



FY 2023

DEFENSE BUDGET

FOR UNCREWED SYSTEMS
AND ROBOTICS



The Association for Uncrewed Vehicle Systems International, the world's largest nonprofit organization dedicated to the advancement of uncrewed systems and robotics, represents corporations and professionals from more than 60 countries involved in industry, government and academia. AUVSI members work in the defense, civil and commercial markets.

Our vision is to create a future in which remotely operated and automated transportation technologies are fully accepted, valued and utilized to move people, things and data safely and efficiently – providing broad and lasting economic and social benefit.

Our community of innovators, leaders, and dare-to-dreamers is drafting the blueprint for autonomy, assuring its safe and seamless integration into everyday life. To learn more or get involved, visit auvsi.org/our-impact.

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Introduction

Military organizations worldwide are continuing to integrate uncrewed vehicles (UxV) into their operations at a growing rate. The United States (U.S.) Department of Defense (DOD) has funded the research, development, test, and evaluation (RDT&E) and procurement of UxV for decades, and support for these systems and associated technologies continues with the President's most recent budget request. The President's Budget (PB) request is released each year which includes justification documents detailing the range of technologies that will be procured and developed with that budget.

For the most recent PB request (hereafter referred to as PB23), each overarching program includes the requested funding for the next fiscal year (FY) (FY 2023), the enacted funding from the current fiscal year (FY 2022), the actual funding from FY 2021 (sometimes the amount enacted does not always match the amount used), and the projected funding for the next four fiscal years (FY 2024 – FY 2027). This report will discuss some of the programs with the largest funding in the next fiscal year as well as some key growth areas over the next five years.

For terminology used throughout this report, overarching RDT&E efforts are classified as Program Elements (PE) which are further broken down into projects and sub-projects. Overarching procurement efforts are often called programs of record (PoR) and when referring to budget documents it may also be called a line item. For the purposes of this report, all overarching efforts are termed "programs." While AUVSI's preferred term for the technologies referenced in this report is "uncrewed systems," the U.S. Department of Defense continues to use the legacy term "unmanned systems" for programs of record and procurement processes. Given the focus of this report and to avoid confusion for the reader, the term "unmanned" will be used in this report when referring to official programs that use the term. [Click here](#) to read more about AUVSI's commitment to inclusive language.



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Procurement of UxV in FY 2023

Starting with procurement, it is clear that uncrewed aircraft systems (UAS) have a significantly larger operational footprint on the battlefield when compared with their counterparts in the ground and maritime domains. In the FY 2023 budget request, 29 programs are fully dedicated to the procurement of UAS, totaling over \$2.6 billion. Figure 1 shows the top 13 of these UAS programs with the largest funding represented by the Navy's MQ-25 (\$748 million) and MQ-4 Triton (\$663

million) aircraft. The Army has also requested \$326 million for the Counter Small UAS (C-SUAS) program. The ground and maritime domains are represented by a single program each: the Army's Robotics and Applique Systems requested \$52 million in FY 2023 to acquire ground robotics and soldier borne sensors; and the Navy's Small & Medium UUV (Uncrewed Undersea Vehicle) program requested \$50 million. Detailed information on these programs and the specific technologies being procured will be provided in the "Program Details" section of this report.

Top Procurement Programs Supporting Uncrewed Vehicles in FY 2023

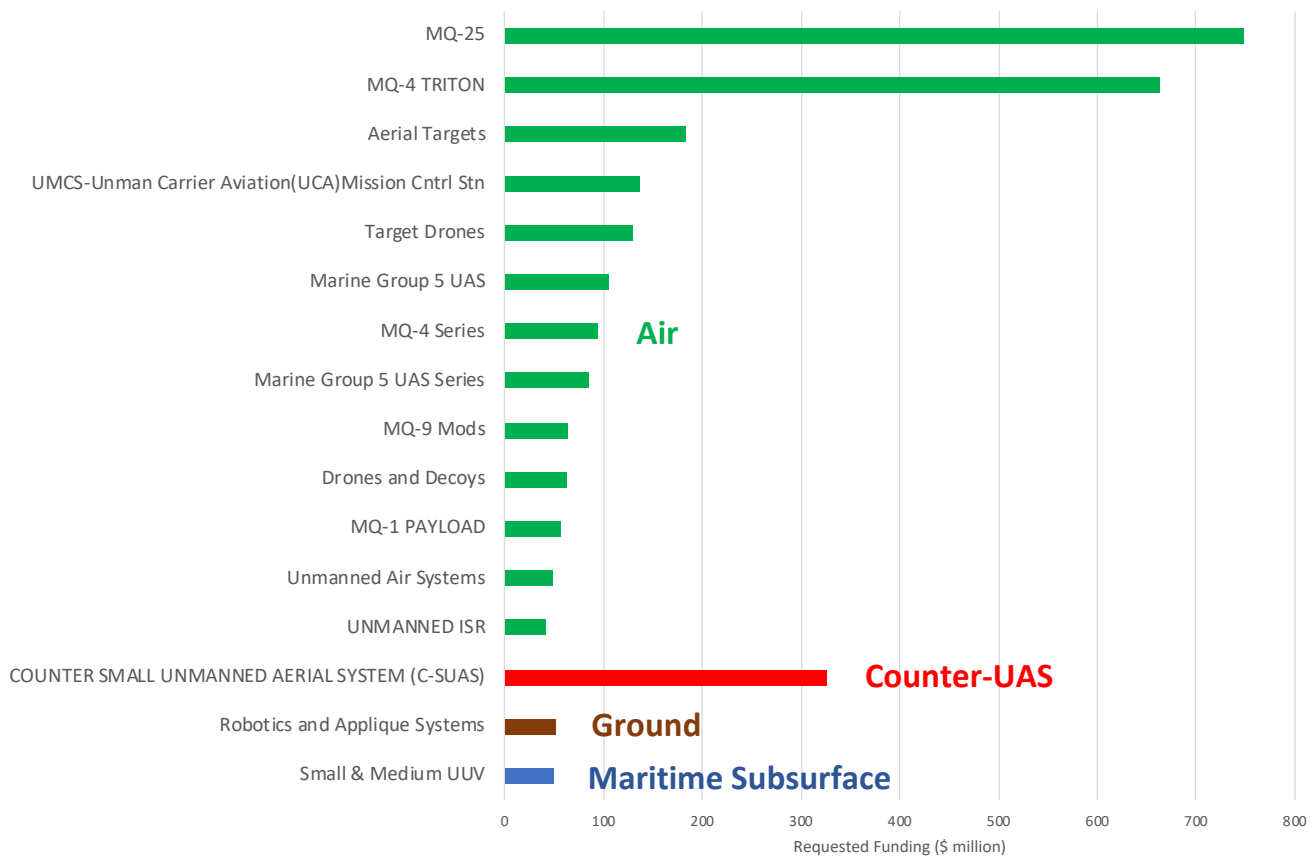


Figure 1: UxV procurement programs in the FY 2023 budget request.

RDT&E of UxV in FY 2023

Moving on to the RDT&E of UxV technologies there is a much stronger representation of programs outside of the air domain (Figure 2).

For maritime technologies, the top four uncrewed surface vehicle (USV) projects total \$457 million in requested funding for FY 2023 to advance the Navy's USV Enabling Capabilities, Large USV, Medium USV, and Mine Countermeasure (MCM) USV programs.

The top four uncrewed underwater vehicle (UUV) programs account for approximately \$245 million in FY 2023 with efforts focused on the extra-large UUV (XLUUV), the Barracuda expendable mine neutralizer, the medium class UUV Razorback (also referred to as the Littoral Battlespace Sensors-Autonomous Unmanned Vehicle (LBS-AUV)), and the medium class Medusa UUV.

In the ground domain, the top five projects have requested a total of approximately \$229 million in FY 2023, four of which are working to develop the Army's robotic combat vehicles (RCV) prototypes and enabling technologies for robotic vehicles deployed in combat

environments. The other is supporting the Army's Leader/Follower project.

The air domain exceeds all others in requested budget for FY 2023, and as was shown in procurement, the top programs are represented by the Navy's MQ-25 and MQ-4 Triton aircraft. Other programs with significant funding include the Marine Group 5 UAS Development efforts and the Army's Future UAS project. The Air Force also has a two noteworthy programs with the RQ-4 Capability Enhancements (\$68.8 million) and MQ-9 SLAM (\$61.4 million) projects.

There are only a few projects which are fully dedicated to the development of Counter-UAS (C-UAS) technologies. These include the Army's C-UAS and C-SUAS Joint New Capabilities Development projects with a total funding request of \$64.5 million in FY 2023. The Navy also initiated a new project in FY 2023 titled DRAKE 2.0 C-UAS Afloat with approximately \$6 million requested.

Detailed information on some of these projects will be provided in the "Program Details" section of this report beginning on [page 9](#).

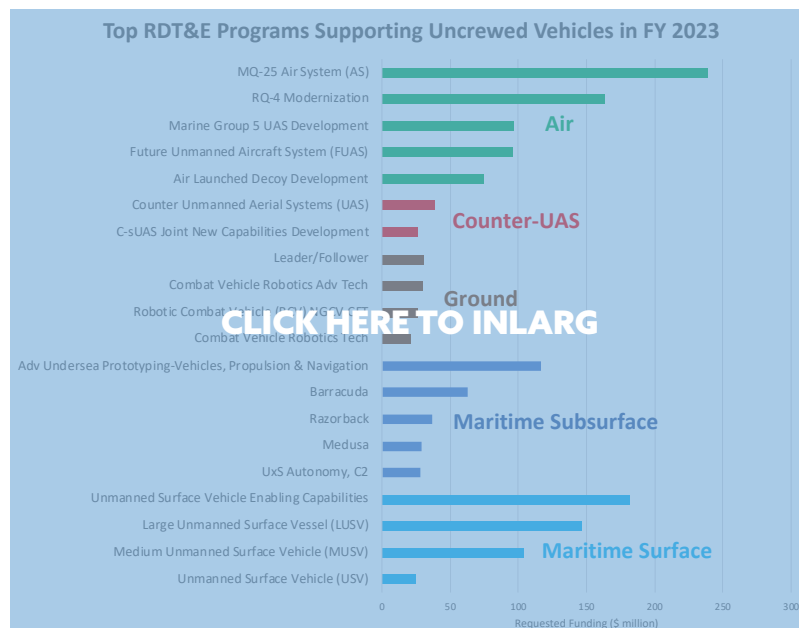


Figure 2: UxV RDT&E Projects in the FY 2023 budget request.

Potential Growth Areas for UxV Technologies

In the next sections of this report, specific RDT&E projects and procurement programs will be identified that represent areas in which funding has the potential to grow in the future. Growth potential for a given program or project has been determined by taking the average of the projected funding (FY2024

– FY 2027) and comparing that with the average of the previous three years (FY2021 – FY2023, hereafter referred to as base funding). A program or project was considered to have “Strong Growth Potential” when the projected funding exceeds the base funding by more than 50%. As a note, for programs or projects that were not funded in FY 2021 and/or FY 2022, the zero values were excluded from the base funding calculation.

Air – Strong Growth Potential

Figure 3 shows the UAS programs/projects in the “Strong Growth Potential” category. These ten programs and projects total approximately \$8.8 billion from FY 2021 to FY 2027 and two are associated with RDT&E funding:

- The Navy’s RQ-4 Modernization project totals approximately \$1.1 billion in the next five years to support development of the MQ-4C Triton, a high altitude-long endurance (HALE) UAS used for persistent maritime intelligence, surveillance, and reconnaissance (ISR). Once fully operational, through a network of orbits the MQ-4C will provide “near world coverage” using maritime radar, electro-optical/infrared (EO/IR) sensors, SIGINT systems, and communications relay.

- The Marine Corps’ Unmanned Air Systems (Intel) project seeks to rapidly acquire and field a family of small UAS platforms with modest funding totaling approximately \$10 million across the FY21-27 period.

The remaining UAS programs in the “Strong Growth Potential” category support the procurement of these systems:

- Procurement of the MQ-25 Unmanned Carrier Aviation (UCA) System will cost the Navy just under \$10 billion based on current budgetary projections. The MQ-25 can be land-based or launched from Navy

nuclear aircraft carriers with a primary mission of aerial refueling while also providing an ISR capability as a secondary mission.

- The UCA Mission Control System (UMCS) provides all necessary support for the land- and ship-based control of the MQ-25 and integrated payloads.

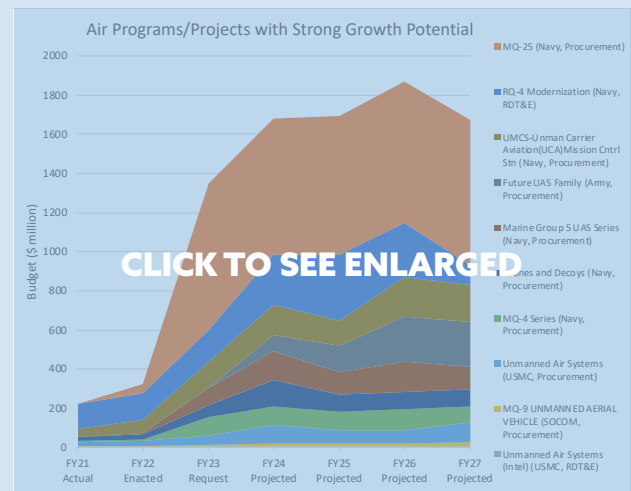


Figure 3: Air programs/projects with projected funding (avg. of FY24-27) increasing by more than 50% of base funding (avg. of FY21-23)

- The Army’s Future UAS Family was not funded in FY 2022 nor FY 2023 and funding prior to those years totals only \$13.2 million. However, current projections show FY 2024 funding will increase to \$81 million and almost triple to approximately \$229 million in FY 2026 and FY 2027. This program is seeking to replace the RQ-7Bv2 Shadow Tactical UAS with a focus on enabling increased adaptability and agility of operations.

- The Marine Group 5 UAS Series is a Medium Altitude Long Endurance (MALE) aircraft that provides domain awareness and survivability. Funding will support modifications to the MQ-9A Reaper UAS.
- The Navy's Drones and Decoys program procures an air-launched electronic warfare (EW) platform also known as the Miniature Air Launched Decoy (MALD). According to the justification documents, the MALD is considered "a critical enabler for joint lethality in contested environments."
- The MQ-4 Series program funds modifications to the MQ-4C Triton to modernize the aircraft. This includes updates to payload mission systems, communication systems, ground control systems, cyber updates, airframe modifications, etc. The program has an estimated value of \$477.6 million

across the FY 2023 to FY 2027 forecast period.

