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Force Generation of Tactical Aviation Flight Engineers

Major Taylor Hall

FORCE GENERATION OF TACTICAL AVIATION FLIGHT ENGINEERS

AIM

1. The Royal Canadian Air Force operates in an environment where a crew's ability to process large amounts of imperfect information and make timely decisions is vital to mission accomplishment. This has always been true, but advances in fifth generation networked warfare will make it even more critical. This paper proposes creating a new trade to replace tactical aviation flight engineers, which includes a more formal selection process and optimized training, with the overall goal to enhance the operational effectiveness of future tactical aviation crews.

INTRODUCTION

2. The RCAF's Future Air Operating Concept (FAOC) provides guidance to force development over the next two decades.[1] Although it does not provide specific guidance in terms of capabilities to be procured, it emphasizes that the Canadian Armed Forces (CAF) must transform into an "integrated and networked force" and includes pushing information to the "right people at the right time".[2] From a tactical aviation perspective, this includes information between air and land assets. Exactly how this concept will be implemented in the CH146 Griffon and CH147F Chinook remains to be determined. However, the latest generation of radios being installed in the Griffon as part of the Griffon Limited Life Extension (GLLE) obsolescence management program have the capability to support a revolution in the way information is shared across the battlefield.[3] Taking advantage of high-speed mobile ad hoc networked (MANET) communications and beyond-line-of-sight (BLOS) connectivity, information such as precision navigation, blue-force awareness, intelligence surveillance and reconnaissance (ISR), and digital messaging could augment and generally replace traditional verbal communications between air and ground forces. However, access to such an incredible amount of information has the potential to overwhelm personnel through an information overload. Leveraging the entire crew, through tools such as individually issued tactical tablets to maintain situational awareness, will help to mitigate the problem. Together, pilots, flight engineers, and door gunners will need to work together in an even more coordinated fashion to succeed.

3. Force generating tactical aviation crews with the right aptitudes and skills to synthesize and act upon the anticipated significant increase in information will require changes to the current model. The RCAF is evolving pilot training through the Future Aircrew Training (FAcT) program; however, the program does not include flight engineers.[4] This paper will focus specifically on tactical aviation flight engineers, and recommend a new trade be created to address their unique operational requirements. First, it will review what capabilities tactical aviation flight engineers currently provide and how they are force generated. Second, it will

[1] Royal Canadian Air Force, *Future Concepts Directive Part 2: Future Air Operating Concept* (Trenton: Canadian Forces Aerospace Warfare Centre, 15 August 2016), 1.
[2] *Ibid*., 6.
[3] Chris Thatcher, "The life extension of the CH-146 Griffon and a plan for what comes next," *Vertical*, 27 May 2021, https://verticalmag.com/news/ch-146-griffon-helicopter-life-extension-what-comes-next/.
[4] Chris Thatcher, "Next-gen aircrew training," *Skies*, 23 July 2019, https://skiesmag.com/features/future-aircrew-training-program-next-gen-aircrew-training/

review the model used by the Royal Air Force (RAF). Finally, it will propose an RCAF implementation plan.

DISCUSSION

4. The RCAF employs flight engineers across a diverse fleet of aircraft. This includes legacy CC130H Hercules and CC138 Twin Otter transports, CP140M Aurora maritime patrol, CH149 Cormorant rotary-wing search and rescue, United States Air Force E-3 Sentry airborne early warning and control system (AWACS), and both CH146 Griffon and CH147F Chinook tactical helicopters. Unsurprisingly, their range of duties varies considerably. Nevertheless, their official responsibilities listed in their Occupational Specification manual is summarized as follows:

> FLT ENGRs provide direct support to [Canadian Forces] air training and air operations. They act as aircraft systems operators, technical advisors, maintenance representatives, sensor operators, mission kits specialist and as the aircraft maintenance release authority to aircraft commanders, [commanding officers], and Group/Command principals. FLT ENGRs provide data and analysis for technical reports and flight safety investigations. FLT ENGR technical abilities and qualifications allow CF aircraft to operate worldwide without the requirement for additional maintenance support personnel.[5]

However, in general, most fixed-wing flight engineers in the RCAF are primarily focused on the active management of propulsion and fuel systems onboard legacy four-engine aircraft, while tactical aviation flight engineers are more focused on the operation of tactical systems, including weapons employment. In effect, if the role of a tactical aviation pilot is to fly the helicopter, then the tactical aviation flight engineer makes it do almost everything else.

