UAV Roundup 2013

Despite tight defense budgets, worldwide demand for UAVs is projected to increase. Military leaders say the growing capabilities of unmanned aircraft will revolutionize the conduct of warfare. As these systems become affordable, they could make some poorer nations and nonstate groups more dangerous as well. In the civil sector, applications also are proliferating, privacy concerns notwithstanding. With the opening of controlled airspace to UAVs, the commercial market could soon dwarf military demand.

by J.R. Wilson
Contributing writer

For UAVs, the road to success has been long and uneven, leading a long-time aerospace executive to label them the 'vampire' technology—rising up one day, only to be killed the next, then revived for a repeat cycle a few years later.

U.S. and Israeli military leaders began serious studies into UAVs in the early 1960s. The USAF and Navy introduced highly classified models into combat over Vietnam.

Development of advanced UAVs continued through the 1990s, leading to their widespread use as U.S. forces moved into Afghanistan and Iraq after September 11, 2001. Then, UAV technologies took a major leap forward with the introduction of MQ-1 Predators armed with Hellfire missiles. Since then, UAVs have flown thousands of missions. Both military and civilian UAVs are in use by almost every country, including nearly 60 with their own manufacturing capability.

Unprecedented growth

UAVs have broken out of their 'vampire cycle.' The withdrawal of U.S. and coalition combat forces from Iraq and the ongoing drawdown in Afghanistan—combined with tight global defense budgets—might seem prelude to a decreased demand for UAVs; yet just the opposite is true.

The *Aerospace America* Global UAV Roundup for 2011 listed 44 nations and 226 manufacturers developing and producing some 675 aircraft—194 of them in the U.S. This year, it contains 57 countries and 270 companies responsible for more than 960 distinct UAVs—144 of them in the U.S. In all three categories, numbers have increased—20% for companies, 30% for countries, and 40% for aircraft.

Some lists claim over 400 manufacturers, but many of those, although included in the 2011 roundup, are missing from the new one. Many were part of buyouts or mergers; others went out of business, some because of their countries' economies. A few were even seized by authorities who charged their owners with fraud, a not-uncommon event in any booming industry.

The rapid change in this sector makes exact counts impossible. For example, as we write this, Germany has canceled the EuroHawk, and the founder of Tasuma in the U.K. announced that he was liquidating his company.

Frost & Sullivan's latest global military UAV market analysis predicted total sector sales between 2011 and 2020 will reach

MQ-8B Navy Fire Scout—U.S.

$61.37 billion—$7.31 billion in 2020 alone, an increase of more than 60% from 2010.

The U.S. will remain the largest producer and operator of UAVs throughout this decade, accounting for about 45% of the global market. Israel is the world's second largest UAV producer—and the largest exporter, selling systems to some 49 countries, with fewer use restrictions than the U.S. places on its customers.

Given U.S. leadership in this industry, significant changes in the country's defense spending also will impact the global market, both military and civilian.

"The U.S. will reduce its spending on UAS as it is adequately equipped to meet its needs. Although the country has plans to increase its inventory by more than 35% over the next 10 years, market revenues are expected to decline at least until 2020; the U.S. military UAS space is undergoing a transition from procurement to sustainment, with most future procurements likely to be limited to upgrades," Frost & Sullivan predicts.

For nations scrambling to create their own UAV fleets, the emphasis is on developing indigenous manufacturing capabilities, a trend likely to continue.

In May the National Defense Industrial Association reported that there are about 4,000 UAVs operating worldwide, the result of double-digit annual growth in demand. Most are small ISR (intelligence, surveillance, and reconnaissance) platforms, but the past five years have also seen growth in civilian applications (primarily agriculture).

Anticipated FAA regulations granting UAVs permission to fly in controlled National Air Space, along with similar measures in Europe and Asia, will provide the foundation for civilian market growth that will dwarf military demand.

