HQDA G-8

Modernizing The Force!

Human Machine Integration Division (FDH)

Robotic and Autonomous Systems (RAS)

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Established 01 June 2023

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Cross-Cutting Collaboration Partners

CFTs:

1. NGCV
2. Soldier Lethality
3. FVL (with sUAS)
4. STE
5. AI2C
6. Contested Logistics

COEs:

1. Maneuver
2. Maneuver Support
3. Sustainment
4. Aviation
5. Mission Command
6. Fires
7. CAC-T

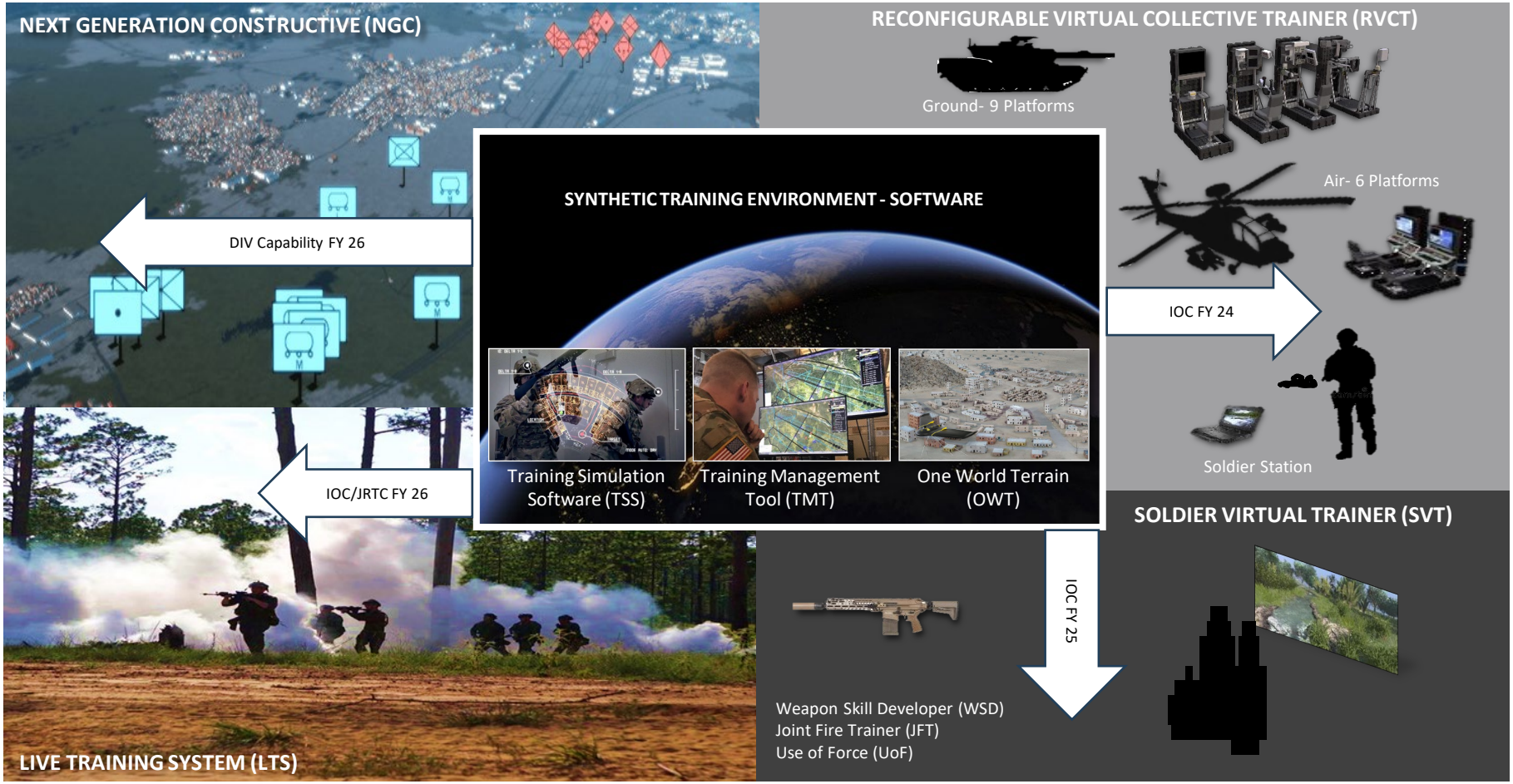
PEOs:

1. Soldier
2. Ground Combat Systems
3. CS & CSS
4. AVN
5. STRI
6. C3T
7. IEWS
8. Missiles and Space

Prepared by DAPR-FDH

Synthetic Training Environment (STE) Overview

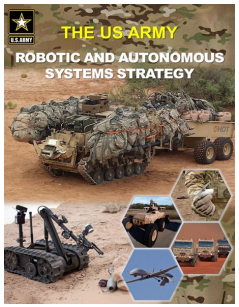
The Army must reduce the use of complicated, cumbersome technology while leveraging technology that cuts cost, including video game solutions that can lower spending on training formations. Using Artificial Intelligence, the Army can replicate realistic battlefield scenarios with less assistance from additional units. CSA GEN George, AUSA OCT 23



Enabling Multi-Echelon Combined Arms Training

Prepared by DAPR-FDH

Army RAS Strategy

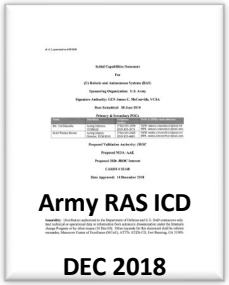


Army RAS Strategy
MAR 2017

Update in FY25

RAS Strategy Priorities:

- Improve **situational awareness** and persistently monitor the environment
- **Lighten** physical and cognitive **workloads**
- Improve **Sustainment** with increased distribution, throughput, and efficiency
- Facilitate **movement and maneuver**
- **Protect** the force



Endstate:

Multi-domain Robotics and Autonomous Systems (RAS), through Human-Machine Teaming (H-MT), enable Army formations to increase their **endurance**, **persistence**, **lethality**, **protection** and **depth**.

Near-Term Priorities 2017-2020

- ✓ Increase situational awareness for dismounted forces at lower echelons
- ✓ Lighten the physical load for dismounted forces
- ✓ Improve sustainment with automated ground resupply
- ✓ Facilitate movement with improved route clearance
- ✓ Protect the Force with EOD RAS platform and payload improvements

Mid-Term Priorities 2021-2030

- ❑ Increase situational awareness with advanced, smaller RAS and swarming
- ❑ Lighten the load with exoskeleton capabilities
- ❑ **Improve sustainment with fully automated convoy operations**
- ❑ **Improve maneuver with unmanned combat vehicles and advanced payloads**

Far-Term Priorities 2031-2040

- ❑ Increase situational awareness with persistent reconnaissance from swarming systems
- ❑ Improve sustainment with autonomous aerial cargo delivery
- ❑ Facilitate maneuver with advancements to unmanned combat vehicles

Prepared by DAPR-FDH

Army small UAS / Robotics / AI Portfolio Overview

Family of SUAS

Small Uncrewed Aircraft Systems

- Joint Tactical Autonomous Aerial Resupply System (JTAARS)
  - Small
  - Medium
- Long Range Recon (LRR)
- Tethered- Unmanned Aircraft Systems (Te-UAS)
- Low Altitude Stalking and Strike Ordnance (LASSO)
- Medium Range Recon (MRR)
- RQ-28A Short-Range Recon (SRR)
- BH-3 / BH-4 Soldier Borne Sensor (SBS)