- The Marine Corps' Unmanned Air Systems program is the procurement counterpart to the Unmanned Air Systems (Intel) RDT&E program noted earlier. However, unlike the RDT&E program, the procurement funding is substantial with \$413 million projected from FY 2021 to FY 2027. The family of SUAS acquired will provide Reconnaissance, Surveillance and Target Acquisition (RSTA) capabilities for both offensive and defensive maneuvers.
- The U.S. Special Operations Command (SOCOM) funds the acquisition of mission kits, payloads, weaponization and other support for the MQ-9 Unmanned Aerial Vehicle. Total funding between FY21-27 for this program is approximately \$108 million.

Ground - Strong Growth Potential

Five Army projects supporting robotic ground vehicle technologies show strong growth potential based on current budgetary forecasts (Figure 4). Each of these projects is associated with RDT&E funding which contrasts with the air domain where most were associated with procurement. This is likely an indicator of the maturity of the technologies in the ground domain relative to air. Concepts of Operation (CONOPS) in the air domain are well defined and UAS have been integrated into a range of missions on the battlefield for many years. On the other hand, ground robotics have only been

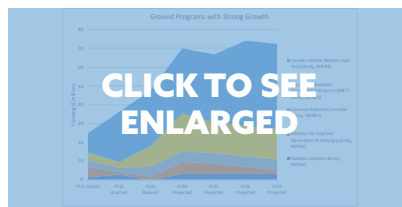


Figure 4: Ground projects with projected funding (avg. of FY24-27) increasing by more than 50% of base funding (avg. of FY21-23)

integrated into highly niche operations and have yet to see widespread deployment.

In total, the five ground projects with strong growth potential in the FY 2021 to FY 2027 period account for approximately \$392 million broken down as follows:

- \$227.6 million for the Combat Vehicle Robotics Advanced Tech project which is further sectioned

into the following sub-projects:

- o Platform Electronic Control: optimizes closed loop control of by-wire vehicle systems.
- o Unmanned Maneuver: advances mobility of autonomous vehicles in complex environments.
- o Soldier-Robotic Interface Integration: improves control of robotic systems including manned-unmanned teaming (MUM-T) in combat scenarios.
- o Small UGV as Deployable Sensor: this is a new sub-project in FY 2023 that seeks to develop a small robotic system that can be deployed from the Next Generation Combat Vehicle (NGCV) to conduct reconnaissance in inaccessible areas like dense urban terrain.

- \$87.6 million for the Squad Multipurpose Equipment Transport (S-MET) project which is used for logistics operations to reduce soldier loads. Current efforts are continuing S-MET Increment I developments such as the Modular Mission Payloads (MMP) and have initiated the Increment II development and prototyping phase.
- \$33.5 million for the Common Robotic Controller project which is developing Universal Robotics Control (URC) systems that provide Artificial Intelligence-enabled command and control capabilities for robotic and autonomous systems (RAS).
- \$26.6 million for the Robotics for Engineer Operations Technology project with a stated goal of developing teleoperated and semi-autonomous robotic construction equipment capable of operating in future combat environments.
- \$16.4 million for the Robotics Systems project which did not request funding in FY 2023 but will average just over \$3 million per year in the four projected years. FY2022 plans involve the expansion of modeling and simulation (M&S) capabilities like the Continuous Autonomy Simulation Test Laboratory Environment (CASTLE). M&S efforts continue in the FY 2024 to FY 2027 forecast period.

Maritime - Strong Growth Potential

While only three uncrewed maritime vehicle programs or project met the criteria for the strong growth potential category, they account for significant funding with over \$1.8 billion projected from FY 2021 to FY 2027.

- Unmanned Surface Vehicle Enabling Capabilities is an RDT&E program which supports the Navy's USV Family of Systems (FoS) through the advancement of a range of USV technologies like autonomy, communication and navigation systems, sensors, data management, and the development and fabrication of payloads. Efforts support both the LUSV and MUSV RDT&E programs mentioned previously.
- The Navy's Small & Medium UUV procurement line funds a range of platforms and associated

equipment used for battlespace awareness, Intelligence Preparation of the Operational Environment (IPOE), and Mine Warfare (MIW) capabilities, including:

- o Lionfish Small UUV, based on the HII Remus 300;
- o MK 18 FoS, based on the Remus 100 and Remus 600;
- o TETRA Remotely Operated Vehicle (ROV), contracted through Oceaneering;
- o LBS-AUV(S)/Razorback medium class UUV, also based on the Remus 600;
- o KNIFEFISH Surface Mine Countermeasure UUV, based on the Bluefin-21 deep-water AUV and last funded prior to FY 2021; and
- o Viper Medium Maritime Expeditionary MCM UUV (MEMUUV) which initiated funding for production

engineering and training in FY 2023.

- In the PB23 request, details for the UxS Autonomy, C2 project were reclassified as SECRET so further information on the FY 2023 plans will not be available in this report. In FY 2022, significant emphasis was made for the support of the Rapid Autonomy Integration Lab (RAIL), Undersea Constellation (UC) efforts, and a UUV Operation Center with the goal of enabling autonomous cross-domain operations of multiple different uncrewed vehicles. UC efforts are in support of Subsea and Seabed Warfare (SSW).

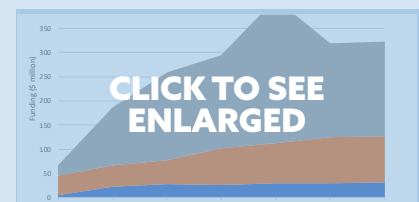


Figure 5: Maritime programs with projected funding (avg. of FY24-27) increasing by more than 50% of base funding (avg. of FY21-23)

Program Details

In the final section of this report, specific programs will be investigated in greater detail.

UAS - Procurement

MQ-25 Unmanned Carrier Aviation (UCA) - Navy Line Item Number 0449

FY 2023 funding for the MQ-25 UCA will support the procurement of four Low Rate Initial Production (LRIP) Lot 1 aircraft, and advance procurement of long-lead materials to support four LRIP Lot 2 aircraft. Funding will also support engines/accessories, avionics, tooling, training equipment, and other costs. Current industry contractors listed in PB documents include: The Boeing Company, Microchip Technology, VIASAT, and Collins Aerospace. Other contractors noted in recent news releases include: Aitech Defense Systems, Frequentis USA, L3Harris, Moog, Pratt & Whitney, and UTC Aerospace Systems.



Figure 6: MQ-25 UCA

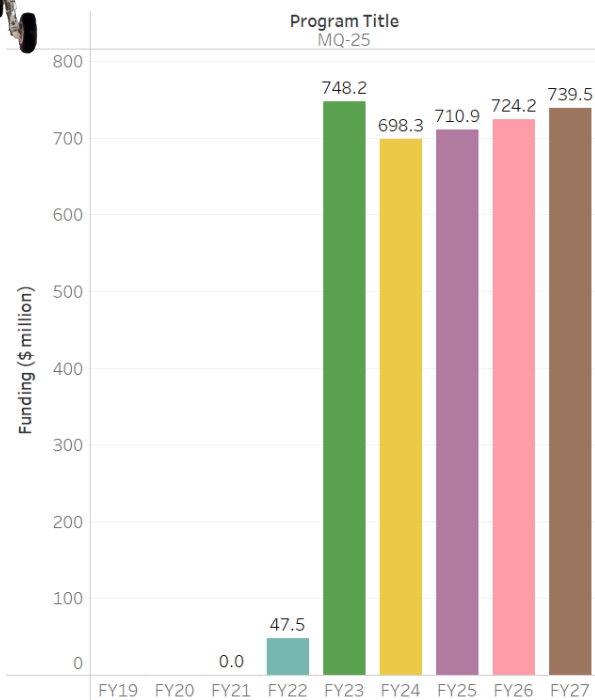


Figure 7: Procurement funding for the Navy's MQ-25 UCA from the PB23 budget request.

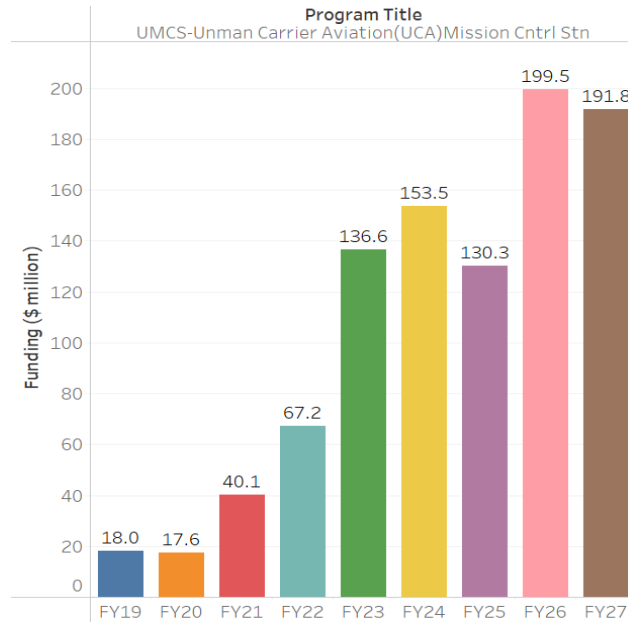


Figure 8: Procurement funding for the Navy's UMCS from the PB23 budget request.



Figure 9: UMCS for the MQ-25

UCA Mission Control System (UMCS) - Navy Line Item Number 4269

FY 2023 procurement for the UMCS has been increased to support two ship-based and four shore-based systems with installations to begin in FY 2025. Previous budget requests only indicated a single installation of each type. In recent news, preparations for integration tests of the MD-5 Ground Control Station (GCS) used by the UMCS were initiated in May 2022 and successful demonstration flights of the MQ-25 were completed at the end of 2021. Additional industry contractors not mentioned above in the MQ-25 overview include: General Dynamics Information Technology, CUBIC, and BAE Systems.

MQ-4 Triton - Navy Line Item Number 0442

Production of the MQ-4 Triton will resume in FY 2023 and FY 2024 with three LRIP requested in FY 2023 along with one Main Operating Base (MOB) Mission Control System (MCS). This corresponds with a peak in funding for the MQ-4 as funding will also cover training equipment, ground support equipment, and additional elements to achieve Initial Operational Capability (IOC) with the new Integrated Functional Capability 4 (IFC-4) in FY 2023. Noted industry contractors include Northrop Grumman and Collins Aerospace. The baseline IFC-3 capability was deployed in 2020 with one aircraft remaining in deployment.



Figure 10: MQ-4C Triton UAV

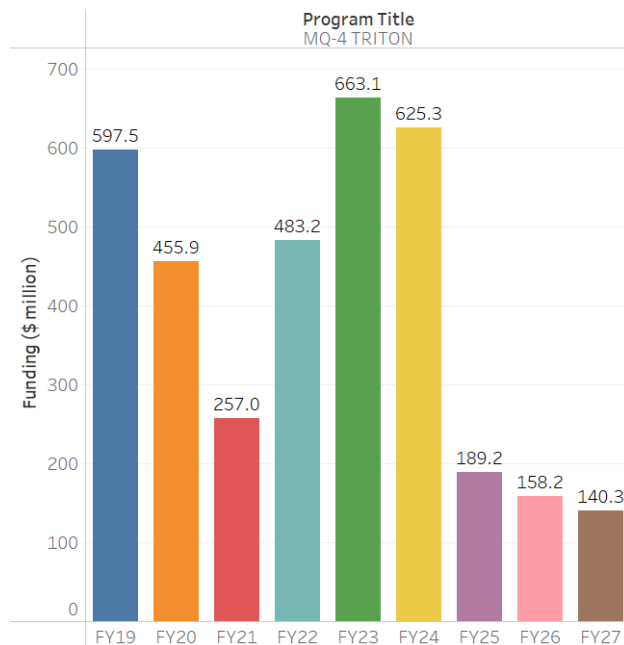


Figure 11: Procurement funding for the Navy's MQ-4C Triton from the PB23 budget request.

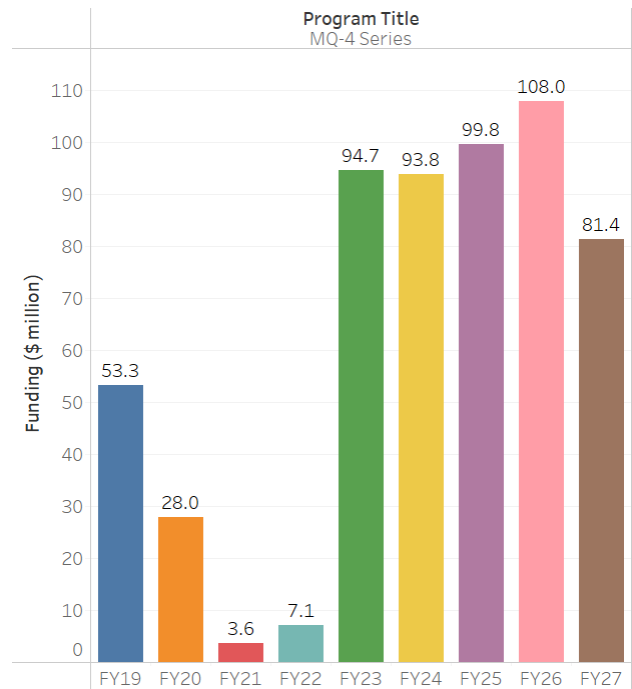


Figure 12: Procurement funding for modifications to the Navy's MQ-4C Triton UAS from the PB23 budget request.

MQ-4 Series - Navy Line Item Number 0596

As previously mentioned, the MQ-4 Series funding line will acquire modifications to modernize the aircraft and improve mission system payloads, GCS equipment, and to correct platform system deficiencies. Some key technology upgrades include:

- Signals Intelligence (SIGINT) antennas and systems
- High Gain Common Data Link (CDL) antenna and associated avionics
- Keyed Broad Area Maritime Surveillance Airborne Recorder (K-BAR)
- Airborne Mission Processor
- Airborne network hardware
- High assurance internet protocol encryptors (HAiPE)
- Voice Communications
- Aircraft modifications to mitigate Electromagnetic Interference (EMI)



Figure 13: MQ-9A Reaper UAV

Marine Group 5 UAS - Navy Line Item Number 0452

The Marine Corps acquired eight MQ-9A aircraft in FY 2022 at a cost of \$19.1 million each. Five additional aircraft will be procured in FY 2023 as a transfer from U.S. Air Force new production quantities and thus have a \$0 cost. Most of the FY 2023 funding will be dedicated to Ancillary Equipment used for mission control and Peculiar Training Equipment to include Mission System Trainers.

Marine Group 5 UAS Series - Navy Line Item Number 0507

FY 2023 funds will modify four MQ-9A Reaper aircraft to an extended range configuration while also acquiring three Detect and Avoid System (DAAS) payloads, six secure GCS air vehicle modifications, and further upgrades to the aircraft, sensors, and ground support equipment. DAAS Procurement will continue through FY 2027 while procurement of EW and Airborne Early Warning (AEW) sensors will begin in FY 2024 and continue through FY 2027.

