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AIRCRAFT FLEET RATIONALIZATION: IS CANADA'S AIR FORCE MISSING STRATEGIC OPPORTUNITIES?

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ABSTRACT

The Canadian Forces (CF) were clearly unsustainable when they entered the 21st Century. After years of declining budgets; however, recent governments determined that re-investment in the military was necessary in response to the post 9/11 security environment. Despite substantial defence budget increases, the many years of neglect, coupled with the rising cost of weapon systems, require a continued focus toward economizing. This prescription is necessary because of the strategic economic and demographic environments. The former indicates that the substantial long-term investment necessary will not likely materialize and the latter demands that personnel economy, flexibility will be needed in a smaller more competitive future workforce.

The costs of air force weapon systems are of such magnitude that they could in fact easily exhaust the CF's entire re-capitalization budget. For this reason, air force transformation initiatives are truly a CF strategic concern. Unfortunately, the air force's propensity toward numerous small fleets stands in stark contrast to the trends in other countries and is counter to economizing requirements. Small fleets produce no economies of scale, limit personnel efficiency, and cannot deliver acceptable availability to operational commanders. Small fleets also limit Canadian industry's ability to effectively compete in an increasingly consolidated, global industry. The air force requires an acquisition strategy to guide future weapon system purchases, but in the interim should reduce the number of types of fleets and require new fleets to demonstrate quantifiable life-cycle cost savings.

Examination of this issue indicates that perhaps Canada still struggles to take a truly strategic, top down, pan-CF approach to acquisition.

CHAPTER 1

INTRODUCTION

After years of decline, the 2005 federal budget signaled a notable change by committing over $12 billion of additional money to defence spending for a five year period.[1] This is a substantial average spending increase of over $2.4 billion per year to be put toward much needed recapitalization, operations and maintenance (O &M), and personnel costs. The new investment will bring 2006 defence spending to about $14.3 billion, or 1.2% of Gross Domestic Product (GDP), and permit the Department of National Defence (DND) and the Canadian Forces (CF) to begin the transformation necessary to respond to the new security environment ushered in by the terrible 2001 9/11 terrorist attacks in the United States and subsequently in London and Madrid. The budget commitment was a concrete step toward financing Canada's recently released 2005 Defence Policy Statement (DPS), which provides a new vision for the CF and charts the transformation necessary in light of the new security realities.[2] Although this is the path chosen by the previous government, the newly elected government ran on a platform of further strengthening defence through budget increases in addition to those announced in 2005 and these promised increases materialized in the May 2006 budget announcement. This renewed interest surely bodes well for DND; however, after years of spending reductions, are the investment commitments sufficient to offer a much needed reprieve to the CF or are there still tough choices ahead?

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[1] Department of Finance, *Budget Plan 2005*, (Ottawa: Department of Finance Distribution Centre, 2005), 207.

[2] Department of National Defence, *Canada's International Policy Statement, A Role of Pride and Influence in the World DEFENCE* (Ottawa: Department of National Defence, 2005).

This paper will examine DND's present financial position, the strategic environment, and implications for Canada's armed forces. It will demonstrate that the CF have atrophied past the tipping point and that the government will have great difficulty, even in the present security environment, dedicating sufficient funds to correct a problem that has been decades in the making. A detailed examination of the air force is provided because, as the paper will demonstrate, it is presently the most vulnerable element of the CF and this liability has the potential to significantly influence the end state of the entire armed forces. Implications and a potential way forward are offered.

The aim of this paper is to demonstrate that Canada's air force must transition to a reduced number of aircraft fleets that are large and robust in number of aircraft in order to develop a capability suitable for future expeditionary operations.

CHAPTER 2

THE STRATEGIC ENVIRONMENT

UNSUSTAINABLE ARMED FORCES

After years of successive deep cuts in defence spending, the CF entered the 21st Century bloodied and bruised. In his 2001 - 2002 Annual Report, the then Chief of Defence Staff, General R.R. Henault, provided a frank assessment:

> …while our strategy for the future is sound, the status quo is not sustainable. Operational and personnel tempo remain high, we face significant recruiting and retention challenges, we are carrying a significant amount of aging infrastructure, and we need to modernize equipment and capabilities in key areas. Most

> importantly, perhaps, and as many of our allies are doing, we need to continue transforming the CF into an organization that has the capabilities needed for the future, and divest ourselves of those that are less relevant to today's security environment.[3]

This along with other analyses prompted many to consider the way forward and invariably they reached two possible conclusions: either the CF would need to be significantly scaled back, shedding considerable core capability in the process, or alternatively a substantial re-investment on the part of the government would be required. Many hoped for the latter, but steeled themselves for the former.

SIGNIFICANT INVESTMENT REQUIRED

Although the government began modest defence budget increases in 2001, the conventional assessment was that considerable funds were required. The results of a 2004 research project conducted by the Queen's University Defence Management Studies Program determined that the CF needed a consistent injection of at least $2-3 billion every year for the next 15 years in order to provide the estimated $50 billion needed to address CF capital replacement and transformation requirements alone. The study also identified that additional funds were needed to address rising O & M and personnel costs. All totaled, the conclusion was that defence spending would need to increase to 1.6% of GDP, or an additional $5 billion annually, in a determined, consistent, long-term manner.[4] Without such an injection, the study estimated that there would only be

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[3] General R.R. Henault, *Chief of Defence Staff Annual Report 2001 – 2002*; available from http://www.cds.forces.gc.ca/pubs/anrpt2002/message_e.asp; Internet; accessed 14 February 2006.
[4] Douglas L. Bland, *et al*, *Canada Without Armed Forces?* (Montréal & Kingston: McGill-Queen's University Press, 2004), 49, 110.

sufficient capital funds available to transform one and a half of the CF Commands into a modern force that would be inter-operable with our allies. In short, either the army, navy, or air force could be fully updated, but not all three. The remaining two Commands not recapitalized and transformed would essentially lose their effective combat capability and become irrelevant. Of course, the assessment assumed that the CF was capable of making the difficult choice where the money would be spent because simply parceling insufficient funds amongst the three Commands would produce inadequate results for all three and strategically nothing would be accomplished. In the case of the air force, the study sounded a particular warning note. It predicted that unless there was a significant change, due to the age of its equipment and the cost to re-equip, it would be the first to lose its core capability, estimated to occur in the 2008 – 2013 period. Depending upon where DND chose to spend its money, either the army or the navy were predicted to follow by losing core capability in the 2013 – 2018 timeframe.[5] Specific warnings for the air force are consistent with other assessments which conclude that "each generation of combat aircraft has been significantly more expensive in real terms than the one it replaced."[6] To put the Queen's study into perspective, in 2005 the Senate Defence Committee conducted its own analysis and concluded that defence spending should increase to about $25 - 35 billion annually or 2.2 – 3.0% GDP![7] Clearly the increased defence expenditures recommended by the Queen's study look paltry in comparison;

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[5] Douglas L. Bland, *et al*, *Canada Without Armed Forces?* (Montréal & Kingston: McGill-Queen's University Press, 2004), 49, 109.
[6] Michael Alexander and Timothy Garden, "The Arithmetic of Defence Policy", *International Affairs 77*, 3 (2001), 516.
[7] Senate Committee on National Defence, *WOUNDED, Canada's Military and the Legacy of Neglect: Our Disappearing Options for Defending the Nation Abroad and At Home*, September 2005; available at http://www.parl.gc.ca/38/1/parlbus/commbus/senate/Com-e/defe-e/rep-e/repintsep05-e.htm; Internet accessed 18 February 2006.

although, when taken together, the two studies identify a consistent need for a substantial long-term commitment to defence spending or recognition that capability will be lost.

Some might argue that the Queen's study has been over taken by events since it was released prior to the 2005 DPS, the 2005 budget increases, and the election of the new government. On the contrary, the study, an external examination of the CF, combined with the 2002 CDS Annual Report, an internal view, together provide a stark benchmark. Review of the study reveals that although released in 2004, it nonetheless remains quite consistent with the transformation agenda articulated in the 2005 DPS. For example, the study assumes that the army's Leopard Main Battle Tanks will be replaced by the Stryker Mobile Gun System and the CC-130 Hercules will be replaced by the C-130J models. In fact, the 2005 DPS calls for additional capabilities that were not addressed in the Queen's study, for example medium – heavy lift helicopters, new ships to support the Standing Contingency Task Force, and Uninhabited Air Vehicles (UAVs).[8] Generally the 2005 DPS aligns well with the new government's election platform. Therefore, one can only conclude that the Queen's study is a conservative assessment of the increased spending requirement and that, although welcomed, the 2005 announced spending increases are insufficient to satisfy defence needs. The 2005 budget promised over $2.4 billion per year for five years to be spent toward capital, O & M, and personnel while the Queen's study assessed that at least this amount was required for re-capitalization alone and more would be required to address O & M and personnel requirements – the latter being particularly challenging because personnel are the most expensive costs and this will be compounded by goals to increase the size of the CF.

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[8] Department of National Defence, *Canada's International Policy Statement, A Role of Pride and Influence in the World DEFENCE*, 2005, 14.

Although the new government promises continued substantial defence spending, as the next paragraphs point out, it is not likely that this will be sustainable due to strategic economic considerations. As a result, difficult choices regarding defence capability will need to be made, particularly regarding the CF's air force capabilities which are particularly vulnerable.

STRATEGIC ECONOMIC CONSIDERATION

Economically, Canada has performed exceptionally well for the past number of years. Posting a budget surplus for the last eight years[9] and forecast to continue for at least the next two years, Canada stands out as the sole exception in the Organization for Economic Co-operation and Development (OEDC) Group of Seven largest economies (G-7). All other G-7 countries have posted budget deficits for at least the past four years and all are expected to post deficits between 3% - 6% of GDP for the next two years. Of particular concern to Canada, because of our integrated economies and destination for 85% of our exports, is the American situation. The United States is carrying a massive debt load, has posted a budget deficit for 15 of the past 18 years and is expected to continue to post a deficit of 4.2% and 3.2% of GDP for 2006 and 2007 respectively.[10] Unfortunately there are no signs on the horizon that American deficit spending trends will cease any time soon. Although fiscal balance is only one of many economic indicators, it is a measure of

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[9] G. Bruce Doern, *How Ottawa Spends, 2005-2006* (Montréal & Kingston: McGill-Queen's University Press, 2005), 233.

