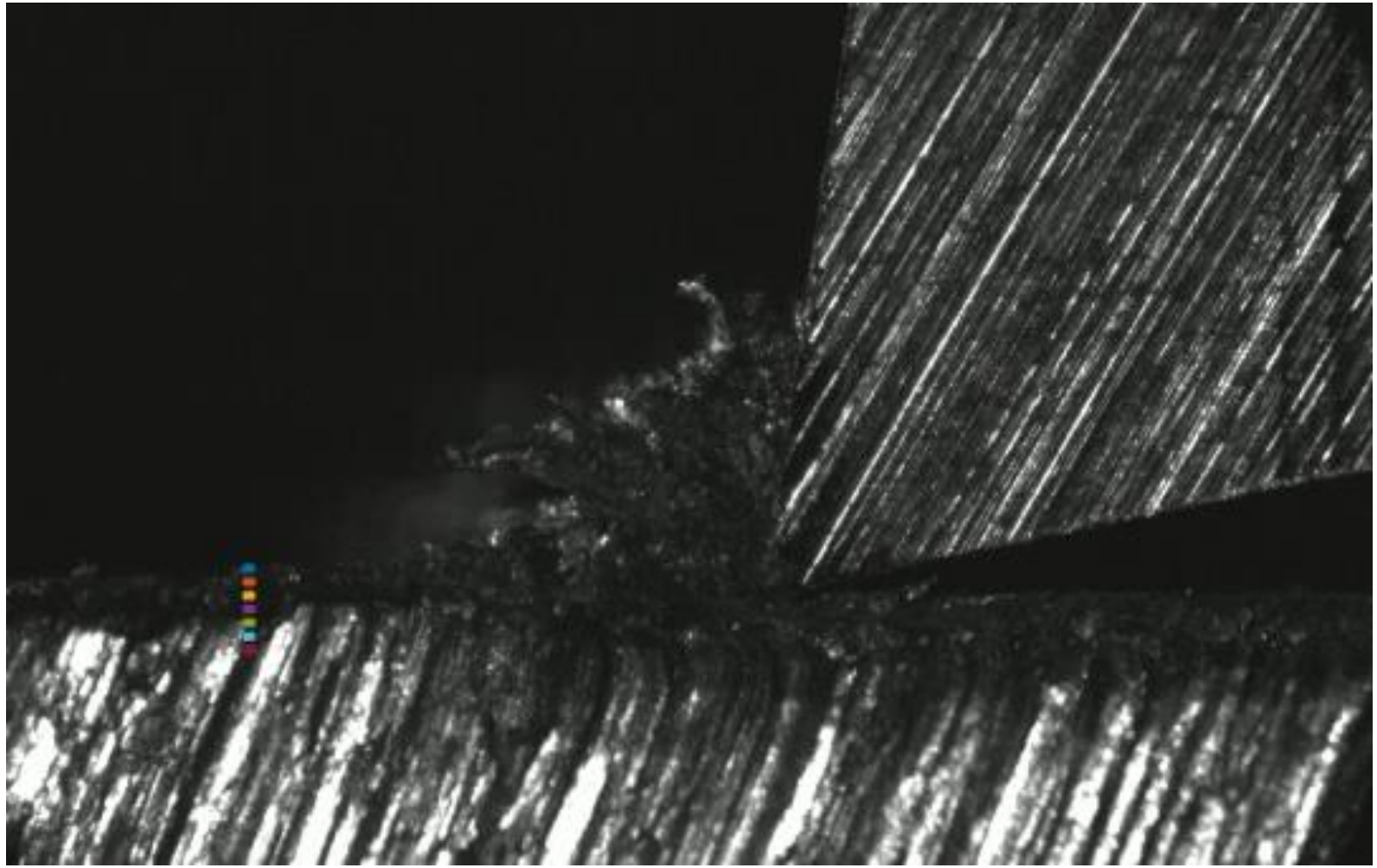
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In situ Analysis of Flow



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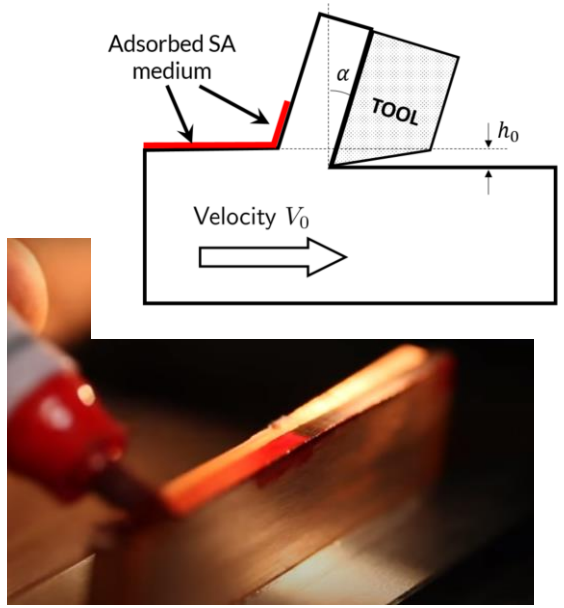
Sinuous Flow in Tantalum