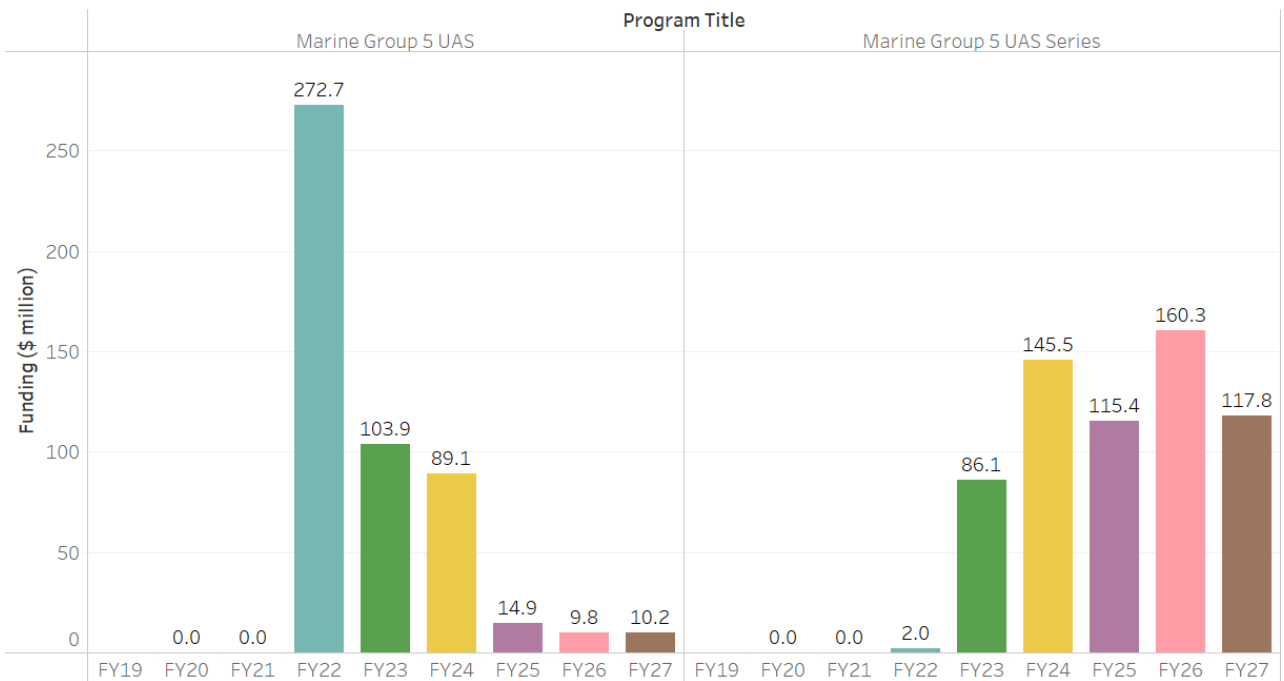


Figure 14: Procurement funding for the Marine Group 5 UAS (MQ-9A Reaper) and associated subsystems from the PB23 budget request.

Unmanned Air Systems – Navy/Marine Corps Line Item Number 4757

Originally, this program acquired specific platforms like the RQ-12 Wasp and RQ-20 Puma, however the Marine Corps has adopted a FoS approach, acquiring a variety of different platforms. These platforms are categorized based on operational capabilities with three main SUAS types:

1. Short Range/Short Endurance (SR/SE), a <10 lb platform with a 5-10 km range and <50 minute endurance.
2. Medium Range/Medium Endurance (MR/ME), a <20 lbs platform with a 10-20 km range and <4 hour endurance.
3. Long Range/Long Endurance (LR/LE), a <55 lbs platform with a 20-50 km range and <6 hour endurance.

In FY 2023, this program has requested 12 LR/LE platforms be acquired at \$2.85 million each and 141 SR/SE at \$95K each. No MR/ME were requested in FY 2023.

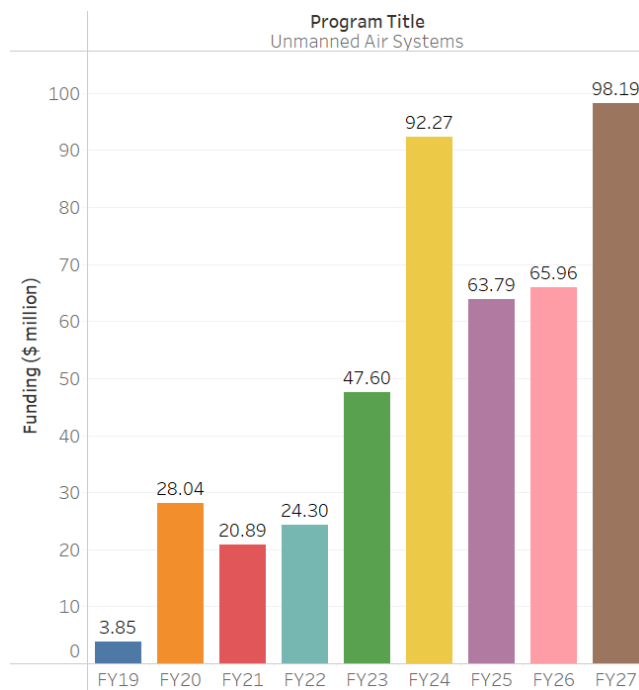


Figure 15: Procurement funding for Marine Corps SUAS from the PB23 budget request.

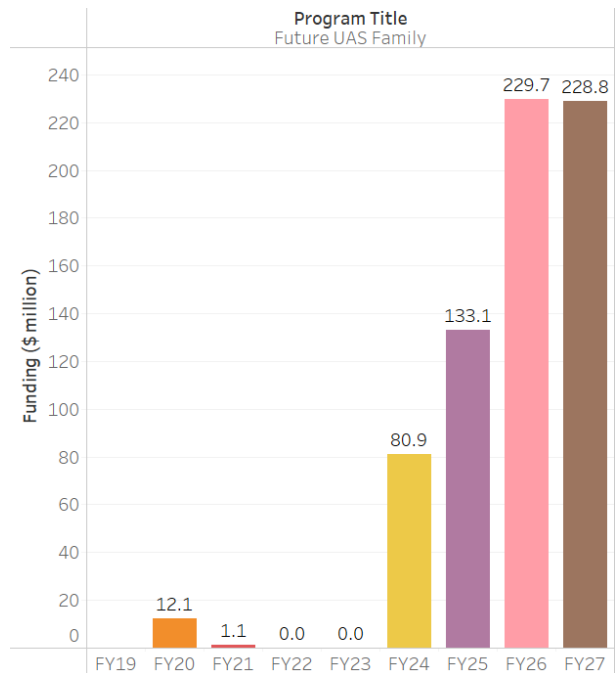


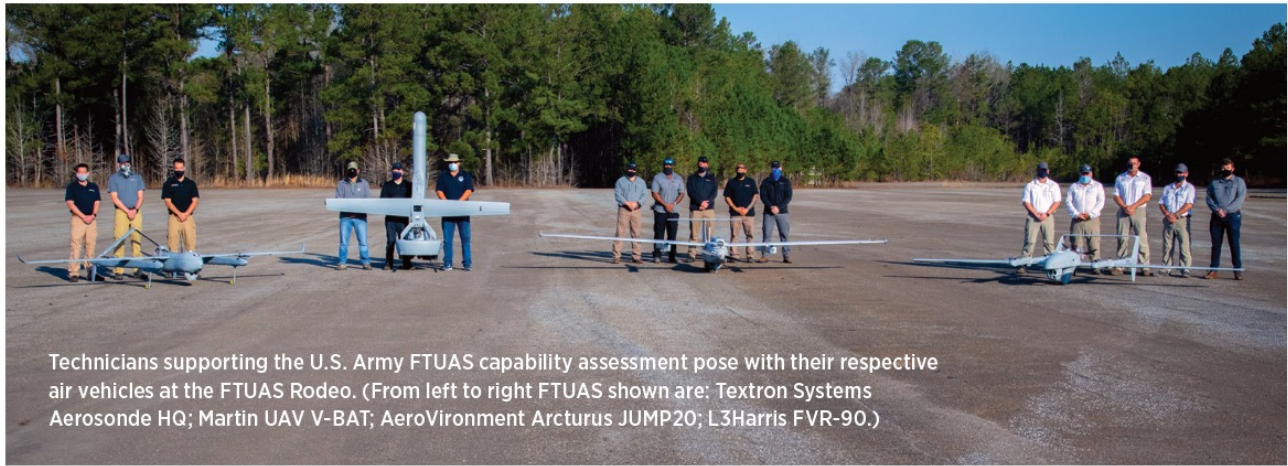
Figure 16: Procurement funding for the Army's Future UAS Family from the PB23 budget request.

Future UAS Family – Army Line Item Number 9672A00510

The RQ-7Bv2 Shadow Tactical UAS has been deployed by the Army since 2016 with initial models awarded contracts as early as 1999. Since then, the v2 model has flown more than 960,000 hours, providing RSTA, ISR, MUM-T, and Battle Damage Assessment (BDA) capabilities. The Army is seeking a replacement to this vehicle that will reduce deployment times and offer greater flexibility on the battlefield. Relevant performance specifications for the aircraft under consideration are provided in the Figure below along with a corresponding picture of each aircraft.



Figure 17: RQ-7B Shadow UAV



SPECIFICATIONS	TEXTRON SYSTEMS AEROSONDE HQ	MARTIN UAV V-BAT 128	AEROVIRONMENT ARCTURUS JUMP 20	L3HARRIS FVR-90
Wingspan	12 ft	9.7 feet	18.8 ft	15.4 ft
Range	140 km	130 km/70 nm	operational range of 185 km (115 mi)	750 km R/T
Endurance (payload dependent)	8 hrs with 10-lb payload	Up to 11 hours	14+ hrs	8-16 hrs
Max Payload	15 lbs	25 pounds	up to 30 lbs	22 lbs
Airspeed	45-65 kt	47 kts max endurance, up to 90 kts dash (based on configuration)	50 kts	65 kts
Time to Deploy (box to launch)	20 min	Assembly from shipping cases in less than 10 minutes, launched in less than 20 min	less than one hr	1 hr
Websites for more information.	textronsystems.com/products/aerosonde	martinuav.com/v-bat/	avinc.com/uas/jump-20	l3harris.com/all-capabilities/fvr-90-airframe

Figure 18: UAS under consideration by the Army to replace the RQ-7B Shadow UAS

UAS - RDT&E

RQ-4 Modernization - Navy RDT&E Program Element 0305421N, Project 2939

Under the RQ-4 Modernization program, upgrades to the MQ-4C are primarily implemented via two sub-projects:

- Product Development Articles with \$125 million requested in FY 2023 (an increase of \$27.9 million from FY 2022) for cyber security upgrades, weather avoidance overlay, de-icing solutions, Sense and Avoid (SAA), Multi-Function Active Sensor (MFAS) Radar upgrades, and other developments related to systems engineering and corrections of deficiencies.
- Test & Evaluation (T&E) Articles for FY 2023 plans enable the testing and fielding of the MQ-4C to support Increment 1 IOC among other T&E support.

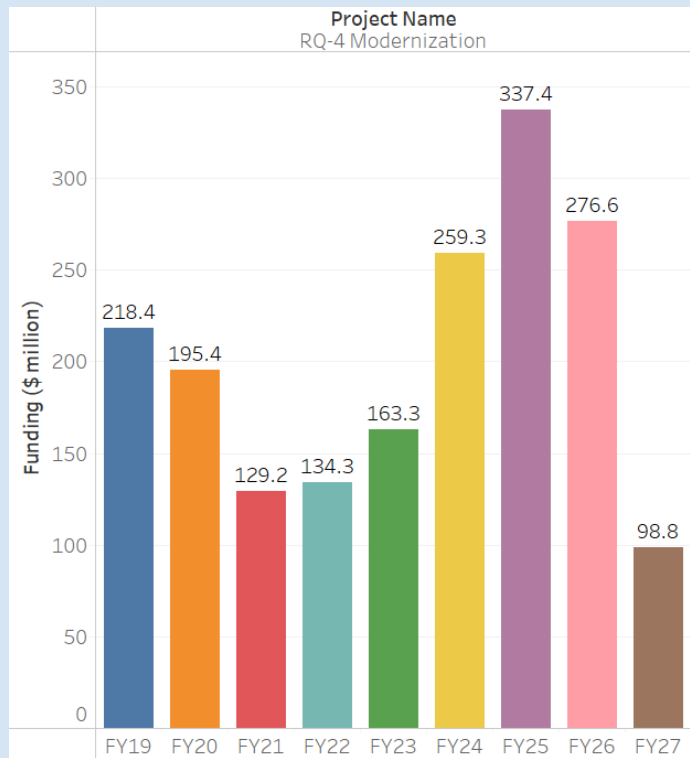


Figure 19: RDT&E funding for upgrades to the Navy's MQ-4C Triton UAS from the PB23 budget request.

MQ-25 Air System - Navy Program Element 0605414N, Project 3278 Unmanned Carrier Aviation Mission Control System - Navy Program Element 0605414N, Project 3279

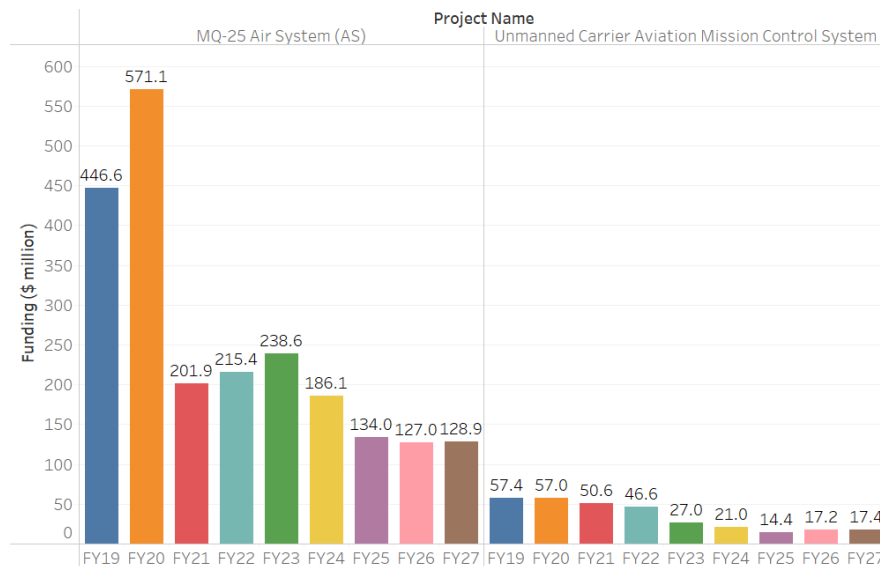


Figure 20: RDT&E funding for the Navy MQ-25 UCA and associated UMCS from the PB23 budget request.

