

SAFE 360°(8 to 10 June 2021)
FDM Workshop – Analysis document

'Monitoring of new safety issues arising at the time of the pandemic'

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Scope of the FDM workshop

With the Covid-19 pandemic, operators are faced with many new safety issues and changes to safety priorities. These may have been caused directly or indirectly by the pandemic or by other factors that have emerged during the pandemic period. These may require adapting the scope of the FDM programmes and their way of operating.

With the acceleration of vaccination campaigns in many countries and especially in Europe, a return of aviation transport to normal operation (RNO) is now in sight.

This analysis document covers the following topics:

- What has been the impact of the pandemic on the FDM programmes?
- What do the new safety issues mean for FDM programmes?
- What is the foreseeable impact of the RNO phase on FDM programmes?

This analysis document was prepared by the **FDM Workshop Members¹** of [EASA SAFE360° – 2021](#) and it was presented and discussed during a live session of that event

¹ FDM Workshop Members of SAFE 360° (2021):

- Leopold Sartorius, Head of Data Analytics, ATR
- Pedro Duarte, SESAR Programme Manager, NetJets
- Hasan Mir, Senior Engineer, Emirates
- Edward Jumi, Manager Global Flight Data Exchange, IATA
- Rudy Pont, Co-chairman Flight Data Working group, ECA
- Guillaume Aigoïn, Senior Flight Data Expert, EASA

Impact of the Covid-19 pandemic on FDM programmes

In essence, FDM is an activity that is fully integrated within the SMS of an airline. It can play a role in identifying a safety issue, risk quantification (e.g. estimation of the occurrence rate of undesired events), and monitoring the effectiveness of any remedial actions. Therefore, it is inherent to an FDM programme to evolve by implementing new FDM algorithms and changing thresholds, sometimes replacing an FDM event definition with another. Such changes used to be relatively infrequent, though, to allow good monitoring as validating an FDM algorithm requires either processing the historical data or waiting enough for the trend to build up.

However, the Covid-19 pandemic has brought disruptive changes to the aviation industry. For instance, by reducing the commercial flight activity much more than cargo operations, the distribution between both types of flights have evolved. For the portion of commercial operations that could be maintained, the passenger loads were reduced, and therefore take-off weights. In addition, wherever and whenever lockdown was enforced and teleworking used massively, different working practices had to be implemented.

1. Main factors that impacted FDM programmes

What were the main factors stemming from the Covid-19 pandemic that have affected the implementation of the FDM programmes?

The Covid-19 pandemic has brought changes in all areas of operations, which affected the FDM programmes as well. These include:

Operational changes

- More frequent queries from both safety and fleet managers to the FDM programmes due to the increasingly dynamic nature of operations.
- More frequent and unique change management requests related to atypical operations (the management of change is part of the SMS, and FDM is an essential tool to support risk analysis and monitor changes)
- More freighter-centric operations.
- New destinations with specific risks or identification of arrival, departure characteristics.
- Temporary improvements to some FDM-based trends due to the reduction of air traffic².
- Lower number of aircraft movements resulting in less reliable FDM event rates and trends.

Impact on flight crew members:

² For example, accident and serious incident data for operators based in an EU Member State show that the rate of serious incidents related to airborne collision has significantly decreased in 2020, compared to 2019. But this does not reflect progress in preventing airborne collisions, and FDM programmes should continue monitoring precursors of airborne collisions.

- ultra long-range operations with difficult layovers and strict quarantine rules have affected flight crew alertness and behaviour.
- Lack of recency, license extensions and stress may lead to an increase in the rates of some FDM events, namely those related to manual flight, cockpit flows/checklists and use of automation.
- Contacts with flight crew members and crew feedback requests after a significant FDM event could be an additional source of stress. Policies and criteria for crew contacts should be adapted:
 - Objectively, making meaningful statistics at the time of the pandemic is challenging, and looking at averages and rates can be misleading. Example 1: a pilot may have a significant increase in his/her rate of events that may just result from the reduced number of flights. Example 2: sending monthly aggregated results to crew members may be counterproductive when the flight activity is too low. Such results become harder to put in perspective and may lead to misinterpretations.
 - Subjectively, an FDM event that previously would have qualified for a flight crew contact may become more "normal" due to a combination of factors resulting from the current situation. For example, in case of an unstable approach whereby the aircraft was very light and the flight crew was short- vectored by the ATC.
- Distractions caused by new flight crew procedures.

