
# Unmanned Aircraft Systems (UAS): Manufacturing Trends

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# Summary

Unmanned aircraft systems (UAS) represent a bright spot for the technology-intensive aerospace manufacturing sector, but military and civil government agencies will likely be the predominant customers for an extended period while such systems are integrated into the U.S. National Airspace System ("national airspace"). Airspace access by commercial UAS users is projected to be much slower than for governmental entities.

U.S. export control policies pose an issue for manufacturers that seek to export UAS. Some UAS are classified as weapons under the International Traffic in Arms Regulations (ITAR), and require an export license approved by the U.S. State Department. UAS are also covered by the Missile Technology Control Regime (MTCR), a voluntary arrangement among 34 member countries to restrict the proliferation of missiles or UAS capable of delivering weapons of mass destruction. Under MTCR guidelines, export of UAS carries a "strong presumption of denial" of an export license. The Aerospace Industries Association (AIA) has stated that advances in UAS technologies have resulted in the development of some systems that are not suited to weapons-of-mass-destruction (WMD) delivery. The association says the regulations will allow nonmember countries (such as Israel or China) to sell UAS with advanced capabilities.

The U.S. Department of Defense (DOD), the major user of such systems, has demonstrated the effectiveness of UAS in Iraq and Afghanistan, but continued development of new systems and capabilities depends on access to the national airspace. UAS spending has been driven primarily by military needs in Iraq, Afghanistan, and other countries where terrorist groups were or are active. Numerous forecasts project that U.S. and global UAS markets will experience strong growth during the next 10 years. A forecast of global UAS demand by the Teal Group shows worldwide annual spending on research, development, testing, and evaluation (RDT&E) and procurement rising from $6.6 billion in 2013 to $11.4 billion in 2022. Total spending for the decade is projected to amount to $89.1 billion.

U.S. aerospace and defense manufacturing firms have a significant lead in military UAS, but Israel is also a strong competitor. Europe, China, and Japan are also expected to press ahead with significant UAS development programs—an area of aerospace deemed critical in terms of defense and industrial capabilities. European manufacturers in particular appear to be focused on potential sales to nonmilitary government and commercial customers.

Many of the U.S. firms that are engaged in UAS research and development and production are privately held companies or small divisions of much larger publicly traded companies. The lack of data on companies, combined with a very limited market for public (i.e., governmental) and commercial users of UAS, makes analysis difficult and speculative. Although the commercial market for UAS is protected to grow, it is forecast to remain below 2% of total global production through 2022.

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# The Market for Unmanned Aircraft Systems in 2013

Unmanned aircraft systems (UAS)[1] represent a bright spot for the technology-intensive aerospace manufacturing sector, but military and civil government agencies will likely be the predominant customers for an extended period while such systems are integrated into the U.S. National Airspace System ("national airspace"). Airspace access by commercial UAS users is projected to be much slower than for governmental entities.[2] The U.S. Department of Defense (DOD), the major user of such systems, has demonstrated their effectiveness in Iraq and Afghanistan, but continued development of new systems and capabilities depends on access to the national airspace. DOD has made such access a priority, and the 112th Congress directed that federal agencies collaborate in accelerating the integration of UAS into the national airspace.[3] Other nations also confront issues related to airspace access, and commonality of standards has been raised as an issue for international discussion.

The development and manufacture of UAS for use by public entities (i.e., federal, state, or local governments, and by public universities) and commercial[4] users are expected to grow over the next few years, but numerous regulatory and technical issues remain to be resolved before government agencies or commercial operators can begin routine flight operations in the national airspace. Concerns about the safety of unmanned aircraft and UAS operations in congested airspace and over populated areas may slow industry growth. A major issue for all UAV operations, whether in crowded commercial airspace or contested battlefield airspace, is the development of sense, detect, and avoid technologies that will provide the same level of collision avoidance as manned aircraft.[5] Privacy concerns have also been raised about the widespread use of UAV by government and business.[6]

[1] Unmanned aircraft systems (UAS) include one or more unmanned aircraft, as well as supporting ground, air, and communications infrastructure. Unmanned aircraft are also referred to as drones, unmanned aerial vehicles (UAV), and unmanned aircraft. The Federal Aviation Administration (FAA) and the Department of Defense (DOD) have adopted *unmanned aircraft system (UAS)* and *unmanned aircraft (UA)* as standard terminology. See FAA, "Unmanned Aircraft Systems Operations in the U. S. National Airspace System—Interim Operational Approval Guidance," Memorandum, AFS-400 UAS Policy 05-01, September 16, 2005, and Department of Defense, *DOD Dictionary of Military and Associated Terms*, Joint Publication 1-02, November 8, 2010, as amended through November 15, 2012.

[2] Teal Group, *World Unmanned Aerial Vehicle Systems: Market Profile and Forecast, 2012 Edition*, Executive Summary, p. 2.