As procurement funding for the MQ-25 Air System ramps up in the coming years, the RDT&E associated with this platform will correspondingly begin to decline. The primary focus of FY 2023 funding will be on integration of the industry-developed GCS/software with the aircraft and associated payloads while also addressing post-IOC requirements like advanced training and obsolescence and sustainment studies.

Marine Group 5 UAS Development - Navy PE 0603128N, Project 3448

This program provides the Marine Air Ground Task Force (MAGTF) with upgrades to the MQ-9A Reaper which operates as a weaponized multi-mission aircraft in contested littoral environments. Funding was initiated in FY 2022 and will peak in FY 2023 as competitive and sole-source contracts are awarded for initial mission payloads. Tier 1 mission payloads include:

- Skytower II Airborne Network Extension (ANE)
- Airborne Early Warning (AEW)/Maritime Domain Awareness (MDA)
- RDESS/SOAR Electronic Warfare (EW)
- Detect and Avoid System (DAAS)

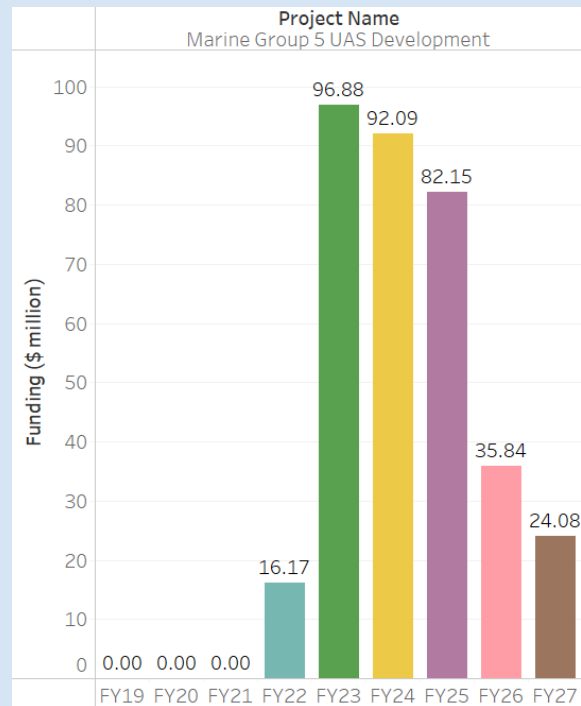


Figure 21: RDT&E funding for upgrades to the Marine Corps MQ-9A Reaper UAS from the PB23 budget request

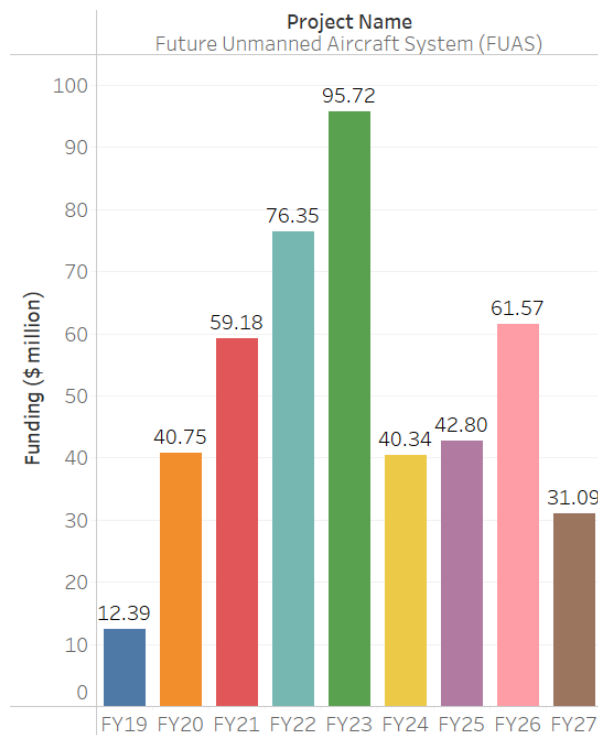


Figure 22: RDT&E funding for the Army's Future UAS project from the PB23 budget request.



Figure 23: Aircraft developed for the Army's Air Launched Effects FoS

Future Unmanned Aircraft System (FUAS) - Army PE 0604113A, Project EX8

The Army's FUAS project supports two main capabilities in FY 2023: the FTUAS which is being developed to replace the RQ-7Bv2 Shadow; and the Air Launched Effects (ALE) family of systems.

- FTUAS: evaluations of competitive prototype vehicles will "ramp up significantly" in FY 2023 along with continued testing of FTUAS component like AI, Identification Friend or Foe (IFF) systems, control systems, and communication relay payloads.
- ALE: the ALE FoS provides a low-cost aircraft that can autonomously or semi-autonomously detect threats and engage targets with both lethal and non-lethal weapons. FY 2023 funding increases by about \$10 million to continue initial prototype demonstrations and integration onto the launch platform.

Uncrewed Ground Systems - Procurement

Robotics and Applique Systems- Army Line Item Number 4868W12002

The primary source of funding for uncrewed ground vehicle (UGV) procurement is through the Army's Robotics and Applique Systems line item. The funding peaked in FY 2021 as 949 Common Robotic System - Individual (CRS(I)) platforms were acquired but has since declined as procurement for this capability was last included in FY 2022.

FY 2023 funding will be used to purchase 145 S-MET platforms which will be used to reduce soldier loads on the battlefield and increase mobility during combat operations. The S-MET



Figure 25: The General Dynamics SMET ground robot

can also be used to support casualty evacuation and can be integrated with a range of Modular Mission Payloads (MMP). Additionally, six Man Transportable Robotic System Increment II (MTRS Inc II) systems will be acquired which support route clearance and other hazardous missions like Explosive Ordnance Disposal (EOD) and detection of Chemical, Biological, Radiological, and Nuclear (CBRN) threats. And finally, approximately \$20 million will also be

Figure 24: The FLIR MTRS Inc II ground robot



used to procure Soldier Borne Sensor (SBS) systems which are SUAS capable of threat investigations in complex environments. The designated contractor for S-MET production systems is General Dynamics Land Systems, the contractor for the MTRS Robot is Teledyne/FLIR and the SBS Phase 2 contractor is TBD.

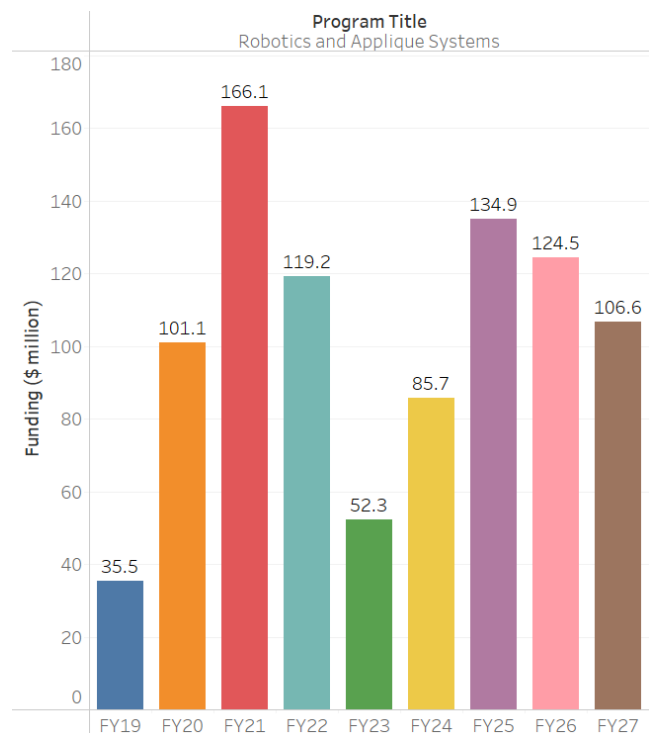


Figure 26: RDT&E funding for the Army's Robotics and Applique Systems project from the PB23 budget request.

Uncrewed Ground Systems - RDT&E

Combat Vehicle Robotics Advanced Technology - Army PE 0603462A, Project BF4

Combat Vehicle Robotics Technology - Army PE 0602145A, Project BF3

Two Army projects within the NGCV Tech / NGCV Advanced Tech programs support the development of robotic combat vehicle capabilities. These projects are working to integrate RAS into Army combat formations to provide autonomous forward surveillance. FY 2023 plans will focus on advanced perception, autonomous

navigation and maneuvering, enhanced cyber resiliency, improved command and control through robotic-soldier interface technologies, integration of RAS into the Robot Operating System - Military (ROS-M), and optimized DBW systems, among others. A new sub-project is also initiated in FY 2023 - M&S for Autonomy Enabled Ground Systems which will assess autonomy developments in the Combat Vehicle Robotics (CoVeR) program using modeling and simulation techniques.

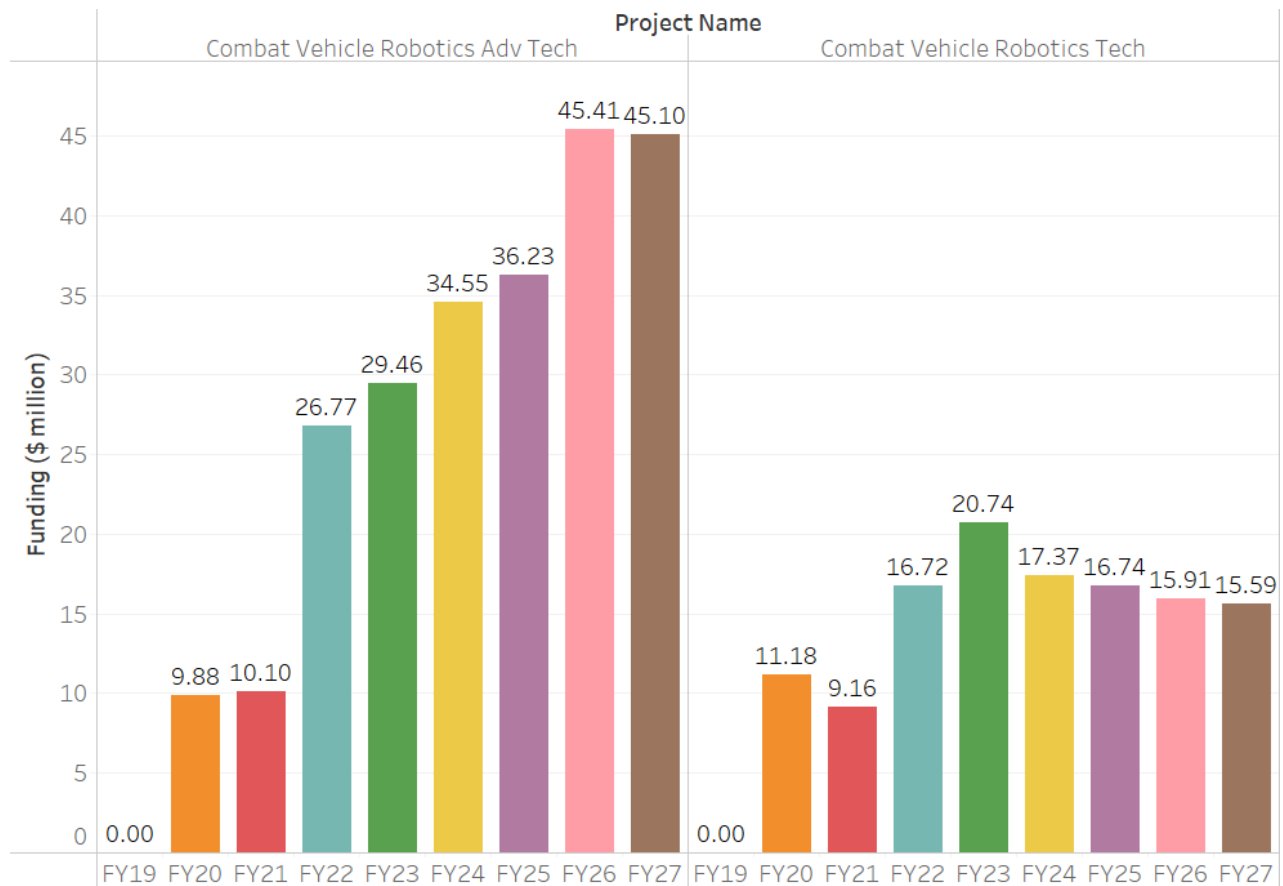


Figure 27: RDT&E funding for the Army's Combat Vehicle Robotics projects from the PB23 budget request.

Robotic Combat Vehicle (RCV) NGCV-CFT - Army PE 0604017A, Project CF4

Robotic Combat Vehicle (BA5) NGCV-CFT - Army PE 0604641A, Project CF5

From FY 2020 to FY 2022, RCV developments were classified in Budget Activity (BA) 4 which is used for Advanced Component Development & Prototypes (ACD&P). In FY 2023, continued efforts will be conducted under BA 5 designated for System Development & Demonstration (SDD). The RCV program is developing two classes of combat vehicles - a light (RCV-L, pictured on the left) and medium (RCV-M, pictured on the right) - which will integrate advanced autonomy capabilities

to provide increased lethality and situational awareness on the battlefield. The projected cost associated with these vehicles from FY 2023 to FY 2027 is over \$700 million. FY 2023 plans involve the development of surrogate RCV-L prototype platforms which will integrate perception sensors, the Common Remotely Operated Weapon Station-Javelin (CROWS-J), and tethered UAS. Contracts will also be awarded to up to five vendors for RCV-L Full System Prototypes. No specific mention of the RCV-M is made in FY 2023 plans, though it has been announced that the RCV-M was used in its first live-fire test in mid-2021.



Figure 28: The Army RCV-L



Figure 29: The Army RCV-M

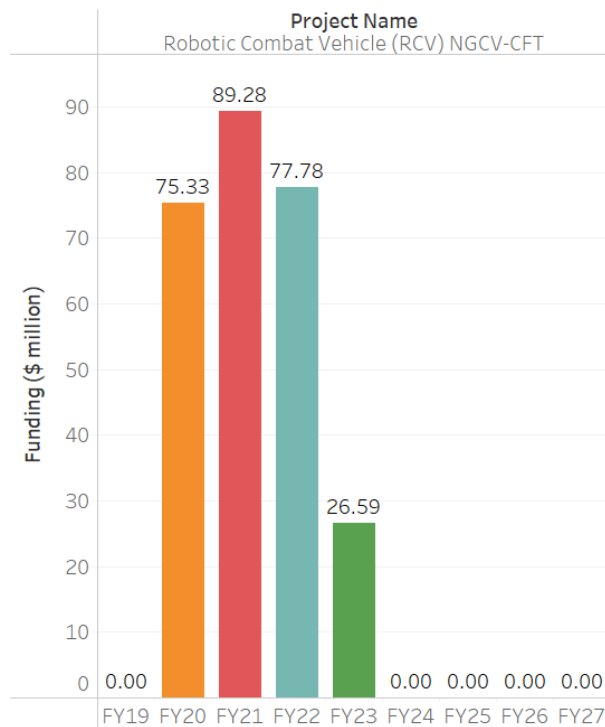


Figure 30: RDT&E funding for the RCV from the PB23 budget request (BA4).

