The Purpose-Driven UAS

By Joseph Barnard

Editor's Note: The United Kingdom-based company Barnard Microsystems recently designed, built and tested a small unmanned aircraft made to meet the requirements of not only military users but civil and commercial ones as well. Beginning with a survey of potential users, including in the oil and gas industries, they developed a twin-engine aircraft called the InView. This is the story of its development and an explanation of some of the design choices the team made.

We have developed an unmanned aircraft system, called the InView, for use in scientific, commercial and state applications. The use of unmanned aircraft in military operations has received a relatively wide coverage. Less well known are the requirements for unmanned aircraft involved in civilian applications.

We had in mind the development of a relatively small, but distinctive, unmanned aircraft that could perform a wide variety of missions throughout the world.

Civil and commercial missions could include maritime border patrol, such as monitoring offshore oil and gas platforms; incident monitoring and relief operations, such as locating victims following earthquakes or mudslides; and oil and gas pipeline monitoring, including using thermal imaging or synthetic aperture radar to detect subsurface oil leaks.

Although developed primarily for use in civilian applications, potential military missions include long-range reconnaissance; wide-area surveillance; comunications relay; submarine detection; and research and development, including the testing of testing electro-optic sensors and ones that could be used for a "detect and avoid system."

We met with staff members at oil, gas and mineral exploration and production companies as well as military personnel in the U.K. and developed a table of the requirements and desirable features that a new aircraft should have.

For safety reasons, and the minimization of the risk of "reputational damage," it was a requirement of some exploration staff that the aircraft should have two engines, and be able to fly on one. Additionally, the aircraft must be able to fly even if an aileron, a rudder or an elevator servo, or linkage, fails. It would need to be able to operate from a grass field and have a range of 500-700 kilometers (310-435 miles) carry a four- to five-kilogram (8.8- to 11-pound) payload.

It should be modular in construction to enable easy transportation in a small van. Assembly and pre-flight checks should take no more than two people and be completed within an hour. The aircraft must be capable of slow flight to reduce motion-induced blur in high-resolution photographs and reduce the noise in measurements of the Earth's magnetic field. Its total weight should be less than 20 kilograms (44 pounds) and the cost of the aircraft and the ground control station should be less than 100,000 euros ($139,000).

The InView aircraft we developed hit pretty close to the mark. It has a wingspan of four meters, a payload of four kilograms, weighs 19.5 kilograms without fuel, has an endurance of seven hours and a "loiter" slow flight speed of 24 kilometers per hour. It can operate from an unprepared grass field and has two Saito FG-30 engines developing 3.6 kilowatts of power.

The first test flight of InView IV-001 took place on 9 April, 2010. We have adopted a development strategy originally suggested by a California business consultant: test early and test often. We learned a lot:

- The correct center of gravity location of a twin-engine aircraft is difficult to realize unless the engines are moved forward, something we only noticed afterwards on detailed inspection of other twin-engine aircraft. We also had to reduce the weight of the tail section to achieve the correct center of gravity, hence our use of the noticeable carbon fiber booms.
- Using a V tail with a twin-engine aircraft is problematic. This tail configuration is found on the Elbit Systems Hermes 1500, but our implementation resulted in an aircraft that was difficult to control. The use of a V tail made our aircraft look like a UAV, but it flew like a brick.
- We had to increase engine power output to enable the InView to fly on one engine. We at first used two Saito FG-20 engines, but increased the engine power in going from InView IV-004 to InView IV-005 by replacing the 20cc engines with 30cc Saito FG-30 engines.
- A modular construction allowed us to quickly and inexpensively change different parts of the aircraft, such as the fuselage, while keeping other sections, such as the wing sections, as they were.
- We needed two people to assemble, test and fly the aircraft. During flight operations, the pilot-in-command keeps a direct eye out for the aircraft, while the copilot monitors the view from the aircraft relayed via a radio link to a laptop computer on the ground. The large aircraft can easily appear to be closer than it really is, and on one occasion we inadvertently landed the InView on the top of some 80-foot-high trees while flying under manual control.

The InView's payload bay.