

significant differences were found to occur during the approach and landing phases. It is industry practice to tolerate very little air speed deviation from the recommended value during approach and landing. The FAA's Practical Test Standards (PTS) or Airman Certification Standards (ACS) for the airline transport rating allow a final approach speed of no more than five knots faster than recommended.

Another situation used in the simulator experiment reflected real world changes in approach that are common and can be assigned on short notice. While a pilot's lack of familiarity with the EFIS is often an issue, the approach would have been made easier by disengaging the automated system and manually flying the approach.

The emergency maneuver, engine-inoperative instrument landing system (ILS) approach, continued to reflect the same performance differences in manual flying skills between the two groups. The conventional pilots tended to fly raw data and when given an engine failure, they performed it expertly. When EFIS crews had their flight directors disabled, their eye scan began a more erratic searching pattern and their manual flying subsequently suffered. According to Dr. Veillette's 2005 article, those who reviewed the data "saw that the EFIS pilots who better managed the automation also had better flying skills."

While the Veillette-Decker study offers valuable information on the effects of cockpit automation on the pilot and crew, experience now shows that increased workloads from advanced avionics results from the different timing of the manual flying workloads. Previously, the pilot(s) were busiest during takeoff and approach or landing. With the demands of automation programming, most of the workloads have been moved to prior to takeoff and prior to landing. Since Air Traffic Control (ATC) deems this the most appropriate time to notify the pilot(s) of a route or approach change, a flurry of reprogramming actions occurs at a time when management of the aircraft is most critical.

Reprogramming tasks during the approach to landing phase of flight can trigger aircraft mishandling errors that in turn snowball into a chain of errors leading to incidents or accidents. It does not require much time to retune a VOR for a new ILS, but it may require several programming steps to change the ILS selection in an FMS. In the meantime, someone must fly or monitor and someone else must respond to ATC instructions. In the pilot's spare time, checklists should be used and configuration changes accomplished and checked. Almost without exception, it can be stated that the faster a crew attempts to reprogram the unit, the more errors will be made.

Since publication of the Veillette-Decker study, increasing numbers of GA aircraft have been equipped with integrated advanced program avionics systems. These systems can lull pilots into a sense of complacency that is shattered by an inflight emergency. Thus, it is imperative for pilots to understand that automation does not replace basic flying skills. Automation adds to the overall quality of the flight experience, but it can also lead to catastrophe if not utilized properly. A moving map is not meant to substitute for a VFR sectional or low altitude en route chart. When using automation, it is recommended pilots use their best judgment and choose which level of automation will most efficiently do the task, considering the workload and situational awareness.

Pilots also need to maintain their flight skills and ability to maneuver aircraft manually within the standards set forth in the PTS or ACS. It is recommended that pilots of automated aircraft occasionally disengage the automation and manually fly the aircraft to maintain stick-and-rudder proficiency. In fact, a major airline recommends that their crews practice their instrument approaches in good weather conditions and use the autopilot in the bad weather conditions and monitor the flight's parameters.

More information on potential automation issues can be found at the flight deck automation issues website: [www.flightdeckautomation.com](http://www.flightdeckautomation.com). This website includes a searchable database containing over 1,000 records of data that support or refute 94 issues with automated flying.

## Realities of Automation

Advanced avionics offer multiple levels of automation from strictly manual flight to highly automated flight. No one level of automation is appropriate for all flight situations, but in order to avoid potentially dangerous distractions when flying with advanced avionics, the pilot must know how to manage the course deviation indicator (CDI), navigation source, and the autopilot. It is important for a pilot to know the peculiarities of the particular automated system being used. This ensures the pilot knows what to expect, how to monitor for proper operation, and promptly take appropriate action if the system does not perform as expected.

For example, at the most basic level, managing the autopilot means knowing at all times which modes are engaged and which modes are armed to engage. The pilot needs to verify that armed functions (e.g., navigation tracking or altitude capture) engage at the appropriate time. Automation management is another good place to practice the callout