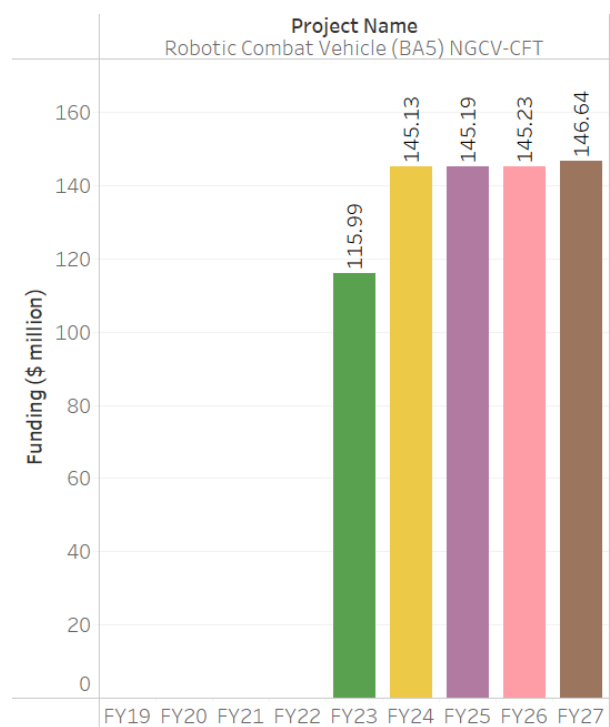


Figure 31: RDT&E funding for the RCV from the PB23 budget request (BA5)

Squad Multipurpose Equipment Transport (SMET) - Army PE 0605053A, Project FB6

The S-MET is based on the General Dynamics Land Systems MUTT (Multi-Utility Tactical Transport) 8-wheeled or tracked ground robot. The vehicle can be integrated with modular payloads to conduct 72-hour resupply and transport missions. FY 2023 funding will support Increment II developments related to platform autonomy, MMP, increased resilience to cyber and electromagnetic interference threats, ballistic protection, and improved battery safety while also adding increased capabilities like dismount radios, C-UAS, and universal battery chargers.

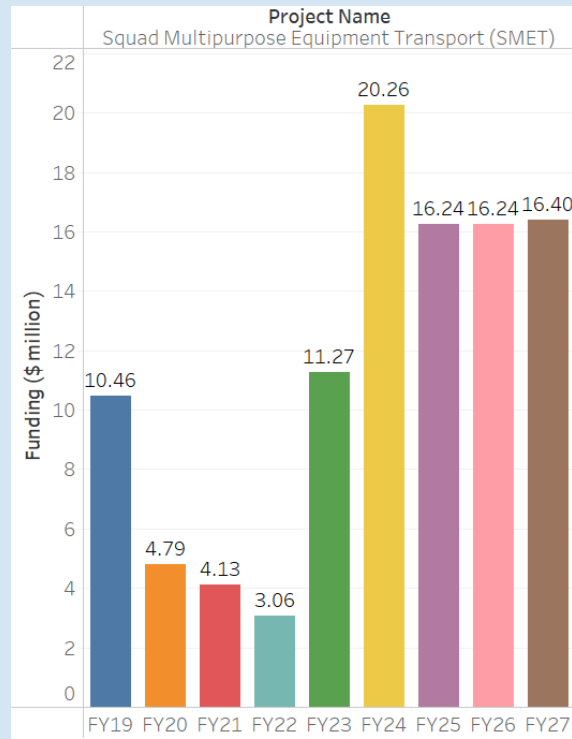


Figure 32: RDT&E funding for the Army's SMET from the PB23 budget request.



Figure 33

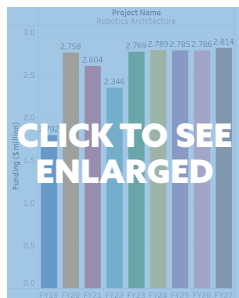


Figure 34

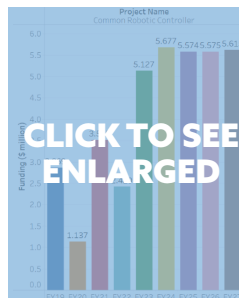


Figure 35

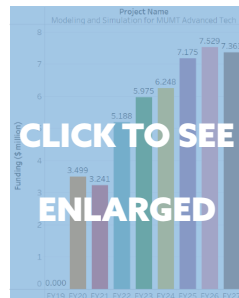


Figure 36

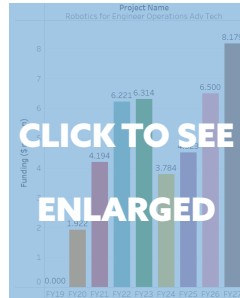


Figure 37

Other Ground Robot Projects

Five Army projects are displayed here which develop critical technologies for ground robots. These include:

- Human Autonomy Teaming is advancing AI-enabled systems to assist future soldiers in complex environments.
- M&S for MUMT Advanced Technology
- Robotics for Engineer Operations Advanced Technology

- Common Robotic Controller is a C2 system that improves operational efficiency through enhanced situational awareness and improved maneuvering of soldiers teamed with RAS.
- Robotics Architecture is an effort focused on interoperability standards amongst RAS systems and common control architecture/software (like ROS-M) for new Army PoR.

Figure 38: The Navy's Small & Medium UUV FoS

Uncrewed Maritime Systems - Procurement

Small & Medium UUV - Navy Line Item Number 1611

The picture to the right shows the UUV FoS currently acquired and/or deployed by the Navy with the largest just under five meters long (KNIFEFISH SMCM) and the smallest about 1.6 meters long (MK 18 Mod 1 Swordfish). The Remus platforms are contracted through Hydroid (owned by Huntington Ingalls) and the KNIFEFISH through General Dynamics Mission Systems. In FY 2023, this program initiates procurement of the Viper MEMUUV which will have a diameter between 10-21 inches and provide enhanced battlespace awareness / MIW capability. Also acquired in this program is the TETRA ROV contracted through Oceaneering. The TETRA is a system of three vehicles that integrates multiple mission payloads for SSW operations. Approximate FY 2023 funding requested includes \$10 million for the Razorback Dry Dock Shelter (DDS) and other support equipment; \$11.3 million for advanced sensors integrated on the MK 18 FoS; \$17.6 million to procure 10 Lionfish SUUV systems at \$1,428K each and associated Mission Support Equipment (MSE) to support Expeditionary MCM (ExMCM) companies; \$2.4 million for initial production engineering and training for the Viper MEMUUV; and \$5.3 million for six TETRA ROV systems at \$377K each along with ancillary equipment kits and sensor integration.

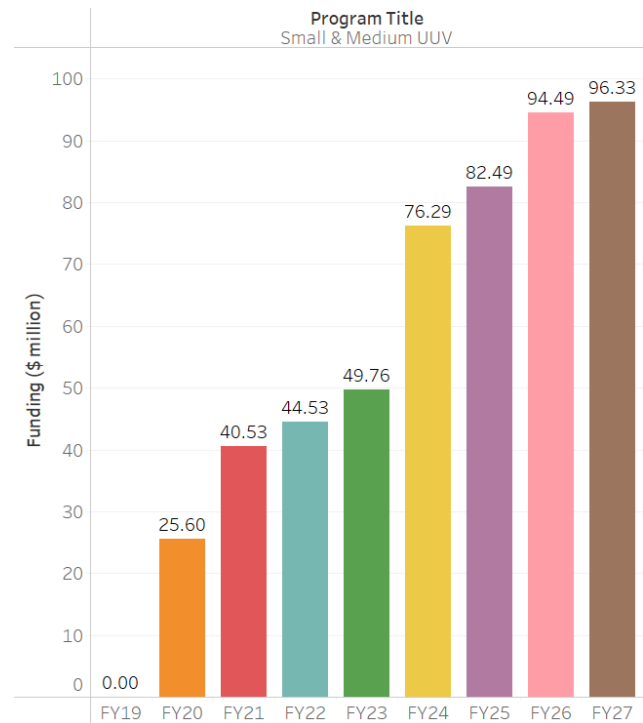
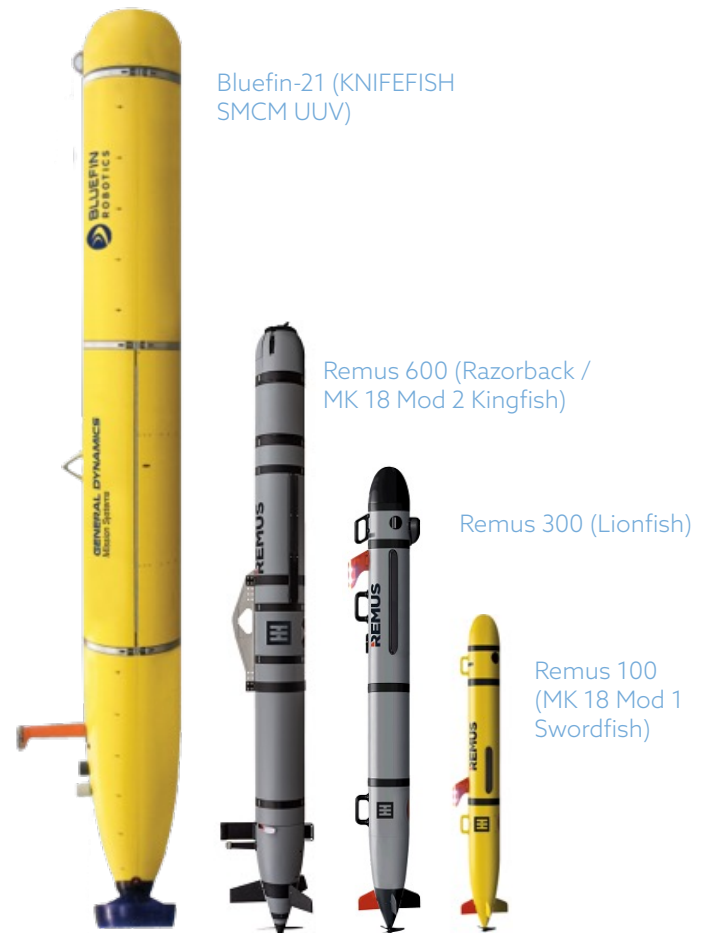


Figure 39: Procurement funding for the Navy's Small & Medium UUV project from the PB23 budget request.

Uncrewed Maritime Systems - RDT&E

Medium Unmanned Surface Vehicle (MUSV) - Navy PE 0605512N, Project 3428

Two MUSVs are currently in the Navy's inventory with the Seahawk (pictured right) delivered to the Navy in early 2021 and the Sea Hunter (pictured left) which has its roots in a DARPA research initiative and was transferred to the Office of Naval Research (ONR) in early 2018 for further development. L3Harris was awarded a \$35 million contract as the system integrator for the first MUSV in mid-2020 with additional contractors including Gibbs & Cox (the Leidos-owned company that completed delivery of the Seahawk), Incat Crowther (providing design support), and Swiftships (pictured below) Shipyard who is manufacturing the vehicle. The initial contract has an option of up to eight more MUSVs for a total cost of \$281 million. In FY 2023, the first MUSV will transition from construction and integration to sea trials with noted funding increases attributed to the evaluation of experimental payloads, the Integrated Combat System (ICS) and Land Based Test Site (LBTS) reliability enhancements. MUSV will integrate modular payloads with initial capabilities enabling improved battlespace awareness.



Figure 40: The Navy's Sea Hunter USV



Figure 41: The Navy's Seahawk USV

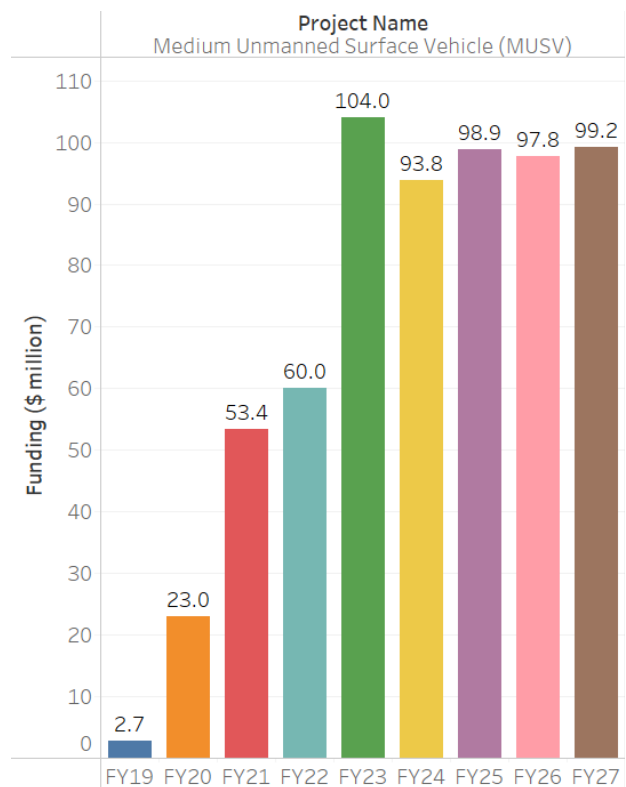


Figure 42: funding for the Navy's MUSV project from the PB23 budget request.

Large Unmanned Surface Vessel - Navy PE 0603178N, Project 3066

The prototype vessels currently in the Navy's inventory and in development include four Overlord LUSVs: Nomad (2019); Ranger (2019); Mariner (2022); and Vanguard (2023). LUSV will be up to 300 ft long and have a displacement of up to 2,000 tons with the ability to integrate modular payloads for offensive strike missions, like anti-surface warfare, while employing autonomous navigation and maintaining compliance with COLREGS. The Navy's most recent shipbuilding plan calls for the acquisition of six LUSV from FY 2025 to FY 2027 with a total estimated cost of \$1.56 billion (\$260 million each on average). Current RDT&E efforts will mature and evaluate technologies integrated on the four existing prototype vessels. Noted focus areas include: hull, mechanical, and electrical (HM&E); Command, Control Communications, Computers, and Intelligence (C4I); USV ICS; Common Control System (CCS); autonomy/perception/data; and prototyping efforts. Increased product development funding in FY 2023 is attributed to ICS hardware procurements.



This report was published by the Congressional Research Service in May 2022 and provides some additional background and potential issues associated with the Navy's LUSV/MUSV/XLUUV efforts.

