Task 13: Very Light Jet Single-Pilot Workload Assessment (Gildea, Hackworth, Knecht)

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Requirements Statement
Operational Shortfall or Knowledge Gap Operating aircraft offering advanced avionics differs from operating those with traditional analog instrumentation, simple autopilot functions, and reference to ground-based navigation. It requires an additional set of knowledge elements and skills. The design of integrated, glass-cockpit systems places a heavy cognitive load on the pilot in terms of long-term memory, workload, concurrent task management, and developing correct mental models of their functioning. These cognitive demands have a direct relationship to pilot errors committed during flight (Burian, 2007). A cursory review of accidents and incidents involving VLJs in the US National Airspace System (NAS) revealed potential issues with runway excursions or overruns. CAMI and NASA personnel will examine the challenges present during single-pilot operations in VLJs.
Benefit in Closing the Shortfall or Gap This research can describe guidance to reduce the cognitive complexity of these systems, minimize the likelihood of human error, and better support pilots managing the workload and resources of TAA in single-pilot operations.
Description of the Desired Product CAMI and NASA personnel will describe the outcomes of the simulator studies. This will include a set of recommendations that include training and technological countermeasures to task overload and workload breakdowns for single-pilots flying very light jets.
Schedule Develop scenarios, identify workload measurements, and developing materials needed for data collection Recruit subjects for study – minimum of 12, maximum of 24 (NASA) Complete trial runs of scenarios in simulator Construct data collection schedule Collect data Analyze data (including video-taped data) Write-up and disseminate results

Research Objective
Identify best practices to mitigate errors for single-pilots in VLJs.

Background

Burian (2007) analyzed almost 400 incident and accident reports, filed over a one year period, to identify the kinds of problems that potential VLJ/ELJ customers/pilots are having in the aircraft they currently fly and in the flight regimes in which VLJs/ELJs will operate. In this study a highly significant correlation between poor workload/time management, (i.e., poor crew and single-pilot resource management; CRM/SRM), and problems using advanced avionics was found. Additionally, it was found that almost two-thirds of the reports analyzed involved at least one of six different cognitive performance problems, and that these problems were similarly experienced by pilots flying professionally and by pilots flying for personal reasons.

Previous Activity on this Task

Three comprehensive IFR flight scenarios involving varying workload demands were developed for use in this study during FY08. The scenarios utilize the full range of automation, information, and resources available in an advanced VLJ/ELJ simulator, such as the primary flight display; flight management, flight guidance, and autoflight systems; FADEC; on-board XM datalink weather; electronic checklists; crew alerting and messaging system; flight mode annunciations; ADS-B; terrain and traffic alerting; electronic charts, taxi diagrams, and airport information, and the communications panel.

Burian and Dismukes (2007a; 2007b) identified numerous training issues for VLJ/ELJ pilots and explored some of the specific concerns of single-pilot operations in TAA and VLJs/ELJs. For example, workload management is probably the most crucial aspect of resource management for single pilots, and—despite what some may advocate—advanced technology and automation are not the same as a human co-pilot; technology can do much that can be quite challenging for humans (e.g., fly a perfect holding pattern compensating for strong winds aloft), but technology also has limitations that co-pilots do not (e.g., technology cannot question a pilot's decision-making or advocate a "go-around"). It is essential that both the advantages and the limitations of technologies are understood if they are to be used effectively.

AFS-800 has examined accidents and incidents involving VLJs in the US National Airspace System (NAS) revealing potential issues with runway excursions or overruns.

Proposed or Planned Research

CAMI and NASA personnel will examine the challenges present during single-pilot operations in VLJs.

Research Question(s)

1. What are the cognitive workload issues during single-pilot VLJ operations associated with abnormal and emergency scenarios in complex airspace or during high-workload phases of flight?
2. What performance-planning considerations should occur before flight for takeoff/landing and during flight for changed landing conditions at runways less than 5000 feet long?
3. Are there issues with stabilized approach criteria and adherence to Airplane Flying Manual (AFM) recommended speeds during visual or IFR circling approaches?

Technical Approach

Current Year

Develop scenarios, identify workload measurements, and developing materials needed for data collection.
Recruit subjects for study

Out-Years

Complete trial runs of scenarios in simulator.
Analyze data (including video-taped data)
Write-up and disseminate results
Examine the impact of NextGen requirements upon single-pilot VLJ operations and other technically advanced aircraft operations.

Air Traffic Resources Required

Air Traffic Controller Subject Matter Expert to assist with scenario development

Information Technology Resources Required

Assist with software integration in simulator upgrades. Assist with Eyetracking software installation; replay of simulation contract

Calibration

Researchers will calibrate eye tracking equipment after purchase and ensure that they are calibrated prior to beginning data collection

FY10 Milestone Schedule		
Description	Proposed Start Date	Proposed Completion Date
Develop scenarios, identify workload measurements, and developing materials needed for data collection	FY09 Q3	FY10 Q3
Complete VLJ Upgrade	FY10 Q1	FY10 Q4
Purchase Eyetracker	FY10 Q1	FY10 Q1
Develop data collection logistics and video equipment set-up	FY09 Q4	FY10 Q2
Submit IRB protocol	FY09 Q4	FY10 Q2
Recruit subjects for study – minimum of 12, maximum of 24 (NASA)	FY10 Q1	FY10 Q3
Complete trial runs of scenarios in simulator	FY10 Q1	FY10 Q4
Collect data from VLJ pilots	FY10 Q1	FY10 Q3
Data Analyses	FY10 Q3	FY10 Q4
Draft report of results	FY10 Q4	FY11 Q3

FY10 Deliverables		
Description	Proposed completion date	Actual completion date
Report summarizing best practices to mitigate errors for single-pilots in VLJs	FY10 Q4	FY11 Q3