Flight Data Monitoring Program

Air Charter Safety Foundation

March 2020

What is a Flight Data Monitoring (FDM) Program?

Flight Data Monitoring (FDM) is the analysis of flight data – from the Flight Data Recorder (FDR) which allows safety managers *to identify hazards and trends* of flight operational 'triggered' events.

This is to continuously improve flight operational procedures and training. FDM is often referred to as Flight Operations Quality Assurance (FOQA).

Why have an FDM Program?

- ***PROACTIVE SAFETY***
- Accident / Incident / Hazard *Prevention*
- Ensure regulatory compliance
- Feedback / lessons learned for continuous improvement
- Fuel burns – Fly-Efficiently
- Reduced maintenance troubleshooting time
- Brand image protection
- Savings on insurance premium

Why have an FDM Program?

- **IT'S ALL ABOUT PROACTIVE SAFETY**
- Accident investigations often uncover latent / hidden risks
- Hidden risks can continue over time if not monitored
- By having an FDM Program, a company can monitor for risks to their operation and *proactively act on them to prevent them from manifesting into an incident or accident*.

Event example – the “Why” to have FDM

- A Global Express flew from the US to Europe – a 7h30m flight
- The pilots contacted the Company and advised the ground lift dump / spoilers did not deploy and the emergency brake was used upon landing to stop the aircraft
- Post flight inspection revealed damage occurred to #1 and #4 tires

Investigation of Global Express Landing Event

Debrief with pilots

- The crew briefed and flew a stabilized approach
- Normal flare and touch down in touch down zone
- Felt like normal brake system failed with sensation of no deceleration *without* a “BRAKE FAIL” Crew-Alerting System (CAS) Messages
- Used emergency / parking brake to stop aircraft on runway
- Flat spotted #1 and #4 tires
- No further incident

Investigation of Global Express Landing Event

Review of weather:

- No significant weather
- POD: warm weather with wet runway conditions
- POA: mild weather, calm winds, cloudy, dry runway condition

Investigation of Global Express Landing Event

Review of aircraft maintenance records

- No relevant history of mechanical irregularities of systems related to:
  - wheels / braking / antiskid system(s)
  - Ground Lift Dump (GLD) system
  - Thrust Reversers (TR)

Investigation of Global Express Landing Event

Maintenance corrective actions:

- Replaced all wheels / tires
- Operational checks of systems:
  - brake / antiskid system(s)
  - Ground Lift Dump (GLD) System
  - Thrust Reversers (TR)
- No Defects Noted (NDN)

