



UAV worldwide roundup—2005

It has been one of the most dramatic and universal changes in military “tactics, techniques and procedures” in history. From a single, barebones “eye in the sky” over Iraq in 1992 to “persistent intelligence, surveillance, and reconnaissance” (ISR) a decade later to “persistent strike” tomorrow, the unmanned aerial vehicle (UAV) has become an absolute necessity to warfighters of all nations, all services, all ranks.

Prior to the closing years of the 20th century, interest in producing even a rudimentary semiautonomous aircraft rarely survived each new round of budget negotiations, despite promising tests of remotely piloted vehicles, uninhabited air vehicles, unmanned aerospace vehicles, and assorted other contortions of the acronym the Pentagon tried out. These begin with the first Firebee target drone order issued in 1948 by the Pilotless Aircraft Branch of the newly formed USAF.

However, the lessons of a decade of technological evolution and tactical application, primarily in the two gulf wars, were taken to heart, not only by those directly involved, but by military planners and politicians throughout the world. By mid-2005, nearly half the nations of the world had some type of UAV in their arsenals, and 43 were on record as producing at least one airframe—a remarkably diverse collection of over 500 systems, including variants and

those no longer in production, according to Unmanned Vehicle Systems International. That represents a significant growth in the global UAV market in only two years since the last *Aerospace America* worldwide roundup (June 2003, page 30). A look at current activities around the world clearly bears this out.

Once little more than flying cameras, current military payloads/missions or those planned in the near term include communications relay, target acquisition/designation, signals intelligence, jamming, search and rescue, anti-mine warfare, anti-submarine warfare, and both air-to-ground and air-to-air attack.

China

The People’s Liberation Army Air Force is believed to be making steady progress in adopting and adapting more modern technologies in China’s domestic military UAV programs, including initial moves into the development of combat UAVs (UCAVs). While details are difficult to verify, the WuZhen-9 stealthy reconnaissance UAV (also designated as WZ-9 and WZ-2000) is, in outward appearance, a virtual clone of the U.S. Global Hawk, although considerably smaller.

The design certainly could handle satellite communications, a synthetic aperture radar for surveillance and reconnaissance (S/R) missions, electronic intelligence or electronic counter-

by **J.R. Wilson**
Contributing writer



measures, as well as ground attack munitions. Officials from the manufacturer, Guizhou Aviation Industry Group, have been quoted as saying the WZ-2000 will be scalable for a variety of missions, but when—or if—it first flew has been the subject of conflicting reports for the past three years.

There appears to be greater certainty regarding the J-5, a conversion of China's first indigenous jet fighter—a licensed copy of the Soviet MiG-17—into a suicide UAV, more cruise missile than UCAV. Brought out of retirement, stripped of its original weaponry and cockpit, then equipped with an upgraded autopilot and a 1,000-lb bomb, it theoretically could achieve supersonic speeds at ranges up to 1,000 mi. before crashing into a target.

One of the most advanced UAVs in China's inventory, however, created a serious rift between the U.S. and Israel recently when it was learned China not only had purchased about 100 Israel Aircraft Industries (IAI) Harpy UAVs in the 1990s, but now was seeking major avionics upgrades from IAI. Part UAV, part cruise missile, the 300-mi.-range Harpy can loiter in the target zone until called upon to attack an enemy radar, self-detonating just above the target for maximum effect. The U.S. concern, however, appeared to focus more on the threat upgraded Harpys might represent to the U.S. Seventh Fleet and Taiwan.

Combined with Predator-sized UAVs that also may be designed for weapons delivery as well as S/R missions, China has demonstrated a growing potential to bring U.S.-style unmanned combat assets to any future conflict.

The country also has become an exporter of UAVs to such countries as Bangladesh, Egypt, Pakistan, Sri Lanka, Tanzania, Zambia, and Zimbabwe, through the efforts of the government-owned China National Aero Technology Import and Export Corporation.