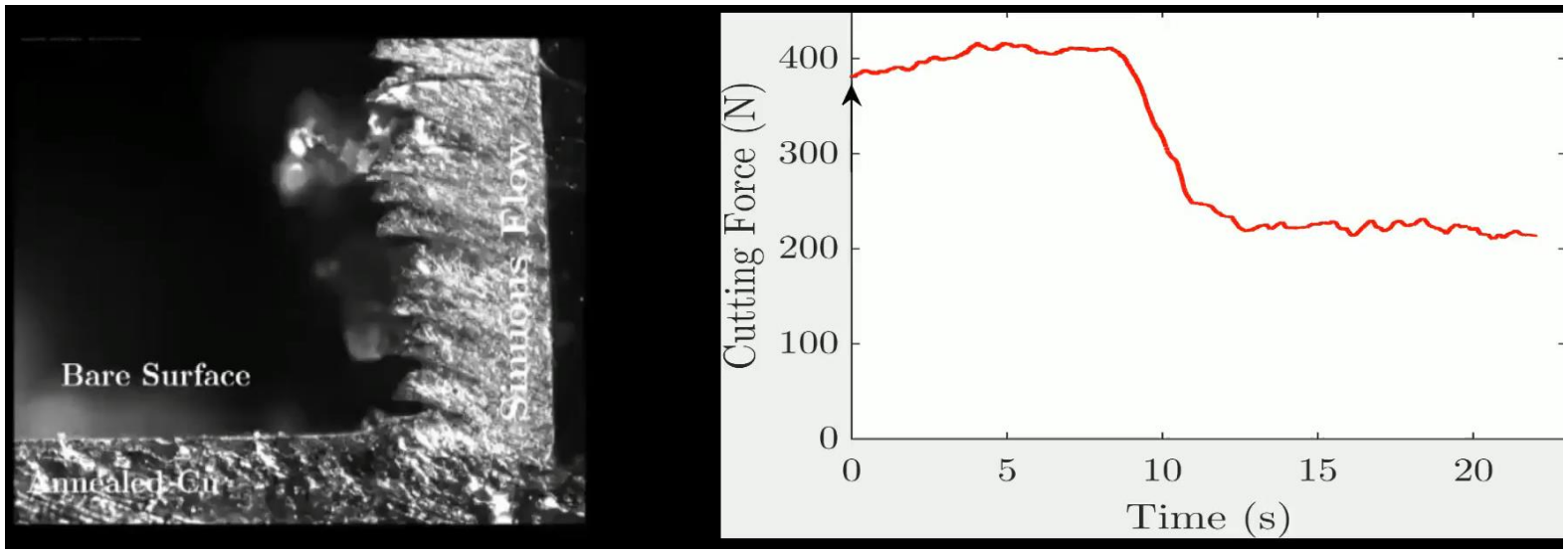


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Mechanochemical Effect

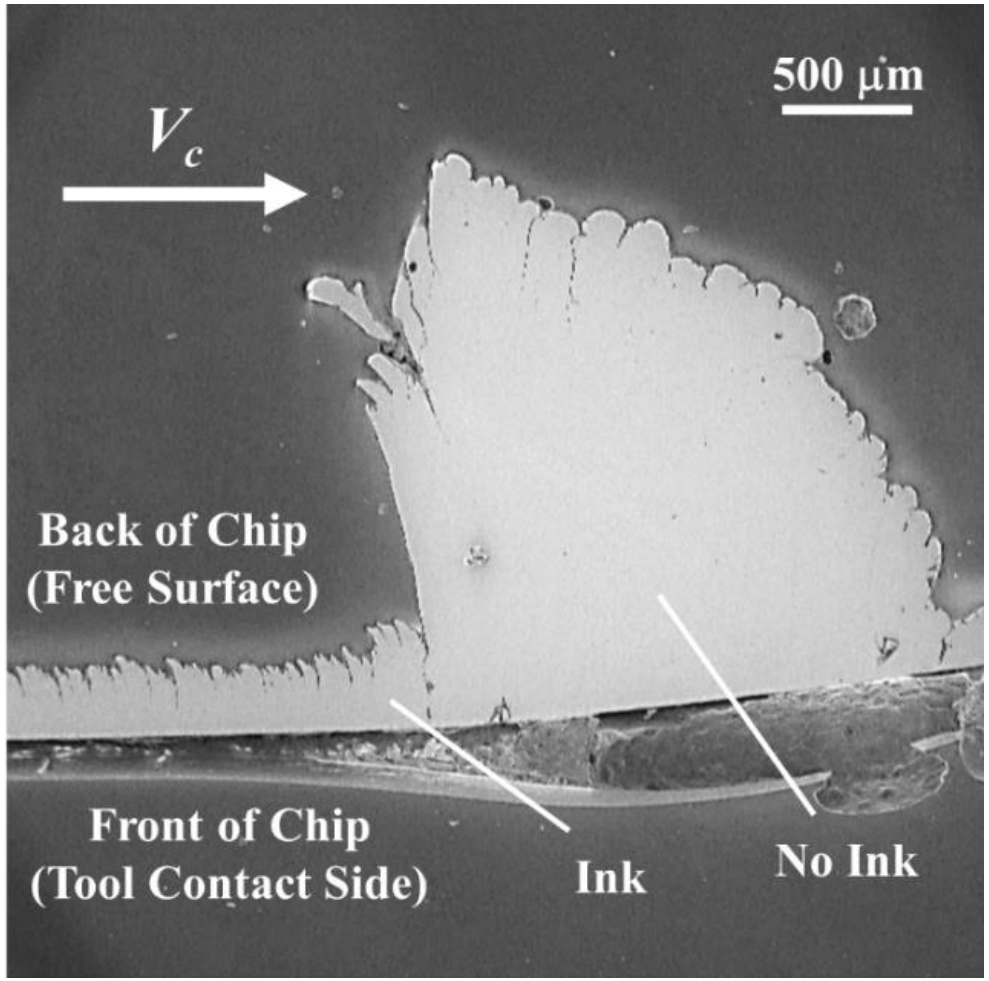
- Mechanochemical effect – changes in plastic deformation response of a material due to presence of a chemical medium; closely tied to adsorption properties, initial mechanical state of material, defect structure, conditions of fracture and deformation
- Common media such as metal marking inks, school glue, and permanent markers have been found to transition sinuous flow to segmented flow





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Comparison of Chip Morphology



Non-inked region

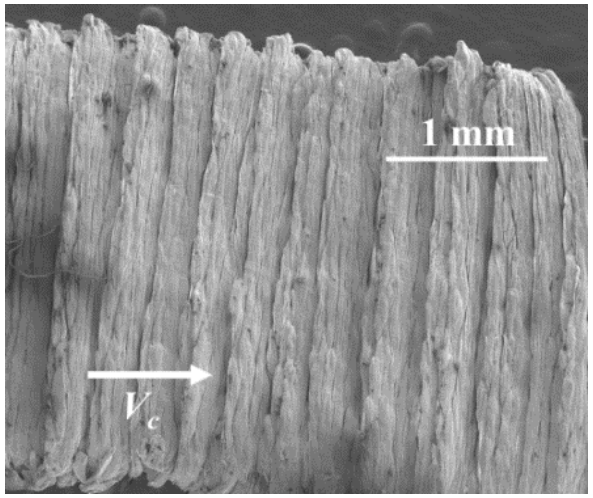
- ~ 34-fold thickening in chip thickness
- Mushroom-like free surface morphology

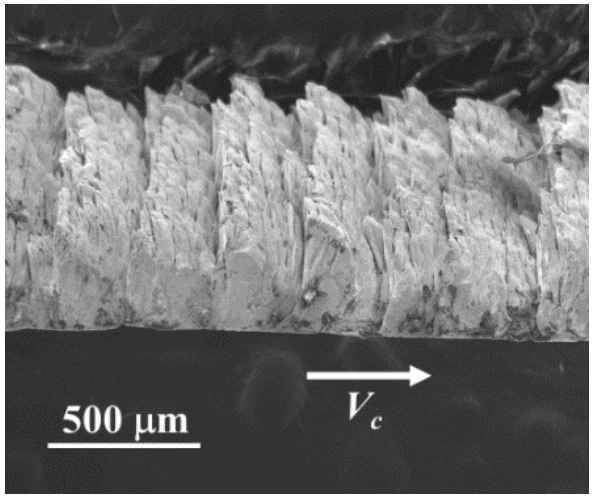
Inked region

- ~ 5-fold thickening in chip thickness
- Segmented morphology (saw-tooth)

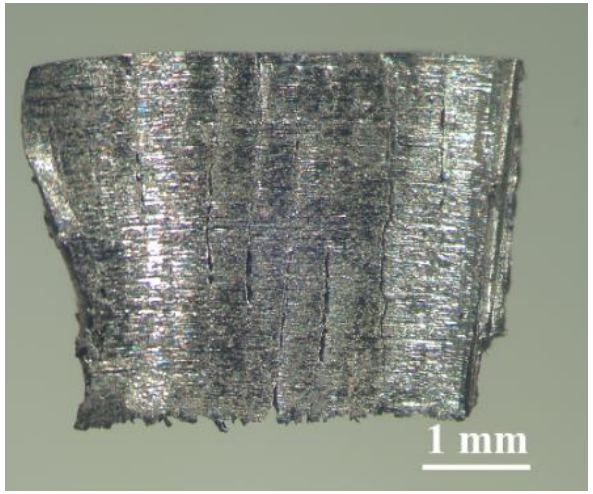
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Segmented Flow in Tantalum (with Ink)





