Roundup 2011

Today, companies in nations around the globe are building—or at least designing—some type of UAV, both for their own militaries and for a fast-growing worldwide market. Their many benefits—multiple suppliers, relatively low cost, and demonstrated abilities for widely varying applications (persistent ISR, command and control, communications relay, and 'hunter-killer')—have made most nations eager to add UAVs to their military fleets.

Technology

Operational experience and tighter defense budgets have reduced warfighter and service chief wish lists to what is most needed, most quickly attainable, affordable, most versatile, able to use an integrated ground control station (one that can control multiple UAVs and/or types of aircraft), and able to be easily integrated into a multiservice, multination networked battlespace.

The past two decades have seen almost every conceivable type of craft and propulsion system thrown into the air in hopes of being ordered. UAVs have gained enough technological maturity and user acceptance to move from revolutionary concept to evolutionary development.

This is not to say that DARPA and its counterparts around the world will not continue to push the envelope on every aspect of UAVs—materials, shape, propulsion sys-

Because UAVs are inexpensive, easy to maintain and, most important, eliminate risk to human pilots, they are now on the wish lists of many nations. Although many countries are building their own systems or seeking such capability, some find it more efficient to buy UAVs from the world's leading manufacturers. Either way, the growth in sales of these aircraft is projected to continue at a brisk pace worldwide.

J.R. Wilson
Contributing writer

tems, sensors, artificial intelligence, scalable lethality (including the ability to change in mid-mission), guidance, operating environment), and size.

The past two years, for example, have seen new efforts in the development of unmanned helicopters. These aim at meeting a Marine Corps requirement for a system to resupply forward units (especially with water) while relieving manned rotorcraft for other missions, without increasing the demand on—and dangers to—ground convoys. At the same time, the MQ-1 Predator has seen its last procurement, with future acquisition going to the MQ-9 Reaper. It has a strong Predator lineage (it was once called Predator B), but was designed from scratch to be a true hunter-killer, using an expanded weapons set and advanced sensors.

Some consider the Reaper the first true UCAV (unmanned combat air vehicle), because its size, flight envelope, and weapons capability—including GPS-guided joint direct attack munitions, Paveway laser-guided bombs, and Sidewinder air-to-air/air-to-ground missiles—give it precision-strike and ground-support capabilities far exceeding those of the Predator.

Designated UCAV projects now include the Northrop Grumman/USN X-47B naval unmanned combat air system, which made its first test flight on February 4, BAE Systems/U.K. Taranis, the six-nation European nEUROn, Russia's MiG Skat, and multiple (but unverified) Chinese programs.

Interest in UCAVs has grown as the likelihood of a non-U.S. near-term fifth-generation manned fighter remains remote, despite Russian and Chinese claims to be on the verge of producing such aircraft. A fleet of UCAVs would be far easier—and less expensive—to acquire. But they also have grown more important to the U.S., especially given predictions the combined U.S. air fleet will fall short of requirements because of delays in the F-35 and a significantly reduced buy of F-22s. The Navy, for example, sees UCAVs as a way to put more strike aircraft with longer range and endurance to sea in less time.

Manufacturers

The numbers in the accompanying chart have changed significantly with each biennial edition. The last one, in 2009, showed far more companies in far more countries

MQ-9 Reaper (USAF photo by Tech. Sgt. Efren Lopez.)

The X-47B is expected to demonstrate carrier-based launches and landings in the 2013 timeframe.

working on many more UAVs than did its predecessor.

But it also reflected the beginning of a consolidation of design and development efforts, a new concentration on specific mission types and capabilities, and a falling away of those 'manufacturers' who were offering little more than remote-controlled hobby airplanes carrying new small cameras and data transmission systems based on commercial technology (primarily advances in smartphones).

That consolidation has continued, at all levels. And although this report reveals as much information as we could gather—surprisingly little in response to direct requests to more than 500 companies, universities, labs, and so on—the discussion will focus on the legitimate major players, both nations and companies

These will be UAVs built for their own militaries, for allies and alliances, and for general sale. It also will include as much information as possible on 'black' programs—the DARPA-level efforts that continue the UAV revolution. In some cases, little more than a name is known—and, often, even that may not be real. In this category, special care has been taken to verify, validate, and confirm the information presented.

