Helicopter Flight Data Monitoring

Summary Report

Helicopter Safety Enhancement No. 82

This Summary Report was prepared by the H-SE-82 Team to inform the USHST, FAA, and industry and serve as a gateway document that promotes HFDM, particularly for small operators who may not be aware of its benefits.

April 19, 2023

Prepared for the USHST for promotion through industry stakeholders and safety advocates.

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Table of Contents

Table of Contents ....................................................................................................................................................... 3
1. Background............................................................................................................................................................. 5
2. Scope ...................................................................................................................................................................... 6
   Notes Regarding H-SE Scope .................................................................................................................................. 6
3. What is HFDM? ..................................................................................................................................................... 7
   3.1 Flight Data Capture..................................................................................................................................... 7
   3.2 No HFDM ..................................................................................................................................................... 8
   3.3 Camera-based HFDM................................................................................................................................. 8
   3.4 Parametric HFDM .................................................................................................................................... 9
   3.5 Monitoring................................................................................................................................................ 10
4. Understanding, Implementing, and Harnessing the Value of HFDM ............................................................... 11
   4.1 Why is the use of data recording devices valuable to an owner/operator? ............................................ 11
   4.2 How can I implement HFDM in my operation? ........................................................................................ 11
   4.3 When is HFDM required? .......................................................................................................................... 11
   4.4 What is a FAA-approved HFDM, and can HFDM be part of a FOQA program? ................................. 12
   4.5 What is a Safety Management System (SMS)? ........................................................................................ 12
   4.6 How is HFDM part of an effective SMS? ................................................................................................... 13
   4.7 How can HFDM benefit from global safety metrics? .............................................................................. 13
   4.8 What is ASIAS? ........................................................................................................................................ 13
   4.9 How can HFDM work with ASIAS? ........................................................................................................... 13
5. HFDM: Disposition of Project ................................................................................................................................. 15
   5.1 Changes to Key Goal ................................................................................................................................... 15
      5.1.1 The original key goal (Performance Goal Indicator) of H-SE 82 was: ...................................... 15
      5.1.2 The revised key goal of H-SE 82 is: ................................................................................................. 15
   5.2 Status of Project: Disposition of Actions in Output #1 (Educational Outreach): .................................. 15
   5.3 Status of Project: Disposition of Actions in Output #2 (FAA Call to Action): ........................................ 18
      5.3.1 Original H-SE 92 Output #2 ............................................................................................................ 18
      5.3.2 Updated Output 2: FAA Call to Action .......................................................................................... 18
6. Summary.................................................................................................................................................................. 20
1. Background

The US Helicopter Safety Team (USHST) is a volunteer team of US government and industry stakeholders formed to improve the safety of civil helicopter operations in the National Airspace System. The USHST’s vision is a civil US registered helicopter community with zero fatal accidents. Through data-driven accident and flight safety data analyses, the USHST’s mission is to understand the US helicopter community’s safety issues and use that understanding to promote the development and implementation of voluntary, consensus-based risk mitigations called helicopter safety enhancements (H-SEs).

During the USHST 2016 deep analysis of 52 fatal accidents from the 2009-2013 dataset, the majority of fatal accidents that occurred had insufficient data surrounding the details of the helicopter’s state (i.e., flight data, audio/video from the cockpit, control positions, etc.) when the critical events occurred. This is in direct contrast to commercial aviation where flight data recorders and cockpit voice recorders provide investigators and operators with a multitude of parameters for accident/incident investigation and trend/anomaly detection. Although some of the helicopters in the dataset did have flight data monitoring devices installed, they were a very small minority.

The premise of this safety effort is that data recording devices combined with an effective feedback mechanism (i.e. a HFDM program) enable proactive intervention before an event occurs. Based on some of the fatal accidents in the 2009-2013 dataset, the USHST working group thought a flight data monitoring system could have made a difference if it was operated as part of a voluntary safety program (and greater benefits are possible when linked to ASIAS or other comparable programs). Hazardous behavior could have been identified with the opportunity to break the accident chain before it resulted in a fatality.

The following 15 fatal accidents prompted H-SE 82 (by NTSB Accident Number):

<table>
<thead>
<tr>
<th>CEN10FA424</th>
<th>CEN10FA509</th>
<th>CEN12FA621</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEN13FA357</td>
<td>ERA09FA417</td>
<td>ERA14FA010</td>
</tr>
<tr>
<td>WPR09FA104</td>
<td>WPR11FA239</td>
<td>WPR11FA350</td>
</tr>
<tr>
<td>WPR12FA282</td>
<td>ERA10FA283</td>
<td>WPR12LA259</td>
</tr>
<tr>
<td>ERA10LA348</td>
<td>WPR13FA080</td>
<td>ERA13FA273</td>
</tr>
</tbody>
</table>
2. **Scope**

The USHST established H-SE 82 - Helicopter Flight Data Monitoring as a desired safety enhancement that recommended technology and equipment solutions to capture data, monitor trends and provide operational feedback to improve safety and reduce fatal rotorcraft accidents. This safety enhancement is related to several initiatives including:

- 2016 thru 2021-22 NTSB Most Wanted – [Install Crash-Resistant Recorders and Establish Flight Data Monitoring Programs](#)
- FAA Rotorcraft ASIAS
- Previous 2011 IHST/USHST Safety Recommendations (IHST is now the VAST).

The data recorder equipage promoted in H-SE 82 would greatly inform and improve all current and future safety initiatives. Additionally, this effort is related to USHST H-SE 100 - Digital Copilot, which involves data capture and analysis specifically intended to provide contextual advisory and assistance to a pilot during flight.