Free-surface of chip



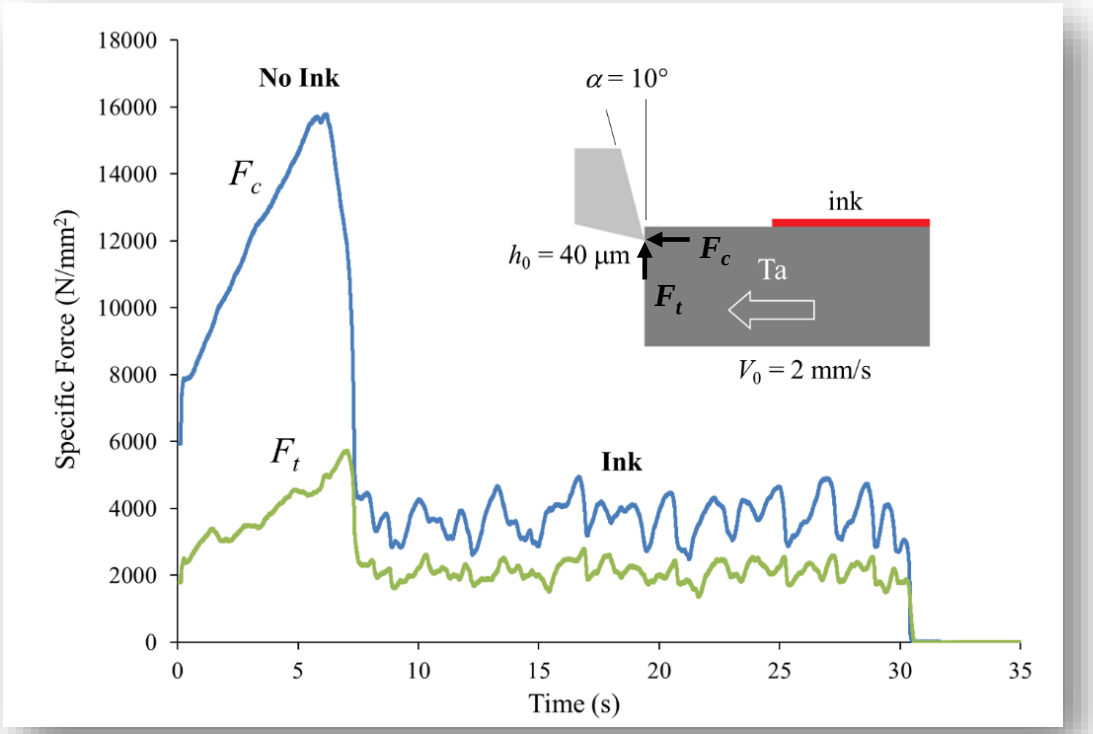
Tool contact surface of chip

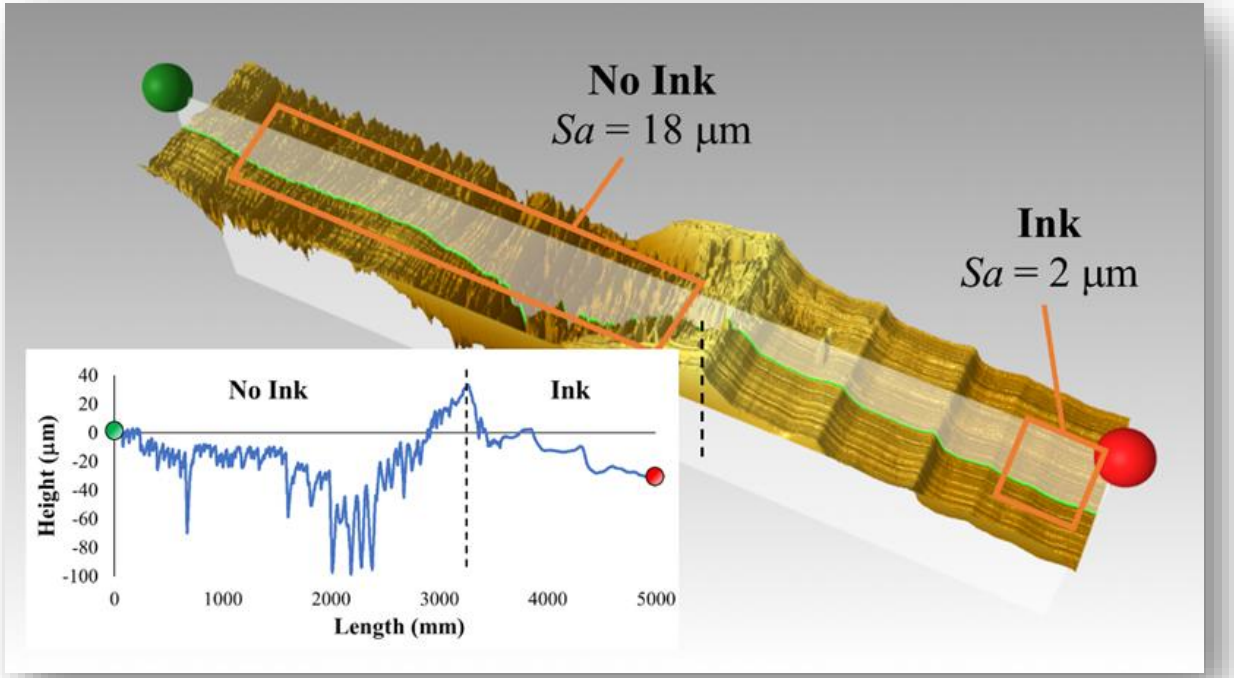
$\alpha = 10°$
$V_0 = 2$ mm/s
$h_0 = 40$ μm

- **Upon application of ink (~ 200 nm thick) prior to cutting, much thinner chip results with saw-tooth morphology**

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Specific Force & Surface Roughness

