# RA 1208 - Flight Data Monitoring

## Rationale

*Flight data obtained from onboard flight recorders provides a valuable source of information which can be used to provide Assurance that an Air System►◄ is being operated safely[1]. Without a coherent approach to the management and exploitation of this data within a Flight Data Monitoring Programme (FDMP), assuring Air Safety►◄ and delivering improvements will be less effective and ►operating◄ Safety may be compromised with the associated increase in Risk to Life. This Regulation requires Aviation Duty Holders (ADH) and Accountable Managers (Military Flying) (AM(MF)) to introduce and maintain an FDMP which is integrated with their Air Safety Management System[2] (ASMS) for the exploitation of flight data from capable Air Systems.*

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## Definitions

### Definitions relevant to this RA

1. **Flight Data Monitoring (FDM)** is the systematic, pro-active use of flight data to enhance the delivery of operational capability by improving Air Safety through effective integration with ASMSs►◄ within an intrinsically just Air Safety culture.

2. **FDM Programme (FDMP)**: The FDMP includes the people, processes, tools and documentation which form a coherent system for delivering the required outputs from FDM. ►An FDMP allows an ADH / AM(MF) to compare their Standard Operating Procedures (SOPs) with those actually achieved in everyday flights, identify areas of Risk and measure current Safety margins; more mature programmes can also enable improved Maintenance and operating efficiencies.◄

3. **Flight Data Recorder (FDR)**: FDR refers to the crash-protected recording device which is mandated for all new Air Systems[3].

## Regulation 1208(1)

### The Flight Data Monitoring Programme

1208(1) Operating Duty Holders (ODH) and AM(MF) **shall** implement an FDMP[4] for all Air Systems fitted with an FDR[5].

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### The Flight Data Monitoring Programme

**►Programme Objectives and Outcomes◄**

4. ►◄

5. ADH / AM(MF) **should** specify the objectives[6] required from the FDMP and the intended ►Air Safety benefits and◄ outcomes. When an ODH / AM(MF) is temporarily allotted an Air System for a specific purpose[7], they **should** support the owning ODH's FDMP.

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[1] Safe operation includes compliance with Release To Service (RTS) limits, meeting Statement of Operating Intent profiles, and following specific operating procedures.
[2] Refer to RA 1200 – Air Safety Management and the Manual of Air Safety (MAS).
[3] Colloquially termed the 'black box', FDR requirements are ►contained in the relevant Parts of◄ Defence Standard 00-970 ►◄ Design and Airworthiness Requirements for Service Aircraft.
[4] Consideration is required to determine whether the most efficient option would be an FDMP per Air System, or per larger grouping.
[5] For ►Specific S2 sub-category or for Certified category◄ Remotely Piloted Air Systems (RPAS), the ODH / AM(MF) are to justify within the Air System Safety Case (ASSC) how recorded flight data (either from onboard or the ground station) is exploited to meet the intent of this Regulation. ►There is no requirement to develop an FDMP for Open Category or Specific S1 sub-category RPAS.◄
[6] Objectives are to consider the operating Risk and monitoring of required Safety margins as a minimum so that ►Aircrew◄ procedures and training can be optimized as a key element of an ADH's / AM(MF)'s ASMS; further detail is at paragraph ►25◄. Throughout this Regulation the ODH is used when the context is ownership of the FDMP; ADH is used when the context is the specific aspect of detailed FDMP management and integration with ASMSs.
[7] Such as post-Maintenance test flying or trials evaluation. Refer to RA 1164 – Transfer of UK Military Registered Air Systems.

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**Airborne Recording Systems**

6. ►When no FDR is fitted, the ODH / AM(MF) **should** include an argument within the ASSC[8] either justifying non-fitment or referencing a Modification plan.

7. When an FDR is fitted but there is not currently a workable method to download or exploit the flight data, the ODH / AM(MF) **should** include an argument within the ASSC either justifying why implementation of the capability is not reasonable, or referencing a Modification plan.◄

8. If the Air System monitored by an FDMP has a single recording device that is shared with the Accident investigation download, consideration **should** be given to fitting a separate data recorder to remove the Risk of compromising Accident investigation capability[9].

9. ►In addition to Air System Modification requirements, ODH / AM(MF) planning for implementation of an FDM capability **should** include development of the required off-board processing, analysis and exploitation capability.◄

10. ODH / AM(MF), supported by the Type Airworthiness Authority (TAA[10]), **should** ensure that the necessary usage rights and technical detail of the recorded data are available to permit its exploitation.

