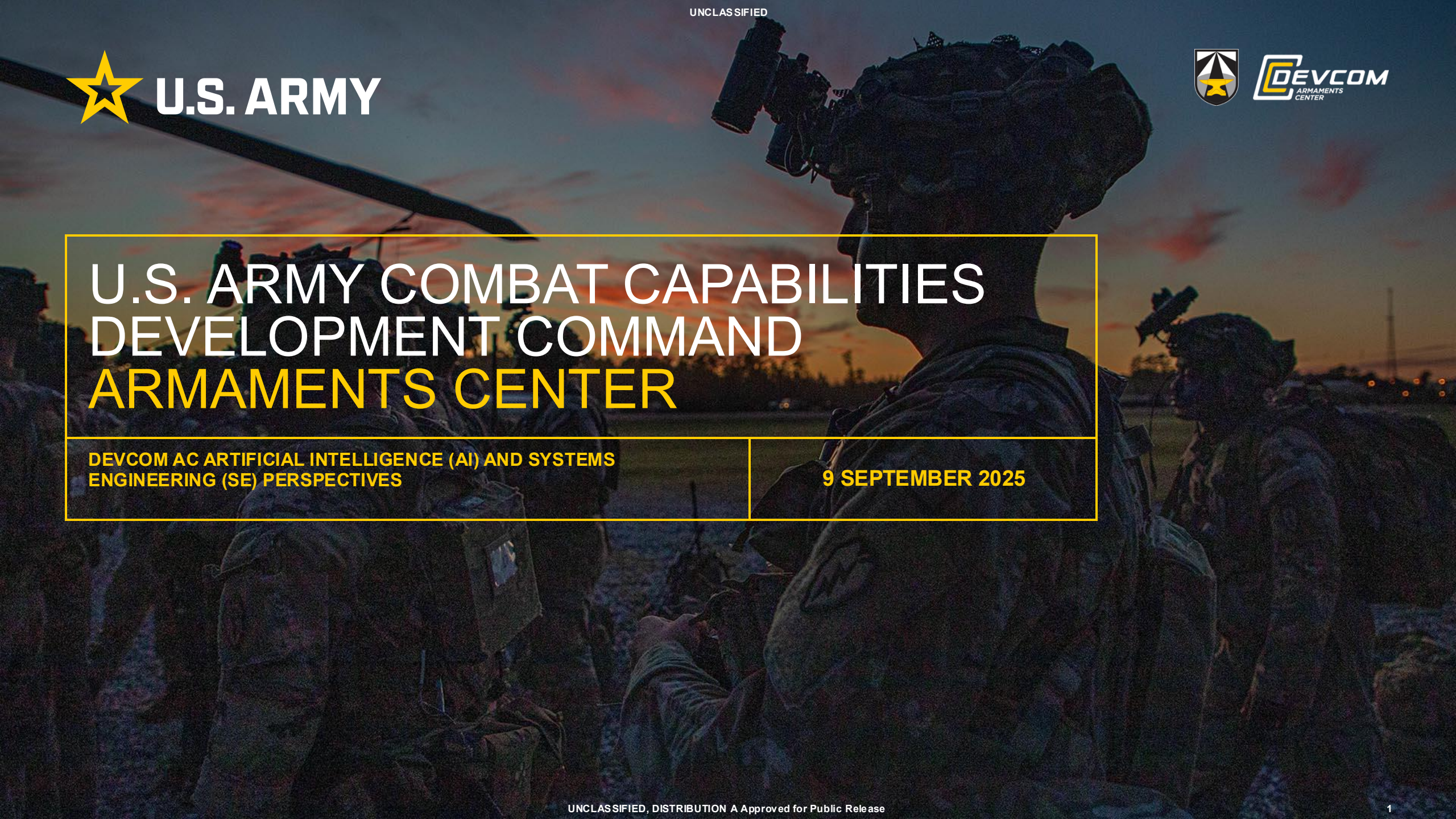


U.S. ARMY

DEVCOM ARMAMENTS CENTER

U.S. ARMY COMBAT CAPABILITIES DEVELOPMENT COMMAND ARMAMENTS CENTER

DEVCOM AC ARTIFICIAL INTELLIGENCE (AI) AND SYSTEMS ENGINEERING (SE) PERSPECTIVES

9 SEPTEMBER 2025

DEVCOM ARMAMENTS CENTER

MISSION

Lead innovative research and lifecycle engineering of armaments solutions.

