Flight Data Monitoring (FDM)

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Introduction

The Embry-Riddle Aeronautical University Prescott campus maintains a fleet of twenty aircraft, sixteen Cessna 172S NavIII and four Diamond DA42NG, which are all equipped with flight data monitoring software capability. The data can be used to detect and analyze non-compliance with company operational policies, performance trends for higher-risk operations such as landing and takeoff, and to create both textual and visual reports on any findings. The data is consistently being used to track and note all parameters by the Department of Flight Safety.

Problem

Topics that are currently being pursued include the following:

- Comparing detected taxi speeds with operational recommendations
- Comparing the taxi speed exceedances with the reported wind speed
- Noting engine overspeeds and categorizing according to intensity

Method

System

- Flight data is recorded on an SD card within the multi-function display of the Garmin G1000 system.
- Capable of recording 64 parameters at a 1 hertz frequency.
- Data is extracted from the multi-function display at intervals encompassing two weeks of flight time.
- Analyzed by software that has been developed by Garmin and Embry-Riddle Aeronautical University.

Taxi Speed Exceedances

- The ERAU Flight Operations Manual defines an appropriate taxi speed as “that which gives the pilot safe, positive control at all times”
- Taxi speed s are recorded once at 25 knots, and again at 30 knots, for the duration of travel above either speed.

RPM Overspeeds

- The ERAU Standard Operating Procedures Amplifier (SOPA) defines a momentary engine overspeed as "an increase of not more than 10% of the engine's rated RPM for a period not exceeding 3 seconds.
- The ERAU SOPA defines the alternative as such: "If an overspeed of more than 3 seconds occurs between 2700 RPM and 2970 RPM, the aircraft must be downed upon return, the event documented on the discrepancy form, and a hazard report filed“
- In the system, momentary overspeeds are coded yellow, and the more serious overspeeds are coded red.

Wind Data

- Wind is collected daily from the local Automatic Terminal Information Service (ATIS) by the flight supervisor