**Process Control Tools and Procedures**

11. The FDMP **should** have effective means of tracking the data downloaded from the Air System to detect data losses and delays in transmission.

12. Failures in sensors and onboard recording equipment detected by the FDMP **should** be reported via established defect reporting channels for resolution.

13. The FDMP **should** employ software tools with the capabilities to:

a. Convert the downloaded binary data into usable engineering units.

b. Automatically analyze the data to generate “measurements” and “events”.

c. Generate various forms of visualisation of the data for interactive analysis.

d. Integrate flight data with external data sources.

14. The FDMP **should** employ effective methods and techniques to assess the quality of the data and derived information and take corrective actions as required.

15. The information exchanged with the ►Aircrew◄ during the investigation of flights **should** be stored in a system that enables efficient retrospective analysis.

**Communication**

16. The FDMP **should** establish an effective communications plan, tailored to the type of information being delivered and the target audience.

17. Where appropriate, lessons learned **should** be shared with the wider Regulated Community►◄.

**FDM Documentation**

18. All the manuals and documentation necessary for the correct interpretation of the data and configuration of the analysis software **should** be readily available.

19. ADH / AM(MF) **should** develop procedures to ensure effective operation of the FDMP and document them in ►appropriate◄ orders; the following **should** be included as a minimum:

[8] ►Refer to RA 1205 – Air System Safety Case; this requires FDR and FDM to be explicitly addressed.◄

[9] Consideration of any Modification requirement is expected to include a cost / benefit analysis; paragraph ►21◄ provides more detail of system requirements.

[10] ►Where the Air System is not UK MOD-owned, Type Airworthiness (TAw) management regulatory responsibility by either the TAA or Type Airworthiness Manager (TAM) needs to be agreed within the Sponsor’s approved model; refer to RA 1162 – Air Safety Governance Arrangements for Civilian Operated (Development) and (In-Service) Air Systems, or refer to RA 1163 – Air Safety Governance Arrangements for Special Case Flying Air Systems. Dependent on the agreed delegation of TAw responsibilities TAM may be read in place of TAA as appropriate throughout this RA.◄

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a. **Data Recovery Targets**: Minimum targets for the percentage of data recovery and the download frequency.

b. **Data Management and Security**: Data access and security policies which **should** be compliant with UK data protection law and UK military data management requirements, defining as a minimum:

(1) The retention period for data and derived information.

(2) Levels of access to authorized personnel.

(3) The process to establish contact with ►Aircrew◄.

(4) The process and conditions for withdrawing confidentiality.

c. **Roles and Responsibilities**: Define the various roles, responsibilities and Authorization requirements for downloading, processing, transferring, storing, analyzing and assuring the data, and responsibilities for ensuring effective integration with the ASMS.

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## The Flight Data Monitoring Programme

**►Development Flying Activity**

20. Due to the nature of the flying activities, there is no requirement to implement an FDMP for Air Systems being operated within the Military Operated (Development) or Civilian Operated (Development) Defence Air Environment (DAE) Operating Categories[11]. Similarly, there is no FDMP requirement for those undertaking Development activity within the Special Case Flying DAE Operating Category. However, this does not preclude the ODH / AM(MF) choosing to do so where they see benefit in such a programme.◄

**Airborne Recording Systems**

21. It is possible to use data downloaded from the crash protected FDR to support the FDMP. However, repeated use of the FDR may cause a degradation of its serviceability which means the FDR might not be available in case of an Accident. Modern FDRs store data in solid state memory units and are very resilient but the installation of onboard Quick Access Recorders (QAR) or equivalent technology is recommended for FDM purposes; these devices connect to the same data acquisition unit as the FDR►◄. A QAR will also generally have a longer record time which would allow greater flexibility of data download frequency before FDR data is overwritten, so the required cost / benefit analysis will need to consider such broader issues[12].

22. The suitability of a data recording system for FDM purposes is primarily dependent on two aspects:

a. The quality and quantity of recorder flight parameters.

b. The practicality of the process of extracting data from the Air System.