The military future

The current upsurge in demand for UAVs began with the success of the rudimentary Pioneer in Desert Storm. Improvements in computing technology, communications, and GPS navigation led to the 'decade of the robot,' launched by post-9/11 U.S. combat operations in Afghanistan and Iraq. The use of the Hellfire missiles on the Predator marked a quantum leap for UAS, providing not only persistent ISR but also a developing persistent strike capability.

Lethal UAVs also evolved into personal attack systems like the Switchblade mini-UAV (MUAV) and, though still in development, bird-like and even insect-like flap-

ping-wing reconnaissance and situational awareness micro-UAVs (MAVs).

Northrop Grumman's X-47B UCAS-D—about two-thirds the size of a V-22 Osprey—in May became the first UAV to take off successfully from a modern aircraft carrier. The U.S., Europe, Russia, China, and India are leading proponents in the development of UCAVs, including what is termed a sixth-generation optionally piloted stealth fighter. The potential use of UCAVs in combat has led some to predict that the fifth-generation F-35 may be the last manned-only fighter built by the U.S. However, the first step is expected to be an integration of manned and unmanned aircraft, flying joint missions with the F-35 pilot controlling one or more UCAVs in a coordinated strike.

Venturer—Canada

Because UCAVs have far greater range than any manned fighter and can perform high-speed maneuvers impossible for a pilot, that advance would be the next major change in air warfare, following stealth and supersonic flight. A complete conversion to an unmanned fleet, which some UAV experts believe could become a reality before midcentury, would forever change the shape of not only air combat, but warfare itself.

At the other end of the spectrum, advanced batteries, electric power systems, and miniaturized computing will change the nature of ground combat. That will include a wider variety of MAVs, as well as new 'nano-UAVs' such as swarming intelligent robot 'flies,' with enhanced ability to enter buildings and perform stealthy 'perch-and-stare' ISR missions.

Although much of the capability for creating such top-of-the-line aircraft has been developed by the world's technology superpowers, it also relies on commercially developed technologies, especially in onboard computing. Thus, while a true sixth-generation UCAV likely will remain in the fleets of fewer than a dozen nations during most of this century, the types of UAVs used by the U.S. and its allies in Southwest Asia will become common in the inventories of nearly all nations—and of nonstate groups such as al-Qaeda as well.

Civilian UAVs and privacy concerns

"As commercial mobile robot use continues to grow, defense spending will increase as commercial systems drive capability, reliability, and price points. Specifically for UAS, as legislation barriers gain definition over the next several years, commercial spending will exceed defense spending," Derrick Maple, principal analyst at IHS Industry Research and Analysis, predicts. "Countries that delay airspace integration will lag in technology development, manufacturing, job development, and economic stimulus and will have to rely on imports."

UAVs already are making their way into civilian applications. Initially, these are low-level law enforcement and environmental monitoring efforts far from populated areas. However, generally small platforms operating in uncontrolled Class G airspace—up to 1,200 ft above ground level—have become increasingly common at universities. Demand also is growing for UAV use in monitoring crops, wildlife, forest fires, and traffic, as well as remote-area delivery of medicine, aerial news and sports photography, TV and movie production, and more.

All this has placed increasing pressure on the FAA and others to approve the use of UAVs in civilian airspace. It has also led legislators to create laws regulating both civilian use of UAVs and the extent to which they can be used by government.

While only a handful of UAVs were aimed at the civilian market in 2011, many offered today are either dual-purposed for both military and civilian applications or intended for commercial, academic, law enforcement, and even personal use.

This year the FAA forecast that some 7,500 commercial small UAVs could be flying in the U.S. within five years. While the media have focused on law enforcement demand, a March AUVSI study predicted that "the agriculture market will be at least 10 times the public safety market."

Key to obtaining approval from regulatory agencies is a proven 'sense-and-avoid' capability to prevent collisions with other aircraft. Although civilian R&D is under way, that technology, too, may come from the military, a response to pilots who faced thousands of UAVs operating in Iraq and Afghanistan.

