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AGILE AND RESPONSIVE? IS THE ROYAL CANADIAN AIR FORCE CONTRACTING OUT ITS AGILITY AND RESPONSIVENESS THROUGH OUTSOURCING SUPPLY CHAIN MANAGEMENT?

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ABSTRACT

The Royal Canadian Air Force (RCAF) has continued to display an inability to adequately support its various aircraft platforms. The aircraft spares support to the RCAF is a persistent challenge that burdens leadership and oftentimes impinges on the ability of Canada's air force to support and sustain deployed operations. The supply system underperforms and struggles to have the right part, in the right location at the right time. The RCAF has witnessed several iterations of spares support frameworks in recent history in an attempt to diminish the capability gaps that are experienced; yet, disparity still exists between what is being developed versus what is required to meet Canada's air power missions.

The RCAF supply community has found itself in a position where its expertise and *raison d'etre* is being contracted out with a view of gaining efficiencies and diminishing costs, but with minimal input from the supply community for these long-term and often vastly divergent decisions. To date, it has not been abundantly clear if these anticipated proficiencies are truly being realized as the CAF does not have the capability to easily measure this type of success or failure. Without adequate metrics the CAF is essentially making blind decisions in the hope that operational performance will increase. This paper will argue that current contracted supply chain practices are, in general, jeopardizing the RCAF's operations but if developed and applied appropriately and with the correct performance measures, contracted aircraft spares support can have positive advantages for the RCAF and help enable its mission.

The RCAF has an opportunity to better the supply support that is currently offered to its platforms to increase its ability to project air power. Sustainment is the foundation to all command functions. Strategic vision from one sustainment command will allow the RCAF to prioritize and repair the identified supply chain weaknesses that leave the RCAF vulnerable. Currently, the RCAF is on a path toward outsourcing its agility and responsiveness because it does not adequately develop and manage its existing aircraft spares contracts. Contracted supply chains have a place in the RCAF; however, they must be better developed and managed. This cannot be a subjective decision based on opinion alone. Additional rigour must be applied to all spare support contracts because of the high indirect stakes that exist, and ultimately impact the RCAF's ability to achieve its mission.

LIST OF ABBREVIATIONS

ADM(Mat) – Assistant Deputy Minister (Materiel)

CAF – Canadian Armed Forces

CDS – Chief of Defence Staff

CJOC – Canadian Joint Operations Command

CLSSA – Cooperative Logistics Supply Support Arrangement

CWO – Chief Warrant Officer

DGAEPM – Director General Aerospace and Engineering Program Management

DND – Department of National Defence

DRMIS – Defence Resource Management Information System

GoC – Government of Canada

ISR – Intelligence, Surveillance, and Reconnaissance

ISSCF – In-Service Support Contracting Framework

LCMM – Life-Cycle Materiel Manager

MOB –Main Operating Base

MSS – Mission Support Squadron

NATO – North Atlantic Treaty Organization

NCM – Non-Commissioned Member

NDHQ – National Defence Headquarters

OEM – Original Equipment Manager

OWSS – Optimized Weapons System Support

OWSM – Optimized Weapons System Management

PA – Procurement Authority

PAV – Primary Air Vehicle

PY – Person Year

RAAF – Royal Australian Air Force

RCAF – Royal Canadian Air Force

SI – Sustainment Initiative

SSE – Strong. Secure. Engaged.

USAF – United States Air Force

USG – United States Government

YFR – Yearly Flying Rate

CHAPTER 1: INTRODUCTION

The line between disorder and order lies in logistics.

- Sun Tzu

The Royal Canadian Air Force (RCAF) has continued to display an inability to adequately support its various aircraft platforms. The aircraft spares support to the RCAF is a persistent challenge that burdens leadership and oftentimes impinges on the ability of Canada's air force to support and sustain deployed operations. The supply system underperforms and struggles to have the right part, in the right location at the right time. The RCAF has witnessed several iterations of spares support frameworks in recent history in an attempt to diminish the capability gaps that are experienced; yet, disparity still exists between what is being developed versus what is required to meet Canada's air power missions. How much aircraft spares support should be outsourced to commercial industry? Is it important to maintain a particular level of requisite knowledge within the Canadian Armed Forces (CAF)? What is the optimal balance between efficiency and agility? How should contractor performance be measured? These are all critical questions that need to be examined to create a support construct that is a force multiplier which allows the RCAF to be relevant, agile, and responsive to defence operations.

It could be argued that the main priority for any air force supply organization is to provide world-class support to aircraft weapons systems; thus, aircraft spares is a fundamental element of a supply organization. A supply squadron needs to be empowered with the ability to meet the higher commander's mission by equipping maintenance organizations with the right part, in the right location, at the right time. If a supply squadron is not charged with this

responsibility they are not truly performing an integral military function that directly supports operations and are perhaps more focused on domestic operations.

The CAF continues to experience fiscal constraint which has increased the appeal of contracting support from defence industry, which is in direct contrast to the new defence policy. *Strong Secure Engaged* plans for a significant increase to the RCAF's current inventory of aircraft, yet it makes no mention of any of the support frameworks required to sustain each of these new capabilities. In fact, the Defence Renewal initiative's goal is to generate savings while creating a lean and efficient organization.[1] This is a five year initiative from 2013 to 2018, whereby the government expects hundreds of millions in defence reinvestment opportunities by streamlining training, maintenance and materiel, information and technology, infrastructure personnel practices, and management systems. Under paragraph 7.2 Maintenance and Materiel, is where the largest reinvestment opportunity of between $280 million and $450 million is expected. Within the Defence Renewal Charter it is recognized that, "Defence is having difficulty predicting the demand for spare parts and other components in an efficient manner."[2] Thus the shortcomings of the CAF supply chain are acknowledged; however, it is difficult at this stage to determine if enough is being done to actually increase the efficiency of the supply chain for the long-term. The charter continues to confirm that there are, "inefficiencies in the way Defence manages its broad range of materiel and maintenance related contracts."[3] This was the impetus of the Sustainment Initiative contracting framework that will be discussed in more detail in chapter three.

Within the Department, and Director General Aerospace and Engineering Program Management (DGAEPM) in particular, there is an expectation that the privatization of the supply

[1]Department of National Defence, *Defence Renewal Charter* (Ottawa: DND, 2013), 4.
[2]Department of National Defence, *Defence Renewal Charter* (Ottawa: DND, 2013), 12.
[3]Department of National Defence, *Defence Renewal Charter* (Ottawa: DND, 2013), 12.

chain will increase efficiency and reduce costs; thus creating an opportunity to have an increased level of aircraft availability. So much so, that all new contracts following the new contracting framework are being directed to include supply chain management in contract proposals. Yet, the RCAF still experiences continued frustrations with its support construct that creates operational implications and erodes the trust in the supply chain. The RCAF must objectively evaluate potential opportunities to provide increased support to operations through assessing the current obligatory contracting framework models with a thorough focus on in-service support for the supply chain.

The RCAF supply community has found itself in a position where its expertise and *raison d'etre* is being contracted out with a view of gaining efficiencies and diminishing costs, but with minimal input from the supply community for these long-term and often vastly divergent decisions. To date, it has not been abundantly clear if these anticipated proficiencies are truly being realized as the CAF does not have the capability to easily measure this type of success or failure. Without adequate metrics the CAF is essentially making blind decisions in the hope that operational performance will increase.

This paper examines the need for military supply specialists to provide direct support to operations through aircraft spares support and how best to leverage the capabilities of industry to meet the RCAF mandate. A better understanding of the requirements of the supply chain is gained through examining the tenets of airpower and analyzing how the RCAF support framework aligns with these tenets and the requirements of 21st century air power. The RCAF mission and the support framework will be compared and contrasted to determine if the support framework aligns with the ultimate mission of the RCAF. This study will be valuable for the RCAF because it currently cannot accurately measure total supply chain performance based on

timely and cost-effective delivery of materiel and logistics services to operational customers. Without this data, uninformed decisions are made that impacts the performance of the supply chain for many decades. RCAF supply chain management needs to be streamlined in order to meet the needs of its war fighter.

This paper will argue that current contracted supply chain practices are, in general, jeopardizing the RCAF's operations but if developed and applied appropriately and with the correct performance measures, contracted aircraft spares support can have positive advantages for the RCAF and help enable its mission. To achieve this there needs to be more standardization across the various fleets' support contracts to gain efficiencies in first and second line support and to ensure that end-users are better educated on the elements and requirements of the contract. More specifically, open dialogue needs to occur between the weapons system management (WSM) staff that manage the contract and the support staff that execute the contract to ensure that the contractor is meeting its contractual obligations but more importantly, that the contract is written in such a way that allows for flexibility and agility for support staff to execute in a manner that enhances the RCAF's mission.

Ultimately, a centralized supply authority is required to create a concerted effort across the CAF, and RCAF, and ensure not only that the supply community is focused toward the same goals but that its ambitions are being championed. To come to this conclusion, this paper will explore published literature on alternate service delivery before it examines the RCAF tenets of aerospace power and compares those to sustainment principles. The paper will then outline the three major contracting frameworks currently employed in the RCAF and how performance based logistics and efficiency versus effectiveness impact these frameworks, underlining the

importance of performance metrics. The concept of equipment life expectancy will be unpacked as well as the type of supply support that exists for each of the operational fleets in the RCAF.

Within the CAF, the RCAF is the leader in contracting spares support, holding 14 spares support contracts. As of fiscal year 2014/2015, the CAF had $1.4 billion comprising of approximately 187,000 line items of government owned materiel at industry, while the RCAF held $1 billion and 153, 389 line items;[4] or 72% of all government owned materiel for the CAF. The RCAF employs contracted supply chains in many areas and for various fleets. This structure, the level of contracted support, and how the contract is arranged will be discussed in chapter four to gain a thorough understanding of the intricacies of the support in the RCAF supply chain. Finally, several recommendations will be provided to assist the RCAF in minding the gap it currently faces when comparing its support expectations to its current level of service.

Literature Review

The author's career and experiences as a supply officer for the past 14 years will be leveraged in this paper. This experience includes various positions within a Wing Supply organization, including Systems Control Officer, Materiel Control Officer, and Officer Commanding Supply and Food Services, A4 Logistics at 1 Wing headquarters, Wing Logistics Officer of Joint Task Force Afghanistan - Air Wing, and supply operations officer in DGAEPM. In the most recent position, there was significant daily involvement in contracted supply support within DGAEPM which provides significant foundational knowledge with how current contracts are managed and the challenges that are faced from a supply chain perspective. These professional insights are essential to this study because the formal literature on contracted supply for military air forces, particularly in Canada, is marginal.

[4]Director General Materiel Systems and Supply Chain, *Government Owned Materiel Project: Project Charter.* (National Defence Headquarters: Version 0.9), June 2016, 2.

Although there has been a significant amount of literature discussing the government procurement process, there is an obvious gap of formal literature on Canadian military supply chain management. Andre Tchokogue, Jean Nollet, and Julie Fortin discuss outsourcing in general in the Department of National Defence in their journal article, "Outsourcing Canadian Armed Forces logistics in a foreign theatre." Although this article is looking at all logistics functions in a theatre of operations, the conclusions are still very relevant to a contracted supply chain. The authors echo what Davids, Beeres & Van Fenema, Glas, Hofmann & Ebig all mention in that the largest challenge faced by the Armed Forces is to determine how to use available resources very efficiently.[5] There are several resources that accolade outsourcing military logistics[6] but the perceived improved performance must also be weighed with poorly-implemented contracts and the repercussions, in addition to poor performance indicators that ultimately disallow the RCAF to accurately assess the level of service it is receiving. The article also demonstrates the change in culture towards institutionalizing logistics outsourcing through the increase in private contractors being hired for various logistics activities.

The risks identified with outsourcing include a potential loss of control over some activities, a loss of internal skills and competencies, potential for delayed responses during high tempo operations, and lack of flexibility for commander's mobilized resources. These are all significant risks that should be assessed when determining contracted support frameworks. The authors situate that the two main collaboration phases of any contract negotiation are the formation phase and the implementation phase; consequently, the RCAF must apportion

[5]Andre Tchokogué Jean Nollet, and Julie Fortin. "Outsourcing Canadian Armed Forces Logistics in a Foreign Theatre," *Canadian Journal of Administrative Sciences / Revue Canadienne Des Sciences De L'Administration* 32, no. 2 (Jun, 2015) : 113.

[6]Scott Campbell, "Civilians on Operations – Canada Can Learn from the Past" (Joint Command and Staff Program, Canadian Forces College, 2010), 2. Robert Getso, "Department of Defense Civilian Contractors and the Global War on Terrorism" (master's thesis, Excelsior College, 2009), iv. Thomas Johnson, Mickey Howard, and Joe Miemczyk, "UK Defence Change and the Impact on Supply Relationships" *Supply Chain Management: An International* Journal 14 no . 4 (2009): 273.

sufficient resources to both of these phases to ensure the necessary expertise is available to develop a strong framework foundation. These authors contend that strategic vision is lacking when developing support contracts as a result of limited knowledge in matters of outsourcing.

Most writings on alternate support delivery (ASD) tend to come from the United States but this is a country whose emphasis on effectiveness versus efficiency is quite different, and perhaps almost exactly opposite of Canada's approach. Due to the sheer size of the United States Air Force and the number of aircraft platforms it operates, America's negotiating power with defence industry commands attention and is not something DND will achieve based on its comparatively smaller size. In the early 2000s there was a strong push to outsource all non-essential activities when Secretary of Defense, Donald Rumsfeld streamlined Office of Management and Budget Circular No. A-76 report that forced the government to compare costs of outsourcing to doing the work in-house.[7] A defence outsourcing task force determined in 1996 that the US could save an estimated $7-12 billion per year through outsourcing, while a second task force concluded that outsourcing could save the department as much as $30 billion per year. This analysis does not deem that the military was not providing quality support, but rather, that it could seldom match the efficiency of the private sector.[8] Notwithstanding, the United States Department of Defense has identified that outsourcing still must be entered into carefully, even with financial pressures from the Pentagon. In fact, the pendulum has swung the other way with the Obama administration who charged the DoD with hiring a larger workforce through insourcing, deeming the DoD had degraded its in-house expertise to unacceptable levels and the

[7]Karla Marquis, "Insourcing and Outsourcing for U.S. Department of Defense IT Projects: A Model" CSC Papers, 2011, 2, last accessed 8 April 2018, http://www.dtic.mil/dtic/tr/fulltext/u2/a549027.pdf.

[8]Loren B. Thompson, "Defense: Outsourcing: The Coming Revolution" *Sea Power* 40, no. 2 (Feb 1997): 32.

organization was too reliant on contractors.[9] The moratorium on outsourcing DoD positions has been rejected by the House of Commons as recently as Fall 2017, although an agreement could not be reached amongst the house representatives on if outsourcing was truly a cost-saving measure.[10]

In his article *War is Not a Commercial Function,* Jayson Spiegel discusses these funding pressures and that the appeal of contractors to mitigate costs is directly related to logisticians. There are opinions that there should only be trigger pullers and contractors on the battlefield but Spiegel challenges that with the thought that too much effectiveness is at stake when one focuses too much on economic drivers. As Jonathan Figg alludes to in his article *Outsourcing: A runaway train*, transferring processes, and ultimately risks, can derail even the most steadfast organization. He goes on to attest that, "the allure of outsourcing as a quick fix to budgetary woes or organizational inefficiencies may blind management to the potential dangers of shipping an internal process to third-party contractors."[11] It could be argued that this is exactly the situation that the RCAF currently faces when determining supply chain management support for an existing or new capability. The RCAF was forced onto a contracted solution as a result of fiscal restraint in the mid-1990s and it could be argued that it was not well-positioned to execute this enduring task. Figg concedes that outsourcing can prove beneficial, and be a force enabler, so long as independent internal audits are continuously conducted; something that is currently lacking within the Department.[12]

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[9]Karla Marquis, "Insourcing and Outsourcing for U.S. Department of Defense IT Projects: A Model" CSC Papers, 2011, 2, last accessed 8 April 2018, http://www.dtic.mil/dtic/tr/fulltext/u2/a549027.pdf.

[10]Charles S. Clark, "House Rejects Outsourcing of Federal Jobs in Vote to Block Revival of Circular A-76," *Government Executive,* last modified 28 July 2017, http://www.govexec.com/contracting/2017/07/house-rejects-outsourcing-federal-jobs-vote-block-revival-circular-76/139829/

[11]Jonathan Figg, "Outsourcing: A runaway train" *The Internal Auditor* 57, no. 3 (Jun 2000): 49.

[12]Although each contracting authority is required to perform regular performance reviews, there is no independent auditing function where an organization that is at arm's length of the contract reviews the entire supply chain processes and performances.

Conclusion

Given the various pundits' opinions on outsourcing military services, one can find corroborating evidence for whichever solution one desires. However, what remains clear, whether one insources or outsources, sound contract development with supply experts engaged early, married with performance management and internal audits are the foundation to a successful contracting framework. However, to better understand how to implement optimal outsourcing, one must first have a clear understanding of the RCAF's current application of both air power and sustainment.

CHAPTER 2: RCAF AIR POWER AND RCAF SUSTAINMENT

> *Mission: The Air Force will provide the Canadian Armed Forces with relevant, responsive and effective airpower to meet the defence challenges of today and into the future.*
> *Vision: An agile and integrated air force with the reach and power essential for Canadian Armed Forces operations.*
>
> *-Air Force Vectors*

In today's world and the context of conflict in the 21st century, the ability for any military force to be agile and flexible is vital to achieve operational objectives and this is no different for the RCAF. The underpinning of the RCAF is the ability of its forces to have relevant, responsive and effective air power that is both agile and integrated.[13] Consequently, the supply chain must be equally agile and flexible to enable operations and ensure that the operators can execute their planned missions. RCAF Doctrine asserts that, "[s]ustainment is the bridge that connects the nation's support capacity to its combat capability."[14] Thus, support staff must be cognizant of the desired effect and operational imperatives to ensure that support priorities are aligned with operational priorities.

Supply chain management principles[15] have remained relatively unchanged in the 21st century; however, the reach[16] of any military has substantially increased. As a result, the supply system needs to become more robust in order to support a force that rapidly deploys to multiple locations.

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[13]Department of National Defence, A-GA-007-000/AF-008, *Air Force Vectors – Abridged Version* (Ottawa: DND Canada, 2014), iv.

[14]Department of National Defence, B-GA-400-000/FP-001, Canadian Forces Aerospace Doctrine, 3rd Edition (Ottawa: DND Canada, 2016), 39.

[15]Department of National Defence, B-GL-005-400/FP001, *Canadian Forces Joint Publication – CFJP 4-0 Support, 1st Edition.* (Ottawa: DND Canada, 2016), 1-3. CAF Support Doctrine outlines the principles of support as: foresight, economy, flexibility, simplicity, cooperation, self-sufficiency, visibility, responsiveness, and survivability. By focusing on these tenets, supply experts will be optimally positioned for support to successful operations.

[16]Department of National Defence, B-GA-400-000/FP-001, Canadian Forces Aerospace Doctrine, 3rd Edition (Ottawa: DND Canada, 2016), 14. The CAF Aerospace Doctrine defines reach as when aerospace power can be projected globally, unimpeded by surface features such as mountain barriers or water expanses.

