

Unmanned Aircraft Systems (UAS)

Unmanned Aircraft Systems (UAS), also commonly referred to as Unmanned Aerial Systems or Unmanned Aerial Vehicles (UAV), are air vehicles and associated equipment that do not carry a human operator, but instead fly autonomously or are remotely piloted. UAS must be considered in a systems context which includes the remote human operator(s), a command, control and communications (C3) system, a payload, as well as the air vehicle, or multiple vehicles.

There currently is no widely accepted common classification system for UAS vehicles or systems due to the wide variety of capabilities, size, and operating characteristics of different systems. Most UAS are described in terms of weight, endurance, purpose of use, and altitude of operation. For the purposes of this report, broad categories and uses are as follows:

Table 1: UAS Categories and Uses

Name	Altitude	Endurance	Typical Uses
High Altitude	Over 60,000 ft (above class A airspace) ¹	Days/weeks	Surveillance, data gathering, signal relay
Medium Altitude	18,000 – 60,000 ft (class A airspace)	Days/weeks	Surveillance, cargo transportation
Low Altitude	Up to 18,000 ft (class E airspace) ²	Up to 2 days	Surveillance, data gathering
Very Low Altitude	Below 1,000 ft	A few hours	Reconnaissance, inspection, surveillance

¹ In the U.S., Class A airspace is controlled airspace from 18,000 feet Mean Sea Level (MSL) up to and including Flight Level (FL) 600.

² In the U.S., Class E airspace is controlled airspace that is not designated as Class A, B, C, or D and is above Class G surface areas from 14,500 MSL to 18,000 MSL.

