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Analysis of Capital Infrastructure Projects

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Caveat

The analysis conclusions do not have the weight of an audit or formal evaluation. While sufficient to enable the development of recommendations for consideration by management, the assessments provided and conclusions rendered are not based on the rigorous inquiry or evidence required of an audit.



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Acronyms and Abbreviations

ADM(IE)	Assistant Deputy Minister (Infrastructure and Environment)
AOPS	Arctic Offshore Patrol Ship
BC	British Columbia
Bldg	Building
BOD	Beneficial Occupancy Date
CFB	Canadian Forces Base
CID	Capability Investment Database
CIP (Infra)	Capital Investment Plan (Infrastructure)
CISOE	Construction in Support of Equipment
C/S	Cost/Schedule
CRS	Chief Review Services
CSE	Communications Security Establishment
CSOR	Canadian Special Operations Regiment
DCPD	Director Construction Projects Delivery
DEF	Definition
DND	Department of National Defence
DRDC	Defence Research and Development Canada
EPA	Effective Project Approval
FMF	Fleet Maintenance Facility
FY	Fiscal Year
HQ	Headquarters
ID	Identification
IMP	Implementation
LAV	Light Armoured Vehicle
MHLH	Medium-to-Heavy-Lift Helicopter
NCM	Non-Commissioned Member
NJ	Navy Jetty
OA	Options Analysis
OAG	Office of the Auditor General
ON	Ontario
OP Comd	Operation Command
PAG	Project Approval Guide

PCRA	Project Complexity and Risk Assessment
PM	Project Manager
PPA	Preliminary Project Approval
QC	Quebec
REPA	Revised Effective Project Approval
RID	Revised Identification
RMC	Royal Military College
RPPA	Revised Preliminary Project Approval
SRB	Senior Review Board
Tpt	Transport



Introduction

Background

In accordance with the Chief Review Services (CRS) Internal Audit Work Plan for fiscal year (FY) 2010/11 to 2012/13, CRS conducted an analysis of capital infrastructure projects. This analysis provides management with information to assist in determining which projects would benefit from audit or additional follow-up.

By examining lessons learned and findings from past audits and analyses,¹ CRS has developed criteria and a scoring methodology in order to focus audit resources where the Department would realize the most benefit. This approach gathers data from numerous sources of project information into a single consolidated analysis to help identify projects that exhibit indicators that could contribute to higher project costs or a delayed capability for the Department.

Objective

To conduct an analysis of capital infrastructure projects to determine which infrastructure projects may warrant audit attention or benefit from additional follow-up.

Scope

The analysis covered 321 infrastructure projects worth \$10.9 billion included in the Capital Investment Plan (Infrastructure) (CIP (Infra)) as of December 2010.

Methodology

The main sources of data were as follows:

- Primary: The CIP (Infra) is the departmental 10-year construction plan listing projects valued at \$1 million and above, detailing new construction, recapitalization, betterments, acquisitions, capital leases, transfers and potential disposal revenues and expenditures.
- Secondary:
 - Project approval documents and other key project documents;
 - Project Complexity and Risk Assessment (PCRA) Tool;
 - Director Construction Projects Delivery (DCPD) Project Activity Tool; and
 - Capability Investment Database (CID).

¹ Analysis of Capital Equipment Projects, September 2010; Analysis of Information Management Projects, December 2009 (<http://www.crs-csex.forces.gc.ca/reports-rapports/2009/130P0891-eng.aspx>).

CRS Analysis Process of Infrastructure Projects

Following an initial filtering of the population, a three-step process was used to analyze the remaining 129 projects listed in the CIP (Infra). The results of each step are summarized in Table 1. A detailed description of the methodology is provided at [Annex A](#).

Initial Filtering (321 Projects to 129 Projects). The initial 321 projects (worth \$10.9 billion) in the CIP (Infra) form the departmental 10-year construction plan from FY 2010/11 to FY 2020/21. Projects with a value of less than \$10 million were scoped out, as well as those with no forecasted Vote 5 spending before FY 2012/13. After removing those projects, 129 projects remained.