Tenets of Air Power as it Relates to Sustainment

The RCAF abides by seven tenets which enhances the employment of air power through unity of effort. Each tenet provides a unique perspective for all airmen and airwomen to adhere to; however, RCAF sustainment does not necessarily follow the same tenets to meet operational objectives for the air force, which will be analyzed.[17]

Centralized Control and Decentralized Execution

Centralized control and decentralized execution is the ideal command and control construct for most western military air forces. According to Canadian Forces Aerospace Doctrine, "Centralized control gives coherence, guidance, and organization to the employment of air power."[18] This is achieved through one aerospace commander who has the authority to assign assets to best meet the mission. Moreover, this commander has control to redistribute assets as necessary to ensure the most efficient use of resources. This charges one individual with a comprehensive view and the requisite authority to make decisions in order to meet changing situations. On the other hand, "decentralized execution allows commanders at all levels to apply their expertise and understanding of local conditions for mission accomplishment, while also fostering initiative and situational responsiveness in a dynamic environment."[19] This gives latitude to commanders to make decisions as circumstances change in order to maintain avenues for success.

From a sustainment perspective, it could be argued that a decentralized control and *decentralized* execution model is employed. Logistics does not have its own command structure and thus does not have one authority that controls assets and makes decisions at an operational or

[17]Of note, synergistic effects will not be discussed because it is less relevant to sustainment.

[18]Department of National Defence, B-GA-400-000/FP-001, *Canadian Forces Aerospace Doctrine*, 3rd Edition (Ottawa, DND Canada, 2016), 17.

[19]Department of National Defence, B-GA-400-000/FP-001, *Canadian Forces Aerospace Doctrine*, 3rd Edition (Ottawa, DND Canada, 2016), 17.

strategic level for the entire supply chain. It could be argued that the Strategic J4 within the Strategic Joint Staff could play this role; however, the position is still relatively new and authorities of this magnitude have not yet been assigned. Additionally, the CAF employs the Joint Operational Support Group (JOSG) but this unit has a deployed focus and thus is subordinate to Canadian Joint Operations Command (CJOC). Instead, logisticians report to their operational chains of command but are responsive to many other agencies that develop and implement policies. This stands true within 1 Canadian Air Division (1 CAD), the RCAF's operational headquarters. This can be a challenge because oftentimes personnel at the tactical level do not have the breadth of knowledge required from a pan-air force perspective yet are making local decisions that will impose on the RCAF's ability to support operations. For instance, Wings have the latitude to implement supply support solutions as they see fit as is demonstrated at 4 Wing Cold Lake where there exists only minimal second line supply support.[20] Although this sounds like the underpinning of an agile organization, it creates significant operational level challenges due to the varied support structures.

Decentralized command is also a challenge during deployed operations as we are not necessarily 'training like we fight.' According to the RCAF Sustainment Doctrine, "Air Force sustainment champions the well-known axiom "'train as you fight – fight as you train,'" as this represents the optimal approach to sustainment for aerospace and other military operations."[21] If strategic guidance was provided for all logistics units to adhere to, there would be an opportunity to experience an economy of effort especially because non-logisticians in the chain of command

[20]4 Wing does not provide a centralized High Priority Requisition (HPR) cell as most Wings and bases do. This means that the WComd does not have one agency to provide a pan-Wing picture of sparing pressures. Nor does the Wing have a centralized agency to inject concerns to 1 CAD or DGAEPM. This is a concern for an aging fleet whose supply chain is exhausted and will only further erode with the proposed ELE extension.

[21]Department of National Defence, B-GA-406-000/FP-001, *Canadian Forces Aerospace Sustain Doctrine* (Ottawa: DND Canada, October 2011), 26.

would not have the latitude to disregard logistical requirements. Additionally, due to the multiple supply chains that exist within the RCAF there is always a requirement for CJOC to develop a unique concept of support for deploying each aircraft type. This was seen when providing support to the CH-147D Chinook in Afghanistan and is currently being developed for the CH-147F in Mali. [22]

Moreover, decentralized control creates the potential for additional support structures. Having centralized control of the logistics chain would provide logisticians the support to influence and implement changes that may not otherwise be given a priority if it is always in competition with operational priorities. Moreover, this would better replicate the "train as you fight motto" because in a deployed setting there is always a Joint Task Force Support Component (JTFSC); but this equal-footed support organization does not exist at the operational or strategic level.

Flexibility and Versatility

Flexibility and versatility are critical imperatives for any military in the 21st century where one faces a broad range of adversaries from any corner of the globe. Canadian doctrine states, "Inherently flexible and uniquely versatile, air resources can be quickly and decisively shifted from one objective to another…"[23] Consequently, it is equally critical for the supply chain to be flexible and versatile. It must be capable of responding to the changing operating environment in a short timeframe with minimal impact to operations. Yet, time and again, the supply chain proves that it is not flexible nor is it versatile. It can be argued that moving to a contracted supply chain structure further limits the flexibility and versatility of the RCAF supply

[22] Lyndon Crowder, Director Air Procurement 8-3, DGAEPM, email correspondence with author, 24 April 2018.

[23] Department of National Defence, B-GA-400-000/FP-001, *Canadian Forces Aerospace Doctrine,* 3rd Edition (Ottawa, DND Canada, 2016), 17.

chain. The nature of our contracts severely limits our ability to change support structures on a moment's notice. For instance, the CC-150 Airbus contract did not initially allow for a deployed operations scenario. When the contract was initially let, the intent for this platform was for passenger and cargo operations, thus there were no contract conditions for continuous operations in a high threat environment when the fleet was modified to provide an air-to-air refuelling capability. As a result, contract amendments were initiated to reflect the re-rolling of this platform to operate in a high-threat environment. Additionally, the costs associated with deploying this fleet must be considered when developing a contract because they increase the contract cost exponentially.[24]

Persistence

Persistence is an important tenet because it ensures that influence can be projected for the duration required. RCAF doctrine attests that "[t]he persistent employment of aerospace power gives a commander influence and presence in an air environment."[25] From an RCAF supply chain outlook persistence is important to ensure lines of communication[26] are well-established and can endure the length of the mission. When we look at contracted supply support, persistence can often be a weakness because contracts are often focused on supporting domestic operations. There have been instances where the CAF must interject to ensure persistence is achieved. For instance, most aircraft support contracts will stipulate that the contractor is obligated to ship aircraft spares anywhere the RCAF is operating. However, contractors do not

[24]This figure is classified. The deployed support costs are a contract addendum determined on a case by case basis founded on the threat, tempo and requirements. These costs are over and above any costs associated with the original contracting framework but are still believed to be more cost effective than deploying equivalent military personnel to perform the same functions.

[25]Department of National Defence, B-GA-400-000/FP-001, *Canadian Forces Aerospace Doctrine,* 3rd Edition (Ottawa, DND Canada, 2016), 17.

[26]Department of National Defence, B-GA-406-000/FP-001, *Canadian Forces Aerospace Sustain Doctrine* (Ottawa: DND Canada, October 2011), 82. Line of communication are defined as, "All the land, water, and air routes that connect an operating military force with one or more bases of operations, and along which supplies and reinforcements move.

have the same customs clearances afforded to the CAF thus there are often significant delays when transporting spares into a theatre of operations. As a result, the CAF lines of communication are often used to mitigate any shipping delays. This means that there is potential for the RCAF to pay for shipment of aircraft spares twice: through the base contract but also when executing the shipment through its own lines of communication.

Concentration

To achieve sustainment success, there must be a concentration of effort to ensure that all entities are working towards the same goals and have consistent priorities. "Effective employment of air power must achieve concentration of effort and guard against fragmentation of effort in attempts to fulfill the competing demands of the operation."[27] Due to the decentralized control and decentralized execution of the supply chain, concentration of effort is absent in the RCAF. The priorities that exist for each RCAF unit is extremely vast and thus priorities are different. Moreover, because one central command for oversight of the supply chain does not exist, there have been occurrences of organizations working on similar initiatives in stovepipes. All supply organizations that support the RCAF have the same inherent mission of providing the best possible aircraft support to operations; however, this is not capitalized on because the RCAF lacks concentration of effort.

Priority

Setting priorities is essential for any command to ensure that limited resources are properly assigned as well as ensuring that all organizations are working toward the same end-state. "Because of limited air resources, prioritization of demands is essential for optimization of

[27]Department of National Defence, B-GA-400-000/FP-001, *Canadian Forces Aerospace Doctrine,* 3rd Edition (Ottawa, DND Canada, 2016), 17.

air power employment."[28] Prioritization is so unique to each unit again because of the decentralized control within the community. Each support organization has its own purview to set priorities without perhaps appreciating the bigger picture. Historically, logisticians at the tactical level are not well-read on operational priorities thus further creating an opportunity for misalignment and perhaps even jeopardizing the mission.

Balance

Through the contracting of the supply chain the RCAF must balance the goal of persistence with the business aspect of developing, executing, and managing a contract. It is questionable whether these tenets of air power are factored into the decision process for any contract in support of an RCAF aircraft platform. With the new Sustainment Initiative, the four tenets that are adhered to are: performance, value for money, flexibility and economic benefits.[29] It could be argued that the focus with the current contracting framework is on business acumen rather than projecting air power and this misalignment is impacting the RCAF's ability to be efficient.

21st Century Air Power and Support Requirements to Meet the New Era of Conflicts

Canada's 2017 defence policy, *Strong Secured Engaged* (SSE) is the most robust modernization of defence spending Canada has witnessed in several decades and promises to increase the defence budget from $18.9 billion in 2016-17 to $32.7 billion by 2026-27, an increase of over 70 percent.[30] The new defence policy states "Canadians want a military that is agile, highly trained, superbly equipped, capable and professional. [SSE] delivers exactly that."[31]

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[28]Department of National Defence, B-GA-400-000/FP-001, *Canadian Forces Aerospace Doctrine,* 3rd Edition (Ottawa, DND Canada, 2016), 17.

[29]Government of Canada, "The Sustainment Initiative: How government is modernizing defence procurement," Last modified 03 February 2017, https://www.canada.ca/en/department-national-defence/news/2017/02/sustainment-initiative-government-modernizing-defence-procurement.html.

[30]Department of National Defence, *Strong. Secure. Engaged.* (Ottawa: DND Canada, 2017), 43.

[31]Department of National Defence, *Strong. Secure. Engaged.* (Ottawa: DND Canada, 2017), 33.

It is argued that although this may be the case when focused strictly on the platforms and their capabilities, when looking at the CAF supply chain, it lacks all of these facets, particularly being agile and superbly equipped. The supply chain is too cumbersome to be agile and it struggles to have adequate technology and equipment in place to foster agility.

The new defence policy marks the first plan to fund the sustainment portion of new platforms rather than just the initial acquisition costs.[32] This is a necessary decision to increase supply support to all RCAF platforms and provides an opportunity to increase long-term responsiveness; however, it must be understood that this decision impacts platforms specifically and not the supply chain writ-large. Thus there needs to be a mechanism that will address weaknesses in the supply chain whereby the CAF, and thus the RCAF, can benefit and gain efficiencies.

SSE promises the addition of at least three piloted platforms to RCAF inventory.[33] Although this will assist the RCAF in meeting its strategic operational imperatives, there has been an absence of in-depth analysis of how these fleets will be supported and the overall impact on the RCAF, and CAF, supply chain. Currently, the RCAF struggles to adequately support its 13 operational fleets[34] and this will only be intensified with the addition of new fleets and, most likely, new contracted support frameworks.

Canada's defence policy has a new approach to defence: anticipate, adapt, and act.[35] SSE expresses that Canada will "…adopt a new approach to defence – one that values the ability to anticipate new challenges, adapt to changing circumstances, and act with exemplary capability

[32]Department of National Defence, *Strong. Secure. Engaged.* (Ottawa: DND Canada, 2017), 44.
[33]Department of National Defence, *Strong. Secure. Engaged.* (Ottawa: DND Canada, 2017), 39.
[34]For the purposed of this study, operational fleets are defined as any fleet that would operate outside of Canada expect for the CT-114 Tutor and CC-144 Challenger as they do not perform a typical operational role.
[35]Department of National Defence, *Strong. Secure. Engaged.* (Ottawa: DND Canada, 2017), 63.

and professionalism while supporting peace and security around the world."[36] Although this focus is used in direct relation to the complex security environment Canada currently faces, it should also be examined and applied from a sustainment perspective. In order to fully support Canada's defence policy, the supply chain must also be capable of anticipating, adapting and acting to optimize its support to operations. To date, it could be argued that the RCAF has only been able to anticipate sustainment challenges; that they have not yet been able to fully adapt and act. SSE emphasizes funding to ensure planned capabilities will continue to be funded even when political powers change. However, funding is just a portion of what is required for adequate supply chain support.

The CAF needs to *anticipate* the operational requirement and tempo that will be experienced with the additional fleets and complete a thorough analysis to outline any weaknesses or limitations in the supply chain to meet these mission imperatives. "The Defence team will improve its ability to provide timely information to decision-makers…,"[37] which has historically been an oversight within the CAF supply chain. As witnessed before with the addition of the fifth CC-177 for instance, when sustainment is not adequately planned or anticipated the RCAF cannot fully realize the expected capabilities. There was an expectation from a strategic perspective, that the fifth CC-177 would increase the RCAF's capability proportionately; however, the organization continues to be limited by the number of trained crews and maintenance personnel to operate and maintain this platform.[38] Although, this is not a

[36]Department of National Defence, *Strong. Secure. Engaged.* (Ottawa: DND Canada, 2017), 15.
[37]Department of National Defence, *Strong. Secure. Engaged.* (Ottawa: DND Canada, 2017), 15.
[38]Office of the Auditor General, "Chapter 7 Operating and Maintenance Support for Military Equipment – National Defence," Last accessed 20 March 2018, http://www.oag-bvg.gc.ca/internet/English/parl_oag_201611_07_e_41836.html

supply chain issue it clearly demonstrates that support capabilities must be aligned with the operational appetite.

In general, the contracting process in Canada does not allow for a significant amount of anticipation and thus the Canadian Armed Forces has difficulty with being responsive to a changing environment. However, with the CH-148 Cyclone, the contract office has been able to identify shortfalls with the original contract that was developed and make small amendments to better meet the needs. Sikorsky, the contractor providing support to the CH-148, has not typically provided in-service support and could not accurately anticipate the level of effort required to meet the sustainment demands of the contract. As an example, Sikorsky could not support the training hours required to complete the initial cadre training for the RCAF pilots with their own resources as the company was originally obliged to support as per the contract. To mitigate the impact to the RCAF, the contract was amended to utilize two RCAF CH-148s to allow Sikorsky to complete this training. Although this example demonstrates that there is an ability to make contract amendments, even for large scale contractual changes, it must be acknowledged that there is a culture within DGAEPM that fears making contract changes because of the time and effort required, in addition to the possibility of the contractor wanting to renegotiate other terms of the contract. As a result, although necessary changes are anticipated, unless, contract changes are operationally imperative they do not often get executed.

The support systems must also be sufficiently dynamic and robust to *adapt* to the new operational tempo expected with the additional platforms and capabilities. "Adapting to the rapid pace of change in today's fluid security environment is fundamental to operational success."[39] The supply chain is struggling to support the fleets in the RCAF currently due to its lack of adaptability. Supply procedures and performance consistently lag behind operational needs

[39]Department of National Defence, *Strong. Secure. Engaged.* (Ottawa: DND Canada, 2017), 15.

which have driven the maintenance community to seek alternatives such as contracted support in an attempt to increase the responsiveness of the supply chain. As an example, although the need has been identified for over 20 years, the CAF still does not employ an automated barcode system across all its supply warehouses. There have been several analyses on the development of radio frequency identification (RFID) technology and its application for the CAF yet little progress has been made. For instance, in 2007, Canadian Operational Support Command (CANOSCOM)[40] analyzed this technology but it is still not a capability that is adopted at most first or second line warehouses. From a contracted supply chain perspective, the CH-147 Chinook fleet has been struggling with data integrity with a high risk of double accounting for aircraft spares due to the cumbersome and costly interface between DRMIS and the contractor's IT system.[41] These are but two examples that demonstrate the slow progress seen from a supply chain perspective due to the low priority historically given to sustainment practices. Until this is addressed, the CAF will continue to experience a supply chain that is incapable of adapting to operational requirements.

Finally, and perhaps the most important aspect of this equation: *act*. Even if an organization is able to anticipate and adapt, it will not be successful without acting. "To act decisively with effective military capability is the ultimate goal of Canada's new approach to defence."[42] Due to the decentralized control of the CAF supply chain, the ability to act in a coordinated manner is curtailed. Level One (L1) organizations make decisions independently of other L1s often duplicating efforts or making decisions that impact another organization without

[40]Lam, Albert and Patricia Moorhead. *Future Utilization of RFID Technology in the DND Supply and Distribution System.* Ottawa, DND Canada, 2007. CANOSCOM has been revamped and now this function falls within the Canadian Joint Operations Command (CJOC).

[41]Lyndon Crowder, Director Air Procurement 8-3, DGAEPM, email correspondence with author, 24 April 2018.

[42]Department of National Defence, *Strong. Secure. Engaged.* (Ottawa: DND Canada, 2017), 16.

their input. An example of this is where ADM(Mat) is responsible for the procurement and life-cycle management of all aircraft spares; they control the disposal of any unneeded equipment.[43] However, Canadian Materiel Support Group (CMSG), who falls within the CJOC L1 organization, is responsible for the storage of these aircraft spares and any expenses related to the warehousing.[44] As a result, if ADM(Mat) does not prioritize the disposal of obsolete spares, CMSG will incur unnecessary implications on financial and human resources. This creates the opportunity for a very inefficient and non-responsive supply chain due to the competing priorities within the various support silos.

RCAF Force Sustainment Doctrine

Sustainment in the RCAF is unique and varied and cannot be directly compared to requirements of the other operational commands. "The Royal Canadian Air Force is an agile and integrated force whose reach and power is essential to Canadian Armed Forces operations at home and abroad."[45] Consequently, a supply chain required to support this style of operational force needs to be equally agile and integrated. The RCAF is an environment where multiple supply chains exist due to the support structure of each platform that is operated; this creates a complex sustainment framework, where logisticians are not formally trained on this varied support construct and are required to learn on the job instead.

As Lieutenant-General J.J.C. Bouchard has attested, "when you have no relevant doctrine, the army and the navy do not understand what you do nor how hard it is to do it properly."[46] This same argument could be made for sustainment and the RCAF. The first RCAF

[43]Department of National Defence, B-GA-406-000/FP-001, *Canadian Forces Aerospace Sustain Doctrine* (Ottawa: DND Canada, October 2011), 33.

[44]Department of National Defence, B-GA-406-000/FP-001, *Canadian Forces Aerospace Sustain Doctrine* (Ottawa: DND Canada, October 2011), 36.

[45]Department of National Defence, *Strong. Secure. Engaged.* (Ottawa: DND Canada, 2017), 38.

[46]Department of National Defence, B-GA-400-000/FP-000, *Canadian Forces Aerospace Doctrine,* 2nd Edition (Ottawa, DND Canada, 2010), 33. Although this edition has now been revised and does not include this quite, it is

sustainment doctrine manual was published in 2011; thus, until then, it was difficult for any air entity being supported by the RCAF to have an appreciation of RCAF sustainment capabilities; the strengths and weaknesses, opportunities and threats of the support framework.[47] Yet sustainment is arguably the foundation of all military operations; "within the CF, Sustain is understood to be the capability to maintain fighting power…In the Air Force, Sustain is the function that regenerates and maintains capabilities in support of operations."[48] Thus, it could be argued that sustainment is the foundation of all operations and requires adequate attention and resources to ensure that it is sufficiently established to support operations.