France

France continues to dominate the UAV landscape in Europe, with some 50 different platforms or variants in domestic production and a role in dozens of programs for other nations, ei-

ther as a partner or a primary supplier. French UAVs also cover the full spectrum of platforms, from micros and minis to low, medium, and high altitude and endurance. In fact, by most listings, France has failed to field only one category of flying robot to date—a dedicated UCAV.

"Field" is the operative word, however, as Dassault Aviation has the lead in the six-nation European Neuron UCAV technology demonstrator. Launched by the French defense ministry at the 2003 Paris Air Show, with a full-scale mock-up unveiled by President Jacques Chirac during the 2005 Air Show, the Neuron is not intended to become an actual combat aircraft, but rather to validate that existing or near-term team technologies are adequate to facilitate such a program.

Dassault is charged with the system design and architecture, flight controls, final assembly, and testing; Alenia (Italy) is contributing the internal smart weapon bay, air data, and electric power systems; EADS (Spain) has the wings, ground station, and datalink integration; Hellenic Aerospace Industry (Greece) will provide the rear fuselage, exhaust, and test rig; RUAG

"Currently, there are so many different UAV systems in various stages of development that they are outstripping the ability to evolve standards and approaches for common mission management."

—U.S. Defense Science Board,
"Study on UAVs & UCAVs," February 2004

(Switzerland) the wind tunnel tests and weapons interface; and SAAB (Sweden) the equipped fuselage, avionics, and fuel system. Alenia and SAAB also will participate in the general design and flight testing, scheduled for 2009-2010.

Dassault and Sagem, builder of six French





Photos courtesy UAVforum.com

UAV platforms, hope to beat Neuron into the skies with the all-French Moyen DUC (medium demonstrator UCAV) in 2007-2008.

With more than a dozen companies producing rotary, fixed-wing, stealthy, subsonic, supersonic, and other configurations of UAVs, France is looking to provide a full complement of unmanned capabilities to all of its military services, as well as domestic security and law enforcement agencies. The wide variety also has fueled French foreign sales and international collaborations around the globe.

Germany

Germany has had one of the most active UAV deployment records in Europe, beginning with the EADS Dornier CL-289 reconnaissance UAV operating in Bosnia and Kosovo during the 1990s, where the German army flew over 450 missions. During a subsequent NATO deployment to Macedonia in 1998, a German battery averaged four flights a day. That experience proved invaluable in 2003, when the LUNA tactical reconnaissance UAV built by EMT flew more than 1,200 day and night missions over Afghanistan.

The German Interior Ministry also plans to use the LUNA for border surveillance, the first such use of a UAV by a civil agency in Europe, although restraints on the operation of unmanned aircraft in segregated airspace in Germany has put that plan on a temporary hold.

The army returned from Afghanistan with a new requirement for micro UAVs (MAVs) to support standoff reconnaissance and urban surveillance operations by dismounted infantry and special operations forces. ISR mission plans

have led to stated requirements for a wide range of new UAVs, including outsized high- and medium-altitude/long-endurance (HALE and MALE) platforms. EADS Defense and Communications Systems has teamed with Northrop Grumman to offer a new version of the Global Hawk, designated EuroHawk, for the HALE requirement. Current plans call for initial EuroHawk deliveries to the Luftwaffe in 2007.

EADS Dornier is teamed with Diehl BGT Defense to build a new German airborne minefield reconnaissance system in 2008-2010.

Although Germany has not been as aggressive as France in UAV proliferation, the army's battlefield experiences and plans to take advantage of new capabilities now entering final development stages presage a sustained growth in both domestic production and military and civil utilization of UAVs through the rest of this decade and beyond.

Great Britain

While six fellow European Union members have formed the all-European Neuron UCAV demonstrator program, Great Britain has signed on to the Joint Unmanned Combat Air System (J-UCAS) under way at the U.S. Defense Advanced Research Projects Agency.