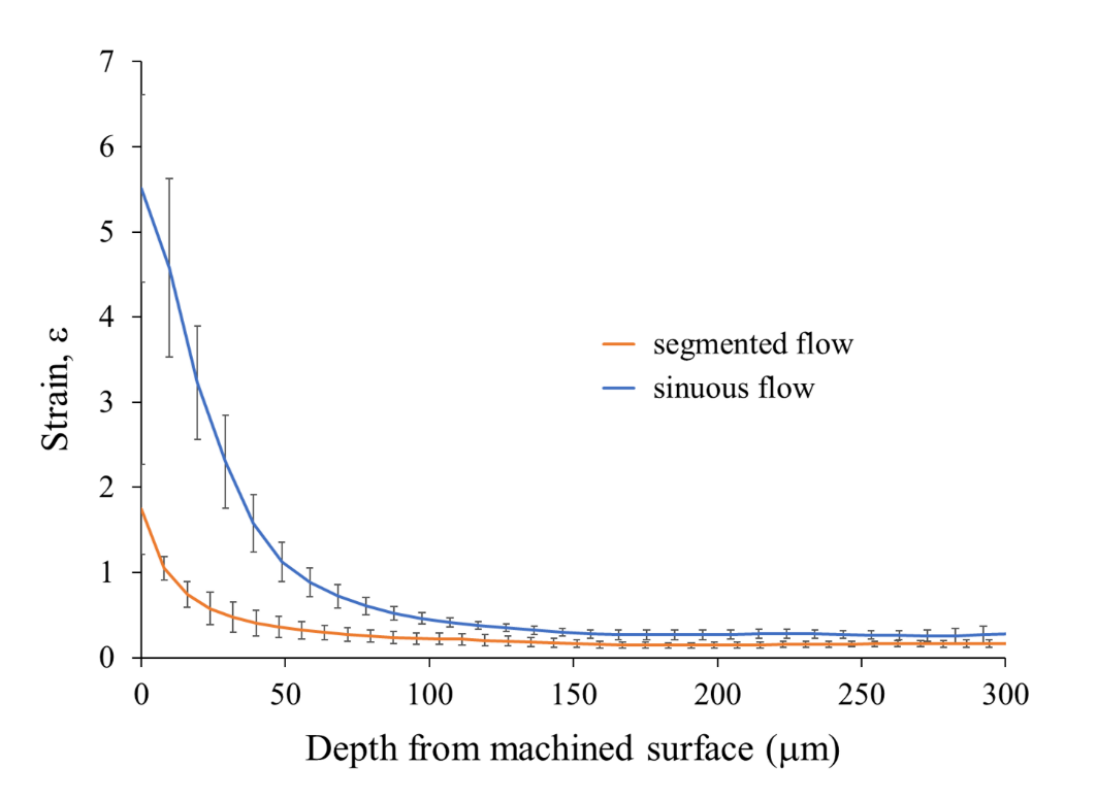


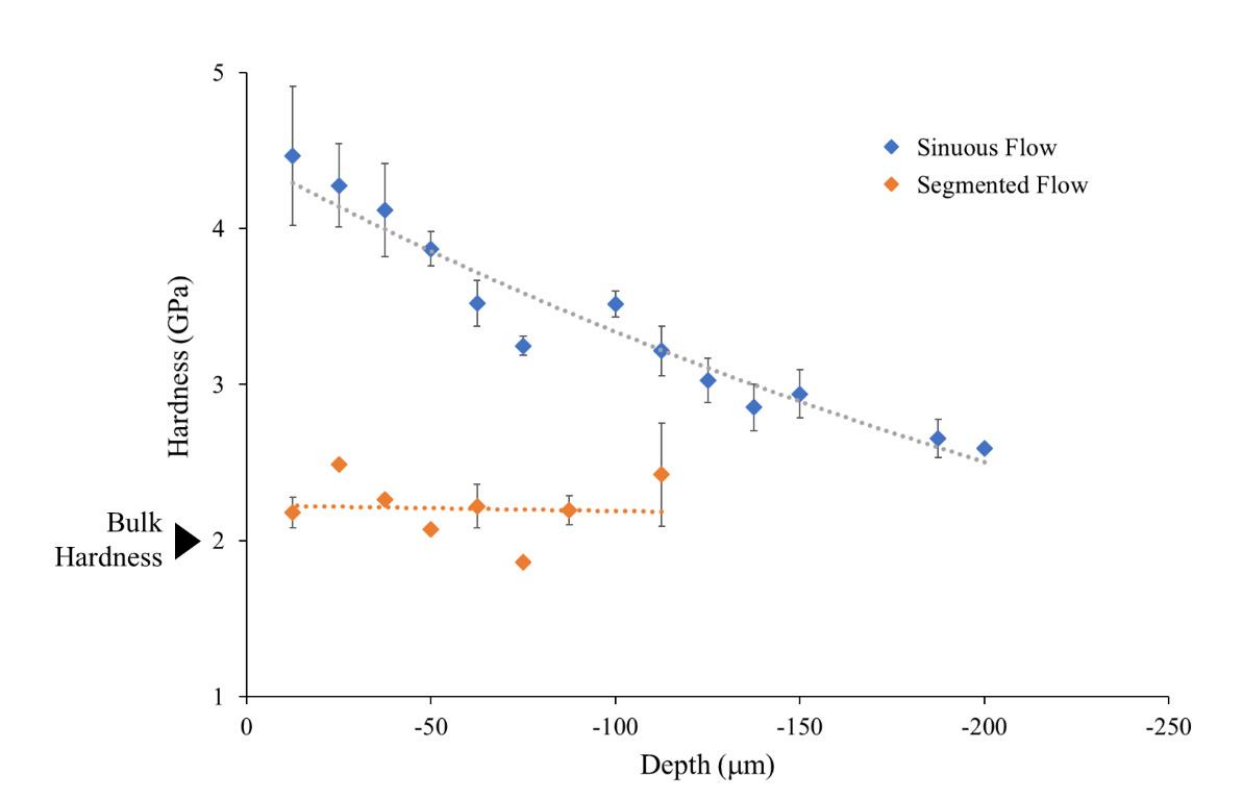


- **Lower forces decrease tool breakage and increase active cutting**

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Surface Strain & Surface Hardness





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Why Does Phenomenon Occur?

- Folding creates notches which are natural stress concentrators
- Surface adsorbing media induces tensile surface stress
- Additional surface stress triggers cracking at the notch tips
- Transitions deformation from plastic to brittle

- Near-surface effect (< 150 µm)

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Research Approach

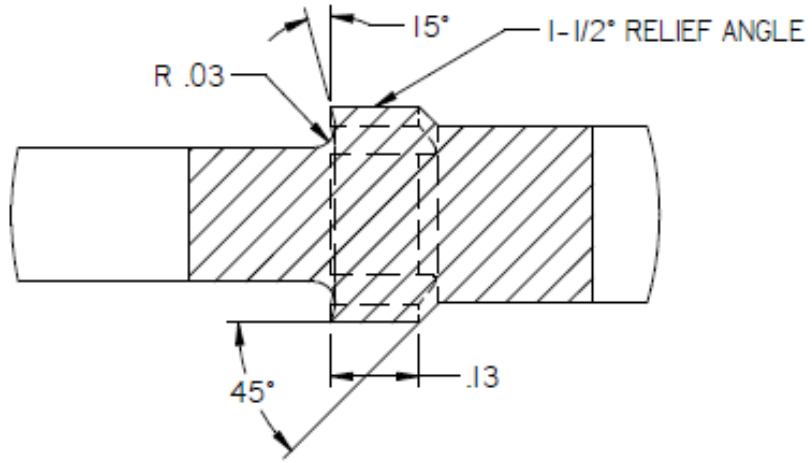
- Leverage basic research conducted as a Phase I SMART Scholar
  - Underlying mechanism that makes some metals ‘gummy’ when cut
  - Use of a mechanochemical effect to alleviate ‘gumminess’
- Apply basic research to the broaching/rifling of representative refractory tubes
- Success will be measured through force/torque and surface quality measurements

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Basic Research vs. Broaching

How applicable is the basic research to broaching/rifling?
Or restated, does it fall within the parameters over which sinuous flow occurs?

Parameter	Basic Research	Broaching
Tool Rake Angle (α)	0 – 20°	0 – 15°
Cutting Speed (V_0)	< 4 m/s	0.05 – 0.1 m/s
Undeformed Chip Thickness (h_0)	< 150 µm	10 µm



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Project Plan Overview

Phase I

Media screening FY21

Identify effective cutting media through controlled experiments – force measurements, chip morphology, surface quality, and/or high speed video.

- Drilling
- Linear cutting

Metals of Interest:
- Nb, Ta

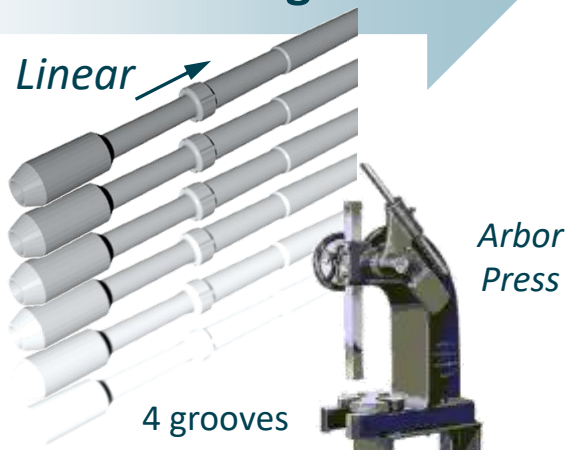
Phase II

Straight push broaching FY22

Series of Broaches

Linear

Increasing cutting diameter



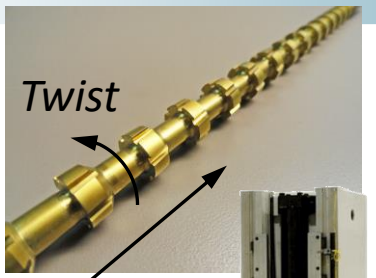
Arbor Press

Metals of Interest:
- Cu 101, Nb
  (ID 0.300”/OD 1”, 6” length)

Phase III

Spiral pull broaching FY23

Gang Broach



Increasing cutting diameter

Vertical Broaching Machine



Metals of Interest:
- Nb, Ta
  (ID 0.300”/OD 1”, 6” & 18” length)

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Next Steps – FY22

- Complete media screening and measuring of surface stress
- Finish fixture design for arbor press
- Conduct straight push broaching of 6” Cu and Nb
  - Broaches and Nb tubes in-hand
- Characterize surface quality of broached tubes
- Finish design and procure spiral pull broaches
- Procure 6” and 18” Ta tubes

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Acknowledgements

Science, Mathematics & Research for Transformation (SMART) Scholar SEED Grant Program

Center for Materials Processing & Tribology – Purdue University

American Broach & Machine Co.

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Thank You!