We will also look at end users—nations that plan to buy and use one or more types of UAV, or have already done so, rather than attempting to develop an indigenous manufacturing capability. Even the most prolific manufacturers fall into this category, as do some nations that have sufficiently advanced infrastructure to develop their own UAVs but have decided not to 'reinvent the wheel,' instead spending their scarce defense R&D funds on other projects.

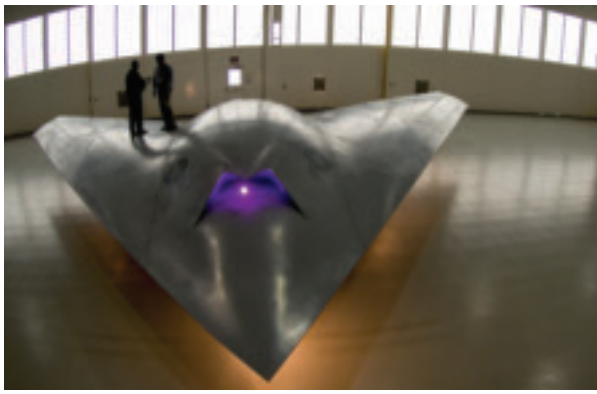
Even so, the Teal Group's 2010 UAV market study predicts a worldwide demand of more than $80 billion for UAVs and related systems through the coming decade, with expenditures more than doubling from a current worldwide level of about $4.9 billion per annum to more than $11.5 billion. And despite increasing global interest in the technology, the report also predicts the U.S. will be responsible for 76% of all RDT&E spending on UAV technology and about 58% of all procurement through 2020.

United States

While Israel was the first to send UAVs into situations where it was unwise to risk a human pilot, the U.S. has become—after a decidedly slow and reluctant start—the most prolific developer, producer, and user of UAVs of all types and sizes.

Although budget constraints have sent some early concepts back to the drawing board and many companies have dropped away, the number of manufacturers and UAVs remains high. Perhaps more important for the future is the continued growth in academic involvement, not only in training the next generation of scientists and engineers, but also in pushing the envelope on such areas as nano- and pico-UAVs.

One area that has progressed far more slowly than some had expected is UCAV programs, although RDT&E continues. The most public of those—and black programs in this area are a given—is the X-47B. Boeing and Lockheed Martin also continue to pursue the technology, while companies such as Predator/Reaper prime contractor General Atomics can be expected to build on existing hunter-killer platforms.



Boeing took the basic design of the X-45A and B to produce the X-45C Phantom Ray.

While the USAF has an official lock on all current, and presumably future, large UAVs, the Navy is back in the hunt for a carrier-based UCAV. Cancellation of J-UCAS temporarily stalled Navy efforts, but, as with 'joint' programs in the past, the withdrawal of one service revealed the real desire of the other to push forward.

From the ashes of J-UCAS rose UCAS-D (demonstration), with an ultimate down-select to the X-47B, which the Navy sees as precursor to a strike-fighter-sized, carrier-capable, transformational UAV capable of ISR, target acquisition, and strike missions.

The need for a carrier-based UCAV has grown even greater with the decrease in U.S. aircraft carriers and fully equipped air wings. Also spurring Navy efforts is China's public stance that, in any future armed conflict with the U.S., its goal would be to destroy U.S. military airfields and carriers before they could launch manned aircraft toward China. Having a fleet of long-range, preferably stealthy UCAVs that could be airborne long before any such attack—and possibly help thwart it—is rapidly becoming a Navy 'urgent need.'

The Air Force, while less public in its pursuit of UCAVs than the Navy, nonetheless did not abandon interest in them with the end of the J-UCAS. With that in mind, Boeing took the basic design of the X-45A (J-UCAS) and X-45B (its UCAS-D effort) and pushed forward with internal development of the X-45C—which came out of Boeing's Phantom Works in 2010 as the Phantom Ray. In response to one major UCAV concern—aerial refueling for extended range and endurance—Boeing is under contract on several key R&D programs.

The service also plans to take delivery of its last Predator this year. While it will continue to fly both armed and unarmed Predators for some time—as will several other operators, from allied militaries to the U.S. Border Patrol—the emphasis for this decade will be on the Reaper. The Reaper was built by General Atomics from scratch to be a hunter-killer; to some, that makes it the first true UCAV.