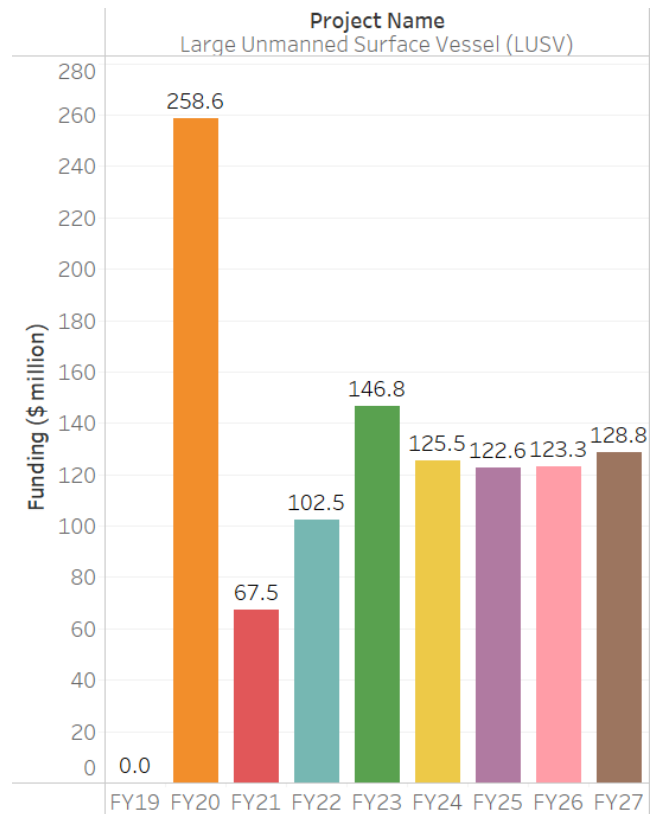


Figure 43: RDT&E funding for the Navy's LUSV project from the PB23 budget request.



Figure 44: Navy Ghost Fleet Overlord LUSV test vessel



Figure 45: Navy Overlord LUSVs Ranger & Nomad

Unmanned Surface Vehicle Enabling Capabilities – Navy PE 0605513N, Project 3067

Funding for the USV Enabling Capabilities project was initiated in FY 2020 to develop technologies that are critical to the operation of the LUSV and MUSV. This includes USV autonomous systems, modular payload systems, and Command & Control (C2) systems. FY 2023 plans will develop unmanned cryptographic systems and advance techniques for data transfer. Significant emphasis will also be made on sensor payload developments, maturation of the integrated autonomy software, and the common core ICS which will be used by both the LUSV and MUSV platforms. The ICS will provide a solution that connects a network of distributed sensor and weapon platforms to conduct coordinated tactical operations.

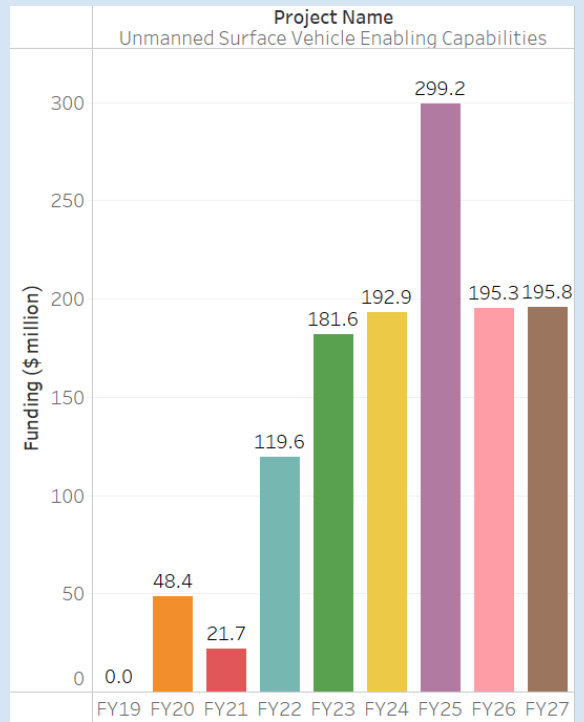


Figure 46: RDT&E funding for the Navy’s USV Enabling Capabilities project from the PB23 budget request.



Figure 47: The Boeing Company Echo Voyager UUV used for the Navy’s XLUUV

Adv Undersea Prototyping-Vehicles, Propulsion & Navigation – Navy PE 0604536N, Project 3394

Boeing was selected as the primary contractor for the Orca XLUUV in FY 2019. However, “contractor challenges and supplier issues” have delayed vehicle delivery and testing to FY22-23. The next round of fabrication contracts will be awarded starting in FY 2024 and further procurement will be assessed based on the successful delivery of the next five systems. In May 2022 it was

announced that an additional XLUUV will be built to test the integration of a 34-foot-long payload section that will enable offensive mine-laying capabilities.

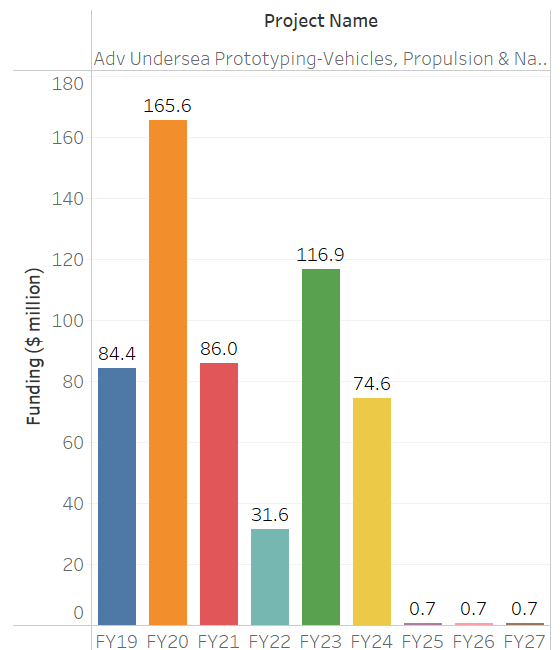


Figure 48: RDT&E funding for the Navy’s XLUUV from the PB23 budget request.

Small/Medium Unmanned Undersea Vehicles - Navy PE 0604028N

Funding for the Small/Medium UUV program peaks in FY 2023 with \$106 million split across five projects:

- Project 2482 – Small UUV supports continued upgrades to the LIONFISH UUV with FY 2023 plans focused on cyber security, autonomy, Automated Target Recognition (ATR), Synthetic Aperture Sonar (SAS), and Forward Look Sonar (FLS) with the goal of delivering a LRIP vehicle for acceptance testing.
- Project 2483 – Medusa funding will be used to award an initial prototyping contract and begin preliminary design of the vehicle. Medusa will be deployed from a submarine for offensive mining missions.
- Project 3123 – SMCM UUV (KNIFEFISH) is employed for mine detection operations and achieved LRIP in FY 2019 with five Block 0 systems contracted through General Dynamics Mission Systems. FY 2023 plans involve the development and Initial Operation Testing and Evaluation (IOT&E) of the Block 1 system while also ensuring cybersecurity

compliance. Funding for the KNIFEFISH averages approximately \$20 million per year from FY 2021 through FY 2023, and the Navy's goal is to achieve IOC in FY 2024 after which point the RDT&E funding for this platform drops off. A competitive production contract will be awarded following Block 1 IOT&E.

- Project 3785 – Razorback can be torpedo launched or deployed from a DDS to provide persistent, autonomous situational awareness. FY 2023 plans involve the execution and completion of both the Preliminary and Critical Design Reviews (PDR / CDR), fabrication of the engineering development model (EDM), and support of other certification and integration requirements.

- Project 4023 – Expeditionary Underwater Systems funds the development of UUV technologies used for EOD and MCM missions. FY 2023 funding of \$14.1 million will be used to conduct a CDR of the Viperfish EDM; development and testing of upgrades to the MK 18 Mod 2; and support investments in Artificial Intelligence/Machine Learning (AI/ML) and data management solutions.

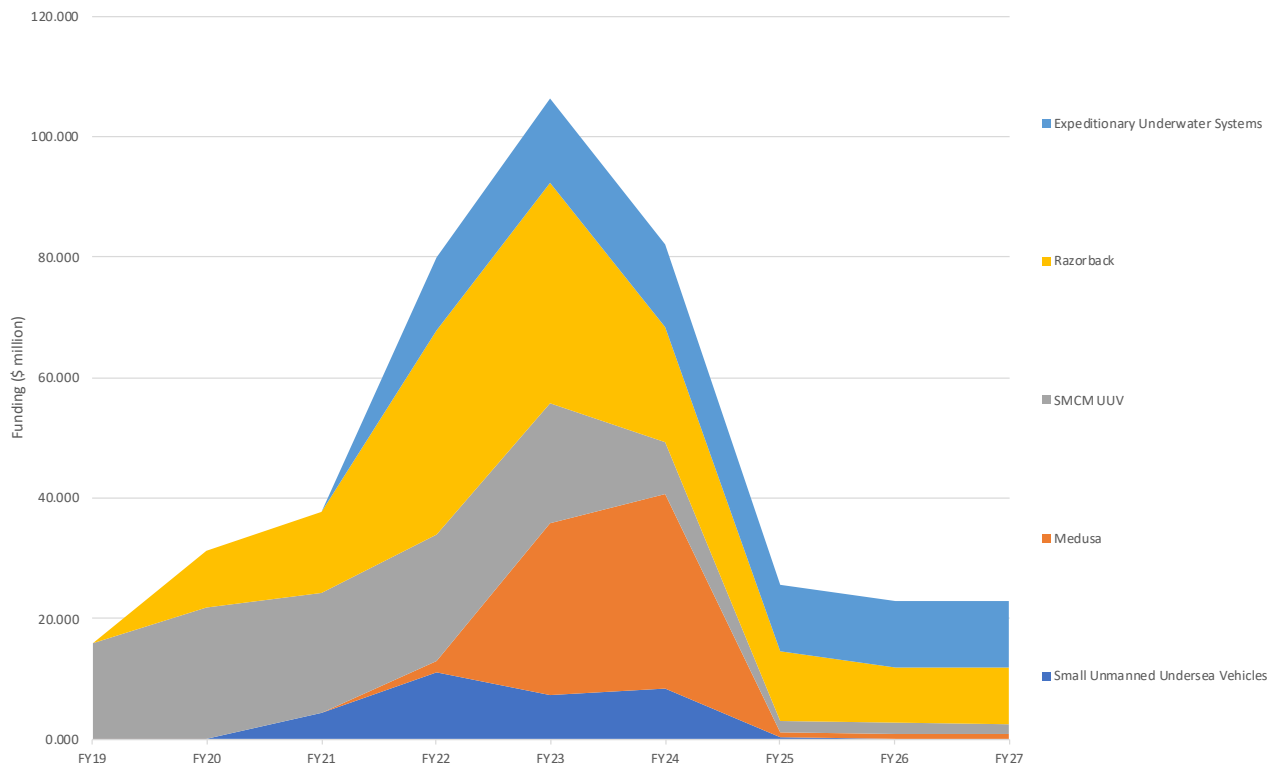


Figure 49: RDT&E funding for the Small/Medium UUV program from the PB23 budget request.

UUV Core Technologies - Navy PE 0604029N

The UUV Core Technologies PE totals approximately \$315 million from FY 2023 to FY 2027 with just under half of that funding dedicated to the UxS Autonomy, C2 project. Detailed plans for this program have been reclassified as SECRET in FY 2023 but based on previous budget

requests, this program supports the Navy's UUV FoS by developing, testing, maturing, and demonstrating enabling technologies in critical areas including autonomy, communications, C2, navigation, endurance and energy, payloads, launch & recovery systems, and integration with host platforms.

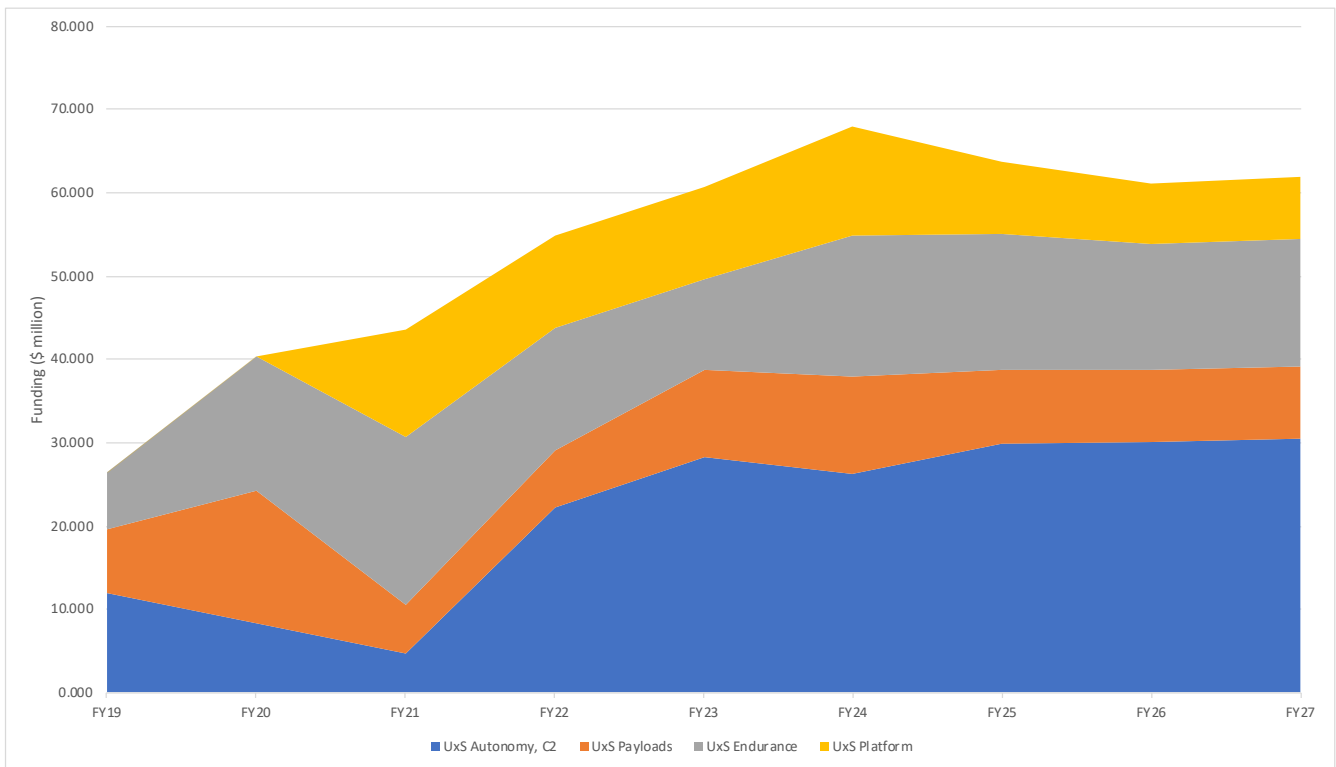


Figure 50: RDT&E funding for the UUV Core Technologies program from the PB23 budget request.

