

# COST / SCHEDULE CONTROL IN PROJECT MANAGEMENT: A CANADIAN APPROACH

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## Introduction

The development of the Canadian Cost/Schedule Performance Management Standard (C/SPMS) is the result of more than a two-year cooperative effort by joint government and industry working groups culminating in the first issue of C/SPMS in July 1992. The standard provides guidelines and instructions for consistent application of effective cost and schedule control requirements for projects in Canadian procurement environment, i.e., to provide an accurate and realistic projection of the integrated scope, cost and schedule parameters of projects to assist both contractors and related government departments and agencies management in their timely decision-making processes while reducing costly implementation experienced during recent application of the U.S. Cost/Schedule Control System Criteria (C/SCSC) on major Canadian projects. The standard is approved for use by all departments and agencies of the Canadian government such as the Department of National Defense (DND), Department of Supplies and Services (DSS), Department of Transport (DOT), the Canadian Space Agency (CSA) ..etc.. as well as many industry associations. The purpose of this paper is to examine and discuss the following key areas of C/SPMS:

- Evolution of C/SPMS for Canadian project management
- The C/SPMS in major projects
- Conclusion

## Evolution of C/SPMS for Canadian Project Management

The evolution of C/SPMS began in 1982 with the Canadian government's Request For Proposal (RFP) requiring implementation of the Cost/Schedule Control System Criteria (C/SCSC) for the Canadian Patrol Frigate (CPF)

program. Since there was no Canadian standard available at that time, the US DOD 7000.2 C/SCS criteria or CS<sup>2</sup> (superseded by DOD 5000.2) were applied by default on this important program. Consequently, the U.S. criteria dominated the practices of Cost/Schedule Control approach in project management in Canada for many years, particularly for projects in the electronics, aerospace and defense industries. Since 1967, these criteria have been designed and refined many times in the U.S. to assess and define an adequate contractor's cost/schedule management control system.

The criteria formally specified definitive requirements which contractors must implement to provide the basis for an effective cost/schedule management control system. These requirements have been designed to be flexible enough to remain essentially unchanged to accommodate applications to different types of projects (aircraft, ships, missiles, construction, space, electronics, etc.), project phases (development, system testings, production, deployment, etc.) despite significant changes in the U.S. DOD acquisition process and environment over the years. A control system's compliance to the criteria is a must. Basically the criteria's requirements include: definition of the product-oriented Work Breakdown Structures (WBS), identification of the organisation-oriented structures performing the project's workscopes, maintenance of firm Performance Measurement Baseline (PMB), use of cost accounts (CAs) as management controlled points, performance data analysis and traceability, detailed system documentation and client's evaluation and demonstration reviews/surveillances of the cost/schedule system implementation. The criteria are grouped into five major categories involving the following requirements<sup>1</sup>:

Organisation: Definition of the project's scope of work through the framework of the contract WBS (Work Breakdown Structure). Identification of responsible, performing organisations participating in the project by using a personnel project organisation structure including major

subcontractors. By incorporating the WBS elements to the corresponding responsible organisational structures, responsibility for identified manageable work to the appropriate, specific organisation elements will be identified, i.e., establishment of responsibility for identified work tasks.

Planning and Budgeting: Define the authorized work execution strategy by developing a baseline for planning and budgeting, i.e., the establishment of a time-phased budget baseline against which contract performance can be measured. This Performance Measurement Baseline (PMB) integrates time, cost and work performance in timely-manner baselines through a realistic schedule that identifies the sequence of work, task interdependencies required to meet the development, production and delivery requirements of the project, and through budgets for all authorized work compliant with the organizational criteria as well as through work authorization that defines the scope of work and assigns it to responsible performing program organisations.

Accounting: Records of the contractor's direct, indirect and material cost accomplished must be done in a manner consistent with acceptable accounting practices. Summarization of actual costs from the cost control points into the WBS as well as the contractor's functional organisational elements must be done without any repeated allocation.

Analysis: Establish the performance measurement characteristics that a contractor's project management system must have, i.e., cost and schedule variances from plan at all levels of the contract's authorised work and contractor's functional program organisation structures can easily be identified. Analysis of these variances must be done if pre-established thresholds are exceeded. This will result in identifying problems encountered, formulating problem solutions and evaluating program status at completion, i.e., effective progress measurement, variance analysis and reliable estimate at completion.

