

8. HELICOPTER SIMULATION: MAKING IT WORK

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The benefits of flight simulation are well documented. The evidence is in daily practice throughout the world, but so far is confined mainly to fixed-wing aviation. Yet, the opportunities for improved training and checking using helicopter simulators are greater than for airplane pilot training. For example, simulators facilitate training environments conducive to the development of pilot decision-making, situational awareness, and cockpit management, all skills that are essential to a reduction in human-error accidents.

Accident data compiled from New Zealand's Air Transport Division mirrors data and reports from the NTSB, the FAA, the U.S. Army, and the Canadian helicopter operators. These data indicate that most helicopter accidents involve complacency or lack of training in how to handle the "chain of errors" that generally results in an accident. New Zealand studies confirm that most helicopter accidents in that country are also caused by pilot error, that these are not confined to any group of experience levels, and that 65% of the causes listed are not specific to the helicopter type. It is also worthy of note that helicopter accident rates have not seen significant improvements even though the machine's reliability has improved.

Studies from around the globe readily confirm what helicopter operators already know—the rate of accidents is too high and human error is the leading factor in aviation mishaps involving professional pilots.

Eighty percent of the world's helicopters are single-engine types operating almost exclusively in VMC and performing everything other than a flight from one airfield to another. Today's helicopter pilots operate in environments that require a wide range of skills that were not likely to have been addressed in traditional training. Most operators are conscious of this and do their level best to manage risks. However, for a great many this task has its own special difficulties.

For example, how effective can you be when the operation utilizes 28 helicopters comprising six different

types flown by 86 pilots of various nationalities all working in a foreign country and scheduled on flexible tours to perform a wide range of tasks in an environment that could involve sea-level jungle operations or mountains typically at 9,000 to 12,000 feet with temperatures of ISA +20. In these circumstances, for helicopters operators based in Papua, New Guinea, training and checking have their own special problems.

Likewise, a typical operator in New Zealand may operate two helicopters, both different types. These could be flown by two full-time and two part-time pilots. Any pilot may be expected to spray potato crops before breakfast, sling drilling material and supplies late morning, undertake a corporate mission in the early afternoon, and be called upon to consider a medivac after dark. A small Australian operator with one helicopter type may be supported by two casual pilots who also supply their services to at least three other operators, and in the course of their duties fly several different helicopter types on a variety of tasks, each with its own peculiar standards.

Although the examples used here are focused on the southwest Pacific area they illustrate a point that is common to a great deal of the international helicopter fraternity. That is, the use and variety of operational tasks expected from a helicopter are many times more varied and considerably more complex than those involving airplanes. Additionally, the commercial and economic reality of our industry will continue to ensure that even more innovative ways will be found to increase helicopter utilization. The risk-management difficulties faced by the average helicopter operator therefore can be quite complex. This task is often further exacerbated when the best solutions must also confirm with a regulatory requirement, the roots of which may have been specifically designed for an IFR airplane operation between airports.

Any pilot involved in training and checking commercial helicopter pilots can forecast with relative accuracy the types and circumstances of accidents that will occur within various operational roles. For example, it can be

said with assurance that within the month, somewhere in Papua, New Guinea, a pilot with more than 1,500 hours flight time and the benefits of recent sling-loading experience will be involved in an accident as the result of pilot error while sling loading. The circumstances will not be new. It may be the result of a skid having caught in a net while lifting off, or a rotor-strike while attempting to recover from a downwind approach without releasing the load. Whatever the cause, it will not be a new one, but a well-tried one repeated. In New Zealand this winter we can again expect a helicopter pilot to enter a cloud while trying to remain visual and as a result lose control and crash. The human-error accident, unfortunately, is the easiest to predict.

A study of New Zealand helicopter accidents from 1980 through 1989 showed that fewer than 10% of the human-error causes could be considered peculiar to the helicopter type involved. Very few accidents involving helicopters have a cause limited to only one specific manufactured type.

The reduction of human error is the most fertile area for an improvement in our helicopter accident rates. Universally the helicopter accident rate is managed by means of training and checking programs, the minimum requirements of which are usually determined by civil aviation regulations or rules. However, it is the quality and content of this training that will determine if the helicopter accident rates remain constant or are reduced.

Since there are obviously far more applications for commercial helicopters than for airplanes, there would seem to be a requirement for a greater diversity of skills among helicopter pilots. This strongly suggests a greater need for quality recurrent training with an emphasis on the occurring factors as evidenced in accident data. It is in this role that the helicopter simulator has its greatest future.