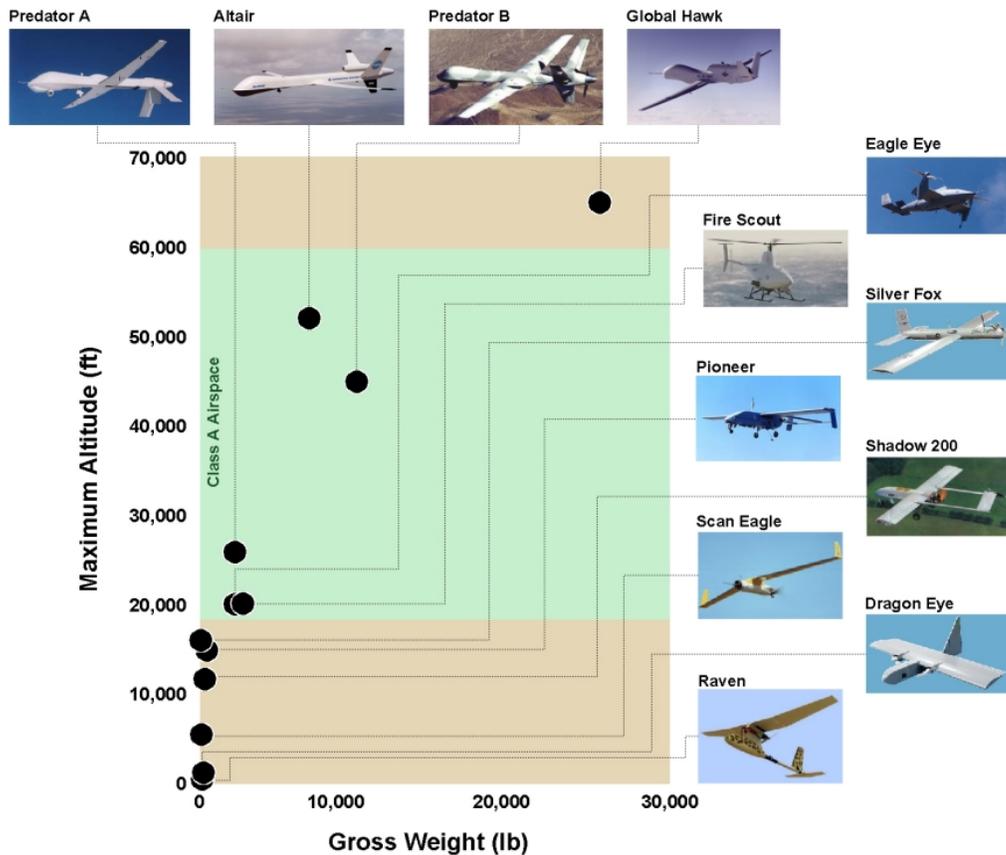


Figure 1: Current U.S. Operational UAS³

Market Trends

Almost all UAS operations and vehicles around the world today are for military purposes. The absence of standards, regulations and procedures to govern the safe integration of civil-use⁴ UAS into civilian air space are key factors limiting growth in the non-military UAS sector. In the short-term, existing military UAS manufacturers likely will dominate civil-use UAS markets if they are able to leverage their capabilities and technologies in the adaptation of existing platforms or development of new systems for civil purposes. In the long-term, however, military UAS manufacturers will likely face stiff competition from new entrants to the market.

³ “The Impact of Unmanned Aerial Vehicles on the Next Generation Air Transportation System: Preliminary Assessment”, Unmanned Aerial Vehicle National Task Force, October 22, 2004

⁴ For purposes of this paper, “civil-use” UAS is defined as non-military (government agency or private operator)

Military Markets

The U.S. Department of Defense (DOD) continues to lead the development, ownership, and operation of UAS globally. The DOD currently has more than 7,000 unmanned aircraft in its inventory, compared to fewer than 50 in 2000.⁵ The majority of these aircraft are currently being used in support of ongoing operations overseas. In particular, the use of smaller, shorter range UAS has increased dramatically. Today's operational military UAS encompass a wide range of sizes, gross weights, speeds, and operating altitudes (Figure 1). The smallest operational UAS is the four-pound Raven that flies for about one hour at 50 knots and normally below 1000 feet. The largest is the Global Hawk, which weighs 25,600 pounds, and flies at 400 knots for over 30 hours at 65,000 feet.

The Department of Defense (DOD) plans to invest billions of dollars in the development and procurement of UAS. In fiscal year 2011 the DOD requested \$6.1 billion and expects to need more than \$24 billion from 2010 through 2015 for new UAS and expanded capabilities in existing ones.⁶ Several Government Accountability Office (GAO) reports have identified issues with DOD's UAS programs, including cost increases, schedule delays, performance shortfalls and the need for personnel, facilities and communications' infrastructure to support growing UAS inventories.⁷

In recognition of the broad use of unmanned ground and maritime systems and the need to facilitate the integration among platforms as well as with manned systems, the DOD released the second edition of its integrated "Unmanned Systems Roadmap 2009-2034" (Roadmap) in March 2009.⁸ The roadmap identifies a DOD-wide vision for all unmanned systems, identifying critical capabilities, obstacles and priorities for the next 25 years. The DOD is implementing the Roadmap despite a November 2008 GAO report that identified problems in the effectiveness of DOD's management and integration efforts.⁹

The 2010 DOD Quadrennial Defense Review (QDR) and the DOD's FY 2012 Budget Request¹⁰ call for increased reliance on UAS for intelligence, surveillance, and reconnaissance (ISR) to succeed in DOD's counterinsurgency, stability, and counterterrorism operations. The FY 2012 budget includes \$4.8 billion to develop and procure UAS in three UAS categories: the Global

⁵ Unmanned Aircraft Systems: Comprehensive Planning and a Results-Oriented Training Strategy Are Needed to Support Growing Inventories GAO-10-331, March 26, 2010. Available at <http://www.gao.gov/new.items/d10331.pdf>; March 23, 2011 statement by U.S. Representative John F. Tierney on the "Rise of Drones: Unmanned Systems and the Future of War". Statement available at <https://hsdl.org/?view&doc=120460&coll=limited>.

⁶ Unmanned Aircraft Systems: Comprehensive Planning and a Results-Oriented Training Strategy Are Needed to Support Growing Inventories - GAO-10-331, March 26, 2010. Defense Acquisitions: DOD Could Achieve Greater Commonality and Efficiencies among Its *Unmanned Aircraft Systems* GAO-10-508T, March 23, 2010. Available at <http://www.gao.gov/new.items/d10508t.pdf>.

⁷ GAO-10-331; GAO-08-511; GAO-09-520.

⁸ Department of Defense (DOD) Unmanned Systems Roadmap 2009-2034. Available at <http://www.dtic.mil/cgi-bin/GetTRDoc?Location=U2&doc=GetTRDoc.pdf&AD=ADA522247>.