The H-SE 82 HFDM project is divided into Output #1 which is to develop an education outreach campaign to promote HFDM adoption, and Output #2 which is an FAA effort to clarify policy issues related to HFDM implementation.

**Notes Regarding H-SE Scope**

a. Detailed changes from the original H-SE 82 scope are described in Section 5, HFDM: Disposition of Project.

b. Special emphasis will be placed on justifying the cost of HFDM adoption and ease of effective use for small operators.

c. HUMS and HFDM technologies are likely to merge over time due to advances in computation and sensor technology.

d. The NTSB has noted that recording equipment, such as may be used in HFDM, does not often survive post-crash unless it meets a crashworthiness specification such as ED-155.

e. HFDM data can support safety tools such as SMS, FOQA, and ASIAS.

To help prevent fatal helicopter training accidents resulting from inadequate preflight risk assessments, this H-SE should provide recommended practices for pre-flight risk assessment guidance and advisory information specific to the training environment.
3. What is HFDM?

Helicopter Flight Data Monitoring (HFDM) is the systematic, pro-active use of flight data from routine helicopter operations to improve safety and operational efficiency. HFDM programs assist operators to objectively identify, quantify, assess and address operational risks, improve flight crew performance, operating procedures, flight training, aircraft maintenance and more.

HFDM is an on-going virtuous cycle that generally looks like:

![Diagram of HFDM cycle]

There are two main components to HFDM: a system that captures flight data (technology and people) and a system that monitors flight data (trends, analysis, feedback and people management).

3.1 Flight Data Capture

The flight data capture part of HFDM can be accomplished by various means and three general approaches are broadly compared in the table below and discussed in more detail in the section following:

<table>
<thead>
<tr>
<th>Area of Consideration</th>
<th>No HFDM</th>
<th>Camera-based HFDM</th>
<th>Parametric HFDM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acquisition costs $</td>
<td>n/a</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Operating costs $ and time</td>
<td>n/a</td>
<td>Moderate</td>
<td>Low</td>
</tr>
<tr>
<td>Total costs $ and time</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Data Acquisition</td>
<td>n/a</td>
<td>Moderate</td>
<td>High</td>
</tr>
<tr>
<td>Data Scope</td>
<td>n/a</td>
<td>Moderate</td>
<td>Moderate to High</td>
</tr>
<tr>
<td>Data Objectivity</td>
<td>n/a</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Analysis cost</td>
<td>n/a</td>
<td>Moderate</td>
<td>Low</td>
</tr>
<tr>
<td>Analysis Scope</td>
<td>n/a</td>
<td>Moderate</td>
<td>Moderate to High</td>
</tr>
</tbody>
</table>
### 3.2 No HFDM

The simplest type of HFDM data capture system to imagine is no HFDM, which is also the most widespread and cheapest to implement. It is also the costliest since no robust mechanism exists to reduce the chance of the next unscheduled inspection, component overhaul, or to catch undesirable flight operations that may precede a mishap or fatal crash. Even if you only fly your own ship and your operation is not subject to any requirement for HFDM, the cost justification to support adopting HFDM can often be found in evaluating a single exceedance event. The analysis of fatal accidents performed by the USHST revealed that very little flight data exists about most mishap flights outside of crash scene evidence.

The costliest mistakes are often the ones repeated, and without HFDM, it is unlikely an operator has a systemic way to objectively categorize important criteria, capture exceedances, procedural non-compliance or manage needed improvements. Since there is no data capture, very little trend analysis is possible outside of unscheduled maintenance costs and accident rate. Pro-active measures to avoid expensive mistakes rarely happen without a system such as HFDM.

### 3.3 Camera-based HFDM

A camera-based data capture system is usually aimed at the pilot’s forward view and may also capture audio, cockpit activities and instrument indications. This requires equipment to be purchased and installed on the helicopter. Camera-based recording systems can provide the most intuitive sort of HFDM data for personnel to review since it likely provides valuable ‘out the window’ context. These systems may also capture supporting parametric data such as GPS, attitude and accelerations which help with context.

This type of system relies on regular review of camera-based data and may need further resources to categorize important exceedance.

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Figure 1: Example HFDM camera frame from a night hover taxi
and compliance criteria and extract useful analysis. Additional computer resources may be needed to manage a
large flow of data from a camera-based system to review data before it is erased (or overwritten). If data
extraction from camera images of aircraft instruments is important (such as the position of the needle on a
mechanical gauge), further image processing resources may be needed. If data can be digitized, threshold values
can be defined, and parts of the analysis can be automated. Image resolution, frame rate, crashworthiness,
resistance to tampering and security of removable data storage devices need to be considered by the operator.
Camera-based data can be used to objectively categorize important criteria, capture exceedances, procedural
non-compliance and perform trend analysis to take pro-active actions while not posing an undue burden on the
operator.

3.4 Parametric HFDM

A parametric data capture system is composed of digital recorder equipment interfaced to various sensors and
signals throughout the helicopter and therefore requires a more extensive installation. Parametric data
recording systems can provide many channels of detailed data on various systems, air data, GPS, accessories,
rotor and engine parameters.

Parametric data is arguably the least subjective HFDM dataset, however judgment is required to understand the
context in which data is captured if the ‘out the window’ context is not captured or understood. Parametric data
is well suited to digital statistical analysis and large datasets and large numbers of flights can be analyzed and
stored with minimal resources. Threshold values can be defined, and parts of the analysis and monitoring can be
automated.