The Reaper can fly twice as fast and twice as high as the Predator, carries 10 times the payload (including a far wider range of weapons), and has enough additional on-board power to handle a broader array of new or improved sensors. The first USAF Reapers entered service in 2007 and have been flying combat missions in Southwest Asia, piloted (as is Predator) by crews based near Las Vegas, Nevada.

Reaper already has an upgrade—the jet-powered Predator C Avenger. With significant weight, payload, speed, and other advantages, the Avenger—which also boasts a version of the F-35's electrooptical targeting system—also has been proposed by General Atomics to meet the Navy's requirement for an "unmanned carrier-launched airborne surveillance and strike (UCLASS) system."

The Global Hawk can fly halfway around the world without refueling.

A brief history

Advances in military aviation technology historically follow a two-war development phase. The first heavier-than-air combat aircraft were introduced in WW I, but their varieties and massive use during WW II earned that conflict the title of the world's first 'air war.'

A handful of helicopters saw use in WW II, but their first real application was during the Korean conflict, primarily for medical evacuation and resupply. But the next major U.S. war, in Vietnam, saw thousands of combat helicopter sorties by gunships, as well as their medevac and logistics missions, making Vietnam the first true 'helicopter war.'

Israel introduced the concept of UAVs for intelligence, surveillance, and reconnaissance applications in the 1980s, but these planes did not earn worldwide attention until the first gulf war. The primitive (by today's standards) Pioneer UAV became so closely attached to attacks by ship guns and rockets, as well as air strikes, that Iraqi soldiers eventually tried to surrender to the flying robot.

But it is the second gulf conflict that has become known as the 'UAV war,' because of the vast numbers and varieties involved, including the centerpiece of the conflict, the MQ-1 Predator. This was the first UAV to be armed, its Hellfire air-to-ground missile originally designed for helicopters. The skies over Iraq and Afghanistan have been filled with UAVs operated by multiple nations. They range from the tiny hand-launched Wasp to the massive Global Hawk.

UAVs became so numerous that pilots of manned combat aircraft flying through the same battlespace sometimes referred to them as 'aerial FOD' (foreign object debris).

UAVs now come in multiple sizes, carry varied payloads, and use different propulsion systems. Launch methods range from slingshot-style hand-launched to rocket-launched and long-range, from home basing to target zone—Global Hawks can fly halfway around the world without refueling, while Predators routinely are 'flown' by pilots at air bases near Las Vegas while performing missions over Southwest Asia.

Although they require highly skilled, well-trained pilots and sensor operators, UAVs typically are less manpower-intensive than manned aircraft. But most important, they do not put these operators at risk of death or capture. Thus, they can be flown into situations that might otherwise be considered too dangerous. Depending on the type of aircraft and mission, they also can be 'swarmed' against a well-defended target, increasing the likelihood that at least one will get through.

Future UAVs may replace most of the manned fighters in an attack formation, with one piloted aircraft controlling multiple UAVs. A mixed formation of unmanned combat air vehicles and F-35 Lightning II stealth ground attack fighters could significantly enhance the survivability and mission capability of the JSF, which has only marginal stealth attributes.

Meanwhile, the Army has a variety of new and upgraded unmanned aircraft systems (UAS—which include both the aircraft and its ground control station) in development and testing. A major demonstration—the manned/unmanned systems integration concept, or MUSIC—is scheduled at Dugway Proving Ground, Utah, in September.

An MQ-1C Grey Eagle/Sky Warrior, RQ-11 Raven, MQ-5B Hunter, and RQ-7B Shadow UAVs will exchange information with AH-64D Apache Block III attack helicopters, with the Apache crew taking control of the UAVs in flight.

That level of manned/unmanned interoperability is considered crucial to the future integration of both ISR and hunter-killer UAVs in the network-centric battlespace now being implemented in Southwest Asia and planned as the future centerpiece of allied military operations.

