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Flight Data Analysis: A Mixed Methodology Construct

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Abstract

This exploratory study utilizes large data sets emanating from flight data recorders on a fleet of general aviation training aircraft. These flight data sets reveal and provide potential correlations between pilot experience levels and in-flight engine events within a flight school environment. The origin of this research comes from the collection of flight data that is produced during a flight school aircraft operation and analyzed by an Aviation Safety staff at a major flight training university. These data were collected over a period of six calendar months during the calendar year 2018. The raw data is analyzed through a Flight Data Management program created and used by Embry-Riddle Aeronautical University. The results will be de-identified, as the focus of the research utilizes a grounded theory model to conceptualize results from the flight data recorders. The results will be presented with a mixed methodological construct that provides outcomes for flight safety enhancement. Results are not yet defined and will only be presented to flight management.

Introduction

This research data collected over a six-month period allows a qualitative deduction of theories about the existence of certain flight events, some of those critical safety incidents. In order to achieve improvements in safety, flight school operations such as Embry-Riddle, or any other operation voluntarily participate in Operational Flight Data Monitoring. In 2004, the Federal Aviation Administration introduced a voluntary program to improve safety called Flight Operations Quality Assurance, or FOQA. This safety program allows commercial airlines to share flight data with the FAA. Some of the objectives of the program are to monitor operational safety, evaluate training, and to survey any operational issues with aircraft systems (FAA, 2004). Any identifying information is removed from the data before it is shared. The reason for de-identification is that there is high value in the voluntary surrender of information that may not be otherwise gathered. The purpose of the information sharing between commercial operators and the FAA is not to pursue regulation violations. This partnership allows the Federal Aviation Administration to observe information that is fundamental in the improvement of flight safety. According to the FOQA Advisory Circular, the most value of flight data monitoring is the ability to identify trends before they become accidents. (FAA, 2004)

Most modern aircraft are equipped with automatic recording systems. These systems usually include flight data recorders and cockpit voice recorders (CVR). Flight data recorders monitor and record parameters and flight limitations. According to Rodrigues and Cusick (2012), flight data recorders were originally installed with the intention of assisting investigators in the event of a large commercial airline disaster. Pilots and air traffic controllers agreed to the use of recorders for the betterment of the industry, and in exchange were promised protection from disciplinary action unless willful malintent was discovered.

On a regular basis, flight recorder data is downloaded and analyzed. This process allows flight operators to identify and evaluate trends and precursors to risk. The Garmin G1000 Flight Deck is an integrated flight instrument system used in general aviation aircraft (Meyers, 2009). It is installed in Cessna 172R, 172S, and 182 aircraft (Garmin, 2011). The system contains data collection cards which can be extracted from the aircraft by a safety staff member, and the data is then uploaded into a Flight Data Management software. The data points are collected per month of flight hours, are recorded from a fleet of nineteen aircraft. Parameters that are being analyzed include levels of pilot experience indicated through flight hours, flight curriculum, flight maneuvers and phases of flight in which certain events occur. Flight data management contributes to increases in safety and efficiency for operators who participate. The data provided can aid in the prevention of accidents an incident, which reduces both material and human losses (FAASTEAM, 2014). Data from a flight operation can proved insight to the operator and allow for improvements and growth. In a flight school environment, data can allow for the adjustment of curriculum and procedures to benefit the instructor, student and the operation.

Application

A mixed methodology approach is ideal for flight data analysis, as this approach allows the integration of numeric data and observational data. Quantitative data collection occurs when the event data is catalogued by aircraft tail number, event duration and phase of flight. The quantitative data instrument to be used will be the Flight Data Management program and flight data recorder process. Qualitative data collection will occur when numerical data is compared to pilot logs provided by a flight training schedule program. This data will reveal the rate an event occurs over the six-month period of flights recorded. ETA, or Education and Training Administration provides Embry-Riddle flight students and instructors with a system that records

training records and schedules flight activities. Through this program pilot training levels and curriculum can be observed. As a student advances through flight courses, flight the activities they participate in will allow them to advance through private pilot, single-engine, multi-engine, and eventual Flight Instructor courses. The data used for this research will come from all but multi-engine flight recorders. The results may include both observations and statistical analyses. The quantitative data to be collected will allow the researchers to understand any behaviors related to event occurrence (Salkind, 2006).

