Helicopter Flight Data Monitoring Toolkit
US JHSIT
Second Edition
Helicopter Flight Data Monitoring Toolkit
Second Edition

US Joint Helicopter Safety Implementation Team
HFDM Working Group

International Helicopter Safety Team
IMPORTANT NOTICE: All information in this publication has been provided in good faith. Every effort has been made to ensure the accuracy of the information contained in this publication. Neither the International Helicopter Safety Team (IHST) nor any of its members or contributors, past, present, or future, warrants its accuracy or will, regardless of its or their negligence, assume liability for any foreseeable or unforeseeable use made thereof, which liability is hereby excluded.
About This Document

This edition of the HFDM Toolkit is designed to provide a summary of existing flight data monitoring guidance and to serve as a step-by-step guide to helicopter operators considering or currently implementing a Helicopter Flight Data Monitoring (HFDM) program. It is also intended to address some unique challenges specific to helicopter operations.

It is our hope that you find this toolkit a valuable resource as you work toward implementing an HFDM program in your organization. This edition includes case studies, a discussion on Health Usage and Monitoring Systems (HUMS), industry best practices from the Global HFDM Steering Group, detailed information of management decisions, and a new common event set for helicopters. Additional HFDM guidance and resources are included as appendices or attachments to this document.

We encourage you to seek additional information from others who have implemented HFDM programs in their organizations; there is no better resource available.
About the IHST

The International Helicopter Safety Team (IHST) is a cooperative government-industry team that was formed in 2006 with the goal to reduce the worldwide helicopter accident rate by 80% by the year 2016. The IHST is comprised of an executive committee and the following teams (multi-regional):

- **Joint Helicopter Safety Analysis Team (JHSAT)** - Analyzes aviation accidents, identifies problems, and recommends solutions.

- **Joint Helicopter Safety Implementation Team (JHSIT)** - Strategically addresses and implements JHSAT recommendations.

The US JHSAT analyzed a group of US helicopter accidents and recommended the following related to information recorders:

- Information recorders can be utilized reactively (after the accident) and proactively (to monitor precursor events and data needed for an SMS). Information recording devices will allow accident investigators to obtain essential information about the circumstances of an accident to allow greater understanding of accident causes and potential for safety improvements. **Proactive use of recorders allows the operator to provide individual aircraft flight operations oversight and to identify and correct poor habits and [standard operating procedures (SOP)] non-compliances before it escalates into an accident.** (Recommendation # IN2)

- Install [Health Usage Monitoring Systems] HUMS to detect needed maintenance interventions, and utilize [Helicopter Flight Data Monitoring programs (HFDM)] to evaluate flight operations and address flight crew habits that may contribute to an accident. (Recommendation # SE1)

Members of the US JHSIT evaluated these recommendations and researched existing flight data monitoring programs in both helicopter and fixed-wing operations. They also researched existing guidance material, which they found to be heavily focused on fixed-wing operations. Recognizing that helicopter operations are unique and bare very few similarities to scheduled air carriers, the JHSIT determined specific guidance was needed for the implementation of HFDM programs in helicopter operations.

IHST Resources

A list of just a few resources available on the IHST website:

**HFDM Toolkit**
Designed to provide a summary of existing flight data monitoring guidance, and to serve as a step-by-step guide to the implementation of HFDM.

**HFAP(P) Interactive Tool**
Designed to provide interactive development of HFDM events based on available parameters.

**Maintenance Toolkit**
Designed to provide operators a framework to ensure that they can safely maintain their aircraft in the most cost-effective manner possible.

**Risk Assessment Toolkit**
Designed to provide small and medium sized operators and private pilots an opportunity to assess their operation relative to key IHST recommendations for the US fleet.

**SMS Toolkit**
Designed to help organizations understand the fundamentals of a safety management system, and to provide guidance in the implementation and management of an SMS.

**Training Toolkit**
Designed to help organizations understand the fundamentals of effective training, and to provide guidance in the implementation of a functional training department.

For more information... Please visit the IHST website at [www.ihst.org](http://www.ihst.org)
Contents

Acknowledgement  vii
List of Illustrations  ix
Definitions  xi
1 Helicopter Flight Data Monitoring  1
2 Before You Begin  7
3 Where to Start  11
4 FDM Process: Global HFDM Steering Group Best Practice  19
A Appendix A  List of Attachments  25
B Appendix B  HFDM Resources  27
C Appendix C  FAA STC Approvals  31
D Appendix D  HFDM Event Set  33
E Appendix E  Case Studies  37
Acknowledgement

On behalf of the US Joint Helicopter Safety Implementation Team and the Helicopter Flight Data Monitoring Working Group, I wish to acknowledge the group of professional helicopter safety experts who made this edition of the toolkit possible.

Thank you all for your contributions to helicopter flight data monitoring and for your exceptional commitment to making our industry safer.

Best regards,

Stuart “Kipp” Lau
Vice President, Flight Data Monitoring, CAPACG
HFDM Working Group Lead, IHST
IHST Liaison, Global HFDM Steering Group
Thank you!

Fred Brisbois
Sikorsky Aircraft Corporation
Co-Chair, US JHSIT, IHST

Larry Buehler
Flight Standards ASI, FAA
Co-Chair, US JHSIT, IHST

Tony Cramp
Sr. Advisor, Air Safety & Global Projects,
Shell Aircraft

Lindsay Cunningham Evans
Manager, Accident Investigation,
American Eurocopter

Joan Gregoire
Aviation Safety Analyst,
REACH Air Medical Services

Kevin Kelley
Voluntary Safety Programs ASI, FAA

Patrick Pezzatini
Operational Fleet Safety, Eurocopter

Captain Mike Pilgrim
Flight Data Monitoring Advisor, CHC
Co-Chair, Global HFDM Steering Group, IHST

Bernard J. Raysor
Vice President, Flight Operations,
7 Bar Aviation
HFDM Working Group, IHST

Bob Sheffield
Managing Director, Shell Aircraft
Member, IHST Executive Committee

Jared Simon
Manager, LAMP, PHI
HFDM Working Group, IHST

Bruno Villela
Flight Data Analyst, CAPACG
HFDM Working Group, IHST
List of Illustrations

Figures
1.1 FOQA Results for a Small Operator  2
1.2 MOST Model  3
1.3 HUMS Overview  4
1.4 CHC Super Puma in the North Sea  6
1.5 HFDM Guidance Material  6
2.1 Just Culture  8
2.1 Unsafe Acts Algorithm  9
2.3 Three Main Areas of Discussion  9
3.1 Generic FDM System Installation  14
3.2 HFDM Checklist  17
4.1 Generic FDM Process  21

Tables
1.1 HFDM Program Names  5
1.2 Operators with HFDM Programs  5
2.1 ROHSEI Applied to HFDM  8
A.1 List of Available Attachments  26
B.1 HFDM Equipment Providers  28
B.2 HFDM Software and Analysis Services Providers  29
C.1 FAA STCs Available for LARS Equipment  32
Definitions

**Advisory Circular (AC).** An Advisory Circular is the FAA's means of providing non-regulatory guidance to the public.

**Analysis software.** A software application program designed to: transform airborne-recorded data into a usable form for analysis; process and scan selected flight data parameters; compare recorded or calculated values to predetermined norms using event algorithms; and generate reports for review or trending when they are detected.

**Aviation Safety Action Program (ASAP).** An FAA voluntary program under which employees of Operators may report safety related events, including possible violations by the reporting employees themselves, of violations of FAA regulations. The objective of the ASAP is to encourage voluntary reporting of safety information that may be critical to identifying potential precursors to accidents. Under ASAP, safety issues are resolved through corrective action rather than through punishment or discipline.

**Crew contact.** The confidential process by which a gatekeeper may contact a pilot/crewmember for purposes of validating data or mitigating a risk identified through the HFDM process; the only case in which identity of individual crewmembers may be associated with HFDM data.
data validation. A process during which flight data are reviewed to see that they were not generated as a result of erroneous recording or damaged sensors.

de-identified data. Data from which any identifying elements that could be used to associate them with a particular flight, date, or flight crew has been removed.

equipment. For the purposes of this document, any hardware that captures data for the purposes of helicopter flight data monitoring

event. An occurrence or condition in which predetermined values of aircraft parameters are measured. Events represent the conditions to be tracked and monitored during various phases of flight and are based on the sensory data parameters available on a specific aircraft fleet.

event category. Event categories are areas of operational interests (e.g., aircraft type, phase of flight, geographical location) on which event monitoring and trend analysis is based.

event level. The parameter limits that classify the degree of deviation from the established norm into two or more event severity categories. When assigning levels to an event, consideration is given to compliance with federal regulations, aircraft limitations, and company policies and procedures.

event set. A collection of events designed to measure all aspects of normal flight operations for a particular aircraft type at a particular operator. The event set for a particular fleet may be limited by the available parameters on the aircraft.

event validation. The process in which an event is determined to be a valid sample of operation outside the established norm.

Federal Aviation Administration (FAA). The agency under the United States Department of Transportation tasked with the regulation and promotion of air commerce.

flight data recorder (FDR). A device that records pertinent parameters and technical information about a flight. At a minimum, it records those parameters required by the governing regulatory agency, but may record a much higher number of parameters. An FDR is designed to withstand the forces of a crash so that information recorded by it may be used to reconstruct the circumstances leading up to the accident.

Flight Operational Quality Assurance (FOQA). A Helicopter Flight Data Monitoring program which combines flight 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 (ATC) procedures. A common term used in the United States of America.

gatekeeper. The HFDM Team member who is primarily responsible for the security of identified data. The gatekeeper is the individual(s) who can link HFDM data to an individual flight or crewmember. The gatekeeper is normally a member of the pilot union or group.

