Success is not always measured by just talent. Sometimes achievement is a question of timing, persistence and luck. Such is the case of Robinson Helicopter Company, which for years has dominated the small, piston-powered helicopter market and now offers a small turbine helicopter, the R66, that costs significantly less than competitor rotorcraft.

Robinson, which opened its doors in 1973, considers itself “an engineering company that places great emphasis on research and development.” By 1988, it was producing more light helicopters than any other manufacturer. Today, it is the world’s leading maker of civil helicopters in terms of units sold and is likely to retain that top position for the next decade.

Clearing Hurdles

The company may need that room if R66 international sales accelerate. Recent FAA action could help remove hurdles hindering the R66’s use in Canada, Europe and Russia and the Commonwealth of Independent States (CIS).

The hurdles stem from Robinson’s use of a non-redundant control valve in the hydraulic flight control system for the R66. When the FAA issued the R66 type certificate on October 25, 2010, it exempted the aircraft from a requirement that the system’s control valve could not be a possible single-point failure.

Under existing bilateral airworthiness agreements, several other countries have accepted the FAA type certificate. But Transport Canada, the European Aviation Safety Agency (EASA), and the Interstate Aviation Committee (the regulator for Russia and the CIS) would not do so with that exemption, which meant R66s generally could not be operated in those key markets. That cut into sales. Seventy percent of Robinson helicopters are sold outside the U.S.

To overcome this, Robinson sought an FAA Equivalent Level of Safety (ELOS) finding for the R66 control system. Such a revision of the type certificate would declare that the probability of failure of the R66 flight control system design (and the consequence of its failure) was equivalent to the failure probability for a compliant redundant system.

Robinson’s pursuit of the ELOS certification included reliability analysis to support a calculated failure rate of less than one in a billion flight hours, and demonstrations that a pilot could exert enough force to control the R66 if the hydraulics failed. That and other testing over more than a year satisfied the FAA, which issued the ELOS finding on February 25. In March, Robinson announced that the Russian Interstate Aviation Committee had issued a type certificate for the R66, and that the company was now fulfilling 47 orders to Russian customers, all for delivery before the end of the year.

At press time, Transport Canada and EASA were reviewing the FAA ELOS.
Robinson's first helicopter, the two-seat R22, received its FAA type certificate in March 1979. It had a $40,000 base price. Deliveries began in October 1979.

In the mid-1980s, the company began work on the larger, four-seat R44. First flight was in March 1990. Certification followed in December 1992, and the first R44 was delivered in February 1993.

The R66 filled a void between piston helicopters and low-end turbine ones that widened when Bell Helicopter in 2008 said it would discontinue production of the widely popular light, single-engine turbine 206B3 JetRanger.

"They have long dominated the piston market," says Douglas Royce, aerospace analyst with Forecast International and author of annual market forecasts on commercial and military rotorcraft, including the one presented in this issue of Vertiflite. "The natural growth pattern [for Robinson] was to move into the turbine market."

That made good business sense because sales of smaller helicopters like the R22 and R44 are more sensitive to economic changes than those of larger, turbine-powered equipment, Royce says, and sales of larger helicopters generally are more lucrative.

The company's emphasis on R&D is evident in its tradition of product improvements. More powerful engines for the R22 and R44 over the years enabled improved altitude and hover performance, higher gross weights and higher takeoff ratings. Enhancements like airborne law enforcement and electronic news gathering packages, larger instrument panels, auxiliary fuel systems, fixed floats and adjustable tail-rotor pedals improved their utility.

Robinson is benefitting as the world's economies recover. The company has more than doubled piston-model production since 2010 and has delivered more than 300 R66s since that aircraft's certification late that year, Royce says. Forecast International projects Robinson will remain the world's leading rotorcraft manufacturer in terms of unit production through 2022.