New FDM monitoring requirements

- FDM events for aircraft dynamics at take-off and landing may need to be expanded or updated to capture more data. Refer to question No 5.

FDM software, hardware and personnel issues :

- FDM data retrieval from off station parking requires maintenance intervention and powering the aircraft again.
- Many FDM systems have a client-server architecture that does not support cloud-based access. Also, data recording media are sometimes retrieved and processed at a central location. Both of the above have resulted in FDM team members being required in the office to access the FDM system and process the data.
- The challenging commercial environment with layoffs and loss of FDM team members may result in slower data analysis, reporting, and increased difficulty in adapting.

2. Changes to other operator's processes and their side impact on FDM

Has the impact on other domains or processes at operators (e.g. SMS, flight crew training programmes, occurrence reporting) required adapting the FDM programme or changed the role of the FDM programme?

The following changes have required adapting the FDM programmes:

- Reduction of resources: reducing the workforce and data in the various pillars of the SMS necessitates prioritisation and more strategic preparation to identify risk areas.
- Lack of flight recency and extension of licenses: standard training syllabi may not be adequate to cover the current training gaps, and with the expected RNO, there might be insufficient capacity of training centers to address a demand surge. FDM might become even more relevant for supporting evidence-based training and required to adapt for that purpose.
- Changes to occurrence reporting caused by a combination of factors:
 1. fewer flights usually mean more time for crews to report but fewer reported occurrences;
 2. Lack of flying increases the rates of certain types of events. On the other hand, the rate of events related to traffic congestion has decreased compared to 2019;
 3. Flight crew members may be less inclined to report due to stress (fear of layoffs, etc.), or they may perceive the reports are less relevant due to the low amount of activity (no flights = no problems);

FDM can help to verify and analyse reportable events and detect under-reporting.

3. Recommendations to Safety managers and FDM Programme Managers

What are the lessons learnt and the main recommendations to the Safety managers and FDM Programme Managers to maintain FDM programmes effective despite a crisis like that caused by the pandemic?

- When the data flow is significant, an individual flight analysis is generally not possible (too time-consuming), and the best way to validate FDM measurements and events is to observe the statistical distribution for a given batch and check that it makes sense, often looking individually at extreme data points to provide a good level of confidence. With lower flight activity, the meaningfulness of FDM-based statistics could be reduced (low number of FDM events and erratic statistics), requiring changes to the way the FDM data are analysed. The picture of the top FDM events, helping to set the priorities in terms of feedback to flight crews for example, could also completely change. Being capable of considering new assumptions is essential under such circumstances. It does not necessarily imply changing thresholds, FDM measurement or event definitions, but rather, for example, to switch from a statistical type of analysis to a more individual flight-by-flight type of analysis.
- This may also be a good time to review the capabilities offered by the system used, including the capability of remote access (e.g. using software-as-a-service (SAAS)/ cloud-hosted type of platforms or VPN, for example). In that case, adequate access control and safeguards must be in place to ensure data protection.