Revision and Access to Data: Maintain a valid performance measurement baseline by imposing strict control to baseline changes as well as provide access to all information and supporting documents relating to change control to authorised client's personnel when required, i.e., control and maintain a meaningful performance measurement baseline.

The U.S. criteria, therefore, provide the basis for

determining whether a contractor's project management control system meets project management needs. Contractors are allowed to use the specific management procedures of their choice but have to comply with the characteristics and capabilities of an effective cost / schedule control system. A validation process is to be carried out by a review team of experienced CS<sup>2</sup> client's staff to determine control system compliance with CS<sup>2</sup>. System acceptance and continuous surveillance will also be monitored by the client's review team. The criteria are applicable to any types of contracts in excess of approximately \$60 millions for research and development programs or \$250 millions for production ones, except firm, fixed-priced contracts.

In a CS<sup>2</sup> environment, earned value technique is used to provide cost and schedule performance measurement. It is based on the measurement of the budgeted value of the work actually carried out, its comparison with the budgeted value of the work that should have been carried out and what it actually costs. The followings are important basic data elements which must be used to determine and plan for objective evaluation of project's progress and performance:

- Budgeted Cost for Work Scheduled (BCWS): The time-phased budget plan, applicable to the work scheduled to be accomplished within a given timeframe, against which performance is measured.
- Budgeted Cost for Work Performed (BCWP): The budgeted cost for all work actually accomplished during a given time period, i.e., Earned value.
- Actual Cost for Work Performed (ACWP): The cost actually incurred and recorded in accomplishing the work performed within a particular time period.
- Budget at Completion (BAC): The sum of all budgets allocated to all contract's authorized WBS elements.
- Estimate at Completion (EAC): The costs allocated to the work-to-date plus the estimate of cost to complete (ETC) for authorized work remaining.
- Management Reserve (MR): An amount of the total allocated budget withheld for management control purposes rather than designated for the accomplishment of a specific task or set of tasks. It is not considered to be part of the Performance Measurement Baseline.
- Cost/Schedule Performance Indices (CPI/SPI): Cost/Schedule Efficiency with which project work has been accomplished.

Although there were concerns with the criteria's application and implementation, the U.S. approach with its 25 years of hard-won experience in industry, is still considered by project managers as one of the most valid concept and approach to assess and control contract performance status in today's project management environment. However, the flexibility of the criteria's interpretation relating to its application and implementation purposes has resulted in increasing concerns<sup>2</sup> within Canadian industries and governments as application experiences were gained on major Canadian projects. There was also a valid concern that some of the practices have been question-driven. Confidence of project managers in the criteria's cost and schedule control processes has been slowly eroded resulting in the need to respond directly to these problems. A consensus was obtained during an industry/government exchange conference in 1990 in Ottawa to develop a Canadian Cost/Schedule policy which, in general, should be compatible with the U.S. criteria while minimizes government bureaucracy and reduces application burdens on contractors. It accelerates the push to quickly introduce this policy on all government's major projects. As a result, the Canadian government initiated the effort to involve government and industry experts in the development of the Canadian Cost/Schedule Performance Measurement Standard (C/SPMS), taking into consideration the fact that in the absence of a Canadian standard, the application of the U.S. criteria on Canadian projects has culminated in the following issues:

- The criteria approach is a sound and good project management principle. However, it is too costly and complicated for Canadian governments and contractors.
- Implementation requires significant amount of paper work, reflected through long guidelines, check lists and significant amount of reports generated. Excessive criteria rules and processes demand such a volume of findings during demonstration and application reviews that project activities are swamped by forms and papers.
- The Performance Measurement Baseline (PMB) monitoring is too rigid, inflexible, complex and vague, eg., the Over Target Baseline (OTB) process.