Helicopter Flight Data Monitoring (HFDM). A systematic method of accessing, analyzing and acting upon information obtained from flight data to identify and address operational risks before they can lead to incidents and accidents.

Helicopter Flight Data Monitoring (HFDM) Team. A group responsible for reviewing and analyzing flight and event data and identifying, recommending, and monitoring corrective actions. Including a pilot member(s) as part of the team is recommended.

Implementation and Operations Plan (I&O Plan). Required for FAA-approval; a detailed specification of key aspects of an HFDM program to be implemented by an operator, including:

• A description of the operator’s plan for collecting and analyzing the data
• Procedures for taking corrective action that analysis of the data indicates is necessary in the interest of safety
• Procedures for providing the applicable regulatory agency with de-identified aggregate HFDM information/data
• Procedures for informing the applicable regulatory agency as to any corrective action being undertaken

International Helicopter Safety Team (IHST). A government-industry team formed in 2006, whose goal is to reduce the worldwide helicopter accident rate by 80% by the year 2016.
Joint Helicopter Safety Analysis Team (JHSAT). Analyzes aviation accidents, identifies problems, and recommends solutions.

Joint Helicopter Safety Implementation Team (JHSIT). Strategically addresses and/or implements JHSAT recommendations.

Just Culture. A culture in which personnel are encouraged to and feel comfortable disclosing errors, including their own, while maintaining professional accountability. A just culture is not, however, tolerant of reckless behavior or intentional non-compliance with established rules or procedures.

Lightweight Aircraft Recording System (LARS). A system or combination of systems, which record a helicopter’s flight performance and operational data.

parameters. Measurable variables that supply information about the status of an aircraft system or subsystem, position, or operating environment. Parameters are collected by a data acquisition unit installed on the aircraft and then sent to analysis and reporting systems.

phase of flight. The standard high-level set of activities performed by pilots on all operational flights (i.e., preflight, engine start, hover, taxi, takeoff, climb, cruise, descent, holding, approach, landing, taxi, and post flight operations).

Quick Access Recorder (QAR). A recording unit on board 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.

Safety Management System (SMS). A systematic, explicit, comprehensive and proactive process for managing safety risks that integrates operations and technical systems with financial and human resource management to achieve safe operations and compliance with applicable regulations.

stakeholder. Constituencies that are potential users of HFDM data and that have a stake in the program’s success.

steering committee. An oversight committee formed at the beginning of HFDM program planning to provide policy guidance and vision for the HFDM effort. Membership may include senior management personnel and representatives from key stakeholder departments, such as flight operations, maintenance, training, and safety. A representative from the pilot staff/association is strongly recommended.

Wireless Data Link (WDL). A system that allows the high-speed transfer of on-board aircraft data to ground facilities using various wireless technologies. It may also allow for upload of data to the aircraft. Sometimes referred to as Ground Data Link (GDL).
1 Helicopter Flight Data Monitoring

Helicopter Flight Data Monitoring (HFDM) is a systematic method of accessing, analyzing, and acting upon information obtained from flight data to identify and address operational risks before they can lead to incidents and accidents.

The information and insights provided by HFDM can also be used to reduce operational cost and significantly enhance training effectiveness and operational, maintenance, and engineering procedures. Information from HFDM programs is unique since it provides objective data that otherwise is not available.

An HFDM program is a key component of a Safety Management System (SMS). In the SMS context of risk management strategies, HFDM is reactive (past events), proactive (seeks identification of hazards), and predictive (identifies future problems/trends). Safety risk management is assured by using objective flight data to support an SMS. HFDM allows the operator to objectively establish the context or level of risk and then identify, analyze, assess, and control risks. For more information on SMS, please see the IHST SMS Toolkit on the IHST website.
**Safety Benefits**

The following are just some of the safety benefits to be realized through an effective HFDM program:

- Accurate identification of risks with empirical data
- Just culture management of safety issues (Example: This is what really happened and why; enhanced data available for root cause analysis)
- Due to the protections afforded by an FAA-approved HFDM/FOQA program, a more open dialogue is possible between pilots and management based on digital data to determine how to improve operations and safety (Where no formal approval program exists, operators outside of the US can base their HFDM programs on FAA guidelines and industry best practices including those published by the Global HFDM Steering Group)
- Evidence-based decision making
- Enhanced training scenarios
- Risk mitigation possible with empirical data (See Figure 1.1)
- Remedial action effectiveness confirmation by continued monitoring

The following is an example of risk identification and mitigation possible through HFDM:

**Costs of an Accident**

Before considering the operational and cost benefits HFDM has to offer, it is important to first consider the costs associated with accidents and some incidents:

- Loss of life
- Hull replacement costs
- Third-party damage costs
- Loss of revenue through loss of assets
- Loss of revenue due to negative public perception (not only of your own operation, but of the industry as a whole)
- Reduction in company value (stock) due to the above
- Insurance deductibles
- Increase in insurance premiums
- Litigation

**Operational and Cost Benefits**

The following are just some of the cost benefits to be realized through an effective HFDM program:

- Cost savings through reduction of incidents and accidents (long term)
- Operational/procedural improvements – identify operational inefficiencies through flight data, and change procedures for potential cost savings (Example: implement stabilized approach policy)
- Insurance savings based on long-term safety improvements through HFDM

---

**Figure 1.1**

HFDM Results for a Small Operator

---

<table>
<thead>
<tr>
<th>Rates of Events per 100 Flights in a Specific Location</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Graph" /></td>
</tr>
<tr>
<td>Oct-09</td>
</tr>
<tr>
<td>40</td>
</tr>
</tbody>
</table>

- Excessive Climb
- Excessive Descent
- Excessive Pitch Up During Landing
• Increased aircraft availability due to quicker diagnosis/investigation
• Repair savings as a result of fewer incidents and accidents or elimination of unnecessary inspections

Other Intrinsic Benefits

The following are just some of the other intrinsic benefits to be realized through an effective HFDM program:

• If HFDM is managed correctly utilizing just culture, an improvement in trust and respect between stakeholders is possible with a resultant improvement in communication
• Increased communications lead to improvements not only in safety, but efficiency of operations and customer satisfaction
• Problems and deviations are more readily identified
• Objective information and risk identification leads to accountability

Case Studies

Using the MOST model (See Figure 1.2), case studies were collected throughout the industry to demonstrate HFDM applicability, benefits, and results. They are included in Appendix E of this toolkit.

Health Usage and Monitoring Systems

Health Usage and Monitoring Systems (HUMS) is another discipline that focuses on the use of flight data. HUMS is a maintenance and reliability program. The number of HUMS users is gaining momentum in the helicopter industry. For example, the US Army has HUMS on about half of its 3,500 helicopters with the remainder to be equipped by FY 2013. This several hundred million dollar military investment is starting to trickle over to the civilian world. Sikorsky made HUMS standard equipment on the S-92 and S-76D models and other manufacturers are either announcing or delivering systems as optional or standard equipment. Additionally, several companies offer HUMS to retrofit existing aircraft for various models. Currently, HUMS systems are certified on most medium and heavy helicopters. Cost and certification issues are barriers for light and legacy helicopter operators.

The safety contribution of HUMS equipment was verified by the International Helicopter Safety Team (IHST). The JHSAT reported “The development, installation and use of HUMS on aircraft to monitor the status of the aircraft systems and their level of use, or equivalent Engine Monitor Systems (EMS). The JHSAT has identified 24 (47%) of the part/system failure accidents that may have potential for mitigation by monitoring systems.” The full report can be found on the IHST website.

The “Health” part of HUMS is techniques and procedures by which selected incipient failure or degradation can be determined. One example of this is vibration monitoring. The “Usage” part is techniques and procedures by which select aspects of service history can be determined. Both of these systems consist of a variety of sensors, data acquisition, and processing systems.

Condition Based Maintenance (CBM) derived from HUMS is a set of maintenance processes and capabilities for a specified component derived primarily from real-time assessment of conditions obtained from HUMS usage data. To establish these processes, parameters such as temperature, altitude, gross weight, center of gravity, air speed, applied power, and accelerations in the form of data are used to calculate flight regimes. These regimes are then mapped to known aircraft maneuvers for which representative flight loads are available from load surveys determined through flight testing. These processes can extend or reduce component inspection and retirement time while not increasing the system baseline risk.

Unlike fixed-wing aircraft, helicopters perform a variety of missions from heavy lift to transportation. These missions greatly affect the life of components on the aircraft but little consideration
is given to the life of a part based on actual usage. CBM has the potential to increase operational efficiency and improve safety concurrently.

HUMS systems out-of-the-box already increase operational efficiency through reductions in unscheduled maintenance of the power train, enhancing aircraft availability, and avoiding mechanical failures in flight. The long-term outlook has the promise of Condition Based Maintenance (CBM) bringing HUMS to a whole new level, which in turn will encourage more wide-spread deployment of these systems. Additional HUMS information can be found in the IHST Maintenance Toolkit on the IHST website.