[3] The National Defense Authorization Act for Fiscal Year 2013 (§1052 of H.R. 4310; P.L. 112-239) and the FAA Modernization and Reform Act of 2012 (H.R. 658; P.L. 112-95; 126 Stat. 11). The FAA reauthorization act requires FAA to develop a plan to accelerate the safe integration of civil unmanned aircraft systems into the national airspace system ("national airspace") no later than September 30, 2015 (Sec. 332). The law also requires FAA to designate and establish six test ranges as part of the process of integrating UAS into the national airspace, and also allows government public safety agencies to operate unmanned aircraft weighing 4.4 pounds or less, subject to various restrictions. Federal Aviation Administration, "Fact Sheet—Unmanned Aircraft Systems (UAS)," December 14, 2012, http://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=14153.

[4] FAA defines UA as "aircraft" under 14 C.F.R. 1.1 and uses the term "civil aircraft" to denote a commercial or private aircraft. Elsewhere (e.g., space), FAA uses the term "civil" to describe nonmilitary governmental activities.

[5] See CRS Report R42718, *Pilotless Drones: Background and Considerations for Congress Regarding Unmanned Aircraft Operations in the National Airspace System*, by Bart Elias; *Inside the Pentagon*, "Air Force Seeks Industry Input For Airborne, Sense-And-Avoid Technology," July 19, 2012.

[6] For a discussion of these issues, see CRS Report R42701, *Drones in Domestic Surveillance Operations: Fourth Amendment Implications and Legislative Responses*, by Richard M. Thompson II.

## The Department of Defense Remains the Key Driver of UAS[7]

Sales of UAS equipment have been driven primarily by military needs in Iraq, Afghanistan, and other countries where terrorist groups were or are active. The scheduled withdrawal of most troops from Afghanistan by 2014 has reportedly led to an intensification of UAS use to protect remaining forces.[8] In April 2012, DOD reported that it had more than 7,100 UAS in its inventory.[9] In its *Unmanned Systems Integrated Roadmap FY2011-2036*, DOD outlined its efforts to consolidate and streamline the UAS fleets it had acquired quickly as wartime needs rose. The report emphasized that in a highly constrained fiscal environment, "unmanned systems [must] be affordable at the outset and not experience significant cost growth in their development and production evolution."[10] The President's FY2013 budget requested $3.8 billion for UAS acquisition, down from $4.8 billion in FY2012.[11] A June 2011 analysis by the Congressional Budget Office (CBO) examined DOD UAS acquisition costs based on DOD's FY2012 budget request, and reported procurement costs for the 2011-2020 period would amount to nearly $37 billion.[12]

## Forecasts for the UAS Market Are Strong

Numerous forecasts project U.S. and global UAS markets will experience strong growth during the next 10 years.[13] The Teal Group's forecast of UAS demand shows worldwide annual spending on research, development, testing, and evaluation (RDT&E) and procurement rising from $6.6 billion in 2013 to $11.4 billion in 2022. Total worldwide spending for the period is forecast to amount to $89.1 billion. Throughout the forecast period, Teal expects the U.S. share of RDT&E to account for 62% of worldwide spending, while U.S. procurement will amount to 55% of worldwide spending. According to Teal, UAS procurement will mirror demand for high-tech arms procurement in the Asia-Pacific region and in Europe[14] (see **Figure 1**.)

[7] See CRS Report R42136, *U.S. Unmanned Aerial Systems*, by Jeremiah Gertler.

[8] Graham Warwick and Larry Dickerson, "Cooling Down? Export and civil unmanned aircraft demand will grow, but mainstay military markets may slow," *Aviation Week & Space Technology*, December 31, 2012, p. 80.

[9] DOD, *Report to Congress on Future Unmanned Aircraft Systems Training, Operations, and Sustainability*, April 2012, p. 2.

[10] DOD, *The Unmanned Systems Integrated Roadmap FY2011-2036*, Reference No. 11-S-3613, p. 15.

[11] Operations and maintenance costs are not included. Department of Defense, Fiscal Year 2013 Budget Request, February 2012.