The airplane simulator has proven the benefits of simulation in imparting quality training. A study by United Airlines concluded that training in the flight simulator was 150% more effective than training in the actual aircraft. Simulator development for the airplane industry has been driven by cost benefits and regulatory compliance. Identical factors would also power a helicopter simulator industry. Cost-effective simulation, together with rules that would recognize training credits, would be sufficient for many operators to move their training and checking in the direction of helicopter flight simulation. The principal element involved is that the needs of a typi-

cal helicopter operator are very different from those of an airplane operator.

The use of helicopter simulation as a pilot recurrent-training tool has the potential to reduce accident rates, which has not, so far, been achieved using currently applied methods. For example, a sling-load training exercise with a pilot who incorrectly judges the wind direction and attempts a downwind approach could not be continued beyond a very early stage, for the risk to machine and occupants would be too great. In the aircraft, the training captain may establish the gravity of a given situation; however, the pilot concerned may not recognize a similar situation in the future because it was not prudent to repeat the exercise. The same exercise conducted in a simulator could be continued to conclusion and then repeated to illustrate the cues that could be used to recognize a similar situation again. Such training methods usefully demonstrate the benefits of procedures, decision points, etc.

Like a great many of the skills a helicopter pilot must maintain, sling-load training is not entirely helicopter-type-specific. The same background skills and experiences are applied to all sling loading regardless of what helicopter type is being operated. The same analogy can be made for many helicopter tasks ranging from hovering to mountain flying. To be effective, helicopter simulation must meet the broad needs of the 80%, mostly single-engine, VFR-only segment of our industry.

Based on our own experience, the evolution of simulation software, hardware, and visual systems can currently provide realistic and cost-effective helicopter simulation. Present technology can field a fixed-base cockpit, equipped with 150° day/night visuals and capable of mountain flying, sling loading, elevated heliports, etc. Such a device can be operated at costs that equate favorably with light turbine helicopters. Results can verify effectiveness. It is a fact that right now helicopter simulation has the capability of providing operators with the best risk-management tool available.

The conflict occurs when a definition of helicopter simulation is required in order to satisfy present rules and regulations. Immediately, comparisons are made with airplane simulators built to satisfy regulatory requirements for type transition, recurrent, and route training and checking. Although such requirements will fulfill the needs for a segment of the helicopter industry they fall wide of the mark when compared with the majority needs.

The establishment of our helicopter flight simulator in New Zealand first highlighted some of the difficulties that have yet to be resolved. In the absence of local policy

and relevant regulations, our air Transport Division looked to the FAA for assistance. As a consequence, we can foresee the very real danger that specifications and requirements applicable to the airline industry will be applied to helicopter simulation. Such an approach to rule making would no doubt keep helicopter simulators well out of reach of those 80% who need them.

By way of example, New Zealand's aircraft civil register lists approximately 330 helicopters (Australia has around 4,000). Typically, these constitute a mixed fleet of various types and models engaged in a wide variety of operations. As a comparison, the combined value of New Zealand's helicopter fleet would not exceed the value of two Boeing 747 airliners. Advanced training and checking technology translates into very costly equipment which has to be justified against relative values.

The answer may well lie within the significant research work that has been undertaken since the advent of modern flight simulation. Sufficient verification by authorities such as Alfred T. Lee and Paul W. Caro has removed the blurred distinctions that exist between training technology and flight-simulation technology. To provide characteristics of the helicopter that do not support that training objective is to increase the cost of the system for cosmetic rather than training purposes. Acceptance of such criteria will be fundamental to ensuring cost-effective helicopter flight simulation.

New helicopter-simulator criteria are vital and they should be in place now. A great many of the skills required by helicopter pilots are not type-specific and indeed could, for that matter, be accomplished in a generic simulator. Hovering, sling-loading, confined-area landings, mountain flying techniques—the list goes on. When using a simulator to check a pilot's emergency procedures in the event of an engine failure while carrying a sling load, the position of the cargo release becomes a mere detail if the pilot did not even consider releasing the load.