Ground Robotics

- Common Robotic System Individual (CRS-I)
- M160 Light Flail
- Robotic Combat Vehicles (RCV)
  - RCV - Medium
  - RCV - Light
- Man Transportable Robotic System (MTRS) INC 2
- Common Robotic System - Medium (CRS-M)
- CRS-Heavy
- Enhanced Robotic Payloads (ERP) – Unmanned Ground Systems (UGS)
  - **Extended Range Mesh Network (ERMN)**
  - **Pan/Tilt Imager (PTI)**
  - Obstacle Avoidance / Digital Modeling (OA/DM)
- Small-Multipurpose Equipment Transport (S-MET)
  - S-MET Modular Mission Payloads (MMPs)
- **Uncrewed Vehicle Control (UVC) Software**
  Robotic and Autonomous systems Command and Control (RAC2) Software

Robotic Applique

- Autonomous Transport Vehicle System (ATV-S)
- Exoskeleton
- Warrior Exosuit

Artificial Intelligence

- **Project Linchpin**

Other

- Robotics Development
- Robotics Architecture

Emerging Programs	5
Actively Managed	14
Programs in Sustainment	4
Total Programs	**23**

Photos are Notional

Emerging Programs | **Actively Managed** | **Production in 2024** | **Sustainment**

Prepared by DAPR-FDH

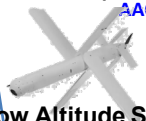
Army Robotic and Autonomous Systems

Interoperability, Common Chassis, Modular Mission Payloads, Common Control Software

Long Range Recon (LRR)
AAO: 2,130

Joint Tactical Autonomous Aerial Resupply System (JTAARS)
AAO: TBD

Medium Range Recon (MRR)
AAO: 3,683
APO: 2,485

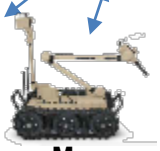


Low Altitude Stalking and Strike Ordnance (LASSO)
AAO: TBD

RQ-28A Short-Range Recon (SRR)
AAO: 6,963

Soldier Borne Sensor (SBS)
AAO: 10,317
APO: 7,899 (T)

Common Robotic System-Individual (CRS-I)
AAO: 4565
APO: 1760



Man Transportable Robotic System (MTRS) INC 2
AAO: 1200

CRS-Heavy
AAO:248
APO: 128

Enhanced Robotic Payloads (ERP)

Launched Effects (LE)

Aviation Portfolio (FDV)

Future Tactical Unmanned Aircraft Systems (FTUAS)
AAO: 115

MQ-1C Gray Eagle
AAO: 204

Mobility Portfolio (FDB)

Assault Breacher Vehicle (ABV) Remote Control System
AAO: 141
APO: 136

Scalable Control Interface (SCI)

UAS Universal Ground Control Station

Autonomous Transport Vehicle System (ATV-S)
AAO: 3300
APO: 776

M160 Light Flail
AAO: 72

Robotic and Autonomous systems Command and Control (RAC2) Software
AAO: TBD

Common Control Software Stack

Common Controllers

Tethered UAS (Te-UAS)
AAO: TBD

RCV Mounted Control Station

Dismounted RCV / OMFV Controller

Warrior-Machine Interface (WMI)

Common Autonomy Software Stack (Software Foundry RTK)

Small Multipurpose Equipment Transport (S-MET)
AAO: 2,818
APO: 624

Robotic Combat Vehicle (RCV) – Basic Chassis with Light Payload
AAO: TBD
APO: 841 (T)

RCV – Advanced Configuration with Medium Payload
AAO: TBD
APO: 795 (T)

Maneuver Portfolio (FDD)

Armored Multi-Purpose Vehicle (AMPV)
AAO: 2,897
APO: 2,897

Photos are Notional

Modular Mission Payload (MMP) Capacity and Users:

~ 5 lbs	~50 lbs	~300 lbs	~2500 lbs	~10,000 lbs	~10,000 lbs	~20,000 lbs
IN, EN, CAV, EoD, CBRN, MP, SOF	EN, EoD, CBRN, SOF	EoD	IN, EN, CAV, EoD, CBRN, SOF, SFAB	IN, AR CAV, EN, CBRN	IN, AR CAV EN	IN, AR CAV