Conclusion

The programs discussed in this report cover the major funding areas for UxV systems across all operational domains. The platforms range greatly in size and mission profile but the core technologies being developed share a common theme. There is significant emphasis on autonomy and MUM-T solutions which improve the efficiency and survivability of UxV teamed with soldiers on the battlefield. Autonomy can be found in most subsystems integrated on UxV platforms such as sensors, navigation and control systems, communication systems, mobility solutions, and others. Additional areas of significant focus include common control systems, cross-domain interoperability, cyber resilience, and improved energy and propulsion systems.

With regards to funding, air programs continue to exceed all other domains. However, there are programs with strong growth potential in each operational domain. In a Tableau workbook forthcoming later this year, each effort supporting

UxV RDT&E and procurement will be described in greater detail along with other trend analysis.

As a final note, this report only covers the requested budget for FY 2023. Congressional committees will review these requests and finalize the budget through the National Defense Authorization Act (NDAA) and the Consolidated Appropriations Act for FY 2023. The Chairman's Mark for the NDAA was recently released which shows a net increase of over \$107 million in funding for UxV technologies. The largest increase is associated with the MQ-9 UAS Payloads program with \$40 million added to procure electronic support measure payloads. All UxV-related changes from the Chairman's Mark are provided in the Table 1 below. AUVERSI will continue to track this legislation and provide updates throughout the remainder of the budgetary process.

Table 1: UxV-related changes to the PB23 budget request from the Chairman's Mark to the NDAA.

PE	Category	Organization	Type	Program Name	Item Name	Chairman's Mark (\$M)	Domain
PRDTB3	OTHER AIRCRAFT	Air Force	Procurement	MQ-9 UAS PAYLOADS	Program increase—electronic support measure payload	40	Air
9678A12500	FIXED WING	Army	Procurement	SMALL UNMANNED AIRCRAFT SYSTEMS	Short Range Reconnaissance acceleration	10	Air
PRDTB2	OTHER AIRCRAFT	Air Force	Procurement	MQ-9 MODS	Unjustified cost—MQ-9 Upgrade	-6	Air
0452	OTHER AIRCRAFT	Navy	Procurement	MARINE GROUP 5 UAS	Program decrease	-10	Air
PRDTB1	OTHER AIRCRAFT	Air Force	Procurement	MQ-9	Early to need—production shutdown	-10.027	Air
0442-1	OTHER AIRCRAFT	Navy	Procurement	MQ-4 TRITON	Program decrease	-20	Air
0604101A	ADVANCED COMPONENT DEVELOPMENT & PROTOTYPES	Army	RDT&E	SMALL UNMANNED AERIAL VEHICLE (SUAV) (6.4)	Program Protection	20	Air
0604258A	MANAGEMENT SUPPORT	Army	RDT&E	Target Systems Development	Small UAS engine development	20	Air
0604113A	ADVANCED COMPONENT DEVELOPMENT & PROTOTYPES	Army	RDT&E	FUTURE TACTICAL UNMANNED AIRCRAFT SYSTEM (FTUAS)	Identification Friend or Foe (IFF) modernization	20	Air
1105219BB	OPERATIONAL SYSTEMS DEVELOPMENT	Defense-Wide	RDT&E	MQ-9 UAV	MQ-9 Mallett reprogramming	5.87	Air
1105219BB	OPERATIONAL SYSTEMS DEVELOPMENT	Defense-Wide	RDT&E	MQ-9 UAV	Speed Loader Agile POD	5	Air
0603122D8Z	ADVANCED TECHNOLOGY DEVELOPMENT	Defense-Wide	RDT&E	COMBATING TERRORISM TECHNOLOGY SUPPORT	VTOL Loitering Munition (ROC-X)	5	Air
0603216F	ADVANCED TECHNOLOGY DEVELOPMENT	Air Force	RDT&E	AEROSPACE PROPULSION AND POWER TECHNOLOGY	Attributable combat UAV propulsion	5	Air
0305220N	OPERATIONAL SYSTEMS DEVELOPMENT	Navy	RDT&E	MQ-4C TRITON	Program decrease	-15	Air
0602150A	APPLIED RESEARCH	Army	RDT&E	AIR AND MISSILE DEFENSE TECHNOLOGY	Counter-UAS Center of Excellence	5	Counter-UAS
4868W12002	ENGINEER (NON-CONSTRUCTION) EQUIPMENT	Army	Procurement	ROBOTICS AND APPLIQUE SYSTEMS	SMETS program delay	-15	Ground
0603044A	ADVANCED TECHNOLOGY DEVELOPMENT	Army	RDT&E	SOLDIER ADVANCED TECHNOLOGY	Small Unit Digital Twin for Robotic and Sensor Systems Integration	3.5	Ground
1611	OTHER SHIP SUPPORT	Navy	Procurement	SMALL & MEDIUM UUV	Unjustified growth	-5	Maritime
0602123N	APPLIED RESEARCH	Navy	RDT&E	FORCE PROTECTION APPLIED RESEARCH	Additive Manufacturing of Unmanned Maritime Systems	10	Maritime
0602747N	APPLIED RESEARCH	Navy	RDT&E	UNDERSEA WARFARE APPLIED RESEARCH	Undersea vehicle technology partnerships	5	Maritime
0602747N	APPLIED RESEARCH	Navy	RDT&E	UNDERSEA WARFARE APPLIED RESEARCH	UUV Research	5	Maritime
0602747N	APPLIED RESEARCH	Navy	RDT&E	UNDERSEA WARFARE APPLIED RESEARCH	CPF—Persistent Maritime Surveillance	4	Maritime
0602131M	APPLIED RESEARCH	USMC	RDT&E	MARINE CORPS LANDING FORCE TECHNOLOGY	Unmanned logistics solutions	10	Unspecified
0601103N	BASIC RESEARCH	Navy	RDT&E	UNIVERSITY RESEARCH INITIATIVES	Advanced autonomous robotics	7.5	Unspecified
0602123N	APPLIED RESEARCH	Navy	RDT&E	FORCE PROTECTION APPLIED RESEARCH	Relative Positioning of Autonomous Platforms	5	Unspecified
0602131M	APPLIED RESEARCH	USMC	RDT&E	MARINE CORPS LANDING FORCE TECHNOLOGY	Unmanned Logistics Solutions for the U.S. Marine Corps	3	Unspecified

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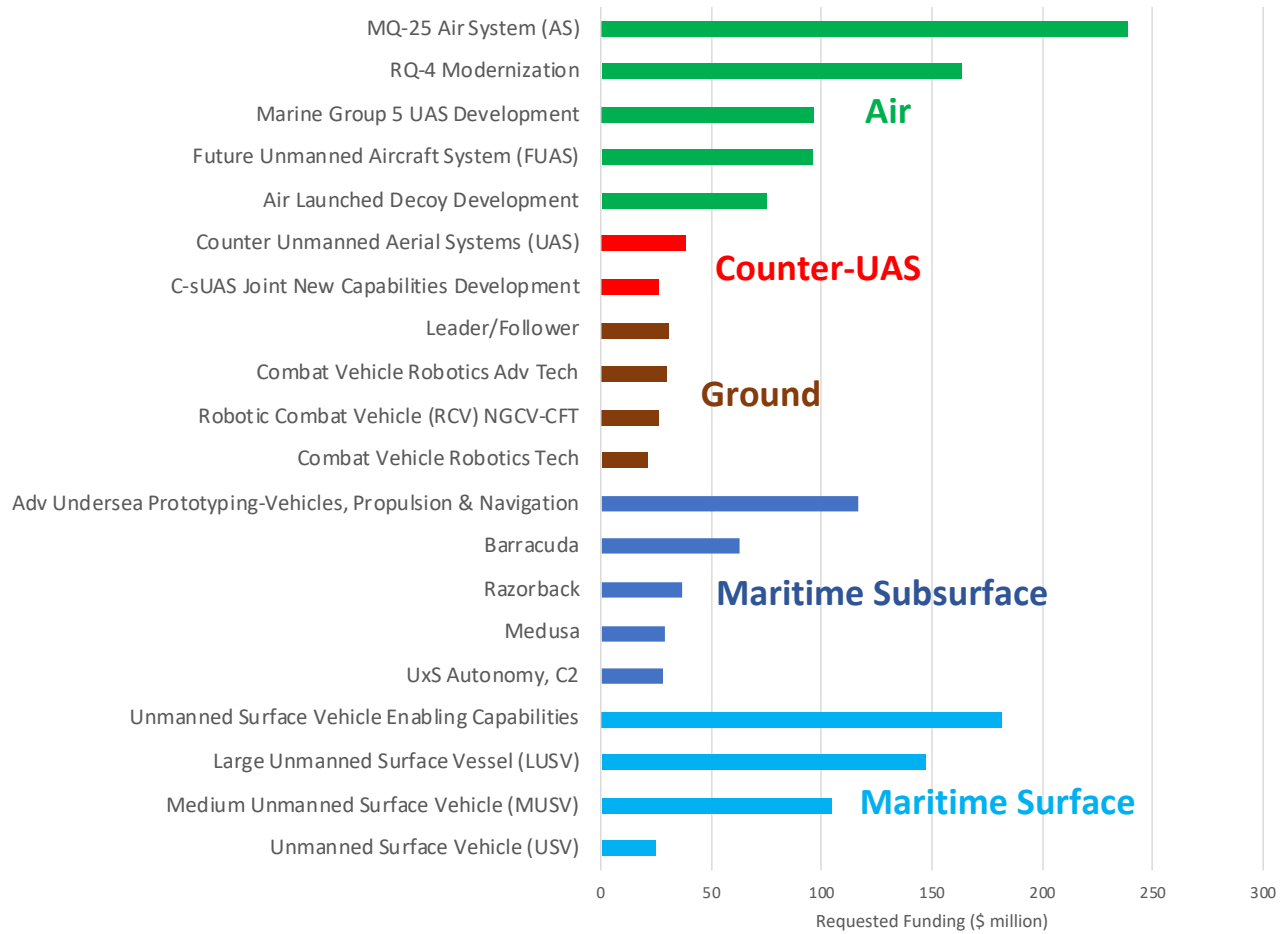
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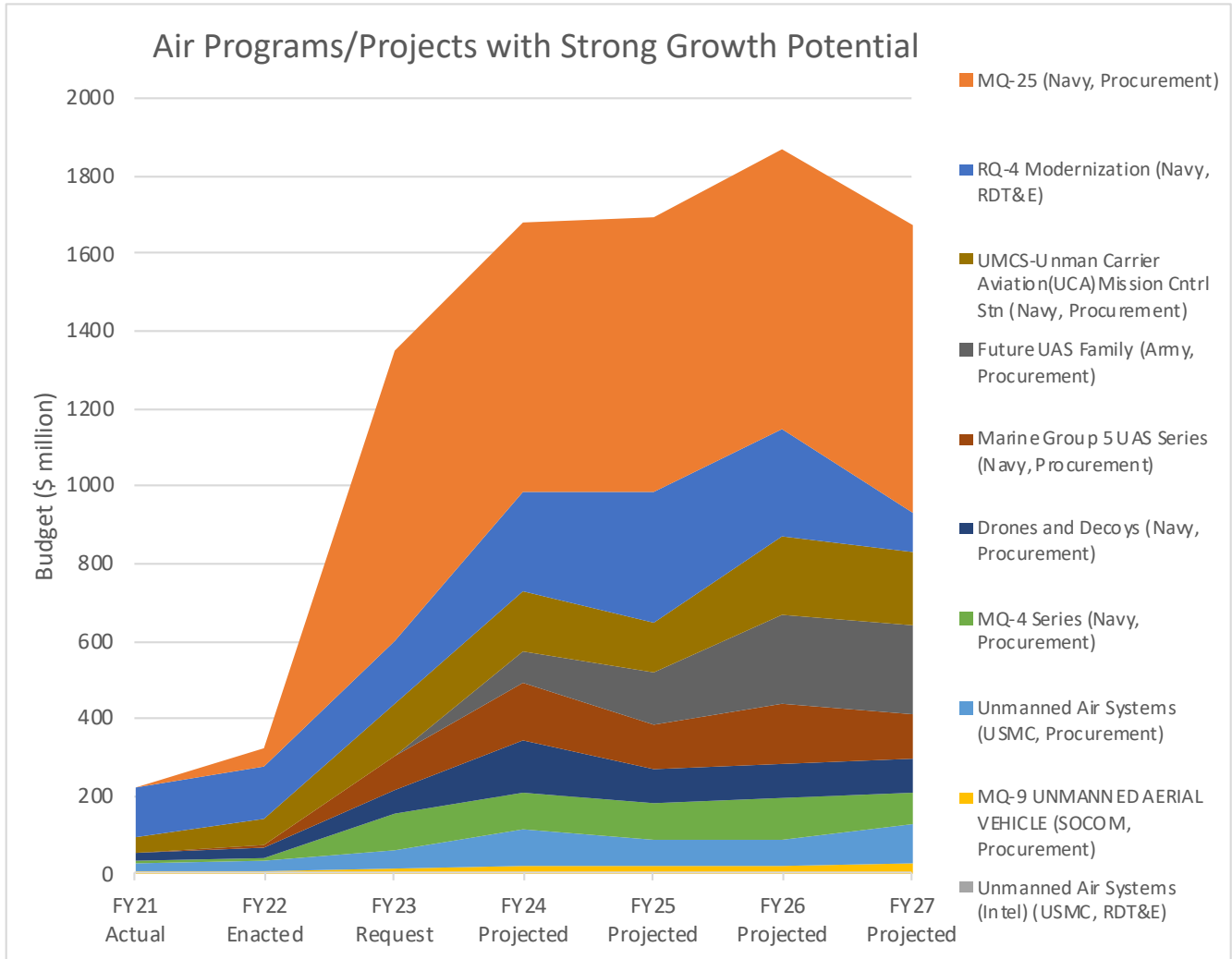
FIGURE 2