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Crane, IN 47552-5001
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References

- De Rosset W. (2015). Explosively bonded gun tube liner development (ARL-CR-0771).
- Davis, J. M., Saei, M., Mohanty, D., Udupa, A., Sugihara, T. & Chandrasekar, S. (2020). Cutting of tantalum: Why it so difficult and what can be done about it. *Int*. *J*. *Mach*. *Tools Manuf*, *157*, 103607.
- Sugihara, T., Udupa, A., Viswanathan, K., Davis, J. M. & Chandrasekar, S. (2020). Long-chain monolayers disrupt plastic flow in metals. *Science Advances*, *6*(51), 1-7.
- Udupa, A., Viswanathan, K., Davis, J. M., Saei, M., Mann, J. B., & Chandrasekar, S. (2019). A mechanochemical route to cutting highly strain-hardening metals. *Tribology Letters*, *67*(4), 1-12.

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The Marvin Group

The Marvin Group
NDIA
Future Force Capabilities
2021

MARVIN ENGINEERING COMPANY

MARVIN TEST SOLUTIONS

MARVIN LAND SYSTEMS

Armament Sustainment and Lethality Multipliers in Expeditionary Settings

20 October 2021

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INTEGRITY - PARTNERSHIP - CAN-DO ATTITUDE - INNOVATION

What is an Expeditionary Setting?

- Marine Corps Doctrinal Publication 3 (MCDP 3*), "Expeditionary Operations,"* establishes doctrine for the conduct of military operations by the US Marine Corps.

- USMC is ***"…An expeditionary force-in-readiness that is manned, trained, and equipped specifically to respond quickly to a broad variety of crises and conflicts across the full range of military operations anywhere in the world."***

- ***"This naval expeditionary character provides capabilities both to forward-deploy forces near the scene of potential crises as well as to deploy sustainable, combined arms teams rapidly by sea and air."***



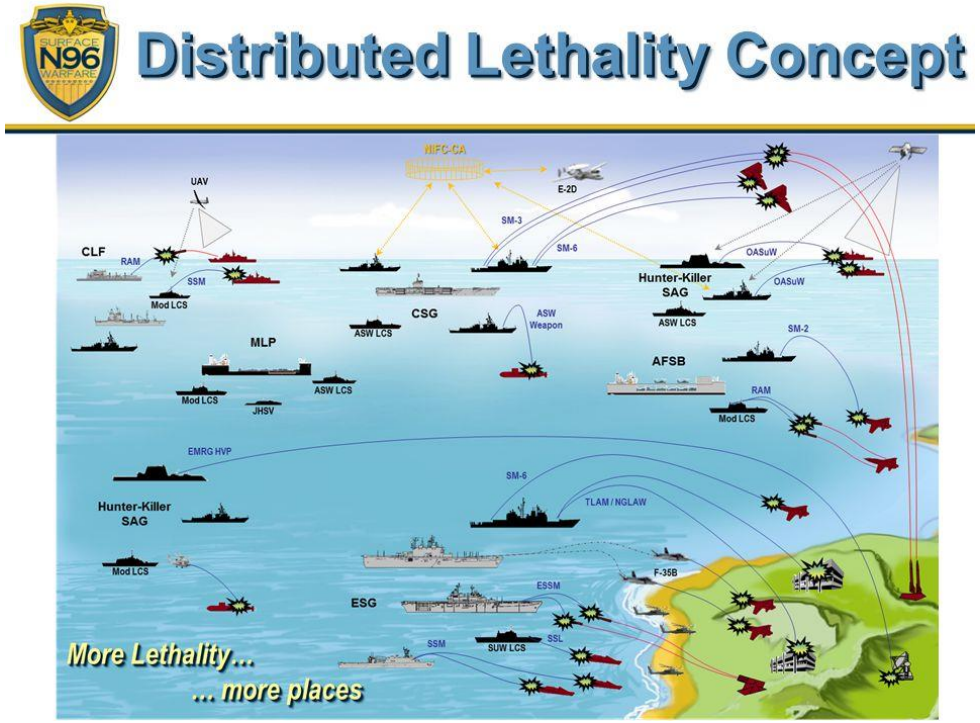


What is an Expeditionary Setting (Cont'd)?

- For Naval Forces, Expeditionary Advanced Base Operations (EABO) and Distributed Maritime Operations (DMO) are currently professed doctrine and synergistic

- At their core, it's about being nimble, adaptable, and lethal, units "punching above their weight"





"DMO is a combination of distributed forces, integration of effects, and maneuver. DMO will enhance battle space awareness and influence; it will generate opportunities for naval forces to achieve surprise, to neutralize threats and to overwhelm the adversary; and it will impose operational dilemmas on the adversary."

- Vice Adm. Phil Sawyer, USN, 2 Feb 2021

And More…

- Army and Air Force are capable of expeditionary deployments with certain units and in specific contexts

- Moving heavy armor and large formations is not truly expeditionary, but the more nimble responses of Special Operations and Quick Reaction Forces such as Airborne units better fits this model

- The Army's *"Win in a Complex World"* concept defines expeditionary as the ***"ability to deploy task-organized forces on short notice to austere locations"*** and being ***"capable of conducting operations immediately upon arrival."***





Air Force Not to be Left Behind…

- Agile Combat Employment (ACE) definition: ***"ACE combines adaptive basing, the operational maneuver of air forces, assured command and control, mission-type orders, and other elements to ensure [the force] can generate and sustain combat sorties."*** *(Mark Gunzinger, Director of Future Aerospace Concepts And Capabilities Assessments, AFA's Mitchell Institute for Aerospace Studies)*

- Training multi-capable Airmen to deploy quickly and minimize the logistics footprint and enable agility

- De-centralization and dispersion of squadrons to operate in smaller ship formations from austere locations





What Expeditionary is Not











Inherent Challenges

- We as industry do not set the doctrine, nor the operating requirements, ***but we need to be responsive and be able to demonstrate the "art of the possible" where appropriate***

- ***We cannot "referee" doctrinal conflicts or lack of clarity between and among the armed services,*** but we can present capabilities that address their stated desires to serve our warfighters and our partners and allies

- Despite different concepts of "expeditionary," ultimately, it comes down to available manpower, maintaining a small footprint, and not relying on equipment that realistically will not be available in austere, forward-deployed locations



What can we bring to "The Tactical Edge?"

The Tactical Edge

- **Operating at the "Tactical Edge"**
  - Warfighters at Risk
  - Risk of Disruption / Adversarial Realities
  - Distributed Lethality | Decentralized Forces
  - Infiltration/Exfiltration
  - Anti-Access/Area Denial – "Flipping the Script on Adversaries"









Help Warfighters "Punch above their Weight"

- Keep Battalions/Companies/Platoons/Squads/Fire Teams in the field
- Provide logistical support to 2-Ship / 4-Ship / 6-ship Aircraft Formations
- Reduce over-reliance on extended resupply chains
- Create more organic capabilities at a lower echelon level









Get warfighters what they need, when they need it, with minimal baggage and set-up

Solutions – Containerized and Partially Containerized Kits

- Logistical considerations for Air/Land/Sea transport
- 40-foot ISO Containers are ***too large and unwieldy*** for true expeditionary deployment
- 20-foot ISO Containers, where necessary for the additional protection they offer, are a reasonable compromise
- Combined with soft shelters, these can be moved more readily without specialized equipment, quickly set up, and provide some environmental protection







Experimentation with Mobile Sustainment Concepts

- **CARD as a proof-of-concept / lessons learned**
  - Marvin Engineering Co. IRAD Program
  - Partnership with Lockheed Martin Aeronautics
  - Socialized with F-35 JPO and Partner Nations

- **SPEAR conceptualization / emerging definition**
  - Proposed Capabilities Tailored to End User Requirements:
    - *C4/ISR*
    - *Power Generation/Regeneration*
    - *Repair & Maintenance*
    - *Possibly 3D Printing of certain spare parts/simple small unmanned systems*
    - *Munitions, including Small Arms Ammunition*
    - *"Weapons in a Box"*