23. There will be a link between the objectives desired from an FDMP and the parameters available for recording since what is not recorded cannot be monitored. Therefore, any Modification action to enhance the list of recorded parameters will require appropriate cost / benefit assessment[13]. ►Whilst it is the existence (or not) of an FDR that drives the context for an appropriate FDMP argument within the ASSC, an ODH / AM(MF) may choose to argue for implementing an acceptable FDMP that delivers the Regulatory intent using alternate data sources if no FDR exists and the required cost versus benefit Safety argument can be made.◄

24. The detailed format of the FDR binary data stream is required to enable its processing and exploitation. This 'Data Frame Layout' is an important document which contains the necessary information to convert the binary data downloaded from the Aircraft into engineering units which is required for the proper configuration of the FDM software. This information is generally the same as that used in the processing of the

[11] ►Refer to RA 1160 – The Defence Air Environment Framework.◄
[12] ODH / AM(MF) need to ensure that the TAA's Air System Support Policy Statement (SPS) includes adequate requirements for the management of recorded data to support the FDMP. ►Refer to RA 5407 – Support Policy Statement.◄
[13] Civil Aviation Authority (CAA) Civil Aviation Publication (CAP) 1394 provides details for potential simple FDM solutions.

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annual FDR downloads which is an Air Navigation Order (ANO) requirement[14]. It is also necessary to ensure that there are no Intellectual Property Rights issues with the recorder manufacturer which would prevent data exploitation within the FDMP.

**Process Control Tools and Procedures**

25. In order to meet the desired objectives set for the FDMP, the software needs to be configured to capture the relevant events and / or measurements. All FDM software tools can be configured to raise "events" for conditions where parameters exceed certain threshold limits in a given flight. For example, a "Velocity, Maximum Operating (VMO) Exceeded" event can be raised whenever the Indicated Airspeed (IAS) parameter exceeds the VMO envelope[15]. In addition to "events", FDM software tools can be configured to generate "measurements" for every flight, such as "Maximum IAS". Events are only created for flights which exceed pre-determined thresholds while measurements can be created for all flights whether or not events have also been detected.

26. Events[16] are useful means of prioritizing attention to specific flights where unusual situations have occurred, while measurements provide a more complete representation of the entire operational envelope. Not every flight will have events, therefore events are exceptional and represent only the "tip of the iceberg". Measurements on the other hand are abundant not only because they will exist for every flight but also because it is common to have hundreds of different measurements generated for each flight.

27. Flight data records what happened on a given flight but not why it happened. To understand causal factors, it is often necessary to augment the recorded flight data with external data such as flight logs, Flight Plans, Electronic Flight Bag (EFB)[17] data and weather data. This level of integration invariably requires IT development efforts to facilitate communication between systems in an automated manner. Flight manuals, operations manuals, Maintenance manuals, approach charts, Aerodrome charts, terrain maps, etc are also normally necessary to contextualize and interpret the flight data and derived information.

28. It is essential that data quality is routinely checked for accuracy and completeness so suitable arrangements are to be included as part of local management systems.

29. A system is required to manage ►Aircrew◄ contacts so that it can be carefully monitored and linked with the related flight data. This capture of ►Aircrew◄ perspectives regarding the events and their insights about related Safety issues will enable a richer source of information and identify potential trends etc.

**Communication**

30. Analysis of the flight data can identify a range of finding categories[18] which will necessitate different communication approaches, so the required communication channels and procedures need to be pre-established to ensure they work effectively and efficiently; this is particularly important in the cases when error management and data protection principles need to be observed. Adequate management of the communication between the FDMP and other stakeholders is fundamental to promote and maintain the reputation and trust in the programme; MAS chapter 3 provides further guidance on managing the required Air Safety culture.

**FDM Documentation**

31. FDM ►◄ orders need to be produced to address the following aspects as a minimum:

[14] There is an ANO requirement for all Aircraft to maintain a reference sample from their FDR to support potential Accident investigations; whilst this requirement is not directly applicable to military Air Systems, it is to be included in the SPS.
[15] European Aviation Safety Agency Regulations ORO.AOC.130 (fixed wing) and SPA.HOFO.145 (rotary wing) contain examples of potential FDM events.
[16] Development of the correct events to monitor Safety and Airworthiness issues is key to FDMP effectiveness; TAA input will be required.
[17] European Union Aviation Safety Agency (EASA) AMC 20-25 provides further detail on EFB requirements.
[18] Categories range from individual Airworthiness events or isolated handling anomalies, through to events which may affect most or all ►Aircrew◄ due to systemic operating issues.