The most vocal concerns about UAV use involve privacy. Legislatures in 33 states have introduced bills to restrict UAV use within their borders, and both parties in Congress have voiced support for similar federal legislation. In Europe, government hearings and similar studies on privacy issues also are under way.

"We urgently need greater clarity and transparency about when and how these tools are deployed," says Eric King of Privacy International. "Not too long ago, this was the stuff of science fiction, but flying robotic devices equipped with facial recognition technology and mobile phone interception kits are increasingly commonplace.

"However, the secretive way in which surveillance drones have been put into operation—and the failure of the police to recognize and address the human rights issues involved—has created a huge potential for abuse."

UAV opponents face a strong economic argument. A recent AUVSI report predicts that opening civil airspace to UAVs will create up to 100,000 new jobs in the next decade or so, add as much as $100 billion to the nation's ailing economy, enhance public safety, and enable more productive agriculture, resulting in lower food costs.

"The economic benefits to the country are enormous," the report said. "States that create favorable regulatory and business environments for the industry and the technology will likely siphon jobs away from states that do not."

U.S.

The future development and use of military UAVs offer great opportunities to U.S. industry and defense, but not without risk.

In 2012, a Chief of Naval Operations Strategic Studies Group tasked with generating innovative concepts for the use of unmanned systems in all domains, issued a report entitled "Way Ahead Plan: The Unmanned Opportunity."

"Incremental projections of today's successes do not look sufficiently far into the future," the report warned. "A mismatch between future capabilities and challenges represents risk to both the Navy and the nation….Ad hoc procurement of more unmanned vehicles, devoid of an overall concept of their use in the context of the entire naval force and the uncertain threat environment, will increase that risk."

Jago—U.S.

With implications for the other services as well, the report said the Navy must merge manned and unmanned force structure "in a cohesive and seamless fashion" if it is to meet the dynamic range of emerging challenges. To that end, it proposed an "Over-arching Concept" for UAVs.

"The Navy must adapt to evolving mission sets. Maximizing naval mission effectiveness will require integration of manned and unmanned entities in all domains (land, sea, air, space, and cyberspace). This

Penguin B—U.S.

integration will also provide new opportunities for mission accomplishment that will revolutionize concepts of operations and related doctrine—and may render some current missions, systems, and approaches obsolete," said the report. "Integrated and netted manned/unmanned force structure will be a force multiplier."

Stories of armed Predators and Reapers carrying out strikes in Afghanistan and Pakistan have made these aircraft the primary image of U.S. UAVs. In truth, both the platforms and the technologies they use will soon be replaced, not only by larger, more versatile, and more lethal UCAVs, but also by MUAVs such as Switchblade and even swarms of robotic flies.

As the rest of the world struggles to catch up to and even improve on current U.S. platforms and capabilities, DARPA, AFRL, NRL, and industry are pushing both to the next level.

Israel and the Middle East

Israel, needing to maintain a high level of ISR along its borders and even over the sometimes hostile states that surround it, was the first to create a modern UAV. It has remained a design and technology leader, often working with U.S. and European companies to develop new platforms and capabilities.

Second only to the U.S. in the production—and, some argue, sophistication—of UAVs, Israel also has become the world's number one exporter of unmanned systems, including to some Islamic states, such as Turkey and Azerbaijan. Since 2005, Israeli UAV exports have totaled $4.6 billion, jumping from a nominal $150 million in 2008 to a record $979 million in 2010. Recently, sales have trended the other way, down to $627 million in 2011 and only $260 million in 2012.

Anka—Turkey

Those sales are subject to the often volatile politics of Israel's customers. Turkey, for example, has grounded all of its Israeli-built UAVs to focus on domestic platforms in what is generally seen as an effort to shore up Turkish standing in the Muslim world. And in April, Israel's largest customer, India—to which it has sold nearly $1-billion worth of Heron UAVs—announced it was rejecting a proposed joint UAV development program, reportedly worth several hundred million dollars, to focus on purely domestic projects.

