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FLIGHT DATA MONITORING FOR THE ROYAL CANADIAN AIR FORCE

Lieutenant-Colonel Matthew J. Lederle

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By Lieutenant-Colonel Matthew J. Lederle

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AIM

1. Aircraft fleets continue to gain increasing access to significant amounts of flight data. To ensure that this data is used appropriately across the Royal Canadian Air Force (RCAF), and to fully leverage the data's value, the RCAF should implement an overarching Flight Data Monitoring (FDM) policy.

INTRODUCTION

2. Flight Data Monitoring (also variously referred to as "Flight Data Analysis" (FDA) or "(Military) Flight Operations Quality Assurance" (M)FOQA), is the "routine collection and analysis of flight operational data to provide more information about, and greater insight into, the total flight operations environment."[1] The concept itself is not new; however, as large amounts of data becomes increasingly available, the applicability of FDM continues to broaden. FDM offers potential safety benefits, by routinely monitoring the way that aircraft are flown. It also provides various training benefits and can provide economic insights that could lead to reduced operating costs.

3. As more aircraft are equipped with systems capable of providing the required data, there is a risk that squadron-based *ad hoc* FDM programs will develop without any higher-level guidance or policy. This could create multiple problems. First, without standards in place, there could be an uneven or unfair application of FDM measures to flying crew. Second, without any overall data governance architecture in place, RCAF

[1] Federal Aviation Administration, *Advisory Circular 120-82: Flight Operational Quality Assurance* (Washington, DC: U.S. Department of Transportation, 2004), 4, https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_120-82.pdf.

FDM data would remain in individual fleet silos and might not be amenable to RCAF-wide analysis. As such, the RCAF should institute an overarching FDM policy framework, to provide support and guidance to fleets that are aiming to develop their own FDM programs.

DISCUSSION

4. The concept of Flight Data Monitoring lines up well with current Canadian Armed Forces (CAF) policy. *Strong, Secure, Engaged* recognizes the importance of data.[2] VCDS LGen Rouleau has said that the CAF needs to "start to understand and leverage the power of data," and has put data and digitalization among his four main priorities.[3] FDM also aligns well with the Department of National Defence's (DND) *Data Strategy*, which aims to "create a culture where data is valued, and the use of data is habitual."[4]

5. Although the RCAF has a relatively long experience using flight information in Flight Safety investigations, such as Flight Data Recorder (FDR) and Cockpit Voice Recorder (CVR) data, the routine application of FDM to all operations offers a new avenue to harness the power of data.

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[2] Department of National Defence, *Strong, Secure, Engaged: Canada's Defence Policy* (Ottawa: Government of Canada, 2017), 55, http://dgpaapp.forces.gc.ca/en/canada-defence-policy/docs/canada-defence-policy-report.pdf.

[3] LGen Mike Rouleau and David Perry, "Defence Deconstructed: The Canadian Armed Forces, Data, and Digitization," *Canadian Global Affairs Institute Podcast Network*, 13 November 2020, https://soundcloud.com/user-609485369/defence-deconstructed-the-canadian-armed-forces-data-and-digitization.

[4] Department of National Defence, *The Department of National Defence and Canadian Armed Forces Data Strategy.* (Ottawa: DND Canada, 2019), 15, https://www.canada.ca/content/dam/dnd-mdn/documents/reports/data-strategy/2019/dgm-25419-j4j-data-strategy-dia-en.pdf.

Benefits of FDM

6. A robust FDM program could contribute to safety in several ways. First, FDM data could supplement CVR/FDR data in flight safety investigations. Depending on the FDM implementation, this could provide substantially more information than FDRs, providing high-frequency updates on a myriad of aircraft components and overall flight behaviour. FDM could also be used in other ways that support mandated Flight Safety activities, including Flight Safety prevention and promotion activities.[5] Preventively, FDM can identify concerning trends before incidents occur, allowing them to be addressed. FDM could also be useful for providing relevant case studies for use in Flight Safety promotion and briefing material.