⁹ Unmanned Aircraft Systems: Additional Actions Needed to Improve Management and Integration of DOD Efforts to Support Warfighter Needs - GAO-09-175, November 14, 2008. Available at <http://www.gao.gov/new.items/d09175.pdf>.

¹⁰ Department of Defense FY 2012 Budget Request: <http://comptroller.defense.gov/budget.html>.

Hawk Class (RQ-4), Predator Class (MQ-1/9), and other smaller low altitude systems.¹¹ In FY 2012, the DOD aims to grow to a capacity of 65 Predator-Class Combat Air Patrols (CAPs)/orbits by the end of FY 2013.¹²

The Air Force plans to expand its Reaper/Predator UAS fleet and is developing a stealthy UAS to provide reconnaissance and surveillance support to forward deployed combat forces. The Army's FY 2012 Budget calls for expanding all classes of UAS, including accelerated procurement of the MQ-1 Grey Eagle Extended Range Multi-Purpose (ER/MP) UAS (\$659 million, 36 aircraft), RQ-7 Shadow (\$95 million) and development of a new vertical takeoff and landing UAS.¹³ The U.S. Army is also working with several companies to develop a long-endurance multi-intelligence vehicle (LEMV) that will be capable of remaining aloft for 21 days at a time.¹⁴ The Navy is introducing sea-based UAS and in March 2011 issued a broad agency announcement for the Unmanned Carrier-Launched Airborne Surveillance and Strike (UCLASS) program.¹⁵ The Navy's MQ-4C Broad Area Maritime Surveillance (BAMS UAS) program is scheduled to reach Initial Operational Capability (IOC) in 2015.¹⁶ The DOD is exploring ways to enhance the effectiveness of its fleet of ISR aircraft by developing innovative sensor technologies, support infrastructures, and operating concepts.¹⁷

Most governments around the world are seeking to integrate UAS capabilities into their defense forces, either through acquisition of foreign systems or through development of indigenous systems. Coalition forces are using UAS in Iraq and Afghanistan, as well as in security operations around the world. At least forty other countries are currently developing unmanned systems technology.¹⁸

Israeli manufacturers have influenced UAS development programs, entering into industrial partnerships, and marketing and co-production agreements around the world. Elbit Systems' Silver Arrow subsidiary is currently the Israeli Defense Force's principal supplier of UAS with the Hermes family of vehicles, and has worldwide business relationships. Israel Aircraft Industries' Malat division (IAI-Malat) has produced a broad range of UAS including the Searcher, Heron and Hunter lines.

Although many European companies are developing indigenous capabilities and technologies,

¹¹ *Ibid.*, p. 24.

¹² *Ibid.*, p. 24.

¹³ U.S. Army FY 2012 Budget Overview: http://usarmy.vo.llnwd.net/e1/rv5_downloads/misc/FY12-PBO-110210-FINAL.pdf.

¹⁴ February 2, 2011 Flight International article, "LEMV Airship Design Gets U.S. Army Approval": <http://www.flightglobal.com/articles/2011/02/02/352646/lemv-airship-design-gets-us-army-approval.html>.

¹⁵ Unmanned Carrier-Launched Airborne Surveillance and Strike Broad Agency Announcement (BAA):

https://www.fbo.gov/download/2ee/2ee91b8c57fba6c7aaa9a9b0f6f6e79a/UCLASS_BAA.pdf.

¹⁶ <http://www.navair.navy.mil/index.cfm?fuseaction=home.displayPlatform&key=F685F52A-DAB8-43F4-B604-47425A4166F1>

¹⁷ 2010 DOD Quadrennial Defense Review, p. 22. Available at http://www.defense.gov/QDR/images/QDR_as_of_12Feb10_1000.pdf.

¹⁸ March 23, 2011 statement by U.S. Representative John F. Tierney on the "Rise of Drones: Unmanned Systems and the Future of War". Statement available at <https://hsdl.org/?view&doc=120460&coll=limited>.

some have entered into joint agreements with U.S. companies to develop and/or build new and derivative aircraft. For example, European Aerospace Defense and Space (EADS) and Northrop Grumman established a joint venture to develop the Euro Hawk, a derivative of the Global Hawk.