**HUMS Cost Benefits**

The following are just some of the other intrinsic benefits to be realized through an effective HUMS program:

- Reduced dedicated maintenance
- Improved maintenance scheduling and logistic support
- Reduced parts usage through accurate and automated usage monitoring
- Reduced no-fault-found (NFF) events
- Reduced consequential damage through early diagnosis
- Improved event/incident/mishap analysis

**HFDM by Another Name**

Flight Data Monitoring (FDM) programs have been in existence for over four decades with large airlines worldwide. Helicopter operators in the North Sea began investigating the use of FDM programs in the late 1990s. Today, a number of large helicopter operators have formal HFDM programs. Operators, regulators, and various governing bodies have assigned various names to FDM programs. Table 1.1 highlights some of the program names/acronyms associated with helicopter FDM programs around the world. The IHST has identified “Helicopter Flight Data Monitoring” or “HFDM” as the designation for government/industry led flight data monitoring activities related to helicopter operations.
**Table 1.1**
HFDM Program Names

<table>
<thead>
<tr>
<th>Program Acronym</th>
<th>Program Name</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOQA</td>
<td>Flight Operational Quality Assurance</td>
<td>FAA</td>
</tr>
<tr>
<td>FDA</td>
<td>Flight Data Analysis</td>
<td>ICAO</td>
</tr>
<tr>
<td>HFDM</td>
<td>Helicopter Flight Data Monitoring</td>
<td>CHC, Cougar, Arkansas Children’s Hospital</td>
</tr>
<tr>
<td>HOMP</td>
<td>Helicopter Operations Monitoring Program</td>
<td>Bristow</td>
</tr>
<tr>
<td>LAMP</td>
<td>Line Activity Monitoring Program</td>
<td>PHI</td>
</tr>
<tr>
<td>MFOQA</td>
<td>Military Flight Operational Quality Assurance</td>
<td>US Air Force</td>
</tr>
</tbody>
</table>

**A Brief History**

Long track records of effectively using FDM information - over 40 years in the case of British Airways and Scandinavian Airlines System - have provided airlines with clear evidence that data obtained in an FDM program represents a source of valuable information that can contribute greatly to aviation safety when used appropriately.

Since the late 1990s, most large airlines in the US, Europe, and some Asian countries have adopted FDM as an operational best practice. Air Carriers that currently have FDM-type programs agree that the insights derived from these programs have prevented serious incidents and accidents and have led to improved operating efficiencies.

In late 1998, following the completion of an initial feasibility study, the UK Civil Aviation Authority (CAA) and Shell Aircraft Limited commissioned a study that laid the groundwork for much of the pioneering work done with HFDM programs. Together, the CAA, Shell Aircraft, Bristow Helicopters, and Smith Aerospace Electronic Systems with technical support from British Airways successfully demonstrated real safety benefits of HFDM programs applied to helicopters.

Initially, five flight data recorder (FDR) equipped Super Puma aircraft were involved in this Helicopter Operations Monitoring Program (HOMP) funded by the CAA and Shell Aircraft. CHC conducted follow-up studies that involved an S-76 aircraft, and expanded the analysis to low speed operations, pilot workload, mapping helideck environments, and allocating severity values to HFDM events.

**Table 1.2**
Operators with HFDM Programs

<table>
<thead>
<tr>
<th>Operator</th>
<th>Primary Industry (Secondary)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bond</td>
<td>Oil and Gas (Search and Rescue)</td>
</tr>
<tr>
<td>Bristow</td>
<td>Oil and Gas (Search and Rescue)</td>
</tr>
<tr>
<td>Bristow – Gulf of Mexico</td>
<td>Oil and Gas</td>
</tr>
<tr>
<td>CHC</td>
<td>Oil and Gas (Search and Rescue)</td>
</tr>
<tr>
<td>Cougar Helicopters</td>
<td>Oil and Gas (Search and Rescue)</td>
</tr>
<tr>
<td>Era Helicopters</td>
<td>Oil and Gas (Emergency Medical Services)</td>
</tr>
<tr>
<td>PHI</td>
<td>Oil and Gas (Emergency Medical Services)</td>
</tr>
<tr>
<td>Arkansas Children’s Hospital</td>
<td>Emergency Medical Services</td>
</tr>
</tbody>
</table>

Today, most helicopter operators supporting the major oil and gas producers (OGP) in the North Sea and around the world have active HFDM programs. Other segments of the helicopter industry are beginning to explore and implement HFDM programs. Historically, most operators embracing HFDM programs, both fixed and rotary wing, have operated large fleets comprised of large aircraft. Recent advances in technology have allowed smaller operators with light and legacy aircraft to embrace HFDM as a best practice.
Approved vs. Non-approved Programs

In some countries, the civil aviation regulatory agency may encourage or require operators to obtain approval for HFDM programs. It is important to check with your local regulatory agency to determine whether this is the case.

In the US for example, the FAA has established formal policies, procedures, and protocols to support HFDM (FOQA) programs. Operators are encouraged to develop HFDM programs in accordance with FAA Advisory Circular (AC) 120-82 (Attachment E). This document builds the foundation and outlines a plan for implementing and operating a successful HFDM program.

Benefits of an approved program will vary by country. Following is a list of benefits some operators may gain by obtaining regulatory approval:

- In the US for example, approved HFDM programs provide Federal protection of the data collected. Protection is even granted from the Federal Freedom of Information Act (FOIA) for HFDM/FOQA data.
- A reduction in an exposure to liability for the operating certificate, pilots, and organization as a whole.
- Data cannot be shared with customers in approved programs unless the pilot involved grants permission to the company to do so via reports or summaries in a de-identified format.

While regulatory approval offers these benefits and others, it is important to note that some operators have implemented successful and effective programs without regulatory approval.
2 Before You Begin

Do you have upper management support?

Upper management support is absolutely mandatory for the success of an effective HFDM program. Upper management personnel must make their support of the HDFM program known to stakeholders and clearly communicate their expectations to each person who has a role to play in the program. An organization where a CEO “talks the safety talk”, but doesn’t “walk the safety walk” is very unlikely to succeed at any safety program.

The case of HFDM paying for itself…quickly!

Like SMS, it’s important to view HFDM as an operations tool for management. The risk management process within the SMS includes the need to determine the cost of implementing versus not implementing HFDM as a control measure.

Example: A two-aircraft operation experiences an excessive yaw event on one of their aircraft in IMC. Following the event, there was concern that an RFM limit was exceeded. Without HFDM, the aircraft would have to undergo an extensive tailboom inspection costing over $40,000. With the ability to analyze the objective flight data versus the subjective pilot report, the operator was able to determine that the

Photo Courtesy of American Eurocopter
limitation was not exceeded, eliminating the need for the inspection and supplemental lift to cover operational needs.

The cost for the equipment, set-up, and continued operations for the first year of the HFDM program was $45,500 for both aircraft ($22,750/each). This one event would have cost the operator $40,000 (inspection + supplemental lift).

There are tools available to perform more detailed and complex financial analysis that are easily used by aviation management professionals. One tool is Return on Health, Safety, and Environmental Investments (ROHSEI) software developed by the ORC Occupational Safety and Health Group. Members of this group include ALCOA, Allied Signal, ARCO, Bayer, Bristol-Myers Squibb, Colgate-Palmolive, IBM, Johnson & Johnson, Dow, Duke Energy, Eli Lilly, and Monsanto to name a few. Teamed with Arthur Andersen, the group tailored traditional financial investment analysis processes and applied them to achieve a better understanding of business impacts of health, safety, and environmental investments. To accomplish these objectives, the project went beyond the measure of failure to formulate a set of analytical tools to provide cost/benefit information for making effective cost/risk decisions.

The US JHSIT performed a ROHSEI analysis on HFDM - the assumptions were based on a small operator implementing HFDM. In this case, when projecting the investment on safety over 10 years, the operator’s risk of an accident was reduced by 50%, and the payback period was 0.1 years (see Table 2.1).

<table>
<thead>
<tr>
<th>Table 2.1</th>
<th>ROHSEI Applied to HFDM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Implement HFDM</strong></td>
<td></td>
</tr>
<tr>
<td>Net Present Value (NPV)</td>
<td>$945,018</td>
</tr>
<tr>
<td>Internal Rate of Return (RR)</td>
<td>2773%</td>
</tr>
<tr>
<td>Return on Investment (ROI)</td>
<td>137%</td>
</tr>
<tr>
<td>Discounted Payback Period (DPP)</td>
<td>0.1 years</td>
</tr>
</tbody>
</table>

A “just culture” is absolutely mandatory for the success of an effective HFDM program. A just culture is a culture in which personnel are encouraged to and feel comfortable disclosing errors, including their own, while maintaining professional accountability. As described in the Prince study (1999) “the only group that can identify hazards consistently, accurately, and dependably are those engaged in the operation under study…it requires the “E” in SME (subject matter “expert”) be part of the team…the real world experience of the frontline employee to name for us those hazards they live with everyday”.[1] “The Safety culture of an organization is the product of individual and group values, attitudes, competencies, and patterns of behavior that determine the commitment to and the style and proficiency of an organization’s health and safety programs”.[2] A just culture is not, however, tolerant of reckless behavior or intentional non-compliance with established rules or procedures. The target for an HFDM program is to maintain data security and crew confidentiality within a just culture. See Attachment K and the IHST SMS Toolkit (2nd Edition) for more information about just culture.

Program management decisions

Besides the HFDM Checklist described in the next chapter, there are key management decisions that have to be taken to develop and implement an HFDM program. The process begins with a needs assessment and includes all stakeholders. This assessment should layout the expectations and demands of all stakeholders. Managing expectations is essential otherwise disappointments occur when expectations and reality don’t align.

The model in Figure 2.3 forms the basis for preliminary discussions within three main areas - program structure, status, and technology selection. (See also section 3 of this toolkit.)

Structure. Evaluating your organization’s corporate infrastructure and personnel talents, management has to decide whether the company is capable to support the program. Often smaller organizations will outsource certain functions of their HFDM program. There are capable third-party organizations that can provide analysis, reporting, and IT functions at a reasonable cost. Surveying internal expertise and available resources will provide initial information to the decision makers.