VISION

To be the most trusted and responsive provider of pioneering armaments solutions for decisive victory.

Forging the Future of Armaments

ARMAMENTS CENTER CORE COMPETENCIES

Weapon Systems & Technologies

- Integrated Weapon Systems
- Gun Mounts & Recoil Mitigation
- Non-Lethal, Directed Energy Weapons & Target Effects
- Remote & Automated Weapon Systems
- Ammo autoloaders and magazines
- Large Caliber Cannon Design, Prototyping & Certification
- Weapons Manufacturing Technology

Logistics

- Class V Ammunition Packaging, Handling, Storage, Planning Distribution, & Transportation
- Logistic Engineering & New Equipment Training

Fire Control Systems

- Embedded/Real-Time Software
- Fire / Weapon Control Hardware & Integration
- Ballistic Data & Products
- Prognostic / Diagnostics
- Automated Test Sets
- Networked Lethality
- Weapon System Assurance
- Emergency Management & Anti-Terrorism Systems
- Embedded Training for Ground Combat & Soldier Platforms

Munition Systems & Technologies

- Gun Launched Munition Systems
- Non-Lethal and Scalable Munitions
- Grenades, Demolitions, Signal Flares
- Countermeasure Flares / Decoys
- Guidance, Navigation, and Control
- Interior, Terminal & Aeroballistics
- Fuzing & Munition Power Systems
- Telemetry
- Munition Producibility & Manufacturing Sciences
- Explosive Ordnance Devices
- Maneuver Support Munitions
- Reactive Armor

Enterprise Engineering & Business

- Systems Engineering & Analysis
- Quality & System Reliability Engineering
- Modeling & Simulation of Armaments
- Product and Technical Data Management
- Acquisition Support, Business Process Management
- Industrial Base Analysis/Obsolescence Management

Energetics, Warheads & Materials

- Propellants & Propulsion Systems
- Explosives
- Pyrotechnics
- Warheads / Lethal Mechanisms
- Demil & Environmental
- Integrated Explosive Detection Systems
- Munition Production Engineering
- Stockpile Reliability

Armaments Life-Cycle Engineering: Research, Development, Production, Field Support & Demilitarization

FUTURE ARMAMENTS TECHNOLOGIES OF INTEREST (SOME EXAMPLES…)

Project Priorities

- Blast Overpressure (BoP)
- AFATDS Artillery Execution Suites (AXS)
- Munitions Industrial Base (existing and advanced)
- Lethal UAS
- C-UAS/C-SWARM
- Enhanced Range & Lethality Mortar
- Tank Armament & Ammo
- Lethality Enabling Engineering functions
- Machine-Gun for maneuver
- Lethality Automation in Contested Environments

AC Accomplishments

Foundational Investments

WEAPON SYSTEMS

- Attritable armament systems
- Optionally autonomous weapon systems
- Counter-UAS / swarm defense
- Remote, robotic & optionally manned systems (HMI-F)
- Signature reduction
- Suppressive effects
- Adaptive terrain shaping systems

FIRE CONTROL

- AI-enabled / collaborative fire control
- Supervised autonomy
- Advanced ballistic algorithms
- Photonics solutions for fire control
- Soldier aim augmentation
- Tactical data collection and processing

