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A Force Structure Model of Canada's Military: Costs and Personnel



OFFICE OF THE PARLIAMENTARY BUDGET OFFICER
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The Parliamentary Budget Officer (PBO) supports Parliament by providing economic and financial analysis for the purposes of raising the quality of parliamentary debate and promoting greater budget transparency and accountability.

This report details the development of a framework to address the costs of military capabilities and the potential trade-offs implied should a government policy require the adjustment of the structure of the Canadian Armed Forces.

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Highlights

The PBO has developed a Force Structure Model of Canada's military. This consists of an independent estimation of annual personnel, operations, and sustainment costs of 21 identified military capabilities across all branches of the Canadian Armed Forces, supplemented with estimated personnel counts for each capability.

The model, which has been made publicly available and is hosted on the PBO website, allows for portfolio-level tradeoff analysis of the full suite of military capabilities, providing users the ability to examine changes in costs and personnel counts as the quantity of a given military capability is adjusted.

Summary

This report details the development of a framework to address the costs of military capabilities and the potential trade-offs implied should a government policy require the adjustment of the structure of the Canadian Armed Forces (CAF).

Based on six years of Department of National Defence (DND) expenditure data, the PBO Force Structure Model contains estimates of personnel and recurring annual personnel, operations, and sustainment (POS) costs of 21 identified military capabilities across all branches of the CAF. The personnel counts and costs associated with enabling indirect capabilities and overhead or "institutional" capabilities are likewise included.

The model allows for portfolio-level tradeoff analysis of the full suite of military capabilities, providing users the ability to examine changes in costs and personnel counts as the quantity of a given military capability is adjusted.

Summary Table 1 presents a summary of costs for each branch of the CAF. In total, direct costs for CAF capabilities amount to 32 per cent of total POS costs. In military parlance, this figure represents a "tooth-to-tail" ratio of about 1:2, meaning that about a third of every dollar spent on personnel, operations, and sustainment goes towards those elements that produce a direct military effect.

Summary Table 1

Personnel, Operations, and Sustainment Costs by Military Branch (millions of dollars, 2022-23)

Environment	Direct Costs	Indirect Costs	Overhead Costs
Canadian Army	1 630	2 010	2 000
Royal Canadian Air Force	2 690	830	1 700
Royal Canadian Navy	1 780	680	1 300
Joint	730	500	-
Institutional	-	-	5 600
Total	6 830	4 020	10 600
%	32%	19%	49%

Sources:

PBO Calculations and Department of National Defence.

Notes:

Totals may not add due to rounding. Figures reflect an average of 6 fiscal years of POS costs spanning 2016-17 to 2021-22, with each year of data inflated to 2022-23.

Introduction

Combined, Canada's military establishment, the Canadian Armed Forces (CAF), and its civilian parent agency, the Department of National Defence (DND), accounted for approximately \$24.1 billion in government spending in 2021-22. Of this amount, over 80 per cent is attributable to recurring personnel, operations, and sustainment (POS) costs associated with the CAF's military capabilities.

Existing analytical and reporting frameworks of Canada's military spending focus on inputs, such as in the Public Accounts of Canada (for past expenditure) or Main Estimates (for current and projected expenditure). These sources are supplemented by the Government of Canada's Departmental Results Framework (DRF) which associates spending to measurable effects. While the DRF establishes a logical relationship between inputs and the strategic outcomes they serve, it combines results across multiple military outputs with intermediate outputs such as expenditure on training and infrastructure. The DRF therefore does not enable the assessment of recurring operating expenditures on individual military capabilities, such as armoured battalions or naval surface combatants.

To bridge this gap, the PBO developed a Force Structure Model of Canada's military. This consists of an independent estimation of annual personnel, operations, and sustainment costs of 21 identified military capabilities across all branches of the CAF, based on multiple years of accounting data provided to the PBO by the Department of National Defence. These costs are divided into three categories: direct costs, indirect costs, and overhead costs, so as to provide a clearer understanding regarding the proportion of expenditure that enables the use, support, and maintenance of a military capability versus that which is a necessary part of the force mix but does not produce an independent military effect itself.

The PBO Force Structure Model also includes estimates of personnel figures associated with each capability, at each of the direct, indirect, and overhead levels. This allows for the combined analysis of estimated POS costs and personnel levels associated with each capability.

What are Personnel, Operations, and Sustainment Costs?

As the name suggests, POS covers all those cost categories involved with the employment and support of the CAF's various capabilities. Personnel costs include salaries, benefits, training, and other ancillary elements associated with CAF members attributed to a given capability; operations costs include the cost of employing the capability, such as fuel and oil for naval vessels, or munitions and kit for soldiers; and sustainment costs refer to all costs associated with the maintenance and repair of military equipment. Importantly, major capital expenditure for the procurement of new military systems is excluded.