According to another rotorcraft forecast, light single helicopters are the most popular product class. This Honeywell forecast, based on potential buyers' purchase expectations through 2017, says light singles provoke the greatest purchase interest in North America and have shown "a noticeable surge in interest" in the Middle East and Africa compared to earlier surveys.

In 2008, Robinson says, it produced a record 893 helicopters. But the recession that began late that year hammered all civil manufacturers and Robinson's sales slumped. In 2009, its unsold inventory grew. In 2010, the company produced 162 helicopters—112 R44s, 40 R22s, and 10 R66s (the first year the turbine was available).

A turnaround began in 2011, when Robinson produced 356 units (212 R44s, 88 R66s and 56 R22s). Last year, production rose 45% to 517 (286 R44s, 191 R66s and 40 R22s).

The key to sustaining profitability will be the R66.

"Having a turbine-powered aircraft for certain markets is a big benefit for us," says CEO Kurt Robinson, who took over in August 2010 when his father, company founder Frank Robinson, retired. "But the higher-priced R66 had to have something the R44 didn't have. It had to be faster and have cargo capacity."

The R66's never-exceed airspeed VNE—at sea level and its maximum weight of 2,700 lb (1,225 kg)—is 130 kt indicated (241 km/hr), compared the Raven II's sea-level VNE of 120 kt indicated (222 km/hr) at its 2,500 lb (1,134 kg) max weight. The R66 has an 18 cu ft (0.5 cu m), 300 lb (136 kg) capacity baggage compartment behind the cabin.

Engine selection helped the R66's appeal. The Rolls-Royce R300 turboshaft powerplant for the R66 is lighter and more powerful than the six-cylinder, carbureted Lycoming 0-540 in the R44 Raven I and the fuel-injected IO-540 in the Raven II. It also burns jet fuel and not avgas, which is difficult to find in several parts of the world.

(Robinson is working with Lycoming to gain FAA approval for R22 and R44 operators to burn unleaded gas, which it says is more environmentally friendly. According to the Robinson CEO, Lycoming must obtain approval to burn unleaded fuels in its engines and Robinson must conduct testing with such fuels on board its airframes to establish, among other things, compatibility with fuel system components, such as bladders and O-rings.)
Although larger and more costly to operate than the R44, the R66 is in a class by itself in terms of acquisition and direct operating costs. It costs about $830,000, while competitors like the Eurocopter EC120 and Sikorsky/Schweizer S333 each sell for roughly $1.4 million. Royce says in a recent civil rotorcraft report that the S333 “has been gutted by the R66, which offers similar payload and range at almost 60% of the price.” (The smaller R22 costs about $275,000, while the R44 Raven I goes for $375,000-400,000 and the Raven II costs about $450,000, Robinson says.)

The company says it has sold out R66 production until September 1 based on the current production rate of five a week. Robinson now produces six R44s and one R22 a week. It has no plans for developing plants elsewhere.

Royce estimates Robinson will sell 1,700 R66s over the next 10 years, but concedes that could be conservative, particularly now that the certification hurdles may be falling.

**Company Genesis**

Frank Robinson didn’t start out intending to run his own helicopter company. After earning a Bachelor of Science degree in mechanical engineering from the University of Washington and attending graduate school at the University of Wichita, Frank began his career in 1957 at Cessna working on the CH-1 Skyhook helicopter. That was followed by stints at McCulloch Motor Company, Kaman Aircraft, Bell Helicopter, where he earned a reputation as a tail rotor expert and Hughes Helicopter.

Along the way, Robinson became convinced that there was something missing from the helicopter market. Most owner/operators couldn’t afford rotorcraft that were versatile but had direct operating costs five times that of comparably sized fixed wing aircraft. He decided to design a small, personal helicopter for those customers.

He showed early designs of what would become the R22 to Bell, but the company was military-based and not interested. He also got the cold shoulder from Hughes.

So Robinson would design and build the helicopter himself.

