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Scientific Letter

The PORTFOLIO APPROACH developed to underpin the Capital Investment Program Plan Review (CIPPR)

To better prepare senior management for meetings about CIPPR in November 2014, this scientific letter has been prepared upon request [1] to clarify some of the key concepts about the new *analytical approach* that has been used to produce alternative project portfolios for consideration within the Capital Investment Program Plan Review (CIPPR). This approach has come to be known as the **portfolio approach**. This letter begins with a brief description of CIPPR and situates the portfolio approach within it. The approach is then introduced in comparison to a less sophisticated method (based on a ranked list) that has been used at Defence in the past. This letter concludes with a brief discussion about some of the advantages that this new approach provides. Other letters are currently being prepared to explain the CIPPR project **value framework** and the CIPPR **portfolio creation model** which fall under the umbrella of the **portfolio approach** described herein.

Background

The Capital Investment Program Plan Review (CIPPR) was formally initiated through a directive [2] from the Vice Chief of Defence Staff (VCDS) and the Associate Deputy Minister Finance and Corporate Services (ADM FIN CS). The aims of this first iteration of CIPPR were articulated as follows:

1. Undertake a rationalization of all investments at the Identification (ID), pre-Identification (pre-ID) and Options Analysis (OA) stages¹ that have an acquisition cost of greater than \$5 million.
2. Produce a consolidated balanced portfolio consisting of critical, viable, and affordable capabilities representing best value for money.
3. Institutionalize a process that will be transparent, repeatable, rigorous and coherent against which all present and future investment will be assessed.

In the directive all Level One organizations within Defence that routinely participate in the development or execution of Capital projects at the pre-ID, ID and OA phases were directed to collect project data and aid in the assessment of the expected merit of each project. At the time of writing these efforts continue to be guided and coordinated by a CIPPR working group led by the Direction General of Capability and Structure Integration (DGCSI) within the Chief of Force Development (CFD) organization.

The CIPPR working group was established in December 2013, just prior to release of the CIPPR directive. The authors were involved in formulation discussions in the lead-up to the CIPPR directive and were assigned to enable the CIPPR working group staff. The role of Operational Research and Analysis in support of CIPPR was to:

1. Provide scientific support to the development of a traceable and sustainable approach and process by which to create project portfolios and make future investment decisions, and
2. Develop analytical methods and associated toolsets to support fulfillment of the CIPPR aims.

¹ These stages are part of the project delivery process as laid out in the Defence Project Approval Directive (PAD).



Method

Rather than tackle the three CIPPR aims in sequence, the authors proposed and helped develop of a multi-pronged method designed to answer the CIPPR remit by Fall of 2014. The first element was to develop the **portfolio approach**. While this approach is not new, its application at the strategic level at Defence is relatively novel. After development of the portfolio approach, latter elements have proceeded in parallel. The scope of work in each element is outlined below.