Results

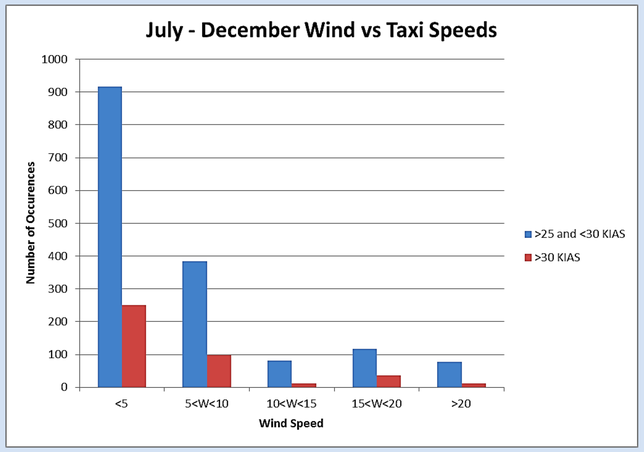

Figure 1

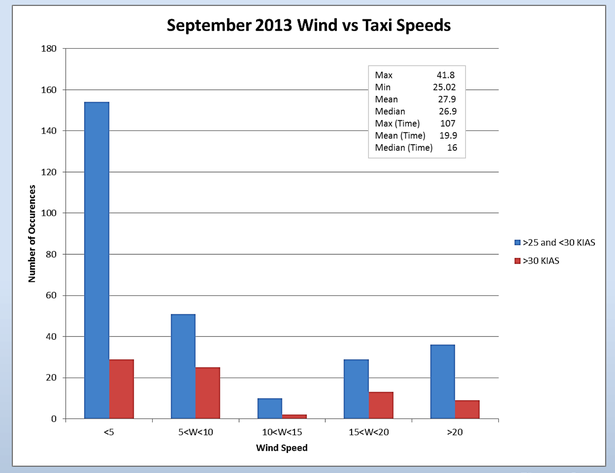

Figure 2

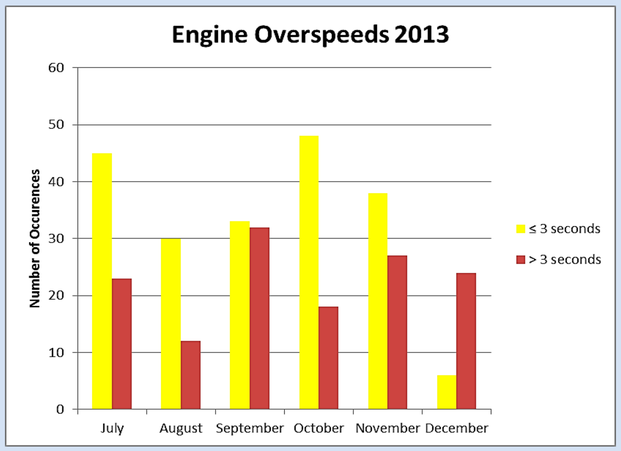

Figure 3

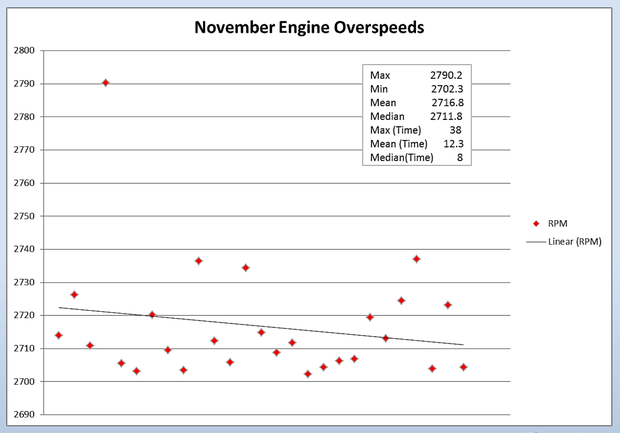

Figure 4

- Speed measured in Knots Indicated Airspeed (KIAS)
- Time measured in seconds
- Overspeeds measured in Revolutions Per Minute (RPM)
- Figure 1: A cumulative graph of taxi speeds as related to wind from July to December 2013. The different bars represent the different events flagged on the system.
- Figure 2: An example of the data from a single month within the scope of Figure 1.
- Figure 3: A cumulative graph showing the number of overspeed between July and December 2013. The different colors represent the different events flagged on the system.
- Figure 4: A graph showing specific overspeed occurrences from a single month within the scope of Figure 3. This graph only shows the “red” events. Line of best fit shown.

Findings

- The majority of taxi speeds flagged by the system were speeds of under 30 knots.
- The cumulative results mirror the graph shapes of the individual months.
- The majority of overspeeds are momentary.
- Red overspeed flags are much more likely to be caused by time than RPM.
- The majority of yellow flags can be grouped into events that happened in quick succession (opposed to approximately 1/3 of red flags).

Future Directions

- Taxi speed exceedances could be further studied by comparing the plane’s location on the field with the speed in a manner similar to the current comparison with wind.
- Analyzing approach angles of flights conducted under visual flight rules (VFR).
- Comparing the approach angle to the reported wind speed, including the headwind and crosswind components, or to the active runway during the flight.

Research Proposal – Flight Data Monitoring (FDM)

The Embry-Riddle Aeronautical University Prescott campus maintains a fleet of twenty aircraft, sixteen Cessna 172S NavIII and four Diamond DA42NG, which are all equipped with flight data monitoring software capability. The flight data is recorded on an SD card within the multi-function display of the Garmin G1000 system. The system is capable of recording 64 parameters at a 1 hertz frequency. The data is extracted from the multi-function display at intervals encompassing two weeks of flight time. It is then analyzed by software that has been developed by Garmin and Embry-Riddle Aeronautical University. The data can then be used to detect and analyze non-compliance with company operational policies, performance trends for higher-risk operations such as landing and takeoff, and to create both textual and visual reports on any findings. While the data is consistently being used to note all exceedances, specific projects that are currently being pursued include the following:

- Comparing detected taxi speeds with operational recommendations
- Comparing the recommended taxi speed exceedances with the reported wind speed
- Analyzing engine overspeeds and the frequency of occurrence

Although the current visual representations are based on the aforementioned topics, there are several opportunities to explore these projects more in-depth. For example, taxi speed exceedances could be further separated by which taxiway the plane was on, or engine overspeeds could be further separated between the different phases of flight. Both projects could incorporate the experience levels of the student and instructor in the same way that wind is currently being used for comparison.