The RCAF doctrine adheres to nine defining principles that should guide the planning and conduct of sustainment: foresight, economy, flexibility, simplicity, cooperation, self-sufficiency, visibility, responsiveness, survivability.[49] It could be argued that the RCAF is not planning strategic sustainment with these principles in mind. The RCAF lacks an adequate IT system to allow them to have the foresight to properly plan and execute operations. This also hinders its ability to achieve economy because decision-makers lack reliable data to create a truly efficient supply chain. Moreover, through decentralized execution of the supply chain, this economy is difficult to realize. By ensuring that one of the four pillars of SI is flexibility, contracting teams must evaluate the flexibility of each sustainment contract. This evaluation should analyze the flexibility as it relates to air power and not solely on the flexibility of the

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an important opinion that clearly outlines the challenges of providing a level of support if one or one's customers do not have a clear indication of their roles and responsibilities.

[47]Department of National Defence, B-GA-400-000/AF-000, *Out of the Sun: aerospace doctrine for the Canadian Forces* (Ottawa: DND Canada, 1997). This old doctrine manual did briefly describe supply sustainment for the RCAF but was limited in scope to a few short paragraphs.

[48]Department of National Defence, B-GA-406-000/FP-001, *Canadian Forces Aerospace Sustain Doctrine* (Ottawa: DND Canada, October 2011), 2.

[49]It is worth noting that the characteristics of sustainment in the 2017 edition is quite different than the 2011 edition where there were five principles of sustainment: primacy of operations, economy, flexibility, simplicity, and cooperation. This change in doctrine aligns the RCAF with Canadian Army and NATO sustainment doctrine. One major difference from the first edition is the absence of primacy of operations within the sustainment principles; however, it could be argued that this principle is partially identified under the 2017 edition's foresight principle.

contracting framework. Meaning, does the Commander have the ability to change supply chain processes based on the nature of the operation? In the case of a contracted supply chain, this is exceedingly difficult to achieve. The very nature in how the RCAF supply chain is constructed makes simplicity difficult to achieve. In comparison to the Royal Canadian Navy or the Canadian Army, as of January 2018 the RCAF has 32 contracted supply chains that can complicate the support framework domestically, but in particular, abroad. Cooperation becomes paramount in a deployed setting and "…is particularly important when the RCAF is involved in multinational or joint operations where national or service interests and competition for scarce resources have the potential to undermine relationships."[50] The importance of relationship building cannot be overlooked as it can be seen as the key to sustainment being a force enabler; if sustainers cannot fully understand the requirements of the mission it is increasingly difficult to anticipate the necessary support. Self-sufficiency is an important principle when the RCAF is the first element to arrive in theatre but it is a concept that becomes unclear when contracting support because of the various contractual obligations and the requirement for unique concepts of support. Although visibility is important for all materiel types, "this is particularly important for critical supplies such as…aircraft spares."[51] This principle becomes increasingly difficult to achieve when no one information system displays aircraft spares holdings for the entire RCAF; thus, information can be fragmented and difficult to collate in a theatre of operations with multiple supply chains and information systems. Responsiveness is critical to meeting the RCAF's mission but can be cumbersome with the traditional supply chain and the sometimes restrictive politics; however, this is only magnified with the addition of contracted supply chains

[50]Department of National Defence, B-GA-402-003/FP-001, *Royal Canadian Air Force Doctrine: Force Sustainment* (Ottawa: DND Canada, July 2017), 8.

[51]Department of National Defence, B-GA-402-003/FP-001, *Royal Canadian Air Force Doctrine: Force Sustainment* (Ottawa: DND Canada, July 2017), 9.

where each contract has a different acceptable response time. This creates a system where the support to war becomes a political game versus an operational tool. Which begs the question as to whether this is the position the RCAF wants to find itself in? Finally, being able to meet operational needs in all types of environments is critical to supporting conflicts. Survivability is "…the capacity of the support framework to prevail in the face of potential or actual threats."[52] The fragility of the supply chain, given its many nodes, can create a complex endeavour in the face of adversity. To minimize this occurring, the RCAF supply community needs to be better educated on the various supply chains and how they are managed.

Consequently, when applying the current RCAF support framework to its own principles of sustainment, the RCAF is not meeting its own thresholds. The RCAF will not be able to align itself with the 2017 Force Sustainment doctrine unless it injects into the contracting process to better align contracted support with sustainment objectives.

Characteristics have also been identified in the RCAF Sustain Doctrine that should be incorporated in all sustainment components, but the relative importance will vary depending on the circumstances faced; they are: robustness, agility, scalability, integration, and reliability.[53]

Robustness

A robust supply chain that is capable of meeting the operational imperative is a critical asset that needs to be pursued. "Sustainment personnel must embrace the expeditionary fighting spirit, which includes effective leadership and requires a robust training regime, thus enhancing overall performance in the most demanding of conditions."[54] The supply technicians in the CAF

[52]Department of National Defence, B-GA-402-003/FP-001, *Royal Canadian Air Force Doctrine: Force Sustainment* (Ottawa: DND Canada, July 2017), 9.

[53]Department of National Defence, B-GA-402-003/FP-001, *Royal Canadian Air Force Doctrine: Force Sustainment* (Ottawa: DND Canada, July 2017), 9.

[54]Department of National Defence, B-GA-406-000/FP-001, *Canadian Forces Aerospace Sustain Doctrine* (Ottawa: DND Canada, October 2011), 9.

do embrace the 'fighting spirit' and will do what is required to get the job done; however, the CAF lacks adequate formal training on the unique RCAF supply chains which can hinder response times.

Agility

An agile supply chain is a necessary component in aerospace power in the 21st century. Air force operations are so dynamic and reactive; the supply chain must be equally agile in order to keep pace with operations. One must appreciate that "[t]hrough responsive speed of action and complimentary reaction, agility in sustainment permits aerospace operations to withstand the unexpected."[55] Although, in general, the supply chain can be agile when necessary, it is often criticized for not being able to meeting the changing demands of its customers. This is evidenced by the desire to contract the supply chain for many RCAF fleets; "[f]or much of the RCAF fleet, parts management has been turned over to contractors in the form of either OWSM or ISSCF contracts."[56] The customers – the aerospace engineers – have not been historically satisfied with the delivery and support from the CAF supply chain and are thus choosing to contract the support with the expectation of creating a more agile supply chain.

Scalability

The current Air Expeditionary Wing concept is predicated on the ability to scale the resources to meet the needs of the deployment.[57] RCAF Force Sustainment doctrine opines that "[s]calability of the sustainment organization and plan, including personnel and materiel, permits resources to be efficiently reduced or increased in size or extent to adjust to a changing

[55]Department of National Defence, B-GA-406-000/FP-001, *Canadian Forces Aerospace Sustain Doctrine* (Ottawa: DND Canada, October 2011), 9.

[56]Chief of Review Services, *Evaluation of Aerospace Equipment Maintenance* (Ottawa: CRS Canada, February 2013), 19.

[57]Department of National Defence, B-GA-406-000/FP-001, *Canadian Forces Aerospace Sustain Doctrine* (Ottawa: DND Canada, October 2011), 78.

operational tempo and threat."[58] As such, it is important for the RCAF to continue to tailor its supply chain to the specific operation. This is a characteristic that the RCAF currently embraces but can be limited by the support requirements of a contracted supply chain. In fact, contracts can often dictate the number of resources and personnel that the RCAF must deploy to a theatre of operations to satisfy the terms of the contract and ensure performance expectations are not compromised.

Integration

Although it is important domestically, the requirement for an integrated supply chain is magnified in a deployed setting. With the advent of a scalable AEW, it becomes important for each distinct supply chain to become truly integrated in order to gain efficiencies. The RCAF defines integration as "…the characteristic that brings together or incorporates diverse sustainment parts into a common team, system, or service…Integration creates synergistic effect…whereby the net benefit is much greater than its constituent parts."[59] This can be difficult when the RCAF employs many supply chain models and that, as mentioned previously, these models are not formally trained. Further, a decentralized control structure, as seen currently in the CAF, restricts its ability to achieve integration. As a result, it can be difficult for support personnel at the operational level to have the requisite knowledge to develop optimal courses of action to support any given operation.

Reliability

Having a reliable supply chain is imperative. "Reliability is the characteristic that ensures the consistency and dependability of sustainment effects…It results from the effectiveness of the

[58]Department of National Defence, B-GA-402-003/FP-001, *Royal Canadian Air Force Doctrine: Force Sustainment* (Ottawa: DND Canada, July 2017), 10.

[59]Department of National Defence, B-GA-402-003/FP-001, *Royal Canadian Air Force Doctrine: Force Sustainment* (Ottawa: DND Canada, July 2017), 9.

sustainment team…, the dependability of infrastructure, materiel, and services, as well as the trustworthiness of information."[60] Again, the contracting of most of the RCAF supply chains demonstrates the distrust customers have in the supply chain. Additionally, in a theatre of operations, the perception that the supply chain was unreliable prevailed. As an example, during Operation ATHENA in Kandahar, Afghanistan, "…when items were identified as particularly high priority by the user in-theatre, those responsible for getting them to Kandahar did not rely on the supply chain, but instead made phone calls back to Canada to ensure that items were flagged and shipped right away."[61] This further indicates that customers do not perceive the supply chain as reliable and have a lack of trust in the current system. Considerable adjustments need to be implemented to gain the trust of the RCAF or the engineering community will continue to contract the supply chain.

Conclusion

The RCAF supply chain is becoming irrelevant because it cannot adequately meet the five RCAF Sustain Doctrine principles or the seven RCAF tenets of air power nor can it meet the sustainment characteristics. This shortcoming is primarily due to its lack of flexibility, simplicity, agility, and reliability. Each of these facets needs to be scrutinized in further detail to determine the most appropriate course of action that will increase the ability of the RCAF supply chain to support operations. As it stands, the RCAF supply chain will be incapable of adequately supporting the desired end-state of *Strong, Secure, Engaged* because the support systems and lack of integration do not allow for an all-encompassing system. In response to the failing supply chain, DGAEPM is defaulting to contracted spares support in the hope of increasing the

[60]Department of National Defence, B-GA-402-003/FP-001, *Royal Canadian Air Force Doctrine: Force Sustainment* (Ottawa: DND Canada, July 2017), 10.

[61]Office of the Auditor General. *Chapter 2 Support to Overseas Deployments.* (Ottawa: OAG Canada, May 2008), 11.

responsiveness of the RCAF supply chain. Exploring the sustainment culture in the RCAF, as well as the parameters of performance-based logistics and efficiency versus effectives, we can better understand and analyze the contracting frameworks in the RCAF.

CHAPTER 3: CAF CONTRACTING FRAMEWORKS

The only security upon which sound military principles will rely is that you should be master of your own air.

-Winston Churchill, *First Lord of the Admiralty – March 1914*

Introduction

Contracting in the Canadian Armed Forces has continued to evolve over time, due to financial constraints as well as changing operational requirements. Until the 1990s the CAF performed almost all aircraft spares support for all platforms; however, it was determined that this was not sustainable and thus various contracting frameworks have since been explored. The RCAF has taken the lead on contracted spares support, as it currently has 14 aircraft spares contracts. The initial contract framework applied within the CAF was Optimized Weapons System Management (OWSM), which was later replaced by In-Service Support Contracting Framework (ISSCF) due to the desire to manage fewer contracts per platform. As recently as January 2018, ISSCF was replaced by the Sustainment Initiative (SI) with the view to balance performance, value for money, flexibility, and economic benefit.[62] Both OWSM and ISSCF have been criticized for not optimizing value for money which provided the avenue for change and the implementation of the SI contracting framework.

Although the RCAF currently employs all three contracting frameworks, each contract style is predicated on performance measurements to allow DND to determine the best value for money; which seems to be the most important facet for all contracting frameworks. However, the RCAF must ensure that the expected fiscal efficiency does not negatively impact operational requirements. From a military standpoint, performance and operational effectiveness will always remain the priority when purchasing or supporting any air force fleet. Although many appear to

[62]Public Works and Government Services Canada, "Defence Procurement – Sustainment Initiative," last modified 19 October 2016, https://buyandsell.gc.ca/policy-and-guidelines/policy-notifications/PN-118

understand the balance required, it could be argued that the indirect operational impacts are not necessarily acknowledged. This is the biggest weaknesses for each framework as the RCAF has significant challenges to overcome before it can assess contract performance on a continuous cycle. This chapter will review the current sustainment culture in the RCAF and how it is impacting the support provided to its air force platforms. It will also look at performance based logistics and how it can be applied in a military concept and the three contracting frameworks DND has implemented since the 1990s. The importance of performance metrics will be applied to our current contracting frameworks to determine how successful the RCAF is at evaluating contracting successes or failures. Finally, this chapter will discuss the balance of efficiency versus effectiveness and how this dialogue applies in a military concept and how it supports the attainment of strategic goals.

Sustainment Culture in the Royal Canadian Air Force

Military culture is the foundation that influences attitudes, actions and priorities. In his book, *Understanding Military Culture: A Canadian Perspective,* Allan English attests that military culture, which is based on values, beliefs, attitudes and behaviours, is often more influential to how an armed force operates than perhaps their own doctrine. He reasons that one must modify attitudes in order to instill change.[63] This is a significant challenge to surpass for CAF sustainment culture because, for decades, the culture in the RCAF has been that supply has a hard time meeting requirements.

Sustainment doctrine is a relatively new concept for the CAF and the RCAF in that the first joint sustainment publication was promulgated only in 2010 while the first RCAF

[63]Allan D. English, *Understanding Military Culture: A Canadian Perspective,* Montreal, Que: MQUP, 2004. *eBook Collection (EBSCOhost)*, EBSCO*host* (accessed March 27, 2018), 5.

sustainment doctrine manual was promulgated in 2013. This demonstrates the lack of priority given to sustainment and that it has been military culture as English suggests, that has been driving sustainment for the CAF and RCAF. Supply support, in general, in the RCAF has not been a priority in recent years. This may be due to the fact that there have been too many competing priorities, or the operational tempo may have been too demanding, or perhaps there has never been a large enough appetite to take on such a demanding challenge. No matter the reason, the lack of focus on the supply chain combined with an attitude of expecting the supply chain to just meet the demands required to support the RCAF has been detrimental to the community's ability to support operations. Supply units have been challenged to meet operational tempos because they can often be impeded by rigid policies and contracts or unmanaged expectations.

As an example of the CAF's lack of priority on supply practices, supply personnel are currently incapable of generating a report to determine a unit's ability to meet supply demands. In 2014, the RCAF was the last environment to deliver a new information management system to manage supply, referred to as Defence Resource Management Information System (DRMIS).[64] Although this system is new and expected to be quite robust, the reporting abilities of DRMIS leaves the RCAF supply community is a less responsive position than that of the early 2000s. Currently, there are no tools that report on number of demands received, turnaround times to fill demands, both regular priority and high priority demands, or missed lines of tasking due to parts unavailability, to name a few. Nor is there an ability to see spare parts demands by fleet to determine if the support concept for that specific fleet is adequate. Without simple reports such as these, the supply community has little ability to evaluate its performance or forecast future

[64]Government of Canada, "Defence Resource Management Information System In-Service-Support", last accessed 4 April 2018, http://www.forces.gc.ca/en/business-defence-acquisition-guide-2015/joint-and-other-systems-899.page.

requirements. The community is in a constant state of reacting to requests which impacts its ability to address systemic issues or increase performance. How can one increase one's performance if one cannot determine one is failing? How does one address the concern of one's customers who are unsatisfied with one's inventory levels or turnaround times without the necessary reporting tools to analyze the situation? The current situation is not a result of a lack of motivation by the supply community. In fact, the level of professionalism demonstrated by this community is the key to any level of success the RCAF enjoys. Not a single person in the supply chain wants to see it fail, so it does not fail. This does not mean though that it is providing premier support or that supply experts are afforded the tools to offer the best service possible; the system is failing the front line supply specialists because they lack the tools to provide top-notch customer service. This needs to change for the RCAF to remain agile and responsive**.**

This challenge is magnified by the way the civilian supply chain industry has adapted to technology and people are accustomed to quick delivery times and having almost anything they desire at their fingertips. Looking at well-regarded supply chain experts, such as Walmart or FedEx, customers can track their orders anywhere in the world from their personal smartphones. Their warehousing systems make use of automatic re-ordering of a product from the distribution centre or even the manufacturer.[65] Customers of the defence supply chain expect a similar level of service. Yet, in the RCAF, this is not the case. It is acknowledged that a military supply chain cannot be fully modeled from industry best-practices due to political and operational constraints, as well as security concerns; however, there is certainly room for improvement based on current information system capabilities.

[65]Ken Mills, "Logistics: Reducing Friction Through Understanding, Integration, and Ownership" (Joint Command and Staff Programme Course Paper, Canadian Forces College, 2014), 49.

Since the mid-1990s, the RCAF has shown a desire to move away from the traditional aircraft support model whereby it sometimes employed upwards of 100 contracts to support a single fleet.[66] The new method was designed to increase efficiency and responsiveness of the supply chain. As demonstrated in a recent OAG audit, "National Defence recognized that the traditional approach had often resulted in unsatisfactory performance and poor contractor accountability, which put at risk the availability of military equipment."[67] With this, the OWSM model was developed and implemented; and now we are seeing the third reinvention of contracted spares support through the Sustainment Initiative. As the Chief of Review Services' report on Aerospace Equipment Management notes, "The management of spare parts has been an issue for many years and has been reported previously by CRS Audits, the Auditor General, and the Public Accounts Committee."[68] As such, various methods have been explored and reworked based on changing priorities and updated information. "Concerns exist with parts availability, storage and disposal, and the effectiveness of the inventory control system,"[69] which run the full gamut of the supply chain. Although, ADM(Mat) has formally acknowledged these issues as recently as 2013,[70] there has not been adequate movement to close the gap and regain trust from all aircraft spares customers.

Alternate service delivery is an attractive option for the RCAF due to the human resource challenges it continues to face. There continues to be pressure to reduce civilian positions, professional services contractors, and military personnel, yet the requirements to support existing

[66]Office of the Auditor General, "Chapter 5 – Maintaining and Repairing Military Equipment," Last Accessed 25 February 2018, http://www.oag-bvg.gc.ca/internet/English/parl_oag_201111_05_e_35937.html#hd4b.

[67]Office of the Auditor General, "Chapter 5 – Maintaining and Repairing Military Equipment," Last Accessed 25 February 2018, http://www.oag-bvg.gc.ca/internet/English/parl_oag_201111_05_e_35937.html#hd4b.

[68]Chief of Review Services, *Evaluation of Aerospace Equipment Maintenance* (Ottawa: CRS Canada, February 2013), 16.

[69]Chief of Review Services, *Evaluation of Aerospace Equipment Maintenance* (Ottawa: CRS Canada, February 2013), 16.

[70]Chief of Review Services, *Evaluation of Aerospace Equipment Maintenance* (Ottawa: CRS Canada, February 2013), 16.

fleets and introduce new ones remain,[71] creating juxtaposition in the sustainment environment whereby they are often expected "to do more with less." However, even with the clear knowledge that contracted support has historically been the only viable option due to military personnel shortages, well-defined parameters and expectations must be developed to ensure that each contract is performing as expected. On average, fleets that have their supply chain contracted have increased turnaround time for parts demands;[72] however, the financial costs and the support to operations of this marginal increase in support has not been given a priority.

Performance-Based Logistics

Performance-based logistics has become a common theme for many military forces because it transfers more responsibility and risk to the contractor and thereby encourages increased efficiency. Research performed on United States Department of Defense support contracts identified that, "support expenditures of a weapon system, including logistics, exceed the costs of development and production by two or three times."[73] It would be fair to expect the same to be true for CAF contracts because it has already been noted in Office of the Auditor General reports that the cost of in-service support is often far exceeding the initial acquisition costs and that the CAF has been poor at accurately forecasting these costs.[74]

In response to the significant life cycle costs, the early 1990s saw the CAF following support frameworks of other militaries, such as the US, and implementing a performance based

[71]Chief of Review Services, *Evaluation of Aerospace Equipment Maintenance* (Ottawa: CRS Canada, February 2013), 29.