Civil Markets

There is large potential for civil applications of UAS, ranging from surveillance and reconnaissance to scientific data gathering or delivery of services (crop dusting, telecom relays, etc.). For purposes of this paper, “civil-use” is defined as non-military UAS operations (government agency or private/commercial operators). The vast majority of civil UAS operations in the U.S. are performed by government agencies. Private/commercial UAS operations in the U.S. are currently limited to testing and demonstration.

The absence of standards, regulations and procedures to govern the safe integration of civil-use UAS into civil airspace are key factors limiting growth in the non-military UAS sector. As a result, most civil operations of UAS in 2010 were related to test or demonstration flights. According to a 2011 study by the Teal Group, world civil UAS production is forecast to make up 8.7 percent (\$296 million) of the \$3.4 billion in 2011 global production value, falling to 5.64 percent (\$498 million) of global production value (\$8.8 billion) by 2020.¹⁹

The U.S. Federal Aviation Administration (FAA) has imposed strict limitations on UAS operations in the national air space (NAS) until sufficient standards and regulations can be developed. In February 2007, the FAA published policy guidance to clarify exactly which authorities exist for UAS operations in the NAS.²⁰ At the same time the FAA continues to develop domestic certification regulations that will address all relevant technology, policy, regulatory and infrastructure issues necessary to safely integrate UAS into the NAS.

In 2009, the FAA created the Unmanned Aircraft Program Office (UAPO) and the Air Traffic Organization (ATO) UAS office to integrate UAS safely and efficiently into the NAS and coordinate all FAA certification and operational policy activities related to UAS. In October 2010, the UAPO published a Civil/Public UAS roadmap to clarify the path toward normal certification and operation of UAS in the NAS. The roadmap predicts that routine civil UAS access to the NAS will occur sometime after 2020.²¹

For public operation (U.S. government organizations), UAS certification is granted under a Certificate of Authorization (COA) or Waiver.²² For civil operation (private industry), organizations/individuals are permitted to operate UAS under the authority of a Special

¹⁹ Teal Group: 2011 World UAV Market Profile and Forecast. Executive Summary available at http://www.tealgroup.com/index.php?option=com_virtuemart&page=shop.product_details&flypage=flypage.tpl&product_id=98&Itemid=5.

²⁰ *Federal Register*: February 13, 2007 (Volume 72, Number 29), Rules and Regulations, Pages 6689-6690; available at <http://www.gpoaccess.gov/fr/retrieve.html>.

²¹ Roadmap available at <http://www.faa.gov/about/initiatives/uas/>.

²² http://www.faa.gov/aircraft/air_cert/design_approvals/uas/cert/

Airworthiness Certifications, Experimental Category (SAW-EC). Like the COA process, the SAW-EC is an exception process and requests are reviewed on a case-by-case basis. As of January 21, 2011, the FAA had 18 active certificates on 17 aircraft types.²³ In the United States, access to the NAS is predominately granted through COAs for public UAS operation. Under a COA, UAS operations are permitted only for specific times, locations and operations. The number of COAs issued by the FAA has grown significantly in recent years, reflecting growing demand by non-military and civil users. 85 COAs were issued in CY 2007, 164 in CY 2008, 146 in CY 2009, and 298 in FY 2010.²⁴ In 2010 the agency issued COA's to 95 users on 72 different aircraft types.²⁵ As of January 21, 2011, the FAA had 266 active COAs and 151 total pending COAs.²⁶

Most other countries also do not have civil certification regulations that permit the operation of non-military UAS in civil air space. However, extensive civil-use UAS operations exist in Japan, where unmanned rotorcraft are widely used in agriculture (primarily spraying). As of May 2009, there were an estimated 2,300 unmanned helicopters and over 12,000 certified UAS operators in Japan, compared to a total of 730 non-government-operated manned helicopters and 3,600 professional helicopter pilots.²⁷ Yamaha Motors Company currently supplies over 60 percent of the Japanese market for unmanned agricultural spraying applications. Yanmar Agricultural Equipment Co., Kawada Industries, Inc. and Fuji Heavy Industries share the rest of the market.²⁸ Australia also has robust civil UAS operations. The Australian Civil Aviation Safety Authority (CASA) permits public and commercial operation of UAS in its national airspace with proper approval.²⁹ Uses include advertising, aerial photography, surveying, and law enforcement. Canada³⁰ and the United Kingdom³¹ also have regulations governing civil-use UAS.