5. With regards to the Griffon, flight engineers work with two pilots, the aircraft captain and first officer, as part of a crew. For combat operations, a trained door gunner will complete the crew for a total of four members. Based on the inherent flexibility of the Griffon, its crews conduct the majority of the RCAF functions and capabilities.[6] This includes air attack, air mobility, intelligence surveillance and reconnaissance, electronic warfare (electronic protection), command and control, as well as force protection of other air and ground-based assets. The flight engineer is the crewmember primarily responsible for overall cabin operations, including clearing the aircraft with the assistance of the door gunner for manoeuvres in confined areas, the tactical loading and unloading of passengers, firing the various crew-served door-mounted weapons systems, connecting and monitoring underslung loads, operation of the hoist and the high-intensity illumination spotlight, and the deployment of tactical infrared illumination flares. More impressively, flight engineers often conduct these duties concurrently. Non-flying duties include the conduct of pre- and post-flight inspections, power and performance calculations, elementary fluid replenishment, and assisting maintenance with periodic maintenance

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[5] Department of National Defence, "Occupational Specifications – Flight Engineer", *The Canadian Armed Forces Military Employment Structures Manual*, Volume 2 Occupational Specifications, Part 2 Non-Commissioned Member Occupations, Change 13, 22 October 2020. 3.5.1.(1).

[6] Department of National Defence, B-GA-400-00/FP-001, *Royal Canadian Air Force Doctrine*, 3rd Edition, November 2016, 32. https://publications.gc.ca/collections/collection_2017/mdn-dnd/D2-368-2016-eng.pdf.

inspections and repairs.

6. It should be noted that flight engineers are not strictly required to conduct flying operations. Pilots are sufficiently qualified to conduct pre- and post-flight inspections, power and performance calculations, and elementary fluid replenishment as well. As a result, the RCAF considers pilots capable of safely operating without a flight engineer for administrative-type flights such as transits. However, it must be emphasized, that the Griffon is at its operational best when all four members work together as a complete crew.

7. With regards to the Chinook, the duties of flight engineers are effectively the same as the Griffon, with more emphasis towards the tactical movement of troops and underslung loads. Their weapons are limited to defensive roles only, and they have no hoist or high intensity spotlight. Furthermore, they may operate with a second flight engineer or loadmaster in addition to a door gunner, to operate a rear gun in addition to the two side guns. It should also be noted that the Chinook is also a more complex aircraft than the Griffon, with greater maintenance support requirements for inspections and repairs, which makes it more difficult to conduct maintenance and repairs away from a main operating base.

8. Currently, the RCAF recruits all flight engineers from aviation and avionics systems technicians. These are the technicians responsible for the regular maintenance and repair of the RCAFs entire fleet of aircraft. They must be fully qualified with at least one year experience conducting independent maintenance without supervision (level-A).[7]

9. Typically, the training process for a civilian who applies directly to the military to become an aircraft maintainer begins with basic recruit training at the Canadian Forces Leadership and Recruit School in Saint-Jean-sur-Richelieu. Their basic occupational qualification training is then completed at the Canadian Forces School of Aerospace Technology and Engineering in Borden. Griffon and Chinook specific maintenance training takes place at 438e Escadron tactique d'hélicoptères in Saint-Hubert, and 450 Tactical Helicopter Squadron in Petawawa respectively. Then finally, on-job training at their first operational unit. This process takes approximately five years to complete.[8]

10. Once the technician decides to request an occupational transfer to flight engineer, the process begins with a formal nomination by their aircraft maintenance organization chain of command, and their file reviewed by a personal selection officer. This is followed by the Basic Flight Engineer Course at 426 Transport Training Squadron in Trenton, aircrew medical and survival training at the Canadian Forces School of Survival and Aeromedical Training in Winnipeg, and finally the Griffon tactical flight engineer course at 403 Helicopter Operational Training Squadron in Gagetown. This process normally takes over a year-and-a-half to complete. In combination with their previous aircraft maintenance training, this represents almost seven years in the military before a newly qualified flight engineer begins flying at their first unit.[9]

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[7] Royal Canadian Air Force, "Information Session – 2021 Flight Engineer Presentation," (Flight Engineer Recruitment Presentation), Slide 10.
[8] 1 Wing A7 Stds 4-2, telephone conversation with author, 14 January 2022
[9] *Ibid*.