The U.K. also is continuing its Joint UAV Experimentation Programme to explore emerging new UAV requirements and capabilities and the addition of the European UAV Systems Centre to manufacturing and development facilities at the ParcAberporth-UK UAV Centre of Excellence in Wales. ParcAberporth is being built with an eye toward inter- and intragovernment test and development efforts with industry on both military and civil UAVs. The first flights to demonstrate the cross-management of military and civilian airspace for UAV operations are scheduled from the site this month.

On another front, Boeing joined the Thales-directed team that includes Elbit Systems, LogicaCMG, Cubic, Vega Group, Praxis, Marshall SV, QinetiQ, Supercat, Tamam, and L3 Wescam on the sometimes controversial U.K./U.S. Watchkeeper consortium. Watchkeeper will be an intelligence, surveillance, target acquisition, and reconnaissance tactical UAV system, scheduled to enter service in 2010. More than that, however, it also is intended to support and bolster the U.K.'s UAV industrial base and self-sufficiency in tactical unmanned systems.

Pending deployment of Watchkeeper and whatever comes out of the J-UCAS effort, the Ministry of Defence will continue to rely on the Phoenix UAV, which was deployed to Iraq, and



"We are working on the interoperability of networked communications, including radar, airplanes, satellites, UCAVs, etc. There are challenges involved in controlling flight between a Rafale-UCAV fleet, including other air traffic, collision-avoidance, and other such issues."

—Jacques Louis, Assistant Director for Planning, Dassault Aviation



more than a dozen other operational and developmental UAVs, primarily in surveillance and reconnaissance roles.

Israel

Israel remains one of the world's major UAV suppliers, especially to India and the Asia/Asia-Pacific area in general, although they are facing increasing competition from China and others. Market analyst Frost & Sullivan predicts South Korea, Singapore, and possibly even Japan may also seek to break Israel's lock on the market as they make UAVs an increasingly important part of their defense industries, both domestically and for export.

Even so, Israeli companies such as IAI and Silver Arrow (a collaboration between Elbit Systems and Federmann Enterprises) believe the advanced capabilities they will continue to offer will help offset expected lower prices from competitors. Systems helping push Israeli technological advances include the IAI-Malat Heron multirole and Elbit Hermes 1500 MALE UAVs; variations of the Israel Military Industries air- and ground-launched Delilah/Light Defender (with both UAV and cruise missile capabilities); and miniature UAVs developed by IAI (Mosquito, Bird-Eye, and SpytHERE), RAFAEL (Skylite), and Elbit (Seagull and Skylark).

Israel also reportedly is resuming UAV joint development work with India, which had been in stasis following the formation of a new Indian government in May 2004. Israel had been India's sole (public) source for UAVs, from the Searcher-1/2 to the export Heron, as well as providing assistance on Indian UAV programs such as the Nishant.

Italy

Reinforcing Italy's reputation for innovative and preemptive engineering and design, Alenia Aeronautica launched Europe's first successful UCAV technology demonstrator in July, when the 22.6-ft-long Sky-X lifted off the Arctic Vidsel Base runway in northern Sweden. With the pilot in a ground station about 2 mi. away, the swept-back wing demonstrator began the continent's first experiment in developing unmanned mission profiles for air-to-surface strike and suppression of enemy air defenses.

Sky-X's modular design will enable researchers to reconfigure the aircraft as the flight test program progresses, including a tailless concept. In addition to possible future Italian UCAV programs, Alenia plans to apply what it learns to the multinational Neuron demonstrator, scheduled to fly at the end of this decade.

The Sky-X flight came just three weeks after Italy's most prolific UAV manufacturer, Galileo Avionica, scored a first of its own when the Italian Civil Aviation Authority, on behalf of the European Aviation Safety Agency, issued civil identification numbers (I-RAIE and I-RAIF) for two research and development UAVs, making them the first unmanned aircraft ever to receive the same type of flight authorization given to manned aircraft. It also was the first step toward full civil certification for the company's FALCO surveillance UAV.