Competitors

The U.S. UAS industry is undergoing a major transition. Almost all major U.S. aerospace prime contractors are involved in UAS programs and are expected to remain working on UAS for the foreseeable future. Numerous small and mid-sized companies also entered the market in the

²³ February 4, 2011 presentation by FAA's UAS Group. Available at <http://www.ofcm.gov/uas/workshop/07%20UAS%20Briefing%20for%20Meteorology%20Miniworkshop%20V1.1.pdf>.

²⁴ FAA UAS Factsheet, December 1, 2010. Available at http://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=6287

²⁵ Ibid.

²⁶ February 4, 2011 presentation by FAA's UAS Group. Available at <http://www.ofcm.gov/uas/workshop/07%20UAS%20Briefing%20for%20Meteorology%20Miniworkshop%20V1.1.pdf>.

²⁷ UVS International 2009/2010 UAS Yearbook - UAS: The Global Perspective - 7th Edition - June 2009.

²⁸ "UAV Systems: The Global Perspective 2005", UVS International

²⁹ CASA Civil Aviation Safety Regulation 101 (CASR101) covers UAS. Available at http://www.casa.gov.au/scripts/nc.dll?WCMS:STANDARD::pc=PC_100376.

³⁰ Section 101.01 of the *Canadian Aviation Regulations*: <http://www.tc.gc.ca/eng/civilaviation/standards/general-recavi-brochures-uav-2270.htm>.

³¹ UK Civil Aviation Authority:

<http://www.caa.co.uk/application.aspx?catid=33&pagetype=65&appid=11&mode=detail&id=226>.

1990s. Some small companies failed or withdrew from the UAS market, others were acquired (part of the industry consolidation), and a few new companies entered the market. Industry consolidation is expected to continue for the next several years.

U.S. manufacturers are a mix of public and privately owned companies. Five of the twelve U.S. manufacturers of UAS that have operated in Operation Iraqi Freedom and/or with systems that have received experimental civil certification from the FAA are part of publicly traded corporations. For each of the publicly traded companies, UAS development, manufacture and operation make up a relatively small percentage of overall corporate revenues. Most privately held U.S. UAS manufacturers are not widely diversified out of this market segment, although they may produce a variety of UAS. A number of U.S. manufacturers have established partnerships with non-U.S. companies to strengthen their market presence and to supply UAS to the U.S. military. In addition, some foreign companies have established subsidiaries in the U.S.

There are a number of publicly available, authoritative studies by other federal agencies and private organizations about the military UAS manufacturing industry, which provide details about the military UAS market structure and competition. However, given the large number of uncertainties in the civil UAS market (absence of a measurable civil-use UAS market; prevalence of international partnerships to develop, manufacture and operate UAS; incomplete legal and regulatory structure to integrate UAS into the NAS), it is extremely difficult to perform an accurate and comprehensive assessment of competitors in the civil-use UAS market.

The following list of companies is intended only to provide a representative snapshot of the UAS industry through 2010. These U.S. companies manufacture UAS currently in use in Operation Iraqi Freedom (excluding very small “micro/mini” UAS) and/or have been granted experimental airworthiness certification by the FAA:

Table 2: U.S. UAS Manufacturers*

Company	Products
Aerovironment	Raven, Pointer, Dragon Eye
Aurora Flight Sciences	GE-50*
Cyber Aerospace (acquired by Vought March 2010)	CyberBug*, CyberScout
General Atomics	Predator*, Reaper, Altair, Sky Warrior*, GNAT, Mariner
Honeywell	gMAV*
Insitu (acquired by Boeing July 2008)	Scan Eagle, GeoRanger, Insight

Lockheed Martin	Desert Hawk
Northrop Grumman	Global Hawk, Fire Scout
Raytheon	Cobra*
Textron/AAI	Bell Eagle Eye*, AAI Shadow*
Telford Aviation	SkyBus 30K*

* Has received a civil experimental airworthiness certification

Outlook

In 2011, military use of UAS is expected to grow as new systems are fielded and new capabilities are tested. The U.S. military is seeking new UAS capabilities to support new war-fighting doctrines and operations. The DOD is seeking improved payload capabilities, adding the number and types of sensors available on different platforms. For example, it is pursuing new operational capabilities such as autonomous mission operations, multi-vehicle systems, aerial refueling, stealthy UAS for ISR, as well as increased modularity to enable “plug-and-play” systems and maintenance. The DOD is evaluating options for weaponized unmanned combat air vehicles (UCAV) as force multipliers for fighter and bomber aircraft. Previous year estimates of growth across all sizes and classes may be impacted by current economic conditions and DOD budget constraints. The greatest increases in 2011 will be in small UAS as more systems are deployed in active combat at the unit level.

