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SNAP ALTER HEADING: AIRCRAFT FLEET CONSOLIDATION IN THE RCAF

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Exercise *Solo Flight*

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INTRODUCTION

In many discussions of airpower[2], the Italian General Giulio Douhet is often cited in the observation that flexibility is the key to airpower[3]. Royal Canadian Air Force (RCAF) doctrine states that flexibility and versatility are key tenets of airpower[4]. In the RCAF context, this means that the rapid and decisive redirection of air forces from one objective to another can be conducted at all levels of warfare from the tactical all the way to the strategic[5]. This flexibility and versatility, however, comes at a cost.

Aircraft are central to the conduct of air force operations. It is a conundrum that the technology that enables aircraft to conduct their missions also makes them susceptible to technological advances. This ensures that the rate of technological change has direct impacts on the operational effectiveness of an aircraft system. This not to say that the introduction of a new type of radar or computer will be able to reduce an aircraft's range or payload; it is that the system's operational effectiveness will change over time as

[1] Command used by Air Navigators using dead reckoning procedures that indicates to the pilot in control that a large course correction is about to be given.

[2] Convention within the RCAF is in transition where the phrase "aerospace power" is gradually being replaced by the word "airpower". Air Force Vectors has led this change although many source documents have yet to be amended. The adoption of the term "airpower" is intended to de-conflict the scope of RCAF doctrine from the anticipated stand-up of a separate Canadian Armed Forces Space Command in the future. For the purposes of this paper, "airpower" is used to in the broadest definition of both.

[3] Giulio Douhet, *The Command of the Air*, trans. Dino Ferrari (Air Force History and Museums Project, 1998), 10.

[4] Commander 2 Canadian Air Division. *Canadian Forces Aerospace Doctrine 2nd Edition* (Oct 2010), 28.

[5] *Ibid*.

contributing systems no longer provide the advantage or capability required to support the mission. This reliance on technology results in high systems' complexity. Complexity leads to high procurement and in-service costs for aircraft in addition to significant technological support and training costs. While some of these costs are tied to the number of a particular type of aircraft in service, many still are tied to the mere existence of a fleet in service be there one or one-hundred. The placement of capabilities within small, specialized fleets results in specialist forces that are below the critical mass required to justify the required supporting functions. The increasingly narrow focus of individual fleets runs counter to the tenets of flexibility and versatility.

Recent injections of funds into the Canadian defence budget have led to the emergence of a number of projects to add individual aircraft fleets to the force to add capability[6]. These continue independently despite similar performance specifications. The consolidation of capabilities through the strategic procurement of fewer fleets with broad capabilities is not generally considered. This paper will demonstrate that the future RCAF would realize increased operational flexibility and versatility while decreasing operating expenses through the consolidation of a number of training, transport, and Intelligence Surveillance and Reconnaissance (ISR) activities within two fleets instead of the current seven[7]. The model used here will: describe the concept, examine the technical and political feasibility of the concept, and examine the force generation and employment

[6] Assistant Deputy Minister (Materiel), *Capability Investment Database* (accessed May 2015).

[7] Current Plan: Twin Engine: CC-138 Twin Otter / Utility Transport Aircraft Project; CT-142 Dash-8, CC-115 Buffalo / FWSAR Project, Special Operations Force Intelligence Surveillance & Reconnaissance Aircraft Project, Multi-Engine Utility Flight; Four Engine: CP-140M Aurora / Canadian Multi-Mission Aircraft, CC-130J Super Hercules.

benefits and challenges before drawing conclusions against the concepts of flexibility and versatility.

CONCEPT

The central concept of this paper is that current technology permits the operation of twin and four-engine aircraft in scalable configurations to deliver missions ranging from transport to ISR requiring the deployment of weapons. The requirement to deliver ISR missions from the most basic: Search and Rescue (SAR) through special operations and up to Anti-Submarine Warfare (ASW) would drive the assignment of aircraft and crews as required. Local maintenance in standard aircraft configurations will be tied to squadrons with the two fleets being centrally managed. Likewise, transport fleet requirements will require the assignment of sufficient aircraft numbers in locations demanded by operational necessity. For simplicity, it is assumed that the current assignment of ISR and transport aircraft could be replaced one for one with consolidated fleets. The exception would be the consolidation of Operational Training Units (OTUs) and Test and Evaluation Forces (TEFs) into one of each per fleet. A central OTU would train all aircrew to basic operation of the aircraft including basic SAR. The designation of basic SAR as a secondary mission for all RCAF fleets and provides the OTU with the responsibility to instil the ISR mission planning mindset in the formation of crews. Advanced training to Special Operations Forces (SOF) support and ASW missions would fall on the squadron training sections that already exist in the current squadron makeup.