He resigned from Hughes and in June 1973 started Robinson Helicopter in his Palos Verdes, California home with partner Gus Le Fiell. They built the R22 prototype in a hangar at nearby Torrance Airport. In August 1975, Robinson flew it for the first time. In 1979, after a trying 3.5 years of technical analysis and testing, the R22 received its FAA type certificate. Deliveries began shortly thereafter.

“The R22 didn’t turn out to be what my father envisioned,” says Kurt. Intended as a personal helicopter, the R22’s maneuverability and low operating costs made it appealing to flight schools as a trainer. The aircraft helped lower training fees, enabling more students to get helicopter licenses. (The helicopter also found a niche herding cattle and other animals in Texas, Australia and New Zealand.)

“He was an accidental pioneer” in the helicopter business, Kurt says.

**Demanding Aircraft**

The R22, like the R44, uses a semi-rigid, two-blade main rotor with a teetering hinge and two coning hinges, a two-bladed, teetering tail rotor and a unique T-handle cyclic positioned...
between the two seats. (The left half of the T can be removed if the person in the left seat is not to fly.) The combination makes these aircraft highly responsive to control inputs.

Use of a single, central cyclic column supported Frank’s goal of producing a low-cost helicopter. It eliminated the expense of designing, producing and maintaining two traditional, interconnected cyclic columns in front of each seat – as well as the weight of the second column and its control run. (The tri-hinge main rotor design also eliminates the complexity, cost and weight of one using lag hinges, dampers and hydraulic struts.)

But the high responsiveness caused problems.

Between 1981 and 1994, a special investigation by the U.S. National Transportation Safety Board found the R22 “experienced fatal accidents involving loss of control, including accidents involving loss of main rotor control, at rates much greater than other helicopters.” These could not be attributed to “any precipitating progressive mechanical failures or material defects.”

According to the FAA, many R22 accidents were caused by low-rotor RPM or low-g conditions that resulted in mast bumping or the main rotor striking the airframe. Investigators attributed the accidents not to the flight control system’s design but to errors by pilots inexperienced in helicopters in general (a key part of the R22’s target market) and in the use of the Robinson flight controls.

The R44 had similar issues.

The FAA conducted a special certification review. On March 1, 1995, it determined that “apparently qualified pilots may not be properly prepared to safely operate” the R22 and R44 “in certain flight conditions.” It then issued Special Federal Aviation Regulation (SFAR 73) covering just those aircraft.

That special rule prohibits a person from serving as a pilot in command (PIC) or a certificated flight instructor (CFI) in an R22 or R44 unless he or she receives awareness training on energy management, mast bumping, low-rotor RPM and blade stall, low-g hazards and rotor RPM decay.

Further, no person can serve as PIC of an R22 or R44 who has fewer than 200 flight hours in helicopters and fewer than 50 flight hours in the R22 (or, for the R44, fewer than 50 flight hours in Robinson helicopters), or who has not received 10 hours of dual instruction and an annual flight review from a CFI who has satisfied SFAR 73’s requirements. The annual instruction must cover at least enhanced autorotation procedures, controlling engine rotor RPM control without the use of the governor, and recovering from low-rotor RPM and low g maneuvers.

An R22 CFI must have at least 200 flight hours in helicopters, with at least 50 in the R22. An R44 CFI must have at least 200 flight hours in helicopters, with at least 50 in Robinsons (of which 25 can be in the R22). The CFI must have completed flight training in an R22 or R44.

SFAR 73 remains in effect. “People who learn to fly in the R22 are better pilots because it requires a much better reaction time. When you transition from the R22 to the R44 or another helicopter, your skills are well developed,” Kurt says. Owners of commercial helicopter operations and flight schools have said the same.

Tip weighted blades and a governor added in the 1990s made the R22 easier to fly, Kurt adds, “but by no means, can you be complacent with this aircraft.”