ENABLING

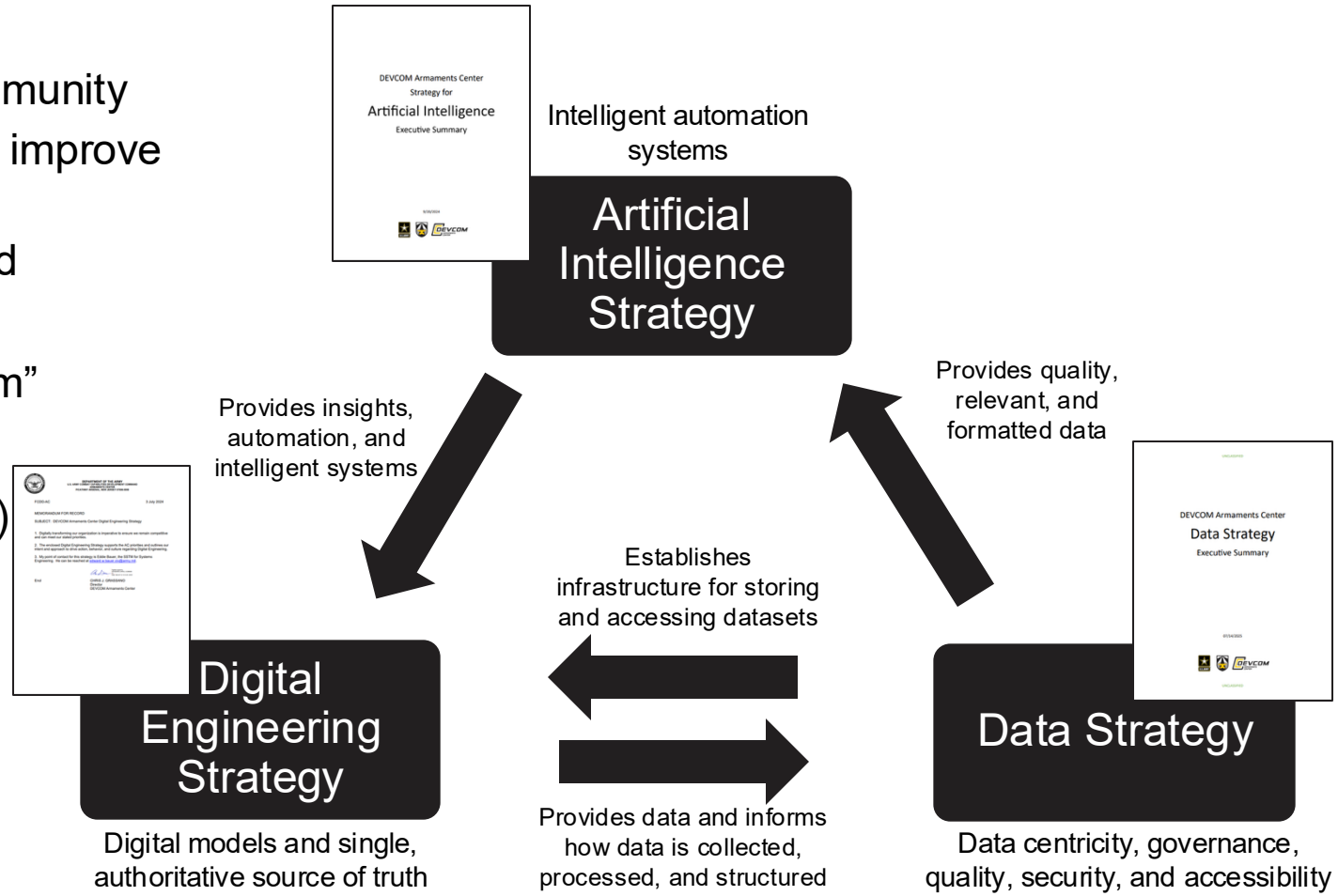
- Quality, reliability & safety engineering
- Contested logistics & resupply
- Alternative materials / sources / manufacturing methods
- Software, MOSA, digital eng & predictive analytics
- Design for demil / reduced lifecycle impact

MUNITIONS

- Collaborative seeking munitions / submunitions
- Adaptive Countermeasures
- Agile warhead concepts
- Munition-delivered sensors / non-kinetic effects
- MDO / Multi-mode submunitions
- Dynamic re-targeting
- Assured PNT for GPS denied environments
- Munition concepts for surge capacity