According to a report from Market Research Media, the U.S. military UAS market is projected to grow at a CAGR of 10 percent between 2010 and 2015 and will generate \$62 billion in revenues during this period.³² Industry analysts have found a widening gap between the growing UAS fleet and UAS infrastructure development, especially in sectors such as training; service, support and maintenance; and data management. This gap creates market opportunities for UAS vendors, both large defense contractors and small technology companies.³³

U.S. federal agencies are expanding their use of non-military UAS as well. Recent examples include:

- In 2010, NASA’s Global Hawk flew missions over tropical storms and hurricanes in partnership with NOAA to collect data on severe weather formation.
- The Department of Agriculture and NASA’s Western States Fire Mission has a multi-year effort using the Ikhana Predator B for wildfire support.
- The Department of Homeland Security (DHS) continues to use its fleet of six UAS for border patrol activities.

³² Ibid.

³³ Ibid.

- The U.S. Geological Survey (USGS) has supported the U.S. Forest Service and several Department of the Interior Agencies by flying Raven UAS to monitor wildfires and support wildlife inventories
- U.S. Air Force's Global Hawks provided imagery of the damage caused by the March 2011 earthquake and tsunami in Japan
- Various law enforcement agencies will continue additional demonstration tests.

A U.S. domestic policy initiative that will affect U.S. UAS operations is the FAA's Transportation Modernization and Safety Improvement Act (H.R. 658).³⁴ Some of the UAS-related aspects of the bill include: U.S. government-industry collaboration to develop a plan to accelerate the integration of civil UAS into the NAS (the plan shall provide for the safe integration of UAS not later than September 30, 2015); FAA establishment of pilot projects in Class G³⁵ airspace for small UAS experiments and data collection by government public safety agencies; and FAA establishment of a program to integrate UAS into the NAS at not fewer than four test ranges. As of April 4, 2011, the U.S. House of Representatives and the U.S. Senate still need to resolve the differences between the two versions of the bill before it is sent to the President for signature.

The FAA has initiated development of a Special Federal Aviation Regulation (SFAR) to govern operation of small, low-flying UAS within visual line-of-sight that are used for commercial purposes. The SFAR will provide a process for small UAS to operate in the national airspace under low-risk conditions without undergoing the case-by-case approval process that is currently required. Such guidance could enable small UAS users to initiate or continue operations that do not present a safety threat to the public or to other aircraft prior to the finalization of complete certification regulations for all classes of UAS. To make recommendations on how to proceed with regulating small UAS (SUAS), the FAA chartered an Aviation Rulemaking Committee (ARC) composed of government and industry officials which submitted its recommendations in April 2009. The recommendations subdivide SUAS into five groups and provide guidance on operational capabilities and limitations, pilot-in-command (PIC) and observer training, airworthiness eligibility and certification, and other issues. The FAA's is expected to publish the proposed rule in late 2011, with a final rule expected in late 2012.

At the same time, the FAA will continue to develop standards and policies for all UAS systems, drawing on technical recommendations from the Radio Technical Commission for Aeronautics (RTCA) Special Committee-203³⁶, coordination with other civil aviation authorities directly and through the International Civil Aviation Organization (ICAO) UAS Study Group, and interagency collaboration as a member of the Department of Defense Joint Integrated Product Team (JIPT) for UAS. However, little appreciable increase in UAS operations will occur in the United States in 2011, based on the cumulative number of experimental airworthiness certifications estimated by the FAA to date.

³⁴ April 22, 2011 version of H.R. 658

³⁵ Class G (uncontrolled) airspace here refers to areas "outside of five statute miles from any airport, heliport, seaplane base or spaceport, or any location with aviation activities".

³⁶ RTCA Special Committee-203 UAS Homepage: <http://www.rtca.org/comm/Committee.cfm?id=45>

Given the rapid growth of UAS operations for governmental purposes, there appears to be tremendous potential for U.S. industry in the evolving commercial UAS sector. However, it is extremely difficult to determine actual commercial market size in light of the many regulatory and technological obstacles to be overcome before UAS can be integrated into civilian air space. Various studies have been conducted regarding the future market opportunities for civil UAS sales worldwide. Many analysts are bullish on market growth, although there is wide variance in views about actual market growth, which range from 10-15 percent per year to order of magnitude growth in civil market opportunities.