Most of these costs are captured under Vote 1 of the Public Accounts of Canada; however, the PBO accounting of POS costs includes some elements of Vote 5 Capital, for instance the salaries of public servants working as project managers of the capital equipment program. All responsible revenues earned by the Department of National Defence are omitted from the model.

What are Direct, Indirect, and Overhead Costs?

Canada's military capabilities are classified by the PBO into 21 distinct categories across the main branches of the CAF: the Canadian Army (CA), the Royal Canadian Air Force (RCAF), the Royal Canadian Navy (RCN), and a

Joint branch that draws personnel from the three other branches. These 21 capabilities are direct capabilities, meaning they represent a capability that delivers a direct military effect; for instance, the Canadian Army's Direct Fire Regiments which include deployable Leopard II tank and Light Armoured Vehicle squadrons, the Air Force's Tactical Fighter capability, or the Navy's Halifax-class Frigates. The direct costs associated with these 21 capabilities are therefore the POS costs that are attributable to the manning, support, maintenance, and employment of each of these capabilities. Estimated personnel figures for direct capabilities largely consist of military personnel at the direct level.

Indirect costs are POS costs associated with what are termed "indirect" capabilities. These are capabilities that do not necessarily produce a military effect on their own but are either necessary for the deployability of a direct capability, support a direct capability, or are generally deployed only as part of a force mix with direct capabilities. Estimated personnel figures for indirect capabilities include a combination of military and civilian personnel¹.

Overhead costs refer to institution-level costs that are not deployable but are nonetheless necessary for the proper functioning of the CAF. These include administrative costs, base-level costs, force generation costs, research and development costs, etc. The estimated personnel figures for overhead capabilities include a combination of military and civilian personnel.

Data and Methodology

For this analysis, the PBO requested, and was provided, detailed expenditure data from the Department of National Defence for fiscal years 2016-17 through 2021-22. These datasets consist of line items detailing spending amounts associated with general ledger (GL) codes, funds, DRF categories, and so forth, with the total expenditures per year reflecting that which is presented in Canada's Public Accounts. An example of these line items is presented in Table 1.

Table 1
Example of National Defence Expenditure Data

Fund	C113	L101
Fund Description	NATIONAL PROCUREMENT - TBA B120	OPERATING EXPENDITURES - TBA B120
Cost Centre /WBS Element	8485ND	19259A
Cost Centre/WBS Element Description	CH147F CHINOOK	FMF CAPE BRETON QUALITY CONTROL
GL Account	4640	4411
GL Account Description	V1 CONTRACT ADMINISTRATION SERVICES	V1 MEDICAL PROFESSIONAL FEES
DRF Description	Aerospace Equipment Support	Naval Equipment Servicing
Expenditure Amount	\$X	\$X

Source:
Department of National Defence.

Note:
Expenditure amounts withheld due to sensitivity.

After removing non-POS line items and spendable revenues from the data, over 100,000 entries remain. In addition to expenditure amounts, each entry contains relevant information on accounting attributes such as GL Accounts, Funds, Cost Centres, and DRF Descriptions.

Cost Data Mapping Process

To map cost data entries to capabilities, the PBO builds upon the methodology developed in a 2009 study by DND's scientific authority, Defence Research and Development Canada.² This research document references the underlying accounting framework that was in effect in the Department in 2009. As such, PBO has undertaken an extensive updating of the mapping process to appropriately assign cost elements to the full suite of capabilities that exist currently. Importantly, certain capabilities no longer exist, such as the Iroquois-class Destroyer fleet, and new capabilities are in the process of emerging and maturing, such as the Arctic Offshore Patrol Ships (AOPS). Further, many accounting attributes have since fallen into disuse while new accounting attributes have been added, requiring a careful review to ensure the new mapping process developed by the PBO remains accurate.

In the first step of the mapping process, each cost entry receives an initial assignment. These assignments are based on both previously established and PBO-developed accounting relationships linking costs to capabilities using the available descriptors associated with each entry. This step maps only a small proportion of cost entries to their final capabilities; the remaining entries are collected in several temporary assignment bins that require a separate methodology to be mapped to a final capability and are grouped depending on the type of cost to be allocated. Examples of these temporary assignments and their distribution methodology include:

- Expenditures on infrastructure and minor equipment: distributed proportionally to other capabilities, such that a capability with a larger expenditure share receives a larger share of the amount to be distributed, and vice versa.
- Military pay: collected under a common assignment and redistributed to capabilities according to a distribution initially formulated by

Kerzner (2011)³ and updated by the PBO for the purposes of this model.

