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Weapon System Cost Analysis in the Canadian Armed Forces

by Ross Fetterly

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POLICY PERSPECTIVE

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Cost estimation in defence is a primary management tool employed to assist decision-makers in evaluating resource requirements at key project milestones in the acquisition process. The institutional reason for defence cost-analysis is to inform decision-makers of the costs, benefits and trade-offs which are involved in their decisions. The central problem facing defence cost analysis is how to develop and apply concepts and strategies to assess the economic cost and alternative future approaches under conditions of uncertainty. While this does not significantly reduce the risk inherent in a defence acquisition program, it does help decision makers "understand the nature of the risks involved in order to develop effective mitigation strategies."[1]

When Canadian governments are faced with significant budgetary deficits and resort to cost reduction measures, defence – as the largest "discretionary spending category"[2] – customarily shoulders the biggest funding reduction. This results in multi-year impacts on the overall planned military capital equipment program. The resulting resource constraint problems in national security are discussed in the first section of this article. The second section describes the distinguishing features of the defence cost analysis framework, the evaluation of the procurement of a new weapon system, and the importance of understanding life cycle costs. The third section considers the trend in increasing life cycle costs, and concludes with consideration of life cycle and procurement trade-offs as a critical enabler of effective defence resource management.

The Resource Constraint Problem in Defence

"Hard power such as military capability is important and will become more so with geo-economic shifts. But it takes time to build."[3]

The resource constraint problem in defence can simply be viewed as an excess of demand for resources against a limited funding allocation from the federal government. However, the resource constraint problem is largely derived from a diverse range of factors. In particular, the demand for defence resources is greater than the actual available supply of government funding. Furthermore, accurate cost knowledge is critical for the maximization of efficient use of capital expenditure funding. In particular, inefficient or incomplete cost estimates can result in substantial under- or over-expenditure resulting in sub-optimal expenditure on defence capital procurement in a particular fiscal year. The defence capital equipment market is unique – there is both a knowledge and information asymmetry in understanding weapon system costs between

[1] Abderrahmane Sokri (2014) Risk Analysis of Defence Acquisition Projects: Methods and Applications (Defence Research and Development Canada, Ottawa), 1. https://publications.gc.ca/collections/collection_2018/rddc-drdc/D68-2-124-2017-eng.pdf
[2] David Perry and J. Craig Stone (2021) Economic Benefits of Defence Spending (Canadian Global Affairs Institute, Ottawa), 1 https://www.cgai.ca/economic_benefits_of_defence_spending
[3] Peter McKay (2023) quoted in the Globe and Mail newspaper in an article by Campbell Clarke on 16 Dec 23, page A12

the government and manufacturer of the weapon system: as a significant percentage of defence expenditure is spent on advanced technology.

The defence market is characterized by constant technological advancement – often characterized as an arms race. In Western governments, there is a large number of capital equipment procurement programs at various stages of acquisition at any one time – with projects ranging in progress from Rough Order of Magnitude (ROM), to indicative, and then substantive cost estimates. In Canada, Department of National Defence capital equipment programs generally have a small number of very large cost projects – in which a significant cost variance in any one project can adversely impact the defence budget.

Defence capital acquisition decisions by the Canadian government affects how well the military can implement defence policy. The amount and type of equipment the Canadian Forces purchase directly affects their ability to carry out their roles, which in turn determines how and where the government can deploy them. Finally, the elevated level of Canadian participation in high-intensity international operations in recent decades increases the costs of operation and maintenance of frequently deployed weapon systems.

Addressing resource restraint issues requires efficient management of defence resources. The requirement for a high degree of accuracy in determining the quantity of resources and when they will be expended is an important consideration in defence. Experience has shown that many project difficulties are directly related to the poor quality of cost estimates and unrealistic milestones. With a large number of defence capital equipment projects[4] in various stages of development, contracting and production, the resource constraint problem in defence remains an ongoing issue for the department and government.

Common Factors in Defence Capital Equipment Cost Estimates

In the 2003 budget, the Government of Canada implemented its commitment to present its financial statements on a full accrual accounting basis. Previously, its financial statements were prepared under modified accrual accounting. This was a significant change to defence funding. The Canada First Defence Strategy (CFDS)[5] provided a twenty-year acquisition plan. The associated funding framework at that time was an unprecedented indication of the government's intention to pursue a long-term defence plan for equipment recapitalization, including long-term cost estimates.