According to a 2011 study by the Teal Group, the current UAS market will more than double in the next decade: worldwide UAS Research, Development, Test & Evaluation (RDT&E) and procurement expenditures are expected to increase from \$6.0 billion in 2011 to over \$11.3 billion in 2020, totaling over \$94 billion in the next ten years³⁷ The study suggests that the U.S. will account for 77 percent of RDT&E spending on UAS technology over the next decade and 38 percent of the procurement.³⁸ The study predicts that UAS demand will be highest in the U.S., with Asia-Pacific representing the second largest market, followed closely by Europe.³⁹

The time needed to resolve UAS airspace issues will likely slow the growth of the global civil UAS market for the next several years. During this period, the civil UAS market will be concentrated around government organizations requiring military-type surveillance systems, such as coast guards, border patrol organizations and similar national security organizations. In addition, foreign and U.S. government agencies (the National Oceanographic and Atmospheric Administration (NOAA), the National Aeronautics and Space Administration (NASA) and the U.S. Geological Survey (USGS) are using UAS for scientific monitoring and data collection. Once the airspace issues are resolved, a commercial, non-governmental UAS market should slowly emerge.⁴⁰

U.S. industry sources have cited two primary export barriers to U.S. UAS exports: (1) U.S. export control policy and (2) the multilateral Missile Technology Control Regime (MTCR), a multilateral regime designed to help slow the proliferation of unmanned weapons of mass destruction systems (WMD). Under current U.S. export control policy, some UAS are subject to the International Traffic in Arms Regulations (ITAR), which authorizes the U.S. State Department to control the export and import of defense articles and defense services.⁴¹ In accordance with section 71(a) of the U.S. Arms Export Control Act (22 U.S.C. 2797), the list of items on the MTCR Annex is included on the U.S. Munitions List, thus subjecting UAS exports to licensing requirements.⁴² In August 2009, President Obama announced the Export Control

³⁷ Teal Group: 2011 World UAV Market Profile and Forecast. Executive Summary available at http://www.tealgroup.com/index.php?option=com_virtuemart&page=shop.product_details&flypage=flypage.tpl&product_id=98&Itemid=5.

³⁸ Ibid.

³⁹ Ibid.

⁴⁰ Ibid.

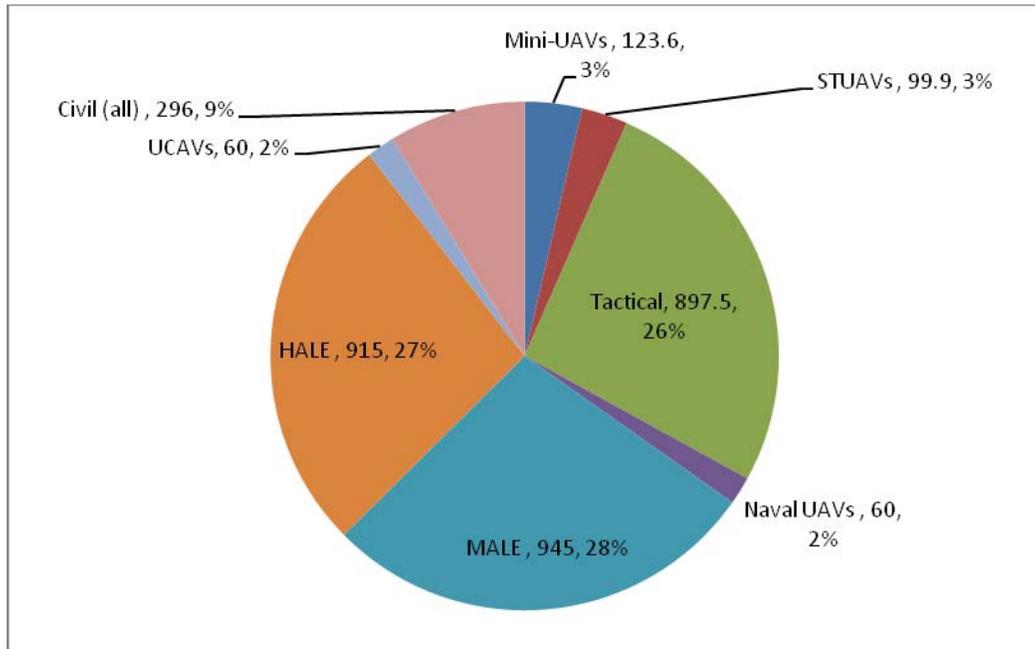
⁴¹ 22 U.S.C. 2778 of the Arms Export Control Act (AECA): http://www.pmdtc.state.gov/regulations_laws/aeca.html.