An enduring challenge to the conduct of operations within Canada is geography[8]. Regardless of the required mission, the ability to deliver aerospace effects across the Canadian area of interest is shaped by time and space. A review of in-service fleets and upcoming projects as per Table 1 shows two broad classes of multi-engine turbo-propeller driven aircraft: four-engine and twin engine. The aberration within the table is the CC-130 Twin Otter, which is a light twin. The Utility Transport Aircraft project Statement of Requirement (SOR) sets out a significantly expanded role for a northern utility aircraft, which includes an indication of Intelligence, Surveillance & Reconnaissance (ISR) missions such as Search and Rescue (SAR) [9] that may demand the increase in absolute aircraft size and range.

The procurement of two aircraft to deliver all missions delivered by the aircraft found in Table 1 would require aircraft that are reconfigurable to both transport and ISR roles. Consolidation of force development and generation functions would be in two OTUs along with two technician schools, two operational TEFs, two Assistant Deputy Minister (Material) offices for life cycling and engineering support. Compromises with aircraft performance are inevitable with combining functions on single aircraft. A CC-130J with added wing pylons, for example, could provide shorter range, speed, and endurance when filling a mission formerly filled by a CP-140. In the end, an increase in assigned aircraft may be required. Likewise, using a larger twin-turboprop to replace the CC-138 could result in lower sortie rates and faster transits. The key to realizing this operational capability within two airframe types would be the development of a

[8] Director General Air Force Development, *Air Force Vectors* (2014), 8.

[9] SAR is correctly considered a subset ISR mission with the caveat that the objects of the search are at worst case unable to indicate their position as opposed to ‘traditional’ ISR where targets are expected to actively hide or disguise their actions.

combined SORs combining mandatory capabilities and missions at the outset as opposed to re-purposing aircraft already in service.

The option would exist for regional composite squadrons providing all transport and ISR functions required by that specific region. The current tiered readiness system in place supports this construct. Current CP-140 squadrons operate under a Combat Training Directive with eight combat qualifications[10]. All crews on a squadron maintain the three basic qualifications while Combat Capable crews hold a designated five and Combat Ready crews hold all eight[11]. The tiered system provides a graduated scale, which readily employs new squadron arrivals and guides their development over time.

Table 1: Performance Criteria for Selected In-Service RCAF Fleets[1] and Projects

Class	Airframe	# in Service	Role[2]	Cruise Speed	Range[3]	MTOW[4]
Four-Engine	CP-140 Aurora	18	ISR	349kts	3995nm	142,000lbs
	CC-130J Super Hercules	17	Transport	350kts	3700nm	164,000lbs
	CC-130E Hercules	23	SAR / AAR	300kts	3900nm	175,000lbs
Twin-Engine	CC-115 Buffalo	6	SAR	224kts	1209nm	45,000lbs
	CT-142 Dash-8	4	Training	270kts	1296nm	42,461lbs
	CC-138 Twin Otter	6	Transport	181kts	770nm	14,000lbs
	Fixed-Wing SAR Project	15[5]	SAR			
	Utility Transport Aircraft Project	up to 12[5]	Transport			
	SOF Airborne ISR Project	TBC	ISR			

Notes:

1. All data for in-service aircraft taken from RCAF Internet Homepage and converted to imperial units.
2. Roles:

[10] 1 Canadian Air Division Headquarters, *CP-140 Combat Training Directive* (2014), 3.
[11] *Ibid*.

   a. ISR: Intelligence, Surveillance, and Reconnaissance
   b. SAR: Search and Rescue
   c. AAR: Air-to Air Refuelling
3. Range is dependent on flight profile and payload carried. For general comparison only.
4. Maximum Take-Off Weight (MTOW) presented as a general indication of size class of aircraft.
5. As per project documentation on the Capability Investment Database (CID)