There are many important skills that contribute to safe helicopter flight. They apply to all pilots regardless of the type of aircraft or style of operation. Their relative importance, however, may be different for each crew member and operation. These are skills that are highly suited to be learned and practiced in the course of simulator training and checking exercises. They are:

1. Cockpit distractions
2. Stress management
3. Use and function of checklists
4. Communication skills

5. Workload assessment and time management
6. Decision-making and judgment
7. Management of flight resources
8. Managing people
9. Flight planning and progress monitoring
10. Pattern (chain of events) recognition

The state-of-the-art visual systems, such as the IVEX VTS 1000, can provide realistic cueing sufficient to conduct simulated day-time operations including hovering exercises. When such visual systems are integrated with a fixed-base cockpit exhibiting genuine helicopter characteristics, there begins to emerge a practical training tool fully capable of influencing the unfavorable accident statistics generated by the helicopter industry.

Although the practical benefits and training effectiveness of helicopter simulators can be argued, widespread acceptance of such devices by operators will largely depend on the results of rule makers and the training and checking credits available to offset the use of actual aircraft instead.

MR. LOMBARDO: Several times today I have heard this recurrent theme about the procedures, that it is not so important that the simulator be exact in terms of hardware. There is a piece of research that just came out, in the most recent issue of the Human Factors Journal, and I will quote it in my paper tomorrow in the low-cost session. But for the benefit those of you who cannot attend that session, a researcher has taken a group, split them in half, had one group learn to deal with the conceptualization of a piece of equipment, and then they went on to try and do the task on that equipment. Another group learned to do the procedure, but on a piece of equipment that wasn't the same as that used for the final tasks. Guess who won? The group that practiced the procedure won over the group that was familiar with the hardware. They were more readily able to adapt a known procedure to another piece of hardware than they were just to shift the concept of how something works.

So that recurrent here is a very, very strong theme. That is what I think we are looking for—the procedure.

MR. PAYNE: I agree with you. We can illustrate the point that every year somebody ends up autorotating a helicopter and putting it on the ground when it was perfectly serviceable to begin with. That is, it was perfectly serviceable up to the minute that it touched down. What the pilot saw and reacted to was what he thought was an engine failure. All his training taught him to do autorotation, touch-down autorotation. But the opportunity doesn't occur often enough to break down bit by bit what is

actually happening. So every year, your statistics, our statistics, show that if anyone who has a gauge failure and who doesn't pick that up as a gauge failure reacts to an engine failure, rolls the throttle back like they do in practice every time and carry on to the ground and usually muck it up.

And a simulator can help identify that. It will certainly provide the training in identifying the problem and, again, it can be a turbine simulator. It does not have to be one particular type.

MR. WALKER: I seem to see a difference in opinion about the requirement for ground contact maneuvers between you and the PHI paper [Gerald Golden, Petroleum Helicopters, Inc.]. Is that true?

MR. PAYNE: Well, I can understand any operator who says I don't want my equipment being smashed onto the ground. There are even experienced instructors who may not have the judgment, the continued day-after-day judgmental skills to ensure that an operator's very valuable equipment can exit a touchdown autorotation in a 100% serviceable condition. And I can understand any operator who says I don't want my equipment being subjected to that risk for training. That is a reality of life. So it does not obscure the fact that touchdown autorotations, I believe, are a very necessary part of training.

Our simulator does a pretty good simulation of a touchdown autorotation, although the last couple of feet are not all that realistic. But it becomes a lot more realistic when winding on the throttle at 100 feet and recovering with a flow through. What's more, you don't have to fly the circuit in between to reposition the helicopter. Again, you start from 2,000 feet. You can do repetition autorotations that have a lot of training value. My opinion is that the autorotation is a skill that the pilot must have, and maybe a simulator is a way of providing it with less risk.

MR. KATZ: This is a combination of a comment and a question. I very much appreciate and like what was said here about the skill being generic—I think the term was not used, but this is what it meant. Many of the skills are not type-specific. And therefore adherence, fidelity to a particular type, is not essential to get the training benefit. And I would like to throw out the suggestion that maybe you don't really have to adhere to any particular type, and maybe the most cost-effective way to reap training benefits for generic skills is in a generic simulator which may be a physically correct helicopter, which nevertheless does not correspond to any actual type.

MR. PAYNE: Thank you, I agree with you. And it certainly makes the collection of data to produce the model much easier. Thank you.



Barry W. Payne has worked extensively in the field of recurrent pilot training and human factors. He qualified as an aircraft engineer, airplane pilot, and helicopter pilot while a member of the Royal New Zealand Air Force. Following his military service, Mr. Payne worked in various general aviation roles throughout the southwest Pacific and Asia. He is a licensed aircraft engineer, an A-category instructor pilot with instrument rating, and has more than 10,000 flight hours. His company, Aviation Network (NZ) Limited, operates a Bell 205/UH-1H simulator which is used to train military and civilian pilots.

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