In a rare interview with the Israeli daily *Haaretz*, army reserve Brig. Gen. Ophir Shoham, head of the Defense Ministry's R&D division, predicted that demand for Israel's advanced UAVs will remain high, especially in a period of austere budgets. This is because it is cheaper to buy and operate a top-of-the-line UAV than to train a pilot and acquire and maintain his aircraft.

"In recent years, there have been more pilotless sorties than piloted ones in the Israeli Air Force," he said. "Within a few years, there will be a number of operational missions of a known character that we will be able to carry out with a small number of unmanned devices. That's the direction we are taking."

Others in the region have had a hard time developing domestic UAVs with even a fraction of the reliability or capability of Israeli, U.S., or European systems. Most rely on platforms purchased from abroad.

Adcom in the UAE has been among the most prolific manufacturers, with a wide range of UAVs bearing the name Yabhon, though they have little else in common. The company's most recent program—the United 40—is aimed at the international market for medium-altitude, long-range UAVs, on which Turkey also has designs. Through domestic production and multiple purchases from almost every major manufacturing nation, the UAE also has become the largest UAV operator in the Arab world, with possibly the largest fleet of small unmanned helicopters in the world.

According to officials of the 2013 International Defense Exposition (IDEX) in Abu Dhabi, the Middle East market should equal $1 billion through 2021. For the first time, IDEX dedicated an entire exhibition hall to unmanned systems during the show.

While Israel will continue to dominate UAV production in the region, the fastest growing user nations—Saudi Arabia, Egypt, Iraq, and the UAE—are not likely to be cus-

Camcopter S-100—Austria

tomers. Nor is one of the most enthusiastic users of combat UAVs—the Iranian-backed, Lebanon-based terrorist organization Hezbollah, which has sent numerous UAVs into Israeli airspace in recent months.

Europe

While nearly every European nation is working hard to develop both national and EU development and manufacturing capabilities for leading-edge UAVs, NATO—with 26 of those countries as members—generally reflects the views of each. That is, of course, strongly influenced by what happens in the U.S.

"Over the next five years, NATO nations (especially the U.S.) will considerably reduce their investment in defense and security UAVs, while the non-NATO world will move into those military and police UAVs in a relatively big way," the Market Intel Group predicted in its report, "Unmanned Aerial Vehicles for Defense and Security: Technology & Markets Forecast—2013-2021," issued in April.

"The U.S. DOD is changing its focus from counterinsurgency to a more traditional conflict against a near-peer. That move will reduce the need for expensive UAVs, but will increase the need for fast, stealthy, survivable UAVs."

Military UAV growth in Europe, from domestic production as well as purchases and leases from the U.S. and Israel, has been substantial. However, significant gaps remain in future defense requirements. Highly capable high-altitude/long-endurance (HALE) UAVs are beyond the budgets or technological capability of many nations, while more affordable medium-altitude/long-endurance (MALE) platforms lack some of the capabilities being sought. Thus there is intense competition to develop UAVs that fall somewhere between MALE and HALE.

Europe also is working hard to develop its own UCAVs, from the multinational nEURON to the British Taranis, EADS Barracuda, and BAE Systems Corax.

Joint efforts in Europe include working with regulatory agencies to enable UAV flights in civilian airspace (taking a lead over the U.S.), joint venture development of new technologies and platforms, and expanded use of UAVs for border and coastal patrol and homeland security.

One such effort is PERSEUS (protection of European seas and borders through the intelligent use of surveillance), a consortium of 29 companies and government agencies from 12 European nations. Approved by the EC in March 2010 and launched in 2011, the four-year project's main objective is to integrate existing systems with new ISR technologies (especially UAVs) to build and evaluate the European Common Situational Information Picture.