TECHNICAL AND POLITICAL FEASABILITY

The advancement of the concept of fleet consolidation in order to realize flexibility is an alien concept to many within today's air force. Much effort has been expended to develop specialist squadrons who excel in their assigned realm of operations. At present, there is little overlap amongst the assignment of missions to fleets. The overlap that does exist is with the tasking of SAR squadrons to provide transport missions on a non-interference basis with their primary task. Likewise, CP-140 crews have provided personnel and material transport albeit at much lower cargo densities than dedicated transport platforms. The feasibility of assigning a mission to a particular platform is tied to the criteria for success of the mission. While a CC-130 or CC-115 configured for SAR or a CP-140 can provide transport services, a line CC-130 is not equipped to provide surveillance support to Special Operations Forces (SOF). Ignoring the training and readiness aspects, the aircraft is simply not equipped for the mission.

Mission complexity for multi-engine turboprops exists on a continuum from the most basic transit to complex ISR missions demanding high degrees of coordination and risk. At the most basic level is the transport mission. This is not to say that the transport mission is simple. Transport flights in operational theatres a fraught with complexity and

risk. Additional complexity is added as ISR missions require attention to more details and cooperation with more agencies. At the highest complexity of the scale are the SOF support missions or the Anti-Submarine Warfare missions in a multinational cooperative context. The point is that as missions increase in complexity and risk, additional hardware is required and in many instances, additional aircrew are required.

The relative inefficiency of the CP-140 as a transport aircraft results from it being filled with mission equipment for its other missions. In addition, the CP-140 is limited by the width of its main cabin door and a limited reinforced floor as cargo areas. The FWSAR project is a middle step between the CP-140s communications, sensors, and weapons systems and the basic transport aircraft[12]. FWSAR intends to bring communications, data management, and sensors online to aid in the SAR mission by extending the awareness of the search crew beyond the visual range of an observer at a side window[13]. Advances in the aviation industry with equipment designed to roll-on and roll-off a transport aircraft has opens the door to more flexible possibilities[14].

Lockheed Martin's CC-130J Sea Hercules is one such system[15]. Lockheed Martin is proposing an ASW variant of their C-130J that would include the ability to carry torpedoes or other airdropped weapons and materials[16]. The core airframe carries all basic aircraft operating systems, a robust communications system, and extra power

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[12] Assistant Deputy Minister (Materiel), *Capability Investment Database – FWSAR Project Page* (accessed May 2015).

[13] *Ibid*.

[14] 2000 / 2001 AIAA Undergraduate Team Aircraft Design, *Chimera Naval Common Support Aircraft* (2001), iii-iv.

[15] Mike Bell, "Sea Hercules" (briefing to Chief of the Air Force Staff, National Defence Headquarters, Ottawa, ON, Aug 2012).

[16] *Ibid*.

generation[17]. As an addition, wing pylons and fuselage stations are designed to be rapidly configured with antennae and pylons for sensors as required. A proposal made to the Chief of the Air Staff in 2013 included provision for all sensors currently carried on the CP-140 with additional space reserved for future growth. While the conversion of a transport aircraft to an ISR variant is not a new idea, what set Lockheed Martin's approach apart is that it is designed to be reconfigured at the normal operating hangar within hours of a decision being made. Fitting the basic airframe with the growth provision is purported to compromise only 5% of the payload with the ISR mission kit removed[18]. Airbus Military has a similar system in their Fully Integrated Tactical System (FITS) currently in service with the Turkish Air Force's C295 patrol aircraft and the Spanish Air Force's P-3 Orions[19]. While technically feasible, the decision to pursue this course for the RCAF is largely a political one.