AC SYSTEMS ENGINEERING FOCUS

- Acknowledgement of the Challenge Across Community
  - How do we leverage AI-enabled capabilities to improve SE execution? (AI4SE)
  - How do we execute SE activities on AI-enabled systems? (SE4AI)
- Better Definition and Management of the “System”
  - System Model Advancements & Ontology
- Data-driven Decisions (technical and operations)
  - Statistical and Analytical Approach
  - Reinforcement Learning & Machine Learning
  - Automation
- Development of Major Strategies
  - Digital Engineering (DE)
  - Artificial Intelligence (AI)
  - Data



AC is committed to evolving with AI-enabled capabilities to improve Systems Engineering Execution
Achieving Army Future Command’s Goal: “…faster innovation, experimentation and demonstration”

DEVCOM AC DIGITAL ENGINEERING (DE) STRATEGY

Purpose: Transform the culture and workforce to adopt digital engineering across the lifecycle by using models to inform the enterprise and provide the authoritative source of truth.

• **LOE 1: Build the Digital Foundation:** • *Continue transformation from documents to models & digital data.*	• Model-based tools and templates that transform development of SE artifacts (ie. risk profiles) • Successfully conducted model-based technical reviews
• **LOE 2: Establish the Data Architecture:** • *Build the data infrastructure & development of Armaments ontology*	• Developed baseline armaments ammunition domain ontology

• **LOE 3: Deploy Digital Engineering Ecosystem (DEE)*:***
  • *Deployment of an ecosystem to realize Digital Twin/Thread*
  • *Enabling catalyst for use of AI to support the synthesis of data across the enterprise*
	• Vendor demonstrations and updates
	• Consolidated findings and recommendation made for down-select

• **LOE 4: Grow Workforce Digital Literacy and Adoption:** • *Workforce development will be key to success of digital transformation.*	• LLM knowledge base for knowledge transfer

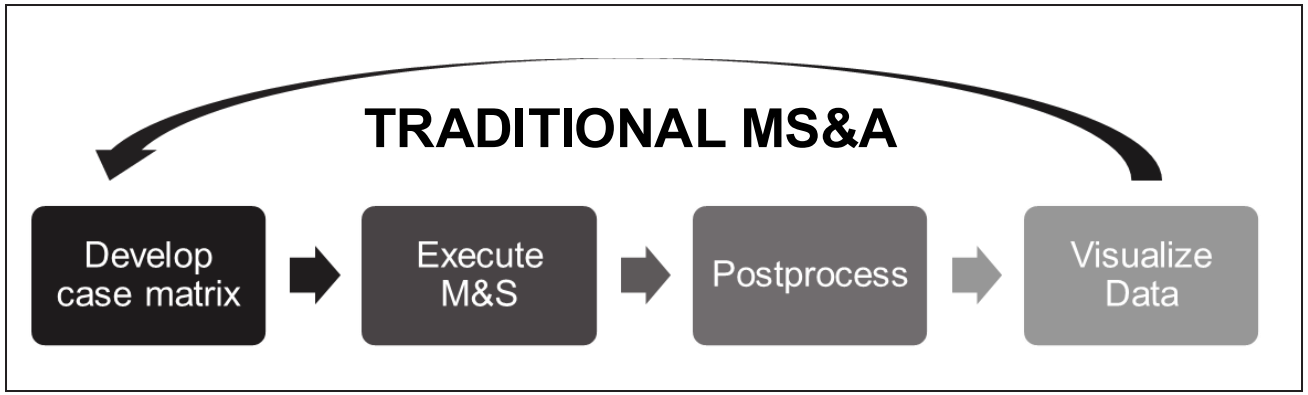
The SERC is a key partner to help realize our DE Infrastructure