Step	Number of Projects	Project Value	Project Value Unspent
Initial Filter	321	\$10.9B	\$10.0B
Step 1	129	\$8.2B	\$7.3B
Step 2	25	\$5.2B	\$4.9B
Step 3	25	\$5.2B	\$4.9B

Table 1. Risk Analysis Steps. Although the analysis focused on 25 projects (i.e., 8 percent of total projects), their \$5.2-billion value represented 48 percent of the total dollar value.

Step 1 (Scoring 129 Projects). Projects were scored against the seven criteria detailed in [Annex B](#) to select 25 projects for further analysis.

Step 1 Results. Project scores ranged from a low of 9 to a high of 18 out of a possible 22. The materiality criteria was given a higher weighting so that higher-dollar-value projects, given their significance to the departmental infrastructure program, received higher scores. The 25 highest-scoring projects with one exception² were selected for further analysis, as depicted at [Annex C](#).

Step 2 (Scoring 25 Projects). The 14 criteria detailed in [Annex D](#), which required more time-intensive file review, were applied to the 25 infrastructure projects selected in Step 1. This provided a more refined ranking of the 25 projects to guide CRS in selecting audit priorities.

Step 2 Results. Scores ranged from 16 to 29 out of a possible 39. The results of the 25 projects scored from Step 2 are provided at [Annex E](#).

² Project C.001598 was removed from the analysis because it will not be implemented by Assistant Deputy Minister (Infrastructure and Environment) (ADM(IE)). Project ||| ||| ||| is a multi-phased project, and will be scored as two separate projects.

Step 3 (Step 1 and Step 2 Results with Dollar Materiality Factor). A materiality factor with a score ranging from 1 to 3 was applied to the score results from the previous two steps to place a heavier weighting on higher-dollar-value projects. Projects were scored based on the individual project's proportion of the total value of the 25 projects.

Step 3 Results. The materiality factor was combined with results from Step 1 and Step 2 and the 25 projects were re-ranked. Combined scores ranged from 35 to 51 out of a possible 64. The final 25 projects after Step 3 are listed at [Annex F](#).



Annex A—Analysis Methodology

As shown in Figure 1, the initial list of 321 projects (worth \$10.9 billion) came from the CIP (Infra) which included infrastructure projects from FY 2010/11 to FY 2020/21. Two further population attributes were examined to add relevance and focus the analysis: materiality and project spending.

- **Materiality.** 152 projects with values of less than \$10 million were scoped out, reducing the list by 47 percent. However, the population dollar value was only reduced by 13 percent (\$1.4 billion), thereby retaining significant coverage of the infrastructure program.
- **Project Spending.** 40 projects (worth \$1.3 billion) were scoped out as they had no forecasted spending until FY 2012/13. These were not included for the purpose of the analysis due to the limited information available for these projects.

After scoping these projects out there were 129 infrastructure projects worth \$8.2 billion for further analysis.

Step 1 (7 Criteria). The remaining 129 projects were ranked using seven criteria. These initial criteria were based on available electronic “data fields” in the CIP (Infra), enabling the use of automated scoring to refine the list. The maximum possible score was 22. [Annex B](#) explains the criteria and [Annex C](#) details the 25 projects that were selected for further analysis. The total value of the 25 project selected in this step was \$5.2 billion.

Step 2 (14 Criteria). Fourteen further criteria were applied to the 25 projects selected in Step 1. These criteria offer a greater level of refinement in measuring indicators of risk. The maximum possible score was 39. [Annex D](#) and [E](#) provide a detailed explanation of the criteria and the Step 2 scores for each project, respectively.

Step 3 (Materiality Factor). In this step, the same 25 projects that were selected for Steps 1 and 2 were scored based on their percentage of the \$5.2 billion total value:

- Score: 1—Less than 5 percent;
- Score: 2—Greater or equal to 5 percent and less than or equal to 10 percent; or
- Score: 3—Greater than 10 percent.

Scores from Step 1 and Step 2 were added to the materiality factor score and the projects were re-sorted based on the total score for the three steps ([Annex F](#)). The maximum possible score for all three steps is 64.