7. However, it is important to highlight that notwithstanding its safety benefits, FDM is separate from Flight Safety, especially in terms of Flight Safety's role as Airworthiness Investigative Authority. FDM activities contribute to safety, but the primary purpose is not to assist in investigations. Rather, FDM is intended to be a routine monitoring of all flight operations, and its uses go beyond safety. FDM can provide a channel outside of Flight Safety to provide insights into the type of training that aircrew could benefit from. In broad terms, FDM data can be used to identify fleet-wide trends or issues before they develop into safety concerns. For example, FDM data could provide statistics on how frequently approaches exceed stability criteria, and how many of these unstable approaches continue to a landing rather than ending with a go-around. In this vein, Transport Canada has specifically identified unstable approaches as a hazard that

[5] Department of National Defence, *A-GA-135-001/AA-001, Flight Safety for the Canadian Forces* (Ottawa: DND Canada, 2020), Ch. 4–5, https://divsurg.afod-pofa.com/DIVSURG/APP/FLIGHT-SAFETY/A-GA-135-001.pdf.

can be mitigated by an FDM program.[6] On an individual level, it is also possible to identify problems and target remediation. However, this is a significantly more sensitive area, since it is important that FDM be implemented as a non-punitive program, similar to Flight Safety.[7] FDM also offers a valuable ability to receive feedback on training changes after they are made. As opposed to checkrides, which offer only a snapshot of how crewmembers operate, FDM can provide a continuous look at operations. Furthermore, it eliminates the effects of having the examiner present on the checkride, and offers truer information on how routine operations are regularly conducted.

8. Finally, even though the main purpose of an FDM program is to increase flight safety and improve training, FDM can also offer potential economic benefits. Aggregate data could be used to identify fuel usage trends on aircraft fleets, and identify areas where savings are possible.[8] These areas could include specific airport operational procedures, individual technique, or operator decisions. For example, high landing fuel weights could be indicative of a trend of carrying excess fuel beyond mandated reserves, which leads to higher fuel burns. If FDM identifies this as an area of concern, it could be addressed, and cost savings could result.

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[6] Transport Canada, "Using SMS to Address Hazards and Risks Associated with Unstable Approaches - Civil Aviation Safety Alerts (CASA) No. 2014-03," Transport Canada, January 10, 2020, https://tc.canada.ca/en/aviation/reference-centre/civil-aviation-safety-alerts/using-sms-address-hazards-risks-associated-unstable-approaches-civil-aviation-safety-alerts-casa-no-2014-03.

[7] European Aviation Safety Agency, *Good Practice on the Oversight of Flight Data Monitoring Programmes* (Cologne, Germany: European Aviation Safety Agency, 2017), 8, https://www.easa.europa.eu/sites/default/files/dfu/EAFDM_GoodPractice_FDMOversight_v1_Ed2017.pdf.

[8] Woodrow Bellamy, "Royal Air Force Invests in AirFASE to Upgrade A400M Flight Data Monitoring," Aviation Today, December 20, 2019, https://www.aviationtoday.com/2019/12/20/royal-air-force-invests-airfase-upgrade-a400m-flight-data-monitoring/.

Current FDM Usage

9. FDM offers broad benefits, and it is no surprise that operators are increasingly adopting FDM programs, and some jurisdictions are now requiring its use. In Canada, Transport Canada safety publications have highlighted the importance of FDM as far back as 2005, encouraging their voluntary adoption.[9] The Transportation Safety Board has highlighted the value of FDM programs in several recommendations; Transport Canada has supported some of these recommendations, and it agreed in 2014 to "consider adding FDM principles in future regulatory initiatives."[10] Although focus groups and stakeholder engagement have occurred, it has not yet led to any firm requirements.[11] In the United States, the Federal Aviation Administration (FAA) has recommended FDM since 2004 as a "voluntary safety program… to share de-identified aggregate information with the FAA" to monitor trends and address risks.[12] Across the Atlantic, Europe has required FDM for "large aeroplanes" (defined as over 27,000kg maximum certificated takeoff weight) since 2012.[13] The European Aviation Safety Agency (EASA) also recommends FDM programs for lighter aircraft, due to its proven benefits.[14] Across the board, international carriers have been mandated since 2008 to develop FDM programs to meet International Civil Aviation Organization (ICAO) requirements for aircraft over

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[9] Howard Posluns, "Flight Data Monitoring - A Proactive Approach to Safety," *Aviation Safety Letter* 2005, no. 1 (2005): 6, https://tc.canada.ca/sites/default/files/migrated/1_2005.pdf.