Another major factor in the future of UAVs will be the ability of U.S. allies and coalition partners to share useful information in real time. Ongoing efforts to integrate NATO and other allies into a distributed common ground system for UAVs enhance their capabilities for dealing with regional threats and mitigating the risks to all involved. A key to achieving that will be the 2012-2014 delivery and implementation of the NATO Alliance Ground Surveillance system, jointly developed by 21 nations since 2007.

Europe

Although a number of European Union nations have their own, often robust, UAV R&D and production programs, defense manufacturing is one of the primary areas in which EU cooperation is a reality.

A leading example of that is nEUROn, a B-2 lookalike designed to be a European UCAV technological demonstrator. While France's Dassault Aviation is prime, the craft gains its EU label from Dassault's five partners: Alenia (Italy), SAAB (Sweden), Hellenic Aerospace Industry, or HAI (Greece), EADS (in Spain), and RUAG (Switzerland).

EADS has recently led the charge to get Europe to focus on specific UAV programs rather than allowing many competing programs to drain scarce government and corporate resources. For example, CEO Louis Gallois, while vowing EADS would continue developing the French/German/Spanish Talarion MALE (medium altitude/low endurance) UAV with its own funds, demanded that Europe "make a choice" about its MALE UAV requirements. Gallois was referring to the competing BAE Systems Mantis UAV, claiming that continuing both developments was a 'risk' to BAE and EADS.

The Talarion is being developed by EADS to meet Future European needs for a UAV for reconnaissance and surveillance.

EADS has offered the Talarion to meet the U.K.'s Scavenger ISTAR UAV requirement, which also is being competed by two U.S. firms—General Atomics (Avenger) and Northrop Grumman (Global Hawk). Published reports have indicated the U.K. Ministry of Defence's ultimate decision will be based as much on politics as military requirements—a not uncommon occurrence with military acquisitions, especially those involving international competitors.

But the U.K. is not alone in trying to make such choices. The French government is weighing competing offers on the Dassault/Thales Systeme de Drone MALE and Sagem's Patroller UAV.

Gallois has suggested that the various EU nations considering future UAV requirements come together with a multinational industry effort to design and develop a single system—an 'Airbus for UAVs.'

"We have to avoid having two MALE programs," Gallois says, adding that EADS plans to jump-start the multinational approach by forming associations with some of its competitors to market UAVs around the world. "We are going to partnership. If we want to sell in Brazil or India, we need

to have a partner. We are discussing with a lot of them," he says, while declining to reveal any details of what he calls a "three pillars" approach to dealing with the UAV market and competition in Europe, the U.S., and emerging nations.

At the same time, France and the U.K. are going head-to-head in developing a European UCAV despite similar warnings from Dassault that within two decades European industry could 'compete' itself out of existence while the U.S.—already ahead in UAV technologies—dominates the market.

Mirroring EADS' position, Dassault is calling for a pan-European 'combat aircraft program' to replace the continent's existing manned combat fleet. In the absence of such a program, the firm is pushing acceptance of the nEUROn as a way to keep multiple European companies involved and pushing UAV technologies.

The nEUROn technology demonstrator is scheduled to begin flight tests in 2012, almost a decade after its launch. While drawing heavily on commercial off-the-shelf avionics and computers, it was intended to be the first major stealth platform designed entirely in Europe. However, it now faces a British competitor: the Taranis.

As with Germany, France, and other members of the EU, it is sometimes difficult to separate British UAV developments from those of the EU as a whole. One distinct exception, however, is the Taranis UCAV concept demonstrator, on which the MOD has invested over $227 million with a British industry team (BAE Systems, Rolls-Royce, GE Aviation, and QinetiQ).

"Taranis has been three-and-a-half years in the making and is the product of more than a million man-hours. It represents a significant step forward in this country's fast-jet capability," according to Nigel Whitehead, managing director of BAE Systems' Programmes & Support Group. "This technology is key to sustaining a strong industrial base and to maintain the U.K.'s leading position as a center for engineering excellence and innovation."

The initial Watchkeeper platform is based on Elbit Systems' Hermes 450 UAV platform.

Iinitial flight testing for Taranis, another B-2 look-alike about the size of the BAE Hawk, is planned for this year. It is intended to validate technologies needed to develop an intercontinental stealthy UCAV by the end of the decade. It has two internal weapons bays for bombs and missiles, and is expected to be capable of using future directed-energy weapons, either high-power microwave- or laser-based.