Status. As already discussed in section 1, approved and non-approved programs have their own advantages and disadvantages. The Implementation and Operations (I&O) Plan is considered a business plan for operating your organization’s HFDM program. Regardless of the status, all operators should develop a sound I&O Plan that outlines the HFDM program’s policies, procedures, and protocol for event notification.

Technology. Each organization should begin their search for hardware and software with a fleet equipage survey. In general, medium to large helicopters will be equipped (or required to be equipped by local regulations) with a flight recorder. Most light helicopters are not equipped with recorders. Depending on the type of aircraft, there are several Lightweight Aircraft Recording Systems (LARS) available (see Appendix B for a list of resources). The operator should also consider fleet stability. Equipping the entire fleet is desirable, however, it may not be economically feasible to equip aircraft scheduled to be retired or removed from the fleet. Also, when able, it is desirable to have a common analysis software platform.
3 Where to Start

Planning and Preparation

Identify stakeholders. Identify those who will be affected by the HFDM program. Every operation will have stakeholders; most will include at a minimum:

- Management/Owners
- Flight department (including pilots)
- Safety department
- Maintenance department
- Training department
- IT department
- Legal staff
- Insurance carrier

During the process of identifying stakeholders, identification of the key stakeholders required to become part of the steering committee should begin to develop.

Establish a steering committee. Identify key stakeholders to participate in an HFDM steering committee. The composition of the steering committee will be heavily dictated by the size and scope of your operation. Too large a committee and it will become cumbersome, but capturing key stakeholders will be instrumental in overcoming push-
back to the idea of an HFDM. Some stakeholders you may want to include in the steering committee are:

- HDFM Team Leader or Gatekeeper (may be the same)
- Company President or CEO
- Chief Pilot
- Pilot Union Representative (if applicable)
- Safety Department Representative
- Maintenance Department Representative
- Company Legal Representative

**Define goals and objectives.** The steering committee must set the goals and objectives for the HFDM program. These objectives will assist in setting the event triggers to capture the type of data needed, as well as drive the type of HFDM equipment required to achieve the goals. Likewise, some goals and objectives may be driven by cost or the type of equipment available for your fleet. Some examples of goals and objectives are:

- Improved training programs that address authentic mission scenarios and promote improved decision making skills
- Improved data during incidents or abnormal events to allow root cause analysis
- Identify deviations from standardized procedures
- Identify ways to improve procedures and techniques to improve safety, operational efficiency, and reliability
- Report to company management on safety risks and recommendations in a fact-based manner.

**Select HFDM Team.** Identify the members of the HFDM Team, including the gatekeeper(s), and define team member responsibilities (see Attachment A). The gatekeeper is the HFDM Team member who is primarily responsible for the security of identified data. He/she is also the individual who can link HFDM data to an individual

---

**HFDM Best Practices**

The Global HFDM Steering Group has identified the following best practices related to the HFDM organizational structure:

- **Appoint an independent manager with responsibility for overall management of the HFDM program and timely reporting of the results of flight data analysis**
- **The FDM Program Manager should be an experienced pilot, respected and trusted by the pilot group, and not a part of the core senior management team**
- **Identify experienced and trusted pilots to act as pilot liaisons, or gatekeepers, responsible for contacting crews when alert deviation threshold exceedances occur, and reviewing and explaining the data utilizing playback and analysis software; provide pilot responses back into the analysis process**
- **Identify individuals competent in the use of the analysis software to validate events, analyze flight data and trends, produce FDM reports and newsletters, and provide data in a format usable and easily understood for pilot debriefs and crew feedback requests**
- **Create an FDM Review Group comprised of people responsible for operational standards and flight safety, including the Chief Pilot and HFDM Program Manager**
- **The FDM Review Group should determine and periodically review alert deviation thresholds, conduct periodic reviews of aggregate de-identified flight data, recommend changes to procedures and training, investigate significant events discovered by the HFDM program, and remove the protection of confidentiality in cases of gross misconduct or continued non-compliance with SOPs**
- **Allocate sufficient resources for the HFDM program to be effective**
- **All people involved with the HFDM program are bound by the conditions specified in the confidentiality agreements in force**
- **All people involved in the HFDM program are adequately trained for their role**
flight or crewmember. Gatekeepers must be trustworthy and respected by their peers. Gatekeepers are normally members of the pilot union or pilot group.

Another major challenge for many helicopter operators is their size; smaller operators often lack available resources, expertise, and/or infrastructure for an in-house HFDM Team. These organizations may benefit by using a third-party team for data analysis. This model has many advantages; however, if chosen, it is still necessary to choose a gatekeeper within your own organization to coordinate with the third-party.

For larger operators who decide to perform analysis in-house, it is recommended that a dedicated data analyst be added. This will provide expertise on the software systems in use, which in turn will allow greater development of events and will reduce the burden on the gatekeepers who will normally have line flying duties as well. It is not suggested that the dedicated analyst perform any crew contacts, but that he/she provides information to the gatekeeper and assists with analysis and investigation of events.

Define safeguards. Confidentiality and security of data is essential to the success of the program! Define policies and procedures regarding the de-identification, analysis, and secure storage of all data gathered as part of the HFDM program. Also define exceptions to de-identification of data (i.e. urgent safety action required, confidential crew contact, gross negligence). Define a clear process for initiating corrective action in these cases to ensure confidentiality is maintained. Also include scenarios for information requests by pilots, maintenance personnel, etc. Ensure the gatekeeper and anyone who may have access to identified data has a clear understanding of these policies and procedures. For an example of an email one operator uses to initiate the crew contact process, please see Attachment D.

Select equipment & software. Equipment (hardware) and software decisions will impact the capital outlay, installation, certification costs, length of out-of-service time for installation, man-hours, depth of the data collected, and ultimately, the goals and objectives your organization can realistically attain in their HFDM program. The type(s) and size(s) of aircraft in your fleet will also dictate the type of equipment available for your HFDM program. Many operators use a mix of equipment based on what is available for the different aircraft models in their fleet.

Light & legacy fleet equipment

One historical challenge for “light and legacy” aircraft with regards to HFDM has been the lack of availability of low cost, lightweight, unobtrusive equipment. This challenge, combined with the fact that the majority of the worldwide helicopter fleet is in the “light and legacy” category, is one of the main reasons the helicopter community has not embraced HFDM earlier. However, within the past few years, practical HFDM equipment for light and legacy aircraft has come to market.

Many of the current “light and legacy” or LARS HFDM systems on the market cost less than $15,000 to install. This equipment may interface directly with aircraft systems or use independent inertial sensors to capture parametric data. Because it may not be feasible to capture certain aircraft parameters with traditional sensors, some HFDM equipment records cockpit images to capture supplemental information that is otherwise unavailable.

Medium & heavy fleet equipment

Traditional equipment such as flight data recorders (FDR), quick access recorders (QAR), and multifunction data acquisition units (MFDAU) are currently being used in HFDM programs for medium and large aircraft. These devices, which are often required by the regulatory authority for medium to large aircraft, are beneficial in that they typically provide more parameters and data to support both operational and maintenance monitoring programs. This more complex equipment allows the operator to monitor a wider range of events.

Software

Selection of the appropriate software is just as important as selection of the appropriate equipment. Some aircraft and/or HFDM equipment manufacturers offer software that is complimentary to the specific HFDM equipment installed in the aircraft. However, many HFDM equipment manufacturers do not. If this is the case, it is important to select a software analysis tool compatible with the equipment you have chosen and the goals and objectives of your HFDM program.
A list of equipment and software/analysis providers can be found in Appendix B. Chapter 3 of the CAA CAP 739 provides the description of a typical FDM installation. Survey other operators with similar aircraft types or the aircraft manufacturer to see what equipment and software they recommend. Figure 3.1 depicts a generic FDM system installation.

Review your goals and objectives once more. Will the equipment and software you have selected allow you to meet the goals and objectives of your HFDM program?

**Define events.** It will be necessary to define “events” or operational limitations you would like to monitor in your HFDM program, in addition to levels of severity for events outside normal operational limitations. The events will be dictated by type of equipment you have chosen (available parameters) and may be tailored to the specific mission and standard operating procedures of your operation. Many operators find that defining events for multiple-mission categories can be quite challenging. If this is the case, it is recommended to begin the program with a list of common events for all mission categories and then slowly begin to add more detail by mission. The industry conducted a project to collect a generic event set from different operators and vendors. The result is presented in Attachment C, as well as Appendix C of this toolkit. (Also, HFAP(P), which is an interactive tool that tails HFDM events to the

**HFDM Best Practices**

The Global HFDM Steering Group has identified the following best practices related to HFDM hardware, software, and system capabilities:

- Allow for media with sufficient data recording capacity
- Provide practical capability to download data from aircraft to ground station
- Provide a ground station, with the capability to transfer data to the analysis system, at every operating base
- When temporary remote bases are in operation, provide capability to transfer data to the analysis system
- Ensure analysis software provides capability to conduct detailed flight data analysis, as well as long-term trend analysis, and display information in a logical, user-friendly way
- Ensure analysis software provides capability to set a range of alert detection thresholds for each event
- Ideally, define three levels of alert detection for each event based on nature of event, magnitude of exceedance, and potential consequences
- In addition to events and alert detection thresholds based on rotorcraft flight manual (RFM) limits, define additional events and alert detection thresholds related to specific operational flight profiles, SOPs, and airmanship principles
- Effective visualization software, including relevant instrument and aircraft systems graphics, to affect review and debrief of crew at all base locations
- Retain data for a minimum of 12 months; routinely back-up data
- De-identify all data following a defined period of time
available recorder parameters, is available on the IHST website.