[10] Transportation Safety Board of Canada, *Reassessment to the Response to TSB Recommendation A18-01: Mandatory Installation of Lightweight Flight Recording Systems* (Ottawa: Transportation Safety Board, 2020), 2, https://www.tsb.gc.ca/eng/recommandations-recommendations/aviation/2018/rec-a1801.pdf.

[11] Transportation Safety Board of Canada, 9.

[12] Federal Aviation Administration, *AC 120-82*, 1.

[13] European Commission Regulation (EC) No 965/2012, Article ORO.AOC.130 (2012), https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ%3AL%3A2012%3A296%3A0001%3A0148%3AEN%3APDF

[14] European Aviation Safety Agency, *Flight Data Monitoring*, 5.

27,000kg.[15] Although not strictly mandated for smaller aircraft and operators, FDM programs are also making inroads on lighter aircraft as FDM systems become increasingly available and affordable.

10. FDM programs are also being increasingly adopted by allied militaries. The United States Air Force (USAF) introduced its MFOQA Program in 2005.[16] Similar to civilian guidelines, MFOQA is not used for punitive purposes, except in cases of willful disregard of regulations.[17] Although the USAF was at the leading edge of FDM implementation, other Air Forces are currently developing their own FDM capabilities. In December 2019, the Royal Air Force contracted to add FDM capabilities to its A400M fleet, which marked the first purchase of FDM equipment in response to a 2014 Ministry of Defense regulation which identified the need for FDM.[18] In Canada, the Flight Safety program has pointed out that "many nations are now employing FDM," and has identified that it could be a valuable capability on "those fleets with Flight Data Recorders capable of supporting this program."[19]

11. However, even in the absence of dedicated FDM equipment or FDM-capable FDRs, it can still be possible to leverage existing data collection systems towards FDM purposes, and implementation of an FDM framework should not be delayed until after

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[15] International Civil Aviation Organization, *Annex 6 Part I - International Commercial Air Transport - Aeroplanes*, Eleventh Edition (July 2018), Amendment 44 (July 2020) (Montreal: International Civil Aviation Organization, 2020), 3.3.2, https://www.bazl.admin.ch/dam/bazl/en/dokumente/Fachleute/Regulationen_und_Grundlagen/icao-annex/icao_annex_6_operationofaircraftparti-internationalcommercialair.pdf.download.pdf/AN06_P1_cons.pdf.

[16] United States Air Force, "Air Force Safety Center > Divisions > Aviation Safety Division > Proactive Aviation Safety > MFOQA," Military Flight Operations Quality Assurance, January 25, 2021, https://www.safety.af.mil/Divisions/Aviation-Safety-Division/Proactive-Aviation-Safety/MFOQA/.

[17] *Ibid*.

[18] Bellamy, "A400M Flight Data Monitoring."

[19] Department of National Defence, "Annual Report," Royal Canadian Air Force Flight Safety, last modified September 15, 2020, http://www.rcaf-arc.forces.gc.ca/en/flight-safety/statistical-reports.page.

FDM equipment is procured. As one example, the CC-177 (C-17) Globemasters operated by the RCAF, RAF, and Royal Australian Air Force (RAAF) all contain onboard Central Maintenance Computers (CMC) that captures over 65,000 aircraft parameters, aimed at monitoring aircraft systems in order to make maintenance recommendations.[20] The data provided by the CMC includes enough parameters to recreate the flight performance of the aircraft, and although its primary purpose is maintenance, the potential FDM benefits are immediately apparent. Indeed, 429 Squadron has already worked with Boeing Vancouver to develop FDM dashboards that can detect, monitor, and report on unstable approaches and excess fuel tankering. Even without using any CVR/FDR data, or installing dedicated FDM equipment, Flight Data Monitoring has already reached the RCAF.