Prepared by DAPR-FDH

Challenges of Integrating RAS and AI

- **Culture** – **Imagination** to integrate disruptive technology into Concepts, Requirements, Doctrine, and Formations
- Adaptive Acquisition Framework – Innovative tools provided to deliver capability at the **speed of relevance**
- **Perfection is the enemy of Good Enough**; must overcome a Risk Averse culture
- **Trust and confidence** in increasingly autonomous and lethal technology – Test & Evaluation and Verification & Validation; Training
- Develop and maintain **Modular Open Systems Architecture** (MOSA) standards for maximum Interoperability
- **Resources** – Time, People, Funding, and Infrastructure
- Transition from Tool to *Team Member*; and from Control to *Command*

Bottom Line: If we are not fielding, we are failing!

Prepared by DAPR-FDH

Robotic Warfare Battlefield Geometry

Network Lethality
Sensors collate data into a Common Operating Picture. (1)
AI/ML rapidly generate options for the Commander and identify the best available system to deliver effects. (2)
Commander conducts multi-domain strike. (3)

Sensor Influence
Theater assets develop situational understanding of the Close and Deep Maneuver Area. (1)
Unmanned ground sensors and UAS swarms develop COP. (2)
EW capabilities and sensor feed identify HPTs; UAS lethal strikes and loitering munitions achieve desired effects. (3)

Robotic Influence
Provide additional space and time prior to the first human engagement with the threat. (1)
Provide advanced capabilities at the Company level via modular mission payloads. (2)
Attrit and disrupt the threat's scheme of maneuver prior to first human engagement. (3)

Rebalancing The Principles of War with RAS

- **Supposition**:
  The Contemporary Operating Environment and current state of technology (EW, Armed UAS, and Fires) presage the dominance of the Defense over the Offense.

- **Proposition**:
  Human-Machine Integration of RAS-enabled formations can rebalance the Principles of War to restore Maneuver and Offensive action

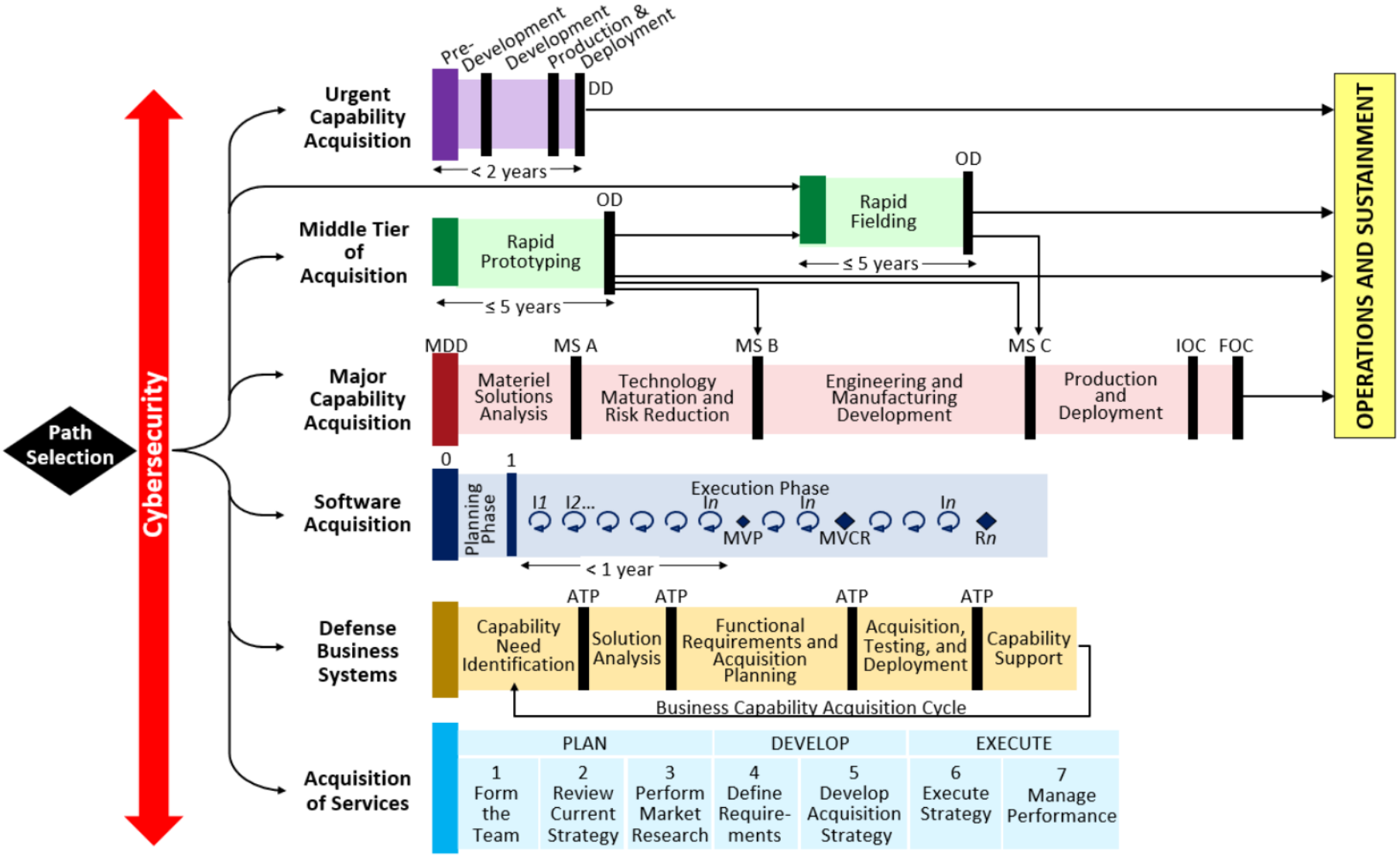
Bots before Boots!