[72]Greg Gagne, Data Analysis and Information Reporting Team Lead, DGAEPM, email correspondence with author, 7 January 2018. See table 4.1 – Average Serviceability Percentage Rates by Fleet from FY10/11 to FY16/17 on page 68.

[73]Andreas Glas, Erik Hofmann, and Michael Eßig, "Performance-Based Logistics: A Portfolio for Contracting Military Supply" *International Journal of Physical Distribution & Logistics Management* 43, no. 2 (Mar 8, 2013): 105.

[74]Office of the Auditor General, "Chapter 7 Operating and Maintenance Support for Military Equipment – National Defence," Last accessed 20 March 2018, http://www.oag-bvg.gc.ca/internet/English/parl_oag_201611_07_e_41836.html

logistics approach for its contracts. As Andreas Glas, Erik Hofmann, and Michael Eßig note, this type of contracting framework is "addressing the problems of extraordinary support costs for complex product systems such as aircraft, infrastructures and weapon systems in defence supply chains."[75] Nevertheless, the CAF is still trailing behind with possessing robust in-house knowledge on developing smart supply chain contracts. As seen in the DoD, "…practitioners lack appropriate instruments for PBL management…"[76] In order to excel at managing PBL frameworks, the CAF must arm its experts with adequate tools to meet the government's expectations of sound contracting stewardship, which in addition to in-depth training, includes cost-effectiveness, visibility of assets, and performance measurement tools.

With a PBL-type contract, the contractor inherits more of the risk, whereas in contrast with previous contracting models, DND was assuming the majority of the risk. This shift towards PBL contracts is a move to encourage contractors to improve efficiency in order to increase their profit margin, as seen in table 3.1.

[75]Andreas Glas, Erik Hofmann, and Michael Eßig, "Performance-Based Logistics: A Portfolio for Contracting Military Supply" *International Journal of Physical Distribution & Logistics Management* 43, no. 2 (Mar 8, 2013): 97.

[76]Andreas Glas, Erik Hofmann, and Michael Eßig, "Performance-Based Logistics: A Portfolio for Contracting Military Supply" *International Journal of Physical Distribution & Logistics Management* 43, no. 2 (Mar 8, 2013): 98.

Table 3.1 – Performance Based Logistics Contract Types

Demand definition \ Contract pricing	Cost-plus	Cost-plus incentive fee	Pay for performance (variable price)	Fixed price incentive	Fixed price
Activity-based demand definition	Non-PBL "Consumption-based contracting" (Kim et al., 2010) "Input-based pricing" (Hünerberg and Hüttmann, 2003)				
Performance-based demand definition	Non-PBL	PBL in the wider sense (Type B)	PBL in the narrower sense (Type A)	PBL in the wider sense (Type C)	PBL in the wider sense (Type D)
Distribution of risk in the defense supply chain	Customer (military) covers risks				Contractor (service provider) covers risks

Source: Glas, Hofmann, and Eßig, "Performance-Based Logistics: A Portfolio for Contracting Military Supply", 103.

PBL works to better align military supply support with that of civilian industry. Yet, it must be appreciated that "…the "first mile" of military logistics is very similar to private sector logistics, that "last mile" is completely different."[77] The CAF must ensure that it employs PBL smartly to ensure that the contract can still support it in that "last mile." In contrast to civilian industry where profit margins drive all decisions, "…the military acts in unstable and dangerous conditions while simultaneously trying to reach several military, political, and economic objectives. Economy and efficiency are, thus, somewhat secondary or side conditions of military tasks…."[78] However, economy and efficiency are key drivers in funding military contracts and thus military activities.

[77]Andreas Glas, Erik Hofmann, and Michael Eßig, "Performance-Based Logistics: A Portfolio for Contracting Military Supply" *International Journal of Physical Distribution & Logistics Management* 43, no. 2 (Mar 8, 2013): 98.

[78]Andreas Glas, Erik Hofmann, and Michael Eßig, "Performance-Based Logistics: A Portfolio for Contracting Military Supply" *International Journal of Physical Distribution & Logistics Management* 43, no. 2 (Mar 8, 2013): 98.

Efficiency versus Effectiveness

As with any military, the RCAF receives its annual budget based on the government's priorities. This requirement to be responsive to the political needs of the country results in a continuous need to balance efficiency and effectiveness. Efficiency is deemed fiscally responsible, which is addressed in the SI framework's pillars of value for money and economic benefits. Comparatively, effectiveness relates directly to the ability to meet military needs and operations, which is addressed in performance and flexibility in the SI framework. One could argue that these two attributes are on a competing scale and further argue that the Government of Canada currently prioritizes efficiency over effectiveness because cost is the primary driver when planning and decision-making. To achieve successful military operations, effectiveness must be at the forefront.[79] The challenge for the RCAF is to convince the government of this priority. As respected military writer Stephen Biddle notes, "Military effectiveness thus lies at the heart of key policy debates. From the fate of major weapons programs to the size or makeup of the military budget, the defense debate centers on the creation of effectiveness." [80] While this disjointed view exists, it will be difficult for the CAF to be adequately resourced for the operations that are expected of them. This necessitates an examination of each of the Canadian approaches to contracting frameworks, which are all very much entrenched in politically driven outcomes.

[79]Noel Young, "Efficiency and Effectiveness – Military Myth or Necessity?" (Joint Command and Staff Programme Course Paper, Canadian Forces College, 2015), 29.

[80]Stephen Biddle, "Military Effectiveness," *The International Studies Encyclopedia.* Denemark, Robert A. Blackwell Publishing, 2010.

Optimized Weapons System Management Contracting Framework

With the advent of optimized weapon system management (OWSM) in 2002[81], the RCAF saw the first modern framework adopting the concept of contracted support, also referred to alternate service delivery. This concept is a, "strategic contract framework that ensures maintenance and support remain at the highest level of effectiveness and efficiency for the life of the aircraft."[82] This begs the question of how effectiveness and efficiency is balanced in the RCAF if, as previously mentioned, they are competing characteristics on opposite ends of the spectrum. The CAF is not yet prepared to prioritize one characteristic over another and thus the support community is left to try and meet the expectations of the organization.

Table 3.2 outlines the anticipated benefits of the OWSM approach when it was unveiled. The expectations were quite ambitious and DND was not in a position to properly evaluate if, how or when it realized any of the anticipated benefits. There is a strong focus on defence industry and increasing its competitive advantage both nationally and internationally. This strategic benefit does not necessarily align with operational performance and can even hinder it. Although this is not necessarily a valid concern for the Government of Canada, it must still be acknowledged when evaluating the effectiveness of the RCAF at that same strategic level. This concept was also focused on savings, in both financial and human resource. Since the advent of the OWSM concept has DND been able to evaluate the realization of these savings? Or has the desire to measure its success been replaced by fear of failure?

[81]National Defence and the Canadian Armed Forces, "Optimized Weapons System Management for the CC130 Hercules Fleet Airframe," last modified 25 October 2005, http://www.forces.gc.ca/en/news/article.page?doc=optimized-weapon-system-management-for-cc-130-hercules-fleet-airframe/hnocfod6.

[82]National Defence and the Canadian Armed Forces, "Optimized Weapons System Management for the CC130 Hercules Fleet Airframe," last modified 25 October 2005, http://www.forces.gc.ca/en/news/article.page?doc=optimized-weapon-system-management-for-cc-130-hercules-fleet-airframe/hnocfod6.

Table 3.2 Major Benefits of the OWSM Program

Contractor responsibility and accountability	Longer term contracts hold industry accountable to the levels of performance and service promised in the bid and contract development phases.
Focus on required performance and operational outputs	The Department of National Defence (DND) receives a better service through regular evaluation of the companies' performance standards and by providing them with incentives to optimize their performance as well as penalties for failing to meet requirements.
Cost-savings to the Canadian Forces	Potential reduction in aircraft fleet support costs of 15 per cent.
Aircraft operational availability	Optimized maintenance and support performance leads to faster turn-around times for aircraft, directly resulting in an increase in operational fleet availability.
Availability of DND manpower	By transferring the management of a large number of maintenance and support contracts to industry, DND members will be available to focus on new and future projects.
Canadian defence industry global competitiveness	Foreign nations will be interested in how DND can maintain and support aircraft faster and at less cost and potentially seek business with those same companies.
The level of cooperation between DND and defence industry	Fostering a relationship based on collaboration and teamwork.

Source: National Defence and the Canadian Armed Forces, "Optimized Weapons System Management for the CC130 Hercules Fleet Airframe," last modified 25 October 2005, http://www.forces.gc.ca/en/news/article.page?doc=optimized-weapon-system-management-for-cc-130-hercules-fleet-airframe/hnocfod6

The OWSM approach has three separate support contracts to maintain a single fleet: the airframe and its related components (primary air vehicle), the avionics system, and the propulsion system. When implementing the contract support for the CC-130H fleet in 2005 it was believed that, "[b]y implementing this highly responsive, long-term maintenance and support program, OWSM allows National Defence to leverage the best of both military and Canadian aerospace resources while meeting the demands of Canada's Air Force."[83] Yet, one could argue that since DND does not have adequate performance measurement tools, it is difficult to determine how responsive the program is and how well it is meeting the demands of the RCAF.

[83]National Defence and the Canadian Armed Forces, "Optimized Weapons System Management for the CC130 Hercules Fleet Airframe," last modified 25 October 2005, http://www.forces.gc.ca/en/news/article.page?doc=optimized-weapon-system-management-for-cc-130-hercules-fleet-airframe/hnocfod6.

OWSM was a result of not having the in-house expertise to meet RCAF operational demands after the Force Reduction Program in the 1990s.[84] This was a performance based approach that was new to the RCAF contracting system that also focused on outcome and incentives.[85] As a result, this supply chain decision was based out of necessity rather than sound business acumen. Such decisions have implicated the support to the RCAF for almost three decades.

In-Service Support Contracting Framework

In-Service Support Contracting Framework (ISSCF) was the Government of Canada's second iteration to implement a contracting framework whereby the OEM is selected to manage the in-service support of the corresponding fleet. The DAOD that outlined the procurement and management of ISS for CF platforms was rescinded in 2015 thus it is difficult to objectively evaluate the direction and expectations against the outcome of this framework. However, a 2013 CRS audit indicates that, "[m]etrics for ISSCF contracts, for the most part, seem to be developed in isolation."[86] This creates a supply chain that is difficult to assess at the operational level and thus difficult to determine if the contracting framework is meeting the original intent: to increase efficiency and reduce costs. This audit also indicated that five years after implementation it was still unclear whether the ISS contracting framework was actually providing value for money. Some of the observations made during a 2013 CRS audit indicated the weakness of contracting with the Original Equipment Manufacturer (OEM) because, "…although the contractor had extensive in-depth experience as a manufacturer, it had limited experience as a support provider.

[84]Chief of Review Services, *Evaluation of Aerospace Equipment Maintenance* (Ottawa: CRS Canada, February 2013), 30.

[85]Chief of Review Services, *Evaluation of Aerospace Equipment Maintenance* (Ottawa: CRS Canada, February 2013), 4.

[86]Chief of Review Services, *Evaluation of Aerospace Equipment Maintenance* (Ottawa: CRS Canada, February 2013), 22.

This inexperience manifested itself to the CF in the form of the OEM being a contractually rigid service provider."[87] This is currently being discovered with the CH-148 Cyclone where the contractor is struggling to meet the aircraft spares obligations set out in the contract because as the OEM, Sikorsky's focus has historically been on maintenance rather than supply chain management. Moreover, the RCAF does not have a significant amount of experience in developing in-service support contracts and often struggles to clearly outline the supply requirements. For instance, when discussing the concept of support for the T-56 and F-404 engine contracts, it was challenging for ADM(Mat) to articulate the supply process requirements to the contractors, Standard Aero and Magellan, respectively. In this instance, due to how the contract was structured and the relatively new requirement for all government owned material to be managed in DRMIS, it was unclear on exact procedures the contractor would perform in the management system. Standard Aero is an example of a contractor that is not familiar with providing in-service support thus creating a situation where delays in support to operation are anticipated. Magellan, in comparison, has sub-contracted out the supply chain management to Peraton (formally known as Harris Canada) who is very familiar with supply chain management for DND.[88]

The challenges with ISSCF are not unique to Canada. "In fact," as the Chief of Review Services report on equipment maintenance notes, "…the Australians have reverted from their ISSCF-life contract for the CC130J to an OWSM-like one."[89] Militaries need to constantly evaluate its contracting frameworks, but more importantly, they need to have the desire to make significant changes if a particular contract is not providing optimal results. The CAF did realize

[87]Chief of Review Services, *Evaluation of Aerospace Equipment Maintenance* (Ottawa: CRS Canada, February 2013), 29.

[88]Scott Snow, Director Air Procurement 3-2, DGAEPM, email correspondence with author, 23 March 2018.

[89]Chief of Review Services, *Evaluation of Aerospace Equipment Maintenance* (Ottawa: CRS Canada, February 2013), 29.

that ISSCF was also not providing optimal results and thus recently implemented a third contracting framework iteration, the Sustainment Initiative.

Sustainment Initiative

The Government of Canada recognized the weakness in its procurement process and introduced the Sustainment Initiative (SI) that reached its steady state in January 2018.[90] The CAF was responding to weaknesses identified in audits whereby it was recommended that "[a] review of the ISSCF contract framework mechanisms be conducted to ensure the ability to manage costs and performance are maximized over the long term."[91] However, since the SI is still so new the success of creating contracts that better identify costs and performance is yet to be demonstrated. The goal of this initiative is to, "use innovative procurement practices to receive best value for Canadian taxpayers,"[92] not necessarily maximizing operational effectiveness. In contrast to the previous contracting models, the SI is focused on four principles to maximize value: performance, value for money, flexibility, and economic benefit. It could be argued that the approach is focused on a business solution and does not necessarily have a primacy of operations focus. Perhaps this is the weakness of the ensuing RCAF support structure. Contracts are generated with a focus on financial viability without factoring in the strategic needs of the user; thus the tenets of air power. Moreover, this framework attests that it is based on contracting best practices but it is still unclear how these best practices were determined. Can a military effectively balance air power with financial restrictions without severely impacting operations? How is this balance struck?

[90]Public Works and Government Services Canada, "Defence Procurement – Sustainment Initiative," last modified 19 October 2016, https://buyandsell.gc.ca/policy-and-guidelines/policy-notifications/PN-118.

[91]Chief of Review Services, *Evaluation of Aerospace Equipment Maintenance* (Ottawa: CRS Canada, February 2013), A-3/3.

[92]Public Works and Government Services Canada, "Defence Procurement – Sustainment Initiative," last modified 19 October 2016, https://buyandsell.gc.ca/policy-and-guidelines/policy-notifications/PN-118.

Performance Measurements

Performance metrics are critical for any organization, military or civilian, to evaluate how effective they are. Performance measurements are the impetus for change. Without accurate and reliable data an organization cannot make informed decisions nor can they determine if their performance is optimal. Although this is particularly true for profit-seeking businesses, it cannot be overlooked for military organizations. If anything, armed forces should be acutely aware of their performance at any given time in order to confidently respond to conflicts.

The RCAF has seven operational fleets that rely on industry contracts for supply support, and each has different performance metrics that are used to evaluate the performance of the contractors and ensure they are meeting agreed upon standards and timelines.[93] Oftentimes, the performance metrics that are developed in the contracting phase are not compatible with the support systems that are used meaning the metrics cannot be evaluated. This is a significant oversight of the contracting process which demonstrates the lack of emphasis applied to the support framework during the initial contracting phase. To increase the opportunity to properly evaluate the performance of its contractors, the RCAF should determine one standard set of metrics for each platform to analyze. This concentration of effort will increase the efficiency of the supply chain and allow for an opportunity to have a focused effort on specific measurement data, thus significantly increasing the possibility of properly measuring the performance of the RCAF's contractors.

Currently, the RCAF's method of assessing contractor in-service support performance is ad hoc at best. As noted in a CRS audit, "[m]etrics to determine how well parts are supplied are difficult to identify…The ADM(Mat) materiel management system does not appear to have

[93]Chief of Review Services, *Evaluation of Aerospace Equipment Maintenance* (Ottawa: CRS Canada, February 2013), 21.

timely metrics to make it a useful tool, nor does it easily allow for tracking of spare parts."[94] As a result, it is difficult to assess whether the service support contracts being entered into are creating efficiency for the RCAF. Until the RCAF can develop timely metrics for all contracts, the performance management system will continue to be ad hoc.

It is not a new phenomenon that performance metrics must be given a higher priority. In fact, the 2013 CRS Evaluation of Aerospace Equipment Maintenance audit recommended that "[p]erformace metrics must be better understood, used more consistently, standardized where possible, and included in all major contracts. Staff must be trained in their use."[95] Although progress is being made with the business intelligence project for DRMIS reporting, this will be a difficult challenge for the RCAF to overcome due to its various supply chains with varied IT systems to manage spare parts.

The table below from a 2013 CRS audit shows the disparity in the number of performance metrics that are used across five platforms in the RCAF. There is the CC-130H OWSM contract that has 14 performance metrics, compared to the CC-130J ISSCF contract that has 3 performance metrics. Although different in size, these aircraft perform the same function yet the desired metrics to demonstrate if the contractor is able to meet support requirements are quite different. One might suspect that this disparity is a result of the evolution from an OWSM framework to an ISSCF framework; however, the fully outsourced CH-149 has 9 distinct performance metrics. The lack of similarity of metrics being used increases the difficulty to both manage the contract and ensure that the metrics can be accessed and assessed in the given supply chain IT system.

[94]Chief of Review Services, *Evaluation of Aerospace Equipment Maintenance* (Ottawa: CRS Canada, February 2013), 16.

[95]Chief of Review Services, *Evaluation of Aerospace Equipment Maintenance* (Ottawa: CRS Canada, February 2013), vii.

Table 3.3 Performance Measures – RCAF Contracts

Air Frame	Contract Type	Number of Performance Measure Metrics	Committee	Incentive	Penalty
CF188	OWSM AVS	3	Yes	Yes	No
CC130H	OWSM PAV	14	Yes	Yes	Yes
CC130J	ISSCF	3	No	No	Yes
CC177	ISSCF	7	USAF-led	Yes	Yes
CH149	Outsourced	9	Yes	No	Yes

Source: Chief of Review Services, *Evaluation of Aerospace Equipment Maintenance,* 21.

Aerospace Engineering Program Management Maintenance Data

One of the most desirable key performance indicators is availability of aircraft. According to the Office of the Auditor General, availability is the, "proportion of time during a stated period that a type of military equipment is in an operable state (not undergoing maintenance) in relation to the total time it is needed for operations."[96] Additionally, DGAEPM tracks the serviceability of all aircraft where DND performs the maintenance. As a result, the serviceability data for the CH-149 Cormorant and the CC-150 Airbus are not readily accessible as this is tracked on the contractor's systems. It should be noted that for an aircraft to be deemed serviceable in any 24 hour time period there must not be a maintenance work order open, even if it does not prevent the plane from flying. Consequently, the data does not truly show serviceability rates as a first line unit would report to 1 Canadian Air Division, for instance, but it does provide an accurate depiction for comparison of maintenance levels required for each platform.