Configurable Armament Repair Depot (CARD)



Testbed Prototype Unit in use at MEC facilities in Inglewood, CA to service U.S. F-35 Armament

Configurable Armament Repair Depot (CARD)

Sustainment & Readiness Solution





The Solution

- Supply “one-stop” repair capability for all AME/AAE used across multiple platforms and aircraft including equipment fault isolation, repair, and repair validation.
- Support multiple airbases with fewer dedicated facilities where applicable.
- Provide mobile repair capability for all AME/AAE without the need for a permanent dedicated building.
- Shorter repair turn-around times for all AME/AAE due to reduced transportation and consolidation of repair resources.
- CARD philosophy can be utilized in support of all levels of logistics. (Depot, I and O Levels)



- *Forward Deployable*
- *Optimizes Mission Readiness*
- *Streamlines Repair Process*
- *Sustains Product Quality*
- *Reduces Footprint of Logistics Support*

Lessons Learned from CARD Development

- Something that is transportable and capable of being set up in austere locations ***is still not necessarily optimized for true expeditionary operations***
- 40-Foot ISO Containers are best suited for setup and operation where there is some logistical infrastructure or facilities available
- For expeditionary purposes, 20-Foot ISO Containers are the largest practical size rigid wall shelter
- The Container structure itself is ***NOT*** the discriminating value; it's the capabilities delivered within this footprint in terms of providing the ability to maintain and repair up to the I-Level armament systems for various aircraft that is meaningful
- CARD capability formed the basis for F-35 Depot facility currently being stood up at Hill AFB

SPEAR Concept

Based on the concept of CARD, the provisionally named Special Purpose Expeditionary Advanced Resource (SPEAR) is envisioned as a highly mobile solution to support expeditionary operations, providing small, dispersed units with the ability to "stay in the fight" even if resupply is limited

SPEAR will marry together standardized 20-foot CONEX containers (modified in similar fashion to the 40-foot units used for CARD), military soft wall shelters, and high mobility lightweight vehicles (such as our affiliated company Flyer Defense's Tactical Utility Vehicle), which can all be readily transported via Air, Land and Maritime platforms, to enable expeditionary ground forces to prosecute and sustain critical warfighting missions.





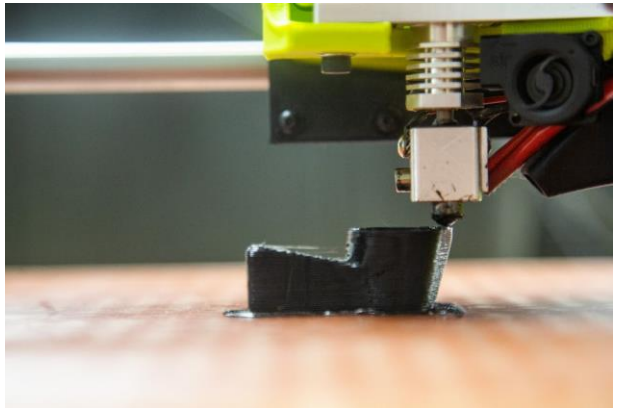


SPEAR Concept (Cont'd)

It is known that U.S. Army and Marines have both conducted experiments with additive manufacturing in the field, but integration with unmanned systems is not currently known.

Proposed SPEAR capabilities:

- Support and sustain small tactical unmanned systems, weaponized or not (including loitering munitions), ideally with ability to 3D print replacements in the field
- Ability to 3D print select small arms ammunition, including 40mm grenades and shoulder-fired missiles such as Carl Gustaf M4 84mmm recoilless rifle munition
- Ability to 3D print replacement parts and conduct repairs on designated individual small arms and platoon and company crew-served weapons
- Power generation/regeneration for supported troops via integrated APUs and/or solar panels to recharge batteries
- Secure communications including voice and data to provide additional C4ISR capabilities at the small unit level





SPEAR Concept (Cont'd)

Currently quiet inquiries are being made to identify potential champions for the SPEAR concept in the warfighting community and to understand what capabilities are most needed.

MEC is also in discussions with other industry partners to support this capability.

The idea of containerizing warfighting capabilities is not new, and seems to generate interest in some quarters.



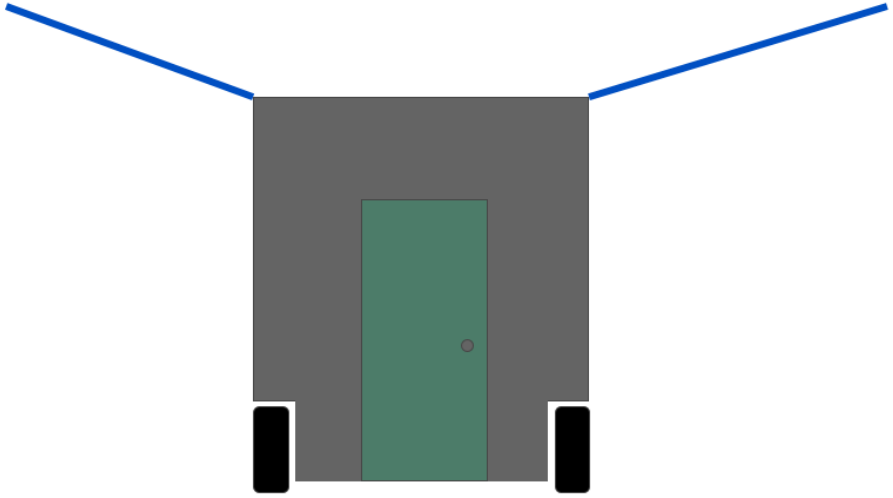


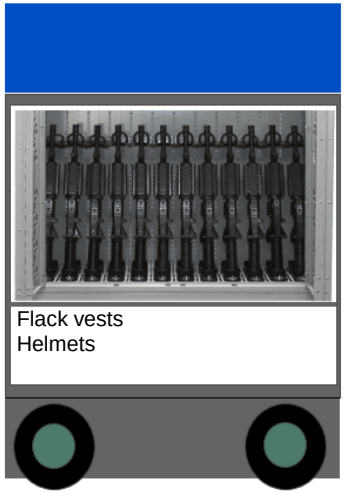




ACCESS Multi Role Container Solutions

- Develop container concepts that meet the ACE concept requirements
  - Mobile (manually pushed)
  - Same foot print as an ISU-90 equal to 1 pallet position (standard cargo container for DoD)
    - Dimension 108"W X 88"L X 91.35"H
  - Multiple roles in one solution (examples)
    - Pilot Debrief
    - Firearm and ammunition storage
    - Personnel Protective Gear
    - Limited O-Level Armament Test
  - Expandable platforms
  - Power
    - Jack boxes
      - Solar charged
    - 110v hook up
  - Additional Options Available to meet requirements:
    - Security Cameras
    - Lighting (Indoor and External)
    - Attached Solar panels
    - Electronic drive motors for wheels









The UxS Opportunity & Challenge

- Support/Sustainment for small UAV/UGV/USV
- Loitering Munitions
- Air Launched Effects (ALE)
- Unmanned Systems are “force multipliers” for ISR/EW/Kinetic Strike/Logistics, etc.
- The ability to regenerate such systems in the field adds additional tools








Solution for UxS – Industry/Warfighter Partnership

- The continued introduction of small, even “micro” tactical systems, particularly those meant to be “attritable,” presents opportunities for repair and even possibly fabrication in forward-deployed settings

- Industry partnerships among OEMs of such systems and engineering firms can provide capabilities to warfighters and serve as “force multipliers”









Indo-Pacific

- The tyranny of distance
- Distributed small units with risk of being cut-off or encircled by hostile forces
- Potential for heavily contested air and sea space that threaten logistics/supply chains (upper-end fight)
- How to enable the ability to strike hard, strike fast, and get out?
- Region lends itself to interdiction, unpredictability, presenting a moving target to adversaries