[10] Organisation for Economic Co-operation and Development, Economic Outlook No. 78, EO78 Annex Tables, *Fiscal Balances and Public Indebtedness*; available from http://www.oecd.org/searchResult/0,2665,en_2825_495684_1_1_1_1_1,00.html; Internet: accessed 14 February 2006.

a government's fiscal flexibility. Clearly, by this measure, Canada stands out as an island of relative economic prosperity when compared to its peers. This position has allowed the country to regain control of its financial situation. The government has started to pay down the debt and as a result now has the financial latitude to spend on other programs, including defence. Notwithstanding, given that we are a trading nation, the long-term, sluggish performance of all other G-7 countries, especially the United States, is concerning. Will this situation lead to a slowdown in the world economy and adversely affect the situation in Canada? Conversely, given a Juglar Business Cycle of nine to ten years between GDP expansion and contraction, are the remaining G-7 economies about to soon turn the corner and commence a new cycle of world prosperity which will benefit Canada and if so will we remain in an opposing cycle to the other G-7 nations?[11] Although it is not possible to predict with certainty the nature of the future world economy, in light of the heavy indebtedness of almost all of the world's leading G-7 economies; it would not be prudent to assume that Canada's relative prosperity will continue unabated, especially since we have just profited from eight successive good years. Certainly another string of 15 consecutive years of prosperity and surpluses to enable Canada to heavily re-invest in its defence capability is not likely. Only one of the 28 OECD countries, South Korea, has accomplished such a feat in the period from 1988 – 2005.[12] Although Canada could repeat South Korea's performance, it would not be prudent to assume that this will be the case.

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[11] Douglas Greenwald, *et al*, *The McGraw-Hill Dictionary of Modern Economics*, 3rd ed. (New York: McGraw-Hill Book Company, 1983), 51.

[12] Organisation for Economic Co-operation and Development, Economic Outlook No. 78, EO78 Annex Tables, *Fiscal Balances and Public Indebtedness*; available from http://www.oecd.org/searchResult/0,2665,en_2825_495684_1_1_1_1_1,00.html; Internet: accessed 14 February 2006.

Elevated Defence Spending Unsustainable

Since defence is the largest single discretionary spending of the government, the tendency is to use it to cushion other economic pressure points, for example during recessions or periods of limited fiscal flexibility. This was aptly displayed during the 1990s when defence spending was significantly curtailed in order to help reduce the deficit. During this period of extreme government constraint, spending was also curtailed on many other national programs, such as transfer payments to the Provinces and Territories, health care, education, infrastructure spending, etc. As a result, the federal government now has tremendous pressure to spend in numerous areas, not just defence. In fact, historically Canadians have demonstrated that they support spending on social programs over defence.[13] For this reason the 2005 budget increases for defence drew criticism because of the perceived need to spend elsewhere.[14] In looking to the future, it is reasonable to conclude that when the economy does slow down and the government must curtail its spending, it is likely that defence spending will be the first to be constrained. After many difficult years of reigning in the deficit caused by over spending on social programs, it is very unlikely that the government will return to this spending approach in order to support future social programs or defence if the economy were to take a down turn.

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[13] J. Craig Stone and Binyam Solomon, "Canadian Defence Policy and Spending," *Defence and Peace Economics*, Vol 16(3), (June 2005), 150.
[14] Patricia Hartnagel, "Hefty Increase for Military Indefensible," *Edmonton Journal*, 16 December 2005, A17.

Therefore, in view of the strategic economic environment, assuming that Canada will be in a position to dedicate approximately 1.6% of its GDP to defence continuously for the next 15 years would not be wise.

STRATEGIC DEMOGRAPHIC CONSIDERATION

In addition to considering Canada's likely future strategic economic situation, changing demographics promise to have a strategic influence on the nation and thus must be considered when contemplating the future of the CF.

Smaller Future Workforce

Regarding demographics, "the emerging environment suggests that the Canadian economy will experience employee shortages in the next 10 – 15 years, due to increasing retirement rates and a smaller replacement workforce."[15] This aging workforce phenomenon is expected to permeate Canadian society and not be stemmed by immigration. Not only will this internal factor potentially have an adverse effect on Canada's long-term economic capacity, but it is also expected to affect all Western and Asian societies.[16] Therefore this factor could also potentially exert external pressure on Canada by adversely affecting the very nations which fuel international economies. The globalization and integration of the international economies renders this a very complex

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[15] Department of National Defence, *HR Strategy Horizon One* (Ottawa: Department of National Defence, 2002), 10.
[16] Margaret Patrickson, "Asia's Ageing Workforce: The Emerging Challenge For The Twentieth Century," *International Journal of Organizational Behaviour*, 3(1), 54.

problem and therefore it is impossible to forecast the extent or magnitude of the economic impact that might be caused by demographics, if any, but it is clear that the smaller Canadian workforce will pose significant challenges.

The forecasted demographic situation has a significant implication for the CF because it will drive stiff competition with industry to attract personnel, particularly the brightest and the best. The "net-centric", sophisticated weapon systems of today and the near future demand an increasingly educated and professional military. This situation will put the CF in direct competition with industry for educated and/or trained personnel and in direct competition with civilian academic institutions for potential students if we wish to attract recruits with a promise of education. Unfortunately, in the looming competitive environment, the CF has two challenges that others do not face.

Visible Minorities Become Majority In 2040

Firstly, an increasing percentage of the available workforce will be made up of visible minorities who the CF, despite concerted effort, have traditionally had great difficulty attracting. By 2016, visible minorities are expected to make up 20% of Canada's population and will outnumber Caucasians by 2040.[17]

[17]Department of National Defence, *HR Strategy Horizon One* (Ottawa: Department of National Defence, 2002), 6.

Inflexible Personnel Structure

The second unique challenge facing the CF is the relatively inflexible nature of its personnel structure. Specifically, we attract and recruit individuals into the CF and they are the ones that are developed for more senior responsibilities. In the civilian sector, however, it is common practice for individuals to enter, and leave, at any level. This makes it much easier for industry to respond to personnel shortages. Instead of taking years to train replacements, they simply hire them immediately. In a competitive environment short of personnel, companies simply raise salary and benefits to attract the necessary talent.

Recruit From Entire Society
And Create Internal Flexibility

Demographic concerns are not merely theoretical notions that will need to be addressed in the distant future, almost half a century away in the 2040 timeframe, but rather decisions today must start to address them. For example, the aircraft that we might purchase and bring into service today will not yet be retired in 2040. As this paper will fully demonstrate in the following pages, the purchase of today's equipment essentially defines the personnel structure for a considerable number of years ahead. As a result, future critical factors, such as the strategic demographic situation, must be fully considered now as acquisition decisions are taken. Even creative acquisition, such as leasing arrangements, will not permit the realities and difficult decisions of today to be postponed. As will be seen later, creative acquisition through a lease generally requires a

long-term commitment and therefore has a similar timeframe in effect to a traditional purchase.

In order to best position the CF to succeed and to fully address the anticipated future strategic demographic situation, the CF must focus on recruiting from all segments of Canadian society. They must aggressively seek-out and attract those with the potential and skill to excel in an increasingly complex, sophisticated military environment. Further, transformation initiatives must ensure that future core capabilities build in as much internal workforce flexibility as possible in order to permit the CF to respond dynamically to the fluid, competitive personnel environment that will likely be short of resources. Specifically, this means establishing broad employment areas that will permit personnel to be rapidly re-assigned internally in response to unforecasted shortages in higher priority employment areas. Although the CF will always likely have a more restrictive personnel structure than civilian industry because of the need to "grow" expertise from recruits, nevertheless, considering the strategic demographic environment, this situation must be mitigated by creating as much internal flexibility as possible.

CHAPTER 3

IMPLICATIONS FOR DND – FURTHER ECONOMY REQUIRED

DND's future must continue to be planned with great care because of the strategic economic and demographic realities that lie ahead. At $14.3 billion per annum, not only is the Department spending a very substantial amount of the government's discretionary funds, but because of the lack of recapitalization over an extended period of time, this

substantial funding is likely insufficient to accomplish the modernization, transformation agenda. Even if additional funds were assigned, it is equally unlikely that the government could sustain such a commitment for the approximate 15 year period required. Likely the government will have difficulty supporting its present commitment over the long term let alone an increased one. To highlight this point, in a recent interview, the Chief of Defence Staff acknowledged that DND did not receive all the money promised in the last federal budget.[18] In addition to these budgetary challenges brought about by the constraints of the strategic economic environment, the situation will be compounded by the strategic demographic environment, particularly the smaller Canadian workforce of the not too distant future.

Transformation must produce a sustainable force that is not only relevant to the new security threat, but also consistent with the financial and demographic environment in which it must exist. Therefore, in charting the way forward, the CF appears to be faced with continued difficult choices of further economizing and/or shedding capability. To this end, the army has provided a tremendous example to the other environments. Deciding that it could not continue to invest in both mechanized (tracked) and motorized (wheeled) formations, it has taken the bold decision to focus on a medium weight wheeled capability standardized on a family of Light Armored Vehicles (LAVs). This decision saw Canada become the first nation in NATO to relinquish main battle tanks from its inventory. Given the nature of the present threat, the army appears to have selected the correct line of advance required to align with the strategic environment. As the navy ponders the future, it too sees the need to economize and therefore intends to

[18] Mike Blanchfield, "Rethink recruiting: Top General: Let landed immigrants who sign up get fast-tracked citizenship, Hillier says," *The Ottawa Citizen*, 25 February 2006, A3.

replace the DDH 280 Iroquois Class Destroyers and FFH 330 Halifax Class Frigates with a common class known as the Single Class Surface Combatant. The army and navy approaches are consistent with the Vice Chief of Defence Staff's (VCDS) procurement reform goal of operating less types of equipment in order to be able to acquire and sustain future weapon systems which will be more expensive than the systems that they replace.[19]

CF & AIR FORCE: AN INEXTRICABLY LINKED FUTURE

Like the army and the navy, Canada's air force must also plan to economize because as it "…enters the 21st Century, it is a fragile organization with approximately half the people and fewer than half the aircraft it had in 1989."[20] These cuts have produced an inefficient structure with sustainability concerns because all the same base infrastructure, and many of the same units, continue to be carried.