Customer Relations

Nearly 30 years ago, shortly after the R22 entered service, Robinson launched a safety course for flight instructors to standardize training at flight schools. The course generally is offered monthly at the Torrance factory and sessions fill up fast; Robinson also offers the course abroad for international customers. To date, more than 17,000 students have gone through the course, which satisfies SFAR 73 requirements.

One story told of Frank is that before his retirement in 2010, he personally would size up customers who came to Torrance to take delivery of a new helicopter. If he wasn’t satisfied that a customer was ready to fly a Robinson, he would refuse to turn over the keys to the aircraft.

Robinson helicopters are generally popular (though many pilots gripe about the T-handle cyclic).

“They’re reliable and we’re able to make money with them,” says Ken Pyatt, president of Dallas, Texas-based Sky Helicopters, which operates 23 R44s.

Lower operating costs are a benefit, Pyatt says. A JetRanger burns about 28 gal/hr; the R44 burns 15. An R44 annual inspection costs about $1,000, compared to thousands of dollars for other turbine aircraft, he adds.

Eric Gould, a director with Calgary, Alberta-based Aerial Recon Ltd., and pilot and operator for more than 30 years, with 15,000 hrs in helicopters and 4,000 hrs in Robinsons, agrees.

Robinson has a long history of market-focused research and development that includes new types like its turbine R66 and product enhancements like the R66 airborne law enforcement mission package, approved by the FAA in 2012. (Robinson Helicopter Company)
"Operating costs are what kill you, not acquisition costs."

Aerial Recon formerly operated 65 aircraft (including 10 R44s) and has been a Robinson dealer since 1985. Since 1985, it has placed 160 Robinson helicopters in Canada. Over the years, little things went wrong with its R22s and R44s, Gould says, but the contract said that if Aerial Recon suggested worthy improvements Frank "would adopt them at the factory. He did. He was true to his word."

Gould is particularly high on the R66. "In a world where things are constantly overstated, I found the R66 to perform better than advertised," he says.

Once the R66 is certified by Transport Canada, Gould expects that aircraft to outsell the R44, in part because of its better altitude and lift capability. A big selling point in Canada is the R66’s sling-load capability.

**Like Father, Like Son**

Gould and other operators believe Robinson could sell more helicopters if it had a finance arm. Some lending institutions remain unfamiliar with general aviation, they contend, so it can be difficult for owners just coming into the industry to obtain proper financing for a new helicopter.

"No one is in a better position than the factory to know the value of the R66," says Gould. "I would love to see us dealers be able to sell a new ship with financing already in place."

Kurt concedes that is a valid concern. "But the last thing I want to do is repossess a ship in Russia. That is not our thing," he says, echoing his father’s view. In addition, "we are seeing an improvement in the ability of customers to get financing for helicopters in the U.S. and elsewhere."

Kurt was recently added to the executive committee of the International Helicopter Safety Team (IHST), the worldwide organization dedicated to enhancing safety and reducing the civil helicopter accident rate. AHS International led the IHST’s establishment in 2005.

"It gives us a chance to promote IHST safety items with our helicopter users and pilots," Kurt says, and gives IHST "our perspective on training safer pilots and reducing accidents."

As for product developments, Robinson is working on floats and a cargo hook system for the R66 and installing the Garmin GTN touch-screen navigator series, GTR communications and GMA 350H audio panel in the R22, R44 and R66. It is also working on the G500H multifunction display (MFD) for the R66.

The OEM is seeking FAA approval for installation of the Aspen Avionics MFD to replace the standard attitude horizon, directional gyro and the horizontal situation indicator.

The company has come a long way since Frank designed the R22 personal helicopter over 40 years ago. The company is not slowing down or altering its successful plan of producing affordable, functional helicopters.

Robinson's unique, centrally positioned T-handle cyclic and main and tail rotor designs reduced complexity, cost and aircraft weight. But early problems with pilot use of the highly responsive control system led to special training requirements for pilots in command and flight instructors. (Robinson Helicopter Company)