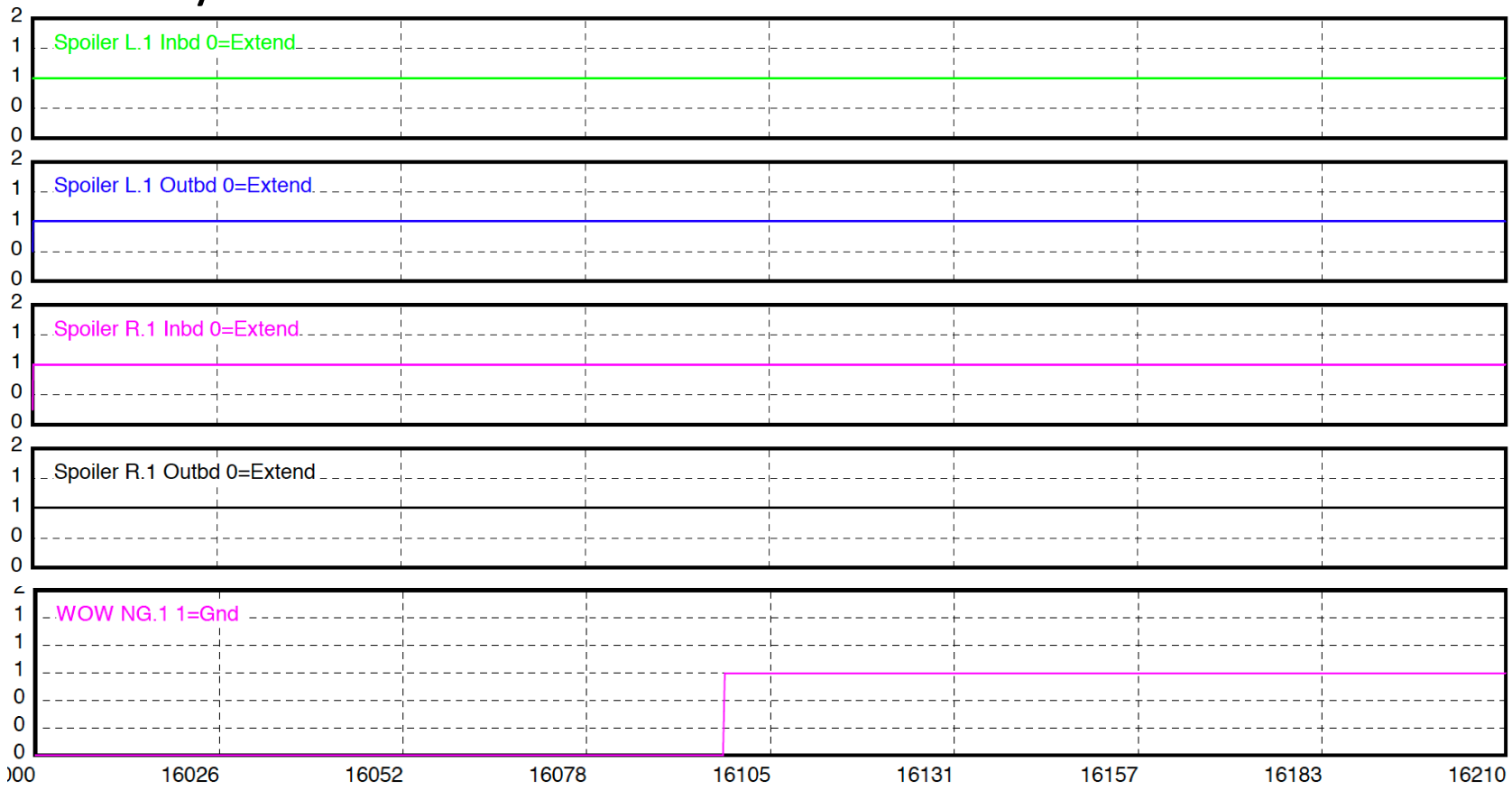
Investigation of Global Express Landing Event

Review and analysis of FDR:

- Stabilized approach
- Ground lift devices did *not* automatically deploy as they should have (but no faults found in system)
- Emergency / Parking Brake used
- No Crew-Alerting System (CAS) Messages

Investigation of Global Express Landing Event

FDR Analysis:



Investigation of Global Express Landing Event

Event findings:

- POD wet runway conditions with 7h30m flight; cold-soaked brakes
- Touch down with (temporarily) frozen brakes, preventing normal wheel spin-up to allow for proper interrogation of the air/ground safety system
- Inhibited the ground spoilers from automatically deploying
- Lack of ‘normal rate’ of deceleration; crew false sensation/perception of brake fail
- Longer than planned runway landing performance (increased risk)

Investigation of Global Express Landing Event

Event findings:

Investigation of Global Express Landing Event

Event findings:

- Manufacturer Advisory Wire AW700-32-0244 Procedures to Prevent Freezing Brakes

This Advisory Wire is to raise awareness that a frozen brake situation may occur subsequent to the brake(s) being subjected to moisture from wet weather, ground operations, aircraft washing, parking and cold weather operations.

Flight crews and maintenance personnel are reminded that carbon brakes are porous and can absorb or retain moisture. Should this occur, a subsequent landing may result in a tire burst.

Investigation of Global Express Landing Event

Event findings:

- Advisory Wire AW700-32-0244 Procedures to Prevent Freezing Brakes

Brake applications must be deliberately applied during taxi, before departure, to ensure the moisture is evaporated away.