Air Force Transformation

The air force transformation strategy for the future is articulated in *Strategic Vectors, The Air Force Transformation Vision* which focuses effort on the following eight vectors: Results-Focused Operational Capability, Responsive Expeditionary Capability, Transparent Interoperability, Transforming Aerospace Capabilities, Transformation-

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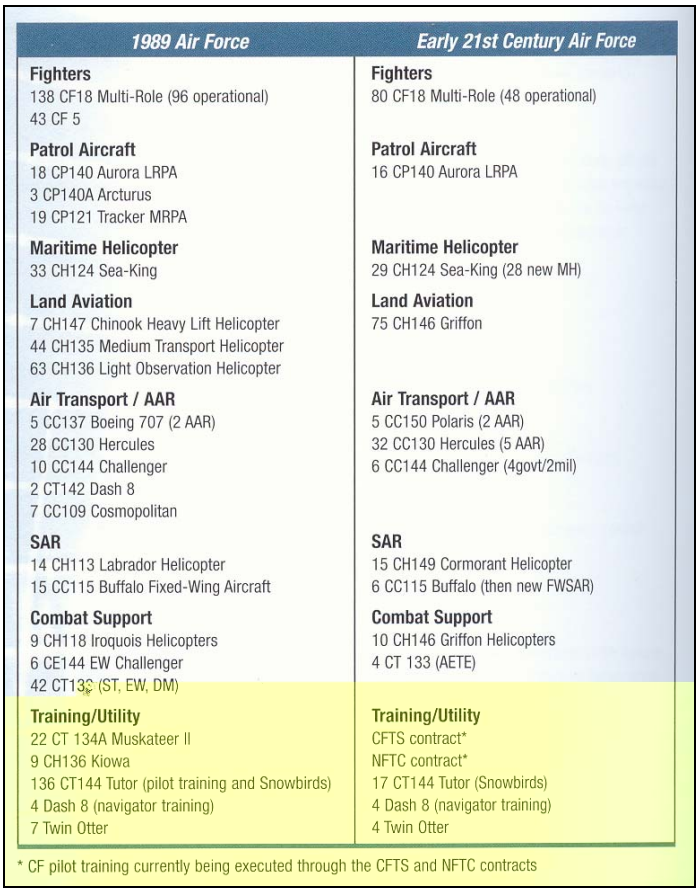
[19] V. Poter, *National Defence Analysis – Procurement Reform*; available from http://www.vcds.forces.gc.ca/dgsp/pubs/rep-pub/analysis/procur/intro_e.asp; Internet; accessed 30 January 2006.

[20] Department of National Defence, *Strategic Vectors, The Air Force Transformation Vision* (Ottawa: Director General Air Force Development, 2004), 22.

Enabling Leadership, Multi-Skilled And Well-Educated People, Actively Engaging Canadians, and Improved Resource Stewardship.[21] The primary economizing effort is to reduce infrastructure, i.e. base closure, and through it produce a streamlined force footprint. Past initiatives such as this have proven difficult to accomplish and even when limited success occurred, it took years to achieve – witness Canadian Forces Base (CFB) Summerside, Chatham, and Shearwater closing or reduction efforts. In essence they become political issues connected to votes. Even closing a base in an opposition riding is difficult because it is a sure way to guarantee votes for the opposition in the next election. Due to the difficulty associated with base closure, alternate economizing efforts must also be considered. Put simply, the air force must seriously consider reducing the types of equipment it is planning to operate in the future. The need to reduce the number of the types of equipment to be operated in order to address future sustainability concerns is the conclusion drawn by the army, the navy, and the VCDS as they looked forward. Unfortunately there appears to be an air force intention to follow quite an opposite path by acquiring numerous small niche fleets. This philosophy promises to exacerbate the air force's already difficult sustainability problem. In the near future, the air force will have an unprecedented number of small niche fleets comprised of about 15 aircraft or less – these include, but are not limited to, Cormorant helicopters, Fixed Wing SAR (FWSAR) aircraft, medium – heavy lift helicopters, CC-130 replacements, and potentially UAVs, Figure 3.1 refers.

[21] Department of National Defence, *Strategic Vectors, The Air Force Transformation Vision* (Ottawa: Director General Air Force Development, 2004), 5.



1989 Air Force	Early 21st Century Air Force
Fighters 138 CF18 Multi-Role (96 operational) 43 CF 5	**Fighters** 80 CF18 Multi-Role (48 operational)
Patrol Aircraft 18 CP140 Aurora LRPA 3 CP140A Arcturus 19 CP121 Tracker MRPA	**Patrol Aircraft** 16 CP140 Aurora LRPA
Maritime Helicopter 33 CH124 Sea-King	**Maritime Helicopter** 29 CH124 Sea-King (28 new MH)
Land Aviation 7 CH147 Chinook Heavy Lift Helicopter 44 CH135 Medium Transport Helicopter 63 CH136 Light Observation Helicopter	**Land Aviation** 75 CH146 Griffon
Air Transport / AAR 5 CC137 Boeing 707 (2 AAR) 28 CC130 Hercules 10 CC144 Challenger 2 CT142 Dash 8 7 CC109 Cosmopolitan	**Air Transport / AAR** 5 CC150 Polaris (2 AAR) 32 CC130 Hercules (5 AAR) 6 CC144 Challenger (4govt/2mil)
SAR 14 CH113 Labrador Helicopter 15 CC115 Buffalo Fixed-Wing Aircraft	**SAR** 15 CH149 Cormorant Helicopter 6 CC115 Buffalo (then new FWSAR)
Combat Support 9 CH118 Iroquois Helicopters 6 CE144 EW Challenger 42 CT133 (ST, EW, DM)	**Combat Support** 10 CH146 Griffon Helicopters 4 CT 133 (AETE)
Training/Utility 22 CT 134A Muskateer II 9 CH136 Kiowa 136 CT144 Tutor (pilot training and Snowbirds) 4 Dash 8 (navigator training) 7 Twin Otter	**Training/Utility** CFTS contract* NFTC contract* 17 CT144 Tutor (Snowbirds) 4 Dash 8 (navigator training) 4 Twin Otter

* CF pilot training currently being executed through the CFTS and NFTC contracts

Figure 3.1 – CF Aircraft Inventory

Source: Canada, Department of National Defence, *The Aerospace Capability Framework*, Annex A.

Impact On Entire CF

The Queen's study, presented earlier, sounded a particular alarm for the air force because of the age of its equipment and the re-capitalization cost. Much like the attempts to save a drowning person, attempts to redress this situation could have significant implications for the entire CF which could very easily be pulled under as well. For example, prior to the 2005 defence budget increases, some determined that if the CF were to attempt to pursue the purchase of a significant number of Joint Strike Fighters (JSFs) as an eventual

replacement for the CF-18 currently being modernized, it "could jeopardize the existence of most other DND acquisitions and modernization projects."[22] The JSF was designed to replace less expensive fighters like the F/A-18 and the F-16 etc. while the more capable F-22 was designed to replace more expensive fighters such as the F-15. A JSF purchase would only address the fighter capability. Other air force capabilities, e.g. Transport, Maritime Patrol, etc., would also require substantial investment. Despite recent budget increases, the strategic resource environment remains tenuous for the CF and therefore the expense of aerospace equipment remains a significant factor for both CF and air force modernization. Due to this critical link between the CF and air force, the recapitalization, transformation intentions of the air force require further strategic examination.

The magnitude of the challenge facing Canada's air force, and the potential repercussions for the CF as a whole, are serious, but not unique. In examining the United Kingdom's situation, one study determined that if the trend of rising aerospace weapon system costs continue, the Royal Air Force will not be able to fund a replacement for the next generation fighter, the follow-on to the Eurofighter Typhoon.[23] Despite a continued relatively substantial percentage of its GDP dedicated to defence spending, Australia's "long-term replacement programme for the F/A-18 fleet is particularly problematic."[24] New Zealand has already faced this situation when the Royal New Zealand Air Force relinquished its fighter capability in the 2001. Undoubtedly other examples exist.

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[22] Phillippe Lagassé, "Specialization And The Canadian Forces," *Defence and Peace Economics*, Vol. 16(3), June 2005: 221.
[23] David L.I. Kirkpatrick, "Trends In The Cost Of Weapon Systems And The Consequences," *Defence and Peace Economics*, Vol. 15(3) June 2004: 270.
[24] Michael Alexander and Timothy Garden, "The Arithmetic of Defence Policy," *International Affairs 77*, 3 (2001): 518.

The strategic resource environment demands that today's decisions pertaining to the air force take a "long view." On average aerospace weapon systems are kept in service for about 40 years. Decisions taken today about system selection indirectly determine other costs that will have implications until approximately 2045, including but not limited to O & M and personnel costs that will remain in place for the entire the life-cycle of the equipment. As a result, decisions today must consider the present and likely future strategic economic and demographic environments.

SMALL FLEETS NOT THE ANSWER – SIZE MATTERS

Sustainability today and in the future is an over-riding concern because of escalating acquisition and life-cycle personnel and O & M costs. These rapidly rising costs are difficult to support when resources are challenged. Small fleet sizes exacerbate the resource constrained strategic economic and personnel environments and produce a solution with questionable sustainability because:

a. acquisition, operations, and maintenance expenses produce no economies of scale;
b. there is reduced flexibility in the operations and support personnel structure; and
c. acceptable availability for operational commanders in expeditionary situations is difficult to maintain.

Economies of Scale – An Acquisition and Future Support Concern

Weapon systems, especially aerospace systems, are very expensive to purchase. Acquisition costs are comprised of Research and Development (R & D) and Investment Costs, which include production expenses, initial sparing etc., Table 3.1 refers. As with any commodity, purchasing in bulk has its advantages for the purchaser. For example, the more units produced reduces the per unit price because the manufacturer's non-recurring expenses are spread over more units. Also, the more units bought by a single customer enables the purchaser to negotiate from a stronger position and likely to further lower the per unit price. Buying a car is one thing, but negotiating to purchase a fleet of cars from a company puts the purchaser in a much stronger negotiating position with potential venders. In the case of aerospace systems, this is not simply a theoretical discussion. For example, purchasing 30 helicopters vice 15, a realistic example in the Canadian context, could make a significant difference. Using the Cormorant as an example, such an increase in the purchase order would have established Canada as the second largest customer in the world since only about 150 total machines have been sold thus far. The additional machines would have increased the world fleet by 10% and could have potentially accrued considerable acquisition savings. When the CF were looking for 15 aircraft to replace the Labrador Search And Rescue (SAR) helicopters, they were also looking for 28 aircraft to replace the Sea King Maritime Helicopters. The Cormorant was specifically designed as a Sea King replacement. In retrospect, the combined purchase of 43 Cormorants as a replacement for both the Labrador and Sea

King would have given the government great leverage during the purchase negotiations. This was the Mulroney government's approach.

Table 3.1 – Acquisition Cost Elements

Research And Development Costs	Investment Costs
Planning Management Engineering Test Evaluation Equipment Facilities	Production Planning Management Initial Spares Training Support Equipment Technical Manuals Engineering Test Facilities Initial Packaging, Handling, Storage & Transport

Source: James V. Jones, *Integrated Logistics Support Handbook*, 18.2.