Japan

Japan has been producing and using rotor-wing small UAVs for agricultural applications since the early 1990s and, more recently, to monitor natural disasters. While safety guidelines and standards for their operation have been developed by the Unmanned Helicopter Consortium since 2002, the four leading manufacturers who comprised that organization (Fuji Heavy Industries, Kawada Industries, Yamaha Motor, and Yanmar Agricultural Equipment) responded to a growing need to extend that effort to fixed-wing UAVs and expand involvement by creating the Japan UAV Association (JUAV) last September. In the following months, Kawasaki Heavy Industries, Mitsubishi Heavy Industries, Sky Remote, and Hirobo joined JUAV, which is now Japan's sole UAV industry representative.

JUAV also will represent Japan on the global level, in cooperative efforts with UVS International, AUVSI, GAI, and other consortia seeking to establish safety and operational standards for all types of UAVs operating in civil airspace.

Since the start of the global war on terror, the Japan Defense Agency and the coast guard also have shown increasing interest in acquiring vertical (VTOL) or short takeoff and landing (STOL) UAVs for coastal and shipboard operations, as well as a HALE system for defense applications. Japan's growing aerospace industry is seeking international partnerships to help meet those needs, including discussions with U.S., Australian, and Israeli companies.

Latin America and Africa

While the global market for UAVs is expected to double in the next decade, the Teal Group market analysts predict little or no change in Latin America or Africa, which have been, at best, "very modest markets for UAVs."

In the early 1990s, Argentina, Brazil, and Chile were seeking to develop domestic and, to an extent, regional aerospace industries. UAVs were expected to play a role in that effort, given

Civil UAV growth...and air traffic management

The civilian side, at less than 15% of the market, has lagged behind—largely because of unresolved issues of operating in commercial airspace. But the widening global war on terrorism has brought homeland, border patrol, and public event security; maintenance and security coverage of oil and gas pipelines, communications, and power lines; as well as forest fire alert, search and rescue, wildlife, and environmental observation; mail and package delivery; and a host of other uses by both local and national governments, industry, academia, and science.

The rapid growth of both platforms and applications also has spurred national and international airspace regulators to begin drafting the rules under which unmanned aircraft will be able to operate in the same airspace with passenger flights. While the U.S. has been the leader in UAV development and military implementation, Europe has taken the lead in this arena, through the efforts of the Joint Aviation Authorities (JAA) and the European Organization for the Safety of Air Navigation (EUROCONTROL), a 34-member-state agency responsible for the advancement of air traffic management (ATM).

"A harmonized European regulatory framework for flights of manned aircraft operated as General Aviation Traffic [GAT] currently exists in the form of the ATM-related provisions drawn up by the International Civil Aviation Organization [ICAO], which are applied extensively by European States," notes EUROCONTROL Director-General Victor Aguado. "Although the application of these provisions to UAVs outside segregated airspace is currently not supported, they have been utilized for the operation of UAVs within segregated airspace. As a function of UAVs' abilities to comply with future stringent criteria related to UAV airworthiness and operational approval criteria, the ATM-related provisions of ICAO may in the future accommodate UAV flights [civil or military] wishing to operate as GAT."

Early on, the nations of Europe recognized a new era of aviation would require a unified approach that set aside individual national rule-making. A 1944 convention in Chicago declared the attending governments "agreed on certain principles and arrangements in order that international civil aviation may be developed in a safe and orderly manner and that international air transport services may be established on the bases of equality of opportunity and operated soundly and economically." The concepts established there are now being applied to UAV operations in Europe, as laid out by a May 2004 JAA UAV Task Force report on regulating civil UAVs. That report specifically excluded military, police, customs, and similar security operations, as well as limited production research and scientific platforms and light UAV systems (with an operating mass of less than 300 lb).