Other European nations are striving to develop indigenous capabilities within one or another UAV niche. Most of these involve small, comparatively basic aircraft for ISR applications, often centered on border patrol or sales to less industrially developed markets in Asia, Africa, and Latin America.

China

In the past two decades, this communist giant has emerged as one of the world's most successful capitalist nations, in many ways returning to its mercantile roots. Because of its massive economy, manufacturing base, and status as both a nuclear power and just the third nation to launch its citizens into space, China has earned its place as a regional superpower and global great power.

However, some things remain unchanged, including a 21st-century 'Great Wall' China maintains around its military technologies and capabilities. Aside from still photos, static airshow displays, and an occasional video of an aircraft 'taxiing,' there is little to prove—or disprove—any claims China makes about its aviation capabilities, including UAVs.

China has proudly displayed models that bear a striking resemblance to the most advanced U.S., European, and Israeli UAVs, but there is little evidence to prove any of their claimed capabilities. However, given the country's known prowess in other areas of high tech—from nuclear weapons to microchips, spacecraft to consumer electronics—it would be foolish to dismiss their UAVs as pure fiction.

Israel

Israel was the first nation to put UAVs into actual military use, telling the world in the 1980s it was far more reasonable to use flying robots for ISR missions than to risk Israeli Defense Forces (IDF) human pilots being killed or captured.

In over 30 years of use and development, Israel has continued to maintain a leadership role in both capabilities and global sales. As with many nations, however, analysts can only speculate about what may exist within the IDF's 'black' programs.

What is widely known, however, is that Israel is not only one of the world's leading marketers of UAVs, but also perhaps the most sought-after partner for those nations wanting to develop an indigenous manufacturing capability.

Israel's Hunter UAV is exported worldwide.

Russia

Since the collapse of the Soviet Union—with at least a decade of decay in its technological infrastructure and the loss of senior scientists to other countries—Russia has struggled to regain its status as a technology leader. In some ways, it has moved back ahead of the U.S.—shortly only Russia will have the ability to carry humans to the international space station. It also has seen some success in resurrecting its fighter aircraft industry, although the actual performance capabilities of its latest jets—despite Prime Minister Putin's claims of fifth-generation status—are questionable.

In terms of UAVs, however, Russia had expected to rely heavily on assistance from Israel. But that relationship appeared to fall apart in the fall of 2010 because of Israeli anger at a Russian decision to supply Yakhont naval missiles to Syria. However, the director general of Vega, Russia's leading UAV manufacturer, claimed Israeli assistance was not necessary.

The Russian military has already purchased several Israeli UAVs, including the Searcher Mk II.

"In the next two or three years, there will be a breakthrough in the Russian UAV market regardless of the Israeli position on this issue," Vladimir Verba told reporters last fall during an international exhibition, adding that the government had approved his company's "comprehensive development program," set to run through 2025.

Verba also claimed Russia's Federal Security Service (FSB) is "quite happy with the quality of our equipment. The FSB is giving us new orders and we are cooperating successfully." Even if the defense ministry did decide to buy UAVs abroad, he said, "there is nothing terrible about that."

His confident remarks, however, did not mesh with the words and actions of the government. Apparently dissatisfied with the progress of Russian industry, and having seen the need for UAVs during recent conflicts with Georgia and Chechnya, the military already has bought a few Israeli Bird Eye 400 reconnaissance, I-View MK-150 tactical, and Searcher Mk II multimission UAVs, with follow-on contracts for three times as many.

More to the point, in April 2010, Russian Deputy Defense Minister Vladimir Popovkin admitted that indigenous UAVs the government had spent about $172 million to develop had failed in testing. And in November 2010, the head of the Russian air force, Col. Gen. Alexander Zelin, said Russian UAVs had failed to meet the military's speed and altitude requirements, among other shortfalls.

The agreement jeopardized by the missile sale had called for a UAV joint production effort, with Israel helping Russia upgrade its domestic capability. The nation also reportedly is looking to France for a similar joint venture.

India and Pakistan

It is difficult to discuss military developments in one of these nations without including the other. While India has by far the larger economy and industrial infrastructure, as well as a more stable government, Pakistan has managed to maintain a degree of equilibrium with its neighbor.