Some would say that combining the requirements of two fleets with two distinct mission requirements would produce unacceptable compromises. A perfect example of this might be the 1990s rationalization of the Tactical Aviation fleet that supports the army. The Chinook, Twin Huey, and Kiowa helicopters were rationalized into a single fleet of Griffon helicopters which it is argued does not perform any role well. Some would counter that the wrong machine was selected and choosing a primarily civilian commercial helicopter, the Bell 412SP, to operate in the field in support of the army was not a particularly good choice. Unlike the Tactical Aviation experience, standardization of fleets to a single aircraft type can produce very good results where excellent

performance capability can be maintained. This example of success is provided by the fighter force. The CF-101 Voodoo, CF-5 Freedom Fighter, and CF-104 Star Fighter were all replaced by the CF-18 Hornet which performed well in all roles. In the SAR and Sea King replacement example discussed earlier, the solution did not necessarily need to be 43 Cormorants. Many nations use their shipboard helicopters as their primary SAR helicopters, for example the United Kingdom and the United States. The CH-148 Cyclone, eventually selected to replace the Sea King, would make a perfectly fine SAR helicopter. In fact, it is currently a contender for the United States Air Force (USAF) new Combat SAR Helicopter project. The real point is that with the expense of aerospace systems, coupled with the daunting air force recapitalization requirement and a tenuous future strategic economic and demographic environment for the CF, opportunities to economize, such as the SAR and Maritime Helicopter replacement projects, cannot be frittered away because the resources are not available to take a traditional approach.

Acquisition costs are high, but they pale in comparison to life-cycle Operation and Support costs, i.e. expenses attributed to O & M and personnel. As Figure 3.2 depicts, acquisition costs account for approximately 28% of life-cycle costs while O & M and personnel account for 72%. As a consequence of increasing costs, Michael Alexander and Timothy Garden note:

> Defence programmes have had to balance their budgets by reducing the fleet size with each generation of equipment. This causes an uncomfortable rise in the relative support costs of fleets as smaller front-line forces still require the full range of maintenance, logistic, and training infrastructure to sustain them.[25]

[25] Michael Alexander and Timothy Garden, "The Arithmetic of Defence Policy," *International Affairs 77*, 3 (2001): 516.

In considering the latest small fleet projects, i.e. the Cormorant helicopters, FWSAR aircraft, medium – heavy lift helicopters, CC-130 replacements, and potentially UAVs, in almost every case a unique military pattern aircraft is either being flown, i.e. in the case of the Cormorant, or is a candidate for purchase. Therefore the government must pay the fixed costs to establish in Canada the entire support infrastructure unique to each small fleet. The CF must pay for these support costs which are summarized at Table 3.2. Because of the small fleet size there are no economies of scale brought to bear during acquisition or during the extensive life-cycle costs which must be paid for the next 40 years. These decisions are saddling the future air force, and by extension the CF, with a huge future debt that must be paid.

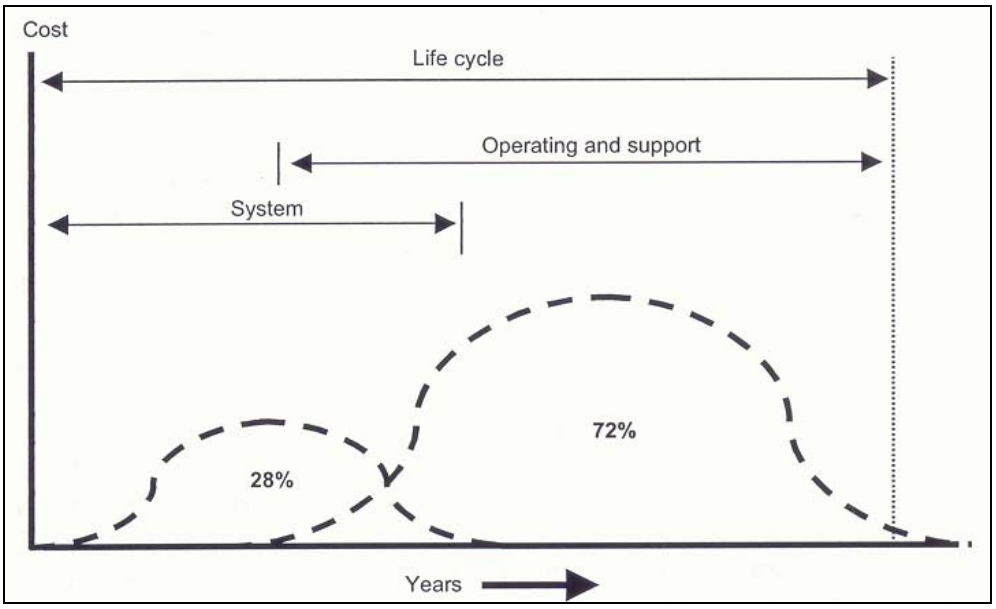

Figure 3.2 – Acquisition vs. Operating And Support (O & S) Costs (O &S = O & M and Personnel)

Source: United States, General Accounting Office, *Defense Acquisitions: Air Force Operating and Support Cost Reductions Need Higher Priority,* 6.

Table 3.2 – Operation And Support Cost Elements (O & M and Personnel)

Direct Costs	Indirect Costs
Personnel Consumables Replacement Spares Support Equipment Facilities Maintenance Technical Data Supply Management Modifications Packaging, Handling, Storage & Transport	Personnel Facilities Training

Source: James V. Jones, *Integrated Logistics Support Handbook*, 18.3.

One time expenses are incurred with the purchase of a single aircraft. Subsequent aircraft purchased can often leverage off these costs. A simple example is the technical manual purchase. These are required for the first aircraft. A second copy may not be required if a second aircraft is purchased, one set might support two aircraft, and so on. One could argue that relative to the multi-billion purchase cost of a new aircraft, a set of technical publications is inexpensive. On the contrary, if the publications need to be formatted into a standard military format, amended to account for a nation's unique technician structure, translated, etc., they can become quite expensive for the first set. Subsequent copies are relatively cheap to produce; this is another way to leverage the investment required for the first aircraft. The contract to simply maintain publications, i.e. amend and update as required, for one of Canada's less expensive air force fleets is approximately $1.1 million per year so the initial acquisition can obviously be quite

sizeable.[26] The more aircraft that are purchased permits greater economies of scale to be realized. In addition to technical manuals, the following paragraphs provide concrete examples of benefits pertaining to technical data, spares, and training. These simply serve as examples that also extend to other areas of support cost such as software support.

Similar to technical manuals, to adequately support a weapon system requires access to manufacturer data. To purchase the right to have on-going life-cycle access rights to weapon system technical data or support can be expensive and the same access is required despite the number of aircraft purchased. Spares are similar to technical publications, but the investment is massive. Either the air force must acquire a critical mass of spares or ensure access to a critical mass; this is expensive whichever route is taken. Even if a spare is required infrequently, it still must be stocked to ensure adequate support to military operations. With a bigger fleet, the initial investment necessary can be leveraged by the additional aircraft. Another way to look at this is that purchasing fewer types of fleets, but the same or similar number of total aircraft, would permit more robust sparing to occur because the money currently spent on, for example four fleets, could perhaps be pooled and spent on one or two with greater benefit. Focusing on fewer fleets could ensure ready access to a more comprehensive suite of spares than might otherwise be held. Conversely, if the intent were to save money, the same capabilities could be produced more economically.

Support costs have been, and continue to be, a real problem for the air force fleets. The majority of maintenance costs, for example spares purchased for the Canadian Forces Supply System, contractor Third Level Inspection and Repair (TLIR), etc. are

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[26] CH124 Sea King Weapon System Manager, Directorate of Aerospace Equipment Program Management (Maritime) 3, e-mail to author, 8:24 AM, 12 April 2006.

centrally funded by the CF's approximately $1 billion National Procurement (NP) program. During the defence budget reduction years, the NP budget was also reduced which greatly increased the difficulty of supporting aircraft and other weapon systems in the inventory. Also, the air force has traditionally, because of the sophistication of its equipment, consumed the lion's share of this budget. However, with the increasing complexity of other CF systems comes an increased support requirement and expense compared to the systems that they replaced; this has caused a further draw and subsequent redistribution of the NP budget, Table 3.3 refers. These NP problems have plagued the air force for the past number of years and have caused very low fleet readiness and as a result have garnered special mention in the *Aerospace Capability Framework*. Nevertheless, when the CF looks forward, even with the budget increases announced in 2005 projected out to 2009/2010, "…the evidence suggests that the increasing rate of growth in NP demand has created a significant strategic risk to future force sustainability and CF transformation."[27] This concern for CF sustainability confirms that tough choices likely lay ahead. The prospect for a healthy NP situation needed to sustain air force, or CF, weapon systems does not appear to be close at hand. Creative support contracts, like those negotiated for the Cormorant or Cyclone helicopters, attempt to leave a larger share of the support burden to the contractor. The contractor's additional risk is mitigated through a guarantee of a long term contract from the government. The end result is that it assists the government's cash flow challenges by not requiring a large immediate outlay of cash, but rather is a contract that guarantees a lesser payment over a longer period. It is analogous to the choice between a purchase

[27] Department of National Defence, National Procurement Oversight Committee (NPOC) Presentation To The Project Management Board (PMB) 11 May 2005.

and a lease. Even though the initial outlay for the lease is less, in the end one pays the same or more for the same service.

Table 3.3 – CF NP History

National Procurement (NP)	Fiscal Year 93/94	Fiscal Year 98/99
Total CF NP ($ Million)	1,448.0	$1,374.0
Air Force Allocated NP ($Million)	820.9	636.2
Air Force % of CF NP	56.7%	46.3%

Source: Canada, Department of National Defence, *The Aerospace Capability Framework*, Annex F5.

Like spares, the investment required in establishing training is very expensive. In most cases, the CF set up a school for each fleet to train the aircrew, aerospace engineers, and technicians. If the aircraft is a civilian pattern machine, it might be possible to leverage from a civilian training program, but only if the military were planning to fly the aircraft in the same manner as a civilian operator. For this reason, the CF usually does not use civilian schools and sets up its own, as it has done with the Griffon. If fewer different types of aircraft were purchased, but the same over-all total number of aircraft maintained, fewer schools would be required, but they would need to be bigger and more robust in order to accommodate greater throughput. Notwithstanding, there would be an opportunity to leverage the initial investment and accrue some economies of scale. It is

an expensive proposition to establish a complete force generation capability for a 15 aircraft fleet.[28]

The overriding observation is that the air force appears to be planning for smaller fleets optimized to perform missions in niche roles. For example, a new FWSAR aircraft may burn less fuel than a C-130J conducting a mission, but all the other support and training costs with a two fleet rather than a one fleet approach will create a sustainability problem for the air force. Just because each mission performance area is optimized with niche fleets does not mean that the aggregate system is optimized. As one contemplates the future, the current air force approach appears unsustainable because these small fleets do not permit economies of scale to be leveraged to reduce either acquisition or life-cycle O & M costs. The number of small fleets we are creating will likely generate a future problem for the air force and CF. In order to maximize the effectiveness of defence funds, the air force must leverage its investments by ensuring economies of scale benefits are achieved. This can only be accomplished through the acquisition of larger fleets; one analyst concluded that "the smallest practical fleet of combat aircraft appears to be about 25."[29]

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[28] As an example, the forecast FY 06/07 cost for the 15 aircraft Cormorant fleet is approximately $66.5 million, equating to $0.665 billion over 10 years. Directorate of Aerospace Equipment Business Management, e-mail to author, 9:22 AM, 26 May 2006.