1. **A value framework for assessing the relative merits of individual projects:** This involved development of a framework that extends concepts utilized during: 1) the 2009 Defence Strategic Review, and 2) the execution of Capability Based Planning (CBP) within Defence. Projects are assessed based on three overarching criteria: alignment with National Policy, alignment with a capability/institutional view of Defence, and sponsor priority. (Note: In the CIPPR context the term *value* does not refer to monetary value, rather it refers to the “degree of goodness” or “merit”.)
2. **An optimization model for creation of portfolios:** This has encompassed the design and implementation of a flexible mathematical model, which has become known as the *portfolio creation model*, to produce alternative but viable portfolios subject to several adjustable constraints (e.g., financial constraints, delivery capacity constraints, project dependency constraints).
3. **An enhanced toolset for collection of project data:** This has incorporated the development of CIPPR *data collection requirements* and associated *data collection tools*, as well as the coordination, collection and validation of project data by Defence stakeholders.
4. **An interactive visualization application:** This has involved the development of an *extendable software interface* that enables decision makers and/or their staffs to explore project data, interact with the portfolio creation model, and visualize the development of alternative portfolios. This software has been called **VIPOR** for **V**isual **I**nteraction **P**lan **O**ptimization and **R**evision. From the perspective of a user, VIPOR *contains* the portfolio creation model but was conceived with the intention that it could be made to *interface* with other new or more enhanced portfolio creation models should they be developed in the future. As such, the visualization application and the portfolio creation model are seen as separate components that are intrinsically linked.
5. **A tool for comparative portfolio analysis:** This has included the *construction of software modules* within the Oracle-Endeca Information Discovery toolset (resident within the CFD organization) in order to explore, visualize and ultimately compare alternative portfolios along various dimensions.
6. **Alternate portfolios for consideration by senior Defence leaders:** This has included the *creation and assessment of portfolios* based on different investment strategies and portfolio constraints using the frameworks, data, applications and tools developed in other prongs.
7. **Selection of a preferred portfolio:** This continues to involve efforts to interface with the Investment and Resource Management Committee (IRMC) as well as senior stakeholders from across Defence in order to take decisions about those projects to include within upcoming investment plans.
8. **Sustained integration into Strategic Planning processes:** This is expected to include the design of an *institutionalized process* that would see CIPPR repeated either on regular intervals or asynchronously in alignment with other Defence planning and investment processes.
9. **Governance:** This continues to include the provision of project planning, resourcing and administration, as well as maintaining continual a connection with senior leadership and responding to changes in direction about the overall progression of CIPPR.

As this letter is being written, the first iteration of CIPPR is still in progress, but the first five elements are largely complete. The latter four activities are currently ongoing. However, initial efforts to create portfolios (element 6) have already begun to show that the portfolio approach, in combination with supporting frameworks, data, application and tools, makes it possible to create project portfolios that:

- are projected to be viable and affordable over time;
- contain critical military capabilities; and
- represent alternative preferences with respect to value for money.

The focus of the remainder of this letter is the **portfolio approach** that underlies the nine elements listed above.



Results: The CIPPR Portfolio Approach

The CIPPR portfolio approach is different from a common approach used to facilitate strategic investment planning in the past. Often referred to as the “ranked-list approach”, this more common approach is typically undertaken as follows.

1. **Create a ranked list:** Score individual projects based on either implicit or explicit determinations of their importance and create a ranked list.
2. **Determine a cut-line:** Using the ranked list created in step 1, select the highest ranking projects whose total cost is less than a given dollar amount.
3. **Assess feasibility:** Using the initial list determined in step 2, undertake several parallel analyses by different departmental stakeholders to determine if the projects within the list collectively satisfy annual feasibility constraints.
4. **Make adjustments:** If it is determined in step 3 that one or more projects, or the entire list itself, does not comply with feasibility constraints, adjust the list as necessary by removing some projects, adding others, and repeating step 3 until there is a degree of alignment between stakeholder preference and practical constraints. When making adjustments to the list, the preferred approach is to first consider projects for inclusion in the list that are just below the cut-line in the order that they appear in the ranked list created in step 1.

The ranked-list approach is often appealing because it is seemingly straightforward and because, by design, it necessitates participation by many departmental stakeholders. However, in practice, it often suffers many shortcomings. Not only is it often onerous to recreate a ranked list when conditions/priorities change (or when projects are added and subtracted from the larger set of potential projects) the ultimate utility of the ranked list itself is often marginalized in step 4 which is where adjustment takes place. The reason for this is that when many projects must be swapped into and out of the portfolio at once, and several departmental stakeholders are simultaneously involved, it often becomes difficult to adhere to the preferred adjustment approach.

