The Changing Landscape of Military Uncrewed Systems

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What will the next generation of military uncrewed system look like?

I had the pleasure of attending AUVSI Defense 2022 last week in Alexandria, VA, just down the road from the Pentagon, an event which featured several prominent speakers from both the defense and commercial industries. A common theme among the speakers was the need for flexibility in the fighting force, how that would shape the next generation of warfare, and how it would shape the defense requirements for autonomous vehicles. This concept will ultimately determine the buildout requirements for the next generation of uncrewed systems to be used on the battlefield, and inform industry and investors where their efforts are likely to be rewarded.

Flexibility was a key talking point at the event, and multiple speakers pointed directly to the Turkish Bayraktar TB2 (USRD specifications in the appendix), a relatively cost-effective combat-capable drone purchased and fielded by the Ukrainian Armed Forces that has acted as a game changer for Ukraine since the war began. Senior defense officials have taken note that while the technical sophistication of the drone was not at the top of the market, it had been fielded quickly, required relatively little training, could be fitted for a variety of purposes, and had become extremely effective even in the hands of relatively unskilled operators. What made this system, and others like it, so effective led to the theme of the day as nearly every speaker came prepared to discuss the need for developing multiple layers of flexibility around the US fighting force.

As Keynote Speaker Bryan Clark of the Hudson Institute pointed out, the modern battlefield is dynamic relative to anything we have seen. Forces have traditionally been put together for a high degree of specialization. Units are outfitted, equipped, and trained to a specific skill set, and equipment is fielded with a precise and narrow function and set of capabilities. While this high-tech and specialized approach has given soldiers a high degree of lethality and capability within a narrow scope of missions, it has limited flexibility, led to long fielding times for equipment, and has an inherently high cost.

Aaron Bull
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AUVSI DEFENSE

2022 Experts

Bryan Clark
Senior Fellow & Director Center for Defense Concepts & Technology, Hudson Institute

Dr. Kevin Pollpeter
Senior Research Scientist, Center for Naval Analyses

Lauren Kahn
Research Fellow, Council on Foreign Relations

RADM Nevin Carr (Ret.)
Vice President Navy Strategic Account Executive, Leidos

Dr. Cara LaPointe
Co-Director, Johns Hopkins Institute for Assured Autonomy

These shortcomings handicap forces that rely on advanced technology for mission execution. The more rapidly the battlefield develops and evolves, the less likely that the correct systems for the mission will be on-hand in such a specialized fielding framework.

US Military leaders have taken note as they have begun shaping the next generation of military equipment outfitting for autonomy. An uncrewed vehicle that can be re-fitted for multiple missions of different types offers an inherent advantage whereby it can be re-fitted and re-equipped around the needs of the mission, rather than have missions designed around available equipment. Flexibility comes with certain considerations that need to be accounted for in equipment design. It must have the ability to be used across a wide array of environments and conditions. It also must be mission-flexible, to allow reconfiguration and re-composure of units to equip for specific non-linear missions, and it requires logistical infrastructure that supports system modularity. As industry and the logistical support function ramp up to support this growing need, it is important for leaders to understand flexibility as a growing requirement and how it can be used to shape the next generation of autonomous systems.

Flexibility of system requirements for the next generation of autonomous vehicles:

- **Flexibility and disguise of role:** Outside parties should not be able to see the system and immediately know its role and capabilities
- **Ability to outfit to different technical and operating capabilities:** Autonomous vehicles will be able to integrate into different missions and to be re-fitted and optimized to specific requirements unique to each mission
- **Flexibility to operate with different levels of human interaction:** Systems should be set up with the ability to mesh human-specific and drone-specific functions. Humans should enhance the capabilities of machines, and machines should enhance the capabilities of humans
- **Modularity to re-fit the drone around the mission and not the mission around the drone:** Autonomous vehicles should come with a base kit that allows for modular exchange of parts and systems. It should be able to be reconfigured on the fly
- **Hardware-to-hardware modularity:** Equipment and components must be able to fit and work across different systems
- **Software to hardware modularity:** Systems should be designed to function with multiple software systems and irrespective of the software used. Software can be swapped and re-calibrated to fit the mission. Software should be developed to fit multiple hardware systems

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Robotics Branch Chief, Headquarters Department of the Army, G8

Dr. Jason Stack
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Director Ground Vehicle Intelligence Systems, Ground Vehicle Systems Center, U.S. Army

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System specifications for the Bayraktar TB2 from AUVSI's USRD Database have been included. Please contact AUVSI if you are interested in membership, event access or USRD database access.

Bayraktar TB2

— Baykar Makina (Turkey)

Domain	Air
Market Category	Civil, Military
Application	Attack, Weapons Delivery; Disaster Response; Imaging; Intelligence, Surveillance, Reconnaissance; Observation; Patrol, Security; Search & Rescue; Target Acquisition
Continent	Asia
Countries	Turkey
Production Status	Actively Marketed

Description:

The Bayraktar TB2 is a Tactical Armed / UAV System, developed and manufactured by Baykar. A highly sophisticated design that provides all solutions that operator may need in one integrated system. The system consists of Bayraktar TB2 Armed / UAV Platform, Ground Control Station, Ground Data Terminal, Remote Display Terminal, Advanced Base with Generator and Trailer modules. Thanks to Baykar's technological accumulation and capabilities, the entire system is produced indigenously.