Top RDT&E Programs Supporting Uncrewed Vehicles in FY 2023



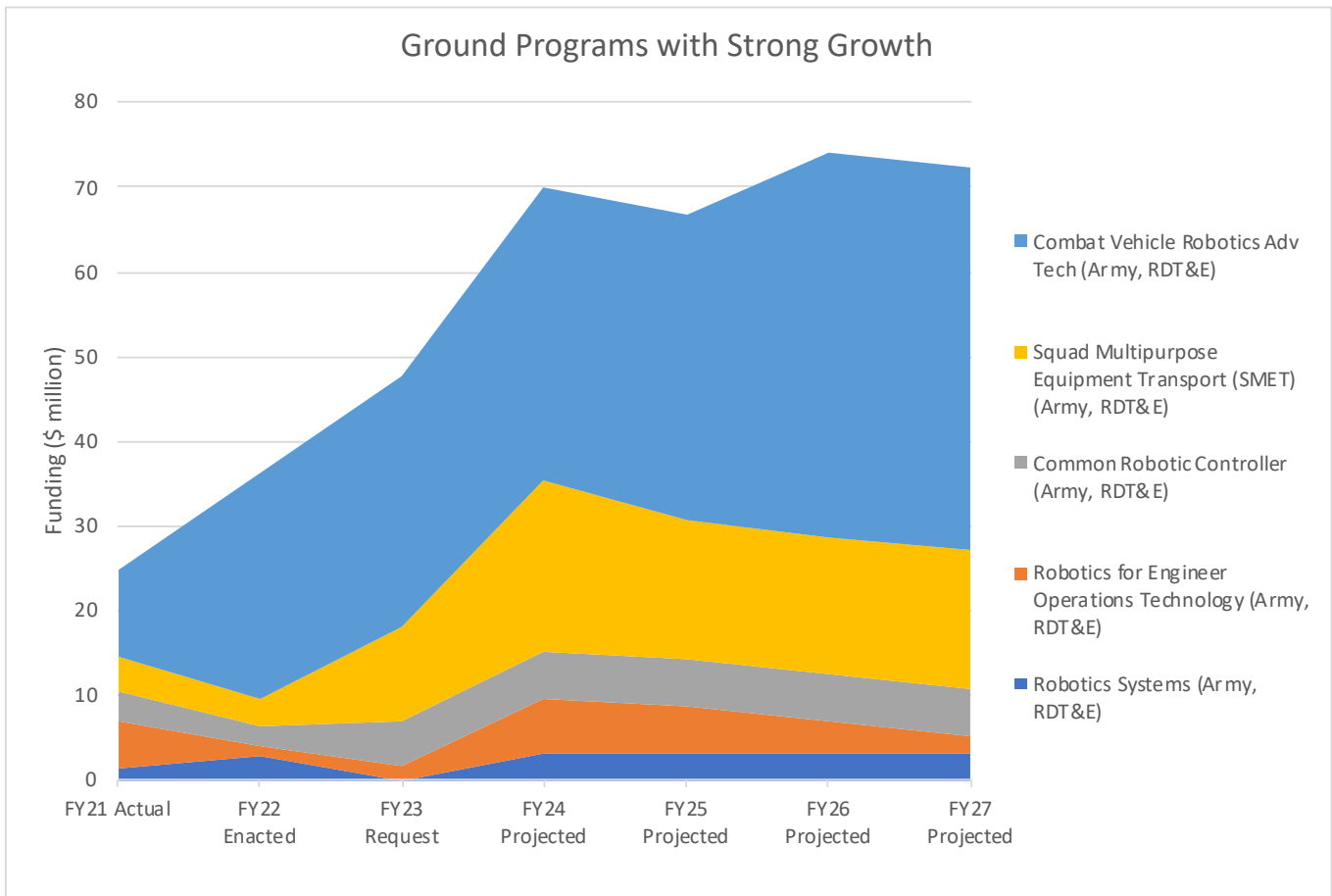
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FIGURE 3



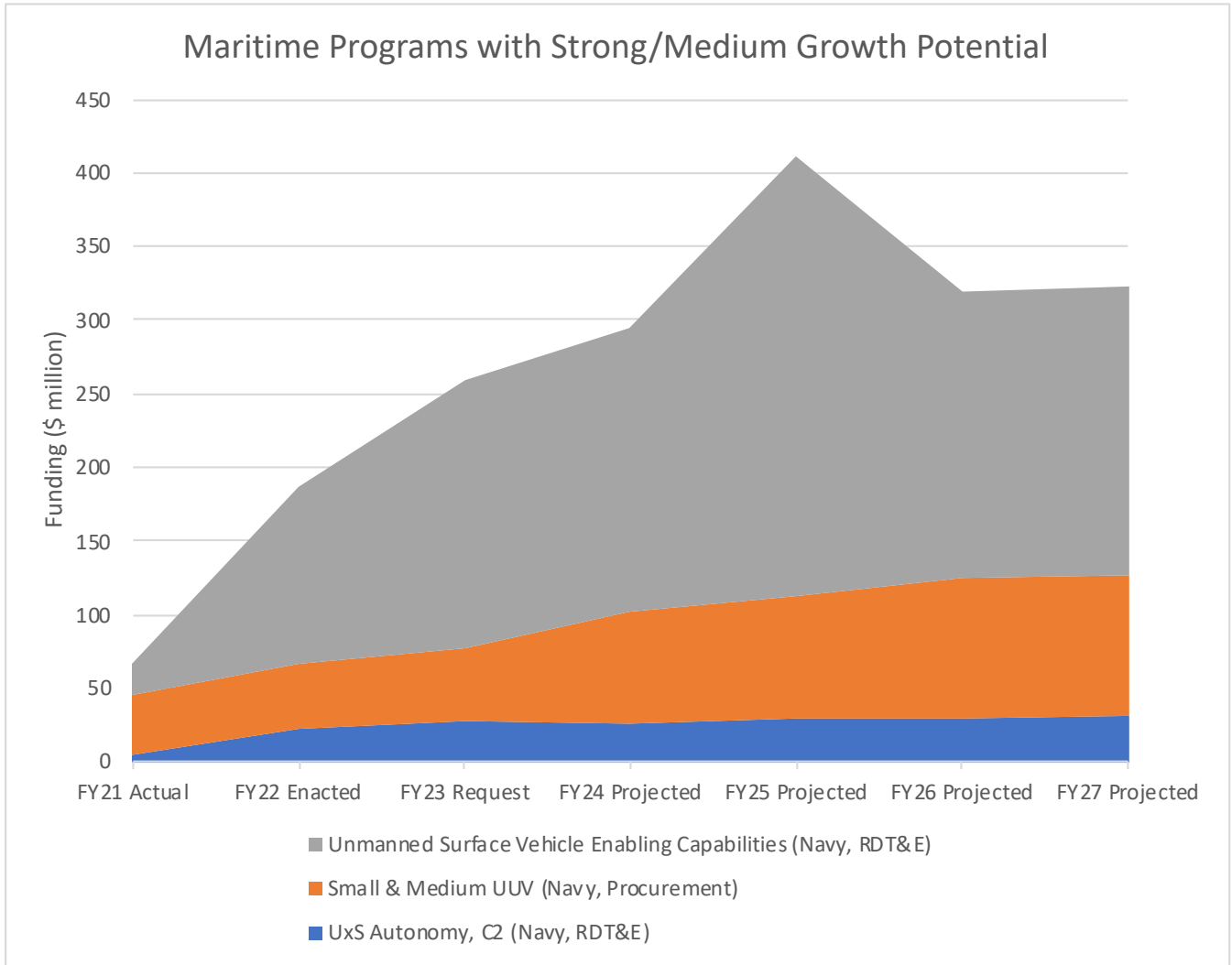
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FIGURE 4



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FIGURE 5



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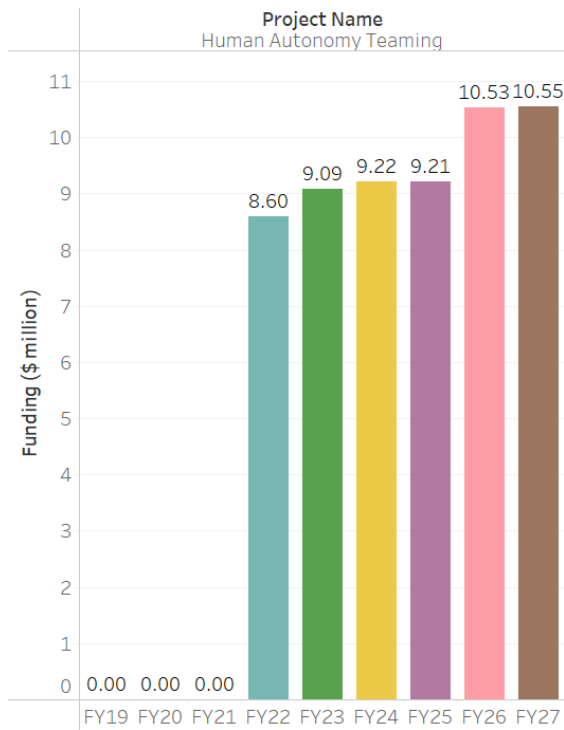


Figure 33: RDT&E funding for the Army’s Human Autonomy Teaming project from the PB23 budget request.

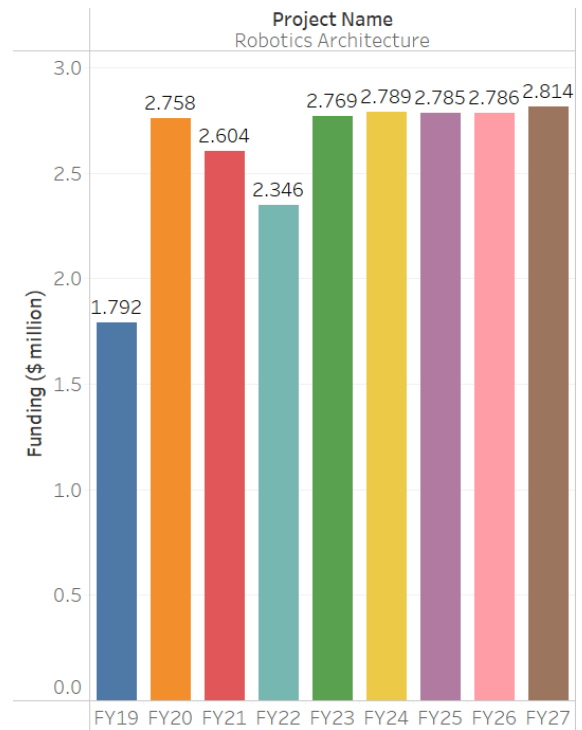


Figure 34: RDT&E funding for the Army’s Robotics Architecture project from the PB23 budget request.

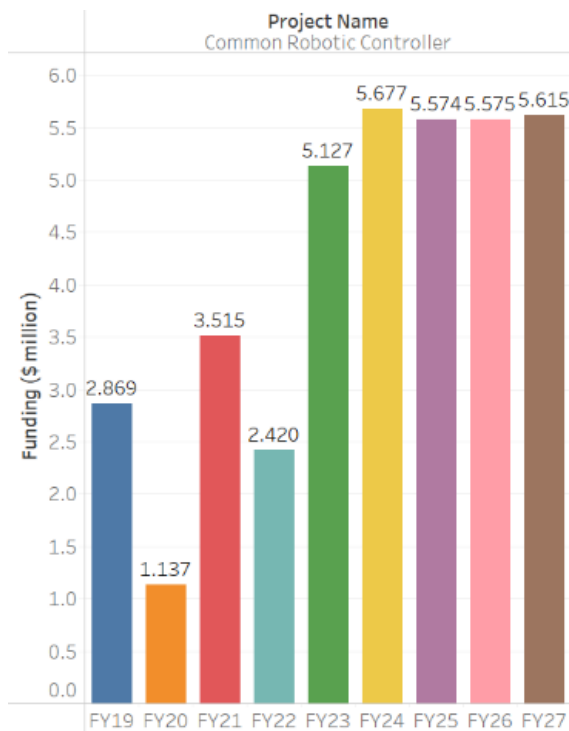


Figure 35: RDT&E funding for the Common Robotic Controller project from the PB23 budget request.

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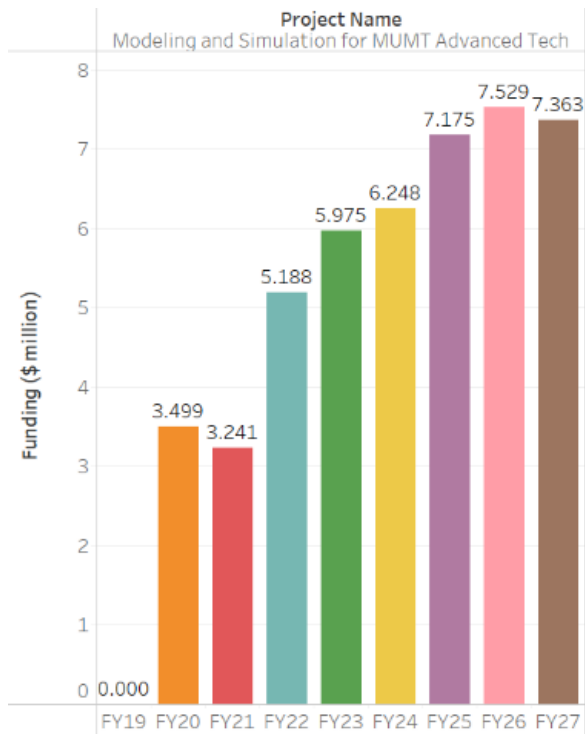


Figure 36: RDT&E funding for the Army's M&S for MUMT Advanced Tech project from the PB23 budget request.

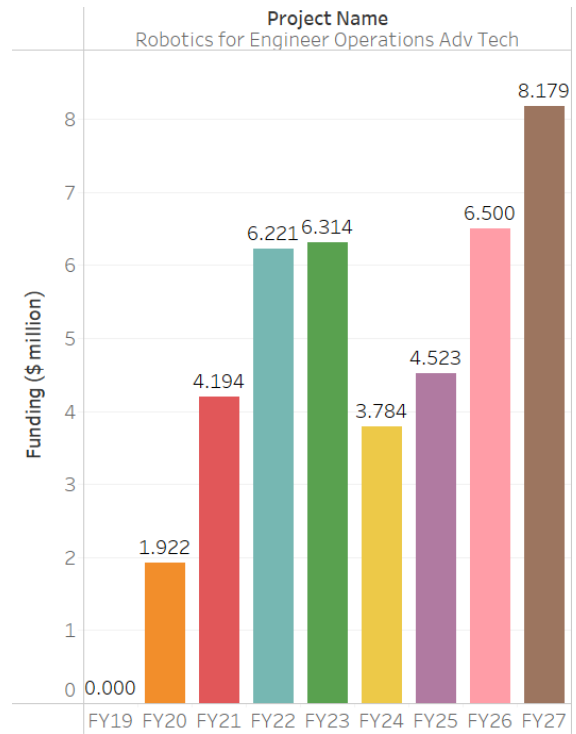


Figure 37: RDT&E funding for the Army's Robotics for Engineer Operations Adv Tech project from the PB23 budget request.

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The Association for Uncrewed Vehicle Systems International, the world's largest nonprofit organization dedicated to the advancement of uncrewed systems and robotics, represents corporations and professionals from more than 60 countries involved in industry, government and academia. AUVSI members work in the defense, civil and commercial markets.

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