In practice, step 4 of the ranked-list approach, which aims at producing a “final list” that conforms to annual resource and capacity constraints, becomes a manual, iterative and organizationally distributed process that is often very time-consuming and difficult to coordinate. Moreover, when step 4 is “complete” it is typically difficult to trace if best value for money has been achieved. For example, the 2008 Strategic Capability Roadmap (SCR), which was the result of a concerted effort to assess Defence capability gaps, produced a ranked list.² Unfortunately, for a variety of valid reasons, this list became somewhat difficult to use for programming projects and producing a Departmental Investment Plan (IP) after a relatively short period of time.

In general, the ranked-list approach can work well when several conditions exist. These conditions include:

1. a relatively small number of projects to consider;
2. a straightforward set of criteria and a relatively simple mechanism by which to determine the importance of projects during production of the ranked list;
3. only a few (if any) very simple constraints upon which to judge the feasibility of the portfolio;
4. a single consolidated analytical body that has access to all pertinent fiscal, resource, and other relevant information concerning projects and feasibility constraints;
5. a low or at least manageable amount of uncertainty with regard to projects, priorities, and feasibility constraints; and
6. a small and agile decision making body that has exacting insight and clarity on how to judge the overarching value of the portfolio.

Unfortunately, the very nature of large dynamic public sector organizations like Defence makes achieving many of these conditions difficult, if not impossible. Therefore, making efficient use of the ranked-list approach becomes very challenging.

²Note that during development of the 2008 SCR attempts were made to select a portfolio of projects using a heuristic optimization algorithm. However, even with this more sophisticated approach, multiple stakeholders were still required to manually determine if the portfolio was feasible against both multi-year financial and organizational capacity constraints.



An improved analytical approach for the development of project portfolios has been devised for CIPPR. In accordance with aims of CIPPR, the objective of this new approach is to facilitate the institutionalization of a process that is transparent, repeatable, rigorous, coherent, and can be used to assess all present and future investments.

In concept, the CIPPR **portfolio approach** is outlined as follows.

1. **Project Value:** Determine the value(s)³ of each individual project.
2. **Portfolio Value:** Determine a measure(s) by which to understand the aggregate value of a portfolio of projects.
3. **Practical Constraints:** Determine a set of constraints that reflect practical limits on the inclusion of projects in the portfolio.
4. **Investment Preferences:** Determine a set of constraints that correspond to strategic guidance pertaining to the preferred attributes of the aggregate portfolio.
5. **Manual pre-determinations about specific projects:** As appropriate, make manual pre-determinations about the inclusion or exclusion of projects in the portfolio (e.g., manually “force” certain projects into or out of the portfolio).
6. **Portfolio Creation:** Design and implement an algorithm and solve for the set of projects to be included in the portfolio so as to maximize its aggregate value subject to all constraints, preferences, and project pre-determinations.
7. **Portfolio Exploration:** Explore the portfolio to understand its sensitivity to the various constraint sets, project pre-determinations, and the measures that have been used to determine both project value and/or portfolio value.
8. **Alternative Portfolios:** Make adjustments to constraints, project pre-determinations, and value measures in order to create one or more alternative portfolios for consideration by senior decision makers and approval bodies.
9. **Portfolio Decisions:** Obtain decisions on the preferred portfolio of projects for execution.
10. **Project Updates:** Over the course of time continue to collect information about potential projects that have surfaced, those that have been abandoned, or those whose attributes have changed.
11. **Formulation Updates:** Over the course of time continue to synthesize strategic information to determine impacts on portfolio constraints, project pre-determinations, or measures of project and portfolio value.
12. **Iteration:** Repeat the entire process on either a regular cycle or asynchronously in accordance with other strategic planning processes or pre-identified events of strategic importance.

Closely connected to the portfolio approach is the **portfolio creation model** that has been developed for CIPPR. Details of this model are to be included in a subsequent letter, however it is worth noting here that this portfolio creation model brings together the following elements of the portfolio approach:

- codification of value measures for individual projects and the aggregate portfolio in steps 1 and 2;
- enforcement of constraints in steps 3 and 4;
- pre-determinations of project inclusion and exclusion in step 5; and
- the creation, exploration and adjustment of one or more valid portfolios in steps 6 through 8.