[96]Office of the Auditor General, "Chapter 7 Operating and Maintenance Support for Military Equipment – National Defence," Last accessed 20 March 2018, http://www.oag-bvg.gc.ca/internet/English/parl_oag_201611_07_e_41836.html

Oftentimes, what is not appreciated is that the in-service support costs of an aircraft will exceed initial acquisition costs over the equipment life expectancy (ELE) of the platform. For instance, based on the 40-year ELE, the in-service support of the CC-130J is USD$4.87 billion whereas the initial acquisition costs was CAD$1.4 billion.[97] Looking at the CC-177 Globemaster aircraft, the initial acquisition cost was CAN$1.6 billion with the in-service support expected to be US$1.76 billion over the 37 year estimated ELE.[98] This is a unique in-service support contract because the support model is based on a foreign military sales contract where Canada has bought into a world-wide support framework. The CH-148 Cyclone, the newest fleet in RCAF inventory, had an initial acquisition cost of CAN$1.9 billion and has an estimated in-service support cost of CAN$6.3 billion over the expected 25 year ELE. In 2013, the RCAF started to receive its CH-147F Chinook helicopters with an acquisition cost of CAN$1.2 billion and an estimated in-service support cost of US$2 billion over its estimated 25 year equipment life expectancy.[99]

What does this mean? More effort and emphasis needs to be placed on developing comprehensive contracts. Moreover, the RCAF and ADM(Mat) must thoroughly and regularly evaluate performance to ensure that they continue to experience a high value for money while still focusing on operational primacy.

The Assistant Deputy Minister (Materiel) manages the National Procurement (NP) program, which is the largest support budget within DND. This program purchases spare parts

[97]Office of the Auditor General, "Chapter 7 Operating and Maintenance Support for Military Equipment – National Defence," Last accessed 20 March 2018, http://www.oag-bvg.gc.ca/internet/English/parl_oag_201611_07_e_41836.html

[98]Office of the Auditor General, "Chapter 7 Operating and Maintenance Support for Military Equipment – National Defence," Last accessed 20 March 2018, http://www.oag-bvg.gc.ca/internet/English/parl_oag_201611_07_e_41836.html

[99]Office of the Auditor General, "Chapter 7 Operating and Maintenance Support for Military Equipment – National Defence," Last accessed 20 March 2018, http://www.oag-bvg.gc.ca/internet/English/parl_oag_201611_07_e_41836.html

and manages contracts with industry and foreign governments for maintenance. As of 2016, the NP program had, "…an annual budget of $2.5 billion, or approximately 13 percent of National Defence's overall budget."[100] As a result, it is critical that ADM(Mat) manages the budget wisely. However, the OAG has observed on more than one occasion, that DND does not manage its support contracts in a proficient manner:

> [The OAG] found that National Defence did not adequately manage support in a cost-effective manner and paid for a higher level of service than it used. National Defence had made some initial planning assumptions that overestimated equipment use, underestimated support costs, and under-resourced personnel requirements.[101]

With the implementation of the Sustainment Initiative program, DND is providing an opportunity to address this shortcoming; however, the program is still so new that it will be several years before the viability of the new contracting framework can be objectively assessed. When looking at OWSM, the expectation was that this framework would improve the value for money for all in-service support contracts by way of receiving more support for equal costs. However, by 2014 it was determined, "…this contracting framework was no longer the default for support contracts. However, existing contracts negotiated under the framework will still be in effect for decades, and our findings apply to any contracting framework or approach."[102] This begs the question if this will be the outcome of the Sustainment Initiative in due course as well. Nevertheless, this demonstrates the need for creating a well-articulated contract from the outset because it is enduring for several years and sometimes decades. In developing an in-service

[100]Office of the Auditor General, "Chapter 7 Operating and Maintenance Support for Military Equipment – National Defence," Last accessed 20 March 2018, http://www.oag-bvg.gc.ca/internet/English/parl_oag_201611_07_e_41836.html

[101]Office of the Auditor General, "Chapter 7 Operating and Maintenance Support for Military Equipment – National Defence," Last accessed 20 March 2018, http://www.oag-bvg.gc.ca/internet/English/parl_oag_201611_07_e_41836.html

[102]Office of the Auditor General, "Chapter 7 Operating and Maintenance Support for Military Equipment – National Defence," Last accessed 20 March 2018, http://www.oag-bvg.gc.ca/internet/English/parl_oag_201611_07_e_41836.html

support contract, DND needs to improve its estimates for total support costs. A recent OAG audit also found that "National Defence did not estimate the total costs to support the equipment over its expected life. Although National Defence monitored actual expenditures for maintaining equipment, we found that it did not monitor total support costs…against its estimate of full life-cycle costs." [103] In addition to creating a comprehensive support contract, DND must ensure that a contract is developed in a way that can be responsive to changing circumstances over time.

Another risk of contracting supply support is that there is an ability for weapons system managers to reallocate in-year funds on activities outside in-service support. [104] Due to fiscal restraints and competing pressures it can be easy to transfer funding for supply chain activities to seemingly higher priority items because, typically, the impact is not immediately felt.[105] One could even argue that perhaps the impacts are never truly appreciated if we cannot truly measure the performance of said contractors.

A 2016 OAG audit outlined the assumptions of the RCAF when developing support contracts and the actual situation and follow-on impact to the forces. This report discusses four main false assumptions that have negatively impacted the RCAF, outlined in appendix 2. For instance, it was assumed that the support costs for new platforms would be similar to the platform it was replacing. When comparing the support contract for the CH-148 Cyclone to that of the CH-124 Sea King, the support for the Cyclone is expected to cost two to three times that of the Sea King. Or, looking at the CC-130 Hercules fleet, the support per hour flown for the J-

[103]Office of the Auditor General, "Chapter 7 Operating and Maintenance Support for Military Equipment – National Defence," Last accessed 20 March 2018, http://www.oag-bvg.gc.ca/internet/English/parl_oag_201611_07_e_41836.html.

[104]Office of the Auditor General, "Chapter 7 Operating and Maintenance Support for Military Equipment – National Defence," Last accessed 20 March 2018, http://www.oag-bvg.gc.ca/internet/English/parl_oag_201611_07_e_41836.html.

[105]The author witnessed this while working at DGAEPM where a WSM team had not funded stock verifications for several years in a row because it did not place a high priority on this task because the impact to operations is often intangible.

model is $18,000 compared to $11,000 for the H-model, thus adding additional funding pressures for all RCAF platforms. Another assumption that was critically misidentified was that replacement platforms would operate at the same rate as the legacy fleets; this misrepresentation caused significant overpayments for the CH-147H, CC-130J and CC-177 resulting from funding and personnel constraints. The RCAF could not meet the personnel or training requirements for any of these fleets and thus paid for services that were not realized.[106]

This same OAG report demonstrates a weakness in how support contracts are developed. In table 3.4, the data indicates that for the three most recent fleets that have been received, the RCAF has paid for contracted support that it did not use based on the yearly flying rate (YFR) that was used. For the CC-130J and the CH-147F, ADM(Mat) contracted for YFR rates that were unachievable due to training and manning challenges. However, due to the inflexible nature of the contracts, ADM(Mat) was caught paying for services that were not rendered. There appears to be a disconnect between ADM(Mat) and the environments in that, although contracts were developed to support a specific initial flying rate, the RCAF had severe challenges to meet this rate with qualified pilots and maintenance technicians.[107] This is a significant event whereby DND's shortsightedness and inability to refocus its personnel had detrimental impacts on the overall success of the RCAF.

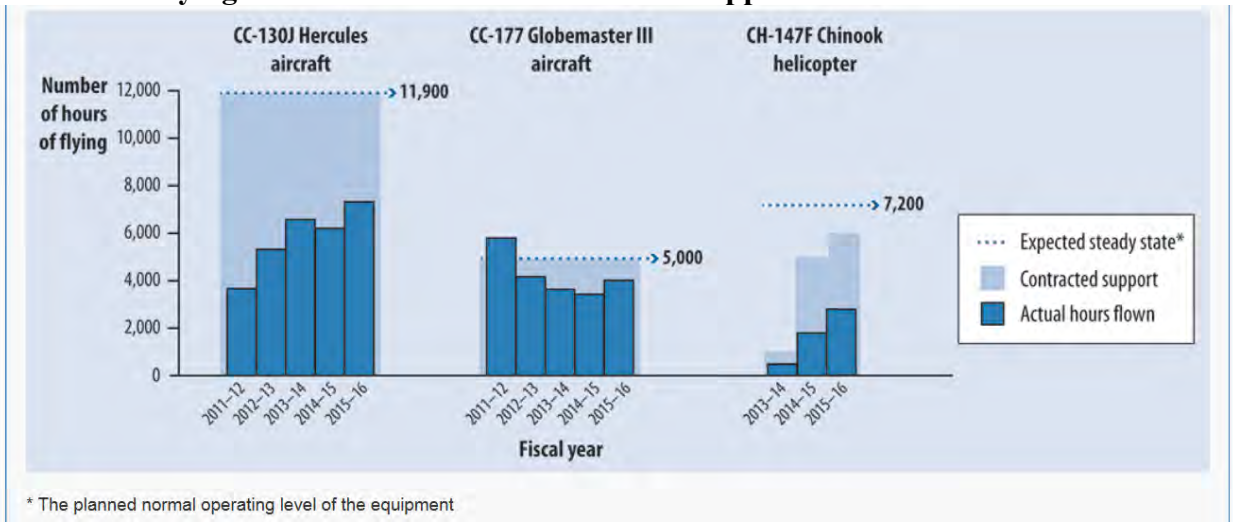
Without have specific financial data to determine the delta between the contracted support and actual hours flown, the table below clearly shows that in the case of the CC-130J and the CH-147F Chinook this delta is more than half of the contract support that was funded by

[106]Office of the Auditor General, "Chapter 7 Operating and Maintenance Support for Military Equipment – National Defence," Last accessed 20 March 2018, http://www.oag-bvg.gc.ca/internet/English/parl_oag_201611_07_e_41836.html.

[107]Office of the Auditor General, "Chapter 7 Operating and Maintenance Support for Military Equipment – National Defence," Last accessed 20 March 2018, http://www.oag-bvg.gc.ca/internet/English/parl_oag_201611_07_e_41836.html.

DND. When looking at the CC-177 one could argue that perhaps the delta is less alarming because the RCAF is not maintaining the aircraft and the fleet is small comparatively.

Table 3.4 – Flying Hours Flown versus Contracted Support



Source: Office of the Auditor General, "C*hapter 7 Operating and Maintenance Support for Military Equipment – National Defence.*

It should be noted; however, that due to the headlong approach to delivering the three most recent fleets, the RCAF has made adjustments to how it will deliver the CH-148 Cyclone. It is allocating significantly less YFR for the initial roll-out of this platform because the RCAF has acknowledged that manning continues to be its weakness when delivering a new capability.[108] This demonstrates that perhaps the RCAF is positioning itself to better deliver on the additional capabilities expected with the introduction of the most recent defence policy.

Conclusion

Every contract for RCAF aircraft spares is unique with varied levels of contracted support creating a complex supply chain. The impact of its inability to generate comprehensive support contracts is still being evaluated; but a focus on efficiency over effectiveness will continue to hamper the RCAF's ability to remain agile and responsive. DND has received

[108]John Alexander, Integrated Logistics Support Manager, Maritime Helicopter Project, email correspondence with author, 18 January 2018.

criticism on its competence to develop adequate contracting mechanisms to support its aircraft platforms, which has resulted in its third iteration of a contracting framework. It is too early to determine if the Sustainment Initiative will mitigate many of the challenges that the RCAF experiences with its OWSM and ISSCF contracts. But, with a focus on best value for Canadian taxpayer dollars, one could anticipate that it will fall short of meeting the principles of sustainment, and ultimately operational effectiveness. However, one could argue that the trust in the RCAF supply chain has continued to dwindle since the advent of contracted support in the 1990s. This could be correlated to the lack of flexibility or perhaps responsiveness of some contractors. But this could also be a result of rapidly increased expectations of a supply chain that is almost immediately responsive to demands, as seen in civilian industry.

The sustainment culture in the RCAF must change before the environment can truly experience a more efficient supply chain. The current lack of trust in the supply community forces decisions that limit supply's ability to respond to customer's demands. With the aggressive timeline and appetite of the new defence policy, it will be imperative for the sustainment culture in the RCAF to improve. First, one must gain insight on how the RCAF is currently supporting each of its fleets and how platforms employ a traditional versus contracting supply chain model.

CHAPTER 4: AIRCRAFT SPARES SUPPORT FOR RCAF OPERATIONAL FLEETS

You will not find it difficult to prove that battles, campaigns and even wars, have been won or lost primarily because of logistics.

-General Dwight D. Eisenhower, Supreme Allied Commander – Europe, World War II

Introduction

As of January 2018, of the 13 operational fleets in the RCAF inventory, seven have contracted supply support over 14 alternate support delivery contracts; meaning there is a minimum of 15 separate supply chains to support, which directly impact first and second line supply on Canadian air wings.[109] The vastness of the supply chain compared to the number of personnel assigned to manage it, married with the decentralization of the CAF supply chain creates a complex situation that no one organization can influence, change or optimize. Of the six operational fleets that have supply chains managed by CAF personnel, two are in the process of being replaced by fleets that have contracted spares support. An additional two platforms are working on contracting their major aircraft spares program, known as Primary Air Vehicle (PAV). The final two fleets are fully supported by the CAF for aircraft spares but experience significant supply chain issues due to the age of the aircraft. This chapter will review the concept of equipment life expectancy and how the RCAF's employment of this model impacts supply chain management. This chapter will then consider each of the traditional supply chain models in the RCAF, as well as the contracted supply chain models; outlining yearly flying rates (YFR) and serviceability statistics for most fleets and determining anomalies of each supply chain and any impact this might have on overall performance of the supply chain.

[109]Appendix 1 provides an overview of each RCAF fleet and how aircraft spares are supported.

Equipment Life Expectancy

The equipment life expectancy (ELE) is an important metric that the RCAF uses for planning support to its platforms. Moreover, it is important to unpack with a supply chain management view as this can be contributed to one of the major factors that weakens the supply chain and thus infringes on the trust CAF members have in CAF sustainment processes. The air force aims to balance the operational utility with the economic value to determine the optimal timeframe to have a platform in service. It should be noted though that political decisions or indecisions can often impact ELE timeframes in that ELEs must often be extended beyond economical or operational means because the Government of Canada tends to value short-term solutions with a long-term loss[110] which is perhaps due to their inability to adequately manage risk. According to Lieutenant-Colonel Don Hamilton, the RCAF's director of air programmes in 2015, the three factors that are considered when determining ELE is the economic perspective, operational perspective and technical perspective. [111]

Despite the sound checks and balances that appear to exist to determine optimal ELEs for any RCAF platform, the RCAF continues to extend the life of an aircraft well beyond the optimal operational capacity which results in reduced availability and cost effectiveness. This can often be a result of unavailable spares requiring parts to be individually manufactured, creating a scenario where not only do costs escalate significantly but time delays for filling demands are increased exponentially as well.[112] As an example, the CF-188 ELE was recently

[110]Shawn Curley, "Fleet Cost and Benefit Optimization: Replace/Extend Decisions in the Age of Accrual Budgeting" (Joint Command and Staff and Staff Programme Course Paper, Canadian Forces College, 2017), 8.

[111]Royal Canadian Air Force, "Estimated Life Expectancy: ELE and the RCAF," last modified 2 December 2016, http://www.rcaf-arc.forces.gc.ca/en/article-template-standard.page?doc=estimated-life-expectancy-ele-and-the-rcaf/i6miz740

[112]Shawn Curley, "Fleet Cost and Benefit Optimization: Replace/Extend Decisions in the Age of Accrual Budgeting" (Joint Command and Staff and Staff Programme Course Paper, Canadian Forces College, 2017), 16.

extended to 2025[113] and there is an ongoing study to propose a new ELE of 2032. This is in direct contradiction to Public Services Procurement Canada's assessment in 2014 that identifies an ELE-extension to 2030 would result in a situation where Canada was the only nation still operating this aged fleet, making the sustainment costs associated to entertain this type of timeline unsupportable.[114][115] What is unclear is whether negotiations or evaluations were completed to determine the supportability of this timeline from a spare parts perspective. The CF-188 fleet regularly experiences substantial delays in filling parts demands due to obsolescence. Granted, the Hornet replacement subject is an anomaly with the controversy surrounding the initial replacement project that has resulted in a significantly delayed procurement process, other fleets are not precluded from having ELEs extended beyond the three perspectives outlined above.

Thus it can be argued that although the RCAF may have good intentions to plan for the life expectancy of its platforms, initial projections are not necessarily reflective of how the government opts to execute budgetary allocations for replacement fleets. The RCAF acknowledges that parts obsolescence is a consideration when determining an ELE but it must be given additional evaluation to confirm that the supportability is well-understood and to ensure the cost of life extension does not surpass the replacement costs.[116] However, contracted supply support could potentially reduce this conundrum because the contractor will be required to

[113]Director General Aerospace Engineering Program Management, "Estimated Life Expectancy (ELE) Change Request and Approval," DGAEPM: AEPM 218, 8 September 2014.

[114]Public Services and Procurement Canada, "Summary Report – The Evaluation of Options for the Replacement of the CF-18 Fighter Fleet," last accessed 30 March 2018, https://www.tpsgc-pwgsc.gc.ca/app-acq/amd-dp/air/snac-nfps/eorfcf18-eorcf18ff-eng.html.

[115]Public Services and Procurement Canada, "Summary Report – The Evaluation of Options for the Replacement of the CF-18 Fighter Fleet," last accessed 30 March 2018, https://www.tpsgc-pwgsc.gc.ca/app-acq/amd-dp/air/snac-nfps/eorfcf18-eorcf18ff-eng.html. It should be noted that the original ELE that was determined by the manufacturer based on other users was 2003; accordingly due to proactive fatigue management and structural repairs programs the CAF was initially able to extend the ELE to 2020.

[116]Shawn Curley, "Fleet Cost and Benefit Optimization: Replace/Extend Decisions in the Age of Accrual Budgeting" (Joint Command and Staff and Staff Programme Course Paper, Canadian Forces College, 2017), 24.

maintain the platform at a set serviceability rate, thus mitigating, but not necessarily eradicating, the possibility of parts obsolescence. The following dialogue outlines aircraft availability versus yearly flying rate statistics for the six operational fleets whereby the supply chain is managed by the RCAF, followed by four of our fleets whose supply chain is contracted. Although this assessment is not a full study of either solution, and many other factors must be considered to determine the supportability of either option, it provides a solid foundation to generate discussion and perhaps question the way forward for the RCAF aircraft spares support structure. Of note, all platforms with a traditional supply chain are at least 35 years old and each one of them has had its ELE extended at least once. What does this mean with respect to how the RCAF plans the lifespan of its fleets? What does this say about the priority the government places on supporting its air power capability? One thing is certain; this challenge in and of itself makes it difficult to directly compare serviceability statistics against newer fleets with contracted support.[117]

The serviceability data that was used for this discussion was provided by DGAEPM's Data Analysis and Information Reporting Team and an aircraft is deemed serviceable if there are no outstanding work orders for that tail number. As a result, this does not necessarily mean it was not available for the flying program. Serviceability can be a very subjective number based on numerous variables such as the time of day statistics are given or any waivers that could be applied to a technical specification. By using the data from this section it provides an even playing field for each fleet; consequently, the individual serviceability rate for any given fleet is not important, nor is it necessarily 100% reflective of the serviceability of that fleet during that year, but it provides an equal footing to compare fleets. Additionally, the Supply Health

[117]It should be understood that DGAEPM does not manage similar data sets for the CC-150 Airbus and CH-149 Cormorant since these fleets are fully contracted – the RCAF does not provide any support, be it logistics or maintenance, for either of these fleets – thus, the available data on these fleets includes YFR and costs. Also, the CH-148 Cyclone is too new to provide much value for comparison at this time but will still be discussed to outline the support construct for this fleet as it is the newest fleet in RCAF inventory.