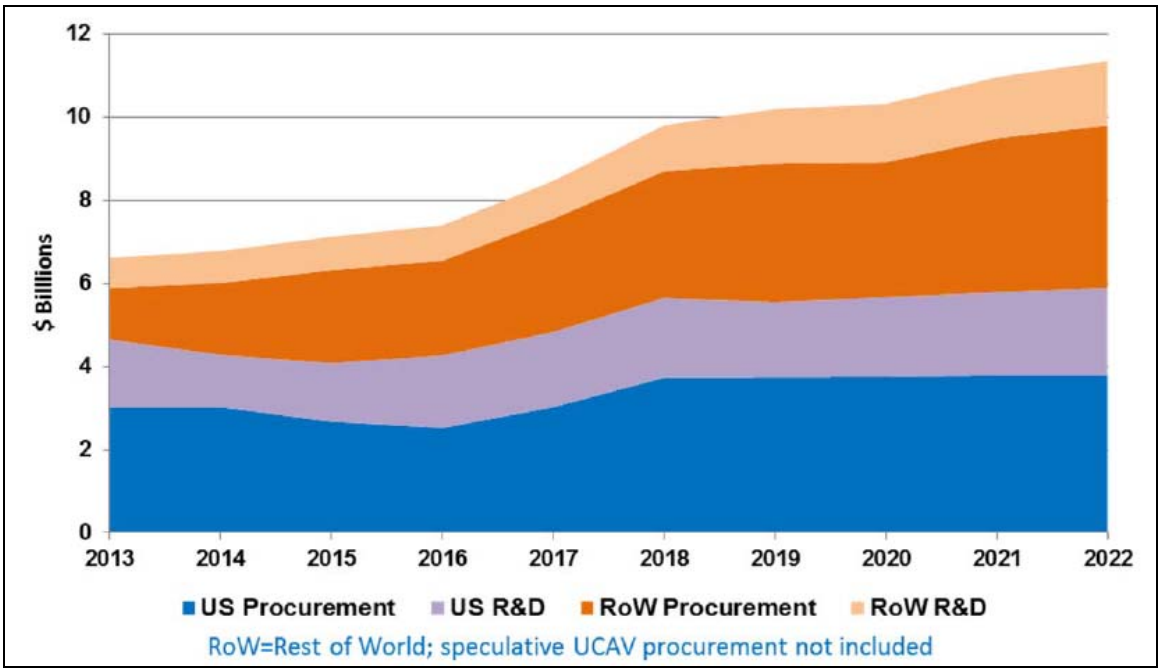
[12] Congressional Budget Office (CBO), *Policy Options for Unmanned Aircraft Systems*, June 2011, Summary Table 1, p. IX. CBO's analysis of "acquisition cost includes the cost of procuring air vehicles, sensors, and ground stations, plus the cost for research, development, test, and evaluation. The services' cost data have been adjusted using CBO's projection of inflation and rounded to the nearest $10 million."

[13] See Teal Group, *World Unmanned Aerial Vehicle Systems: Market Profile and Forecast, 2012 Edition*; the several forecasts by Research and Markets; Forecast International also publishes, *Unmanned Aerial Vehicle Manufacturing in the U.S., 2012*; Forecast International, *UAS Market Heading for New Heights*, September 25, 2012 (summarized in the December 31, 2012, edition of *Aviation Week and Space Technology*); and publications by Frost & Sullivan.

[14] Teal Group, *World Unmanned Aerial Vehicle Systems 2012*, "Executive Overview," pp. 1-2.

**Figure 1. World UAV Budget Forecast**

R&D and Procurement




**Source:** Teal Group, *World UAV Systems 2012: Market Profile and Forecast.*

**Notes:** The forecast is for military UAS. UCAV is the acronym for Unmanned Combat Aerial Vehicle, an armed UAS.

U.S. aerospace and defense manufacturing firms have a significant lead in military UAS, but Israel is also a strong competitor. The European Commission, in a recent report, expressed concern about the potential consequences should Europe not compete for the UAS market:

> [UAS] technologies are a source of important spin-off to civil aviation and a key element of the future aeronautics sector. Presently, the U.S. and Israel dominate the sector although also other non-European countries show great potential to becoming strong competitors. The European aeronautics industry is still lagging behind and must quickly catch up to be able to compete on this global emerging market.[15]

Various analysts suggest that Europe, China, and Japan will press ahead with significant UAS development programs. Japan, for example, has already addressed safety and airspace regulatory issues, allowing civilian use of unmanned aircraft for certain applications, such as aerial spraying of pesticides. The Teal Group expects that investments by China and Japan could be larger than its forecast suggests, because less is known about those countries' intentions and programs. Forecast International projects that, while Europe will account for almost 15% of worldwide UAS procurement, European companies will produce only 3.9% of global production value during the next decade, slightly more than the 3.7% share that Israel is expected to claim.[16]

[15] European Commission, *Towards a European strategy for the development of civil applications of Remotely Piloted Aircraft Systems (RPAS)*, Commission Staff Working Document, SWD(2012) 259 final, Brussels, September 9, 2012, p. 4.

[16] Graham Warwick and Larry Dickerson, "Cooling Down? Export and civil unmanned aircraft demand will grow, but (continued...)