- **Maneuver**: Place the enemy in a position of disadvantage through the flexible application of combat power.
- **Objective**: Direct every military operation toward a clearly defined, decisive, and attainable goal.
- **Offensive**: Seize, retain, and exploit the initiative.
- **Surprise**: Strike at a time and place or in a manner for which the enemy is unprepared.
- **Economy of force**: Expend minimum-essential combat power on secondary efforts to allocate the maximum possible combat power on the main effort.
- **Mass**: Concentrate the effects of combat power at the most advantageous place and time to produce decisive results.
- **Unity of command**: Ensure unity of effort under one responsible commander for every objective.
- **Security**: Prevent the enemy from achieving surprise or acquiring unexpected advantage.
- **Simplicity**: Increase the probability that plans can be executed as intended by preparing clear, uncomplicated plans and orders.

US Army
FM 3-0 Operations
(01 Oct 2022)

Questions/Discussion

Back Up



https://aaf.dau.edu/

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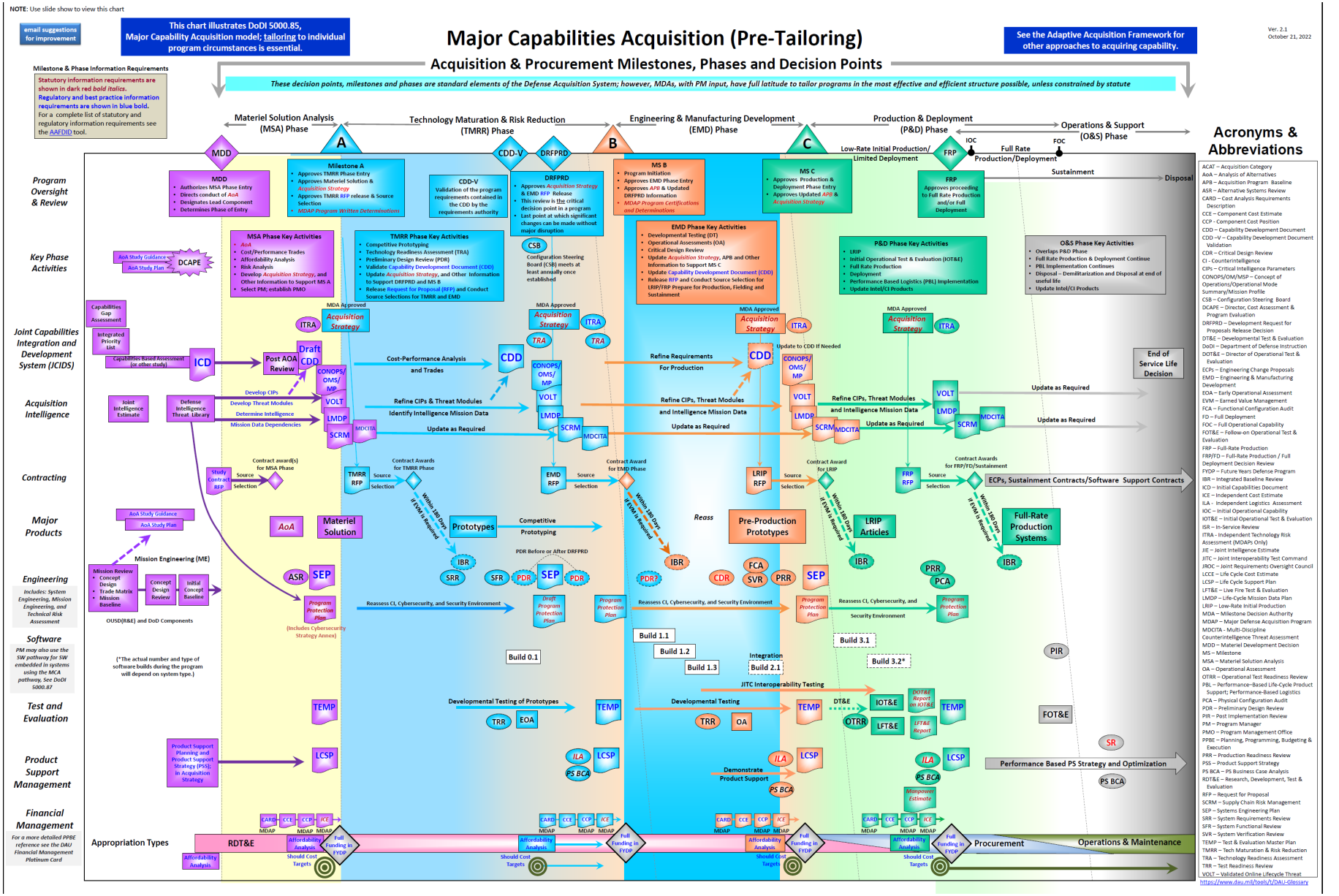