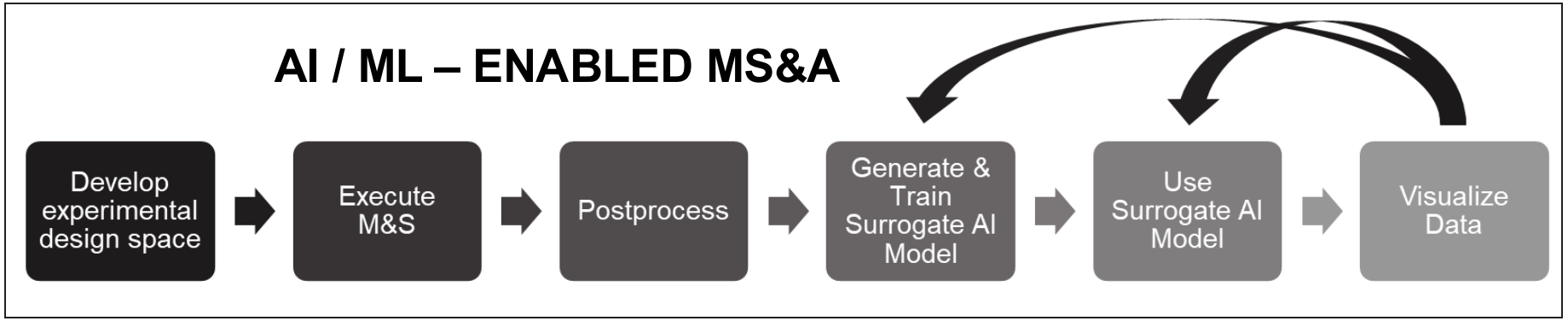
AI/ML-ENABLED MODELING SIMULATION & ANALYSIS (MS&A)

Problem: Traditional MS&A is computationally expensive, generally provides point solutions, and scales up exponentially

Solution: Introduce Design of Experiments in tandem with Surrogate Modeling

Impact: Computational inexpensive surrogate models that can continuously sample the tradespace while enabling rapid downstream changes





AI/ML-enabled MS&A can be applied across multiple Armaments Center functions and domain areas.

AI/ML–ENABLED USE CASES

Performance Assessment ex. C-sUAS

Problem: Mission and solution space for C-sUAS scenario assessment is too large to assess point solutions

Solution: Ranked (bootstrap forest) and quantified (neural network) critical variables during Brigade and below engagements

Impact: Provided analytical underpinning for determining requirements values and informed additional Army-level decisions.

Automated Processing ex. EDC

Problem: Multiple radiographers review X-rays for defects according to MILSPEC requirements. These positions require years of training, and the work is manual, highly regulated, and time consuming

Solution: Automate simple tasks with teal-time predictive aids to focus radiographers' primary attention

Impact: Speed up inspection timelines, making the defective call quicker

Technology Development ex. Propellants

Problem: As upgrades are made to systems to increase performance, increased pressure will have an impact on personnel and materiel

Solution: Utilize functional data analysis in conjunction with design of experiments and surrogate modeling to understand the trade space

Impact: Identified degree of influence key factors have on pressure waves to understand how different combinations influence future designs

Rapid Prototyping ex. Fuzes

Problem: Advanced processing techniques require man-in-the-loop during production for safety, performance, and quality

Solution: Automated robotics training in performing simple operations

Impact: Automation in fuze assembly, safety mitigation, and improved quality free of human factor errors

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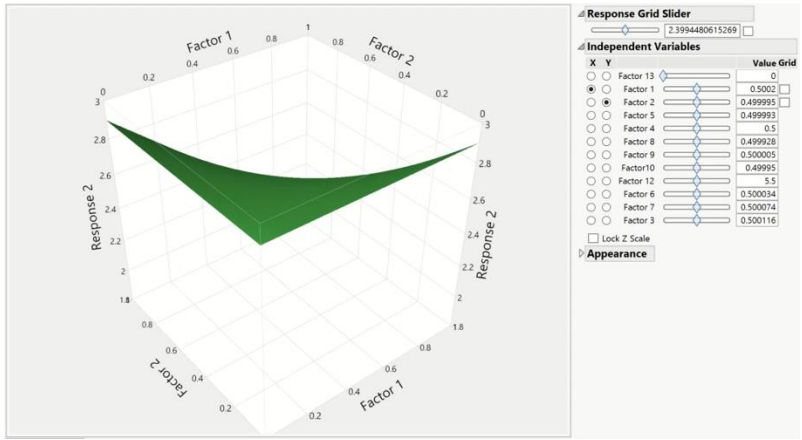