## U.S. Manufacturers of UAS

A number of U.S. firms currently manufacture UAS for military and civil government operations. Depending on the mission, unmanned aircraft are equipped with payloads that typically provide multiple capabilities, which usually include reconnaissance (including surveillance and intelligence gathering) and may also include attack capabilities. All UAS require a ground control component and a communications link to the unmanned aircraft. According to Forecast International, unmanned air vehicles will account for 46% of UAS spending, payloads for 38%, and ground control equipment for 16% during the next decade. U.S. manufacturers with the largest share of the global UAS market include General Atomics (20.4%), Northrop Grumman (18.9%), Boeing (1.5%), and AAI (1.2%).[17] The Association for Unmanned Vehicle Systems International (AUVSI), an advocacy organization that promotes unmanned and robotic systems, had more than 500 corporate members in 2011, representing a significant number of U.S. companies with a stake in UAS manufacturing activities.[18] The rapid buildup of the current UAS fleet is creating additional demand for support infrastructure, including "training; service, support and maintenance; and data management."[19]

The International Trade Administration (ITA) of the Department of Commerce notes a number of practical difficulties in analyzing the civil and commercial UAS market:

> ... 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 national airspace), it is extremely difficult to perform an accurate and comprehensive assessment of competitors in the civil-use UAS market.[20]

Although the commercial market for UAS is projected to grow, it is forecast to remain below 2% of total global production through 2022.[21] As of the end of November 2012, FAA had approved 345 Certificates of Waiver or Authorization (COA) to public entities for the operation of UAS in U.S. civil airspace, mainly for safety and security activities.[22] However, as safety challenges are addressed and approvals are granted to public and commercial users to enter the national airspace, the domestic market is expected to expand rapidly, as the number of potential uses for UAS is quite large (see **Table 1**).

(...continued)

mainstay military markets may slow," *Aviation Week & Space Technology*, December 31, 2012, p. 84.

[17] Ibid.

[18] Association for Unmanned Vehicle Systems International (AUVSI), *2011 Annual Report*, p. 3.

[19] U.S. Department of Commerce, International Trade Administration (ITA), "Unmanned Aircraft Systems (UAS)," *Flight Plan 2011*, March 2011, p. 8.

[20] ITA, "Unmanned Aircraft Systems (UAS)," *Flight Plan 2011*, March 2011, p. 7.

[21] Graham Warwick and Larry Dickerson, "Cooling Down? Export and civil unmanned aircraft demand will grow, but mainstay military markets may slow," *Aviation Week & Space Technology*, December 31, 2012, p. 84.

[22] FAA, *Fact Sheet—Unmanned Aircraft Systems (UAS)*, December 14, 2012. http://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=14153.

**Table 1. Nonmilitary UAS Applications**

| | |
|---|---|
| Border surveillance | Pipe/power line surveillance |
| Suspect tracking | Agricultural applications |
| Traffic monitoring | Communications/broadcast |
| Disaster response/relief | Movie production |
| Damage assessment | Aerial news coverage |
| Atmospheric/weather research | Mail/freight transport |
| Critical infrastructure monitoring | Flood mapping |
| Damage surveying | Real estate mapping |
| Aerial photography | Mining |
| Wildlife monitoring | Sporting events coverage |

**Source:** Association for Unmanned Vehicle Systems International (AUVSI), *Unmanned Aircraft System Integration into the United States National Airspace System: An Assessment of the Impact on Job Creation in the U.S. Aerospace Industry*, 2010, p. 8.

Beyond the issues related to safe operation of UAS within the national airspace, several other issues may limit the growth of the UAS market and export opportunities for U.S. manufacturers. These include U.S. export control policies, which classify some UAS as weapons and other protected military technologies under the International Traffic in Arms Regulations (ITAR). Under ITAR, some UAS are covered under the U.S. Munitions List (USML), and require an export license approved by the U.S. State Department. UAS are also covered by the Missile Technology Control Regime (MTCR), a voluntary arrangement among 34 member countries to restrict the proliferation of missiles capable of delivering nuclear weapons and chemical and biological weapons, and to prevent terrorists from acquiring missiles (including UAS) capable of delivering weapons of mass destruction. The guidelines of the MTCR carry a "strong presumption of denial" for export of UAS. The Aerospace Industries Association (AIA) has stated that advances in UAS technologies have resulted in the development of some systems that are not suited to weapons-of-mass-destruction (WMD) delivery, yet such systems remain covered by the MTCR.[23] Other challenges that may confront manufacturers, UAS customers, and policy makers include the lack of accepted agreements among nations regarding certification of UAS and UAS manufacturers, and a lack of agreement and harmonization addressing radiofrequency spectrum needed to support the wide demand for UAS applications.

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[23] U.S. Department of State, Directorate of Defense Trade Controls, *Consolidated ITAR*, Updated January 16, 2013, http://www.pmddtc.state.gov/regulations_laws/itar_consolidated.html. Aerospace Industries Association, "Establishing More Appropriate Treatment of UAS Technology under the Missile Technology Control Regime," 2009.