Eastern & Central Europe

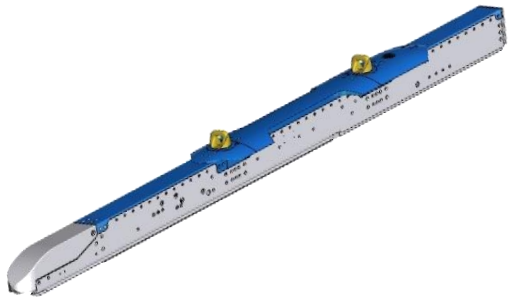
- Potential aggression could lead to capture of NATO member territory in initial thrust before reinforcements available
- Fixed installations would likely be early targets; ability to provide mobile repair and maintenance capabilities is a familiar concept from Soviet/Warsaw Pact Doctrine
- Ability to provide local resistance efforts with enhanced capabilities to fight “guerrilla warfare”
- Place adversary’s logistics chains and reinforcements “at risk” from hard to detect smaller formations



Solutions Today | Multi-Mission Universal Launchers

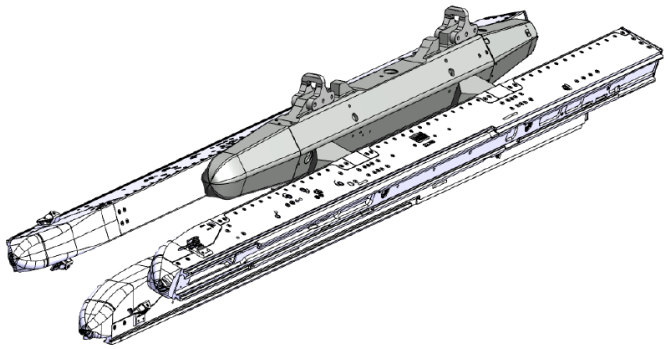
- **Universal Missile Launcher (UML)**

  Adaptation of MRL (LAU-127/LAU-128/LAU-129) series of rail missile launchers



- **Multiple Munitions Launcher (MML)**

  Adaptation of the TER-9/A and MRL series of rail missile launcher



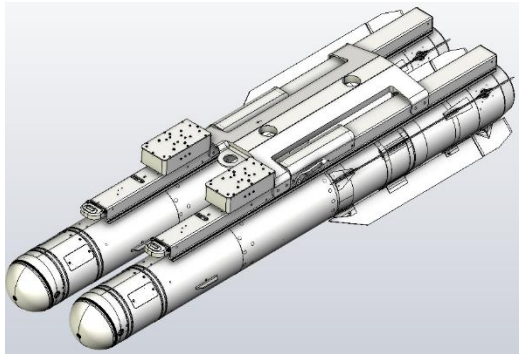
- Combat capability multiplier with minimal reconfigurations cost
- Minimal logistics footprint to support FOB/ACE operations
- Suitable for installation on numerous platforms (Fixed Wing/Rotary/UAV) subject to weight limitations
- Increased load-out of air-to-air missiles on aircraft with 30” ejector racks
- Multi-Service common missile launcher capability
- Missile stations capable of domestic and international missile carriage (AIM-9, AIM-120, IRIS-T, Python, Derby, ASRAAM, and Meteor)

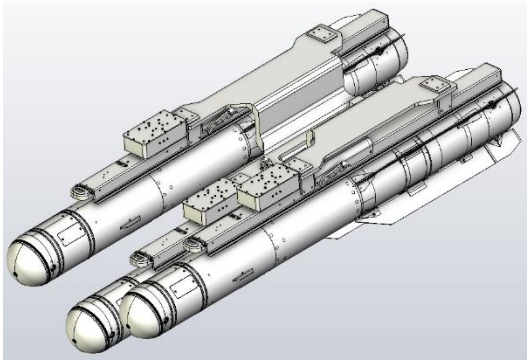
Solutions Today | Lighter Weight Hellfire Class Launchers

- **Hellfire Scalable Rail Launcher (HSRL)**

  Adaptation of current M299/M310 (quad/dual rail) Hellfire missile launchers







- Offers flexibility for single, tandem, triple, and quad clusters of rails for 100 lb. class (and less) air-to-ground munitions
- Miniaturized electronics significantly reduce weight from the M299/M310 series
- Proven Hellfire (qualified) rail design from the OEM manufacturer
- Ideal for UAV, UGV, Light Attack, Rotary/Tilt Wing, and other weight-sensitive applications
- HSRL is compatible with all Hellfire II, Romeo, Longbow, and JAGM missiles

Future Solutions

- Configuration packages for SPEAR
- Dual Rail Missile Launcher with Integrated MIL-STD-1760 Ejector Rack for 500 or 1000 lb. JDAM carriage
- Multi-role Adaptive Ejector Rack
- Disposable Missile Launcher for Attritable UAVs
- ***Modular Containerized*** Surface-to-Surface / Surface-to-Air Launcher

Who is The Marvin Group? (2021)

World Leading High Tech Solutions, Products and Services for

The Global Aerospace & Defense Market

Our Values:

Integrity

Partnership

Can-Do Attitude

Innovation

- Currently 1,000 + employees across 3 business units, local presence via authorized distributors/reps in multiple countries/global regions and FMS/FMF/DCS customers in 40+ nations worldwide
- Total Square footage: Over 500K square feet in Inglewood and Irvine, California
- Classified as “Small Business”
- MEC is **Recipient of FY2019 Nunn-Perry Award for Excellence in DoD’s OSBP Mentor-Protégé Program** along with our partner, Lockheed Martin Aeronautics
- Vertically integrated business units covering Air | Land | Maritime Domains



Relevant NAICS Codes:
336413, 334515, 336992, 336999

The Marvin Group's Companies

MARVIN ENGINEERING COMPANY



Armament Equipment
Air-to-Air, Air-to-Ground, Surface Launch

– Bomb & Ejector Racks
– Missile Rail Launchers
– Multiple Stores Carriage Systems
– Pylons
– MRO/Sustainment
– User/Maintainer Training
– Technology Development

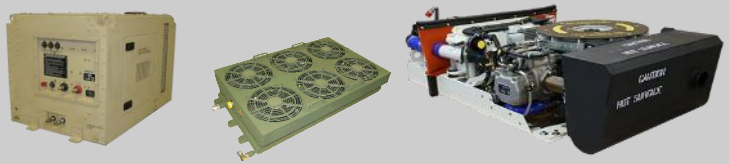
MARVIN TEST SOLUTIONS



Multi-Level Test Systems, Electronic Components | Assemblies

– Armament Test Sets
– SMS Test Sets
– Flightline Testers
– O-/I-/Depot-Level Maintenance Testers
– Airborne electronics
– User/Maintainer Training
– Engineering services