Methodology

A mixed methods approach is proposed for this study due to the nature of the process required to extract the data from the Garmin G1000 flight instrument and locate the location of the events found. According to Plano Clark and Ivankova (2016), mixed methods research is the combination of quantitative and qualitative methods to answer a research question. It also allows the researcher(s) to compare the results from both quantitative and qualitative methods and confirm whether the results agree. The rationale for choosing a mixed methods design lies in the basis that the methods have the potential to follow the same process as flight data monitoring. The data gathered from the Cessna 172 aircraft was recorded from the first day of March 2018 through the end of August 2018. Each data card originates from a specific aircraft tail number. Every flight is coded with a specific file that begins at engine start. At this time the Garmin G1000 begins recording every movement of the aircraft including ground movements. Engine parameters are recorded, which include cylinder head temperatures, RPMs, and fuel and oil pressures. Flight altitude is also recorded every second as well as the position of the aircraft relative to degrees of pitch and roll. When the data is extracted and uploaded into the Flight Data program, it can be reviewed and organized based on the occurrence of a certain event, time and

date, and aircraft tail number. For the purpose of this study, an event will be explored to determine its rate of occurrence. The data is extracted and opened in the Google Earth application to establish the geographic area it took place and record the phase of flight. This information is important to explore the theory of flight curriculum and the relation to event occurrence. When the results of the data management process are recorded and complete, Flight Safety staff will explore the causal factors. These could include flight instructor training hours, student training hours or the current curriculum the student is being trained in. Specific lesson plans also fall into the category of possible causal factors. Geographic location such as the training area the event occurred in, terrain, and proximity to an airport are may be considered the source of an event.

The exploratory mixed methods design closely follows the process used in flight data management. This approach involves a two-phase project in which qualitative data is collected first, and the results allow a second phase of qualitative methods is designed (Creswell, 2013). This method is designed to allow the researcher to explain the reasoning for qualitative data with quantitative results. The qualitative phase of this study occurs when flight data is gathered and organized, and the second phase occurs when the results are explained with quantitative results gathered from survey or observation.

Conclusion

The purpose of this study is to create awareness of event occurrences in flight and share the results with flight management to gain a better understanding of the reasoning for even occurrences. The goal of the research is to improve safety and reduce the number of event occurrences. This study is on-going as a result of the lengthened process of determining phase of flight in Google Earth. Due to the sensitive nature of the study, the results will be de-identified

and shared only with specific management personnel. The purpose of the study is not to pursue or criticize individuals connected to an event occurrence. The identification of hazard trends is the true intention of flight data monitoring. The analysis of flight data allows management to identify event trends and create controls. The outcome of this study will be used to improve Embry-Riddle Aeronautical University flight training and improve the safety of students and instructors.

Future Research

The completion and presentation of this study may create awareness for the monitoring of other specific in-flight or ground events. The event occurrence that is being measured for this study will not be released due to the nature of the event. Future research may include an expanse of event occurrences to be monitored as well as different parameters. An expansion of this project will be explored after completion to determine the scope of future research.

References

Federal Aviation Administration. (2004). Advisory Circular 120-82, *Flight Operational Quality Assurance*. Retrieved from www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document.information/documentID/23227

Rodrigues, C. C., Cusick, S. K., & Wells, A. T. (2012). *Commercial aviation safety* (5th ed.). New York, NY: McGraw-Hill Professional.

Meyers, J. (2009, July). Garmin® Reveals G500 All-Glass Cockpit for Part 23 Class I/II Aircraft. Retrieved from https://newsroom.garmin.com/press- release/aviation/garmin-reveals-g500-all-glass-cockpit-part-23-class-iii-aircraft

Garmin (2011) *Garmin G1000 Integrated Flight Deck Pilot's Guide*. U.S.A., Garmin Ltd.

Creswell, J. W. (2013). Qualitative Inquiry & Research Design: Choosing among Five Approaches (3rd ed.). Thousand Oaks, CA

Plano Clark, V., & Ivankova, N. (2016). *Mixed methods research: A guide to the field*. Thousand Oaks, CA: SAGE Publications, Inc. doi: 10.4135/9781483398341

FaaSTEAM (2014, January). *Flight Data Monitoring,* The General Aviation Joint Steering Committee Safety Enhancement Topic of the Month, FAA Safety Briefing

Salkind, N.J. (2006) Exploring Research. 6th Edition, Prince-Hall, Upper Saddle River.

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