[29] David L.I. Kirkpatrick, "Trends In The Cost Of Weapon Systems And The Consequences," *Defence and Peace Economics*, Vol. 15(3) June 2004: 270.

Operations and Support Personnel Flexibility

Personnel are clearly our most important asset. Figure 3.3 confirms that they are our most expensive investment, followed by NP, and we should be careful how this talent is employed and structured. Our workforce must not only be postured for the requirements of today, but also be prepared for the demands of tomorrow. *Strategic Vectors*, the air force's transformation vision document acknowledges that because there is "a limited

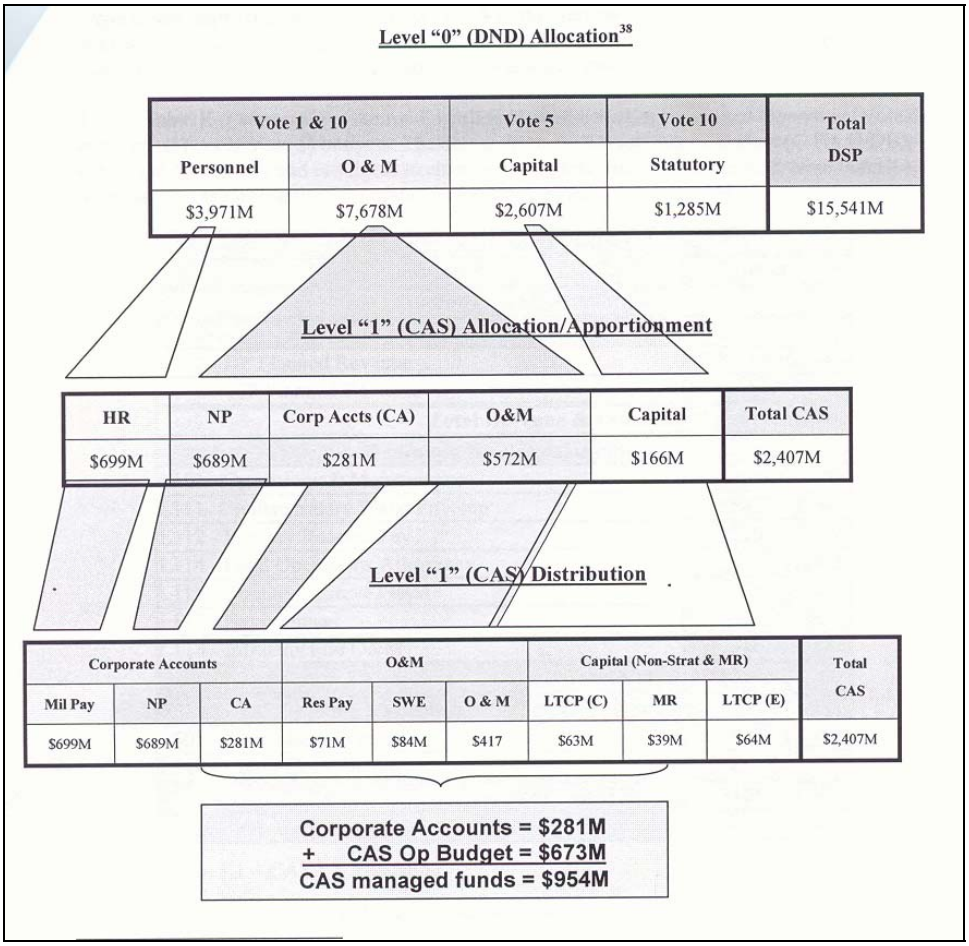

Figure 3.3 – Chief Of The Air Staff Budget

Source: Chief of the Air Staff Level One Business Plan FY 05/06.

ability to regenerate trained and qualified personnel quickly, we are disproportionately affected when limited numbers of experienced personnel leave the air force"[30] and as a result calls for well-educated and multi-skilled personnel in the future as the air force's sixth transformation vector.[31] The air force is perhaps particularly vulnerable because legislation, for example the Aeronautics Act of Canada, and the complexity of the weapon systems, drive extensive training requirements which often necessitate years to produce qualified aircrew, engineers, aircraft technicians, and other very technically skilled support occupations. As previously presented, each aircraft fleet compartmentalizes the publications, technical data, spares, training, etc., required to support it and the same compartmentalization applies to personnel; this therefore poses a barrier to the sixth strategic vector. The inference of multi-skilled personnel is that a workforce can respond in a flexible manner to human resource pressures, but generally this is not efficient across fleet lines, i.e. for an individual to move from one fleet to another. As an example, a Maritime Patrol pilot takes years to develop and perfect the skill, knowledge, and expertise related to the weapon system he or she flies, the operation which he or she conducts, and the environment in which he or she must perform. It is not realistic to redirect this talent to other weapons platforms and as a result this rarely occurs. Engineering and maintenance personnel are also compartmentalized by fleets. Although out of necessity limited postings between fleets do occur, it is not ideal and takes approximately two years for a fully qualified, deployable technician on one fleet to

[30] Canada, Department of National Defence, *Strategic Vectors, The Air Force Transformation Vision* (Ottawa: Director General Air Force Development, 2004), 21.
[31] *Ibid.*

develop basic rudimentary skills and qualifications on a fleet that is new to him or her.[32] Technicians with rudimentary skills of this nature are not usually deployed and therefore require further development. Even though the air force has initiated a program to reduce the training time to develop rudimentary skills from two to one year,[33] posting from one fleet type to another is not an efficient application of the substantial personnel and training investment made in our human resources. Therefore as one casts an eye to the likely future strategic environment where the challenging, competitive dynamics of a smaller workforce will be at play, it is important to recognize that a greater number of fleets produces increased barriers. It does not appear prudent to compartmentalize air force personnel in little 15 aircraft fleets. For example, splitting the homogeneous CC-130 workforce between a replacement tactical airlifter, likely a C-130J, and a new FWSAR aircraft will result in a less flexible overall capability. It might be argued that the FWSAR will also replace the Buffalo, but memories are short. In reality, when the Cormorant was purchased, the Buffalo was to be retired without replacement because of the tremendous capabilities the Cormorants provided. Essentially the Cormorant was to replace the Labrador and the Buffalo.[34] Regardless, if the CC-130 workforce is split, it leaves the important question: What have we gained and how are we better prepared for the expected challenges of the future? Have we made a wise choice, particularly since the end result will be two small fleets? Have we better prepared for the future or extended an unsustainable present? Just "as the number of units in a fleet decreases it

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[32] Air Force Technician Training, 1 Canadian Air Division A1 Training, e-mail to author, 1:25 PM, 19 January 2006.
[33] *Ibid.*
[34] Department of National Defence, *The Aerospace Capability Framework* (Ottawa: Director General Air Force Development, 2003), Annex F6, F7.

becomes increasingly 'fragile',"[35] so too does the personnel structure supporting it. Our aircraft fleets must be large and robust enough that personnel flexibility can occur intra and not inter fleet. This will best prepare a well educated and multi-skilled workforce to respond to the expeditionary operations, the free market pressures, and the unforeseen challenges that will undoubtedly be encountered between now and 2045.

Expeditionary Availability

A minimalist fleet size of 15 aircraft or less produces insufficient capability to be useful to operational commanders in an expeditionary context. Such a fleet typically has at least three aircraft removed from the flight line because they are undergoing long duration heavy maintenance at either a contractor or CF facility. Of the 12 aircraft remaining, those able to deploy, or conduct operations while not deployed, are further reduced by two other factors.

Firstly, approximately a third to a half of the fleet would have insufficient flying time remaining to support a deployment of any consequence before they too would be removed from the flight line and inducted into heavy maintenance. Heavy maintenance would be an inspection similar to a TLIR conducted by a contractor or a Periodic Inspection (PE) conducted either by a contractor or by the CF. Aircraft awaiting these inspections are usually locally employed for force generation and other duties or operations. Three to six aircraft fall into this category. The nature of the aircraft and the operation would determine whether the number was closer to three or six. Aircraft such

[35] David L.I. Kirkpatrick, "Trends In The Cost Of Weapon Systems And The Consequences," *Defence and Peace Economics*, Vol. 15(3) June 2004: 270.

as the C-130J can relatively easily deploy in and out of theatre so less restrictions would apply to a fleet of this nature – therefore only the three in the fleet ready to replace those due out of heavy maintenance would not be able to deploy. On the other hand, helicopters are difficult to get in and out of theatre, especially large ones, therefore more restrictions naturally apply – as a result it would not be wise to deploy the next six due into heavy maintenance. Aircraft due into heavy maintenance, if the inspection and maintenance program is appropriately tailored, are often tired. Approaching the end of their time assigned to the flight line, generally aircraft about to be inducted into heavy maintenance carry a number of unservicabilities that are more effectively or efficiently repaired in the more robust support shop environment available to TLIR or PE. Although these unserviceabilities do not affect the airworthiness of the aircraft, they may limit their full operational effectiveness and therefore they would not be candidates to deploy. If the aircraft are not inducted into heavy maintenance on time, they are grounded and the effective, coherent, co-ordinated support process for the entire fleet begins to unravel because it sits idle awaiting the next input and simultaneously a backlog is created. Only in extreme short term emergencies, such as an aircraft in the midst of conducting a SAR flight or a threat to national security, would delay to the heavy maintenance program for a single aircraft or a fleet be considered. Due to the airworthiness implications, delays of this nature are very rare. Additionally, the aircraft returned to the flight line from heavy maintenance programs often require extensive flight and operational testing before they can be relied upon as suitable deployment candidates. In reality this would further reduce the six to nine candidates considered available in the scenario described; however, to

maximize the number of potential aircraft for deployment this reduction has not been taken into account.

Secondly, on average only 50 - 70% of operational fleet aircraft are available to fly at any given moment because of minor maintenance, inspection, or repairs required.[36] Therefore, of the six to nine aircraft considered able to deploy and support an operation, only three to six would, on average, be available for operations at any one time. Of course the 50 - 70% availability statistics are what is achieved based upon current operations which are conducted almost exclusively from static CFBs in Canada. For example this is why the 15 SAR helicopters assigned to four bases are only expected to produce one to two aircraft at any one time to respond to an emergency in their assigned area. Even in a static non-deployed scenario sometimes this availability is difficult to accomplish. It is a far more difficult proposition to generate aircraft availability in remote, austere, high threat locations supported by long tenuous lines of communication (LOCs). One study indicates that after seven days of a deployment of sophisticated aircraft, i.e. ones with airframe, engine, avionic, electrical, and environmental control systems – which describes any modern aircraft, into an environment of this nature the availability ranged from 70%, assuming no logistic delay, to 41% assuming logistic delay. After two months however, i.e. 60 days, assuming no logistical delays "…the availability decreases to nearly 40% of the initial number deployed on the first day. If logistic delays are included at the repair levels then the availability is likely to reduce to

[36] Department of National Defence, *Director General Aerospace Equipment Program Management, FY 05/06 Business Plan Presentation*, January 2006.