**Pre-brief stakeholders.** What is HFDM and how will it affect them? Many longtime industry veterans are still unfamiliar with HFDM programs and their details, benefits, and available equipment. All stakeholders need to understand the goals and objectives of the program and the sanctity of just culture, as well as the legal support behind an FAA-approved HFDM/FOQA program. It is important to ensure all parties understand the multiple safeguards as well as the overall organizational attributes derived from HFDM. This is even more important in a small operation, as de-identification presents a unique set of challenges in a group of a dozen or less pilots and managers.

**Establish pilot agreement.** Pilot agreements are necessary regardless of the size of operation. This agreement is a clear statement to each pilot or to the pilot group on the intended use of data collected and some of the protections afforded to the pilots and operator for participation in regulatory agency-approved programs. The agreement spells out the commitment to a just culture by management to each pilot. (See Attachment B for an example pilot agreement.)

**Approved or non-approved.** If a formal approval process exists, decide whether or not your organization will request regulatory approval for your HFDM program. For an explanation and the benefits of regulatory approval, refer to “Approved vs. non-approved programs” in section 1.

**Develop Implementation and Operations (I&O) Plan.** An I&O Plan is a living document, and is required when seeking FAA approval of your HFDM program; it is basically an operations manual for your HFDM program. Even if your company will not seek FAA approval, creating and maintaining an I&O Plan is a great way to formalize your program. Please see Attachment A, which was developed for an FAA-approved HFDM program, and is provided as an example to highlight the various sections and content needed for successful implementation. This I&O Plan outlines the necessary components of an FAA-approved plan. This I&O was written with the guidance of FAA Advisory Circular (AC) 120-82, which outlines the minimum criteria for an FAA-approved program; AC 120-92 also proved useful in the creation of this I&O Plan, outlining the benefits of Safety Management Systems (SMS).

Effective programs have an enlightened view of SMS. Support begins with senior management in any organization.

**Apply for regulatory approval.** If the I&O Plan is ready, submit for regulatory approval, if applicable. This can also be submitted during ongoing implementation steps below.

**Implementation**

**Install equipment.** Develop an estimated timeline for installation of all equipment, including equipment and analysis software. If installation of equipment requires obtaining a Supplemental Type Certificate (STC), additional time and resources must be budgeted for this process. Coordination with maintenance and vendors will be required to track progress and resolve problems. (FAA AC 120-82)

**Train the HFDM Team.** If data analysis will take place within the organization, all HFDM Team members should receive training on the analysis and animation software they will be using. Additionally, HFDM Team members should visit other operators with established HFDM programs to gain further insight into the operation of an HFDM program. Other training should be provided as new equipment and/or software is added to the program.

If the data analysis will be contracted to a third-party, the gatekeeper(s) or HFDM liaison should receive training required to perform their duties. This training is usually provided by the third-party.

**Involves stakeholders.** Clearly communicate stakeholders’ roles and responsibilities with regards to the implementation and ongoing operation of the HFDM program. Also communicate when they should expect updates regarding the HFDM program (i.e. quarterly, monthly, etc.).

**Collect and process airborne data.** Define policies and procedures regarding the collection and download of HFDM data. Will data be retrieved from a media card or by wireless data link (WDL)? Ensure there are no scheduling, locale, or manpower conflicts to resolve prior to implementation (Example: For an offsite base, define procedures for secure transfer of data to the analysis base). Ensure data is downloaded
frequently enough that overwrite (media storage size limitation) is not an issue.

**Analyze and validate data.** Data validation is an essential step in the analysis process. The HFDM Team will need to ensure data is valid before taking action. Investigation of software or equipment installation may be necessary.

**Develop information feedback process.** Define policies and procedures for providing feedback for both positive and negative information discovered through the HFDM program. Communicate as many events as possible back to crewmembers through various means. Event severity may be a way to define method of feedback (email advisory, crew contact, etc.).

Define a schedule for HFDM program progress reports (safety risks, operational trends, etc.) to the pilot staff and upper management. Some operators accomplish this by publishing periodic safety bulletins or newsletters. **Completing the information loop is essential to the success of the program!**

**Define remaining start-up criteria.** Audit the program and talk with stakeholders to determine if there are “holes” or barriers to address prior to complete implementation and operation of the HFDM program. If you are applying for FAA-approval, has the I&O Plan been approved?

**Continuing Operations**

**Conduct periodic program audits.** *Implementation of an HFDM program is just the beginning!* To meet an organization’s goals and objectives, a program must continuously evolve and improve. Periodic audits of all aspects of the HFDM program will determine whether the program is working as well as it could or whether changes are required. These reviews will also identify when the program needs to be updated. The lessons the HFDM Team learns should be captured and documented so that subsequent efforts benefit from the team’s experience.

**Track costs and benefits.** *Justifying the investment in an HFDM program is essential!*
Document initial and recurring costs of maintaining the program. Also document downward safety trends and operational and maintenance savings as a result of the program. A decreased accident or incident rate as a result of additional information and safety awareness obtained through HFDM should be translated to cost savings for the purposes of evaluating the value of the program, if possible. Many operators use key performance indicators such as “events per flight” to track and demonstrate the effectiveness of the system.

**Evaluate emerging technologies.** The HFDM Team should continuously evaluate emerging technologies to ensure the program is being conducted with the most benefit to the organization. Emerging technologies could include updated equipment, analysis or simulation software, data transfer technology, etc.

**Expand data usage.** The integration of de-identified HFDM data with other internal safety programs (such as the FAA Aviation Safety Action Program (ASAP)) should be considered to further enhance the safety value of the information. Also consider sharing your findings with other operators.

**Market the HFDM program.** Communicate HFDM successes and lessons learned with stakeholders and other operators. There is no greater marketing tool than the positive testimony of your peers.

**Conduct periodic meetings with stakeholders.** Conduct periodic meetings with stakeholders to report updated trends, risks, and corrective actions. Ensure corrective actions are assigned to an individual, so accountability is clear and can be tracked. Discuss status and/or effectiveness of previously recommended corrective actions.

**Ensure data is used for continuous improvement.** Once a corrective action is implemented, monitor its effectiveness and watch for other resultant risks or unintended consequences. Continue to track cost savings associated with previously implemented corrective actions.

A checklist for developing an HFDM program is shown in Figure 3.2.
HFDM Checklist

1. Planning and Preparation:
   - Identify stakeholders
   - Establish a steering committee
   - Define goals and objectives
   - Select FDM team
   - Define safeguards
   - Select equipment and software
   - Define events
   - Pre-brief Stakeholders
   - Establish pilot agreement
   - Approved or non-approved
   - Develop Implementation and Operations (I&O) Plan
   - Apply for regulatory approval if applicable (can be submitted any time)

2. Implementation:
   - Install equipment
   - Train the FDM team
   - Involve stakeholders
   - Collect and process airborne data
   - Analyze and validate data
   - Develop information feedback process
   - Define remaining start-up criteria

3. Continuing Operations:
   - Conduct periodic reviews
   - Track costs and benefits
   - Evaluate emerging technologies
   - Expand data usage
   - Market the HFDM Program
   - Conduct periodic review meetings with stakeholders
   - Ensure data is used for continuous improvement

Figure 3.2
HFDM Checklist
4 FDM Process: Global HFDM Steering Group Best Practice

The process described in this section is considered best practice by the Global Helicopter Flight Data Monitoring (HFDM) Steering Group. It consists of the following:

- Collecting and processing flight data
- Validating and assessing event data
- Storing data
- Contacting crew
- Acting on cynical abuse
- Performing trend analysis and recording results
- Periodically reviewing results
- Communicating results
- Conducting program audits - internal and external

The full report, *Helicopter Flight Data Monitoring: Industry Best Practice*, by the Global HFDM Steering Group is available on the [HFDM website](#).

**About the Global HFDM Steering Group**

The Global HFDM Steering Group seeks to standardize and improve HFDM practices across the industry by promoting best practice and
cooperation in the design, support, and operation of helicopter flight data monitoring.

The Steering Group was formed following the CHC Safety & Quality Summit held in Vancouver, Canada at the end of March 2010. Bringing together more than 70 people representing 48 organizations from across the globe, the Global HFDM Steering Group seeks to make HFDM as accessible as possible to all operators both large and small by sharing information with the intent of making HFDM easy for operators to implement. The wide adoption of HFDM has been recognized as a key initiative by the International Helicopter Safety Team, formed in 2005 with a vision of reducing the rate of civil helicopter accidents by 80% within 10 years. The Global HFDM Steering Group will publish information on its website at www.hfdm.org.

In some cases, the IHST HFDM Working Group may not endorse all practices as listed. IHST recommends some flexibility in developing practices, procedures, and protocol. As an example, there are alternatives to section 7.3.4, which discusses crew contacts. An alternative to making a crew contact for every medium or high severity event - as suggested by the Global HFDM Steering Group - an operator may choose to only contact crew members if there is an egregious event or additional information is required to enrich the analysis of that event (such as weather, system state, or crew factors). Many fixed-wing operators with decades of FDM experience endorse this practice and rely on timely reporting and education (promotion) to the entire pilot ranks as a mitigation strategy.

Likewise, other documents, including the CAA CAP 739: Flight Data Monitoring document, list alternatives to the staffing requirements outlined in the Global HFDM Best Practice document (see also section 3). For example, CAP 739 specifies that an HFDM Team Leader be an individual with “good analytical, presentation and management skills” and does not specifically mention the need for flight-related skills or qualifications.