Since 1990, government/industry teams have come up with many practical recommendations on how to improve the U.S. criteria (DOD 5000.2) for application in the Canadian context. Many of the objectives set out to achieve by experts on these teams have been realized, culminating in the C/SPMS having the following characteristics:

- The standard promotes "Top concerns" variance analysis reports as opposed to automatic WBS threshold-based ones, emphasizes the importance of graphical, integrated overall program level summary of Cost and Schedule performance data, highlights cost/schedule issues through key schedule dates (milestones) generated from appropriate and reliable scheduling techniques.
- The standard encourages an up-to-date Performance Measurement Baseline (PMB) to reduce unnecessary variance reportings through client's acceptance and training.
- Basic concepts of the standard are compatible with the above-mentioned U.S. criteria (DOD 5000.2) resulting in reciprocating agreement being sought for validation and certification purposes.

#### The C/SPMS in Major Projects

The objectives of the standard<sup>2</sup> are:

- To provide a timely, accurate and realistic projection of the integrated workscope, cost and schedule performance data of a project in order to provide both contractor and customer's management sufficient background to make appropriate decisions.
- To emphasize uniform criteria used to evaluate a contractor's project management cost and schedule control system, provide the baseline requirements for an acceptable system as well as encourage and support contractor to better its planning and control operations by implementing project management systems most effective in managing contract cost/schedule performance.

The intended implementation of the standard for Canadian projects, basically, should involve the same planning and control processes as those required by the U.S. DOD 5000.2 while trying to improve performance measurement and reporting requirements, especially those associated with the scheduling aspect. An official implementation guide will be finalized and issued for use in the very near future. There were, however, differences about reporting specifics. Apart from significant differences in reporting requirements

focussing on cost/schedule issues, implementation of the standard should follow the same cycles<sup>1</sup> as carried out to comply with the U.S. criteria. The C/SPMS's reporting requirements include the following formats<sup>3</sup> as illustrated by the attached figures A - E.

These formats, in general, promote "Top Concerns" issues with significant emphasis on evaluations of scheduled milestones performance as well as forecasts of achievement for these milestones, i.e., reports concentrating on Cost/Schedule Performance Data Integration with resulting Cost/Schedule issues to be highlighted as well as emphasis on contract master schedule's control including Critical Path monitoring.

### Conclusion

It is a true, but little recognized fact, that implementation of the Canadianized C/SCSC DOD 7000.2/5000.2 has encountered interpretation and application problems for projects within Canadian industry in the 1980s. It is also true that a Canadian approach for effective cost/schedule control in project management is urgently required to improve performance management of projects within Canadian industry. Fortunately, the development of C/SPMS had the back-up of 25 years of on-the-job experience associated with the criteria application in the U.S. as these requirements have been overwhelmingly acknowledged, by both U.S. government and industry project managers, as representing good management practices.

The release of C/SPMS is a major milestone in improving the planning and control processes within Canadian project environment. The experiences gained and lessons learned during application and implementation of the U.S. criteria in Canada for the past decade had greatly contributed to this effort. The result is a much simplified standard with significantly enhanced schedule control approach which will definitely assist project managers in meeting client's commitments and objectives in the management of their projects in the future. There is no reason to believe that the C/SPMS will not become one of the most accurate assessments of the cost and schedule status of Canadian projects in the 1990s and beyond. There should be no doubt in my mind that C/SPMS will play a key role in shaping project management direction in Canada in the future.

### References

1. Nguyen, Nghi, M., "CS<sup>2</sup> in High-Tech Program Management", 1988 Transactions, American Association of Cost Engineers (AACE), Morgantown, WV, USA, pp.U.1.1 to U.1.10.
2. Nguyen, Nghi, M., "Cases Impairing C/SCSC Application in Program Management", 1990 Transactions, Association Française des Ingénieurs et Techniciens d'Estimation de Planification et de Projet (AFITEP), Paris, France, pp.E.3.1 to E.3.10.
3. "Canadian Government Cost/Schedule Performance Management Standard (C/SPMS) for Contractor Cost and Schedule Management Systems", Government Policy, July 1992, Ottawa, Ontario, Canada.

