NASAfacts

Ikhana
Unmanned science and research aircraft system

NASA's Ikhana Predator B received an avionics upgrade, wingtip winglets and a new paint scheme in 2013. GA-ASI Photo

NASA acquired a General Atomics Aeronautical Systems Inc. (GA-ASI) MQ-9 Predator B unmanned aircraft system (UAS) in November 2006 to support Earth science missions and advanced aeronautical technology development. Named Ikhana by NASA, the aircraft also served as a test bed to develop capabilities and technologies to improve the utility of UAS.

The word "Ikhana," is a Native American Choctaw word meaning intelligent, conscious or aware. This name was chosen because it is descriptive of the research goals NASA established for the aircraft and its related systems.

Representative Experiments and Projects

The Ikhana UAS, designed for long-endurance, medium-altitude flight, was modified and instrumented for use in multiple civil research roles.

A variety of Earth science in situ and remote sensing instruments were installed to collect data during flights, some lasting more than 20 hours. Data gathered by sensors on Ikhana within the Earth's atmosphere complemented measurements of the same phenomena tak-en from space and from Earth's surface.

The Ikhana UAS participated in the Western States Fire Missions from 2007 to 2009. Through these flights Ikhana demonstrated improved wildfire imaging and mapping capabilities. NASA Ames Research Center at Moffett Field, California, developed the sophisticated sensor and real-time data communications equipment, the Autonomous Modular Sensor (AMS).

During the Fire Missions, the aircraft carried the AMS in a wing-mounted pod. The AMS was capable of peering through thick smoke and haze to record hot spots and the pro-gression of wildfires during a lengthy period. The data gathered was overlaid on Google Earth maps, downlinked in near-real time to the Interagency Fire Center in Boise, Idaho, and made available to fire incident commanders to assist in allocating firefighting resources.

In 2014, in partnership with multiple organizations, Ikhana deployed to Hawaii to demon-strate the capabilities of this type of UAS for scientific and environmental data collection missions over the Papahānaumokuākea Marine National Monument ("the Monument"). The aircraft collected scientific and environmental data during two flights totaling more than 19 hours over northwest areas of the island state. NASA worked with scientists from the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Fish and Wildlife Service to perform surveys of monk seals, sea turtles, sea birds and vegetation. Sen-sors on the aircraft also searched for marine debris over the Monument.

During the 2014 deployment to Hawaii, the Ikhana also flew four missions supporting the U.S. Navy's Rim of the Pacific (RIMPAC) military maritime training exercise. During these missions the Ikhana demonstrated how a UAS with its capabilities could provide visual and radar imagery for a more efficient, effective and safe execution of the training and real-world exercises. The imaging sensor and the radar package on board Ikhana provided ocean range clearance, situational awareness of ship movement, humanitarian assistance and disaster relief training aid during more than 32 hours of flight time.

In 2017, in partnership with Panasonic Aerospace, Ikhana tested their Tropospheric Air-borne Meteorological Data Reporting, or TAMDAR,

equipment. The version flown on Ikhana is the TAMDAR Edge system, a much smaller, lighter weight version of the original technology that had already flown for more than 12 years on commercial airliners. TAMDAR provides real-time weather data for use by other aircraft, as well as ground stations.

The Ikhana also supported the Aeronautics Research Mission Directorate in the advance-ment of unmanned aircraft systems research and technology development.

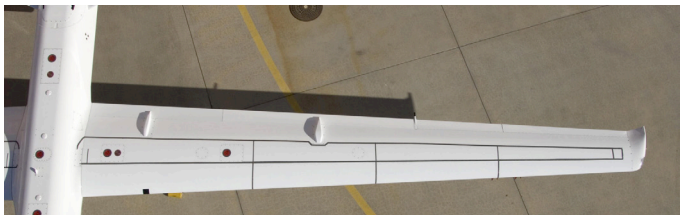
A NASA-patented fiber optic sensor system moved from years of laboratory development and testing to large-scale, dynamic field testing in 2008 when the technology was flown on the Ikhana UAS to measure change in the wing shape in flight. The effort represented one of the first comprehensive flight validations of fiber optic sensor technology.

In support of the Agency's Unmanned Aircraft Systems Integration in the National Airspace System (UAS-NAS) Project, the Ikhana first flew an Automatic Dependent Surveillance-Broadcast, or ADS-B, system in 2012. ADS-B is an aircraft tracking technology that all planes operating in U.S. airspace must adopt by January 2020 to comply with Federal Aviation Administration (FAA) regulations.

More extensive support of the UAS-NAS Project followed from 2014 to Ikhana's retirement in 2018. During this time, the UAS-NAS Project partnered with the FAA, GA-ASI, Honeywell International Inc., and Aviation Communications and Surveillance Systems (ACSS) to sup-port multiple flight test series using the Ikhana at Edwards Air Force Base, California. Ikhana participated in flight tests that engage the core air traffic infrastructure and supporting software components through a live and virtual environment to demonstrate how a re-motely piloted aircraft interacts with air traffic controllers and other air traffic. The aircraft was equipped with partners' developmental detect-and-avoid systems and software.

NASA, working with government and industry partners, used flight test data collected with the Ikhana UAS to provide the Radio Technical Commission for Aeronautics (RTCA) Spe-cial Committee 228 with data to support its development of minimum operational perfor-mance standard (MOPS) necessary for UAS to regularly access the National Airspace System (NAS).

In June 2018, demonstrating the application of the MOPS that Ikhana helped develop dur-ing earlier flight tests, the Ikhana became the first aircraft to obtain a No Chase Certificate of Waiver Authorization (COA) from the FAA, and successfully flew a



Fiber Optic sensors are covered with dark sealant tape on the left wing of Ikhana during a 2008 study to measure change in wing shape. NASA / Tony Landis

six-hour mission through multiple classes of civilian airspace (A, D and E) without the support of a chase plane or visual observers. The teamwork among the various partner organizations made the demonstration a decisive success, and accomplished a major step toward the integra-tion of UAS in the NAS.
Due to this historic achievement, Aviation Week & Space Technology selected Ikhana's No Chase COA flight as a winner of its 62nd Annual Laureate Awards, in the category of Commercial Aviation, Unmanned Systems.

Aircraft Description

General Atomics Aeronautical Systems Inc. of San Diego, California, developed the original Predator A medium-altitude, long-endurance UAS during the mid-1990s for the United States Air Force. Development of the larger, more powerful Predator B was initiated in 2000 by the firm with partial funding from NASA. The agency was interested in the Earth science capabilities of a civil version of the aircraft with a larger payload and higher altitude capability, along with longer endurance. The aircraft is based at NASA Armstrong.

NASA's MQ-9 Ikhana Predator B has a wingspan of 66 feet and is 36 feet long. More than 400 pounds of sensors can be carried internally and over 2,000 pounds in external under-wing pods. Ikhana is powered by a Honeywell TPE 331-10T turboprop engine and is capable of reaching altitudes above 40,000 feet. Ikhana was the first production Predator B equipped with a digital electronic engine controller developed by Honeywell and GA-ASI that makes the aircraft 5 to 10 percent more fuel efficient than earlier versions.

In 2013, Ikhana received a major avionics upgrade, bringing the aircraft's systems to current standards and making the UAS maintainable and sustainable. The Ikhana project also acquired a new 140-inch long, 30-inch diameter generic science pod with a payload capacity of more than 500 pounds. The pod's internal arrangement is reconfigurable to accommodate a variety of science sensors and instruments.

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