20%, a difference of nearly 20%."[37] The deployed force is assumed to have an ability to produce spares ranging from one to ten days. Also the environment is expected to inflict damage to the aircraft similar to that which occurred during the Vietnam War, for example 20 aircraft damaged per one thousand sorties on the first three days ranging to eight damaged per thousand sorties from the second week onward. In a fleet of 15, if the entire six to nine aircraft not ready for heavy maintenance were deployed in support of an operation, after two months one aircraft[38] could be made available to the operational commander assuming that there would be logistic delays in supporting the fleet halfway around the world – a reasonable assumption. It is completely reasonable that in a much more austere environment than a CFB the availability would drop to the numbers predicted. The logistic delay parameters in the study were likely understated because they ranged from one to ten days. This would account for organizations that deployed with spares or an integral repair capability, but could not immediately bring those to bear on an unserviceable aircraft. Even when comprehensive spares are part of deployment kits, often spares must be shipped in from outside the Area of Operation. Given the long LOCs, it is easy to conceive that it might take ten days or more from the time the technician in theatre identifies the need for a spare, this is communicated back to Canada, the spare is removed off the shelf in Canada, shipped to theatre, cleared through customs, processed through the supply receiving facility, separated from all the other items being shipped on a priority basis into theatre and put in the hands of the technician. United States (US) experience during OPERATION ENDURING FREEDOM (OEF) indicates

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[37] K. Sadananda Upadhya and N.K. Srinivasan, "Availability Of Weapon Systems With Logistic Delays: A Simulated Approach," *International Journal of Reliability, Quality and Safety Engineering*, Vol.10, No. 4 (2003), 440.

[38] Between 1.8 and 1.2 aircraft.

that overall the mean time to respond to a portion of the process described above, i.e. only considering the time the part was shipped from a US logistics agency until it was processed through the supply receiving facility, easily took ten days or more when the whole theatre performance was considered.[39] This is consistent with Canadian experience. In the case of small, critical fleets, they determined that in order to be successful, immediate spares support from the United States was needed.[40]

Based upon the scenario presented, one could argue that this is not simply a fleet size critical mass issue. It could be argued that economics always plays a part and challenges can be mitigated. Depending on the criticality of the fleet, comprehensive spares holdings could be purchased and held at the ready or a deployable repair capability could be acquired. However, with all the military and economic resources available to the United States military which is constructed for expeditionary, combat operations, if they found that they needed to provide "immediate" re-supply to their small fleets from the United States to ensure viability during operations this should represent a tremendous concern for a country such as Canada which has a much less robust military and support infrastructure and an economic sustainability concern.

In some cases, the easiest approach to supporting the deployed fleet is to simply deploy an additional aircraft to ensure mission accomplishment; this resolves the problem when the correct spare or repair capability is not available. Notwithstanding, this is usually a luxury reserved for larger fleets that have additional aircraft to deploy. In the above Canadian scenario, all available aircraft were deployed and still produced only one operational machine for the operational commander after 60 days. Nevertheless, one

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[39] Robet S. Tripp, *et al*, *Supporting Air and Space Expeditionary Forces: Lessons from Operation Enduring Freedom*, Report Prepared for the United States Air Force (Santa Monica: RAND, 2004), 66.
[40] *Ibid.* , 65.

could argue that the simulation was unrealistic because it included battle damage inflicted that was similar to that experienced in the Vietnam War. However, the counter argument is that from an air force perspective, where the United States were masters of the skies, they selected the time and place of engagement, and employed relatively sophisticated technology against a far less capable adversary - the situation directly relates to the sort of operations our air force is preparing for in the next 40 years. The intractable, asymmetric, insurgency situation on the ground in Vietnam did not repeat itself in the air where US forces generally reined supreme. In the scenario described above, even if the aircraft remained at their home base, only three to six could be produced for the operational commander using present day CF non-deployed availability metrics. It is therefore very reasonable to accept the proposed deployed results.

The special attention required of small fleets in an operational environment therefore goes directly to their viability. In order to ensure at least two to three aircraft were available to a deployed commander in the scenario described, which is reasonable as one contemplates the future for the CF, a fleet size of at least 30 aircraft should be procured, especially for the larger helicopters which are difficult to get in and out of theatre. This fleet should be supported by a robust spare and deployable repair capability.

CHAPTER 4

WHAT OTHERS ARE DOING

Various countries, companies, and individuals have different strategies to address the problem of escalating aircraft weapon system acquisition and life-cycle O & M costs.

Each new generation of equipment generally comes with increased acquisition and often O & M costs. Even maintaining the older systems appears problematic because aircraft O & M costs increase one – three percent a year in real terms, i.e. adjusted for inflation, for every year they age because of reduced time between failure and increased time and expense to repair.[41] A major theme that is emerging; however, is to directly focus on life-cycle O & M costs and develop strategies to mitigate them. This makes sense from an economics perspective because this is where the majority of expenses are incurred, Figure 3.2 refers. A recent study conducted by the RAND Corporation for the USAF quite rightly points out that there are other considerations at play in addition to economics, such as changing requirements, technology etc., but nonetheless focuses upon the economic considerations to develop the model framework to evaluate military aircraft replacement.[42] Given the overriding pressure that economics will play in the future, including the economic consequences of demographics, this is a reasonable approach.

EUROPE – COLLABORATION TO ACHIEVE LARGER FLEET ECONOMIES OF SCALE

In considering the next 15 – 20 years, some United Kingdom analysts have suggested that although the GDP for that country is expected to rise by 1.3% in comparison to today, over the same period weapon system costs are expected to increase 100% in real terms and personnel costs at least 20%, due to demographic trends.[43] Obviously this does not

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[41] The Congressional Budget Office*, The Effects Of Aging On The Costs Of Operating And Maintaining Military Equipment* (Washington, D.C. The Congressional Budget Office, 2001), 26.
[42] Victoria A. Greenfield and David M. Persslen, *An Economic Framework for Evaluating Military Aircraft Replacement*, Report Prepared for the United States Air Force (Santa Monica: RAND, 2002), xi.
[43] Michael Alexander and Timothy Garden, "The Arithmetic of Defence Policy," *International Affairs 77*, 3 (2001): 520.

bode well for defence budgets which are already challenged. In response they propose that pooling of European Union (EU) capabilities could reverse the trend of rising overhead defence equipment costs. With bigger production runs, unit price would reduce. With bigger fleets, O & M efficiencies could be gained, "the number of people needed would decrease, support manpower costs would decrease, and further savings could be made by outsourcing with larger contracts."[44] The NATO AWACS fleet is held up as an early foray into this idea. An AWACS capability would have been far too expensive for one nation to shoulder, but many smaller counties combined have been able to field a very capable weapon system. In Europe there are many other examples of preliminary co-operation, for example the European F-16, Tornado, Eurofighter Typhoon, and A400M Airlifter programs, etc. Although each member's share of the weapons system program is often affordable because one country does not need to shoulder the entire program cost, opponents of collaboration note that often the product costs more per unit because of numerous competing requirements that must be satisfied. Often collaborative projects also take much longer to produce results because of the negotiations and political bureaucracy involved. However, out of necessity, European analysts see a brighter future. Greater integration will be required in order to minimize tremendously escalating costs. The analysts offer the 137 C-130 Hercules flown by ten different EU nations as an opportunity and propose that if a well integrated solution were established now, it would also be much easier to reach a consensus on the requirements for a replacement fleet. Presumably a similar argument holds for the nations already collaborating in European programs such as the F-16 and Tornado; they too should be

[44] Michael Alexander and Timothy Garden, "The Arithmetic of Defence Policy," *International Affairs 77*, 3 (2001): 520.

able to more easily settle on a follow-on aircraft and the reduced competing requirements should translate into cost savings and more streamlined acquisition. If the trend in spiraling weapon system expense continues, countries will be motivated to further integrate because they will be unable to afford to do otherwise.

INDUSTRY AND US MILITARY – LIFE CYCLE COST FOCUS & STANDARDIZED FLEETS TO ACHIEVE ECONOMIES OF SCALE

Will the multi-nation compromises of the Europeans produce a less than optimal platform at the end of the day? Probably yes. This is exactly the strategy used by industry and recommended by the United States Government Accounting Office (GAO). In response to escalating total ownership costs, increases of approximately 18 % between 2001 and 2003,[45] the GAO examined the best practices of companies like Federal Express, United Air Lines, and Polar Tanker; i.e. companies that use large fleets of trucks, aircraft, and ships, require high readiness, and as low acquisition and O & M costs as possible. The theme running through the GAO analysis is that traditionally the US Department of Defense (DOD):

> focuses attention during product development on achieving revolutionary performance goals while trying to keep acquisition costs for a program as low as possible. Often, it is not until the system is fielded and the responsibility shifts to other agencies or services that the operating and support costs become an overriding concern. By this time, there is no alternative but to pay the bills…[46]

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[45] General Accounting Office, *Best Practices, Setting Requirements Differently Could Reduce Weapon Systems' Total Ownership Costs* (Washington, D.C. United States General Accounting Office, 2003), Highlight.
[46] *Ibid.* , 24.

The GAO previously used the F-22 and the JSF to illustrate this concern. Despite enhanced reliability, maintainability, supportability design criteria of modern weapon systems, often the overall O & M costs for new aircraft is greater than the system it replaces; the GAO is doubtful that these two new aircraft will be any different.[47] Because of the focus on performance requirements and acquisition cost noted earlier, the GAO specifically observed that "projects that could reduce operating and support cost of fielded systems have a lower priority and are generally less able to compete…"[48] Another alternative to being held ransom by high life-cycle costs is simply not to pay the bills and accept a much lower fleet readiness, which is what was occurring in many instances in the US prior to 2001. In order to get the various fleets on an operational footing for war, tremendous investment was required. A reduced readiness is an option for large fleets such as those maintained by the US because a portion of the fleet can be kept in an operationally effective state while the remainder is set aside, cannibalized, etc. This no longer remains an option when the entire fleet is required for operations, i.e. as in the case when the US prepared for action in Iraq, or when the fleet is so small that it does not have a sufficient critical mass and is therefore fully taxed by even routine non-deployed operations, i.e. in the case of a small 15 aircraft fleet.