Acronyms & Abbreviations

ACAT – Acquisition Category
AoA – Analysis of Alternatives
APB – Acquisition Program Baseline
ASR – Alternative Systems Review
CARD – Cost Analysis Requirements Description
CCE – Component Cost Estimate
CCP - Component Cost Position
CDD – Capability Development Document
CDD –V – Capability Development Document Validation
CDR – Critical Design Review
CI - Counterintelligence
CIPs – Critical Intelligence Parameters
CONOPS/OM/MSP – Concept of Operations/Operational Mode Summary/Mission Profile
CSB – Configuration Steering Board
DCAPE – Director, Cost Assessment & Program Evaluation
DRFPRD – Development Request for Proposals Release Decision
DT&E – Developmental Test & Evaluation
DoDI – Department of Defense Instruction
DOT&E – Director of Operational Test & Evaluation
ECPs – Engineering Change Proposals
EMD – Engineering & Manufacturing Development
EOA – Early Operational Assessment
EVM – Earned Value Management
FCA – Functional Configuration Audit
FD – Full Deployment
FOC – Full Operational Capability
FOT&E – Follow-on Operational Test & Evaluation
FRP – Full-Rate Production
FRP/FD – Full-Rate Production / Full Deployment Decision Review
FYDP – Future Years Defense Program
IBR – Integrated Baseline Review
ICD – Initial Capabilities Document
ICE – Independent Cost Estimate
ILA - Independent Logistics Assessment
IOC – Initial Operational Capability
IOT&E – Initial Operational Test & Evaluation
ISR – In-Service Review
ITRA - Independent Technology Risk Assessment (MDAPs Only)
JIE – Joint Intelligence Estimate
JITC – Joint Interoperability Test Command
JROC – Joint Requirements Oversight Council
LCCE – Life Cycle Cost Estimate
LCSP – Life Cycle Support Plan
LFT&E – Live Fire Test & Evaluation
LMDP – Life-Cycle Mission Data Plan
LRIP – Low-Rate Initial Production
MDA – Milestone Decision Authority
MDAP – Major Defense Acquisition Program
MDCITA - Multi-Discipline Counterintelligence Threat Assessment
MDD – Materiel Development Decision
MS – Milestone
MSA – Materiel Solution Analysis
OA – Operational Assessment
OTRR – Operational Test Readiness Review
PBL – Performance-Based Life-Cycle Product Support; Performance-Based Logistics
PCA – Physical Configuration Audit
PDR – Preliminary Design Review
PIR – Post Implementation Review
PM – Program Manager
PMO – Program Management Office
PPBE – Planning, Programming, Budgeting & Execution
PRR – Production Readiness Review
PSS – Product Support Strategy
PS BCA – PS Business Case Analysis
RDT&E – Research, Development, Test & Evaluation
RFP – Request for Proposal
SCRM – Supply Chain Risk Management
SEP – Systems Engineering Plan
SRR – System Requirements Review
SFR – System Functional Review
SVR – System Verification Review
TEMP – Test & Evaluation Master Plan
TMRR – Tech Maturation & Risk Reduction
TRA – Technology Readiness Assessment
TRR – Test Readiness Review
VOLT – Validated Online Lifecycle Threat

https://www.dau.mil/tools/t/DAU-Glossary

https://www.dau.edu/tools/t/ILC

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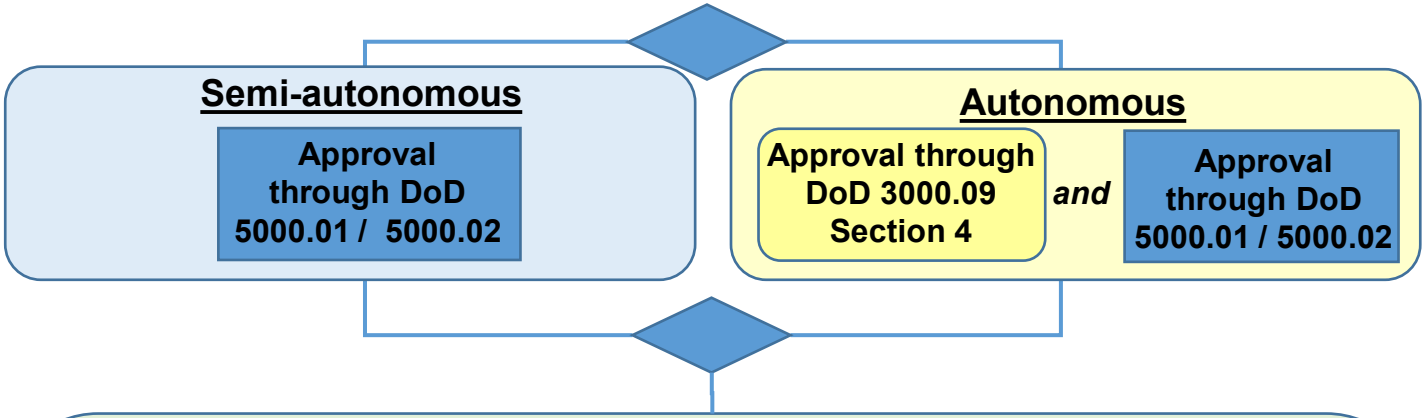
DOD Directive 3000.09
Autonomy in Weapon Systems

"Autonomous and semi-autonomous weapon systems will be designed to allow commanders and operators to exercise appropriate levels of human judgment over the use of force."