Among the major concerns identified by the report

were collision avoidance, overriding of authorized pilot control by terrorists or other malicious individuals, whether visual flight rules (VFR) can apply without "eyes on board" and, similarly, whether a UAV pilot would be able to respond to visual signals in emergencies. Labeled as of immediate or short-term concern and high priority, the task force directed the UAV industry to address those issues, as well as pilot training.

"The following issues need further consideration: medical fitness, licenses and ratings, synthetic flight instruction, age, experience, training, theoretical knowledge, skill and examination, crew composition, multiple type ratings," the report continues. "The operation of UAVs suits the development of new concepts in Control Station set up. Due to the varied UAV world, special emphasis should be paid to human factors on this development. Also, the training of the UAV operators should pay due attention to the human factor aspects in order to make the UAV pilot aware of human limitations when observing and controlling over an extended period of time.

"The delivered Concept is assumed only to create a minimum necessary preregulatory basis that is supposed to be subject to a further evaluation by the [involved] institutions and possibly amended when felt necessary. When accepted, it is assumed to be further developed into detailed regulations for UAVs, covering all areas concerned, i.e., security, airworthiness and environmental certification, continued airworthiness and maintenance, operations, personnel licensing, ATM and possibly other areas in the future [e.g., airports]."

Market analyst Frost & Sullivan says once airspace regulations are established, the commercial UAV market will explode, even as military users—who operate in their own restricted airspace, in civil airspace by special permission, or over enemy territory at will—continue to expand their operations.

With abundant restricted military airspace for training and development operations, the U.S. has not had quite the same sense of urgency as Europe in facing civil regulatory issues. However, the FAA, DOD, NASA, and other agencies with an interest in UAVs, such as the Dept. of Homeland Security, have begun a process similar to that followed by EUROCONTROL.

In February 2004, the Defense Science Board Task Force on UAVs and UCAVs issued a report calling on all U.S. government agencies to take immediate steps toward making unmanned aviation a permanent, significant, and properly regulated part of both military and civilian aviation.

"UAVs are ideal systems to support the emerging joint character and the asymmetric nature of warfare. The Task Force feels it is time for DOD and the Services to move forward and make UAVs and UCAVs an integral part of the

force structure, not an 'additional asset.' To do so requires appropriate planning, appropriate budgeting, and continued management attention of DOD and Service leadership. The DOD and the Services have already started to integrate UAVs into their force structure plans. While progress has been made in planning and funding for UAVs, the Services need to move from deconfliction to integration to interdependence. UAV capabilities should be assessed in the larger context of the Global Persistent Surveillance," the task force report said on the military side.

Then, turning to the broader issue of UAV operations in civil airspace: "The DOD has an urgent need to allow UAVs unencumbered access to the National Airspace System [NAS] outside of restricted areas (airbases and military operating areas), here in the United States and around the world.

"DOD should become an active participant in National Aeronautics and Space Administration, Federal Aviation Administration, and industry efforts to accelerate 'file and fly' capability for all classes of UAVs for operation in U.S. and international civil airspace, as well as provide better integration of UAVs in military airspace during peacetime training and in combat zones. It is absolutely critical that the DOD develop Detect, See, and Avoid [DSA] requirements for all classes of UAVs that they intend to deploy in the NAS and International Airspace. Once these requirements are validated, then technology solutions should be developed and tested to DOD and FAA satisfaction."

Addressing the same issues that concerned European

ance-B (ADS-B), to satisfy the FAA, but added DOD was unlikely to be able to self-certify such a capability.

Assistance there may come from the UAV National Industry Team (UNITE), an alliance created by the high-altitude/long-endurance (HALE) segment of the UAV industry to work toward full civil and commercial access to the NAS. DOD also has joined UNITE, which in turn has formed a partnership with NASA called Access 5. The name refers to their goal of satisfying FAA concerns, currently blocking NAS flight access, within five years of its creation in 2003, beginning with HALE UAVs but ultimately extending appropriate technology, policy, regulatory, and infrastructure solutions to other platforms.