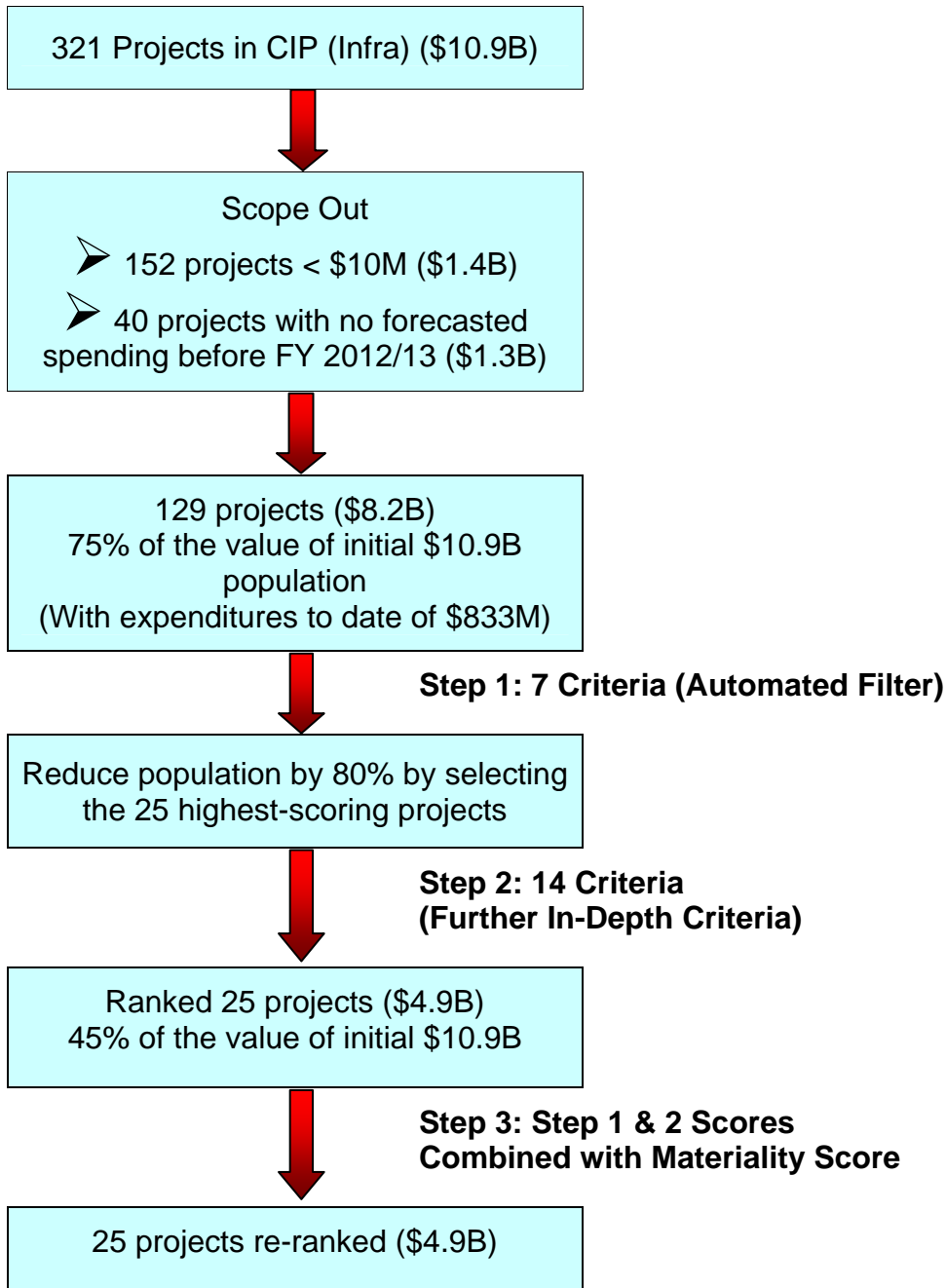


Figure 1. Risk Analysis Methodology. Use of 21 criteria enabled the ranking of 25 projects that could warrant audit attention or review.