11. Both processes are long and involve multiple geographical transfers. In some respects, this is beneficial. Older, more experienced aircraft maintenance technicians bring not only better systems knowledge, but also greater maturity. They can be relied upon to conduct aircraft maintenance independently, especially while operating away from a unit's aircraft maintenance organization. This was traditionally the tactical aviation flight engineer's main raison d'être. However, it comes at a cost. Regardless of if the flight engineer was previously qualified to maintain the aircraft they are selected to fly, they nevertheless lose the majority of their maintenance qualifications as soon as they complete their trade transfer. As a result, the current process generates flight engineers with aircraft maintenance qualifications that will likely never be used during their flying careers.

12. Even considering the maintenance qualifications they do retain, for a comparatively simple aircraft like the Griffon, the number of repairs that can be accomplished without specialized tools and parts is minimal. This is even more true with respect to the Chinook, which consists of many larger more complex systems. As a result, when units send parts and tools into location to fix an aircraft, it is just as easy to also send a qualified aircraft maintenance technician to conduct the repair. Moreover, the number of simple maintenance actions that can actually be performed in the field without parts will be further reduced with Griffon obsolescence management, and the replacement of many of the legacy mechanical systems with digitally controlled components.

13. Furthermore, the RCAF is currently critically short of both flight engineers and aircraft maintenance technicians and has been for some time. Force generating additional flight engineers is challenging because there is an inherent competition between the trades to either recruit or retain talented individuals. Unsurprisingly, aircraft maintenance organization supervisors are often hesitant to recommend members for a trade transfer to flight engineer since they are losing a highly qualified individual who often cannot be easily replaced.

14. It could be argued that prior maintenance experience is vital to provide a deeper understanding of the technical systems onboard a Griffon or Chinook. Nevertheless, the RCAF employs flight engineers on aircraft that they had never previously maintained as an aircraft maintenance technician. And other fleets, such as the CH148 Cyclone maritime helicopter, operate safely with no flight engineer onboard at all. Conversely, the period a flight engineer spends as an aircraft maintenance technician could be replaced with more focused training on Griffon or Chinook specific issues that could occur in flight. Furthermore, if the role of a flight engineer is to discover errors in pre-flight that were missed during a periodic inspection, it could be argued that it is further justification to retain experienced technicians within maintenance organizations to ensure such errors do not happen in the first place.

15. Another issue is that working in the cabin of a tactical helicopter is very physically demanding. Due to poor ergonomics, and the frequent requirement to load and unload heavy cargo, tactical aviation flight engineers are commonly transferred to other less physically demanding fleets after developing chronic back, neck, and knee injuries. A better selection process could screen for candidates that are less likely to develop chronic injuries, and a shorter

training timeline would result in aircrew being employed earlier in their careers when they are less likely to suffer from chronic pain in their knees, necks, and backs.[10]

16. Perhaps most significantly, the fundamental aptitudes of both a good flight engineer and aircraft maintenance technician are sufficiently different to justify separate recruitment criteria. Arguably, a good aircraft maintenance technician should be highly detail oriented, capable of conducting complex multistep technical processes over long hours and be predisposed to seeking advice from higher maintenance authorities to minimize technical risk to flying through detailed engineering analysis. A flight engineer on the other hand, should be biased towards taking immediate action, with excellent spatial awareness, and be comfortable synthesizing imperfect information to make time-critical decisions during the stresses of combat flying. Nevertheless, there is no specialized aircrew selection process for flight engineers like there are for other aircrew trades such as pilots and air combat systems officers.

17. Taking into consideration the increasing situational awareness demands of fifth generation networked warfare, the RCAF must ruthlessly assess legacy qualifications and force generation processes against emerging requirements. To do so, force generation should be reoriented with a greater "aircrew" focus.