If a wet brake is not heated sufficiently to evaporate moisture from the disk surfaces, there is a possibility after in-flight cold soak or parking in known wet or freezing conditions that the brake disk surfaces may freeze together.

Investigation of Global Express Landing Event

Corrective Action Recommendations:

- Pilots and Training Department communication
  - Procedure for Ground Lift Dump not automatically deploying
  - Not to use the emergency brake unless absolute necessity (likely associated with a BRAKE FAIL CAS message)
  - AW – importance of heating carbon brakes sufficiently to evaporate moisture from the disk surfaces during taxi out

Why have an FDM Program?

We believe the greater risk is not having an FDM Program. Furthermore, we believe an FDM Program is a cost of flight operations. FDM acts as in an insurance policy and is much less expensive than an accident/incident.

How to have an FDM Program?

1st – Company needs to support a Just Culture

2nd – financial support / think of as insurance policy

3rd – understand the value of knowing the potential risks to your operation so you can act on them

4th – research; find a company you want to work with

5th – start with aircraft that visit ICAO Required states; ADSB data, FlightAware, or FlightPlan

How does this tie into SMS?

- FDM contributes to SMS by providing safety assurance through evaluation of processes and procedures
- Controls will be implemented based on hazardous trends identified
- Improving the way we fly through continuous improvement

FLEXJET

Elevate Safety Standards

- Elevate *<u>your safety</u>* standards by having *voluntary* safety programs
  - SMS
  - ASAP
  - FDM
- FAA does not require 135 operators to have FDM or FOQA Program.

- SMS and continuous improvement

Quick Access Recorder (QAR)

- Acquires 4.5 million data points from the already present data flow to the flight data recorder
- Transmits data via cellular network after landing
- Receive data and create a usable data package
- This data package is then transmitted via secure data lines for use with analysis software