Figure 2: Example HFDM parametric data with rotor overspeed event detected by analysis
Parametric data can support fast analysis and feedback, in as little as a few minutes to support post-flight debriefing and flight training. In some cases, parametric data can be interfaced to inflight devices for real-time exceedance and trend information. This type of data capture system may use permanently installed memory devices and can readily be made tamper resistant. Data format, scope and sample rate, crashworthiness and security of data need to be considered by the operator. Parametric data can be used to objectively categorize important criteria, capture exceedances, procedural non-compliance and perform trend analysis to take proactive actions while not posing an undue burden on the operator.

3.5 Monitoring

The monitoring component of HFDM is the analysis of captured data to identify trends and operational performance from a standpoint of safety, to support proactive measures for the management of people and procedures to achieve improvement. This is summarized as feedback to management and personnel involved with flight operations to support continuous improvement.

The best HFDM data capture in the world is not very helpful unless it is effectively communicated, and critical processes and personnel are managed. Optimally, this happens proactively, before mishaps. It is often missed that HFDM is comprised of data capture equipment and a monitoring component. This leads to a need to promote technology and safety behavior in parallel, and in some cases consider a Safety Management System (SMS) to address broader aspects of the organization. There are effective concepts in organization, communication and management that can be taken from SMS and Just Culture practices, but the basic concept relevant to HFDM is simply that data capture and monitoring activities are not to be used in a punitive way but rather used in a feedback system to enhance safety and performance. A safety culture of trust must exist for HFDM performance improvements to be realized.

There are outside service providers who may handle HFDM data analysis and other aspects of data management such as auditing services. Please see listings in section 9.

Another outstanding benefit of HFDM is to extend an operator’s ability to monitor and understand important trends that are global, by receiving information from a much larger dataset. This is a metadata approach and opens the door for numerous cutting edge technologies, new algorithms and Artificial Intelligence to identify important patterns. One such program is ASIAS, described later in this section.

Bottom line: If you conduct flight operations, HFDM can save you money.
4. Understanding, Implementing, and Harnessing the Value of HFDM

4.1 Why is the use of data recording devices valuable to an owner/operator?

The use of data recording devices can provide valuable insights that would otherwise be missed. If acted upon and monitored in a program such as HFDM, this information can be used to reduce the cost of operations, support maintenance decision making and flight training.

1. Oversight of your flight operations
2. Fleet management (enabler for remote/dispersed fleet management)
3. Ensure SOP compliance
4. Ensure regulatory compliance
5. Detailed trend analysis to identify safety issues
6. Detailed trend analysis to identify unscheduled maintenance risks
7. Early warning of maintenance issues and troubleshooting support
8. Actionable data for your training effort (pilots, operational personnel and procedures)
9. Detailed support for flight school students, instructors and curriculum
10. Detailed review of specific flights of interest
11. Assistance with investigations, show compliance with airspace, noise abatement, etc...
12. Potential for reducing insurance fees, aid in qualifying for insurance coverage
13. Financial savings at the bottom line

4.2 How can I implement HFDM in my operation?

HFDM requires you to install a recording device and set up a mechanism to review the flight data you capture and provide feedback to appropriate personnel. This document is designed to provide enough information to get you started on the path in implement HFDM. Also, please refer to the HFDM Quick Start Guide in Appendix A.

4.3 When is HFDM required?

As of this writing, Helicopter Air Ambulance operations are subject to a HFDM requirement under 14 CFR §135.607 and the required equipment guidance can be found in FAA Advisory Circular AC 27-1B, MG 6 paragraph b. (13) described as “FDMS”. Further description of the recorder equipment is found in ED-155 which is the EASA minimum operational performance specification for a lightweight flight data recorder (FDR) system.

Under 14 CFR part 121 Operating Requirements: Domestic, Flag, and Supplemental Operations, FDM is part of required SMS processes described in 14 CFR Part 5. Recent events have prompted industry and regulators to strongly promote SMS for a wider range of operations.

In January of 2023, the FAA issued an NPRM proposing SMS will be required for all part 135 air taxi operators, air tours operating under §91.147 and certain holders of a type certificate or production certificate under part 21. HFDM has an important role to play in SMS systems as a means of flight operations data capture. The NPRM can be found here: https://www.govinfo.gov/content/pkg/FR-2023-01-11/pdf/2022-28583.pdf.
A review of the current rules (especially part 91 and 135) applicable to your organization and flight operations should be done at least once a year. HFDM is likely to become more broadly required to support future SMS and recorder needs.

### 4.4 What is a FAA-approved HFDM, and can HFDM be part of a FOQA program?

HFDM is a voluntary program, self-administered and tailored to operator needs. HFDM data, equipment and monitoring procedures can be used as a starting point for other safety programs. Some operators may seek to formalize their HFDM program with the FAA, sometimes to take advantage of enforcement incentives described in 14 CFR §13.401 (e). In this context, HFDM (and FDM) may be thought of interchangeably with a Flight Operational Quality Assurance (FOQA).

- Guidance for FAA approved FOQA programs is currently found in [FAA Advisory Circular AC 120-82](https://www.faa.gov/regulations_policies/advisory_circulars/).
- Guidance for UK CAA programs is currently found in [CAP 739](https://www.caac.gov.uk/).  
- Guidance for EASA programs is currently found in [JAR-OPS 1.037](https://www.easa.europa.eu/).  