Annex B—Step 1 Audit Criteria Definition

#	Criterion (Source of Info)	Threshold	Score	No. of Projects	Rationale for Criteria
1	Project Materiality (CIP (Infra))	< \$30M	1	67	Higher-value projects have a greater financial impact on the Department if risks are realized. Project value thresholds were determined by stratifying the population and incorporating the Minister's approval threshold of \$30M. The average project value was \$63M, and the median was \$30M.
		\$30-60M	2	32	
		> \$60M	3	30	
2	Project Phase (CIP (Infra))	Implementation (IMP)/Effective Project Approval (EPA)	1	46	More weight is given to projects in the earlier stages such as OA and DEF. Earlier phases of a project are generally associated with greater uncertainty.
		Definition (DEF)/Preliminary Project Approval (PPA)	2	57	
		Options Analysis (OA)/Identification (ID)	3	26	
3	Project Expenditures to Date (CIP (Infra))	> 50%	1	20	The scoring targeted projects with some spending (potential for recoveries) but not fully spent to enable CRS to provide preventative recommendations versus lessons learned.
		25-50%	2	8	
		< 25%	3	101	
4	Construction in Support of Equipment Project (CIP (Infra))	No associated Equipment Project	1	116	Generally, in capital equipment projects, the construction aspect of the project is not the primary focus. So projects that have both equipment and infrastructure elements score higher.
		Related Equipment Project	2	13	
5	Location – Inflation Volatility (CIP (Infra)) and DND Historical Economic Model)	Low (QC and various)	1	23	Construction projects in areas of greater inflation volatility could experience higher costs than planned if not adequately considered.
		Medium (ON and Atlantic)	2	79	
		High (BC and Prairies)	3	27	
6	Phased Projects (CIP (Infra))	No Phases	1	123	Phased projects could be impacted in the future by the approval process for the unapproved phases.
		Phased	2	6	
7	Departmental Priority (CIP (Infra))	Below median range	1	28	The impact of higher priority infrastructure projects not delivering on time or budget is more significant to the Department. On average, projects had a Departmental Priority of 60 and the median was 69.
		Median range ³ (40-80)	2	58	
		Above median range	3	43	

Table 2. Explanation of Step 1 Criteria. Step 1 criteria were applied to 129 projects.

³ Median range specified in these criteria is based on the 129 projects from Step 1.

Annex C—Highest Scoring Projects After Step 1

Project Number	Location	Project Title	Approved Project Document	Project Total (\$K)	Step 1 Total Score
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
6	6	6	6	6	6
7	7	7	7	7	7
8	8	8	8	8	8
9	9	9	9	9	9
10	10	10	10	10	10
11	11	11	11	11	11
12	12	12	12	12	12
13	13	13	13	13	13
14	14	14	14	14	14
15	15	15	15	15	15
16	16	16	16	16	16
17	17	17	17	17	17
18	18	18	18	18	18
19	19	19	19	19	19
20	20	20	20	20	20
21	21	21	21	21	21
22	22	22	22	22	22
23	23	23	23	23	23
24	24	24	24	24	24
25	25	25	25	25	25
26	26	26	26	26	26
27	27	27	27	27	27
28	28	28	28	28	28
29	29	29	29	29	29
30	30	30	30	30	30

Table 3. Twenty-Five Projects Selected After Step 1. Highest-scoring projects were selected to proceed to Step 2. The materiality criterion was given twice the weighting. The maximum score for Step 1 is 22.