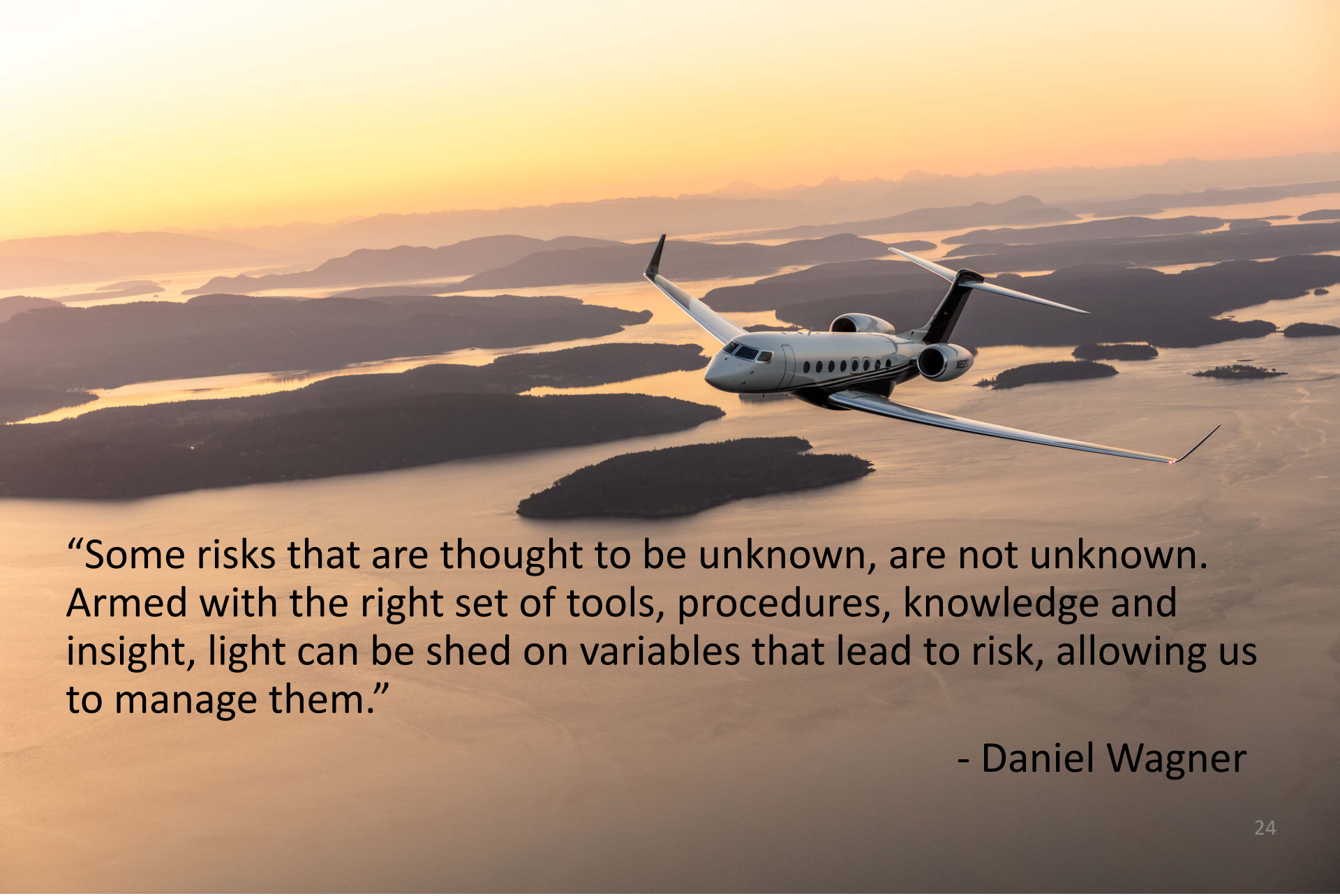
Event trigger examples

MMO Exceedance
Slat Mach Limit Exceedance
No Fuel Flow to Left Outboard Engine
No Fuel Flow to Left Inboard Engine
No Fuel Flow to Center Engine
No Fuel Flow to Right Inboard Engine
No Fuel Flow to Right Outboard Engine
GPWS: Unknown Warning Type
GPWS: Sink Rate
GPWS: Pull Up
GPWS: Terrain
GPWS: Terrain Pull Up
GPWS: Too Low Terrain
GPWS: Look Ahead Caution
GPWS: Look Ahead Warning
GPWS: Minimums
GPWS: Too Low Gear
GPWS: Too Low Flap
GPWS: Glideslope
Engine Fire (right inboard engine)
Engine Fire (right outboard engine)
Smoke Warning (Avionics Bay)
Smoke Warning (Cargo)
Smoke Warning (Lavatory)
Smoke Warning (General)
Airspeed Exceeds Limit for Low Altitudes
Airspeed Low Relative to Stall Speed
Airspeed (calibrated) Disagreement
Low Buffet Speed at High Altitude
MLE (Gear-Down Mach Limit) Exceedance
Low-Level Windshear
EGT Limit Exceedance (Left Outboard Engine)
EGT Limit Exceedance (Left Inboard Engine)
EGT Limit Exceedance (Center Engine)
EGT Limit Exceedance (Right Inboard Engine)
EGT Limit Exceedance (Right Outboard Engine)
Maximum Operating Altitude Exceedance
Flap / Slat Altitude Limit Exceedance
VFE (Flap Airspeed Limit) Exceedance
Slat Speed Limit Exceedance
VLE (Gear-Down Airspeed Limit) Exceedance
VMO Exceedance
Pitch Attitude Disagreement
Stall Warning
Roll Attitude Disagreement
High Bank Angle for this Height
High Roll Rate
Low Hydraulic Pressure
Cabin Pressure Warning
TCAS Traffic Advisory
TCAS Resolution Advisory
Master Warning
Excess Ground Speed: Taxi Out
Takeoff Altitude is Too High
Vtire (Tire Speed Limit) Exceedance during Takeoff
High Rotation Rate
Brake Temperature Exceeds Limit for Takeoff
Speed Brakes Used During Final Approach
VLO (Gear Extension Airspeed Limit) Exceedance
GPWS: Don't Sink
Late Gear Extension
Diversion
Go Around
Final Flap Position not Valid for Landing
Vtire (Tire Speed Limit) Exceedance during Roll Out
Risk of Fuel Exhaustion
Landing Weight Limit Exceedance
Excess Ground Speed: Taxi In
Ground Spoilers Armed Late
Unstable Approach (HAT method)
Predictive Windshear
Envelope Stall Protection (Alpha Floor)
FLCH or Open Descent below Vref
Altitude Hold Engaged During or Prior to Liftoff
High Pitch Angle for this Height
Low Pitch Angle for this Height
Below Vertical Path with Airport Elevation Selected
Approach Mode Engaged during Climb or Cruise
Hard Landing (Acceleration Method)
Pitch High on Takeoff
Pitch High on Landing
Engine Fire (left outboard engine)
Engine Fire (left inboard engine)
Rejected Takeoff
VLO (Gear Retraction Airspeed Limit) Exceedance
Late Final Flap Extension