Contractor	Contract Type & No:	Contract Name	Report Period	Signature, Title & Date
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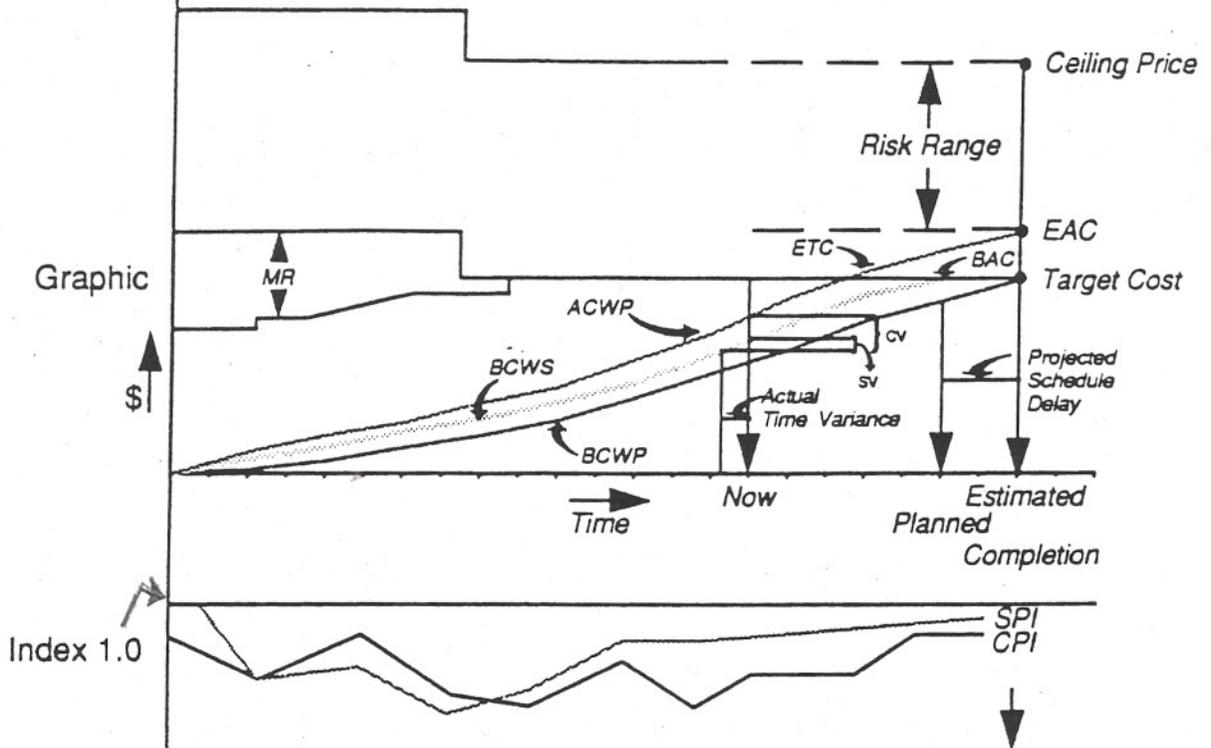


Table	Status of "Selected" Major Milestones and Deliverable End Items in the Summary Master Schedule (SMS)	Planned - Contractual - Actual - Projected Dates
	A ↓ Z	09/30/95 - 11/27/95 - - 10/15/95  ↓ Projected Schedule Completion

**Program Overview**

- Interpretation of performance management data elements associated with the above graphical "S" curve
- Identification of existing and potential risks which may impact the program objectives.
- Address significant cost/schedule/technical problems with corrective actions.

**Format A - Executive Summary**

# Format B Summary Master Schedule (SMS) Status

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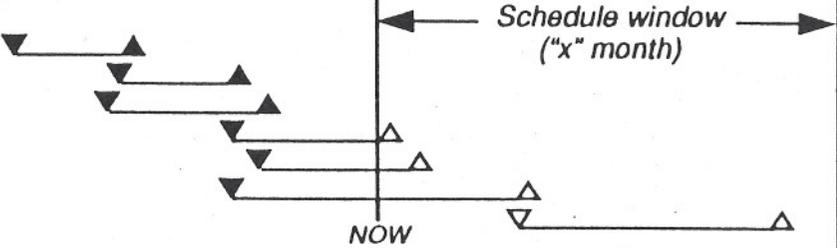
	Contractor:	Contract Type & No:	Contract Name:	Report Period:	Signature, Title and Date:
	Event Completions	Months After Contract			
		Calendar - Months			
Bar Chart	<ul style="list-style-type: none"> <li>• Status of "all" major milestones and deliverable end items</li> </ul> <p>A ↓ D ↓ J</p>				
	Selected "Major" Milestones & Deliverable End Items (DEIs)	Current Schedule	Status		
Table	<p>A ↓ Z</p>	Planned-Contractual-Actual-Projected	Impact-Risk-Workaround-Recovery		
		09/30/95 - 11/27/95 -	10/15/95	<ul style="list-style-type: none"> <li>• Schedule impact of significant delay within the SMS</li> <li>• Schedule projections associated with significant risks</li> <li>• Identification of Work Around Plan (WAP), corrective actions and forecasted recovery dates</li> </ul>	
Narrative	<ul style="list-style-type: none"> <li>• Analysis of the above status in relation to the present contract base critical path.</li> <li>• Interpretation of schedule performance data with respect to schedule slippages/gains, problems and risks</li> <li>• Impact of delays on major milestones, DEIs and the program's cost/schedule completion status</li> </ul>				