Although primarily a buyer of military technology, Pakistan has put considerable effort in recent years into building an indigenous UAV capability. But with India announcing plans to field a fifth-generation manned fighter (coproduced with Russia) by 2015, Pakistan will face technological and numerical challenges it cannot match.

As a result, the Pakistani government is pushing industry to develop a UCAV capable of reducing any new advantage India may gain in the realm of air combat. Indeed, some in Pakistan seem convinced any future sixth-generation fighter will be a stealth UCAV, such as Boeing already has proposed to the USAF. But rather than rely on foreign suppliers, Pakistan wants to develop its own capabilities, not just for UCAVs, but also all other levels of UAVs.

Most nations pursuing UCAV development are working on aircraft that can fight their way into a target zone and back out. However, Pakistan appears to be embracing the concept of a suicide aircraft that, if necessary, would simply crash into its target. Even in air-to-air engagements against a fifth-generation fighter, Pakistani researchers believe a reasonably capable UCAV, operating in a 'swarm,' could overpower and defeat the manned aircraft.

While not claiming to be the technological equal of Europe or the U.S., Pakistan believes it can avoid the political and interservice conflicts that have slowed western development of both UAVs and future UCAVs. The result, they agree, may be more akin to an F-4 than an F-35, but it should also be less expensive and thus easier to field quickly and in large numbers.

In a December 2010 paper on UCAVs and the future of Pakistani-Indian conflict, Malaysian defense analyst Meinhaj Hussain called unmanned aircraft the "golden opportunity to pull ahead" for Pakistan and many other nations.

"If the Pakistan air force can do better and avoid institutional and political barriers that the West is plagued with, they can make a relative leap in capabilities and meet their goals and objectives far better than a linear and asymmetric solution could," he wrote. "Pakistan's aircraft manufacturing industry would remain relevant rather than become outdated and relegated to obsolescence.

"Pakistan does not have the technology or the resources to build an expensive and complex fifth-generation plane. A UCAV, however, is a far more achievable goal. The technologies involved allow far greater flexibility and can be said almost ideally suited to Pakistan's military-industrial complex's strengths."

Such an effort would not necessarily fall entirely to native industry, Hussain added. A UCAV adequate to counter India's larger and more advanced manned air fleet could be built in partnership with China, Turkey, Malaysia, South Africa, Brazil, Iran, Italy, or any combination of those or other nations.

For Pakistan, UCAVs could "become the foot soldier of the skies, lightly armed and yet overwhelming in their numbers," said Hussain. "UCAVs are an emerging technology that has the potential to revolutionize air warfare....[they] provide an interesting paradigm shift that cannot be ignored by those entrusted with the defense of their nations and peoples."

India is not ignoring the value of UAVs, either, but is pursuing that element alongside advanced manned aircraft and missiles. Along with increased purchases—primarily from Israel and Europe—India has spent part of its defense budget increases in recent years on development of such platforms as the Autonomous Unmanned Research Aircraft, a flying-wing design with alleged stealth capabilities developed by the Aeronautical Development Establishment.

In April 2010, a contract to build the Rustom MALE UAV—in the same class as the U.S. Predator and U.K. Watchkeeper—was

Jasoos is designed and manufactured by SATUMA of Pakistan. The Jasoos II Bravo+ variant is currently operational with the Pakistan air force.

A contract to build the Rustom was awarded to state-run corporations rather than private industry.

awarded to state-run Hindustan Aeronautics and Bharat Electronics. The decision marked another in a long line of lost programs India's civil industry has suffered at the hands of government-run competitors.

The Defence Research and Development Organisation (DRDO), India's premier defense research agency, also has been working on a number of new platforms, including the 1.5-kg Netra, intended for anti-terrorist and counterinsurgency operations. Although well-equipped by foreign suppliers, India is looking to DRDO and both its government and civil infrastructure to provide an independent advanced UAV capability before the end of the decade.

Iran

While everything that happens inside Iran is cloaked in secrecy and subject to speculation—often started by the government in what might be considered a smoke-and-mirrors campaign—its technological capabilities cannot be denied. It is the reality of deployable systems that remains in doubt.