Risks in your operation

What are the highest level of risks to your organization?

- Towing the airplane in/out of hangars?
- Taxing?
- Visual Approaches?
- Night operations?
- Unstabilized approaches?
- IMC operations at night in mountainous terrain?



"Some risks that are thought to be unknown, are not unknown. Armed with the right set of tools, procedures, knowledge and insight, light can be shed on variables that lead to risk, allowing us to manage them."

- Daniel Wagner

Business Jet Industry Statistics: Some Perspective

Business Jet Fleet

U.S.	World	U.S. (%)
14,772	**22,567**	**65%**

U.S. Fleet (Jets)

Part 135	All	U.S. (%)
3,950	**14,772**	**27%**

U.S. Charter Industry

	# Operators	# Aircraft
All	**1,935**	**11,209**
Jets only	**571**	**3,950**

U.S. Charter Jets by Category

	# Jets	% Total
Light	1,317	**33.3%**
Mid-size	793	**20.1%**
Supermid	926	**23.4%**
Large Cabin	914	**23.1%**
	3,950	100.0%

Operator Size vs Industry

Op Jet# Category	# Ops	# 135 U.S. Ops	% Industry
1	159	571	**27.8%**
1 - 2	244	571	**42.7%**
1 - 3	313	571	**54.8%**

"1-3 Jet" Operators v Industry Jets

Op Jet# Category	# Jets	# 135 U.S. Jets	% Industry
1 - 3	536	3,950	**13.6%**

U.S. Charter Jets: "1-3 Jet" Operators

	# Jets	% Total
Light	300	**56.0%**
Mid-size	122	**22.8%**
Supermid	51	**9.5%**
Large Cabin	63	**11.8%**
	536	100.0%

Operator Size vs Industry

Op Jet# Category	# Ops	# 135 U.S. Ops	% Industry
>25	18	571	**3.2%**
>50	9	571	**1.6%**

">50" Operators v Industry Jets

Op Jet# Category	# Jets	# 135 U.S. Jets	% Industry
>50	1,138	3,950	**28.8%**

U.S. Charter Jets: >50 Jet Operators

	# Jets	% Total
Light	187	**16.4%**
Mid-size	142	**12.5%**
Supermid	486	**42.7%**
Large Cabin	323	**28.4%**
	1,138	100.0%

2019 Flight Hours

Part 135 Jet	All Biz Jet	%
1,066,976	4,591,723	23%

13 IAS Regis	Part 135 Jet	%
224,646	1,066,976	21%

13 IAS Regis	All Biz Jet	%
224,646	4,591,723	5%

13 IAS Regis	**Statistical**	**%**
224,646	1,000,000	22%

U.S. Charter Jets: 13 IAS Registered

	# Jets	% Total
Light	72	**16.3%**
Mid-size	58	**13.2%**
Supermid	168	**38.1%**
Large Cabin	143	**32.4%**
	441	100.0%