### 4.5 What is a Safety Management System (SMS)?

SMS is a formal, top-down, organization-wide approach to managing safety risk and assuring the effectiveness of safety risk controls. It includes systematic procedures, practices, and policies for the management of safety risk. SMS is defined by FAA Order 8000.369. Rev C, current as of this writing can be found here: [FAA Order 8000.369C](https://www.faa.gov/regulations_policies/orders Circulars/). HFDM is not an SMS but can provide data, analysis and monitoring to support SMS. SMS structure is depicted below and the four SMS components, each of which can be supported by HFDM data and processes:

![Figure 3: FAA SMS Volunteer Program Diagram](https://example.com/sms-diagram.png)

By recognizing the organization’s role in accident prevention, SMS provides to both certificate holders and FAA:

- A structured means of safety risk management *decision making*
- A means of demonstrating safety *management capability* before system failures occur
- Increased confidence in *risk controls* though structured *safety assurance* processes
- An effective interface for *knowledge sharing* between regulator and certificate holder
A safety promotion framework to support a sound safety culture

Further SMS details can be found at https://www.faa.gov/about/initiatives/sms/explained

4.6 How is HFDM part of an effective SMS?

HFDM is not an SMS but can provide data, analysis and monitoring to support SMS. Flight data monitoring provides quantifiable data within a safety management system. This data can be used by operators to make data driven decisions and provides operator confidence in their risk controls though structured safety assurance processes like SMS.

4.7 How can HFDM benefit from global safety metrics?

Participation in safety programs working side by side with HFDM provide a window into global perspectives and broader analysis that can greatly increase the effectiveness of a small operator’s safety program. Additionally, it becomes possible to take a meta-data approach to analysis and leverage data from one HFDM operator to many operators, and vice versa. Thus, even a single ship HFDM operator can benefit from industry wide metrics.

4.8 What is ASIAS?

ASIAS is the Aviation Safety Information Analysis and Sharing which is a meta-data analysis program. All participants are voluntary and represent all segments of aerospace. It is a collaborative government and industry initiative to share and analyze data to proactively discover system safety concerns before accidents or incidents occur, leading to timely mitigation and prevention. More information can be found here: https://www.rotorcraft.asias.info/about.

4.9 How can HFDM work with ASIAS?

HFDM data can be deidentified and shared with ASIAS. Analysis can then be performed on a larger dataset, identifying trends that might not be apparent to any one operator, and how the operator trends relate to other with similar operations. ASIAS can identify broad global trends, and trends specific to a geographic area, particular helipad, or helicopter make/model. ASIAS is not a FAA enforcement mechanism and is not intended to replace operator or vendor analysis of flight data.

Participants can view their own data and ASIAS analysis tools are available by single flight. Flight data is also aggregated and de-identified across the pool of ASIAS participants to enable benchmarking against the larger rotorcraft community. This benchmarking tool adds the capability to compare your operations to industry norms, and to specific safety issues identified by the larger, aggregate HFDM data and potentially before a fatal event. Below is the general data flow in ASIAS:
For example, Loss of control in flight (LOC-I) is a leading cause of fatal accidents in the rotorcraft community. By analyzing accident data across an industry wide dataset, we can better understand the underlying contributing factors of LOC-I events and provide recommendations back to the community to provide quantifiable risk reduction results from the identified risk areas that lead to LOC-I events.

The graphs below describe a Vortex Ring State (VRS) metric that has been developed from ASIAS aggregate data to better understand causes of LOC-I events for the rotorcraft community:
5. **HFDM: Disposition of Project**

The following section describes the changes to the key goal, and status of actions on the H-SE 82 project.

### 5.1 Changes to Key Goal

**5.1.1 The original key goal (Performance Goal Indicator) of H-SE 82 was:**

> “Effective outreach to rotorcraft community that clearly communicates the safety benefits of installing data recording devices. Specific examples of the benefits to using HFDM as described by success stories of those who were early adopters.”

The team conducted an extensive review of existing materials supporting HFDM, ongoing fatal accident statistics, and experience from past outreach (H-SE 82 Output 1, Action 1). It was observed that operators who are already subject to a HFDM mandate or are required to have a defined safety system (FDM, SMS, FOQA) have a good understanding of the safety benefits of such equipment and systems and a wealth of available information about HFDM.

Operators who are not subject to a HFDM mandate and not required to have defined safety systems are in most need of outreach. This group is very sensitive to the time required and costs of HFDM. The data capture and monitoring aspects of HFDM (or related SMS/FOQA) must be simple enough to implement by small operators. The analysis and monitoring component of HFDM must be low cost in terms of dollars and time, and high in ROI for a small operator.

**5.1.2 The revised key goal of H-SE 82 is:**

> “Effective outreach to the rotorcraft community, targeting small operators not subject to HFDM, SMS or FOQA mandates, who also may not attend safety or industry events, that clearly communicates the cost benefits (ROI) and safety benefits of basic HFDM practices including: installing data recording devices, analyzing data to take proactive action, and participating in ASIAS.”

Therefore, simple to understand outreach, brief videos and quick reference guides along with distribution via social media is the preferred means of targeting small operators past methods have not reached. Special emphasis will be placed on HFDM cost justification, time required to implement and ease of realizing safety and cost benefits.

In addition to this document, creation of HFDM gateway content is expected to be an ongoing effort after the close of H-SE 82.

### 5.2 Status of Project: Disposition of Actions in Output #1 (Educational Outreach):

1. USHST Outreach Team review current industry materials describing HFDM (i.e., Fact Sheets, Toolkits, etc.) from USHST/IHST, Global HFDM Steering Group, Rotorcraft ASIAS HFDM research, etc. and develop
modifications for new materials and media types (i.e., audiovisual, mobile app, etc.) for the educational outreach campaign.