In June, UVS International and UNITE/Access 5 announced the launch of the Global Access Initiative (GAI) to "reach out to all stakeholders on an international scale," ensure all information relating to achieving UAV access into nonsegregated airspace is widely distributed, and "contribute to promote international harmonization of UAV-related standards, rules, and regulations at the earliest possible stage." The impetus for GAI was the accumulated growth of organized efforts on both sides of the Atlantic, from the creation of UNITE and Access 5 in the U.S. and the UAV Industry Consultation Body in Europe to the anticipated launch of UAV standards by the European Organization for Civil Aviation Equipment and RTCA (Radio Technical Commission for Aeronautics).

In July, FAA Acting Manager for Safety and Procedures in System Operations John Timmerman addressed a meeting of Access 5. He predicted that the demand for routine UAV flights in all airspace classes, both VFR and IFR, would increase significantly through the next 10 years, a period in which aviation of all types would place ever larger pressures on the NAS. That, in turn, would see both more international efforts to "harmonize out of the box" with respect to UAV operations in civil airspace as well as a growth in conflicting interests among aviation stakeholders. Beyond 2015, he continued, the cost benefits of commercial unmanned aircraft systems would produce steady growth and begin to dominate operations in some aviation sectors—even to the point of passengers accepting a single "supervisory" pilot in a largely automated cockpit—while cargo aviation would remove all human presence from the aircraft.

With that, however, must come efficient management of finite airspace resources and a strongly positive response to increased expectations for higher levels of safety, he added.

Similar efforts are under way in Asia, Australia, Latin America—virtually every part of the world—as a new era of expanded military and developing civil unmanned aviation becomes firmly established.

J.R. Wilson



the vast remote areas that need coverage for everything from environmental concerns to agricultural development to antidrug and anti-terrorist ISR. As the economies of those nations—and the region as a whole—fell sharply in the late 1990s and into the new century, the indigenous aerospace concept was dealt a hard blow.

At the Latin America Aero & Defense trade show and conference in April 2005, there were signs of renewed interest, both in buying UAV technology from the U.S., Europe, and Israel and in the possibilities of domestic development. Brazilian Vice President and Defense Minister José de Alencar, in closing remarks at the show, referred to the “incorporation of new techniques, methods, processes, equipment and, above all...the materialization of partnerships, thus providing a substantial expansion of job opportunities....” Such cooperation would also enable the three so-called “southern cone” governments to modernize their militaries, including enhanced UAV capabilities, with little increase in individual defense spending.

The situation is remarkably similar in Africa, although South Africa—which hosts its own biennial Africa Aerospace and Defense—has the only real aerospace production capability. During the apartheid era, it became one of the world’s most prolific producers and exporters of military hardware.

Today, state-owned Denel markets at least two UAVs—the Seeker II (surveillance) and Skua (high-speed target drone)—and has announced two new concept models—the Seraph (high-speed stealth reconnaissance/strike) and Bateleur (surveillance MALE), which is scheduled for first flight in 2006. Privately owned Advanced Technologies & Engineering produces the Vulture tactical UAV (day/night surveillance/artillery correction), which began delivery to the South African army this year.

Pakistan

Pakistan is the newest member of the nuclear club. As it tries to balance an ongoing confrontation with India over Kashmir, a sometimes uneasy alliance with the U.S. along the Afghan border, and often volatile domestic politics, the country also is building one of Asia’s most extensive indigenous UAV capabilities.

At least eight production facilities—both government and corporate—are involved in the manufacture of two dozen known systems. Those range from the Baaz aerial target drone from the Pakistan Aeronautical Center to the Vector Mk1 and Mk2 short-range tactical UAVs, produced by National Development Complex for the Pakistani army as well as for export.