In September 2011, the Global HFDM Steering Group published a list of industry best practices. These practices are a compilation of recommendations collected from several operators, many of which are large operators supporting the Oil and Gas Producers (OGP) worldwide. The practices listed are often contractual requirements mandated by their customers and might not necessarily fit all operations.
The generic FDM process (Figure 4.1) is considered best practice by the Global HFDM Steering Group and is described in more detail in the remainder of this section.
7.3.1 Collect and Process Flight Data

- FDM data should be downloaded and subjected to initial analysis to identify events on a daily basis.

- For aircraft operating routinely from temporary remote bases, a means of downloading and transmitting the data on a daily basis, or as often as possible, should be established.

- Successful data download rate from the operators fleet can be a useful Key Performance Indicator (KPI).

7.3.2 Validate and Assess Event Data

Event data, both in house data analysis and third party analysis services, should ideally be validated on a daily basis (working days only) to ensure that any events recorded have been generated correctly, subject to the following exceptions:

- For small operators who have just one pilot liaison/analyst, the analysis frequency may have to reflect that individual’s work schedule. However, where practicable, redundancy should be provided by a second pilot liaison/analyst.

- Small operators should consider using a non-pilot staff member whose availability is greater, to conduct a daily first look at the data to establish whether any events have been recorded. They can then communicate the need for further assessment to the dedicated pilot liaison/analyst. This additional staff member would have to be party to the confidentiality agreement.

The key reasons for requiring daily analysis of FDM data are to ensure that any significant medium and high risk events are highlighted to the flight crews as soon as possible to prevent the risk of re-occurrence, and that other events that require crew feedback can be communicated to pilots within a period of time where they will be able to recall the flight with clarity and assist in the analysis process. The risk of delaying feedback requests is that pilots may be unable to recall particular flights and hence the benefit of the feedback system is lost.

The analysis of the data may include a process to exclude events generated during maintenance test flights.

7.3.3 Store Data

FDM data can be stored for extended periods of time and a minimum of 12 months is recommended. If storing data for longer periods, consideration should be given to de-identifying the data to prevent future misuse by third parties.

7.3.4 Crew Contact

Crew contact is an essential element of an effective FDM system. If the only information received by crews is de-identified trended data in periodic reports, then a significant proportion of the benefit of the system may be lost. Individual feedback enables individual accountability and has been shown to have a significant impact in changing behavior.

For this reason it is recommended that all “valid” and relevant medium and high FDM events that exceed operating standards should result in a crew contact. This enables crews to be alerted to even minor departures from operating standards and limits and ensures those events do not become normalized by lack of action. The validation process should discount from future trend analysis those events associated, for instance, with training or maintenance check flights.

For those events that are assessed as medium risk, this contact can be just an advisory contact by email or other means, to alert the pilot or crew of the event, but does not necessarily require further follow-up action.

- This action could be completed by the individual performing the analysis, subject to the confidentiality conditions.

- For events assessed as high risk, a more comprehensive contact should be required, which involves dialogue between the pilot liaison and the crew involved.

- This contact should include a data review in the presence of the flight crew by the pilot liaison on base, the relevant points noted in the data should be discussed, and the flight crew given the opportunity to provide an explanation of the reasons
behind the indicated data. The aim is for the flight crew to assist in the analysis of the event and potentially learn from the review. In cases of flight crews who repeatedly make significant breaches, the system should allow for debriefs to be escalated to management for appropriate remedial and/or disciplinary action (or, if applicable, refer to the labor association’s Professional Standards personnel).

- For remote operations from temporary bases, face-to-face briefings with the pilot liaison and the full use of the analysis playback and review capability may not be possible; in such cases, operators should make the best use of available technology to communicate the event and its consequences to the crew.

operators should have a process in place for crews to request feedback from a particular flight or event. This will only be for a flight which they have personally been operating and may include a visual playback and debrief from the local FDM specialist. The operator should also have a procedure in place to determine when information on a high-risk event may be required to be communicated to other departments. Any such communication should abide by the confidentiality agreements in place for the transmission of FDM data.

The FDM system can also be used as a debrief tool for programmed training flights, provided this has been previously agreed and documented as a procedure.

7.3.5 Cynical Abuse Action

In the event of repetitive, deliberate violations of SOPs and limitations and/or unprofessional, reckless behavior (willful misuse or cynical abuse), the operator should have a procedure detailed in the confidentiality agreement that will enable escalation and in certain defined circumstances, disciplinary or administrative action to be taken (or, if appropriate, refer to the labor association’s Professional Standards personnel).

7.3.6 Perform Trend Analysis & Record the Results

Trend monitoring is another essential element of the FDM system and should be undertaken as a routine part of the process to give advance warning of developing issues in a flight operation.

The aim of trending or aggregating data is to give management the opportunity to intervene before operating limitations are breached. In addition, it enables the identification of trends in the exceedances. When data aggregated over a period of time shows an increasing tendency of crews to operate the aircraft closer to the established operational limitations, action can be taken to adjust procedures and/or practices to reverse the adverse direction of the trends identified. The rationale behind the setting of event detection thresholds supports this process by generating low level events below operational limitations such that these events can be trended to provide warnings before limitations are exceeded. Thus the FDM program becomes predictive and enables preventative action to be taken in advance of operational exceedances, reducing the risks in the operation.

Following analysis of the FDM data and, when necessary, further investigation and crew contacts, the results should be recorded and stored in a format that enables future access for reference and comparison. For example, specific events occurring regularly at specific airports or locations, or events occurring on a seasonal basis due to weather factors.

Once FDM trend monitoring has been established, key performance indicators (KPI) can also be used to measure the effectiveness of the FDM system and any follow-up actions taken.

A common KPI used by many established FDM operators is “events per flight”, but other key performance indicators can also be used, targeted at specific areas of concern or risk.

7.3.7 Periodic Review

The FDM Review Group should meet at regular intervals (quarterly is recommended) to review FDM results and make recommendations for suggested changes to operational procedures or training syllabi.

- A procedure should also be put in place to track the implementation of those recommendations and a monitoring process to determine their effectiveness.
• An overview of these actions, together with the key performance indicators, should be included as an agenda item in the operator’s periodic Senior Management Reviews, alongside the Safety and Quality Assurance (QA) summaries.

7.3.8 Communicate Results

All communication and transfer of FDM data and information must comply with the operator’s confidentiality agreement.

The FDM Manager should produce regular FDM reports, summarizing event activity within the organization and highlighting trends from the analysis. These reports, which can be in the form of newsletters should be made available and communicated to all crews and relevant departments.

• The information contained in the reports/newsletters must be de-identified so that a wide distribution within the organization can be achieved.

• Typically the reports/newsletters will identify the most commonly occurring events per aircraft type or by location. Individual events can also be highlighted if they provide valuable learning.

• When considered appropriate by the operator, de-identified FDM data can also be communicated to outside organizations such as ATC, airports, customers and aircraft manufacturers, if required to initiate or inform safety investigations of changes of procedures within that organization. For example, the use of FDM data to support a change in local air traffic procedures due to repeated events generated by pilots following ATC instruction, or use of FDM data to inform an investigation of an aircraft incident.

7.3.9 Program Audits – Internal/External

The FDM system should be subject to the operator’s internal audit QA process, using acceptable means that do not risk the independence and security of the FDM program, especially in smaller operations where some positions may be combined.
Appendix A  List of Available Attachments

Appendix A contains a list of available attachments to this document. To view the attachments, visit the IHST website.
Table A.1 List of Available Attachments

<table>
<thead>
<tr>
<th>Title</th>
<th>Author</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example: Pilot Agreement</td>
<td>Arkansas Children’s Hospital</td>
<td>Sep 2009</td>
</tr>
<tr>
<td>Generic Event Set</td>
<td>B.T. Villela, CAPACG</td>
<td>Jul 2010</td>
</tr>
<tr>
<td>Example: Crew Contact Email</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Helicopter Operations Monitoring Programme (HOMP)</td>
<td>UK CAA</td>
<td>Unknown</td>
</tr>
<tr>
<td>Light Data Recorder Feasibility Study</td>
<td>EASA</td>
<td>Dec 2008</td>
</tr>
<tr>
<td>A Roadmap to a Just Culture: Enhancing the Safety Environment</td>
<td>GAIN Working Group E</td>
<td>Sep 2004</td>
</tr>
<tr>
<td>CAA Paper 2004/02: Final Report on the Follow-on Activities to the HOMP Trial</td>
<td>UK CAA</td>
<td>Oct 2004</td>
</tr>
<tr>
<td>CAP 731 Approval, Operational Serviceability and Readout of Flight Data Recorder Systems</td>
<td>UK CAA</td>
<td>Jul 2006</td>
</tr>
<tr>
<td>HFAP(P)</td>
<td>B.T. Villela, CAPACG</td>
<td>Sep 2011</td>
</tr>
</tbody>
</table>
Appendix B  HFDM Resources