The H-SE 82 team dispositioned the industry HFDM information available, particularly the excellent 2011 IHST HFDM Toolkit, 2nd edition (located on the VAST website), and found it to be useful and comprehensive. It was noted the materials were targeted towards larger operators subject to a HFDM mandate and formalized organizational structures. Small operators, particularly those not subject to a mandate, are not likely to open a large document that goes on to describe a process to set up a sizable safety team, generate a sizable number of safety documents, plans and committees.

New materials must be better targeted at small operators.

**Description for Output 1**: Develop an educational outreach campaign that address the following:

a. Specific examples of the benefits to using HFDM as described by success stories of those who were early adopters.
   - “We have had numerous occasions where the HFDM helped us quickly analyze and troubleshoot issues that saved countless maintenance manhours, and got the aircraft back in the air quicker; a double advantage for cost savings and keeping the aircraft producing revenue.” – Hampton Roads Helicopters
   - “We were able to use HFDM data to review a rotor overspeed event. The HFDM data supported a return to service by inspection versus replacing the blades. Investing ~$6000 to equip with HFDM saved us many weeks of down time and an unneeded ~$40,000 expense. Further, our pilots reviewed several events that were near exceedances and now we haven’t had any overspeed’s in more than 2 years.” – JM Air, LLC.
   - What is Flight Data Monitoring? Introduction to FOQA/FDM. A high level, lighthearted YouTube introduction to Flight Data Monitoring and FOQA presented by Scaled Analytics.
   - Air Methods Uses Tracker III for FDM and FOQA | Customer Success Stories, Honeywell Aerospace YouTube video announcing Air Methods’ use of its FDM capabilities and data to implement the industry’s first helicopter operator FOQA program.
   - The HFDM Quick Start Guide and further HFDM Webinar information is in the Appendices, Appendix A of this document.
   - Future material will be posted on social media and on vast.aero, ushst.org, rotor.org.

b. How data recording can work side by side with participation in voluntary safety programs such as Aviation Safety Information Analysis and Sharing (ASIAS) and provide information back to the owner/operator on trends and higher risk areas.
   - https://www.metroaviation.com/safety/
   - Future material will be posted on social media and on vast.aero, ushst.org, rotor.org.
2. USHST Outreach team work with the FAA, ANG-E2 to conduct HFDM Knowledge Sessions and safety seminars and outreach sessions at targeted events (i.e., HAI HELI-EXPO, Sun ‘N Fun, EAA Air Venture (Oshkosh), Airborne Public Safety Association (APSA), Air Medical Transport Conference (AMTC), Airshows, FAAST Team events, HAI World Helicopter Day, etc.).

The H-SE 82 team and other HFDM experts and users presented at numerous outreach sessions at the listed events. It is noted that many operators who would benefit from this outreach do not attend safety or industry events. The following are examples of recorded events now available for review.

- HAI Webinar - **HAI@Work: Safer Skies through Data Sharing**
- HAI Webinar - **HAI@Work Webinar: Harnessing the Value of Helicopter Flight-Data**

3. USHST Outreach Team and the FAA, ANG-E2 develop and implement a pilot program (i.e., similar to the General Aviation Demo Project) for expanding recorder usage among targeted helicopter mission segments.

- The H-SE 82 team worked to create a library of simple, real world examples of cost/ROI of HFDM systems, targeted to small operators. The initial effort was to canvas experienced operators already using HFDM, in hopes of having a number of easy to understand example cost/benefit metrics, in the form of a couple slides or couple minutes of video to be posted on social media platforms targeted to small operators.
- Future material will be posted on social media and on [www.ushst.org](http://www.ushst.org) and [www.rotor.org](http://www.rotor.org).

4. The FAA and ANG-E2 collect helicopter flight test data from multiple helicopter types and mission segments for incorporation into ASIAS to demonstrate practical ASIAS capabilities to audiences during outreach.

- A video documenting a HFDM operator enrolling in ASIAS with examples of ASIAS analysis products is in work.
- Future material will be posted on social media and on [www.ushst.org](http://www.ushst.org) and [www.rotor.org](http://www.rotor.org).

**Note** on ASIAS from H-SE 82:

The Federal Aviation Administration (FAA) promotes the open exchange of safety information in order to continuously improve aviation safety. To further this basic objective, the FAA developed the Aviation Safety Information Analysis and Sharing (ASIAS) system. The ASIAS system enables users to perform integrated queries across multiple databases, search an extensive warehouse of safety data, and display pertinent elements in an array of useful formats.

ASIAS is a collaborative government and industry initiative on data sharing and analysis to proactively discover safety concerns before accidents or incidents occur, leading to timely mitigation and prevention. ASIAS has become a national resource for the aggregation, analysis, and dissemination of aviation safety data and products. It serves as the central repository for data and analytical tools used to establish a shared service that
enables the rotorcraft community and its operators to enhance its safety decision making with greater access to relevant data and powerful analytical tools. The aggregation and fusion of data from multiple sources in ASIAS will supplement the SMS process by enabling comprehensive analyses that provide a more complete understanding of contributing factors that extends beyond single root causes. Aggregation and fusion will also support the development of mitigation strategies and the measurement of their effectiveness. ASIAS provides capabilities that can identify emerging safety issues that may otherwise be undetectable through individual data sources or unnoticed by operators who lack insight into hazards that are occurring across the NAS.

The ASIAS program collects helicopter flight test data from multiple helicopter types and mission segments for incorporation into ASIAS to demonstrate practical ASIAS capabilities to audiences during outreach. A phased approach continues to be followed in the construction of this system. Additional data sources and capabilities will be available as the system evolves in response both to expanded access to shared data and to technological innovation. Learn more about ASIAS and ongoing analytical efforts and capabilities here: https://www.rotorcraft.asias.info/contact.