[4] Defence Procurement Announcements (2020) (Department of National Defence, Ottawa) https://www.canada.ca/en/department-national-defence/services/procurement/announcements.html
[5] DND (2015) Canada First Defence Strategy (DND, Ottawa) https://www.canada.ca/en/department-national-defence/corporate/policies-standards/canada-first-defence-strategy-complete-document.html

There are a number of common factors in military capital equipment cost estimates. These include:

- **Priority** – The importance and visibility of each cost estimate is a primary criterion in defining the cost of costing support. Reassessment of staff priorities and resources may be required
- **Sensitivity** – Political, security and contractual issues are the primary initial concern
- **Consequence of Error** – The lack of costing information can result in sub-optimal decision making and under-estimation of cost estimates
- **Time** – An early time appreciation is necessary to determine if the capital equipment project can be completed in the allocated timeframe
- **Personnel** – People – military personnel, DND public servants and contractors – move projects. This includes costs during both the procurement phase and during the equipment operational phase
- **Cost Estimation Accuracy** – Funds wasted at the end of the Fiscal Year due to poor cost estimation are capital equipment funds wasted
- **Equipment Usage Long-term Perspective** – Cost analysis provides a long-term view of related defence costs by examining costs over the equipment under consideration for procurement

Cost information and cost analysis are primary tools in the resource management process, and consequently form the basis for a wide range of departmental decisions. Consideration of alternative actions required in national security problems include:

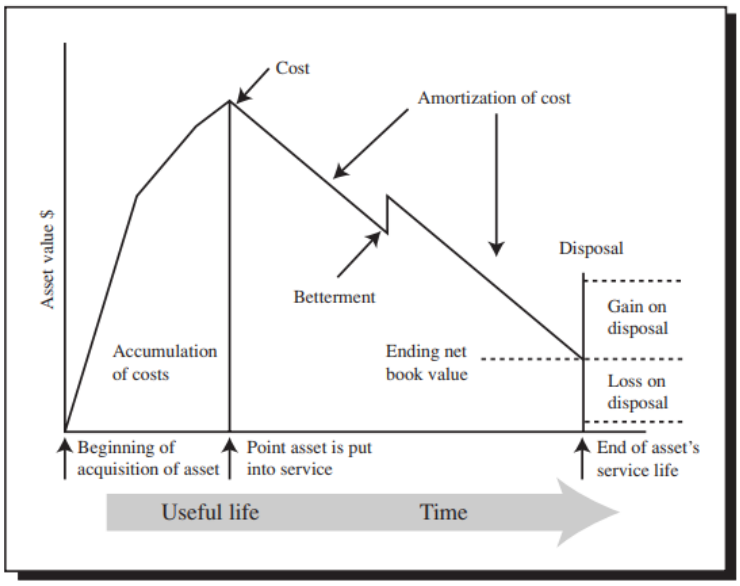
- Proposed **new future capabilities,** including new weapon systems, support systems and infrastructure
- Proposed **modifications** of existing or presently programmed capabilities
- Proposed **deletions** from the presently planned force
- Proposed **combinations** or packages of the above alternative actions

Cost estimates are a management tool used to help decision-makers evaluate resource requirements at key project milestones in the acquisition process. Accurate costs, based on the best available information, are an important component in the decision-making process. The expression of resources in dollar terms permits an objective analysis between alternatives that would have otherwise been obscured by the qualitative or subjective differences. Accrual

accounting[6] in defence is used to spread the capital investments over the life of the assets acquired, with the Department of National Defence having to account for the full costs of the capital investments in budgetary cash during the years in which the assets were acquired. This requires the ability to absorb and then to apply knowledge.

It has always been a necessity for defence departments and military organizations to absorb knowledge and remain privy to substantive defence industry and technological developments. The international strategic environment has changed dramatically in recent years, reinforcing the importance of institutional capability, particularly regarding knowledge acquisition, dissemination and utilization. In their seminal paper on absorptive capability, Cohen and Levintal demonstrated that "prior knowledge confers an ability to recognize the value of new information, assimilate it, and apply it to commercial ends."[7] Furthermore, "knowledge absorption is not linear, but highly iterative"[8].

Chart 1 - Illustration of Accrual Accounting



The Distinguishing Features of the Defence Cost Analysis Framework

The federal defence budget can be viewed as the end result of a lengthy series of decision-making, and in effect the tangible implementation of government policy. In this regard, it is achieved by

[6] Ross Fetterly and Richard Groves (2008) Accrual Accounting and Budgeting in Defence (School of Policy Studies Queen's University, Kingston), 32. https://www.queensu.ca/cidp/sites/cidpwww/files/uploaded_files/Claxton9.pdf
[7] Wesley M. Cohen and Daniel A. Levinthal (1990) Absorptive Capacity: A New Perspective on Learning and Innovation (Special Issue: Technology, Organizations, and Innovation), 128-152.
[8] Angelo K.S. Romasanta, Peter van der Sijde. Iwan J.P. de Esch (2022) Absorbing knowledge from an emerging field: The role of interfacing by proponents in big pharma. https://www.sciencedirect.com/journal/technovation

the information obtained through the cost analysis process. The distinguishing features of the defence cost analysis framework are as follows:

- **Output Orientation** – an output orientated analytical capacity for developing and preventing results in terms of program elements, such as weapon or support systems, of interest to long-range planning decision-makers
- **Life-cycle Analysis** – provision of life cycle identification and development of an appropriate input structure
- **Costs of Alternatives** – focuses on an emphasis on generating economic costs of alternatives – such as incremental or marginal costs or explicit treatment of uncertainty
- **Uncertainty** – provision for explicit treatment of uncertainty
- **Accuracy** – emphasis on accuracy in a relative or comparative sense
- **Collection of Data** – a recognition that the backbone of a cost analysis capability is the systematic collection of data and information, and the derivation of estimating relationships

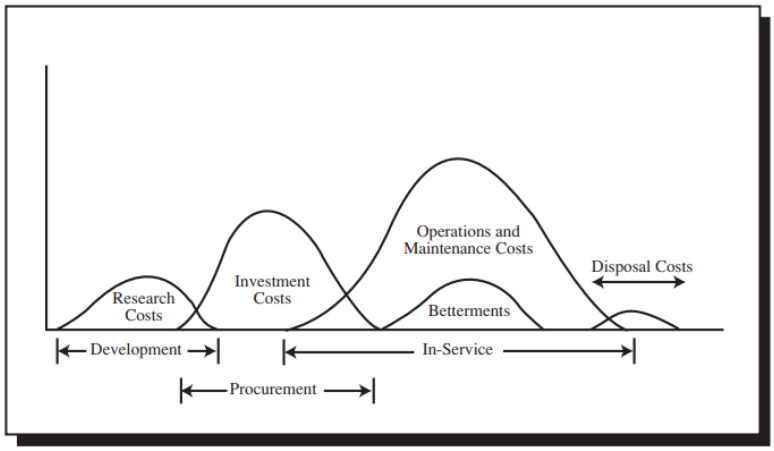
The Defence Cost Analysis Framework supports the procurement evaluation of new weapon systems.

Evaluating Procurement of a New Weapon System

In the evaluating procurement of a new weapon system to either address new or evolving threats, the operating costs receive much less attention than the acquisition costs. Indeed, decision to field a new weapon system brings with it the commitment to support that system for years into the future. The lesson military life cycle and other support costs illustrate to decision makers are that a stream of operating costs over a period of years is an inevitable consequence of the procurement decision.

Capital equipment purchased by the federal government for the Canadian Armed Forces is normally in use for several decades. Operating and support costs over the life of the equipment in use can often be higher than procurement costs. Chart 2 provides an illustration of generic weapon system life-cycle costs. Furthermore, the decisions over Department of National Defence and Canadian Armed Forces support versus contracted support have a significant impact on costs. Finally, sale conditions and the transfer of defence manufacturer technology can also affect weapon system costs.

Chart 2 – Illustration of Weapon System Life-Cycle Costs



Impact on Capital Equipment Procurement from Accrual Accounting and Budgeting in Defence

Prior to the adoption of accrual accounting and budgeting in the Department of National Defence, the historical practice in Canada was to support current operations (the present force) at the expense of investing in capital equipment (the future force). This practice resulted in capital equipment expenditure being treated as a residual. While this effectively supported in-year activities, it had a detrimental effect on the long-term capital investment program in-year, despite substantial over-programming. This surplus was effectively absorbed by the extent of operations and maintenance expenditure incurred by the department. The adoption of accrual accounting by the department dramatically changed this entrenched sub-optimal dynamic.[9]

The Five DND Phases of Military Equipment Acquisition

The Department of National Defence employs a defined and systematic process to ensure procured military equipment "meet a capability deficiency or emerging requirement identified by the Canadian Armed Forces (CAF)."[10] DND's project management approach is governed by policy set by the Treasury Board of Canada, which states that:

- projects achieve value for money
- sound stewardship of project funds is demonstrated
- accountability for project outcomes is transparent

[9] Ross Fetterly and Richard Groves (2008) Accrual Accounting and Budgeting in Defence (Defence Management Studies Program School of Policy Studies, Queen's University) https://www.queensu.ca/cidp/sites/cidpwww/files/uploaded_files/Claxton9.pdf
[10] DND (2023) The five stages of military equipment acquisition (DND, Ottawa). https://www.canada.ca/en/department-national-defence/services/procurement/defence-purchases-upgrades-process.html