- In the context of lower flight activity, maintaining a high flight collection rate³ (percentage of flights flown that are processed by the FDM software) is paramount. While 5 or 10 flights would have typically represented one or two days of operation for a commercially operated aircraft before the Covid-19 pandemic, with highly reduced activity, it could represent one week of operation - a less acceptable data loss. Even though there is no regulatory requirement on the flight collection rate, it is a fact that the fewer the flights, the more critical it is to collect them in the FDM programme. For an operator with low volume of flight activity, an individual flight review is advisable. The operator should consider absolute numbers, as rates are likely to be not relevant or accurate.
- More and more aircraft are equipped with wireless data transmission systems that allow the automatic recovery of the data daily. Apart from reducing the average time to collect the flight data from the aircraft and so shortening the time to detect an FDM event, wireless data transmission can also help increase or maintain a high flight collection rate while reducing the workload on the maintenance side. This period of lower activity may be an opportunity to consider this possibility.
- Evidence-based training (EBT) allows reducing standard syllabus and focus more on actual needs. Now could be a good time to invest in adapting the FDM programme to support EBT since the return on investment and efficiency will increase when returning to normal operations.
- There is an increased need to use data from FDM together with the data from other SMS processes (e.g. use of incident reports from pilots and engineers as well as the use of LOSA information for the operators who have access to it) to create the context of what the potential areas of risk to safety are. The unique challenges that are presented during this crisis could, in some cases, not have been anticipated solely with the FDM events that were monitored by an operator. It's worth using feedback from the other SMS processes to see risk areas and potentially add those areas as monitored events and trends.
- Adapting the FDM programme to changing operations require more frequent quick and ad-hoc risks analyses. It is recommended to collaboratively work with all concerned departments at the operator to mitigate the risk and allow management to make well-informed business decisions.
- External FDM service providers might miss information on the context concerning the operational and safety environments, resulting in less accurate and complete analyses. This limitation is magnified during ad-hoc operations and rapid changes to operations, like those caused by the Covid-19 pandemic. The operator remains responsible for its SMS and can't delegate this responsibility. To be effective, the FDM programme (whether internal or outsourced) should be part of the SMS and well-integrated with the operator's safety risk management.
- Safety promotion may need to take a few steps back and redo some of the work done with internal stakeholders, namely about the importance of reporting.
- Safety promotion material should include positive examples of the occurrence reporting system and FDM to communicate with flight crews.

³ The flight collection rate of an FDM programme is explained in [EOFDM](#) document 'Key Performance indicators for a flight data monitoring programme'

4. Recommendations to authorities

What are the recommendations to authorities for helping operators in maintaining their FDM programmes effective in a severe crisis like that caused by the pandemic?

The National Aviation Authorities (NAAs) should take into account two aspects.

- On the one hand, NAAs should acknowledge the exceptional nature of this crisis and the associated economic impact on operator resources. Therefore, the administrative burden should be kept to a minimum, and the exchange of best practices should be stimulated.
- On the other hand, NAAs should ensure that operators maintain an adequate level of safety by focusing on shifting high-risk areas and requiring a minimum level of staff and resources. Safety staff numbers and the workload of safety staff are not just proportional to the number of flights: they are also dependent on other factors such as the rate of changes to operations.

New safety issues arising with the Covid-19 pandemic

5. Main new safety issues that should be monitored with FDM

What are the main new safety issues that require monitoring with the FDM programmes?

Aircraft-related issues

- When the aircraft loading can vary greatly, the center of gravity position and pitch trim position should be closely monitored. To better understand aircraft loading incidents, manual reconciliation of FDM data and other data sources such as loadsheet and weight and balance systems can be performed.
- Cargo in the cabin added complications to weight and balance requirements since in some operational areas, ballast needs to be added to the cabin.
- Maintenance issues: long periods of aircraft storage on the ground can affect airborne systems such as (IAS , ALT) indicators, pitot tubes' static probe (blockage caused by insects, sand, dust, foreign objects, etc.). As many operators were forced to put their aircraft into short term and long term storage on short notice, it appears that some aircraft may not be under storage based on the prescribed protocols⁴. As aircraft return to service, this could result in various safety issues, such as unreliable airspeed indications or bleed system failures (e.g. cracks caused by extreme temperatures).

Flight crew competency and performance

- Flight crew recency, base training and crew performance: due to the crisis and limited flying, proficiency and skills degradation have been issues.
- Taxi excursion or incursion: ground operations are reduced, and changes to the taxi-out ATC instructions or the usual taxi routes may lead to taxi excursions. (Note: this could be monitored with abnormal braking during taxi and excessive speed during turns.)
- Abnormal pitch rate at take-off: risk of a tail strike on empty and fast aircraft, relating to the flight crew's ability to manage varying take-off masses, i.e. either full or empty aircraft.