5.3 Status of Project: Disposition of Actions in Output #2 (FAA Call to Action):

5.3.1 Original H-SE 92 Ouput #2

To better promote installation and use of data recording devices, the FAA should clarify the following policy issues:

a. Participation in “approved” vs. “unapproved” FOQA/FDM programs (i.e., Advisory Circulars).
b. Interpretation of major vs. minor change/alteration
c. Ability to seek a Field Approval vs. Supplemental Type Certificate for installation of Flight Data Recorders
d. Details of the Helicopter Flight Data Monitoring System (HFDMS) per the 2018 Helicopter Air Ambulance rule.

All Output #2 actions are for the FAA to undertake and methods of promoting the installation and use of recording devices are detailed in the section below. In keeping with recent decisions, the USHST H-SE’s only perform actions that can be managed solely within the USHST membership. Advocacy for Output #2 items will continue after the close of H-SE 82 in various venues and industry/regulator working groups.

5.3.2 Updated Output 2: FAA Call to Action

Additional considerations for the FAA when implementing the four original recommendations are summarized below:

Output 2A

The FAA should clarify when “approved” FOQA/FDM is required. There is a lot of HFDM (HFDMS, FDM, FDA, QAR, Light Recorder, FOQA, SMS, etc..) nomenclature that overlaps causing confusion for new operators, and the hierarchy of recorder mandates should be clearly described and an easy to understand compliance matrix should be created.
Output 2B

The FAA should issue a policy statement on the interpretation of major and minor change/alteration to allow a means of installation of HFDM equipment as a minor change. This would remove significant and numerous barriers and promote the use of off-the-shelf components, vastly lowering the cost and increasing adoption of HFDM. In a similar circumstance of great safety need, the FAA mandated shoulder harness installation in part 23 aircraft and allowed retrofit installation of shoulder harnesses in aircraft as a *minor* change in some cases per the guidance in FAA Policy Statement ACE-00-23.561.01.

From FAA Policy Statement ACE-00-23.561.01:

> Installations approved as a minor change may not provide the occupant with the protection required by regulation (Civil Air Regulation (CAR) 3.386 or 14 CFR part 23, § 23.561). However, a properly installed retrofit shoulder harness installation is a safety improvement over occupant restraint by seat belt alone.

A similar case can be made to support expanded recorder usage. Even though HFDM device installation is more complex, it can also be argued the risk, need and safety benefit is far greater.

Output 2C

The FAA should issue a policy statement which provides ACOs and FSDOs with support for HFDM installation regarding findings of compliance on Field Approvals (form 337 Major Repair & Alteration). The proposed installation policies would create a means of HFDM adoption with *no* STC required.

Additionally, FAA policy support should be considered for FAA ACO evaluation of AML STCs to enable greater make/model applicability and faster HFDM adoption.

Output 2D

The FAA should clarify 14 CFR §135.607 Flight Data Monitoring System. This rule requires all helicopter air ambulance operations to be equipped with an approved flight data monitoring system that is capable of recording helicopter performance and operational data. However, it omits defining the minimum operational requirements of the recorder and omits defining the “Monitoring” aspect of the requirement.

Further, the FAA should also consider a policy statement to address the need for a vast number of low-cost recorders on the forecasted wave of eVTOL aircraft. The risk to public safety posed by such new operations is systemic and complex. Having HFDM/FDM mandated on all the new aircraft, piloted or autonomous, new configurations and novel operations will greatly inform safety and future FAA policy on airspace, operations, required pilot training and aircraft certification.
6. Summary

Data recorders have been an enabler for improvements in many industries. Change driven by analysis from data is very powerful. HFDM is a tool that can inform and improve all current and future safety initiatives by providing important data. The helicopter accident rate can be improved if recorders and data support changes. Cost and time to implement HFDM and clear understanding of operator ROI are the biggest barriers to adoption by operators not subject to a HFDM/SMS/FOQA mandate. HFDM is vastly more effective when coupled with a strong safety culture, effective communication and personnel management (just culture), feedback to management and key personnel. HFDM can perform critical functions to support SMS. Coupling HFDM with a meta-data approach such as ASIAS is an unprecedented opportunity to improve safety by using analysis from an industry-wide dataset. Current and future outreach must target operators that typically may not attend safety or industry events in order to promote HFDM adoption, emphasizing that HFDM can save them money. The FAA must mindfully consider policy that removes barriers to HFDM installation and adoption in a timely, low-cost manner for existing aircraft and mandate HFDM for new operations and aircraft such as eVTOL.
APPENDIX A: HFDM Quick Start Guide

A two-page HFDM Quick Start Guide is provided on next two pages and can also be found as a separate file on the USHST H-SE page located at https://ushst.org/h-se-details/. Once on the page, locate the links for H-SE 82 and there you will see a link for the HFDM Quick Start Guide.
HELICOPTER FLIGHT DATA MONITORING
Quick Start Guide

1. EQUIP!
   • Choose an HFDM capture strategy — and install it.
   • There are affordable camera-based systems and parametric data recorders.
   • Get pilots, maintainers, and management involved.

2. CAPTURE DATA
   • Record as much and as often as you can. Every flight is best.
   • Ideally, a wide scope of parameters is recorded across your fleet, and the data is stored securely.

3. ANALYZE YOUR DATA
   • Regularly review your data.
   • There are many tools & service providers available to detect events of interest, exceedances, and characterize flight ops.
   • Widen your perspective by participating in programs that analyze data from many operators, such as Rotorcraft ASIAS.