In 2010, for example, the commander of Iran's air force announced large-scale production would soon begin on the new Pehpad UAV, which Brig. Gen. Amir-Ali Hajizadeh said was undergoing field tests and training. Pehpad has been called a stealth craft, a claim Iran has made about numerous UAVs for several years. But some reports claim the 'stealth' aspect of the Pehpad consists of USAF markings on a platform designed to look like a Predator.

Iran also has claimed it soon will be able to control UAVs from submarines, will equip all border stations with a variety of such aircraft, has developed long-range UAVs that could sink the U.S. fleet in the Persian Gulf, and so on. The U.S. reportedly did shoot down an Iranian UAV in Iraqi airspace in 2009, although details remain sketchy.

South Korea, Taiwan, and Singapore

Across Asia's broad expanse, nations large and small are seeking to purchase the latest UAV technology available from Israel, the U.S., Europe, Russia, and elsewhere. But in most cases these countries are also developing at least a minimal indigenous manufacturing capability.

High on that list is South Korea. A major share of increases in its defense budget, a reflection of increasingly belligerent acts and statements by its neighbor to the north, has gone toward the purchase of UAVs. At the same time, added emphasis has been placed on becoming at least partially self-reliant in what is seen as a top priority.

Similar concerns about potentially aggressive neighbors have made Taiwan and Singapore active import markets as well.

Recently, however, Taiwan has begun pushing development of its own systems, led by the military's Chung-Shan Institute of Science and Technology (CSIST). Both industry and academia have been working on UAV prototypes for several years, and it now appears CSIST has been tasked with providing the Taiwanese air force with advanced systems it had been expected to buy from Israel or the U.S.

In Singapore, the air force UAV command—actually a joint command staffed by personnel from all three services—is responsible for overseeing both domestic development efforts and the use of existing UAV assets, purchased primarily from Israel. Singapore also is working hard to develop an indigenous capability. In August 2010, Singapore raised its profile by deploying a UAV task force to Afghanistan as part of its contribution to the effort there.

Africa and Latin America

The nations of these two continents run the gamut from the poorest to (potentially, at least) some of the richest. They also host a wide range of technological infrastructure, with some countries capable of producing competitive ISR UAVs—and nearly all in the market for such devices. Applications range from counterdrug and counterinsurgency ISR to border patrol and antipiracy efforts.

In Africa, the lead in UAV development and manufacturing has belonged to South Africa. But what had appeared a promising area of development has now faded. A lack of interest in UAV acquisition by that nation's military has led programs at leading companies, such as Advanced Technologies & Engineering and Denel Dynamics, to stall. Nor have efforts by Russia to boost its own sagging UAV capability by partnering with South Africa led to any improvement in the status of either.

As a result, Israel has found a solid sales opportunity in Africa (and South America), and China is working hard to break into both markets. But the biggest owner/user of UAVs in Africa for now may be the newly created U.S. African Command.

While Africa's interest is waning, several Latin American nations are using their growing fleets of UAVs as a weapon in the war on drugs. Mexico, Chile, Brazil, and others are now flying Israeli UAVs on such missions, while Brazil has formed a joint venture with Israel in an effort to develop a native infrastructure.

With technological capability growing in the region, there have also been efforts to combine internal capabilities, such as a joint program by Chile and Argentina.

The Air Force will take delivery of its last Predator this year, as the UAV gives way to the Reaper and Avenger upgrades.

Every nation is a potential buyer when it comes to UAVs, including the U.S. and Israel. UAVs, and someday, perhaps UCAVs, are far less expensive to acquire and maintain than manned aircraft or satellites for ISR, while offering the added potential of weaponization at no risk to human pilots.

Wars may be won by superior technology, tactics, numbers, or money. UAVs can be an equalizer, even for a small, relatively poor nation with limited technological infrastructure facing a larger, more powerful, and more advanced adversary. For such nations, cheap and plentiful UAVs have been referred to as 'aerial IEDs' (improvised explosive devices), the inexpensive, low-tech weapons of choice for Iraqi and Afghani insurgents and the primary cause of deaths and injuries to U.S. and coalition forces.

What the future may hold for UAVs and UCAVs remains to be seen. What is certain, however, is that the demand for unmanned systems will continue to grow, whether natively produced or purchased from others.