Indicator data provided in a quarterly report to DGAEPM board of directors is mostly a qualitative analysis of an individual fleet's assessment of their supply chain. Oftentimes, quantitative data is not available to accurately reflect the current state of affairs so a subjective response is provided. This may is a biased approach to assess a supply chain; however, the perceived performance of a supply chain is equally important because it demonstrates the level of trust that is placed on the supply chain. Moreover, the individuals that are making their potentially subjective assessment of their respective supply chain's performance are often part of the decision-making team to determine future support structures and supply chain models.

Traditional Supply Chain Models

A traditional supply chain model is applied to most fleets that came in to service pre-1995. This means that these fleets are supported by a military-managed supply chain and spare parts are depot-stocked and each fleet should be supported by a military managed first and second line supply. With a traditional supply chain model, DND is responsible for the end-to-end management of the system, including forecasting requirements, procurement, warehousing and managing of the items. DRMIS is the system of record and is used to track and manage demands and usage. This does not preclude from specific systems having a contracted supply chain, such as the avionics systems for the CF-188 or the engines for the CC-130H, CP-140 and CF-188; however, the main sparing for these fleets are depot-stocked items.

1 Canadian Air Division (1 CAD) A4 Supply recently completed a survey where both supply and maintenance technicians at all rank and experience levels were able to provide feedback on their perception of the RCAF supply chain. This survey demonstrated that 49% of

respondents did not feel that supply was meeting their needs, with most of this satisfaction a result of parts unavailability or lagging delivery times.[118]

The CC-130H Hercules was procured between 1960 and 1997[119] and will reach its end-of-life expectancy (ELE) in 2021. The RCAF is currently conducting an ELE study to extend the fleet's life expectancy until 2025; however, they have already identified that several avionics components are not supportable past 2021 and the primary radar will be obsolete by 2020.[120] The CC-130H, which operates at three main operating bases in Canada, and is being replaced by the CC-130J, is a traditional depot stocked platform meaning that the RCAF and CAF are fully responsible for the fleet's supply chain management. Although this is a fleet that should be fully transparent in DRMIS it is not without its own challenges. For instance, 8 Wing Trenton has historically managed the engines and propellers on a separate account. Consequently, in order to demand either of these items in support of any CC-130 aircraft a supply technician must contact an individual to manually request the items. As a result, the visibility of these parts in particular is low because they are not held on a traditional warehouse account and supply technicians have to manually request items which, since it is not an automated process, can impact the speed in which demands are filled.[121] Perhaps this is just one of the reasons that the CC-130H engines and propellers are now under a contracted support model and managed by Aero Standard.[122]

Based on data from DGAEPM, this fleet has experienced an average of a 32% serviceability rate between FY10/11 and FY16/17. There was a spike in serviceability but a

[118]A.E.M. Clouthier, A4 Supply 2, 1 Canadian Air Division Headquarters, Supply Improvement Questionnaire, Fall 2017.

[119]Government of Canada, "Maintaining Royal Canadian Air Force Aircraft Engines," last accessed 4 April 2018, http://www.rcaf-arc.forces.gc.ca/en/aircraft-current/cc-130.page.

[120]Royal Canadian Air Force, "Air Staff ELE Page," last accessed 29 March 2018, http://collaboration-airforce.forces.mil.ca/sites/AirStaff/DAirProgramming/ELE/SitePages/Home.aspx.

[121]DGAEPM, Supply Health Indicator, FY14/15 Q4 Report, FY15/16Q4 Report, and FY16/17 Q4 Report.

[122]Government of Canada, "Maintaining Royal Canadian Air Force Aircraft Engines" last modified 3 February 2017, https://www.canada.ca/en/public-services-procurement/news/2017/02/maintaining-royal-canadian-force-aircraft-engines.html?wbdisable=true.

slight decrease of YFR flown in FY14/15, which was the second year of service for the CC-130J.[123] The average maintenance hours compared to YFR for this fleet during this 7 year time-frame is 7.1 maintenance hours per flying hour.[124] In comparison to many other fleets of similar age, the supportability of this platform is relatively decent given the extended transition time between the H-model and J-model; in fact, after the CF-188 this fleet has the highest serviceability rate of all traditional supply chain platforms in RCAF inventory. Yet, the cost per flying hour averages $10,591.51[125] which appears to be value for money given the age of the fleet. It should be noted that this cost will most likely increase with the new propulsion group services contract that is just being implement now to manage the engines and propellers for this platform.

The CH-124 helicopters are between 49 and 55 years old, the oldest fleet in RCAF inventory,[126] yet has a fairly low average flying hour cost compared to other traditionally supported fleets at $8,070.32.[127] This fleet, whose ELE is 31 December 2018,[128] operates out of two main operating bases. Like the CC-130 Hercules, it is a traditional platform where the end-to-end supply chain management for the fleet is performed by uniformed supply technicians; all aircraft spares belong to DND and are depot stocked items.

Based on data from DGAEPM, this fleet has experienced an average of 18.5% serviceability rate between FY10/11 and FY16/17. It should be noted that during this timeframe

[123]The CC-130J's support concept will be outlined in the contracted supply chain model portion below.

[124]Greg Gagne, Data Analysis and Information Reporting Team Lead, DGAEPM, email correspondence with author, 7 January 2018.

[125]Matthew Wereley, Division Business Planner, DGAEPM, email correspondence with author, 21 December 2017.

[126]T.F.J. Leversedge, *Canadian Combat and Support Aircraft: A Military Compendium* (St. Catharines: Vanwell, 2007), 226.

[127]Matthew Wereley, Division Business Planner, DGAEPM, email correspondence with author, 21 December 2017.

[128]Royal Canadian Air Force, "Air Staff ELE Page," last accessed 29 March 2018, http://collaboration-airforce.forces.mil.ca/sites/AirStaff/DAirProgramming/ELE/SitePages/Home.aspx

the fleet experienced serviceability rates as low as 13.2% while in FY16/17 the serviceability rate was as high as 26.7%. Without further analysis, the reason for this anomaly is unknown. The average YFR flown during this period was still 7487 hours while the maintenance rate is 8.43 maintenance hours to one flying hour.[129] Although the serviceability of this aircraft is low, the age of the fleet must be taken into consideration. The constant pressure on the supply chain to meet demands is a challenge to satisfy as reflected in table 4.1 which demonstrates that this fleet has one of the lowest serviceability stats in the RCAF. However, based on the Q4 Supply Health Indicator reports for the past three fiscal years, the sparing has improved in FY16/17 for this fleet through a lower number of HPRs and shorter HPR response times.[130]

Procured in 1967[131] and with a current fleet of only six, the CC-115 Buffalo can be expected to have supply chain challenges. Yet, given the serviceability status over the past seven fiscal years, the platform has comparatively good statistics. This fleet is over 50 years old, which one could reasonably conclude that it could be difficult to command the aircraft spares support required from industry, especially because the RCAF inventory is so small. This is often a problem for RCAF fleets whose ELEs become extended.[132] Often Original Equipment Manufacturers (OEMs) no longer fabricate the parts required for RCAF platform models or they are unwilling to fabricate the limited quantity the RCAF would require. This can mean that technicians are frequently waiting for several months, if not years, for Life Cycle Materiel

[129]Greg Gagne, Data Analysis and Information Reporting Team Lead, DGAEPM, email correspondence with author, 7 January 2018.

[130]DGAEPM, Supply Health Indicator, FY14/15 Q4 Report, FY15/16Q4 Report, and FY16/17 Q4 Report.

[131]T.F.J. Leversedge, *Canadian Combat and Support Aircraft: A Military Compendium* (St. Catharines: Vanwell, 2007), 144.

[132]Royal Canadian Air Force, "Air Staff ELE Page," last accessed 29 March 2018, http://collaboration-airforce.forces.mil.ca/sites/AirStaff/DAirProgramming/ELE/SitePages/Home.aspx As of 17 Dec 14 the CC115 Buffalo ELE was extended to 2020. As of December 2014, the ELE for the CC138 Twin Otter was extended from 2015 to 2025.

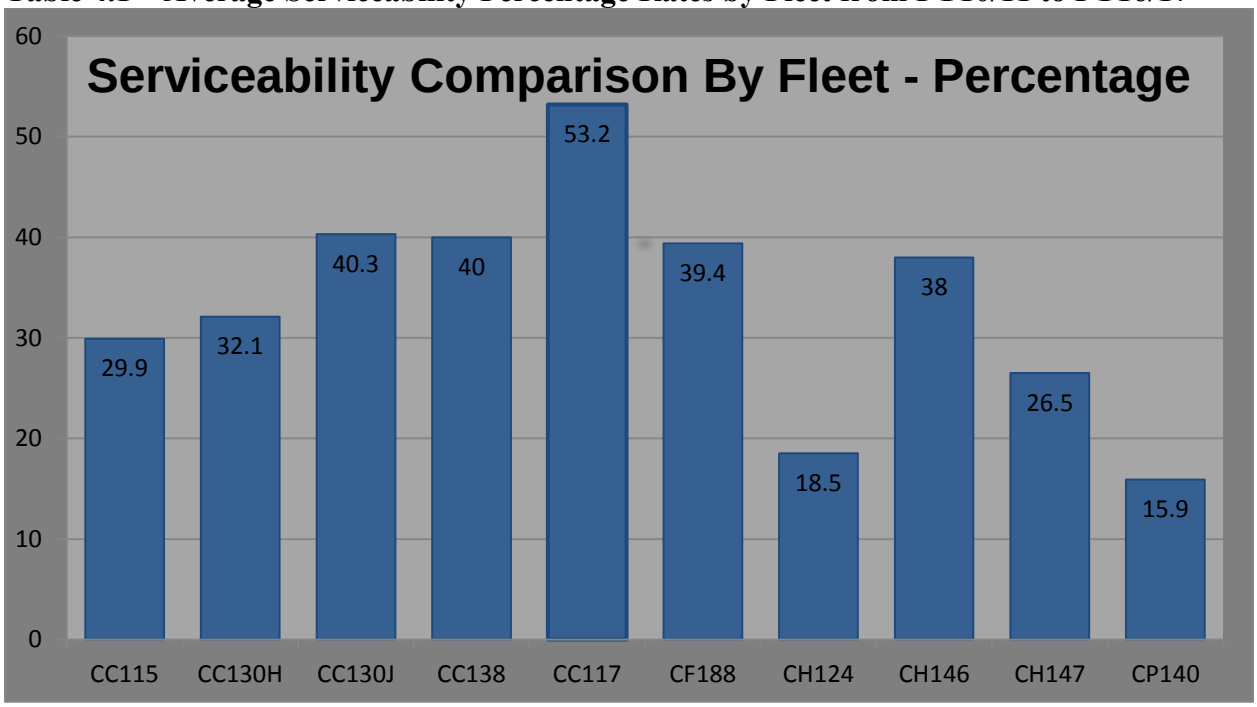
Managers (LCMMs) to contract and procure a replacement part.[133] Yet, even with these challenges, this fleet has remained relatively stable in the last seven years due to the WSM team's flexibility and foresight. This fleet does not have qualitative data on the performance of its supply chain; but it has had to have aircraft parts reversed engineered because many parts are no longer fabricated or the OEM has advised alternate or substitute parts due to obsolescence challenges.[134] Based on data from DGAEPM, the CC-115 Buffalo platform showed a serviceability rate of 29.9% with an average of 10.87 maintenance hours per flying hour[135] and the average cost per flying hour over the same seven years was comparatively low at $7,600.95.[136]

In comparison, a fleet with a similar mission and similar age, the CC-138 Twin Otter averaged a 40% serviceability rate with only 2.38 maintenance hours per flying hour.[137] More astonishing is that the average cost per flying hour is unparalleled at just $1,383.65.[138] This fleet of four aircraft was procured in 1970.[139] With a 48 year life-span currently, it is expected that the Twin Otter would have significant supply chain issues but that is not the case, in comparison to the rest of the RCAF platforms, except for RCAF unique items, parts are readily available for this fleet.[140] With additional time, it would be worthwhile to investigate how this fleet's support arrangement has differed than many of the other traditional supply chain fleets as, given its age and the small fleet size; one could expect to have increased challenges with its supply chain. One

[133]DGAEPM, Supply Health Indicator, FY14/15 Q4 Report, FY15/16Q4 Report, and FY16/17 Q4 Report.
[134]DGAEPM, Supply Health Indicator, FY14/15 Q4 Report, FY15/16Q4 Report, and FY16/17 Q4 Report.
[135]Greg Gagne, Data Analysis and Information Reporting Team Lead, DGAEPM, email correspondence with author, 7 January 2018.
[136]Matthew Wereley, Division Business Planner, DGAEPM, email correspondence with author, 21 December 2017.
[137]Greg Gagne, Data Analysis and Information Reporting Team Lead, DGAEPM, email correspondence with author, 7 January 2018.
[138]Matthew Wereley, Division Business Planner, DGAEPM, email correspondence with author, 21 December 2017.
[139]T.F.J. Leversedge, *Canadian Combat and Support Aircraft: A Military Compendium* (St. Catharines: Vanwell, 2007), 145. This particular model was originally designed for naval use on an aircraft carrier.
[140]DGAEPM, Supply Health Indicator, FY14/15 Q4 Report, FY15/16Q4 Report, and FY16/17 Q4 Report.

reason for this anomaly could be that this fleet is not one with significant RCAF modifications thus there is abundant spares providers. One of the challenges the RCAF faces when supporting its fleets, is the unique modifications that are performed to meet the air force's exact specifications which can create support challenges as the fleets age and other nations to not share the same modifications; this is the situation with the CF-188 Hornet. The CAF required a number of solely Canadian modifications that were incorporated into the contract design such as changes for uniquely Canadian weapons, a power searchlight, a modified survival kit and a land-based landing system.[141]

Table 4.1 – Average Serviceability Percentage Rates by Fleet from FY10/11 to FY16/17



Source: Greg Gagne, Data Analysis and Information Reporting Team Lead, DGAEPM, email correspondence with author, 7 January 2018.

[141]T.F.J. Leversedge, *Canadian Combat and Support Aircraft: A Military Compendium* (St. Catharines: Vanwell, 2007), 208.

Canada was the first export country of F/A-18 Hornet,[142] which came into service from 1982 to 1988 and has already been depleted by almost half over the last 35 years. It is a constant struggle to support this fleet in a timely manner and oftentimes technicians experience unacceptable wait times due to parts unavailability. However, based on table 4.1 this fleet experiences the highest serviceability rates of all traditional supply chain platforms in RCAF inventory; but the cost per flying hour is reflective of this serviceability rate at $66,440.06.[143] It should be understood that a fighter aircraft is expected to have higher costs due to the technical nature of the systems required for this type of capability. Additionally, due to the extensive avionics and structural upgrades required to allow the platform to meet the extended ELEs, the sustainment costs for the Hornet have increased accordingly. The CF-188 Hornet weapons system management (WSM) team is currently investigating the viability of contracting their Primary Air Vehicle (PAV) support to industry because they are so dissatisfied with the traditional supply chain's ability to be responsive to demands. Yet, since February 2015, the previously used HPR database has been decommissioned, thus qualitative data does not exist on how well the supply chain is performing.[144] It can be noted though that the last qualitative data reported, reflected an average wait time of 6.4 days for an HPR which is not acceptable, assuming all demands were validated as HPRs.[145] However even currently, the CF-188 has segments of its supply chain, such as avionics and engine support, contracted out to industry under the OWSM concept. Under this contract, the CAF still owns and stocks all aircraft spares but the contractor performs the first line support at the respective bases. As a result, the

[142]T.F.J. Leversedge, *Canadian Combat and Support Aircraft: A Military Compendium* (St. Catharines: Vanwell, 2007), 208.

[143]Matthew Wereley, Division Business Planner, DGAEPM, email correspondence with author, 21 December 2017.

[144]DGAEPM, Supply Health Indicator, FY14/15 Q4 Report, FY15/16Q4 Report, and FY16/17 Q4 Report.

[145]DGAEPM, Supply Health Indicator, FY14/15 Q4 Report.

maintenance technicians have three separate supply chains to understand and utilize to support a single platform.[146] As mentioned previously, the ELE for this platform is expected to extend the life of this fleet well past 50 years of service thus parts obsolescence, which has been an issue for at least the last decade, will further deteriorate. Based on data from the data analysis and information reporting team at DGAEPM, this fleet has experienced an average of 39.4% serviceability rate over the last 7 fiscal years. The average YFR for this fleet is 13570, which saw a spike in FY11/12 with a YFR of 15049. The fleet requires 15.97 maintenance hours per flying hour.[147] It can be safely expected that this figure will increase as the fleet ages; currently the fleet is expected to operate until 2025 and discussions have begun to propose a new ELE of 2032.[148] Given the ELE extension expected for this fleet, a PAV contract may be optimal; however, it is not well understood if a thorough analysis from a spare parts perspective has been completed to determine the viability of this contract.

Operating out of two main operating bases, the CP-140 Aurora is also an aging aircraft that was initially purchased in 1980.[149] As a result, this fleet experiences significant supply chain issues which has negatively impacted operations; reflected with its average of 15.9% serviceability between FY10/11 and FY16/17. The data shows that this fleet requires, on average, 14.99 maintenance hours per flying hour[150] and costs an average of $18,107.50 per

[146]Eric Rheaume, "Towards an Equilibrium Between RCAF and Contracted Maintenance Following the Procurement of the CF-188 Replacement(s)" (Joint Command and Staff Programme Course Paper, Canadian Forces College, 2017), 68.

[147]Greg Gagne, Data Analysis and Information Reporting Team Lead, DGAEPM, email correspondence with author, 7 January 2018.

[148]Royal Canadian Air Force, "Air Staff ELE Page," last accessed 29 March 2018, http://collaboration-airforce.forces.mil.ca/sites/AirStaff/DAirProgramming/ELE/SitePages/Home.aspx

[149]T.F.J. Leversedge, *Canadian Combat and Support Aircraft: A Military Compendium* (St. Catharines: Vanwell, 2007), 195.

[150]Greg Gagne, Data Analysis and Information Reporting Team Lead, DGAEPM, email correspondence with author, 7 January 2018.

flying hour.[151] The operating costs for this fleet are reflective of the highly technical avionics suites required for an intelligence, surveillance and reconnaissance (ISR) platform. Like with the CF-188, DGAEPM is currently re-writing the CP-140 Aurora PAV contract and is analyzing the viability of a contracted supply chain model.

It is difficult for the CAF supply chain to meet the needs of the platforms that use a traditional supply chain because each of these platforms are quite old and spare parts are difficult to source. As a result, it is difficult for anyone to use the current supply chain's perceived performance as a measure of how effective traditional supply chain programs are and to determine if a contracted spares program would provide better support to operations. Every RCAF fleet that operates with a traditional supply chain that is managed end-to-end by DND experiences significant aircraft spares availability challenges due to the age of the fleet. Consequently, it is not as simple as just determining that traditional supply chain support is weak; one must take into consideration all of the contributing factors when making this assessment. Yet it appears that the subjective supply chain data based on aged aircraft plays a large role in determining the supply chain construct for a new capability. It is acknowledged; however, given the weaknesses of DRMIS, it can be exceedingly difficult to verify data and complete a thorough analysis.