Considerations for Flight Data Monitoring Implementation

12. Given the potential benefits of FDM, it is unsurprising that industry and allied militaries are increasingly adopting its use. FDM has already arrived within the RCAF, and as new fleets come online, its prevalence will only increase. At the institutional level, currently "there is little coordinated and consolidated knowledge or awareness of the data that is collected, used, and maintained in the organization."[21] An overarching FDM strategy would allow the RCAF to maintain awareness of, and access to, the increasing amount of data being generated by its fleets. It would also help to address the institutional shortcomings identified in DND's *Data Strategy*. At a lower level, an overarching policy

[20] These computers have also been installed on some USAF C-17s on a trial basis, but have not been introduced fleet-wide.

[21] Department of National Defence, *Data Strategy*, 6.

would also provide the basis for squadron FDM programs, ensuring alignment between processes and procedures on different fleets.

13. Fortunately, existing civilian and military FDM policies can provide some best practices that should be included in an RCAF FDM policy. First, the overall placement of an FDM program should be considered. As discussed, there are several aspects in which FDM closely mirrors Flight Safety; however, there are important differences. Most notably, FDM provides a near-continuous flow of data, markedly different from Flight Safety, which would typically only examine flight data in the context of an investigation. It may be tempting to place FDM responsibilities with the Unit Flight Safety Officer (UFSO), but this relatively high volume of data risks overwhelming UFSOs or taking them away from their investigatory responsibilities. As such, the UFSO is probably not the ideal person to oversee a squadron FDM program. Instead, because of FDM's training purpose, it may best reside within the unit Training establishment. Here, personnel are already tasked with the routine monitoring of crewmember performance, as well as with developing the training required to address individual or collective shortcomings. If FDM data became relevant for a Flight Safety investigation, then it would still be accessible to the UFSO.

14. Even within the Training department, protection of data and privacy is an important consideration for FDM. Data used in Flight Safety investigations must be safeguarded by investigators.[22] However, because FDM data is not primarily used in an

[22]Aeronautics Act, R.S.C., c. A-2, s. 22 (1985), https://laws-lois.justice.gc.ca/eng/acts/a-2/page-17.html#h-8770; Department of National Defence, *A-GA-135-003/AG-001, Airworthiness Investigation Manual* (Ottawa: DND, 2019), 2-2/3, https://www.rcaf-arc.forces.gc.ca/assets/AIRFORCE_Internet/docs/en/flight-safety/a-ga-135-003-ag-001_chg1_english_19-nov-2019.pdf.

investigatory context, these data protections afforded to Flight Safety do not automatically extend to FDM data. However, for FDM to be embraced by operating crews, a certain level of data protection is still required to allow an "essential level of trust" in the program.[23] Two key elements of this are deidentification of information, and maintenance of a non-punitive safety culture. On the civilian side, this "lack of an effective non-punitive safety culture" can be a key obstacle to FDM implementation.[24] Fortunately, the RCAF's Flight Safety program has already established an effective non-punitive culture that would transfer well to FDM. The other important aspect, deidentification, can be ensured by designating a single FDM "gatekeeper," who is the "only individual who can link [FDM] data to an individual flight or crewmember."[25] This guarantees that even within the broader training department, individual privacy is assured. By maintaining a just culture, and deidentifying FDM data, squadrons can ensure that flight crews do not resent the FDM program or feel that the recorder is a "spy in the cockpit."

15. However, there will be times that identifiable FDM data must be used, and an FDM policy must make these cases clear. First, raw FDM data must be available to Flight Safety investigators as required. This is relatively straightforward, as existing policy already dictates that FDM data would be quarantined and made available to Flight Safety upon an incident occurring.[26] There may be non-Flight Safety cases where the chain of

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[23] European Aviation Safety Agency, *Preparing a Memorandum of Understanding for an FDM Programme* (Cologne, Germany: European Aviation Safety Agency, 2017), 8, https://www.easa.europa.eu/sites/default/files/dfu/WGC_MoU_20170517.pdf.