18. The RAF provides an example that focuses much more extensively on the aircrew aspects of a flight engineer. Their tactical aviation flight engineer equivalent, a weapon system operator crewman, performs similar duties in the rear cabin and are employed onboard Puma HC2s, Griffin HAR2s and Chinooks. However, they are recruited directly, and candidates are screened through a specifically designed aptitude test to select those best suited for their operational tasks. They then conduct an abbreviated form of maintenance training focused on elementary maintenance tasks, while the remainder of their training deals with aspects of flying. As a result, they are typically qualified to commence operational flying after only two and a half years in the military, more than four years earlier than the RCAF best-case scenario.[11]

19. Implementing such a model for the RCAF would most likely require the creation of a separate trade to account for a specialized recruitment and training process. This would require the guidance and close support of the current cadre of Griffon and Chinook flight engineers to preserve best technical practices, while helping further develop the capabilities of the tactical aviation enterprise. Current tactical aviation flight engineers would be retained, and their outstanding professionalism and technical expertise would continue to be recognized while serving as a benchmark for the new recruits.

20. As for the process itself, the organization for evaluating and selecting potential aircrew candidates already exists. The Canadian Forces Aircrew Selection Centre in Trenton could adapt and administer the RAF crewman selection test in a similar fashion to how their RAF pilot test

[10] Engineering solutions such as better seats in the cabin and procedural changes to limit time spent in positions that focus strain on knees, necks, and backs should also be implemented to help prevent flying related injuries. This would help minimize aircrew who become grounded for chronic injuries that are unrelated to flying, which tend to increase in prevalence with years of military service in general. However, such discussions are outside the scope of this paper.

[11] Royal Air Force, "Weapons Systems Operator (WSOp)," Recruitment information package, 20 May 2021, provided by SO1 Flying Branch & NCA Trade Advisor.

was adapted for RCAF pilots.[12] Additionally, the candidates could conduct initial aircraft maintenance courses alongside aircraft maintenance technicians in Borden, followed by either the Griffon or Chinook specific maintenance courses in St-Hubert and Petawawa to provide basic aircraft maintenance skills. Then, a focused on-job-training maintenance period at a line unit to acquire only the relevant skills needed to conduct pre- and post-flight inspections and elementary maintenance procedures. Finally, they could conduct the Basic Flight Engineer Course (BFEC) followed by the applicable flying qualification course for either Griffons or Chinooks at their respective operational training units.

21. Like the RAF, this model would ensure only candidates with the aptitude and desire to be employed within tactical aviation are selected. Furthermore, it would reduce the total time required to force generate a member by eliminating non-relevant aircraft maintenance training, as well as the administrative delays generated by the current trade transfer. All together, these efficiencies could produce better candidates roughly two years earlier and avoid drawing highly valuable aircraft maintainers away from their aircraft maintenance organizations.

CONCLUSION

22. Fifth generation networked warfare will demand aircrew that are better able to synthesize imperfect information and make timely decisions during the stress of air operations. The RCAF's current flight engineer force generation model takes too long and produces crews with many redundant maintenance qualifications that they cannot employ. Furthermore, it makes little consideration for screening and selecting candidates with the aptitudes required now or in the post-GLLE future. The RAF weapons system operator crewman model of recruiting candidates directly with a specially adapted selection and screening process produces similar results in significantly less time and with more operationally focused skills. The RCAF could benefit from implementing such a model, while still leveraging much of the training resources already in existence.

[12] RCAF Press Release, "RCAF improves testing for "the right stuff,"" *Skies*, 29 April 2014, https://skiesmag.com/press-releases/rcafimprovestestingfortherightstuff/.

RECOMMENDATIONS

RECOMMENDATION 1

23. Create a new RCAF trade focused on the increasingly complex role of tactical aviation flight engineers.

RECOMMENDATION 2

24. Directly recruit members for employment within tactical aviation, using a specifically developed screening and selection process similar to pilots.

RECOMMENDATION 3

25. Generate an optimized training program that primarily focuses on flying operations, with secondary consideration for aircrew-specific maintenance requirements.

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