There is a belief that contracting spares support is more efficient and cost-effective for the forces but data that is used to determine the efficiency of the supply chain is often qualitative. For instance, DGAEPM produces a quarterly report that includes a Supply Health Indicator that assesses the supply support for each fleet; however, these reports are based on qualitative data vice quantitative data because quantitative data is not readily available for evaluation and

[151]Matthew Wereley, Division Business Planner, DGAEPM, email correspondence with author, 21 December 2017.

measurement. This holds true even for contracted fleets, reinforcing the conundrum of which support construct is optimal for the RCAF. As seen in the next section, there are definite benefits of a contracted support structure; however, there are inherent drawbacks and even weaknesses as well.

Contracted Supply Chain Models

A contracted supply chain model is one in which a contractor has a primary role at some point in the supply chain. In the CAF there is a desire to have a flexible contracting model; whereby project management offices can determine the optimal level of contract support required based on individual fleet requirements. As a result, the RCAF has fleets where the entire supply chain is contracted, such as the CC-177 or the CH-149. This means that the contractor does not just procure, manage and warehouse the spare parts; they own all of the spares until the RCAF has a requirement. This creates a situation where DND has limited risk from a support perspective and limited upfront costs associated with the initial procurement. Another contract model that is employed is that of the CH-146 where DND owns all the spare parts but Bell Textron performs all second and third line supply activities and is required to ship spare parts anywhere in the world the RCAF requires. In this particular model, the RCAF employs uniformed supply technicians at first line units and any RCAF unique items, referred to as mission kit items, are managed and stocked through the traditional supply chain.[152]

The varied level of support within each contract creates a layer of complexity for the RCAF because one must have a basic working knowledge of each specific contract versus a

[152]It is worthwhile to note that, based on the author's experience as 1 Wing A4 Logistics and DAP 3, mission kits tend to have challenging tracking methods because they are tracked by military supply technicians outside the contractor's IT system. For instance, during the author's posting with 1 Wing Headquarters, she was never able to get a clear list from the WSM, headquarters staff or the first line supply technicians what items were tracked in the Canadian Forces Supply System (CFSS) and what items were strictly managed on the contactor's system. This lack of clarity created additional work for supply technicians.

generic contracted supply chain model. As mentioned, personnel must learn the support construct for these fleets on-the-job and there is a risk of not developing a level of expertise that is more readily attained when the supply chain is not specific to a platform. The complexity of this model is magnified at first and second line units where members are often not privy to contract details and have pressures to support a commander's mission; decisions can be made locally that contradict a contract or transfer efforts from a contractor to the military, which inherently defeats the purpose of a contracted supply chain. As an example, the author has been in a situation where a contractor was unable to staff a critical second line position and the supported unit requested a military supply technician to fill the interim gap. However, the contract and the contractor's obligation were never provided and it was unclear if the WSM was made aware of the situation to ensure that the contractor was penalized accordingly.[153] Another more generic example that is often experienced is a contractor's inability to expeditiously ship spare parts anywhere in the world, as has been experienced with the Chinook fleet.[154] Repeatedly, because contractors do not have the same customs exemptions that are afforded to the CAF, they cannot meet operational timelines.[155] To solve this, the contractor will thus ship items on CAF resupply flights which ultimately means two things: that the RCAF could be paying for the shipment of those items twice, both directly and indirectly; and that if there are any delays in meeting the specified turnaround time it would be difficult for the RCAF to determine if the contractor met its contractual obligations. As a result, the need to ensure that contractual obligations are not implicated from a military perspective, contractor spares are often given special treatment when

[153]Based on author's experiences as Officer Commanding Supply and Foods Services at 4 Wing Cold Lake from July 2011-July 2014.

[154]Lyndon Crowder, Director Air Procurement 8-3, DGAEPM, email correspondence with author, 24 April 2018.

[155]Based on author's experiences as 1 Wing A4 Logistics from August 2008-November 2009 and at JTF-Afg Wing Logistics Officer from November 2009-September 2010.

being shipped via military means. This results in an advantageous situation for the contractor as it becomes increasingly difficult for the military to assess order fulfilment rates or other performance indicators specified in the contract.

There is a strong desire for any supply chain to succeed and it could be argued that most uniformed personnel would do what was required to ensure a supply chain was not broken, whether or not it was their responsibility. Furthermore, many contractor employees are retired military members who understand the RCAF and continue to have a strong network to facilitate any challenges that may be encountered. As an example, the recent engine contract awarded to Standard Aero was floundering from a supply chain perspective during the first few months of the contract because the contractor was unfamiliar with a DND supply chain approach. To help mitigate this challenge, the contractor has since hired retired military members to bridge the gap and better network with the military community.[156] Without this knowledge or expertise it could be exceedingly difficult for a contractor to be successful when they are embedded in a DND work environment.

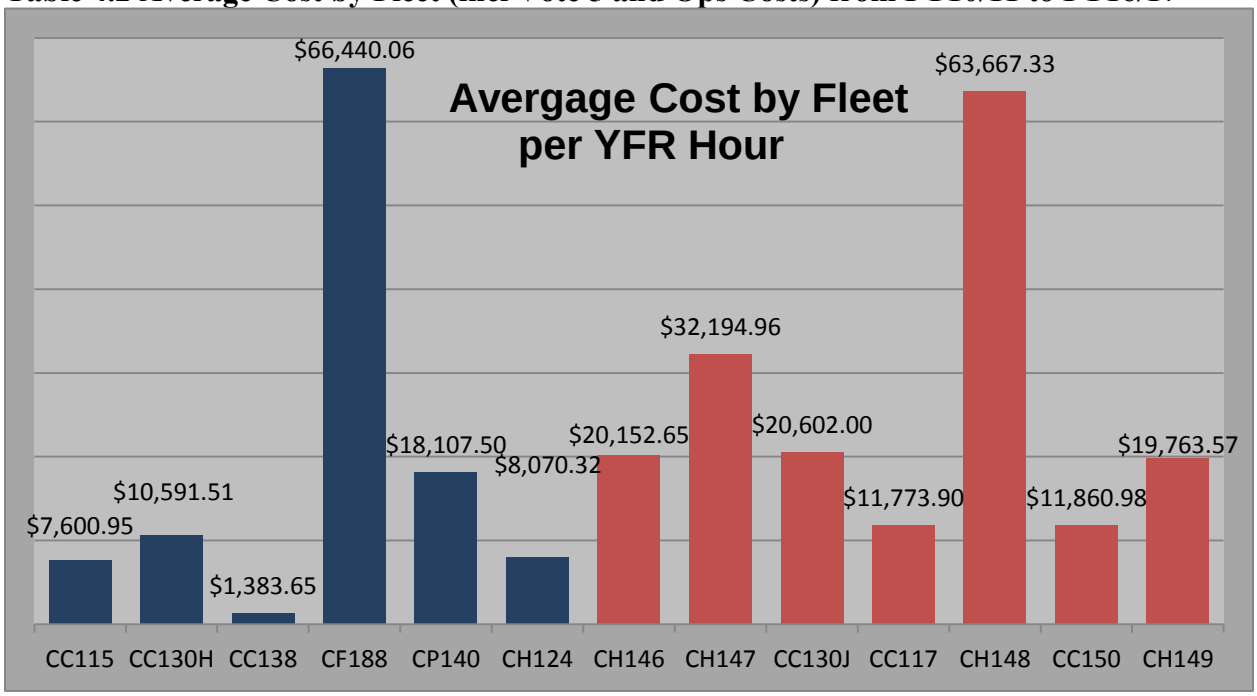
The CH-146 Griffon is the oldest contracted spares fleet in the RCAF inventory and demonstrates consistently high serviceability rates with an average of 38% since FY 10/11.[157] It could be argued that this contract has set the precedent for an aircraft spares support construct where the community is consistently satisfied with contractor performance. Although DND owns all of them, spares are managed and warehoused by the contractor and uniformed supply technicians provide the front line support at all first line units. Unlike most other fleets in the RCAF, this platform performs two separate and distinct primary roles: search and rescue as well as tactical aviation, with the support focus being on the three manoeuver tactical aviation units.

[156]Scott Snow, Director Air Procurement 3-2, DGAEPM, email correspondence with author, 23 March 2018.

[157]Greg Gagne, Data Analysis and Information Reporting Team Lead, DGAEPM, email correspondence with author, 7 January 2018.

Competing priorities for demands through the same supply chain can often create friction; the available data does not provide a breakdown by unit for serviceability to determine the level of friction, if any, is experienced with this fleet. According to DGAEPM's supply health indicator, this fleet is also a victim of obsolescence and required additional funding to increase inventory. Also, although HPR response time was always steady at approximately three days, this metric is no longer evaluated due to the level of effort required.[158] Of note, the current cost per yearly flying hour for this fleet is $20,152.65; however, this will most likely change in the near future when the contract is renegotiated.

Table 4.2 Average Cost by Fleet (incl Vote 5 and Ops Costs) from FY10/11 to FY16/17



Source: Matthew Wereley, Division Business Planner, DGAEPM, email correspondence with author, 21 December 2017.

[158]DGAEPM, Supply Health Indicator, FY14/15 Q4 Report, FY15/16Q4 Report, and FY16/17 Q4 Report. When a first line unit does not have the required part and must input a demand to Bell Textron, constitutes an HPR for this fleet. There is a belief amongst the maintenance community that serviceability rates demonstrate how responsive a supply chain is but this is not the most accurate indicator because it does not differentiate between supply and maintenance performance; thus making it difficult to pinpoint a weakness to improve.

The CH-147 Chinook fleet came in to service in 2013/2014[159] and shows a 26.5% serviceability rate since its inception.[160] This fleet has a fully contracted support structure where Boeing technicians own and manage the spares at the first line unit; DND only owns an aircraft spare once it is embodied on an aircraft.[161] The serviceability rate is expected to increase as the contract continues but currently it has the lowest serviceability rate of all contracted fleets (that data is available for) and has lower serviceability rates of all traditional supply chain fleets but two. This fleet is an example where contracted support is not always a simple implementation process where money can guarantee a high serviceability rate, as DND is currently paying $32,194.96 per flying hour for this fleet.[162] Although this figure should decrease as the contract matures; it still demonstrates a potential weakness in the contracting process. Additionally, it should be noted that this fleet has experienced significant operational challenges due to its support contract and the requirement to use DRMIS.[163] Initially Boeing had challenges in meeting its supply parts target in FY15/16 Q4 and FY16/17 Q4 due to inaccuracies of initial provisioning and stock levels.[164] Late in the project phase, it was determined that the engines for this fleet would be removed from the ISSCF concept for cost savings measures. However, there were several costly impacts to the RCAF including ad hoc initial provisioning to ensure requisite sparing was planned, unforecasted supply staff to provide support for items managed outside the contract, and split support concepts that require asset segregation both physically and

[159]Government of Canada, "CH-147F Chinook," last modified 29 June 2017, http://www.rcaf-arc.forces.gc.ca/en/aircraft-current/ch-147f.page.

[160]Greg Gagne, Data Analysis and Information Reporting Team Lead, DGAEPM, email correspondence with author, 7 January 2018.

[161]It should be noted that the only anomaly to this statement is for engines; DND owns all spare engines for this fleet as well.

[162]Matthew Wereley, Division Business Planner, DGAEPM, email correspondence with author, 21 December 2017.

[163]This fleet performs maintenance in DRMIS; however, aircraft spares are still tracked and managed in the contractor's own IT system. This support concept is in contrast to all other RCAF fleets who perform and track maintenance outside DRMIS.

[164]DGAEPM, Supply Health Indicator, FY14/15 Q4 Report, FY15/16Q4 Report, and FY16/17 Q4 Report.

electronically. This is an example where a financial decision can have a significant impact on a supply chain if it is not fully understood and analyzed.

The CC-177 Globemaster is a fleet of five, initially procured in 2007,[165] which is supported by the Foreign Military Sales (FMS) through the United States Government (USG) whereby DND pays an annual fee to partake in a worldwide CC-177 parts system, referred to as a virtual fleet. The concept of support for this fleet is that there is only one supply chain for all C-17 customers, which allows for specialized expertise on this fleet. All parts and equipment are USG owned, until issued to an RCAF aircraft. Boeing performs as an agent of the USG to manage the supply chain activities for this fleet and manages sub-contractors to accomplish these duties; this is a unique relationship compared to a traditional USG sub-contractor. In general, Boeing has a strong reputation for its responsive supply chain for the CC-177 fleet because of the efficient supply chain management of this fleet. For instance, crews can expect a 48 hour turnaround time for parts delivery for standard demands; which is certainly a force multiplier that the DND supply chain cannot compete with.[166] This lends to the 50.36% serviceability rate that the fleet has experienced on average since its inception. However, there is discontent with some first-line technicians because they must still use two supply chains – one through Boeing and one through USG.[167] Additionally, this fleet costs a mere $11,773.90 per flying hour which provides a positive outlook for a contracted support model.[168]

The first of the J-model Hercules was delivered in 2010 and was able to quickly ramp up to deploy in an operational theatre. The fleet shows 48.95% average serviceability rate and 3.77

[165]Royal Canadian Air Force, "CC-177 Globemaster III," last accessed 4 April 2018, http://www.rcaf-arc.forces.gc.ca/en/aircraft-current/cc-177.page

[166]Department of Defence, *C-17 Enterprise Supply Chain Sustainment Plan* (Georgia: December 2017), 5. Of note, to access this international parts system, the RCAF could not make any unique modifications to the aircraft. This is also the supply chain model that is being employed by the RAAF for their newly procured P8.

[167]1 Canadian Air Division, A4 Supply, Supply Improvement Questionnaire, Fall 2017.

[168]Matthew Wereley, Division Business Planner, DGAEPM, email correspondence with author, 21 December 2017.

maintenance hours. However, it should be noted that data is skewed because of how the contract was developed with respect to expected YFR and there was no maintenance performed for the first FY and only 8 hours performed in the second year of operations. To date, supply chain data for this fleet is not reported on in detail, other than to state that the contractor is meeting its contractual obligations under the established ISSCF.[169] It must be understood that one cannot directly compare data for the CC-130J and the CC-130H because, although these models perform the same function, the CC-130J is a technically superior platform that is capable of flying faster, higher and further with more cargo.[170]

The CH-149 Cormorant has been in service since 2001[171] and is a fully contracted platform whereby the contractor manages the entire supply chain and owns all spare parts until they are embodied on an aircraft. This contracted solution is simpler to execute because the Cormorant usually does not deploy to a theatre of operations, instead it is largely a domestic RCAF capability that completes its mission from its main operating bases in Canada. Escalating parts costs, increased repair and overhaul inductions and a weak Canadian dollar are all major influences on the supply chain for this fleet and for all three fiscal years, the WSM has determined that parts related issues are of concern.[172] However, DGAEPM does not track serviceability rates for this fleet because the maintenance is performed by the contractor. This aircraft averages 5,525 YFR at a cost of $19,763.57 per flying hour.[173]

[169]DGAEPM, Supply Health Indicator, FY14/15 Q4 Report, FY15/16Q4 Report, and FY16/17 Q4 Report.

[170]Royal Canadian Air Force, "*CC-130J Hercules,"* last accessed 4 April 2018, http://www.rcaf-arc.forces.gc.ca/en/aircraft-current/cc-130j.page.

[171]T.F.J. Leversedge, *Canadian Combat and Support Aircraft: A Military Compendium* (St. Catharines: Vanwell, 2007), 243.

[172] DGAEPM, Supply Health Indicator, FY14/15 Q4 Report, FY15/16Q4 Report, and FY16/17 Q4 Report.

[173]Matthew Wereley, Division Business Planner, DGAEPM, email correspondence with author, 21 December 2017.

Similar to the Cormorant, the CC-150 Polaris is a fully contracted fleet that came into service in 1992/1993 whose main role was long-range passenger and cargo transport.[174] Under an ISSCF, parts are fully owned by DND but they are managed by the contractor (considered government-owned material) in a system outside DRMIS; DND does not have real-time visibility of spares and equipment for this fleet. This aircraft has since been reconfigured as a multi-role tanker transport that performs strategic air-to-air refuelling activities to improve the global deployability of the fighter fleet. As a result of re-rolling this platform, the contract has had to be amended to allow for operations in a high-threat environment. This only took a few months to implement but creates a requirement for operational funding to meet the funding gap. However, there are no limitations or impact to operations as a result of this contract aside from the constant outsourcing risk of the contractor not having employees who volunteer to work in a high-threat environment. The current framework for performance measurement is currently being renegotiated but for all contract years to date, the contractor has surpassed expected performance standards. [175]

Conclusion

The complexity of each of the supply chains within the RCAF needs to be acknowledged to fully appreciate the resources and skill required to adequately support these fleets. This complex supply chain is easier to implement at main operating bases versus an in an expeditionary setting because the platforms, and thus their requirements, are established and constant. Consequently, support staff is locally trained for each supply chain. However, in a deployed concept, the lines of communication for each platform can be exceedingly varied and

[174]T.F.J. Leversedge, *Canadian Combat and Support Aircraft: A Military Compendium* (St. Catharines: Vanwell, 2007), 50.

[175]Andrew Langille, Aircraft Engineering Officer CC144/CC150, DGAEPM, email correspondence with author, 6 April 2018.

without direct knowledge of each fleet it is difficult to plan adequate operational sustainment for each fleet. As a result, support to operations can be impacted due to sustainment plans not being inherent.[176]

Based on this surface analysis, designed to be thought-provoking rather than definitive, one cannot readily conclude if a traditional supply chain model is less or more effective than a contracted method. One could argue that if the RCAF aimed to develop subsequent contracts similar to the CC-177 or the Royal Australian Air Force (RAAF) P8 Poseidon (see footnote 169 above) where an international supply chain is in place at several supply hubs world-wide, it would not limit its agility or responsiveness. Moreover, further consideration should be given to creating a standard contracted support construct so performance measurements and service level expectations could be consistent across all RCAF fleets. Finally, the ELE of an aircraft has a large role to play in how responsive a supply chain can be. Though choosing a contracted model, knowing that Canada tends to extend ELEs, may mitigate the risk of parts obsolescence but it will never eradicate it as one sees with the CH-146 or CH-149 fleets. What is clear is that contracted supply support can be a force enabler if applied appropriately with a sound contracting framework.

[176]Scott A. Boorman, "Fundamentals of Strategy: The Legacy of Henry Eccles." *Naval War College Review* 62, no. 2 (Spring 2009): 102.

CHAPTER 5: RECOMMENDATIONS AND CONCLUSION

He who controls the spare parts controls the operations.

-Scott A. Boorman, *Fundamentals of Strategy*

Introduction

Increasing the efficiency of the entire RCAF supply chain is a daunting task but it is a necessary task. Portions of the supply chain are inadequate when comparing its performance to the needs of the RCAF's mission: an agile and responsive support structure that has the reach to support worldwide operations. RCAF must increase its control of aircraft spares, as Scott Boorman opines, "he who controls the spare parts controls the operations."[177] The level of trust that is placed on the supply chain is inadequate for almost every fleet in the RCAF, according to AEPM's subjective supply health indicator and 1 CAD's supply questionnaire. The sustainment culture needs to improve if one can hope the overall support to operations improves. But the question that the RCAF has struggled with is how to achieve this. Although outsourcing can be seen as innovative and is an attractive option for that reason, simply developing contracted solutions without qualitative data to support decisions is not a supportable course of action. In addition to revamping many limiting supply policies, the RCAF must also review its processes for determining supportable equipment life expectancies and it must develop measurable performance metrics for all fleets.