ATC and airport-specific issues

⁴ The Covid-19 Safety Risk Portfolio of EASA has identified the following related issues:

4.1 The scale of aircraft storage and subsequent destorage may lead to technical failures when aircraft are returned to service

4.3 Increased presence of wildlife on aerodromes (including birds and insects nested in stored aircraft)

4.10 Disinfection (biocides) effect on aircraft systems and structural components.

- Unexpected short ATC vectoring increases the number of unstable approaches, as some congested areas before the Covid-19 pandemic are not busy in pandemic operations.
- Ad-hoc operations to freighter remote airports where the availability of nav aids is limited can be challenging for flight crew members. FDM data from arrival to or a departure from such a location can help prepare the next flights into that destination. It is recommended to monitor the approach profiles to such airfields and visual approaches via the FDM programme. This is standard practice for some business jet operators but may be a new practice for other operators.
- Loss of trained personnel and support from some weather data providers. As an example, the condition of higher ISA deviation combined with lower QNH accuracy due to lack of ground support equipment and less frequent weather reports.

6. Safety risk areas to be monitored with FDM

Has the pandemic re-shuffled the cards with regards to the key risk areas to be monitored by operators?

Yes and No. The crisis has brought to the forefront potentially new safety risk areas that were not previously given priority, such as maintenance issues, crew skills degradation, operational performance etc. However, the old risk areas remain present.

All the safety risk areas summarised in the previous question are areas that operators should be aware of and if necessary, implement corresponding measures to prevent an accident or incident. However, the vast majority of safety risk areas such as Unstable Approaches, Control flight into Terrain, Loss of Control, Runway Excursions, TCAS Resolution Advisories, etc., remain an ever-present risk that operators need to keep monitoring.

7. Changes to FDM algorithms definitions

Is it advisable for an operator to review the FDM events and measurements definitions of their FDM programme? What is the recommended approach?

The objective for an operator should not be to implement monitoring of all the potential safety issues and FDM events mentioned in this document, but rather to make the best use of its FDM programme and other data sources of its SMS, to maintain a clear and current picture of the main risks affecting its operations and to monitor the effectiveness of mitigation measures.

Changing FDM event definitions

- Modifying the already validated FDM algorithms may not be very effective or beneficial to address the changes caused by the pandemic. It seems more relevant to identify the risk areas that should be included in the FDM programme or require closer monitoring with FDM. Therefore, operators should strive to retain the competence to design and assess new and revised FDM events and measurements definitions.
- A review could be performed to check whether some FDM event thresholds would need adjustment. In particular, it may be justified to review FDM event thresholds if:
 1. part of a revised policy (such as changes to SOPs) in response to the pandemic;
 2. a new safety concern is identified that can be monitored by adapting the threshold of an existing FDM event algorithm (as if it were a new algorithm);
 3. thresholds become inadequate in light of the new operational reality. To preserve adequacy to the previous and new realities, in case automatic flight classification is not possible, one should consider creating a "twin" event, each one with adequate limits and perform the classification on the validation phase
- FDM event thresholds that are set only to capture the most severe events will not allow observing an adverse trend before the situation gets worse. In such a case, lowering the FDM event threshold for a higher capture may be a way to detect earlier such trends. However, this is only possible with FDM software that accepts several thresholds for a given FDM event algorithm (typically the low, medium and high severity event thresholds);
- FDM events could be added to monitor the status of some aircraft systems after extended periods on the ground. Typically there are a significant number of flight parameters related to systems' status. If an aircraft system is considered sensitive or more prone to faults when the operation of the aircraft is resumed, it may be worth it to check whether these parameters can help to monitor the status of that system;
- Generally speaking, it can be a good opportunity to collect maintenance-related FDM events and measurements. The aircraft maintenance has also been impacted by the Covid-19 pandemic with reduction of staff numbers and loss of recency, so that flight data could also be helpful to support the ramp-up of maintenance activities that will come along with the increase of traffic.