- outcomes are achieved within time and cost constraint

The five phases of military equipment acquisition begin with the identification phase. In that initial phase, the objective is to define the requirement in general terms. The second phase is options analysis, where a preliminary statement of operational requirement is developed, and a detailed business case analysis of the options are identified by the project team. The third phase is the definition phase, which transitions the project towards the what is needed to be accomplished, in order to meet the identified capability requirements. This phase concludes with the determination of the manner in which the selected option will be implemented. The fourth phase is implementation of the project, where the Department of National Defence shifts towards delivery of the acquired equipment. Specifically, that the equipment is delivered as specified in the contract, and that the project remains within scope, on time and within budget – to the extent possible. The fifth and final phase is the closeout of the project. This occurs when the newly acquired equipment and the necessary supporting organization or service, is completely operational. The project manager provides formal notification to departmental leadership that the operational capability has been achieved, and that "all the conditions and limitations imposed on the project have been met."[11]

The 1986 President's Blue Ribbon Commission on Defense Management – An Interim Report to the President, provided a prescient summary of their view of successful characteristics in both industrial or government capital equipment projects:

> ...there are certain common characteristics of successful commercial and government projects. Short, unambiguous lines of communication among levels of management, small staffs of highly competent professional personnel, an emphasis on innovation and productivity, smart buying practices, and, most importantly, a stable environment of planning and funding – all are characteristic of efficient and successful management.[12]

Conclusion

"As security threats mount, the holes in Canada's defences can no longer be ignored."[13]

Under conditions of heightened risk, the reinsurance industry in the private sector increases their premiums to match the higher probability of various events occurring. In defence, increasing national funding for the scaling up of the Department of National Defence and Canadian Armed Forces is necessary to prepare the military for an increasingly more dangerous and contentious

[11] DND (2023) Defence purchases and upgrades process (DND, Ottawa). https://www.canada.ca/en/department-national-defence/services/procurement/defence-purchases-upgrades-process.html
[12] Department of Defense (1986) 1986 President's Blue Ribbon Commission on Defense Management: An Interim Report to the President (President's Blue Ribbon Commission on Defense Management, Washington). https://dair.nps.edu/bitstream/123456789/3705/1/SEC809-RL-86-0106.pdf
[13] Andrew Coyne (2023) As security threats mount, the holes in Canada's defences can not longer be ignored" (The Globe and Mail, Toronto). https://www.theglobeandmail.com/opinion/article-as-security-threats-mount-the-holes-in-canadas-defences-can-no-longer/

world. The defence budgets of our allies are already growing and are likely to continue to increase. As Canadians, we now live in a more hostile international security environment, and like our allies, need to rebuild and grow our military. In the commercial insurance market, insurance companies are the messengers of risk in the economy. Rising defence budgets in Russia and China are also indicators of increased strategic risk to Canada in both defence and security. Unfortunately, Canada has historically under-invested in the Canadian defence establishment during periods of relative peace, at the cost of purchasing new or used capital equipment when our allies are re-supplying their own armed forces. As recently noted in The Economist, "ultimately what matters in war is not the absolute level of a country's defence capabilities, but its strength relative to that of enemies."[14] In this regard, Canada has a lot of work to do in order to increase defence and security capacities to one that is better aligned with our western partners, to support a relative advantage over our common potential adversaries.

[14] The Economist (2023) Can the West build up its armed forces on the cheap? (The Economist, London) https://www.economist.com/finance-and-economics/2023/06/22/can-the-west-build-up-its-armed-forces-on-the-cheap

About the Author

Ross Fetterly *retired in 2017 from the Canadian Forces after a 34-year career as the Royal Canadian Air Force's director of air comptrollership and business management. He previously served as the military personnel command comptroller, and in other senior positions with the Department of National Defence Assistant Deputy Minister (Finance).*

Retired Col. Fetterly completed a tour in February 2009 as the chief CJ8 at the NATO base headquarters at Kandahar airfield, Afghanistan, where he was responsible for finance, contracting and procurement. While deployed he wrote a paper entitled Methodology for Estimating the Fiscal Impact of the Costs Incurred by the Government of Canada in Support of the Mission in Afghanistan with staff from the Parliamentary Budget Office. Col. Fetterly was employed as the deputy commanding officer of the Canadian contingent in the United Nations Disengagement Observer Force in the Golan Heights during the second intifada in 2000-2001. He has served as an air force squadron logistics officer and as a finance officer at military bases across Canada.

An adjunct professor at the Royal Military College of Canada (RMC) department of management and economics, and a Senior Fellow with the Centre for Security Governance, Dr. Fetterly has a B.Comm (McGill), M.Admin (University of Regina) and an MA and PhD in war studies from RMC. His PhD fields of study included defence economics, defence policy and defence cost analysis. His primary research focus is defence resource management. Dr. Fetterly also teaches courses in financial decision-making, defence resource management and government procurement at RMC. Through his company, Ross Fetterly Consulting Inc., he has taught a defence resource management course and a business planning course internationally for the Department of National Defence to senior military officers and defence executives in developing countries.

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