Bayraktar TB2 is a Medium Altitude Long Endurance (MALE), Tactical Unmanned Aerial Vehicle capable to conduct Intelligence, Surveillance and Reconnaissance (ISR) and armed attacks missions. An onboard avionic suite with a triple redundant avionic system encompasses units enabling a fully autonomous taxiing, take-off, landing and cruise. TB2 has proven its efficacy with over 110,000 of operational flight hours. Since 2014, it keeps carrying out missions successfully within the Turkish Armed Forces, Gendarmerie and the Turkish National Police. Currently, 86 armed Bayraktar platform are employed serving Turkey. Bayraktar TB2 holds the record of the Turkish aviation history for endurance with (27 Hours 3 Minutes) and for altitude with (27.030 feet). Bayraktar TB2 is also the first-ever aircraft in its category to be exported abroad.

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— Baykar Makina (Turkey)

PLATFORM SIZE PROPERTIES

Length	6.50 meters (6500.00 mm; 21.30 feet)
Wing Span	12.00 meters (12000.00 mm; 39.40 feet)
MGTOW	630.00 KG (1389.00 lbs)
Less Than 55 Pounds (25 kg):	NO

POWER & PROPULSION PROPERTIES

Power	**74.57 kW (74570.00 W; 100.00 hp)**
Propulsion	Combustion Engine, Propeller
Propulsion Comment	ICE; variable pitch propeller
Energy Source	Gasoline
Fuel Capacity	300.00 L (79.25 gal)

PERFORMANCE PROPERTIES

Cruise Speed	70.00 knots (129.60 km/hr; 80.50 mph)
Endurance	24.00 hrs (1440.00 mins)
Endurance Comment	over 24 hrs
Max Range	150.00 km (93.00 miles)
Max Range Comment	over 150 km communication range
Max Altitude	7315.00 meters; 24000.00 feet

PAYLOAD PROPERTIES

Payload Weight	**55.00 kg (121.00 lbs)**
Payload Weight Comment	over 55 kg
Payload Location	Under Fuselage, Internal
Payload Description	EO Camera Module; IR Camera Module; Laser Designator; Laser Range Finder; Laser Pointer; Capable of carrying the MAM-L smart ammunition produced by Roketsan.

Bayraktar TB2

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OTHER PLATFORM PROPERTIES

Air-Frame:	Aeroplane
Rotors Enclosed:	No
Launch Method:	Runway, Wheeled
Recovery Method:	Runway, Wheeled
BLOS Capability:	No
Navigation/Control:	Technical Performance (Avionics): - Automatic Taxi - Automatic Take Off - Automatic Landing (No external aid) - Automatic Parking - Modern Nonlinear Control System Architecture - Advanced Sensor Fusion Technics - Nonlinear Extended Kalman Filtering for INS-GPS - Modern Stochastic Filtering Hardware Components (Avionics): - Triple Redundant Flight Control System - Mission Computer System - Triple Redundant INS-GPS System - Laser Altimeter Module - Radar Altimeter Module - Triple Redundant Pitot-Static System - Engine Control and Monitoring System - Redundant Servo Actuator Units - Air Data Terminal Systems - Redundant Power Systems Technical Features (Command & Control Interface): - Map Interface (DTED Support) & Mapping Functions - Telemetry Screen - Flight Dynamics Settings - Calibrations - Flight Replay Features - On Screen Display, Headup Display - Real Time Image Processing - Server Client Architecture

Bayraktar TB2

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Navigation Method:	GPS, INS, RC
Miscellaneous:	- Modular composite structure - Carbon fiber, Kevlar with Epoxy Resins - Main Fuselage - Sandwich Structure Wings, Tails - Tail Boom - Bladder Type Fuel Tanks - Retractable Nose Landing Gear - Fixed Rear Landing Gear

PRIMARY ORGANIZATION

Primary Organization:	Baykar Makina (Turkey)
Organization Description:	Baykar Makina pioneers the design, development, and production of innovative solutions in Turkey's aerospace and defense sector. With our multidisciplinary, dynamic, and young engineering team, our activities span a multitude of domains from R&D to production and from system integration to subsystem development. We carry production level systems through the entire development lifecycle from prototyping to production to support. Baykar is proud to provide our customers the most cost-effective and game-changing technologies available on the market. History & Culture Established in 1984 as a CNC precision machining supplier subcontractor, "Baykar" is a portmanteau of the words "Bayraktar Kardesler" (Bayraktar Brothers), who founded the company with the conventional machining of automotive parts with NC and later CNC machines. Baykar has since expanded its expertise with our team of highly motivated engineering teams, focusing today on aerospace, robotics, and control systems specifically housed within our Unmanned Aerial Systems..
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