Skeldar—Sweden

RV-VTOL25—Italy

Europe also has seen faster implementation of nonmilitary UAVs, including their use in the security system for the 2012 Summer Olympics in London. With national civil aviation authorities working closely with their EU counterpart, Europe expects to see civil airspace opened to UAVs by 2016. While that is a year later than the target set by the FAA for the U.S., European officials have expressed doubt the U.S. goal is attainable.

In reality, civil UAVs already are becoming a common sight in many EU nations, especially the U.K. and France. The U.K. has given more than 130 private firms and government agencies permission to fly through civilian airspace, while France has granted limited approval for homeland security-related operations.

China and Pacific Asia

As China continues to expand its military capabilities as a regional superpower, more focused on India and Japan than the U.S. (which it would prefer to simply stalemate), it has become the world leader in robotics. Industrial robots are the greatest example of this, with more than 32,000 expected to be in service by 2014.

Pterodactyl—China

In addition, China has announced plans to launch patrol and coastal surveillance UAVs in 11 provinces, while the People's Liberation Army (PLA) has begun fielding some 100 unmanned VTOLs.

"China has ramped up unmanned systems development faster than any other nation and threatens to surpass the West in technology and capability," says IHS's Maple. "China has been operating UAVs for information security missions for some years now. The future holds more armed capability and export potential."

In March, the Project 2049 Institute, a Washington, D.C.-based think tank with an Asian focus, issued a report noting the PLA's growing emphasis on becoming a leading power in unmanned aviation.

"UAV systems may emerge as the critical enabler for PLA long-range precision strike missions within a 3,000-km radius of Chinese shores. Emphasis on reducing the radar cross-section of new UAV designs indicates an intent to survive in contested or denied airspace," the institute noted. "The ultimate goal of combined UAV and missile campaigns would be to penetrate otherwise robust defense networks through tightly coordinated operations planned to optimize the probability of overwhelming targets."

Despite repeated exhibits of seemingly advanced UAVs at various shows in recent years, the actual level of Chinese technology is unknown. Most experts, however, believe China will continue to lag behind in UAV development for many years.

While no other Asia-Pacific nation has the funding China can bring to UAVs, nearly all are pushing ahead with as much speed and advanced technology insertion as possible. Leading the way are Japan, South Korea, Malaysia, Singapore, Taiwan, and Indonesia. Their research, procurement, and, where possible, domestic production will continue to grow in the foreseeable future.

Asia also is a major growth market for civilian UAVs. In many cases, those nations are not as restrictive in unmanned flight through civil air space as North America or Europe, which could make them the opening front in the coming civil UAV market explosion. Japan, for example, has used UAVs to assist its aging population of farmers for more than 15 years. And Australia has long permitted the use of UAVs for real estate inspections. In addition to increasing requirements in both nations for military UAVs, their civilian markets are expected to continue growing.

Eleron 3sv—Russia

Russia

A spacefaring nuclear power that has sold fighters and other military systems worldwide, Russia has been unusually behind in developing advanced UAVs. In recent years, Russian officials have said that some $172 million spent to develop indigenous UAVs has had unsuccessful results, failing to meet speed, altitude, and other requirements. Until those problems can be resolved, Russia's military is relying heavily on UAVs purchased from Israel.

Russia's breakthrough program appears to be a classified UAV inadvertently revealed in February during a photo opportunity for Defense Minister Sergei Shoigu. The picture showed a model of the Tranzas/Sokol Altius MALE UAV, which officials have promised will be ready in 2014.

It is part of a $13-billion multiyear effort to develop a full line of military UAVs, from ISR to strike, through the end of the decade. The plan, announced by President Vladimir Putin, will likely include collaborative efforts with Israel and European manufacturers.

The question is how far the effort will go toward closing a multidecade gap in development. Lt. Gen. Anatoly Zhikharev, Russia's long-range aviation commander, said in a 2012 interview that the deep strike UCAVs the nation is trying to develop will not see fielding until 2040 at the earliest.