[24] Filipe Chaves, "Airline Safety Management System Issues: A Practitioner's Perspective," *Aircraft Engineering and Aerospace Technology* 91, no. 2 (2019): 119, https://doi.org/10.1108/AEAT-11-2018-0280.

[25] Federal Aviation Administration, *AC 120-82*, 31.

[26] Department of National Defence, *Airworthiness Investigation Manual*, 6F-1/1.

command desires identifiable data for disciplinary or administrative purposes, though. This need is understood within the "just culture" context that already exists within the RCAF, where "negligence or willful, deliberate deviations must not be tolerated by leadership."[27] Current examples of FDM data release standards match this understanding of "just culture," such as in "cases of gross negligence or a significant continuing safety concern."[28] There is also a middle area in FDM data, where behaviour does not rise to the level of negligence, but where individually-targeted remedial training could provide a benefit. This is probably the most sensitive area in terms of FDM data privacy, and this type of remediation must be handled tactfully, such as by being "scheduled into the [training] program in a discrete manner to avoid highlighting the person," while emphasizing that "additional training is not to be considered disciplinary action but merely a safety improvement action."[29] In these sensitive cases, it is important that common standards are applied across fleets to ensure that individuals do not feel unfairly targeted. At the institutional level, common standards for these thresholds are also necessary to ensure that FDM data and trends can be compared between fleets in an *apples-to-apples* comparison.

16. A common framework for FDM is also important to maintain operational security. In some applications, the data gathered by an FDM system could compromise operational security, and it is important that FDM subject-matter experts participate in implementing operational procedures to ensure that classified information is not

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[27] Department of National Defence, *Flight Safety*, 2020, 1-5/12.

[28] European Aviation Safety Agency, *Flight Data Monitoring*, 8.

[29] Civil Aviation Authority, *Flight Data Monitoring* (London: UK Civil Aviation Authority, 2013), 65, https://publicapps.caa.co.uk/docs/33/CAP739.pdf.

compromised by the FDM system. For example, classified theatre flight routes and airspace procedures could become apparent if sufficient FDM data was analyzed, and FDM systems may need to be disabled during certain missions.

17. In all of these cases, current FDM best practices are best implemented by developing an RCAF-wide FDM policy, with squadron-level FDM experts that execute the program for each fleet, using a common framework to guide their approaches.

CONCLUSION

18. Flight Data Monitoring is an important development in aviation, and both civil and military operators are increasingly embracing its use. DND's *Data Strategy* and the VCDS' priorities recognize the importance and power of data, and the RCAF could use FDM data to promote safety, improve training, and optimize procedures within fleets.

19. Although there are many similarities with Flight Safety, and FDM complements Flight Safety well, FDM is nevertheless a separate endeavour. Simply combining FDM into Flight Safety is not sufficient to develop the robust processes necessary for dealing with large amounts of FDM data. Rather, a separate FDM policy framework is required, to ensure that data is collected and used fairly and effectively.

20. FDM has already arrived within the RCAF and will only become increasingly prevalent as time goes on. If ignored, *ad hoc* FDM programs could develop on a squadron-by-squadron basis. This would complicate control of the data, and make comparisons between fleets impossible, reducing the value of the data substantially. To avoid a siloed approach to FDM, an overarching policy should be developed, leveraging the best practices of industry and allied militaries.

RECOMMENDATION

21. FDM represents a substantial new source of data, which should be leveraged in accordance with current CAF policies. The RCAF should therefore develop and publish an overarching Flight Data Monitoring policy, based on current best practices, for individual units to implement. This FDM system should complement, but remain separate from, the existing Flight Safety program at the unit level. Publication of this policy should not be delayed, to ensure a unified approach to FDM as more fleets gain the capability.

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