MLS
MARVIN LAND SYSTEMS

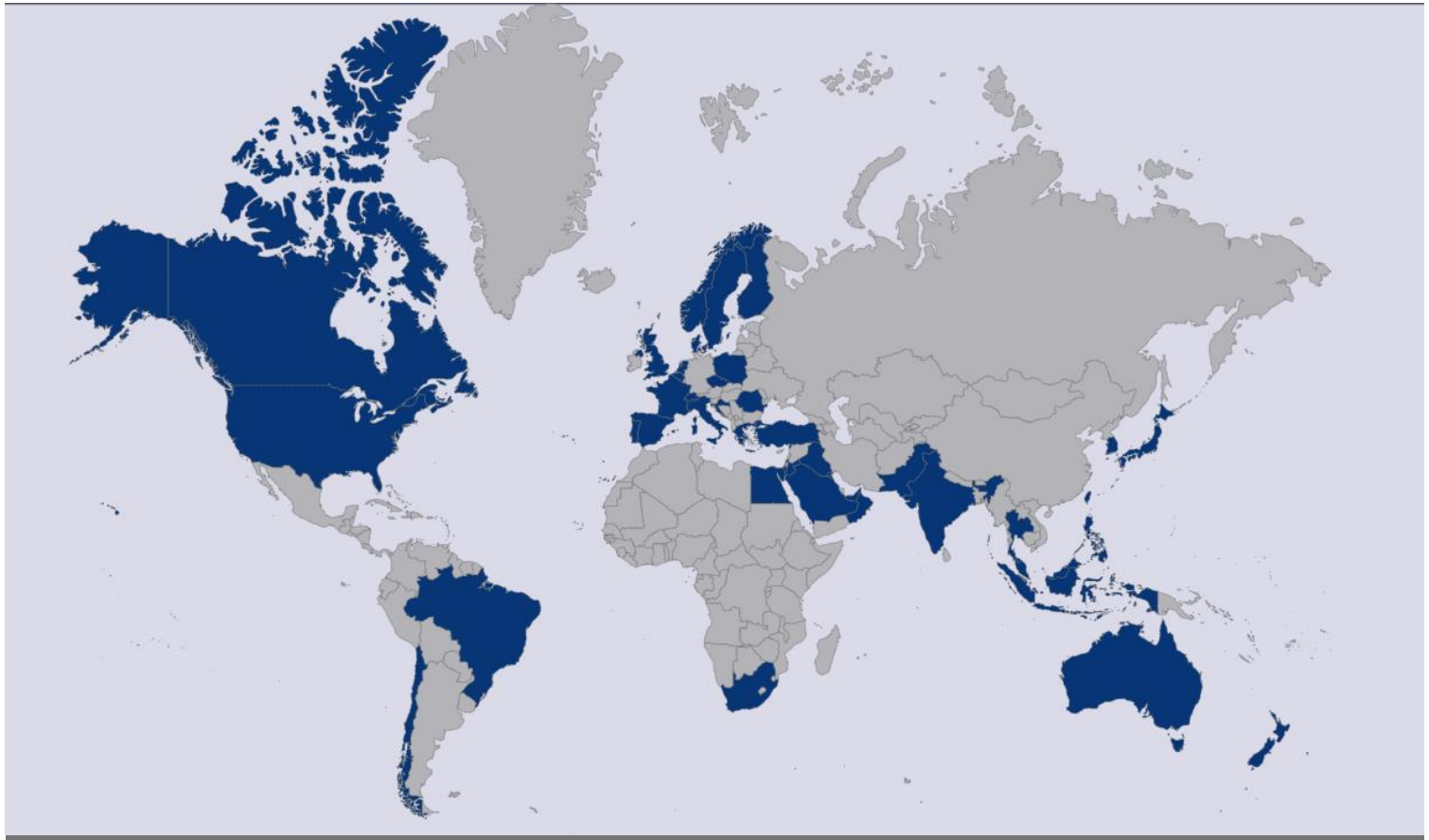


Ground & Maritime Primary | Secondary Support Systems

– Rigid Wall Equipment Shelters
– Environmental Control Units design and production
– Auxiliary Power Units design and production
– Remote Weapons Stations
– Electronics Chillers

The Marvin Group Around the Globe

Australia
Belgium
Brazil
Canada
Chile
Croatia
Czech Republic
Denmark
Egypt
Finland
France
Greece
India
Indonesia
Iraq
Israel
Italy
Japan
Jordan
Korea
Kuwait
Malaysia
Netherlands
New Zealand
Norway
Oman
Pakistan
Philippines
Poland
Portugal
Romania
Saudi Arabia
Singapore
South Africa
Spain
Sweden
Switzerland
Taiwan
Thailand
Turkey
UAE
UK
USA



Currently supporting customers and end users in 40 plus countries via FMS, FMF, and DCS

5 Global Regions: The Americas | Western Europe & Scandinavia | Eastern, Central and Southeastern Europe | Africa, Middle East & Central Asia | Indo-Pacific

Select Customers Around the Globe

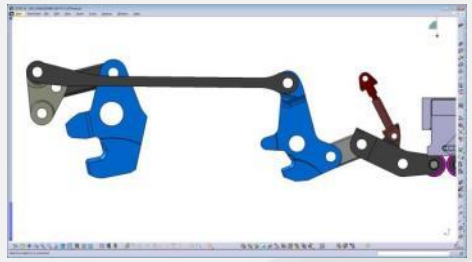
LOCKHEED MARTIN
BOEING
EMBRAER
GENERAL ATOMICS
GENERAL DYNAMICS
KAI
한국항공우주산업주식회사
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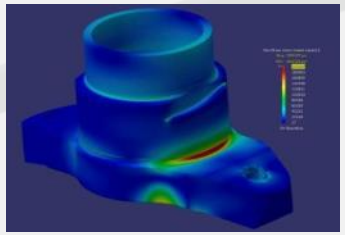


The Total Solution

DESIGN AND QUALIFICATION

- Specification Creation
- Performance Engineering
- Producibility Analysis
- Design-to-Cost
- Qualification Testing





MANUFACTURING AND TEST

- Acceptance Test Equipment
- Design Improvement
- Configuration Management
- Continuous Improvement









MAINTENANCE AND SUSTAINMENT

- Special Test Equipment
- Spares/LRU Supply Chain
- O-/I-/Depot-Level Test Sets
- Technical Documentation
- Comprehensive Training



MEC Proprietary and Confidential



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QUESTIONS?

THANK YOU FOR YOUR TIME!

Industry Panel
Medium and Small Businesses









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Agenda

Panel Introductions

Intellectual Property

GOCO Modernization

Minimum Sustainment Rate

Cyber Security

Approved for Public Release

Panel Members

David Siggers	President, Spectra Technologies LLC
Nick Korinis	President and CEO, SAVIT Corporation
Scott Selle	President, Armtec Defense Technologies
Scott McAnallen Moderator	Program Manager, Azimuth Consulting

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"The Relentless Pursuit of Excellence"

A National Defense Corp Company

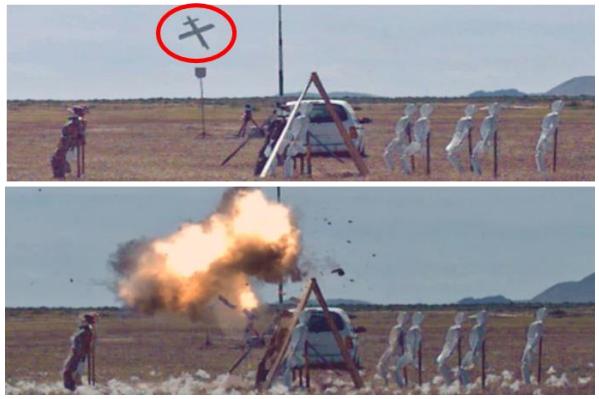
National Armaments Consortium Member



Warheads, Demolitions, 40MM Grenades LAP, and UAV Weaponization



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Traversing The "Valley of Death"





Nick Korinis
President & CEO
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MUNITIONS AND WEAPONS SYSTEM DESIGN

PROTOTYPE SYSTEMS INTEGRATOR

PRECISION MANUFACTURING

COST REDUCTION

SUBJECT MATTER EXPERT RICH TEAM

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Armtec Defense Technologies

Ordnance





- Felted-fiber nitrocellulose combustible large-cal ammo cases
- Pyrophoric day-night-thermal 40mm training grenade payloads



Countermeasures



- Aluminized glass fiber aircraft chaff cartridges and naval chaff payloads
- Magnesium-Teflon™-Viton™ (MTV) pyrotechnic decoy flares



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This presentation contains no ITAR or EAR controlled technical data or technology

Intellectual Property

- Panel Discussion
- Questions for the Panel

GOCO Modernization

- Panel Discussion
- Questions for the Panel

Minimum Sustainment Rate

- Panel Discussion
- Questions for the Panel

Cyber Security

- Panel Discussion
- Questions for the Panel

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David Siggers	Nick Korinis	Scott Selle	Scott McAnallen Moderator

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