Appendix B contains a list of Helicopter Flight Data Monitoring (HFDM) resources including equipment providers and software and analysis services providers.
<table>
<thead>
<tr>
<th>Company Name</th>
<th>Website Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appareo Systems</td>
<td><a href="http://www.appareo.com">http://www.appareo.com</a></td>
</tr>
<tr>
<td>Avionica</td>
<td><a href="http://www.avionica.com">http://www.avionica.com</a></td>
</tr>
<tr>
<td>Black Box Avionics</td>
<td><a href="http://blackbox.aero">http://blackbox.aero</a></td>
</tr>
<tr>
<td>Cosworth</td>
<td><a href="http://www.cosworth.com">http://www.cosworth.com</a></td>
</tr>
<tr>
<td>Guardian Mobility</td>
<td><a href="http://www.guardianmobility.com">http://www.guardianmobility.com</a></td>
</tr>
<tr>
<td>Goodrich</td>
<td><a href="http://www.goodrich.com/sis">http://www.goodrich.com/sis</a></td>
</tr>
<tr>
<td>Helisafe (ISEI)</td>
<td><a href="http://www.helisafe.aero">http://www.helisafe.aero</a></td>
</tr>
<tr>
<td>L3 Communications</td>
<td><a href="http://www.l-3ar.com">http://www.l-3ar.com</a></td>
</tr>
<tr>
<td>North Flight Data Systems</td>
<td><a href="http://www.northfds.com/">http://www.northfds.com/</a></td>
</tr>
<tr>
<td>Outerlink</td>
<td><a href="http://www.outerlink.com">http://www.outerlink.com</a></td>
</tr>
<tr>
<td>Penny and Giles</td>
<td><a href="http://www.pennyandgiles.com">http://www.pennyandgiles.com</a></td>
</tr>
<tr>
<td>Sagem Avionics</td>
<td><a href="http://www.sagemavionics.com">http://www.sagemavionics.com</a></td>
</tr>
<tr>
<td>Star Navigation</td>
<td><a href="http://www.star-navigation.com">http://www.star-navigation.com</a></td>
</tr>
<tr>
<td>Teledyne Control</td>
<td><a href="http://www.teledyne-controls.com">http://www.teledyne-controls.com</a></td>
</tr>
<tr>
<td>Western Avionics</td>
<td><a href="http://www.westernavionics.com">http://www.westernavionics.com</a></td>
</tr>
<tr>
<td>Wi-Flight</td>
<td><a href="http://www.wi-flight.net">http://www.wi-flight.net</a></td>
</tr>
</tbody>
</table>

Note: Some equipment providers also provide software and analysis services.
## Table B.2  HFDM Software and Analysis Services Providers

<table>
<thead>
<tr>
<th>Company Name</th>
<th>Website Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerobytes</td>
<td><a href="http://www.aerobytes.co.uk">http://www.aerobytes.co.uk</a></td>
</tr>
<tr>
<td>Appareo Systems</td>
<td><a href="http://www.appareo.com">http://www.appareo.com</a></td>
</tr>
<tr>
<td>Austin Digital</td>
<td><a href="http://www.ausdig.com">http://www.ausdig.com</a></td>
</tr>
<tr>
<td>Avionica</td>
<td><a href="http://www.avionica.com">http://www.avionica.com</a></td>
</tr>
<tr>
<td>Baldwin Aviation</td>
<td><a href="http://www.baldwinaviation.com">http://www.baldwinaviation.com</a></td>
</tr>
<tr>
<td>CAPACG</td>
<td><a href="http://www.capacg.com">http://www.capacg.com</a></td>
</tr>
<tr>
<td>CEFA Aviation</td>
<td><a href="http://www.cefa-aviation.com">http://www.cefa-aviation.com</a></td>
</tr>
<tr>
<td>Flight Data People</td>
<td><a href="http://www.flightdatapeople.com">http://www.flightdatapeople.com</a></td>
</tr>
<tr>
<td>Flightscape</td>
<td><a href="http://www.flightscape.com">http://www.flightscape.com</a></td>
</tr>
<tr>
<td>Guardian Mobility</td>
<td><a href="http://www.guardianmobility.com">http://www.guardianmobility.com</a></td>
</tr>
<tr>
<td>Helinalysis Ltd.</td>
<td><a href="http://www.helinalysis.com">http://www.helinalysis.com</a></td>
</tr>
<tr>
<td>IATA FDA Service</td>
<td><a href="http://www.iata.org/ps/intelligence_statistics/Pages/fda.aspx">http://www.iata.org/ps/intelligence_statistics/Pages/fda.aspx</a></td>
</tr>
<tr>
<td>Sagem Avionics</td>
<td><a href="http://www.sagem-ds.com/ags">http://www.sagem-ds.com/ags</a></td>
</tr>
<tr>
<td>Sim Author</td>
<td><a href="http://www.simauthor.com">http://www.simauthor.com</a></td>
</tr>
<tr>
<td>Teledyne Controls</td>
<td><a href="http://www.teledyne-controls.com">http://www.teledyne-controls.com</a></td>
</tr>
<tr>
<td>X-Plane</td>
<td><a href="http://www.x-plane.com">http://www.x-plane.com</a></td>
</tr>
</tbody>
</table>

Note: Some software and analysis services providers also provide equipment.
Appendix C  FAA STC Approvals

Appendix C contains the FAA STC approvals, as of February 2011, available for light aircraft recording systems (LARS).
### Table C.1 FAA STCs Available for LARS Equipment

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Agusta 109</td>
<td></td>
<td>✬ ✬</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bell 206</td>
<td>✬</td>
<td>✬</td>
<td></td>
<td>✬ ✬</td>
</tr>
<tr>
<td>Bell 407</td>
<td>✬</td>
<td></td>
<td></td>
<td>✬ ✬</td>
</tr>
<tr>
<td>Eurocopter AS350</td>
<td></td>
<td>✬</td>
<td>✬</td>
<td>✬ ✬</td>
</tr>
<tr>
<td>Eurocopter EC120</td>
<td></td>
<td>✬ ✬</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eurocopter EC130</td>
<td></td>
<td>✬ ✬</td>
<td>✬</td>
<td>✬ ✬</td>
</tr>
<tr>
<td>Eurocopter EC135</td>
<td></td>
<td></td>
<td>✬</td>
<td></td>
</tr>
<tr>
<td>Eurocopter EC145</td>
<td></td>
<td></td>
<td>✬ ✬</td>
<td></td>
</tr>
<tr>
<td>Eurocopter EC155</td>
<td></td>
<td></td>
<td>✬ ✬</td>
<td></td>
</tr>
</tbody>
</table>

* Installed as standard equipment on new Eurocopter AS350 aircraft
** STC pending final approval
Appendix D  HFDM Event Set

Appendix D contains a generic HFDM event set collected from various operators and vendors. This event set is also available on the HFDM website.
## International Helicopter Safety Team

### Helicopter Flight Data Monitoring Toolkit

#### Event Title/Description

<table>
<thead>
<tr>
<th>Event Title/Description</th>
<th>Definition</th>
<th>Parameters required</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>GW Ops Breach - Ground</td>
<td>To identify where the aircraft deviated from the lowest safe altitude above ground level on ground or during takeoff.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GW Ops Breach - Takeoff</td>
<td>To identify where the aircraft deviated from the lowest safe altitude above ground level above ground during takeoff.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GW Ops Breach - Landing</td>
<td>To identify where the aircraft deviated from the lowest safe altitude above ground level on landing.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GW Ops Breach - Offloading</td>
<td>To identify where the aircraft deviated from the lowest safe altitude above ground level during offloading.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GW Ops Breach - Loading</td>
<td>To identify where the aircraft deviated from the lowest safe altitude above ground level during loading.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Flight - Takeoff & Landing

<table>
<thead>
<tr>
<th>Event Title/Description</th>
<th>Definition</th>
<th>Parameters required</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>GW Ops Breach - Takeoff</td>
<td>To identify where the aircraft deviated from the lowest safe altitude above ground level during takeoff.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GW Ops Breach - Landing</td>
<td>To identify where the aircraft deviated from the lowest safe altitude above ground level on landing.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Flight - Speed

<table>
<thead>
<tr>
<th>Event Title/Description</th>
<th>Definition</th>
<th>Parameters required</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>GW Ops Breach - Offloading</td>
<td>To identify where the aircraft deviated from the lowest safe altitude above ground level during offloading.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GW Ops Breach - Loading</td>
<td>To identify where the aircraft deviated from the lowest safe altitude above ground level during loading.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Flight - Altitude & controls

<table>
<thead>
<tr>
<th>Event Title/Description</th>
<th>Definition</th>
<th>Parameters required</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>GW Ops Breach - Takeoff</td>
<td>To identify where the aircraft deviated from the lowest safe altitude above ground level during takeoff.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GW Ops Breach - Landing</td>
<td>To identify where the aircraft deviated from the lowest safe altitude above ground level on landing.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Event Title/Description

<table>
<thead>
<tr>
<th>Event Title/Description</th>
<th>Definition</th>
<th>Parameters required</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>GW Ops Breach - Ground</td>
<td>To identify where the aircraft deviated from the lowest safe altitude above ground level on ground or during takeoff.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GW Ops Breach - Takeoff</td>
<td>To identify where the aircraft deviated from the lowest safe altitude above ground level above ground during takeoff.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GW Ops Breach - Landing</td>
<td>To identify where the aircraft deviated from the lowest safe altitude above ground level on landing.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GW Ops Breach - Offloading</td>
<td>To identify where the aircraft deviated from the lowest safe altitude above ground level during offloading.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GW Ops Breach - Loading</td>
<td>To identify where the aircraft deviated from the lowest safe altitude above ground level during loading.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Flight - Takeoff & Landing

<table>
<thead>
<tr>
<th>Event Title/Description</th>
<th>Definition</th>
<th>Parameters required</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>GW Ops Breach - Takeoff</td>
<td>To identify where the aircraft deviated from the lowest safe altitude above ground level during takeoff.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GW Ops Breach - Landing</td>
<td>To identify where the aircraft deviated from the lowest safe altitude above ground level on landing.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Flight - Speed