Discussion

A new portfolio creation approach has been developed for CIPPR. This represents a significant step forward compared to approaches that have been traditionally used within Defence at the strategic level. Expected advantages associated with implementing the portfolio approach are outlined below.

1. **A better starting-point for decision making:** The portfolio approach should not be seen as a means to provide a final decision, rather, it should be seen as a mechanism by which to produce a strong and stable foundation that allows decision makers to: (1) better understand the problem; (2) identify “maneuver room” within which there is space for discretion and decision making by leadership; (3) ignite fruitful discussion; and (4) evaluate the potential implications of decisions.

³Note, as stated earlier, in the context of CIPPR the term *value* does not refer to monetary value, rather it refers to the degree of “goodness” or “merit” of a project.



2. **Improved agility:** When enabled by a supporting set of tools and models, the portfolio approach can enable a decision cycle that is faster and better informed. It can also be made to respond relatively rapidly to changing realities regarding individual projects, constraints and other external factors.
3. **Improved efficiency:** Simultaneous consideration of value maximization objective and satisfaction of overarching constraints is achieved in one procedural step using the power of advanced mathematics — rather than a series of tedious and time consuming manual verification, correction and iteration processes.
4. **Formulation of the portfolio creation problem is more easily separated from efforts to find the optimal portfolio:** The separation of these two aspects makes it easier to differentiate between: (1) the kind of attributes that a preferred portfolio should have, and (2) the task of representing these as mathematical equations and then developing and/or using an algorithm to solve for a viable portfolio. The former is typically of greatest interest to senior leaders and decision makers, the latter is often left within the purview of management scientists, operational researchers, analysts and staff.
5. **Satisfaction of practical constraints is harmonized with the desire to maximize overall value:** The inclusion of constraints signals explicit recognition of practical limitations that are caused due to the limited availability of fiscal resources — both accrual and cash based. Additionally, the overall cost of the portfolio can be limited to occupy only a portion of the available financial envelope so as to leave space for future projects that have yet to be considered. A variety of other constraints can also be added within a portfolio approach.
6. **Opportunity costs can be better understood:** The portfolio creation approach facilitates the manual inclusion and exclusion of projects from the portfolio. By assessing which projects move into or out of the portfolio in response to manual decisions, the opportunities forgone by individual project inclusions can be better understood.
7. **Decision logic becomes more straightforward to trace:** With the portfolio approach, the simultaneous consideration of project value, portfolio value and the need to satisfy a set of practical constraints and preferences is contained within a single decision support system. As such, the traceability between data collection, option analysis and final decisions about the preferred portfolio is significantly enhanced.

Current and Future Efforts

Presently the focus of the portfolio approach developed for CIPPR is the creation of a balanced portfolio from the set of potential Defence projects that: (1) have acquisition costs greater than \$5 million; (2) are in the pre-ID, ID and OA stages of execution⁴; and (3) have not already been programmed or committed as part of the Defence Investment plan which was recently approved by Treasury Board.

Initial efforts to employ the CIPPR portfolio approach have already demonstrated that, in combination with supporting frameworks, data, application and tools, it is possible to create project portfolios that: (1) are projected to be viable and affordable over time; (2) contain critical military capabilities; and (3) represent alternative preferences with respect to value for money.

It is envisioned that, in the future, the portfolio approach developed for CIPPR could be extended beyond its current scope to other areas where Defence conducts strategic planning, programming, budgeting and strategic management.

Comments or questions about this scientific letter are welcome and should be addressed to Dr Chad Young at chad.young2@forces.gc.ca or Mr Mark Rempel at mark.rempel@forces.gc.ca.

References

[1] Basinger, D., Private Communication. 10 Oct 2014.

[2] Vice Chief of Defence Staff, Capital Investment Program Plan Review (CIPPR) 2014. 1948-1.

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⁴Three projects in the Definition phase were also included for consideration within CIPPR.