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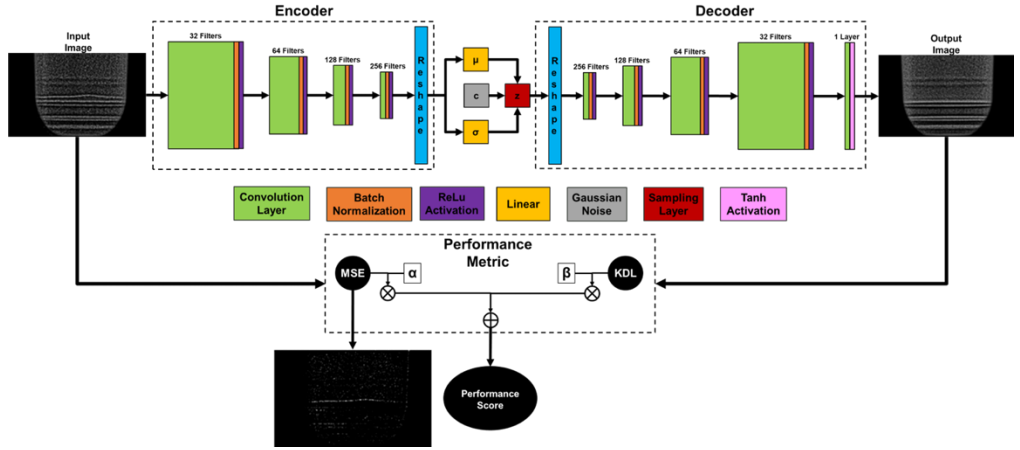

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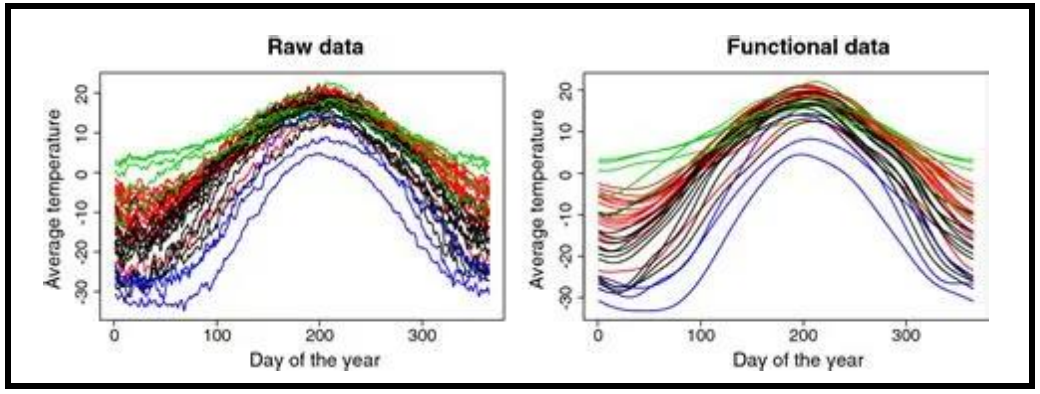

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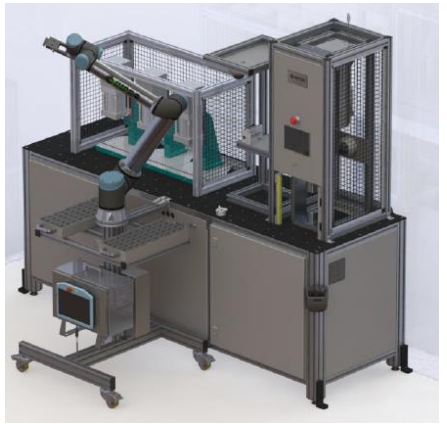

PILLARS OF TRUSTED & ASSURED AI

Trusted AI: Product that the warfighter trusts to deliver desired capability

Assured AI: Product can be released and fielded with confidence that it is robust and resilient after rigorous application of best practices and risk mitigation

Process that certifies that Army materiel is safe, suitable, and supportable before issued to the field through a holistic review by various stakeholders within the Army