Those internally produced systems make Pakistan, by models if not in actual numbers deployed, one of the most prolific UAV manufacturers in the world, ranking alongside Germany. It also reflects the government’s determination to keep Pakistan as self-sufficient as possible across a wide range of military capabilities and enables the country to fill a niche market in the gulf and Africa for low-cost S/R UAVs. With its day/night optical, infrared, and chemical sensors, the Vector series generally tops Pakistan’s order book.

Russia

Russia’s once-vibrant Soviet-era UAV capability has all but vanished from military service since the breakup of the Soviet Union and the dissolution of at least 10 regiments and squadrons, which were operating some 30 UAV systems across nearly the full spectrum of unmanned capabilities as late as 1991.

The current military programs blueprint through 2010 mentions only some efforts to modernize the few remaining Soviet-built systems and no new developments. But at least a limited revival is anticipated before decade’s end, especially in the tactical attack capability arena demonstrated by the U.S. Predator in Southwest Asia and the cutting-edge S/R (and potential weapons) options of a second U.S. platform, the Global Hawk, and its European derivative, the EuroHawk.

As Russia’s UAV operations atrophied in the field, the domestic industrial base was left on its own. It must try to predict where, and when, the government would reverse the downward spiral and how it could remain viable until called upon again, especially given the dramatic evolution of UAVs in the critical decade and a half since they first leaped to the forefront of military plans and operations in the rest of the world. In that respect, inspiration appears to be coming



from a diverse range of U.S., Israeli, French, and other operational and developmental programs, from U.S. UCAV flight tests to the Israeli AeroStar, which has been deployed by the Russian Emergency Situations Ministry as one of the nation's few foreign-made military purchases.

Meanwhile, such world-class names as Sukhoi, Tupolev, Yakovlev, Kamov, and Irkut are showcasing both civil and military UAV capabilities—developed in-house with no official government sanction—at trade shows and exhibits around the world.

Singapore

In recent years high-tech Singapore has invested heavily in UAVs, both as a customer and as a new manufacturing center, in the form of Singapore Technologies (ST). The island nation's unmanned fleet currently includes the Israeli Scout and Searcher II, but various divisions of ST also have provided several domestic or collaborative developments, such as the PhantomEye, Skyblade II, Mini TailSitter, Blue Horizon, Golden Eye, and LALEE.

Those efforts are in support of a Ministry of Defense policy statement, "Defending Singapore in the 21st Century," issued five years ago, identifying UAVs as one of the major technologies essential to the nation's networked battlespace strategy. Singapore's navy, in particular, has made the development of UAV-based over-the-horizon broad-area maritime surveillance, electronic warfare, and weapons targeting, along with small tactical UCAVs armed with high precision guided missiles, a cornerstone of its planned network-centric transformation.

Taiwan

The Taiwanese military and government closely hold their UAV strategies—clearly considered vital to the island's defenses against any military action by China. Their approach no doubt has much in common with Singapore's, however, especially with respect to known requirements for tactical air defense UAVs and multiple-payload-capable long-endurance STOL systems.

Among the few named, but only marginally described, systems in development or in inventory are the short-range tactical surveillance Thunder Eye (Thunder Tiger Model Company)

"The UAV system community has a global problem facing it and should strive towards a global solution."

—Peter van Blyenburgh, President, UVS International



and the Chung Shyang II (Chung Shan Institute of Science and Technology), which may be the STOL component. The institute also developed the short-range Kestrel II tactical surveillance and target acquisition/identification UAV. This year, Yoshine Helicopters revealed a remote-control micro coaxial version of its one-man Ezycopter.

United States

While global UAV industrial capability and civil and military markets have been expanding almost exponentially, official U.S. programs so far have managed to remain at the forefront in both quantity and technical expertise. At last count, more than 200 different platforms were being produced by some five dozen companies—both domestic and U.S.-based divisions of leading international firms seeking to open a door in the congressionally mandated "Buy America" requirement on military procurements.