Annex D—Step 2 Audit Criteria Definition

#	Criterion (Source of Info)	Threshold	Score	No. of Projects	Rationale for Criteria
1	Cost increase from PPA to EPA (percent change) (approval documents)	Below 47% or Not Applicable ⁴	1	23	Cost increases could affect the Department's visibility of program affordability of individual projects and may lead to less than optimal management of changes to the programs. In September 2010, the median range for increase from PPA to EPA was 47% for CID infrastructure projects.
		Above 47 percent	2	2	
2	Project leader rank given project value and risk (CID Analysis Report)	Proper Rank	1	11	Under-ranked project leaders for high-risk projects may not have the experience level to provide proper oversight. Over-ranked project leaders for low-risk projects may result in excess workload by senior management.
		Over-ranked	2	0	
		Under-ranked	3	14	
3	Project Manager (PM) capacity (DCPD Project Activity Tool)	Green (sufficient oversight)	1	19	PM at over capacity may not be able to provide sufficient oversight. Assessment is based on project value, phase, and work load in in-years and out-years, where green denotes sufficient oversight, yellow denotes further oversight may be required while red denotes additional oversight is required.
		Yellow (further oversight may be required)	2	5	
		Red (additional oversight required)	3	1	
4	Number of cost estimate revisions (approval documents)	0 revisions	1	14	Increased number of cost revisions could result in schedule delay. Scoring was based on the number of PPA and EPA revisions.
		1 – 2 revisions	2	10	
		3+ revisions	3	1	
5	Cost or schedule (C/S) delay linked to scope (approval documents)	C/S change links to scope or Not Applicable	1	13	C/S changes should be a result of scope changes. If cost increases, with no scope increase, the same product becomes more expensive. If there is some schedule slippage with no scope change, the product may not be delivered on time. Projects with cost and schedule change but no scope change were given a higher score; 40% of the projects' C/S changed for reasons not related to scope.
		C/S no change, scope decrease	2	2	
		C/S change, no scope change	3	10	
6	Contingency and construction allowance percentage of Project value (approval documents)	Below median range ⁵	1	9	Higher project contingency could be an indicator of higher project uncertainty.
		Median range (12 – 20%)	2	11	
		Above median range	3	5	

⁴ Most projects had not advanced to EPA phase.

⁵ Median range specified in these criteria is based on the 25 projects from Step 2.

#	Criterion (Source of Info)	Threshold	Score	No. of Projects	Rationale for Criteria
7	Security requirements for building (approval documents or PCRA)	Standard	1	14	Buildings (e.g., HQ and OP Comds) with more complex security requirements may experience higher costs due to additional design features.
		Complex	2	11	
8	Site condition considerations (PCRA questionnaire)	No	1	9	Certain site features may result in higher construction-related costs (e.g., requirement for environmental remediation).
		Yes	2	16	
9	Expected duration of Project (approval documents)	Below median range	1	6	Project duration is determined from project initiation to implementation phase. The scoring targeted those projects with longer duration.
		Median range (84 – 105 months)	2	10	
		Above median range	3	9	
10	Project requirements (PCRA questionnaire)	0 – 1 statements true	1	9	PCRA Question 50 “Projects require: a. a high degree of availability, b. customization beyond normal configuration, c. a high degree of performance, or d. a high degree of reliability.” The scoring targeted projects with greater requirements.
		2 – 3 statements true	2	11	
		4 statements true	3	5	
11	Scope (PCRA questionnaire)	All (PCRA – 1)	1	20	PCRA Question 56 “Percentage of total requirements clear, completed, and communicated.” The scoring targeted projects where the requirements were not clearly communicated.
		up to 90% (PCRA – 3)	2	4	
		< 90% (PCRA – 5)	3	1	
12	Overall risk assessment (approval documents)	Low	1	17	The overall risk assessment includes both internal and external risk factors to the project.
		Medium	2	5	
		High	3	3	
13	SRB frequency (CID Analysis Report)	< 1 year	1	12	Projects should provide accurate information for senior management decision making in a timely manner, at least once a year as required by the PAG.
		12-18 months	2	2	
		> 18 months	3	11	
14	Date CID last updated (CID – Project start page)	< 3 month	1	17	Management decision making may be impaired if the most recent information is not uploaded. Not updating the CID could indicate a potential staff shortage.
		3 – 6 month	2	3	
		> 6 months	3	5	

Table 4. Explanation of Step 2 Criteria. Fourteen criteria were applied to 20 projects. Maximum score is 39.

Annex E—Highest Scoring Projects After Step 2

Project Number	Location	Project Title	Approved Project Document	Project Total (\$K)	Step 2 Total	Potential CRS Audit (Yes or No)

Project Number	Location	Project Title	Approved Project Document	Project Total (\$K)	Step 2 Total	Potential CRS Audit (Yes or No)

Table 5. Highest Scoring Projects After Step 2. The maximum score for Step 2 is 39.

Project Number	Location	Project Title	Approved Project Document	Project Total (\$K)	Total After Step 3	Potential CRS Audit (Yes or No)

Table 6. Top 25 Projects Re-ranked After Step 3. Although projects with higher scores would be normally selected for audit, the status of the project will be verified prior to audit notification.