Without a pressing threat on Canadian sovereignty, the Canadian public and press have substantial concern and opinion in the expenditure of funds on military hardware. As seen in the discussion surrounding the F-35, the procurement of the fifth C-17, and the purchase of the FWSAR aircraft, the closer to the system being seen as a weapon, the greater the controversy surrounding its purchase. The National Shipbuilding Procurement Strategy (NSPS) is not immune from the discussion but the close visible links to Canadian industry and jobs appear to temper the criticism somewhat. While at the Aerospace Symposium at the Canadian Forces College in 2013, Deputy Minister Fadden

[17] *Ibid*.
[18] *Ibid*.
[19] Airbus Defence & Space, "Fully Integrated Tactical System," accessed 12 May 2015, http://militaryaircraft-airbusds.com/InnovationAndTechnology/FITS.aspx.

stressed that it is critical for defence procurement to progress in the context of Canadian industry in order to meet the government's procurement and industrial strategies[20].

Canada is home to many aviation industries. Bombardier Aerospace is often noted as the third largest aerospace firm in the world[21]. The production of airframes may be the most visible aspect of an aerospace industry but systems integration and avionics are significant value-added industries. A survey of press releases shows that the Boeing P-8 Poseidon Multi-Mission Aircraft costs $150 million USD per airframe. The P-8 is a derivative of the Boeing 737-800 variant, which retails for $93.3 million USD per airframe[22]. This very limited sample indicates that about 40% of an ISR aircraft's production cost comes from added systems. The mission systems integrator for the modernized CP-140M and the CH-138 Cyclone, General Dynamics Canada, is seen as a world leader in this type of work[23]. Avionics and sensors from Canadian Marconi, L-3 Wescam, IMP, and Thales, to name a few, are a global who's who of Canadian aerospace industry and can all feed into a home-grown industry that would provide a foundation upon which to keep Canada competitive globally while meeting the government's buy Canadian policies[24]. This awareness of Canadian content would be essential in the political and public arenas where billions of dollars would be required to commit to such a grand prospect. Using figures from the Investment Plan 2013 and the Capability

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[20] Richard Fadden (speech, Canadian Forces College Air Symposium, Toronto, November 5, 2014).

[21] CAPA Centre for Aviation, "Bombardier Aerospace," accessed 12 May 2015, http://centreforaviation.com/profiles/suppliers/bombardier-aerospace.

[22] Chris Brady, "737 Sales," *The Boeing 737 Technical Site* (blog), accessed 12 May 2015, http://www.b737.org.uk/sales.htm.

[23] Industry Canada, "Information and Communications Technologies," accessed 12 May 2015, http://www.ic.gc.ca/app/ccc/srch/nvgt.do?lang=eng&prtl=1&sbPrtl=&estblmntNo=900504510000&profile=cmpltPrfl&profileId=2059&app=sold.

[24] Government of Canada, *Canada First Defence Strategy*, (2008), 4.

Investment Database, the combined costs of the Canadian Multi-mission Aircraft ($3.1bn), FWSAR ($1.8bn), CC-130J ($3.1bn), UTA ($250mil), CT-142 replacement ($200mil), and the SOF ISR Capability ($125mil) equals over $10bn when projected to 2020 using inflation rates from the 2013 DND Economic Model[25]. Linking the mission system integration directly to Canadian industry with a global reputation should make selling the program more akin to the NSPS than the F-35 in the public's eyes.

FORCE GENERATION AND EMPLOYMENT

The procurement and production of a two-fleet solution for training, tactical transport, and ISR missions ascribed to the RCAF is but the first battle to be fought in an engineered evolution of the RCAF. Benefits and costs are associated with the conversion of an air force under this concept. This section will examine force generation and operational employment in order to illustrate the overall benefit pending for the RCAF.

Force generation refers to the creation of an operational force. It involves both the hardware and aircrew aspects of a weapon system. In the fleets under discussion in this paper, today's RCAF operates full OTUs to generate aircrew for CC-130 and CP-140 fleets. Distinct OTU flights exist in CC-115, CC-138, and CT-142 squadrons[26]. The quality control question of generating combat-capable personnel from new graduates of flight training schools has resulted in the re-creation of an air standards section within 1 Canadian Air Division. Not that there is a problem with quality control today but the seemingly perpetual deficiency with qualified aircrew raised concerns that training can

[25] Government of Canada, *2013 DND Economic Model*, (2013).

[26] Royal Canadian Air Force, "Wings and Squadrons" accessed 12 May 2015, http://www.rcaf-arc.forces.gc.ca/en/wings-squadrons.page.

take a back seat to the production of replacement aircrew. Dispersal of OTUs increases the risk of deviations from accepted standards due to local pressures.