With all cost entries now attributed to capabilities at the direct, indirect, and overhead levels, the next step in the mapping process is the orientation of these capabilities towards the direct capabilities they support. For example, the Navy's Auxiliary/Support Vessel capability is an indirect capability supporting the Navy's direct capabilities, importantly the Halifax-class Frigate, or the Army's Field Hospital (indirect) capability supporting the Army's direct capabilities such as Mechanized Infantry Battalions. Overhead capabilities are either associated with an environment, such as the Fleet Maintenance Facility capability being associated with the Navy or are considered "Institutional" overhead serving all branches equally, as in the case of Defence Research and Development Canada.

The mapping process is carried out for each of the six years of cost data. Once complete, the costs in each data set are inflated to reflect 2022-2023 prices. The model's final cost estimates for each direct, indirect, and overhead capability thus consist of an average of all six years of data, with adjustments made for either obsolete capabilities or new and emerging capabilities. The estimates therefore reflect, to the extent possible, a current "steady state" military capability posture.

Personnel Estimates

The personnel figures cited within the Force Structure Model and associated with the 21 capabilities as either direct, indirect, or overhead, are assembled from several sources. First, DND's Departmental Results Report includes personnel counts across DRF categories. These figures, being oriented to DRF categories and not military capabilities, are used in conjunction with two other publications in order to derive capability-specific personnel totals: DND's Estimated Expenditures by Electoral District and Province (EDIS)⁴ and the International Institute for Strategic Studies'

Military Balance⁵ publication. The primary methodology for the allocation of personnel is based on the Kerzner (2011) distribution of military pay⁶.

Overview of Model Results

The completed PBO Force Structure Model of Canada's military contains estimates of personnel and recurring annual personnel, operations, and sustainment costs of 21 identified military capabilities across all branches of the CAF. The personnel counts and costs associated with enabling indirect capabilities and overhead or "institutional" capabilities are likewise included. The model additionally allows for portfolio-level tradeoff analysis of the full suite of military capabilities, providing users the ability to examine changes in costs and personnel counts as the quantity of a given military capability is adjusted.

Table 2 presents a summary of costs for each branch of the CAF.⁷ In total, direct costs for CAF capabilities amount to 32 per cent of total POS costs. In military parlance, this figure represents a "tooth-to-tail" ratio of about 1:2, meaning that about a third of every dollar spent on personnel, operations, and sustainment goes towards those elements that produce a direct military effect.

Within CAF branches, the ratio between direct, indirect, and overhead components can vary. For example, the CA has a higher total indirect cost than direct cost. These differences are due to the differing operational requirements and support needs of each environment.

Table 3 provides additional context to cost differences observed in Table 2, displaying estimated personnel counts across all military branches. The CA has the highest personnel count of all environments, with CA indirect personnel exceeding all other categories. This can be understood through the unique dependence of CA capabilities on infantry and support personnel compared to the RCN and RCAF.

Table 2

Personnel, Operations, and Sustainment Costs by Military Branch (millions of dollars, 2022-23)

Environment	Direct Costs	Indirect Costs	Overhead Costs
CA	1 630	2 010	2 000
RCAF	2 690	830	1 700
RCN	1 780	680	1 300
Joint	730	500	-
Institutional	-	-	5 600
Total	6 830	4 020	10 600
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Sources:

PBO calculations, Department of National Defence.

Notes:

Totals may not add due to rounding. Figures reflect an average of 6 fiscal years of POS costs spanning 2016-17 to 2021-22, with each year of data inflated to 2022-23.

Table 3

Personnel Count by Military Branch, Average of 2017-2022 Fiscal Years

Environment	Direct	Indirect	Overhead
CA	14 500	26 100	19 000
RCAF	9 600	6 200	5 000
RCN	3 400	3 500	13 000
Joint	2 800	4 600	-
Institutional	-	-	14 000
Total	30 300	40 400	51 000
%	25%	33%	42%

Sources:
PBO calculations, Department of National Defence.

Note:
Totals may not add due to rounding.

Notes

¹ Examples of civilian personnel associated with an indirect capability include civilian maintenance or engineering support staff for indirect capabilities such as the Army's Armoured Reconnaissance Regiments or the Navy's Auxiliary Support vessels.

² Kerzner, L., Chouinard, P., and Solomon, B. (2009). The Department of National Defence Strategic Cost Model Volume 3: Description and Documentation. (Technical Report TR 2009 – 12). Defence Research and Development Canada, Department of National Defence.

³ Kerzner, L. (2011). Application of the Strategic Cost Model to the Canada First Defence Strategy, DRDC CORA TM 2011-160. Defence Research and Development Canada, Department of National Defence.

⁴ Department of National Defence (2016). Estimated Expenditures by Electoral District and Province.

⁵ International Institute for Strategic Studies (2023). [The Military Balance 2023](#). Accessed 8/29/2023.

⁶ Kerzner, L. (2011).

⁷ While the CAF branch titled "Joint" is not one of the three branches alongside the Canadian Army, Royal Canadian Navy, and Royal Canadian Air Force, two military capabilities are assigned to Joint as they comprise personnel from each of the three branches.

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