FDM tools enhancement and increasing the use of FDM measurements

- Using FDM measurements as the basis for events helps increase the information available on the operational reality and provide the complete picture regarding the trend related to a particular safety concern.
 - For example, one can easily miss a trend of deviations from an SOP becoming more frequent but not triggering any FDM event because it is still under the threshold of an FDM event.
- With FDM measurements, a simple plot may make an increase in "close calls" more apparent. When rates become more challenging to put into context (reduced activity + different operations), measurement-based analysis allows the analyst to have a more detailed picture of the operational reality and draw more informed conclusions.

8. Examples of topics identified by the Covid-19 Safety Risk Portfolio

Since spring 2020, EASA has been working with the Member States and industry partners to identify new and emerging safety issues arising from the Covid-19 pandemic. This has led to establishing a dedicated 'Covid-19 Safety Risk Portfolio (SRP)' (a public summary of which can be consulted at [Review of Aviation Safety Issues Arising from the COVID-19 Pandemic | EASA \(europa.eu\)](#)). Below are two examples taken from the Covid-19 SRP that shows how FDM can be used to improve the monitoring of some of these new safety issues:

1. Carriage of cargo in the passenger cabin

Carrying cargo in the passenger cabin is not straightforward. It requires consideration of weight and balance, smoke/ fire detection, crashworthiness, evacuation procedures and modified loading procedures. The concerned operators should monitor precursors related to abnormal CG position in their FDM programmes. Example methods are provided in [EOFDM](#) document 'Guidance for the implementation of FDM precursors', such as:

- RE01- Incorrect performance calculation (indication of insufficient performance),
- RE08 — Slow Rotation, and
- LOC08 — Centre of gravity (CG) out of limits.

2. Incorrect aircraft navigation due to outdated or inconsistent information

Aircraft may deviate from flight path, assigned flight levels or lose separation due to outdated or inconsistent information. This problem may be caused by difficulties experienced by Aeronautical Information Service (AIS) providers and Aeronautical Database suppliers and ATC officers, flight operations officers, and pilots to access up-to-date information. The concerned operators should monitor precursors related to the risk of mid-air collision (MAC) in their FDM programme. EOFDM Guidance for the implementation of FDM precursors contains the following example methods:

- MAC02 — Lateral deviation,
- MAC03 — Flight level bust, and
- MAC08 — Airborne collision avoidance system (ACAS) alerts.

Impact of the return to normal operation (RNO) on FDM programmes and prospects for the future

9. Challenges raised by the RNO for FDM programmes

What are the foreseeable challenges raised by the RNO for the FDM programmes?

General considerations

The Covid-19 pandemic has caused a significant impact on the aviation industry at various levels. Although the financial aspect is the most apparent, other elements have an important impact on safety, such as:

- the reduction in flying activity affected flight crew currency;
- training programmes may have to be adapted to cope with the surge in demand and extended periods without flying;

In this context, coming back to the previous level of flight activity is not necessarily equivalent to "normal operations" since one needs to consider all other aspects where the pandemic caused an impact.

It is unlikely that safety performance indicators (SPIs) or key performance indicators (KPIs), event rates, and flight crew performance return to desirable levels as fast as flight activity does: flight crew currency and potential negative impact of the pandemic on mental states take their time to return to previous levels. Additionally, the operation itself may have changed in response to the crisis.

Another challenge is how operators define the baseline for measuring safety performance after the restart. Is it advisable to compare with performance levels corresponding to the pre-Covid-19 era or the Covid-19 period?

The FDM team

- The lack of practice may also affect FDM analysts and gatekeepers.
- With the recovery from the crisis, the FDM team could face a higher number of events, increasing the workload compared to before the pandemic. This increase may be exacerbated in teams that have been downsized;
- Objectives, procedures, and policies may require adapting to the aftermath of the pandemic: communications and debriefs with flight crew members need to consider the context, and the same applies to the interpretation of statistical results, probably meaning SPI/KPI alert levels may need to be reviewed.
- Event analysis and risk assessment procedures may need reviewing in light of the changes in the company structure, operations, and flight crew's experience since the pandemic started.