4. NOTE AREAS OF CONCERN
   • Document what you find during your analysis.
   • Define areas that need improvement: changes to your training, SOPs, checklists as well as maintenance practices, dispatch, and management strategies.

5. TAKE ACTION!
   • Attack your risks. Make changes that support improvement and the growth of your safety culture.
   • HFDM can reduce your unscheduled maintenance and reduce your operating costs

6. MONITOR IMPROVEMENT
   Evaluate changes made over time and continue to perform steps 2 thru 6 on a regular basis.
APPENDIX B: HFDM Resources

HFDM-Related Webinars

- HAI@Work Webinar: Harnessing the Value of Helicopter Flight-Data Monitoring https://www.youtube.com/watch?v=FJVBF4kmTZo
- NTSB - MWL Roundtable: Safeguard Your Flights—Practical FDM Solutions for Smaller Operators https://www.youtube.com/watch?v=QUwONESOn_o
- SMS for Small Organizations Templates https://www.caa.co.uk/media/nonmn4ae/smicg-guidance-for-small-organisations-templates.docx

Regulatory Resources

FDM/Flight Operational Quality Assurance (FOQA)

The following companies provide or facilitate flight operations safety data services (FDM, FOQA):

- FAA Advisory Circular (AC) 120-82: Flight Operational Quality Assurance (PDF)
- U.K. Civil Aviation Authority: CAP 739 – Flight Data Monitoring (PDF)
- IATA Operational Safety Audit (IOSA) Standards Manual (PDF)
- EASA Good Practice on the Oversight of Flight Data Monitoring Programmes (PDF)
- FAA Civil Aerospace Medical Institute AM-12/1: Perceptions and Efficacy of Flight Operational Quality Assurance (FOQA) Programs Among Small-Scale Operators (PDF)
- FAA Aviation Safety Information Analysis & Sharing (ASIAS) Program
- National General Aviation Flight Information Database (NGAFID)

Flight Operations Safety Data Analysis Support Organizations

The following companies provide or facilitate flight operations safety data services (FDM, FOQA):

- Web: Aerobytes, Email: sales@aerobytes.co.uk
- Web: Cloud Ahoy, Email: team@cloudahoy.com
- Web: L3Harris Flight Data Analysis Services, Marketing: marketing.fds@L3Harris.com, or General Info: info@flightdataservices.com
- Web: GE Aviation, Email: AviationDigital@ge.com
- Web: Scaled Analytics, Email: info@scaledanalytics.com
- Web: Truthdata, Contact Form: truthdata.net/contact-us

Narrative Safety Data Analysis Support Organizations

The following companies provide or facilitate safety narrative reporting services:

- Air Charter Safety Foundation (ACSF)
- Argus Prism
- Aviation Manuals: info@aviationmanuals.com
- Baldwin Safety and Compliance
• PolarisAero
• WBAT Safety

Aviation Safety Action Program (ASAP)

The following links include information and resources on how to set up, run, and get help managing an ASAP:

• FAA Advisory Circular (AC) 120-66B: Aviation Safety Action Program (ASAP)
• FAA Order 8000.82, Designation of Aviation Safety Action Program (ASAP) Information as Protected from Public Disclosure under 14 CFR Part 193)
• FAA Order 8900.1, Flight Standards Information Management System (FSIMS), Vol. 11, Chap. 2, Sec. 1, Aviation Safety Action Program (PDF)
• FAA ASAP – Policy, Guidance, and Best Practices
• HAI ASAP – Third-party support services provided by Air Charter Safety Foundation (ACSF)
## APPENDIX C: Definitions