Use of Artificial Intelligence (AI)

Use of artificial intelligence (AI) capabilities in autonomous and semi-autonomous weapon systems must be consistent with the DoD AI Ethical Principles:

(1) **Responsible**: exercise appropriate levels of judgement and care, while remaining responsible for the development, deployment, and use of AI capabilities.

(2) **Equitable**: minimize unintended bias in AI capabilities.

(3) **Traceable**: maintain transparent and auditable methodologies, data sources, and design procedures and documentation.

(4) **Reliable**: explicit, well-defined uses, and the safety, security, and effectiveness subject to testing and assurance within defined uses across their entire life cycles.

(5) **Governable**: AI capabilities fulfill their intended functions while possessing the ability to detect and avoid unintended consequences, and the ability to disengage or deactivate deployed systems that demonstrate unintended behavior.

Prepared by DAPR-FDH

Requirements

Approved

- Robotic Combat Vehicle **(RCV)** Software Pathway approved **Feb 22**
- Robotic Combat Vehicle **(RCV)** Abbreviated Capabilities Development Document (A-CDD) AROC approved **Apr 22**
- Robotic and Autonomous systems Command and Control **(RAC2)** Software Pathway approved **Apr 22**
- Fires Synchronization To Optimize Responses in Multi-domain operations **(FIRESTORM)** A-CDD approved **Jul 22**
- Autonomous Transport Vehicle System **(ATV-S)** A-CDD approved **Aug 22**
- Lethal Unmanned Systems (Loitering Munitions) Directed Requirement AFC approved **Dec 22**
- Joint Tactical Autonomous Aerial Resupply System **(JTAARS)** A-CDD AROC approved **Apr 23**
- Small Multipurpose Equipment Transport **(S-MET)** CDD AROC approved **Jun 23**
- Joint small Unmanned Aircraft System **(J-sUAS)** CDD JROC approved **Jun 23**

Working

- **J-sUAS** CDD Annexes:
  - Joint Reference Architecture **(JRA)**
  - Low Altitude Strike Ordnance **(LASO)**
  - Tethered- Unmanned Aircraft Systems **(Te-UAS)**
  - Long Range Recon UAS **(LRR)**
  - Medium Range Recon UAS **(MRR)**
  - Short Range Recon UAS **(SRR)**
  - Soldier Borne Sensor **(SBS)**
- **RCV** CDD
- **Project Linchpin** (AI) Software
- Synthetic Training Environment **(STE)** Software ICD
- One World Terrain **(OWT)** Software ICD
- Reconfigurable Virtual Collective Trainer (Air/Ground) (**RVCT (A/G)**) CDD
- Soldier Virtual Trainer (**SVT**) CDD
- Live Training System (**LTS**) CDD
- Next generation Constructive (**NGC**) CDD

Army Futures Command

Human-Machine Integration (HMI) Board of Directors

- HMI Governance Structure: Army Senior Leaders driving the RAS Enterprise
- HMI Capability Development Pipeline Strategy: Centered on a Light Formation and an Armored Formation
- HMI Increment Strategy: Cascading capabilities from Battle Lab to CTC to FORSCOM Unit

Prepared by DAPR-FDH

Value Proposition for Autonomy

- Robotics, sensors, autonomy software, AI, and data infrastructure are all expensive. Optionally-Crewed systems are more so.
- Warfighter **Productivity** as a metric for combat power.
- **Human-machine teaming** for increased efficiency and effectiveness.
- Augmenting Warfighters, not replacing; however, integrated, not additive.
- Innovation lies in Force Design / DOTMLPF-P integration to best accomplish individual and collective Mission Essential Tasks.
- Integrated RAS expand formations' area of influence and area of operations, providing both decision time and maneuver space for the commander.

Multi-domain Robotics and Autonomous Systems (RAS), through Human-Machine Teaming (H-MT), enable Army formations to increase their **endurance**, **persistence**, **lethality**, **protection** and **depth**.

Prepared by DAPR-FDH