Contractor:		<b>I/CSR Format C - Cost Performance - CWBS Format</b>			Signature, Title and Date:			
Location:		Contract Type & No:	Program Name:	Report Period From: To:				
Contract Data								
(1) Original Contract Target Cost	(2) Negotiated Contract Changes	(3) Current Target Cost (1) + (2)		(4) Estimated Cost of Authorized Unpriced Work	(5) Contract Budget Base (3) + (4)			
Performance Data								
Contract Work Breakdown Structure (CWBS)	Cumulative to Date					At Completion		
	Budgeted Cost		Actual Cost Work Perf'd	Variance		Budgeted	Latest Revised Estimate	Variance
	Work Sch'd	Work Perf'd		Scheduled	Cost			
10 x 0								
20 x 0								
30 x 0								
Overhead								
Gen and Admin								
Undist'd Budget (UB)	████████	████████	████████	████████	████████		████████	
Mgmt Reserve (MR)	████████	████████	████████	████████	████████			
Total								
<p><b>Narrative:</b></p> <ul style="list-style-type: none"> <li>To "back-up" performance data elements associated with CWBS variance identification</li> <li>Analysis of major problems including identification of the top "X" ones impacting contract cost/schedule and technical performances</li> <li>Discussion of the most current and realistic bottom-up Estimate at Completion (EAC) in accordance with the contract provision</li> </ul>								