Putin's government is under increasing pressure to bring the former superpower into parity with other advanced militaries. The gap in unmanned systems development is largely due to decades of Russian military disdain for UAVs.

India and Pakistan

India is now a third of the way through a 15-year, $6-billion plan to design and build an indigenous unmanned aerial capability. That includes production of at least 400 small UAVs and some 100 large UCAVs, along with some mid-size ISR platforms in production by the country's Defence Research & Development Organisation.

Five other Indian manufacturers currently have more than 15 platforms in development or production, all in the small-to-medium classes.

Lakshya II—India

Continued tension and border clashes have spurred the UAV efforts of both India and Pakistan. The latter also reports multiple domestic companies working on nearly three dozen platforms.

The exact status—even the platform names and manufacturers—of many Pakistani and even some Indian UAVs is difficult to ascertain.

Latin America

With only minor, isolated border skirmishes to engage their militaries out-of-country, Latin American nations' interest in UAVs focuses primarily on border security, operations against organized crime, especially increasingly powerful drug cartels, and a few remaining insurgent groups. Thus several of these countries are in the market for both MALE and HALE systems.

Guerrero—Mexico

Nauru—Brazil

Those include the Israeli Hermes 450 UAVs that Brazil has acquired for its army and navy; counter-drug-missioned platforms for Argentina and Bolivia; border patrol and environmental monitoring systems for Venezuela; and both MAVs and tactical UAVs (TUAVs) that Mexico is seeking for naval and homeland security missions.

As part of its growing dominance as the Southern Hemisphere's technology leader, Brazil also has dramatically grown its indigenous UAV capability in recent years. The country currently has at least a dozen government and industry manufacturers with over 30 UAVs in production or development—mostly small target drones and agricultural/environmental monitors.

Africa

South Africa is the only African nation with a UAV manufacturing capability. Denel Dynamics also has been part of the global export market with its Seeker II+ TUAV and newer Seeker 400 and Hungwe UAVs. In addition to a controversial Seeker 400 sale to Saudi Arabia, which would become the platform's first foreign user, Denel reportedly has agreed to help the Saudis build their own armed UAV, something they have been unable to buy from the U.S.


Seeker II—South Africa

As Africa's nations cope with internal warfare, regional conflicts, and pirates, they have become a growing market for UAVs dedicated to border patrol, ISR, and counterterrorism. Examples include Kenya's 2012 acquisition of its first AeroVironment RQ-11 Raven small UAS, and Mali's interest in an antiterrorism UAV.

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UAVs offer even the poorest nations the option of building an aviation force for border patrol and ISR when modern manned aircraft, pilots, and maintainers are unaffordable. But the open availability of UAVs will give nonstate groups greater power as well.

As UAV technology advances, the concept of air warfare will continue to evolve toward a state previously envisioned only in fiction. Although it is unlikely the U.S., China, India, Russia, or most of Europe will convert to entirely unmanned military air fleets, at least through most of this century, smaller nations may decide that is the best course for them, offering high-tech capabilities at far less cost.

Thus the continuing spread and evolving technologies of UAVs will have the contrary effect of giving their users greater security while also making both state and nonstate aggressors more capable and dangerous. This could lead to increased incidents of aggression by nations whose leaders, seeing no risk to their own human warfighters, take a more cavalier attitude toward the use of force.

Meanwhile, the anticipated explosion of demand and production of UAVs for nonmilitary applications is certain to become a new driver in advancing UAV technologies. It also will generate endless debate on privacy issues and place pressure on lawmakers to respond.

What can be posited with relative certainty is UAVs are emerging from a decade of war as the single most important and sought-after technology since the public Internet, with an impact on the future of humankind akin to computers, spacecraft, and manned aviation.

*For a complete list of unmanned aerial vehicles, please see the **2013 Worldwide UAV Roundup**, a supplement to this issue.*