GAO analysis revealed that when faced with such challenges, successful commercial companies purposely manage their ownership costs. The companies that were examined were willing to compromise optimal performance, provided acceptable

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[47] General Accounting Office, *Defense Acquisitions: Air Force Operating and Support Cost Reductions Need Higher Priority* (Washington, D.C. United States General Accounting Office, 2000), 18.
[48] *Ibid.* , 20.

limits were achieved, to ensure reduced O & M costs during the life-cycle.[49] In the case of airlines, companies were also resisting the upward movement of aircraft prices by co-operating amongst themselves to purchase larger overall fleets, encourage standardization and interoperable parts and equipment, and buy the best product at the best price regardless where it is made. The RAND Corporation believes that these practices are relevant to DOD and recommends that strategies that attempt to ensure economies of scale should continue whenever possible. RAND does note that because of differing mission requirements a "Joint" system solution may not always be possible.[50] Consistent with RAND's observations, there are tremendous consolidation plans underway in the US which are likely influenced by the fact that "DOD has set goals to lower life-cycle costs of new aircraft by 20 to 50 percent below the historical experience of predecessor systems."[51] The F/A-18 E/F Super Hornet will replace the United States Navy's (USN's) F/A-18C and F-14A fighters. The JSF will complement the USN Super Hornets, replace the United States Marine Corps (USMC) AV-8B and F/A-18A/C/D aircraft, and replace USAF F-16 and A-10 aircraft.[52] The current inventory of US fighter/attack aircraft will eventually be reduced from seven fleet types (F/A-18 E/F Super Hornet, F/A-18 A/C/D Hornet, F-14, F-15, F-16, A-10, and AV-8B) to three or less (F/A-18 Super Hornet, JSF,

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[49] General Accounting Office, *Best Practices, Setting Requirements Differently Could Reduce Weapon Systems' Total Ownership Costs* (Washington, D.C. United States General Accounting Office, 2003), 35.
[50] Mark A. Lorell, *et al*, *Cheaper, Faster, Better? Commercial Approaches to Weapons Acquisition*, (Portland: RAND, 2000), 126.
[51] General Accounting Office, *Defense Acquisitions: Air Force Operating and Support Cost Reductions Need Higher Priority* (Washington, D.C. United States General Accounting Office, 2000), 15.
[52] United States Navy, *1998 Department of The Navy Posture Statement;* available from http://www.chinfo.navy.mil/navpalib/policy/fromsea/pos98/pos-pg08.html; Internet; accessed 21 January 2006, Part VIII Programs, Aviation Weapons Programs. General Accounting Office, *Defense Acquisitions: Air Force Operating and Support Cost Reductions Need Higher Priority* (Washington, D.C. United States General Accounting Office, 2000), 17.

and F-22).[53] As Figure 4.1 illustrates, tremendous fleet rationalization is also occurring with the helicopters. "The Navy's Helicopter Master Plan reduces the Navy's types of helicopters from eight to two, reducing manpower and logistics-support costs."[54] After the consolidation only the Seahawk and the MH-53 Super Stallion will remain. The Seahawk is a derivative of the US Army Blackhawk helicopter and therefore the two fleets will produce tremendous economies of scale. It is estimated that the USN will save $20 billion alone in Seahawk life-cycle costs by rationalizing the aircraft fleet and leveraging existing support.[55] The USMC Huey and Super Cobra helicopters will both be remanufactured under a program which will maximize commonality between the two fleets, for example they will utilize common engines, rotorheads, transmissions, drive systems, etc.[56]

Another strategy to attack escalating life-cycle costs is to establish long term support contracts with industry, a concept already borrowed by the Cormorant and Cyclone helicopter projects as discussed earlier. This reduces the company's risk by ensuring a reliable commitment and therefore permits the necessary investments to take place to maximize efficiency and profit. Contracts of this nature must be formulated with care to ensure that the company is induced to make such investments and also share the

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[53] The Congressional Budget Office*, The Long-Term Implications of Current Defense Plans and Alternatives: Detailed and Updated for Fiscal Year 2006* (Washington, D.C. The Congressional Budget Office, 2006), 39, 55.
[54] United States Navy, *1998 Department of The Navy Posture Statement*; available from http://www.chinfo.navy.mil/navpalib/policy/fromsea/pos98/pos-pg08.html; Internet; accessed 21 January 2006, Part VIII Programs, Aviation Weapons Programs.
[55] Federation Of American Scientists, *Military Analysis Network, UH-60 Black Hawk*; available from http://www.fas.org/man/dod-101/sys/ac/uh-60.htm; Internet; accessed 21 February 2006.
[56] 1997 Congressional Hearings*, FY 1998 Navy/Marine Corps Acquisition, Testimony Assistant Secretary of the Navy (Research, Development and Acquisition) et al*; available from http://www.fas.org/spp/starwars/congress/1997_h/h970306n.htm; accessed 21 January 2006. United States Navy, *Department of The Navy 1997 Posture Statement, The Navy-Marine Corps Team, Enduring Impact…From The Seat*; available from http://www.chinfo.navy.mil/navpalib/policy/fromsea/pos97/pos-pg08.html; Internet; accessed 21 January 2006, Part VIII Programs, Aviation Weapons Program.

benefits with the customer. Usually incentive clauses which permit the company to keep a portion of the savings can be used to achieve this goal. Although some would argue that such an arrangement reduces competition and therefore is rife for exploitation by industry, the competitive aspect still occurs as a company bids for the contract, "competes" within the bounds of the contract to attain various incentives, and retains a competitive relationship with many of its suppliers. The result of a company's investment is a larger, more robust capability that can better compete in an ever increasingly expensive and technically sophisticated industry. With larger aircraft fleets, these companies can also compete on a larger scale.

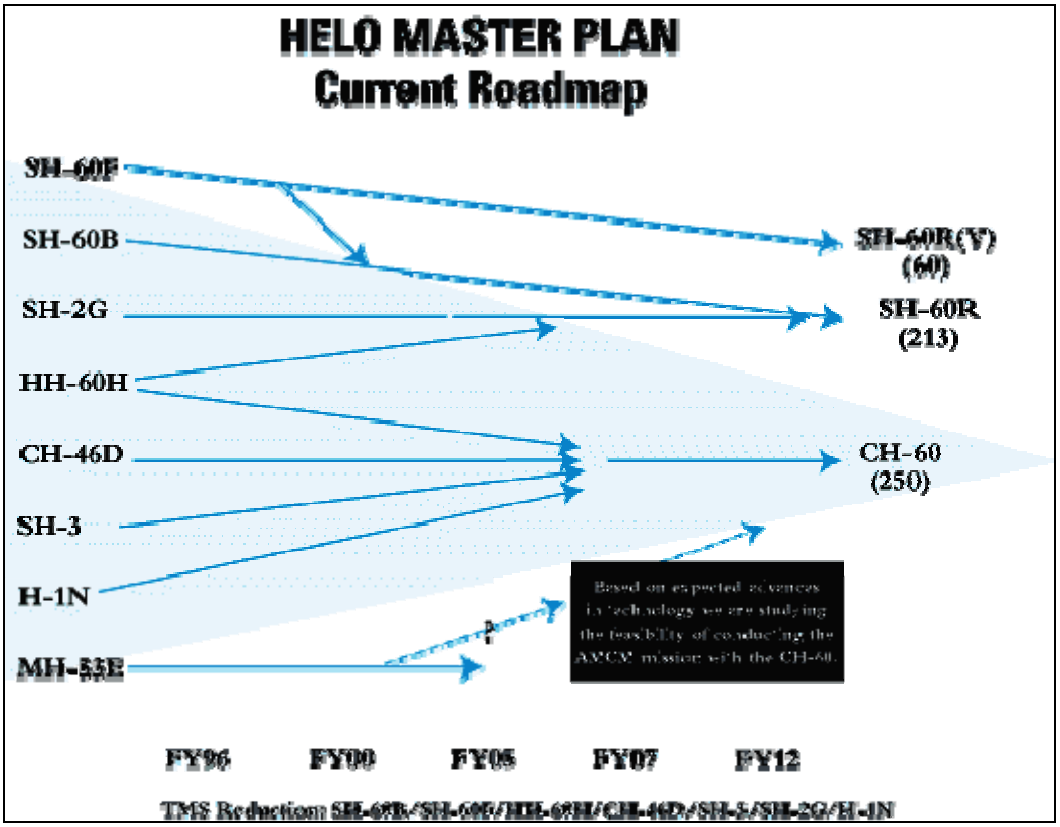

Figure 4.1 - Helo Master Plan

Source: Federation of American Scientists, www.fas.org

COMPLEMENTARY STRATEGY

In addition to a life-cycle cost reduction focus, attempts to curb and reduce acquisition costs continue. A prime example is performance-based acquisition where essentially customers define key performance requirements and contractors determine how they can be best achieved. A successful application of this model was the systems engineering effort for the JSF which is acknowledged as the "acquisition reform flagship program."[57]

THE FUTURE

It is clear that both militaries and civilian industry recognize that rapidly escalating equipment acquisition and life-cycle costs, combined with demographic trends, will produce an extremely challenging future equipment acquisition and sustainment environment. Although there are many solutions, common themes are larger standardized fleets to leverage acquisition, and life-cycle personnel costs. Also, a determined upfront focus is placed on understanding and minimizing life-cycle O & M costs even if performance requirements need to be compromised to do so. It could be argued; however, that in reality nothing has changed and that replacing multiple types of older fleets with one new aircraft, the JSF for example, is simply a way to obtain a lower cost per unit acquisition price in order to increase the new fleet size without a true focus on reducing life-cycle costs. Despite this argument, it appears that the US government is

[57] Robert G. Struth, Jr. , "Systems Engineering And The Joint Strike Fighter: The Flagship Program For Acquisition Reform," *Acquisition Review Quarterly* (Summer 2000): 230.

determined to rein-in run-a-way costs and the GAO and Congressional Budget Office (CBO) are both focusing on life-cycle cost reductions as key to the future.

CHAPTER 5

WHAT SHOULD CANADA DO?

The CF is on the verge of pursuing very expensive new aircraft that will define the structure of the air force for the next 40 years. In considering the future, the present and anticipated realities must be taken into account; they are:

a. the CF cannot, despite recent funding increases, sustain all its current inventories;
b. the CF cannot, despite recent funding increases, replace all its current inventories with modern systems;
c. the future strategic economic environment will likely not support a significant sustained increase in funding sufficient to recapitalize and subsequently sustain new systems at the present force level;
d. replacement systems are usually more expensive to acquire and sustain than the legacy systems they replace; and
e. the future strategic demographic environment will likely require workforce efficiencies.

The present and anticipated realities should give pause. It is clear that the CF, and the air force in particular, because of the tremendous cost of its equipment, must continue to plan to economize. The long view must be maintained when making equipment purchases because they establish the structure, costs, and robustness that will define capabilities for the next 40 years.

The minimalist small fleet approach Canada appears to be pursuing raises concerns about the real capability that can be provided to an operational commander in an expeditionary context. Life-cycle sustainability concerns from a O & M and personnel cost perspective are evident as is the inability to leverage benefits from high acquisition costs. The viability of numerous small fleets therefore appears questionable. A reduced number of larger, more robust fleets would be a more logical approach.