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a. **Data Recovery Targets**: The data recovery target is normally expressed as the percentage of flights captured in the FDM programme versus the total amount of flights flown by the Air System. It will be set to a value that enables capturing a statistically representative sample of the operation. For high-volume operations where flights tend to occur over the same standard routes (such as the case of standard air transport routes) a relatively low data capture rate is sufficient[19]. Operations where each flight is unique and exposed to novel threats require a higher data capture rate.

b. **Download Frequency**: The download frequency needs to be high enough to facilitate the recall of the flight by ►Aircrew◄ members in case of ►an Aircrew◄ contact and to improve the response time for Airworthiness events detected in the data (which may have not been reported by other means). There is a link between download frequency, data recovery targets, recorder capacity and operating necessity so careful consideration is required.

c. **Data Management and Security**: There are detailed requirements specified for generic data governance[20] as well as specific General Data Protection Regulation (GDPR) legislation on protecting personal data, all of which must be considered. There are also security requirements[21] for handling classified or sensitive data which need to be considered, particularly in operational scenarios. MAA Regulatory Publication (MRP) requirements for retaining significant Air Safety related documents[22] also apply. The governance and retention rules need to be adapted to the characteristics of the various types of data used and created by the FDMP[23].

d. **Roles and Responsibilities**: These will detail both specific FDM roles and how effective integration is achieved with the ASMS, including recommended training requirements. ►The additional sources of guidance at Para 33 provide◄ explanation of potential roles including ►Aircrew◄ liaison and technical / operating data interpreters.

**Implementation**

32. Developing an effective FDMP requires consideration of a broad range of technical and procedural issues relating to both the Air System and off-platform infrastructure. Given the similar nature of FDMP requirements across the DAE, it is likely that there will be synergies and economies of scale to be realised by sharing resources.

**► Further Sources of FDM Guidance**

33. Further guidance on implementing an FDM programme is available at the following sources:

a. EASA: GM1, GM2 and GM3 to ORO.AOC.130

b. UK CAA: CAP 739

c. Australian Civil Aviation Safety Authority: Advisory Circular 119-04◄

**Regulation 1208(2)**

## Flight Data Monitoring Effectiveness

1208(2) ODH / AM(MF) **shall** ensure that the FDMP exploits available data to enhance operating effectiveness by providing actionable Safety intelligence that supports the ASMS, and ultimately the ASSC.

[19] Consideration needs to be given to the number of ►Aircrew◄ flying the same routes to ensure a representative sample of performance is obtained.
[20] Refer to Joint Service Publication (JSP) 441: Information, Knowledge, Digital and Data in Defence. Organizations external to the MOD will need to comply with current legislation and relevant contractual conditions.
[21] Refer to JSP 440: Defence Manual of Security, Resilience and Business Continuity. Organizations external to the MOD will need to comply with current legislation and relevant contractual conditions.
[22] Refer to RA 1225 – Air Safety Documentation Audit Trail.
[23] This relates to aspects such as raw FDM data versus processed data etc, and requirements for data anonymisation.

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## Flight Data Monitoring Effectiveness

**Integration with the ASMS**

34. ADH / AM(MF) **should** ensure that the FDMP is integrated with their ASMS to support the following areas:

a. Hazard Identification.

b. Risk Assessment.

c. Safety Assurance.

d. Proactive management of change.

35. ODH / AM(MF) **should** be responsible for the effectiveness of the FDMP in meeting the specified objectives.

**Continuous Improvement**

36. ODH / AM(MF) **should** ensure that the FDMP continuously improves its capacity to generate data and actionable Safety intelligence to further enhance the ASMS.

**Assurance**

37. ODH / AM(MF) **should** implement an Assurance framework for FDM to monitor FDMP effectiveness.

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## Flight Data Monitoring Effectiveness

**Integration with the ASMS**

38. An FDMP can be an important element of the data exploitation strategy[24] of an ODH / AM(MF) since flight data can be used for multiple purposes[25]. However, for the purposes of this Regulatory Article the focus is on integration with the ASMS and ultimately with supporting the ASSC.