Interdisciplinary approach to developing and sustaining systems which focuses on the interfaces between humans and modern systems, with consideration given to human-machine integrated formations, human capabilities, and human behavior

Ensuring the system will perform essential functions in the intended operational environment for the mission duration – an approach ensuring the system is designed for reliability to include early identification and mitigation of potential failure modes across models, subsystems, and enabling technologies

Understanding the criticality and impact data – especially low quality and insufficient data – has on the overall design and development of models and end system applications, assessing assurance, and applying mitigations

Independent methods and procedures that are used to check if a component, product, service, or system meets its established requirements and specifications and that it satisfies its intended overall purpose

DoD approach for identifying hazards and assessing and mitigating associated risks encountered in the development, test, production, use, and disposal of defense systems

Collaboration Across Stakeholders Will Execute Trusted AI and Autonomy Initiatives

CHALLENGES AND OPPORTUNITIES

Strategic Opportunities

- Data-driven & real-time decisions
- Predictive analytics (prognostics / diagnostics)
- Automate repetitive, manual processes
- Cost reduction
- Quality control
- Systems Engineering Artifacts
  - Automated TDP maturity assessment
  - Configuration status accounting tools
  - AI-assisted ECP creation and review
  - Automated PLM metadata generation
- Advanced Analytics
  - Trade space analytics and forecasting

Key Challenges

- Data quality and availability
- Integration / scalability with legacy workflows
- Resource obstacles
- Software and infrastructure restrictions
- Resistance to change
- Workforce development
  - AI/ML literacy gaps
- Technical limitations
  - AI effective for administrative tasks but limited technical analysis

AI, Digital Engineering and Data Strategy Implementation will drive success in opportunities and overcoming challenges

PARTNERING THROUGH TECHNOLOGY TRANSFER

- Our most common tools:
  - Cooperative R&D Agreements (CRADAs)
  - Educational Partnerships
  - Service Agreements
  - Consortia
  - Patent Licensing
  - IR&D
  - SBIR/STTR
  - International Agreements

DEVCOM Armaments Center Transfers Technology to the Industrial Base to Speed Transition to the Warfighter

Visit our Technology Transfer Website
https://ac.DEVCOM.army.mil/collaborate/

Let's continue to work together!

TALKS OF INTEREST FROM AC PERSPECTIVE

- **Two Quantitative Methods for Measuring and Comparing the Performance of Binary Classifiers** (Mikel D. Petty, Ph.D., The University of Alabama in Huntsville)
  - This paper presents Cost Curves and Safety Scores to evaluate binary classifiers in safety-critical applications, with Cost Curves visualizing misclassification costs and Safety Scores providing a numerical measure that integrates accuracy and costs for improved real-world applicability.
- **Stress Testing Safety-Critical Learning Enabled Systems with Optimization and Adaptive Sampling** (Jon Vigil, OptTek Systems)
  - This paper introduces Metaheuristic Optimization and Adaptive Sampling to improve the safety of machine learning systems in military applications, using global optimization to identify failures and Bayesian methods to refine safety and support certification.
- **Reinforcement Learning Qualification Process (RLQP): A Framework for Evaluating Safety and Robustness in Reinforcement Learning** (Steven Senczyszyn, Michigan Technological University)
  - The RLQP framework assesses the safety, robustness, and performance of reinforcement learning algorithms in critical domains, using simulations, perturbation testing, and statistical methods to ensure reproducibility and real-world applicability.
- **Appropriate Levels of Human Judgement for Autonomy** (Elizabeth Mezzacappa, U.S. Army DEVCOM Armaments Center)
  - This paper outlines a framework to ensure "human judgment" and "meaningful control" in autonomous military systems, emphasizing user-centered design, decision-making metrics, and simulation-based testing with iterative feedback.
- **Leveraging AI Agents for Adaptive, Data-Driven Requirements in Army Systems** (Yvan Christophe, U.S. Army DEVCOM Armaments Center)
  - This paper presents a framework using collaborative AI and machine learning to generate, validate, and adapt Army system requirements, refining applications like predictive maintenance and autonomous logistics to meet evolving mission needs.

THANK YOU.


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