ACQUISITION GUIDE

In view of the above, the air force needs acquisition cost, life-cycle cost, personnel flexibility, and expeditionary availability targets for its future weapon system purchases. A dedicated formal study should be initiated to produce these targets. In advance of a formal study, the following interim guide should be considered:

a. new aircraft fleets must demonstrate at least a 10% life-cycle cost saving over the legacy systems they replace. This is an arbitrary goal which will result in concrete saving needed to begin to address the present economically unsustainable, fragile air force position; it is easier to achieve

than the 20 – 50% target in the US. The 10% goal should eventually be replaced by a value determined by analysis of long-term sustainability pressures that the CF are expected to face;

b. a reduced number of fleet types with more aircraft in each fleet must be acquired to improve acquisition cost, life-cycle cost, personnel flexibility, and expeditionary availability factors. As in the US, when considering acquisitions for new roles or missions, preference must be given to aircraft types already in the inventory or alternatively acquisitions for new capabilities must also replace fleets performing other roles;

c. a minimum fleet size should be no less than 30, unless:

(1) a specialized need is required and a civilian aircraft can be acquired and therefore Canadian industry can be leveraged rather than the CF creating the entire support structure in Canada (these exceptions should be minimized because CF resources are still compartmentalized and thus less efficient, e.g. personnel). These specialized systems purchased as exceptions should be heavily supported by reserves from the civilian industries that utilize them, or

(2) a specialized need is required and a standard aircraft used by a close ally can be acquired and the foreign support is leveraged rather than

the CF creating the support structure in Canada (these exceptions should be minimized because CF resources are still compartmentalized, thus less efficient, and relying on support external to Canada creates a vulnerability). In these instances, contractual ties to companies, e.g. Boeing, in foreign countries are preferable than arrangements with governments because companies usually have plants and investments in Canada that would more readily induce them to support the Canadian government even in the event of a bi-lateral dispute between governments.

d. aircraft should not be purchased uniquely for the SAR role. Purchasing fleets of aircraft uniquely for this purpose further compartmentalizes an air force already below critical mass when the SAR role can be adequately filled by the same types of military aircraft purchased for other roles. Airborne SAR is performed by the CF, but it is not a military role. As in other countries, this role could easily be performed by the Coast Guard or other Government Departments. Notwithstanding, in Canada specialized aircraft should not be purchased for this role because numerous military platforms are very capable in performing this function. They have the range, speed, and robustness to satisfy the adverse conditions often associated with this capability. They also have the navigation, communication, and localization equipment necessary to perform this function or it can be easily installed.

Using the interim acquisition guide described above, the helicopter and transport fleets should be closely modeled to determine if they can be better aligned with the expected future strategic environment. Consideration should be given to rationalizing the four types of helicopters that the air force intends on having in inventory; this number should be reduced to one or two types at the most. The logical solution would be to acquire 15 additional Cormorants to satisfy the new medium – heavy lift helicopter requirement and sell the Griffons. Additional Cormorants or Cyclones could be purchased to replace the Griffons assigned to 427 Squadron in their special forces support role. This would produce two helicopter fleets of approximately 30 machines.

Some would question the long-term viability of the Cormorant fleet since only 150 machines have been produced. An analysis may determine that it is more logical to sell the Cormorants now at the beginning of their life-cycle and either:

a. use the Cyclone for all helicopter duties, or

b. acquire 30 Chinooks for both medium – heavy lift and SAR helicopter requirements. The worldwide Chinook fleet is very large and offers significant opportunity to accrue savings because of the ready supply of non-recurring engineering capability, modification and up-grade kits, and spares support. This option would permit 427 Squadron requirements to be satisfied by either additional Cyclones or Chinooks.

Cormorant supporters would argue that since the US has purchased a variant of the aircraft to transport the President, sales will likely increase. Regardless, the scope of this paper is not to determine which fleets should be acquired, but rather to demonstrate a need for Canada's air force to reduce its fleet types. The rationalization argument extends to the no less than six different types of transport/utility aircraft that the air force currently possesses, Figure 3.1 refers. For example, both the C-130J and the FWSAR contender aircraft are tactical transport aircraft.[58] How many new types of tactical transport aircraft can Canada afford, either now or over the next 40 years? How will splitting the current CC-130 Hercules fleet and associated NP Funding, personnel, etc. into two tactical transport fleets, the C-130J and FWSAR aircraft, produce economies of scale? What future savings will be achieved by maintaining two fleets, both of which have insufficient critical mass to support robust operations? The C-130J should be considered for the SAR role as well. Canada is a vast country that will be faced with many challenges in the next 40 years. The C-130J can carry large loads, a capability not readily available on the Canadian civilian market. Therefore the CF would possess a unique national capability to assist in a crisis. Smaller aircraft considered for FWSAR, such as the C-27J Spartan, are tailored for small loads and do not offer a capability much different than what is available on the civilian market. For example, the FWSAR contenders would have had difficulty supporting the recent airlift of water purification and other equipment to the northern community of Kashechewan. As one considers the next 40 years, it is likely a more flexible and efficient solution should be pursued.

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[58] Martin Shadwick, "The Labours Of Hercules," *Canadian Military Journal* Vol. 6, No. 4 Winter 2005 – 2006: 108. Lockheed Martin, *C-27J SPARTAN*; available from http://www.lockheedmartin.com/wms/findPage.do?dsp=fec&ci=11167&rsbci=13145&fti=0&sc=400; accessed 5 March 2006.

Purchasing a niche small fleet of 15 aircraft to perform SAR does not appear prudent. This is but one example which demonstrates the need to rationalize the entire transport aircraft inventory.

INDUSTRY AND POLITICS

The efficiency and effectiveness of the armed forces are but two of many considerations a government must weigh. Industry development and the economy offer two examples of a whole host of other government responsibilities and considerations. Industry, contracts, and the economy are closely linked to politics. Also, focusing on the long-term is difficult especially when often there is a motivation toward a short-term re-election preoccupation. Will politics over-ride the need to economize? Perhaps. Past attempts to bring fleets together have failed for political reasons; witness the termination of the EH101 contract which would have replaced the Sea Kings and the Labradors with a single fleet. Supporting industry with a numerous fleet approach may be considered to be in the government's best interest because it spurs many areas of the economy whereas a reduced number of fleets would not offer such an opportunity. A close examination of the Canadian aerospace industry today, as-well-as likely trends for the future, indicate that this is not the case.

Aerospace manufacture and life-cycle support is an expensive business. Only large corporations have the financial capacity to develop the capabilities necessary to undertake this work. This reality limits the number of companies in the Canadian market. The limited companies in the market result in many of them supporting more than one

fleet, for example L-3 supports the CF-18 Hornet and will support the CH-148 Cyclone. IMP Aerospace supports the CP-140 Aurora and CH-149 Cormorant. Small fleet sizes actually limit the company's ability to develop economies of scale and effectively compete in the global market which is tending to become increasingly competitive and consolidated.[59] A consolidated fleet approach would actually benefit industry. For example, with a 30 aircraft Cormorant fleet or a 60 aircraft CH-148 Cyclone fleet, Canadian companies would have a significant presence on the international market. Perhaps we can no longer afford the practices of the past.

FUTURE RESEARCH

To further analyze the strength of the strategic economic argument advanced in this paper, it would be useful to review Federal Government defence spending over the past number of decades to determine if in fact it is reduced as surpluses reduce, i.e. to determine the connection of defence spending to the business cycle of the nation.

CHAPTER 6

CONCLUSION

Despite hefty budget increases, the CF remain unsustainable. The present and likely future strategic economic and demographic environments indicate that the only realistic manner to address the over-riding sustainability challenge is for the CF to make economizing decisions. The cost of aerospace systems renders the decisions that the air

[59] Mark A. Lorell, *et al*, *Cheaper, Faster, Better? Commercial Approaches to Weapons Acquisition*, (Portland: RAND, 2000), 92.

force must make particularly relevant to the other elements of the CF – a phenomenon not unique to Canada.

Recent new initiatives are promising and appear to signal a recognition that closer attention must be paid to reducing acquisition and life-cycle costs to improve sustainability. Specifically, new initiatives are the streamlined performance-based acquisition approach, proposed for the new Tactical Airlifter and other new aircraft projects, and the establishment of a long-term support relationship with contractors when weapon systems are purchased, e.g. in the case of the Cormorant and new Maritime Helicopters. These evolving signs of increasing acquisition and support sophistication follow trends established in the US. However, Canada's apparent propensity to pursue numerous small fleets of approximately 15 or fewer aircraft stands in stark contrast to the need to economize and the fleet consolidation trends in other countries that are also undertaking cost saving measures. Small fleets produce no acquisition, operation, or maintenance economies of scale, decrease operations and maintenance support personnel flexibility, and struggle to deliver acceptable operational availability to field commanders, especially in an expeditionary context – another path must be chosen!

As the air force prepares for the future, an aircraft acquisition strategy is required. Such a strategy must be supported by analysis. As well as exploring the benefits to the CF as a whole, the acquisition strategy should also identify related benefits to Canadian industry. To further test the strategic economic argument advanced in this paper, the analysis should also include an examination of Federal Government defence spending over the past number of decades to confirm a relationship with surplus/deficit spending and the business cycle of the nation. Until an analytical study can be completed, in

addition to the two new initiatives adopted from the US described above, an interim strategy should be pursued that requires fleet consolidation where possible and quantifiable life-cycle cost savings for new systems when compared to the systems that they replace. Specifically, fleet consolidation entails operating a reduced number of aircraft fleets that are large and robust in number of aircraft in order to develop a capability suitable for future expeditionary operations. This approach would better align the air force to strategic economic and demographic environments and VCDS procurement reform initiatives. In theory this consolidation argument is broader than the air force and applies to the CF as a whole since it is clear that insufficient funds still loom large as a future strategic issue affecting the entire armed forces. The forecasted NP challenges that promise to impact all CF weapon systems demonstrate that insufficient funding at the macro-CF level is truly manifesting itself in significant sustainability problems.

If the prescription proposed in this paper is followed and the future proves to be less daunting than forecasted, then the force structure produced will be very robust and capable of easily accommodating the challenges of the next half-century. If, on the other hand, the prescription is correct, but not followed, the present sustainability challenges will inevitability drown the CF in a sea of rising weapon system costs and reduced resources. Which road will we choose?

As a final observation, the acquisition challenges described herein harkens back to the bottom up service generated projects of the 1950s and 1960s that so frustrated Ministers of National Defence because together they would exhaust the budget. The current challenges remind us that perhaps decades later we have yet to take a truly

strategic, top down, pan-CF approach to acquisition since this is the only true way to remain within government assigned funding and also to maximize the effect of the that funding. If such a system were adopted, would it be healthy to be entirely devoid of competition that the current approach provides? These are also questions for further research.

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