### Table 2: Definitions

<table>
<thead>
<tr>
<th>Term or Acronym</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASIAS</td>
<td>Aviation Safety Information Analysis and Sharing. The ASIAS system enables users to perform integrated queries across multiple databases, search an extensive warehouse of safety data, and display pertinent elements in an array of useful formats.</td>
</tr>
<tr>
<td>Compliance</td>
<td>In accordance with regulations, Standard Operating Procedures, and relevant requirements</td>
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<tr>
<td>EASA</td>
<td>European Union Aviation Safety Agency</td>
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<tr>
<td>ED-155</td>
<td>A specification defining the minimum operational performance specifications for a lightweight data recording system.</td>
</tr>
<tr>
<td>FDA</td>
<td>Flight Data Analysis is the process of analyzing recorded flight data in order to improve the safety of flight operations. (ICAO Annex 6, Part 1) Refer to similar descriptions for FDM, FOQA, and HFDM.</td>
</tr>
<tr>
<td>FDAU</td>
<td>Flight Data Acquisition Unit. A device that acts as a collector of a large number of signals from all over the aircraft and may extract or condition data for use by a recording system such as a FDR or QAR.</td>
</tr>
<tr>
<td>FDM</td>
<td>Flight Data Monitoring. A system in which flight data is regularly downloaded from an aircraft flight recorder and analyzed for the purposes of improving operational safety and efficiency. Refer to similar descriptions for FDA, FOQA, and HFDM.</td>
</tr>
<tr>
<td>FDMS</td>
<td>Flight Data Monitoring System. A system in which flight data is regularly downloaded from an aircraft flight recorder and analyzed for the purposes of improving operational safety and efficiency. Not to be confused with the Federal Docket Management System.</td>
</tr>
<tr>
<td>FDR</td>
<td>Flight Data Recorder. A recording device designed to capture numerous air data and aircraft systems signals and survive the crash and post-crash environment. At present, device requirements are defined in EUROCAE ED-112.</td>
</tr>
<tr>
<td>FOQA</td>
<td>Flight Operations Quality Assurance. May also be referred to as FDM, HFDM, or FDA. A voluntary program for the routine collection and analysis of flight operational data to provide more information about, and greater insight into, the total flight operations environment. The FOQA program combines these data with other sources and operational experience to develop objective information to enhance safety, training effectiveness, operational procedures, maintenance and engineering procedures, and air traffic control procedures. (AC 120-82). Refer to similar descriptions for FDA, FDM, and HFDM.</td>
</tr>
<tr>
<td>HFDM</td>
<td>Helicopter Flight Data Monitoring. A system in which flight data is regularly downloaded from an aircraft flight recorder and analyzed for the purposes of improving operational safety and efficiency. Refer to similar descriptions for FDA, FDM, and FOQA.</td>
</tr>
<tr>
<td>Term or Acronym</td>
<td>Definition</td>
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<tr>
<td>H-SE</td>
<td>Helicopter – Safety Enhancement. Advocacy and outreach programs composed of information, procedures, training, and equipment installations that, when implemented, may reduce the likelihood of accidents in the future.</td>
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<tr>
<td>IHST</td>
<td>International Helicopter Safety Team (IHST). Renamed as the Vertical Aviation Safety Team (see VAST).</td>
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<tr>
<td>HUMS</td>
<td>Health and Usage Monitoring System. A system that utilizes data collection and analysis techniques to help ensure availability, reliability and safety of vehicles.</td>
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<tr>
<td>Just Culture</td>
<td>A system of shared accountability in which organizations are accountable for the systems they have designed and for responding to the behaviors of their employees in a fair and just manner.</td>
</tr>
<tr>
<td>Light Recorder</td>
<td>Also ‘lightweight data recorder’. A device designed to capture air data, aircraft systems, video and audio and survive some crash and post-crash environments. At present, device requirements are defined in EUROCAE ED-155</td>
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<tr>
<td>NPRM</td>
<td>Notice of Proposed Rule Making</td>
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<td>Operator</td>
<td>A pilot, mechanic, owner, or business engaged in flight related activities.</td>
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<tr>
<td>Parametric data</td>
<td>Data that supports statistical analysis such as trends over time and modeling. Contrarily, non-parametric data does not fit a known or well-understood pattern. Useful knowledge may be extracted from both types.</td>
</tr>
<tr>
<td>Procedural non-compliance</td>
<td>Operations not in accordance with regulations, Standard Operating Procedures, and relevant requirements, and that may recur due to unclear standards, inadequate training, or leadership failures.</td>
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<tr>
<td>QAR</td>
<td>A recording unit onboard the aircraft that stores flight-recorded data. These units are designed to provide quick and easy access to a removable medium, such as an optical disk or PCMCIA card, on which flight information is recorded. QARs may also store data in solid-state memory that is accessed through a download reader. QARs have now been developed to record an expanded data frame, sometimes supporting 2,000 plus parameters at much higher sample rates than the FDR. The expanded data frame greatly increases the resolution and accuracy of the ground analysis programs. (AC 120-82)</td>
</tr>
<tr>
<td>SMS</td>
<td>Safety Management System. A coordinated, comprehensive set of processes designed to direct and control resources to optimally manage safety</td>
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<tr>
<td>USHST</td>
<td>United States Helicopter Safety Team. A volunteer team of US government and industry stakeholders formed to improve the safety of civil helicopter operations in the National Airspace System. The USHST is a partner of the Vertical Aviation Safety Team (VAST).</td>
</tr>
<tr>
<td>VAST</td>
<td>Vertical Aviation Safety Team. A public–private initiative to enhance worldwide flight operations safety in all segments of the vertical flight industry.</td>
</tr>
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APPENDIX D: HFDM Contributors and Key Supporters

Table 3: HFDM Contributors and Key Supporters

<table>
<thead>
<tr>
<th>Name</th>
<th>Organization</th>
</tr>
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<tbody>
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<td>Nicky Amour</td>
<td>MITRE</td>
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<tr>
<td>Jeffrey Byrd</td>
<td>USHST H-SE 82 Focal; EIT Avionics, LLC</td>
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<td>Federal Aviation Administration</td>
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<td>Mark Colborn</td>
<td>Dallas Police Department Air Support Unit</td>
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<td>Jeff Currin</td>
<td>Truth Data Insights</td>
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<td>Raj Helwig</td>
<td>Air Methods</td>
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<tr>
<td>Chris Hill</td>
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<td>Cliff Johnson</td>
<td>Federal Aviation Administration</td>
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<tr>
<td>Wayne Keeton</td>
<td>Helicopter Accident Consulting, LLC</td>
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<tr>
<td>Alexia Payan</td>
<td>Georgia Institute of Technology</td>
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<tr>
<td>Sean Payne</td>
<td>National Transportation Safety Board</td>
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<td>Jason Quisling</td>
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<td>Elizabeth Raetz</td>
<td>EIT Avionics, LLC</td>
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<td>Lee Roskop</td>
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<td>Andy Shaw</td>
<td>Federal Aviation Administration</td>
</tr>
<tr>
<td>Scott Tyrrell</td>
<td>Federal Aviation Administration</td>
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</table>

US Helicopter Safety Team

To learn more about the US Helicopter Safety Team, visit [www.ushst.org](http://www.ushst.org). Site visitors can review and download an electronic copy of this report and others in the document repository. A summary of other USHST helicopter safety enhancements and related work is also available for review.