Much of the discussion regarding the required number of CC-130J training crews centred on achieving critical mass to support training year over year. Upon graduation from flight schools, graduates are assigned to fleets and then continue on the assigned path. If one fleet experiences a deficiency in aircrew, the OTU almost always becomes the bottleneck to recovery as it is staffed with limited positions. A consolidation of operations would permit a central flying school to train all aircrew on the basic aircraft type for operations from transport to include basic ISR missions. Squadron-specific training flights would then take these new members and train them on the more complex aspects of the squadron's assigned missions. This mirrors the tiered readiness system in place across the RCAF today[27] and would permit enhanced mobility between squadrons for aircrew. Personnel deficiencies at one Wing could be directly alleviated through the reassignment of personnel without having to complete a lengthy OTU. The same personnel flexibility and agility would exist with the technicians.

Force generation also includes the provision of support to maintain aircraft in service. ADM(Mat) maintains large staffs for each air fleet in service. In addition, the entities involved in the maintenance of technical and operational airworthiness processed are currently required to duplicate efforts for each fleet in service. Fleet consolidation may make requirements monitoring more complex across the breadth of operations but critical mass would exist with a lower number of absolute fleets in service. The benefits seen today with omnibus projects would exist on an unprecedented scale.

[27] 1 Canadian Air Division Headquarters, *CP-140 Combat Training Directive* (2014), 2.

The assignment of aircraft to different squadrons forms the basis of the air force structure. 405 LRP Squadron is a maritime ISR specialist and 436 Sqn is a tactical transport specialist. At present, the specialization of squadrons is tied as much to the aircraft in service as the aircrew. While the intended life expectancy of an aircraft in service is 20-30 years upon procurement, actual service is trending upwards as both the CP-140 and CC-130H fleets greatly exceed their ELEs declared upon procurement[28]. Limitations on operational flexibility exist with the narrow capabilities embodied within current fleets in service. The CP-140 is just as poor a transport aircraft and the CC-130J is at conducting surveillance in their current operational configurations. In the concept underpinning this paper, consolidated fleets would permit rapid reassignment of forces from one mission to another without the need for procurement as the operational landscape changes. Flexibility and versatility exist as key tenets of airpower today only at the tactical level as missions are handed out and re-tasked during flight. Fleet consolidation would for the first time deliver flexibility and versatility to the strategic commanders of the Canadian Armed Forces.

CONCLUSION

The use of specialist aircraft for the spectrum of missions facing the RCAF codifies inefficiency into operations. Duplications in the engineering support, training, and maintenance are unnecessary burdens on a Canadian Armed Forces already stressed for resources. By engineering an air force structure that consolidates capabilities within

[28] Royal Canadian Air Force, "Estimated Life Expectancy: ELE and the RCAF," accessed 12 May 2015, http://www.rcaf-arc.forces.gc.ca/en/article-template-standard.page?doc=estimated-life-expectancy-ele-and-the-rcaf/i6miz740.

fewer airframe fleets, the RCAF will realise efficiency while maximizing operational flexibility. The achievement of critical mass in areas of training, maintenance, and supply would enhance efficiency and give Canada more leverage with manufacturers and suppliers.

Fleet consolidation permits strategic rebalancing of assigned resources to meet changing operational environments. A strategic shift requiring more ISR resources would be delivered through training to already maintained standards based on existing tactics, techniques and procedures and the delivery of in-service mission kits as opposed to new procurement. At the tactical and operational levels, this would widen the pool of aircraft and crews available for high priority missions and permit longer sustainment of required surges.

The procurement of aircraft with the aim of reducing the number of discreet aircraft fleets would require the acceptance of a long-term vision for the RCAF. This could not just happen; it would have to be directed. It is technically feasible as shown by systems in service and under design. Without a diverse aircraft manufacturing sector that produces a number of options for procurement, this course of action would provide a viable mechanism to leverage Canadian aerospace industries in a substantial way. The requirement to be good stewards of public resources demands that the RCAF pursue a future that delivers the maximum capability with required resources. Enhancing flexibility and versatility at all levels of the RCAF can be realized by removing single-use systems and replacing them with true multi-mission aircraft.

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