39. An FDMP can be seen as one of the various sources of data and information feeding the ASMS to support the elements detailed below. The categories of FDM findings which may undermine Safety claims and require corrective action[26] were discussed in paragraph ►30◄.

a. **Hazard Identification**: In contrast with Occurrence Reports[27] submitted by ►Aircrew,◄ flight data is not biased by the perception of the reporter nor the reporting culture of the organization. Flight data therefore offers a potential to identify Safety Hazards that is not possible with other data sources but the FDMP is not intended nor designed to manage the Hazards that it identifies. Instead, such Hazards will be identified in the pre-set 'events' and communicated to the parent ASMS to be appropriately managed; figure 1 below provides a schematic representation of the process.

[24] Refer to RA 1207 – Air Safety Data Exploitation.
[25] An FDMP can be used to enhance Maintenance and operating efficiency by identifying trends which fall below standard thresholds, but that can require more complex and sophisticated exploitation which will be developed in the future as knowledge and experience mature.
[26] Corrective actions could include individual training, amendment of a training syllabus, new SOP or system modification.
[27] Refer to RA 1410 – Occurrence Reporting and Management.

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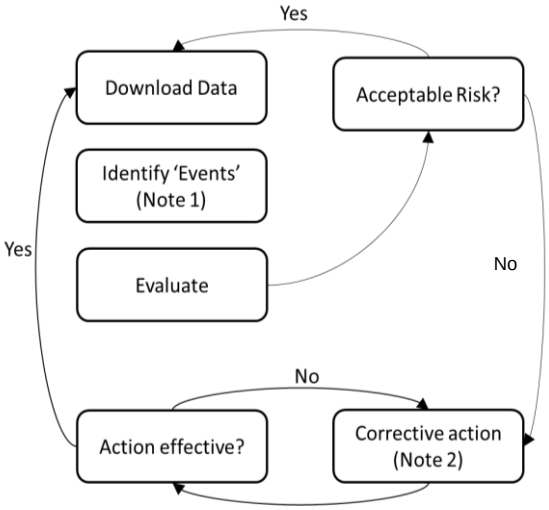
Figure 1 - Integration of FDM within an ASMS




Notes:

1. Events to monitor will be identified by the ADH[16].
2. Corrective actions may include amending SOPs, the Air System Document Set[28] or updating ►Aircrew◄ training.

b. **Risk Assessment**: whether a Safety Hazard has been identified by the FDMP or not, in many cases the FDMP can provide useful data to quantify its frequency and severity in support of Safety Risk Assessments conducted at the ASMS level.

c. **Safety Assurance:** The FDMP can provide data to assess the effectiveness of safety barriers and operational performance over time, in the form of Safety Performance Indicators (SPI). Those SPIs can apply to barriers that already exist or to new barriers just created in response to threats identified by the FDMP or the ASMS. In this context, the FDMP can be a useful tool to support the claims of the ASSC, such as effectiveness of training and ►Aircrew◄ Competence, compliance with SOP and operating within RTS limits.

d. **Proactive Management of Change:** Whenever Safety critical processes and procedures change[29], that change needs to be managed from a Safety perspective. An important part of that management involves establishing a baseline of the Safety performance of the process being changed (via dedicated SPIs). The continuous monitoring of the SPIs before and after the change will enable an operator to assess the impact of the change on the Safety performance of the process. The FDMP can play a role in management of change similar to that in Safety Assurance.

40. Clear lines of Accountability and Responsibility are essential for effectively managing the FDMP and its integration with the ASMS.

**Continuous Improvement**

41. The implementation of an FDMP can be progressive, focusing first on basic functionality such as detection of Airworthiness events and compliance with some SOPs. This will be enough to quickly identify any issues and generate simple but useful deliverables for the ASMS to develop the credibility of FDM as a powerful tool for Safety Management. However, once such 'low hanging fruit' has been addressed, the lack of identified issues can present the illusion of 'Safety' but an FDMP can only answer the questions it has been programmed to 'ask'. This apparent lack of useful outputs from the FDMP can be seen as a form of stagnation and is one of the reasons why Continuous Improvement (CI) activity is so critical. When applied to FDM, CI needs to focus on three main areas to ensure that the FDMP continues to generate actionable Safety intelligence:

a. **Process Optimisation**: Tasks which are very time-consuming and laborious need to be enhanced or automated to free time that can be invested elsewhere.

[28] Refer to RA 1310 – Air System Document Set.
[29] Changes may include to planning systems, SOPs, orders or training.