The success of UAVs in Afghanistan and Iraq has significantly bolstered both Pentagon plans for future system developments and deployment and interest by other government agencies. This is especially true for homeland security-related uses such as border patrol, antidrug surveillance and reconnaissance, and remote critical infrastructure inspections.

The evolution of military UAVs from pri-



marily S/R roles to actual combat, beginning in Afghanistan with the Hellfire missile-armed Predator, also has spurred R&D efforts on the next generation of weaponized platforms, the UCAV. The leading official effort in that area—DARPA's J-UCAS Capability Demonstration Program—has made significant advances in the past year. Those include successful flights by the Boeing-built X-45A and an 18-month, \$175-million extension of the flight test program by DARPA in July for three X-45C demonstrators being built (for first flight in 2007) under Boeing's original \$767-million contract.

"There is no longer any question of the technical viability and operational utility of UAVs. Indeed... recent combat operations appear to indicate that unmanned air systems have at last come of age."

—Maj. Gen. Kenneth Israel (USAF, Ret.) and Robert Nesbit, Cochairmen, Defense Science Board Task Force on UAVs & UCAVs



That extension also includes addition of an autonomous aerial refueling technology, looking to the ability to refuel UCAVs in flight by KC-145 tankers by 2010.

Boeing also completed two weeks of sea trials in July for its ScanEagle long-endurance UAV, including shipboard launches and recoveries. Although those were firsts for ScanEagle in sea-based operations, it has been deployed to Iraq for the past year, logging more than 3,600 combat flight hours with the First Marine Expeditionary Force. With its shipboard capabilities now demonstrated, the ScanEagle will be used for persistent ISR coverage during Naval Expeditionary Strike Group missions, and to provide increased oil platform security in the gulf.

Northrop Grumman demonstrated fully

autonomous flight in a two-hour demonstration by its new RQ-8A Fire Scout VTOL tactical UAV at the Navy's Webster Field annex, Naval Air Station Patuxent River, Md., in June.

Also in development for the Army Future Combat Systems Class IV UAV, Fire Scout is one of several ongoing Northrop Grumman programs to expand the capabilities of the nation's unmanned fleet. Others include the multirole Hunter II, proposed for the Army's next-generation, extended-range, multipurpose UAV program; the X-47 contender for J-UCAS; and Global Hawk B (and its EuroHawk derivative).

Not all new U.S. military UAV programs are entirely "new," as demonstrated by Vought Aircraft's proposal to bring back the seaplane, which went out of service with the Navy 30 years ago. This time, it is a single-engine jet UAV version called the Kingfisher II, which Vought is proposing to either replace or complement other UAVs operating in conjunction with the Navy's new Littoral Combat Ship (LCS).

Named for the company's WW II Kingfisher scout floatplane, Vought officials say the new UAV approach would offer significantly larger payload capacity, speed, and range than rotary wing UAVs the Navy is considering for the LCS. However, Vought will have to convince the Navy that its salt-water-corrosion-resistant composite structures are more than enough to defeat the number one reason seaplanes are no longer part of the Navy inventory, along with the hazardous nature of night, bad weather, and rough sea operations.

The DOD's current UAV master plan calls for continued development and deployment of a wide range of unmanned platforms as each of the nation's military services undergoes varying degrees of transformation into a more agile, precision-lethal force for the 21st century. Those platforms encompass both short and long range, low and high altitude, armed and unarmed, in sizes from hand-held micros to the fighter-jet-sized Global Hawk.

Of considerable economies of scale import to DOD budget writers is the ability of U.S. contractors to find international markets for the majority of their new UAVs, not only for military applications but also for civil missions. The latter range from commercial pipeline inspections to homeland security-related tasks, such as border and coastal patrol.

"Manufacturers must enhance their ability to market beyond the military," warns one study. "The potential uses for UAVs outside the armed forces are numerous...Every system designed to date has received customizations due to unique mission requirements." ▲