The RCAF needs to strike a balance between traditional and contracted spares support where it can be agile and responsive while still being able to operate in a fiscal restraint environment. Supply chain management for any military force is an art in that, "…the military must not only be agile, flexible, robust and effective, but also lean and efficient. Balancing

[177]Scott A. Boorman, "Fundamentals of Strategy: The Legacy of Henry Eccles." *Naval War College Review* 62, no. 2 (Spring 2009): 102.

military requirements (effectiveness) with economy necessities (efficiency) is one major aspect of optimising military logistics."[178] This is the unique challenge a military faces when its government oftentimes demands effectiveness and efficiency but cannot fund both to equal proportions. Balancing these two characteristics is very much a political decision underpinned on thorough data analysis to determine how best to meet the political goals within the funding envelope provided.

It is naïve of the CAF to believe that outsourcing its supply chain will alleviate many of the challenges it has experienced over the past three decades. Even in 2018, one can argue that the CAF still has an immature supply chain due to its decentralized approach to supply chain management. The CAF, and thus the RCAF, still lacks the end-to-end ability to evaluate customer relationship management, customer service management, demand management, order fulfillment, and procurement. Until there is an inherent ability to assess these factors the RCAF will not see a drastic increase to its supply chain performance. It almost appears that the RCAF does not really know what it requires and thus cannot communicate the necessary changes to increase its performance. If the RCAF does not know what it needs then the assigned priority is not sufficient to create change.

The RCAF has been significantly challenged with the level of transparency in its supply chain. For items stocked in DRMIS, the system is unable to pull detailed and timely reports to truly evaluate its performance. For many contracts where contractors manage RCAF-owned spare parts, the RCAF has virtually no visibility on these holdings besides an annual spreadsheet denoting the contractor's inventory; thus depicting just a snapshot in time that is cumbersome to validate. Although this is changing with current aircraft spares contracts requiring all RCAF-

[178]Andreas Glas, Erik Hofmann, and Michael Eßig, "Performance-Based Logistics: A Portfolio for Contracting Military Supply" *International Journal of Physical Distribution & Logistics Management* 43, no. 2 (Mar 8, 2013): 105.

owned spare parts to be tracked in DRMIS, this is a challenge still.[179] As outlined in the *Arabian Journal of Business Management and Review*, "Information systems are considered as the nervous system of the supply chain, considerable efforts have been made by companies to integrate information flows internally, but to integrate information from all actors throughout the supply chain is in itself a major challenge."[180] This still poses a significant challenge for the RCAF, and DND as a whole, and impacts the organization's ability to evaluate the performance of the supply chain writ-large. Further pressure, in addition to financial resources, must be applied to contracts currently in place to increase the transparency to allow RCAF to better analyze its supply chain.

If the RCAF is serious about meeting its mission of being an agile and responsive organization it must apply a greater priority to its supply chain and to determining an optimal supply chain model. It must acknowledge the weaknesses in its current methodology and be willing to implement changes for long-term benefit. It could be argued that no matter what type of contracting framework model is applied, the RCAF will not benefit from great efficiencies if it cannot have better oversight of its entire supply chain. Sufficient importance is not placed on supply chain management; the focus is instead on the contracting framework itself.

Although it appears to be a flexible solution for the Sustainment Initiative to develop a unique contracted solution for each capability, this can actually be a weakness by creating added confusion for those at first and second line supply. What is important is to create a contract to better enable the customer, the users at each Wing, rather than develop a contract that is perhaps

[179]The Government Owned Materiel project has been put on hold because Director Materiel Group Comptrollership and ADM(Finance) were concerned with how to value the inventory and the documentation that is required for future audits because items have been purchased by contractors and thus they hold all invoices and quotes. Further, many items are more than seven years old, meaning background paperwork to determine prices is not always readily available.

[180]Balambo, Mohammed Amine, and Amr MIR, "Maturity of the Supply Chain and Arbitration Between the Internalization and Outsourcing of Logistic Activities" *Arabian Journal of Business and Management Review* 6, no. 10 (Mar 14, 2017): 19.

simple to negotiate or manage. The effects on the RCAF must always be at the forefront when developing any contracted support mechanism. Granted, some contractors will dictate what the supply chain will look like, and thus the contracting framework, such as the CC-177; what the RCAF and DAEPM must move away from is creating contracts and supply chains unique to Canada. The improvement of the RCAF supply support lies largely in the hands of each weapons system team within AEPM. Or said differently, the future of the supply community is at the mercy of its customers, the aerospace engineering decision-makers in DGAEPM, without a united opportunity to provide feedback or input.

Considerations

Stovepipe assessments appear to be the current practice in the supply community due to the decentralized command; to appreciate a comprehensive view of the supply chain an all-encompassing analysis must be done on the full supply chain. The RCAF would benefit from a review of policies as well as a review of its contracting methodologies with a true focus on enabling the RCAF's mission. Without this, the supply community will continue to be marginalized, support will not increase, and trust in the supply chain will continue to be minimal. In particular, warehousing levels and transit methods must be analyzed to move closer to civilian industry standards. Supply policies must encourage flexibility and responsiveness to operational demands. During this analysis the option of a centralized command should be explored because this could minimize stove-piping and maximize efforts to ensure all supply activities are focused on operations rather than business activities. A centralized command would enable a centre of excellence that could develop, oversee and manage lessons learned and best practices. The United States Air Force achieves this through its Air Force Sustainment Center that serves as its

hub for supply chain management and could be viewed as a model to explore.[181] Or to compare to a similar-sized force, the Australian Defence Force, employs a Joint Logistics Command who is responsible for all logistics activities and is commanded by a Major-General who is also responsible as Defence Strategic J4.[182] A central command would also be able to provide strategic oversight on contract development and how a proposed contract will impact operations. This solution does not need to command additional personnel resources as, the organizations and personnel exist, they are just scattered amongst various commands.

Near-Term Recommendations

No matter what type of contracting method that is used, performance metrics must be clear and measurable. More importantly, information systems must be able to produce accurate performance indicators that are accessible to DND at any given time. The current inability for most fleet's supply chains to produce relevant data creates a situation where one can never accurately assess the success of the supply chain; to determine if improvements should be sought. Moreover, developing standard performance metrics for all supply chains will improve DND's ability to ensure that the data is extractable and will also allow Procurement Authorities (PAs) to better assess their contracts. From a traditional supply chain approach, the RCAF is unable to access sufficient data to truly develop a representative depiction of the state of the supply chain. Once this ability is implemented, the supply community would be in a better position to make follow-on decisions and changes. From a contracted supply chain perspective,

[181]Department of Defence, *C-17 Enterprise Supply Chain Sustainment Plan* (Georgia: December 2017), 2. AFSC's has three primary functions including enterprise-wide planning of the Air Force supply chain, exercising command and control as a single point of contact for customers to resolve immediate logistics issues; and acts as the single point of entry and authority for enterprise supply chain information. One might challenge that the USAF is a much larger organization that the RCAF cannot emulate but it could be suggested that their command structure could be explored to develop a sustainment command similar to what was developed for MILPERSCOM and CFINTCOM.

[182]Australian Government, Department of Defence, "Joint Logistics Command," last accessed 24 April 2018, http://www.defence.gov.au/jlc/.

the metrics that are used are vastly different between contracts, and oftentimes metrics have been developed without assessing the capabilities of the corresponding information systems. As a result, it is difficult to definitely determine how well the contractor is performing. It would also be ideal to have all contracts measured against the same performance metrics to allow for efficiencies across the AEPM and an increased ability to share best practices and lessons learned. But this will not be useful without proper training of PAs on how to manage and oversee contracts and performance metrics.[183] This could also alleviate the OAG observation of poor contractor accountability. PAs must be comfortable and confident with a contract and what is required of their specific contractor to meet supply chain requirements. More focus is placed on the financial aspect of managing a support contract at the expense of the accuracy and transparency of contractor support to the RCAF.

Supply experts must be involved during the formation and implementation phases of any contract. As previously suggested, this is a critical time where expertise in supply chain management, and how it relates to the RCAF, is critical. This could assist the organization with more accurate in-service support costs, which, as the OAG outlined in a recent audit, the CAF is poor at forecasting. Moreover, the CAF must move away from being prescriptive on how a contractor must do business but rather rely on sound performance measurements to ensure desired service rates are achieved.

Unique modifications to CAF requirements can also be restricting to the long-term support of an aircraft. The CAF must better weigh the pros and cons of installing unique

[183]Through her experience as DAP 3-4 at DGAEPM, the author has been told by numerous PAs that they have not been adequately trained on managing contracts from a supply chain perspective. The focus tends to be on contracting itself, and even that, the PAs are typically learning on the job. This creates the opportunity for an organization to have personnel with decision-making authority without the requisite knowledge to accurately execute their tasks.

modifications, to ensure it is will to take the risk of obsolescence.[184] Being a small air force, the RCAF does not command enough attention from defence industry to negotiate extended manufacturing or repair lines for unique items whose life is extended beyond the initial forecast.

Additional emphasis must be placed on stock levels and forecasting usage. This is a simple activity for most supply chains but requires discipline and a firm understanding of one's supply chain. For instance, parts must be allocated to each depot based on usage to improve turnaround times for parts demands. Stock levels needs to be determined to accurately reflect usage rates to ensure that items are neither overstocked nor understocked. These are all efficiencies that the RCAF has witnessed through its contracted supply chains but is still challenged to implement for its traditional supply chains.

When equipment life expectancies are looking to be extended, an in-depth look at the ability to support the fleet from a supply perspective is paramount. Much of the supply frustration that arises with an aging fleet is parts obsolescence. The RCAF needs to determine the risk it is will to take from a serviceability and parts availability perspective before it proposes an ELE extension. It is realized that ELE extensions are a result of political pressures and funding limitations; however, DND must be able to provide an accurate analysis on forecasted costing. It is also important for a fleet to declare an acceptable level of degradation to ensure expectations are managed. In general, the RCAF does not adhere to initial ELEs and thus, initial costing and sparing levels that are initially forecast become inadequate. The difficulty with ELE is that it becomes a numbers game whereby the military must keep the forecasted costs within a spending envelope to ensure it gets treasury board approval but this is done at the cost of long-term extended support to the fleet. Perhaps clear acknowledgement needs to be presented to again

[184]Unique modifications are not military components required to meet capability expectations but rather a unique modification that Canada deems necessary that other militaries are not also employing.

ensure that expectations are managed. The supply chain is regularly blamed for insufficient support; yet, it is the result of political decisions that constrains its ability to meet operational demands. By formally acknowledging this and setting lower serviceability rates or demand satisfaction rate, perhaps the trust in the supply system could begin to be restored.

Long-Term Recommendations

To have a truly efficient supply chain, the RCAF must be able to have an information system that incorporates all data from contractor systems. Without this information, commanders are hindered from making educated decisions. The current IT structure where systems are not interconnected and quality reports cannot be produced fractures the RCAF's agility. What the RCAF would benefit from is having the ability to determine a cost/benefit analysis of any given contract from a supply chain perspective at any given time. This would allow the organization to make objective decisions on how best to support domestic and expeditionary operations.

During the in-depth analysis of the supply chain, an assessment of personnel is required. In 1 CAD's supply survey 70% of respondents indicated that supply was understaffed and overtimes maintenance personnel are performing supply activities in order to minimize delays.[185] Perhaps having minimal personnel to perform supply functions for a supply chain that is not straight forward is impacting the community's ability to meet expected performance levels. The structure of supply organizations in the RCAF have not been examined since it has made a move away from traditional supply chains. There has been an expectation that a contracted supply chain will decrease the level of military supply support required; however, it can be argued that it has instead increased the complexity of the supply chain and warrants additional scrutiny to optimize sustainment.

[185]1 Canadian Air Division, A4 Supply, Supply Improvement Questionnaire, Fall 2017.

The culture of RCAF sustainment must improve to better meet the expectations of its customers. To achieve this, the supply and maintenance communities need to increase cross-communication and develop a strategy to work towards the same goals at all levels of the organization. Expectations and capabilities on both sides need to be clear to mitigate conflicting priorities. Both communities ultimately have the same goal; to support the RCAF's mission, yet are not always aligned in achieving this goal. If closer coordination can be achieved between these two entities, one could expect a more cohesive environment thus improving the overall culture of the RCAF.

Finally, worth repeating because it is so instrumental to the future of the supply chain, a centralized command structure for sustainment activities is critical to provide a focus for all support personnel and activities. Similar to the Australian's approach to support, a single command to orchestrate sustainment activities will provide a comprehensive approach to better support all CAF operations.

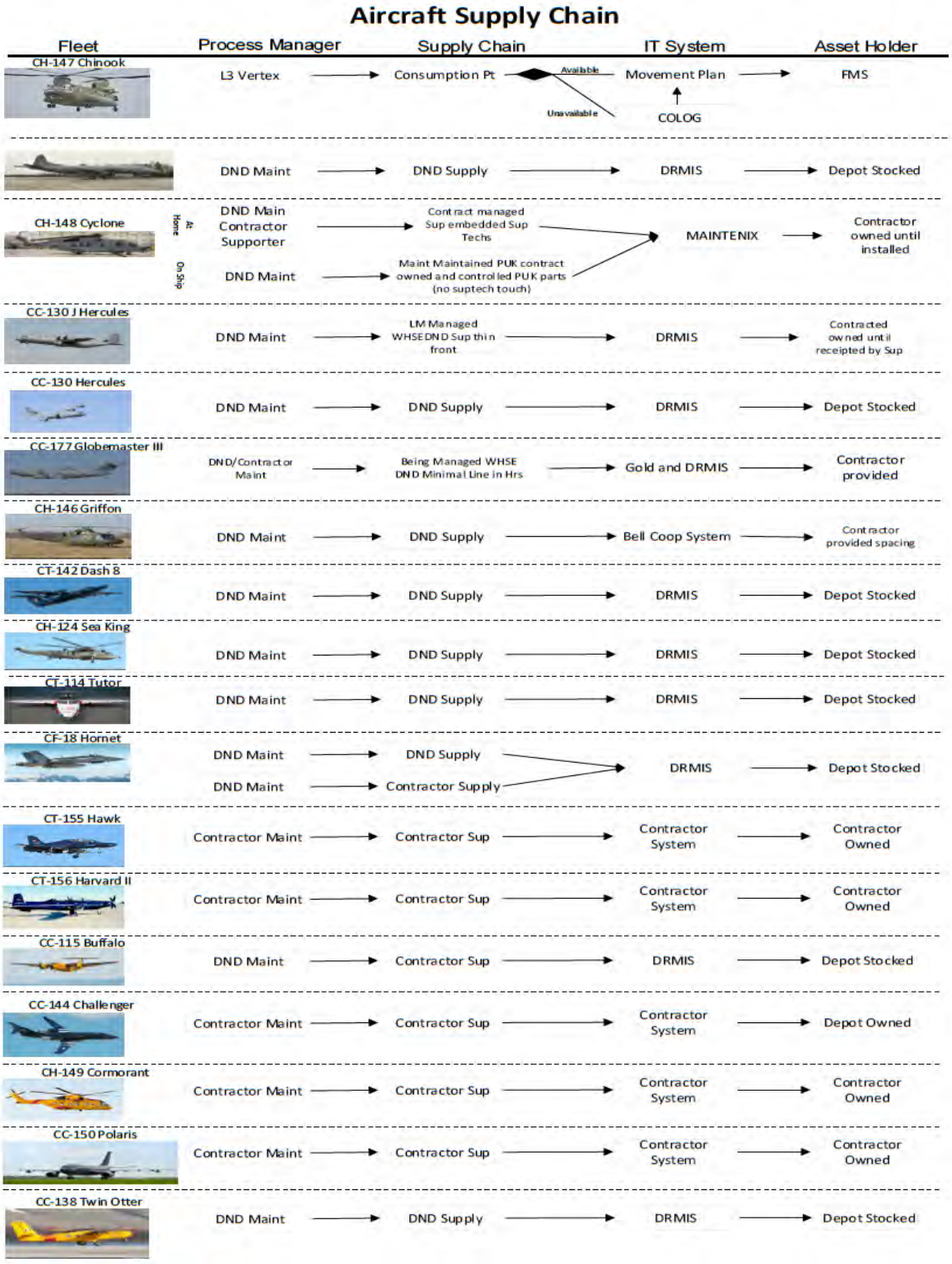
Conclusion

The RCAF has an opportunity to better the supply support that is currently offered to its platforms to increase its ability to project air power. Sustainment is the foundation to all command functions. Strategic vision from one sustainment command will allow the RCAF to prioritize and repair the identified supply chain weaknesses that leave the RCAF vulnerable. Currently, the RCAF is on a path toward outsourcing its agility and responsiveness because it does not adequately develop and manage its existing aircraft spares contracts. Contracted supply chains have a place in the RCAF; however, they must be better developed and managed. This cannot be a subjective decision based on opinion alone. Additional rigour must be applied to all

spare support contracts because of the high indirect stakes that exist, and ultimately impact the RCAF's ability to achieve its mission.

It is critical that a thorough examination of current practices is completed to position the organization in a manner that will allow the new defence policy to be readily supported. The operational community needs to regain confidence in supply's ability to support operations. Without that, while endeavouring to implement the current defence policy over a 20-year horizon, the supply chain will continue to be fragmented and unresponsive. But is this too little, too late?

Appendix 1 – Supply Chains for RCAF Fleets



Appendix 2 – Planning Assumptions for Support Contracts

Assumption	Actual situation and impact	Examples
Support costs for new equipment will be the same or less than for the previous equipment.	Support costs were as much as two to three times more than those of previous equipment due to enhanced operational capability and additional contractor responsibilities.	The support contract to maintain the Cyclone helicopter includes some services that were previously performed by National Defence, such as managing spare parts and warehousing, support, and maintenance for training programs. The contract will be about $5.8 billion to 2038 (plus departmental operating costs), about three times the cost of supporting the 50-year old Sea King helicopter.
	Impact: These costs put pressure on availability of funds to support other types of equipment.	The support costs to maintain the CC-130J Hercules aircraft is approximately $18,000 per flying hour compared with $11,000 per flying hour for the previous Hercules model.
Equipment will be delivered on schedule.	Some delivery schedules were significantly delayed.	The Cyclone helicopters' expected delivery date of 2008 was delayed to 2018 for helicopters meeting all stated requirements. This required the reversal of modifications to ships that will house the Cyclone. It also required $2.3 billion more in support costs to align the contract with the revised delivery schedule for an additional 10 years to 2038. The delay will also result in reduced capacity for training and operations.
	Impact: These delays resulted in increased costs for such things as extending the life of the previous equipment, and increased personnel costs to support old and new equipment. It also resulted in not having the new equipment for training and operations.	
Personnel will come from crews operating and servicing existing equipment.	Insufficient personnel were allocated to operate and support the equipment.	To support the Chinook helicopter, the Royal Canadian Air Force initially estimated 641 members, was approved for 482, and allocated 403 to operate and support the helicopter. However, as of July 2016, it had filled only 322 positions. There were not enough maintenance personnel, pilots, and crew to support and fly at the level that was originally planned.
	Impact: The shortage of personnel reduced the level of equipment usage, availability, and maintenance that could be carried out.	Furthermore, there were 34 percent fewer pilots than planned.
New equipment will operate as planned or at the same level as	Equipment operated less due to funding and personnel constraints.	The CC-130J Hercules aircraft, Chinook helicopter, and Globemaster aircraft were flying less than originally planned

previous equipment.	Impact: National Defence paid for a level of service it did not use, could not meet all operational and training requirements, and had excess capacity.	(Exhibit 7.3).

Source: Office of the Auditor General. *Chapter 7 Operating and Maintenance Support for Military Equipment – National Defence.*

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