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b. **FDM Software Configuration**: Update the questions being asked to match the existing and evolving Safety Risks of the organization.

c. **Staff skills**: The skills of the staff need to evolve to match the maturity of the programme and the more sophisticated questions needing to be asked.

42. Therefore, a robust evaluation framework needs to be implemented to regularly assess the ongoing effectiveness of the FDMP and prompt corrective action as necessary.

**Assurance**

43. An example describing a possible FDMP Assurance framework is within Annex A.

44. The schematic in figure 1 above illustrates how the Hazards identified by the ADH / AM(MF) and added to the FDM software as events are exploited within the ASMS to ensure Risks are actively managed; the Assurance process will assure the effectiveness of this system.

## ANNEX A

## EXAMPLE FDM ASSURANCE FRAMEWORK

| Question | Positive Indicators | Negative Indicators |
|---|---|---|
| What new Safety Intelligence has your FDM programme produced since the last audit? | • Various types of findings, including systemic Safety issues.<br>• Findings arise from both isolated Occurrences and broader management activities.<br>• Findings include original discoveries and confirmation of known problems.<br>• Good rate of discovery. | • "No findings because we're already very safe".<br>• Findings are mainly related to Airworthiness events, personal readiness or noise.<br>• Systemic issues, if any, are mainly discovered from isolated Occurrences (reactive micro-management).<br>• Findings are mainly confirmation of problems already highlighted by other sources.<br>• Poor rate of discovery suggesting stagnation. |
| How are the outputs of FDM communicated? | • Adequate range of channels, appropriate to each type of finding.<br>• FDM review meetings are presented with actionable information about well-defined problems.<br>• FDM review meetings are conclusive, decisions are tracked at ASMS level.<br>• Safety issues are included in Hazard Log.<br>• 'Group think' is adequately managed. | • Over reliance on general newsletters etc. to ►Aircrew◄ members as means to mitigate Risk.<br>• FDM review meetings are largely used to interpret the meaning of data and statistics published in scheduled reports.<br>• Actions and decisions agreed at FDM review meetings are managed in parallel to ASMS processes.<br>• Actions and decisions agreed at FDM review meetings suggest effects of 'group think' and peer pressure.<br>• FDM reports include mostly data and facts but little actionable information. |
| How is FDM used in Management of Change? | • Outputs from the FDM programme are employed in proactive Safety Risk Assessments.<br>• The FDM programme feeds SPI which are project-specific and can be interpreted with little or no additional context (eg "rate of unstable approaches at XYZ", vs "overall rate of unstable approaches"). | • No link between FDM and change management.<br>• No exploitation of FDM in SPIs. |
| Does the event set capture all areas of Risk of the operation? | • Evolving FDM software configuration is driven by reactive (internal ASMS Hazards and Incidents, changing SOPs) and proactive sources of ideas (industry Incidents, third party best practices, brainstorming).<br>• Opportunities for improvement are tracked in a log, with acceptable progress shown. | • Static FDM software configuration ("we follow OEM recommendations").<br>• Purely reactive evolution, in response to internal Incidents.<br>• Internal ASMS Hazards and Incidents not adequately covered.<br>• Excessive dependency on the service provider for managing FDM software configuration. |

| Question | Positive Indicators | Negative Indicators |
|---|---|---|
| How are trends discovered and investigated? | • Data analysis includes regular review of all flight Measurements.<br>• Systematic efforts are in place to identify trends and clusters (systemic issues).<br>• ►Aircrew◄ contacts investigated beyond basic 'stick & rudder' handling causes and are collectively used to build a broader 'view of the forest'. | • Trends limited to analysis of Events (tip of iceberg) over time.<br>• Comparison of current period data against previous period (normalization of deviance).<br>• Limited drill-down to detect hidden clusters (eg 'hard landings by Runway').<br>• Interpretation of trends relies on review meetings. |
| Are there enough qualified and experienced personnel? | • Routine and tedious tasks are largely automated (primarily in reporting and data auditing).<br>• Multidisciplinary team covering all necessary areas of expertise: Aircraft operations, data management, data mining, FDM software configuration, Human Factors, project management.<br>• Gaps are identified and plans are in place to ramp up skills and / or staffing levels. | • Little automation so time wasted on processing and not analyzing.<br>• Too much multi-hatting preventing development of expertise.<br>• No effective training or staffing plans. |