⁴² ITAR Part 121 USML:

http://www.pmdtc.state.gov/regulations_laws/documents/official_itar/ITAR_Part_121.pdf.

Reform Initiative (ECR Initiative), a broad-based interagency review of the U.S. export control system to enhance U.S. national security and strengthen the United States' ability to counter threats such as the proliferation of weapons of mass destruction.⁴³

Figure 2: 2011 World UAS Production Forecast by Type (Value, \$ Millions) - \$3.4 billion total

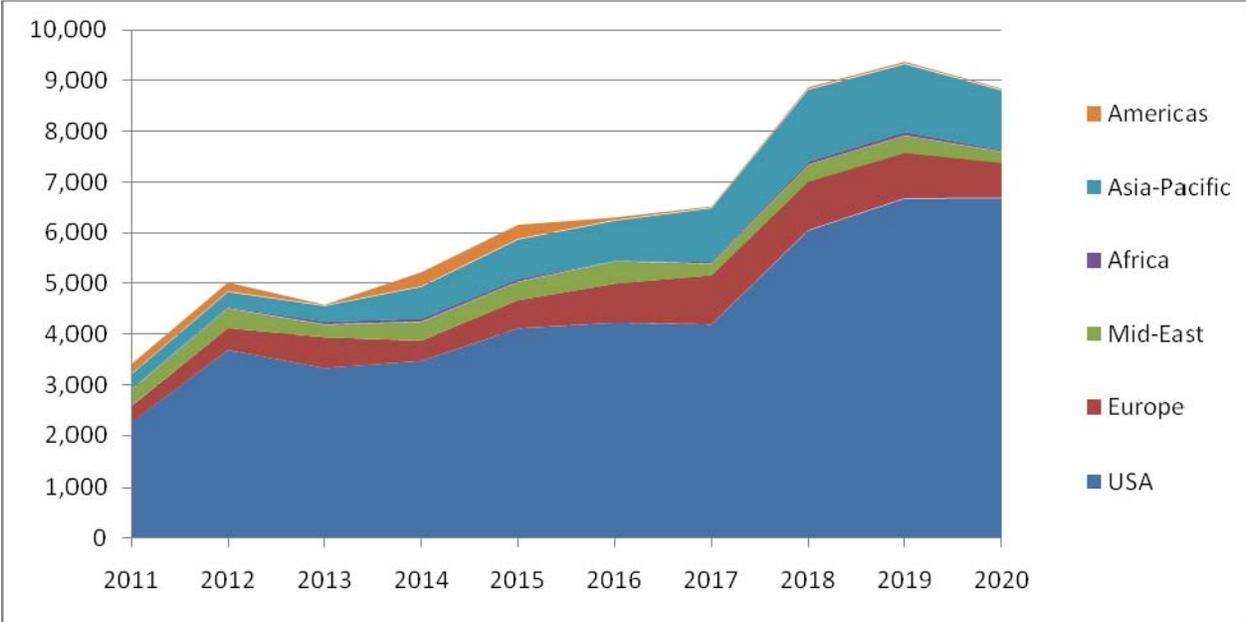


Source: Teal Group, "World UAV Systems 2011 Market Profile & Forecast"

⁴³ Export Control Reform Initiative website: <http://export.gov/ecr/index.asp>.

⁴⁴ Abbreviations: STUAV- Small Tactical UAVs; HALE – High Altitude Long Endurance; MALE – Medium Altitude Long Endurance; UCAV – Uninhabited Combat Air Vehicle.

Figure 3: World UAS Production Forecast by Region (Value, \$ Millions) - contribution of each region to total value



Source: Teal Group, "World UAV Systems 2011 Market Profile & Forecast"

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