Overall, a crisis like that caused by the Covid-19 pandemic may demand closer collaboration between the departments of an operator to allow quicker identification of safety issues and adequate mitigation measures.

10. Using FDM to support the RNO

How can the FDM programme be used to support a safe RNO?

General considerations

As discussed above, FDM is an excellent tool at the disposal of the operator's safety management as it can adapt and evolve. Therefore, returning to "normal" or pre-pandemic operations may not mean much for FDM, and it's probably better to see it as an adaptation to a new situation. The pace of change post-pandemic may be slower than the abrupt disruption the aviation sector faced in 2020. There are reasons to believe that FDM programmes will easily find their way through this period of progressive increase in flight activity.

Returning to an adequate level of flight crew proficiency

The proficiency checks done by operators are thorough but need to be complemented by specific training addressing skill deficiency using flight data.

Also, FDM can provide insight into aircraft system health (see question No 7).

Areas that can be complemented by FDM data include:

- Base training flight crew performance.
- Manual flight skills displayed by the flight crew after return to service after a long time without flying:
 - Rotation rate monitoring
 - Landing distance review
 - Crosswind landings
 - Control input monitoring.
- Supporting training by using real-life 'good examples'. This will increase understanding and acceptance and help crews to identify hazards for themselves.

11. Needs of FDM teams today, and tomorrow

What do FDM teams need now for their job, and what will they probably need tomorrow?

Yesterday, FDM teams needed:

- high-quality data (i.e. continuous data without recording gaps, spikes or other types of data quality issues);
- robust analysis algorithms (tested and correct procedures that reduce the number of manual, time-consuming validations to a minimum);
- adequate training (technical background of data capture, FDM system functionality and programming, confidentiality, SMS background...); and
- a solid understanding of the operators' missions and risk profile;

- understanding how aircraft are operated (flight dynamics, navigation, aircraft systems, and operating procedures); and
- understanding how the flight crew members perceive the operation.

Tomorrow, FDM teams will need:

- All of the above, and additionally:
- better integration of FDM with the SMS. FDM personnel can better cope with the rapid change of operations and risks if they are fully involved in safety risk management, and they look beyond just their flight data;
- a good understanding of the changes caused by the Covid-19 pandemic to the aircraft operation and flight crews behaviours;
- to facilitate data exchange with their peers through aggregated data exchange programmes (e.g. EASA Data4Safety, IATA Flight Data Exchange, FAA Aviation Safety Information, Analysis and Sharing, etc.); and
- more advanced data analysis capabilities and integration with other data sources (e.g. maintenance data, rostering, training, weather data, occurrence reports).

Conclusion

A mature FDM programme should constantly be evolving. The adaptation of FDM event and measurement definitions is driven by the operator's SMS and safety risk management processes and are, by definition, specific to each operator. Before the pandemic, there already were significant disparities in terms of FDM programme maturity between operators. In general, the economic impact of the current crisis has reduced the resources available for FDM, which may lead more operators to underperform in this area. For some operators, the FDM programme may be less mature and affected by a loss of skills, workforce or investment.

The objective for an operator should remain to make the best use of its FDM programme and other data sources of its SMS to maintain a clear and current picture of the main risks affecting its operations and to monitor the effectiveness of mitigation measures.

After over one year of global air travel disruption, it seems that the biggest challenges for FDM teams have been to keep up with the faster pace of change brought by the pandemic and adapt their programmes, and to cope with the reduction in capabilities - either because of layoffs when the economic situation became unfavourable or because of challenges raised by lockdown and social distancing.

On the other hand, the slowdown of the flight activity and the time it may provide to FDM and SMS teams at many operators could be an opportunity to enhance their processes so that they provide more than just compliance with regulatory requirements.

During and after the recovery from the Covid-19 crisis, FDM will probably help in the same way as it did before: if appropriately implemented, it can provide a quick, unbiased and accurate reflection of the operation. It can help identify safety issues early before they are confirmed in other safety data sources and support identifying solutions for those issues. It can provide flight crews with a great self-assessment tool and allow them to identify areas that need improvement. FDM can be even more relevant during the transition in faster recovery environments.