# Format D - Master Schedule Status

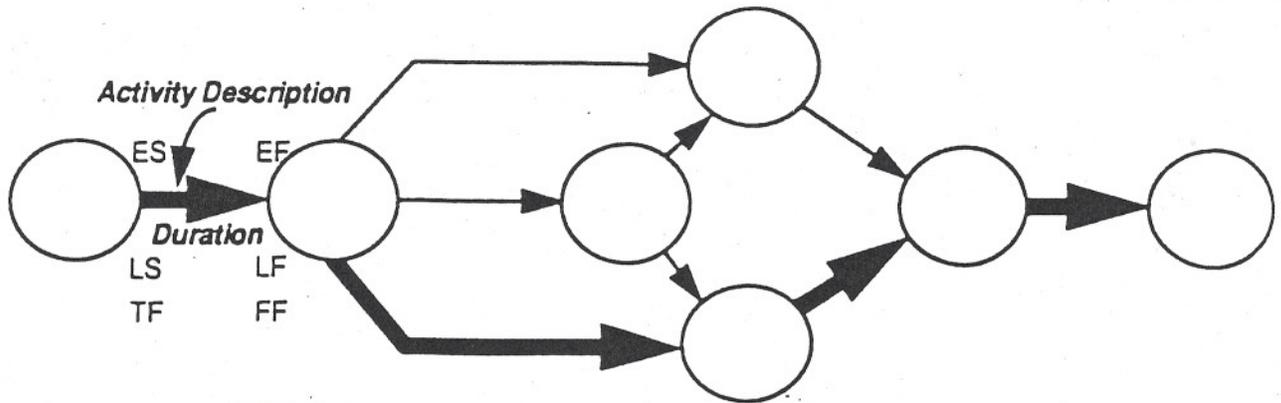
185

Bar  
Chart

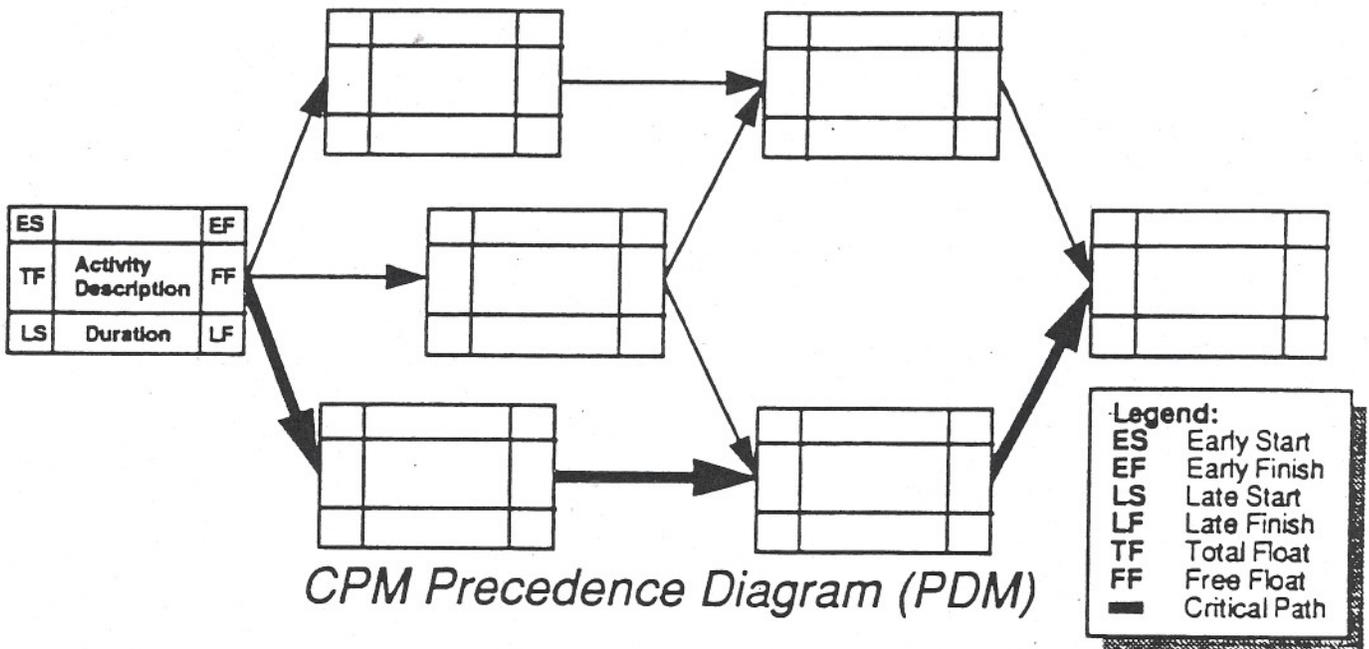
(1)	(2)	(3)	(4)	(5)
Contractor:	Contract Type & No:	Contract Name:	Report Period:	Signature, Title and Date:
Activity Events Description	Calendar			
<ul style="list-style-type: none"> <li>• Status of activities / events at the "Intermediate" level of the Master Schedule</li> </ul> <p>A ↓ Z</p>				
Activity Event	Current Schedule		Status	
<p>A ↓ Z</p>	Planned-Contractual-Actual-Projected <ul style="list-style-type: none"> <li>• Same as Format B for "Intermediate" level activities/events within the master schedule.</li> <li>• Current schedules, consistent with and supported by cost accounts' workscopes in the current Performance Measurement Baseline (PMB).</li> </ul>		Impact-Workaround-Recovery <ul style="list-style-type: none"> <li>• Schedule impact of delays on subsequent milestones and deliverables.</li> <li>• Identification of Work Around Plan (WAP), corrective actions and forecasted recovery dates.</li> </ul>	

able

Contractor	Contract Type & No:	Contract Name	Report Period	Signature, Title & Date
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*CPM Arrow Diagram Method (ADM)*



*CPM Precedence Diagram (PDM)*

Activity Description and Coding	ES	EF	LS	LF	Original Duration	Remaining Duration	Constraints	Predecessor / Successor Listing	% Complete	Total Float

*Logic Listings*

**Format E - Network, Critical Path and Logic Listings**