<table>
<thead>
<tr>
<th>Event Title/Description</th>
<th>Definition</th>
<th>Parameters required</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>GW Ops Breach - Offloading</td>
<td>To identify where the aircraft deviated from the lowest safe altitude above ground level during offloading.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GW Ops Breach - Loading</td>
<td>To identify where the aircraft deviated from the lowest safe altitude above ground level during loading.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Flight - Altitude & controls

<table>
<thead>
<tr>
<th>Event Title/Description</th>
<th>Definition</th>
<th>Parameters required</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>GW Ops Breach - Takeoff</td>
<td>To identify where the aircraft deviated from the lowest safe altitude above ground level during takeoff.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GW Ops Breach - Landing</td>
<td>To identify where the aircraft deviated from the lowest safe altitude above ground level on landing.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Event Title/Description

<table>
<thead>
<tr>
<th>Event Title/Description</th>
<th>Definition</th>
<th>Parameters required</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>GW Ops Breach - Ground</td>
<td>To identify where the aircraft deviated from the lowest safe altitude above ground level on ground or during takeoff.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GW Ops Breach - Takeoff</td>
<td>To identify where the aircraft deviated from the lowest safe altitude above ground level above ground during takeoff.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GW Ops Breach - Landing</td>
<td>To identify where the aircraft deviated from the lowest safe altitude above ground level on landing.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GW Ops Breach - Offloading</td>
<td>To identify where the aircraft deviated from the lowest safe altitude above ground level during offloading.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GW Ops Breach - Loading</td>
<td>To identify where the aircraft deviated from the lowest safe altitude above ground level during loading.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Flight - Takeoff & Landing

<table>
<thead>
<tr>
<th>Event Title/Description</th>
<th>Definition</th>
<th>Parameters required</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>GW Ops Breach - Takeoff</td>
<td>To identify where the aircraft deviated from the lowest safe altitude above ground level during takeoff.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GW Ops Breach - Landing</td>
<td>To identify where the aircraft deviated from the lowest safe altitude above ground level on landing.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Flight - Speed

<table>
<thead>
<tr>
<th>Event Title/Description</th>
<th>Definition</th>
<th>Parameters required</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>GW Ops Breach - Offloading</td>
<td>To identify where the aircraft deviated from the lowest safe altitude above ground level during offloading.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GW Ops Breach - Loading</td>
<td>To identify where the aircraft deviated from the lowest safe altitude above ground level during loading.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Flight - Altitude & controls

<table>
<thead>
<tr>
<th>Event Title/Description</th>
<th>Definition</th>
<th>Parameters required</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>GW Ops Breach - Takeoff</td>
<td>To identify where the aircraft deviated from the lowest safe altitude above ground level during takeoff.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GW Ops Breach - Landing</td>
<td>To identify where the aircraft deviated from the lowest safe altitude above ground level on landing.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>------------------</td>
<td>-----------------</td>
<td>-------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Event Type</td>
<td>Event Description</td>
<td>Conditions</td>
<td>Note</td>
</tr>
<tr>
<td>------------</td>
<td>-------------------</td>
<td>------------</td>
<td>------</td>
</tr>
<tr>
<td>Vortex</td>
<td>Vortex Presumed</td>
<td>Vortex or vortex-like motion was observed, but no definitive evidence of vortex was seen</td>
<td>Vortex is a rotating column of turbulent airflow that can be dangerous for helicopters.</td>
</tr>
<tr>
<td>Gust</td>
<td>Gust</td>
<td>Gust</td>
<td>Gust is a strong, local wind event.</td>
</tr>
<tr>
<td>Turbulence</td>
<td>Turbulence</td>
<td>Turbulence</td>
<td>Turbulence can cause significant changes in lift, drag, and moment on the helicopter.</td>
</tr>
<tr>
<td>Ice accretion</td>
<td>Ice accretion</td>
<td>Ice accretion</td>
<td>Ice accretion can lead to loss of lift and control.</td>
</tr>
<tr>
<td>Lightning</td>
<td>Lightning</td>
<td>Lightning</td>
<td>Lightning strikes can cause serious damage to helicopters.</td>
</tr>
<tr>
<td>Other</td>
<td>Other</td>
<td>Other</td>
<td>Other events may include engine failure, structural failure, or human error.</td>
</tr>
</tbody>
</table>
Appendix E Case Studies

Appendix E contains four case studies that pertain to the use of Helicopter Flight Data Monitoring (HFDM):

- Maintenance and HFDM: Autopilot Yaw Excursions
- Operations and HFDM: Noise Complaints
- Training and HFDM: HFDM in a 14 CFR Part 141 Flight Education Environment
- Safety and HFDM: Flight Director Policy Change
Case Study E.1: Maintenance and HFDM

Title: Autopilot Yaw Excursions

Date: August 2009

Problem: During a routine flight, the flight crew of an S-76C+ experienced two autopilot excursions in the yaw axis that caused minor in-flight upset. Using only subjective pilot reports, the operator could not determine the severity of the event; the amount of change in the yaw rate could not be quantified.

Approach: The operator requested the third-party HFDM team to review the associated flight files and report their findings, which would then be compared with the limits specified in the maintenance manuals.

Results: Using objective flight data, HFDM analysts were able to determine that there were no limitations exceeded and the aircraft was returned to service without impacting the normal flight schedule. The two excursions were separated by 33 minutes and the maximum yaw rate (12.67 deg/s) occurred during the first excursion. The airframe limit is 30 deg/s. The associated roll and pitch rates, and lateral, longitudinal, and normal accelerations were also checked to ensure that no other limitations were exceeded.

Benefits: Exceeding the flight limitations would result in an AOG situation, negatively impacting the flight operations and causing an expensive inspection to return the aircraft to service. The data captured by the HFDM system enabled an objective analysis of the yaw excursions to determine the aircraft’s airworthiness. The cost of an AOG situation was averted due to the quick (less than 24 hours) coordination between the operator and the third-party HFDM team.
Case Study E.2: Operations and HFDM

Title: Noise Complaints

Date: May 2010

Problem: A helicopter operator received noise complaints from a citizen whose house was located near the helicopter operator's temporary base of operations. The complaints suggested that the helicopters were flying low and the associated noise was bothersome. One month after the initial complaint, a complaint was filed with the local regulatory authority.

Approach: The operator requested the third-party HFDM analysis team to develop specific events to detect the frequency of flights near the complaint location. Six events were created for various distances and altitudes (AGL) relative to the complaint location. All flights for 2010, which included the flights during the complaint period, were reviewed and analyzed.

Results: HFDM analysts determined the monthly rates of flights triggering each of the six events. The altitude (AGL), ground speed, vertical speed, time, and day of the week were processed and analyzed to provide the operator with a general picture of flight operations near the complaint location. As a result, the HFDM analysis team suggested that the flight paths be modified to prevent further noise complaints.

Benefits: Helicopters do not have noise abatement procedures like airlines due to their limited size. However, low flight in heavily populated areas can lead to the interference with inhabitants' regular lives. Using the aggregate data collected by the HFDM program, the operator was able to respond to the complaints and develop mitigation strategies to prevent future occurrences.
Case Study E.3: Training and HFDM

Title: HFDM in a 14 CFR Part 141 Flight Education Environment

Date: January - September 2009

Problem: Offshore operators were early pioneers in HFDM programs. In this sector, HFDM has become commonplace with mature individual programs (for example, HOMP, FOQA, and FDM) that have yielded encouraging results. These results have made the program popular with many safety-minded operators, but with little acceptance in other segments such as flight schools. Recently, a 14 CFR Part 141 certificate holder conducted a research project to collect this missing data.

Approach: A two-fold approach was used. First, it was designed to evaluate the operational use of HFDM equipment and programs in a flight education environment, which included collecting data during training flights and reviewing the data during post-flight briefings to enhance instructional effectiveness. Second, to compile flight data and generate reports with de-identified data to enhance safety by identifying noncompliance of operational norms. After flights, debriefing forms were used to collect the student's and flight instructor's perception of the use of HFDM during the debriefings.

Results: Both students and instructors found the use of the HFDM system beneficial for training. At all levels of helicopter training, subjects found that the use of HFDM enhanced their training, and strongly (52%) supported the continued use of the HFDM system for training.

 Benefits: Taking the opinions of both students and instructors into consideration, the certificate holder proved that using available HFDM technology enhances instruction. The ability to review each maneuver performed in flight was especially relevant since the use of objective data could be used to correct students' mistakes. Instructors were able to detect students' noncompliance with SOPs and immediately address the issue, and thus reinforce good flying habits.
**Case Study E.4: Safety and HFDM**

**Title:** Flight Director Policy Change

**Date:** October 2008

**Problem:** During the investigation of an unrelated event, the HFDM analysis team detected the misuse of the flight director by the pilots operating a specific aircraft model.

**Approach:** The operator was monitoring the use of the flight director in various aircraft models as a procedures compliance check. During an investigation of an unrelated occurrence, the misuse of the flight director was identified as a causal factor, creating the need to set new baselines in the FDM program to obtain a better understanding of the problem. A new event was developed for the specific model to track flight director misuse. If the flight director is coupled on the ground, it can command drive collective up, causing a dangerous situation for passengers and crew moving around the aircraft. Also, if not properly programmed and coupled, following flight director commands can lead to a stall or over torque situation while the aircraft is turning and during approaches.

**Results:** The safety team determined that the recurrence of flight director misuse was unacceptably high. A Flight Operations Notice was immediately generated and distributed to pilots in order to correct the procedure failures that were occurring and to bring to light the correct manner in which to use the flight director.
Helicopter Flight Data Monitoring Toolkit
US JHSIT
Second Edition