Analyzing the Contingency Reserve

For: DHS Cybersecurity Acquisitions Programs

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Abstract

This poster presents a research study made on multiple Department of Homeland Security (DHS) Cyber-security major acquisition programs cost estimates' uncertainty and risk analysis results and the determination of a Contingency Reserve in a program's cost estimates. This study will analyze the use, application and behavior of the Contingency Reserve within such programs. The value of this research will be to provide program managers and decision-makers an assessment of the amount of Contingency Reserve needed to protect a Cyber-security program from cost overruns due to risk and uncertainties in its estimates.

Problem Statement

It is an established rule that programs must use a 50% confidence interval as the basis for the objective cost with the Threshold being set up to 15% above the objective cost parameter. Subsequently, program offices always fund programs at the 50% confidence level regardless of the program's risk, uncertainties and/or their complexity. Having adequate funding is paramount for optimal program execution since it can take many months to obtain the necessary funding to address an emergent program issue.

Without available risk funding, cost growth is likely, hence the importance of having the actual impact of the risks accounted for. This can be achieved via the correct allocation of a Contingency Reserve.

Research Background

The Department of Homeland Security (DHS) uses a four-phase framework for managing systems and programs to ensure that the proper time and effort is dedicated to each critical step of the process. There are Acquisition Decision Events (ADEs) that occur at the beginning of and, in some cases, during a phase to make sure the program is progressing well, risks are being tracked and controlled, and the overall program is being managed well before the program moves from one phase to the next.

Affordability is the degree to which an acquisition program's funding requirements fit within the agency's overall portfolio plan. Whether a program is affordable depends on the quality and assumptions made on its cost estimate.

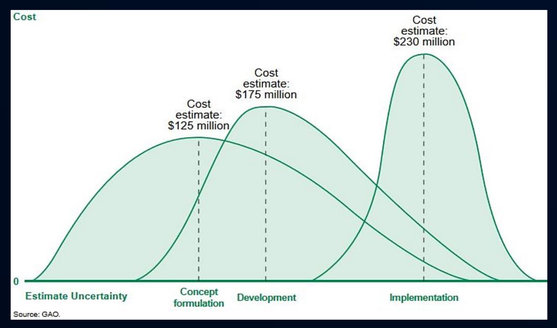

Figure 1
Cost Estimates Across Acquisition Life Cycle

Research Background

Cost estimators utilize various methods to develop a Point estimate. The Point Estimate provides an estimated cost for all elements and all years within the LCCE. As the program matures through its life cycle and more data become available, or as changes occur, the cost estimator should update the point estimate. Therefore, once the point estimate has been developed, it is important to determine how sensitive the total cost estimate is to changes in the cost drivers.

As a best practice, sensitivity analysis should be included in all cost estimates because it examines the effects of changing assumptions and ground rules. Since uncertainty cannot be avoided, it is necessary to identify the cost elements that represent the most risk and, if possible, cost estimators should quantify the risk. This can be done through both a sensitivity analysis and Risk/uncertainty analysis.

A way to determine whether a program is realistically budgeted is to perform uncertainty analysis so that the probability associated with achieving its point estimate can be determined. A cumulative probability distribution, more commonly known as an S-curve usually derived from a simulation such as Monte Carlo, can be particularly useful in portraying the uncertainty implications of various cost estimates. Figure 2 shows an example of a cumulative probability distribution with various cost estimates mapped to a certain probability level.

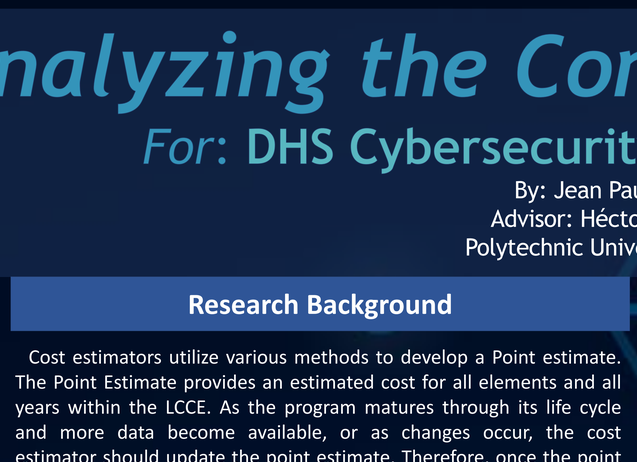

Figure 2
A Cumulative Probability Distribution, or S-curve

Analysis Approach

The idea behind this research was to collect and analyze the Contingency Reserve data from past cost estimates for the DHS Cybersecurity portfolio of programs. Data was available but not centralized and basic statistics were unknown and had not yet been studied in aggregate.

The data collected came in the form of ACEIT cost estimating software risk-adjusted models. Thirty-four cost estimates, from three different components and six separate programs were analyzed. The estimates utilized allow the study of the programs at multiple life cycle stages of development.

Research Results

The data spoke almost as immediately as the basic statistics where being calculated. The data validated some assumptions while providing new insights and questions. For the analysis of the data, different tools where utilized (Excel, Minitab, and Tableau for data visualization); The variable of interest in this study was the "Contingency Reserve" and the visualization of the data provided a dynamic way of asking and answering questions from the data. As the research dove deeper into the relations and interaction of the CR with the other variables, the value of the study became clear.

Table 1
Sample of Basic Statistics

Variable	Total Count	N*	Mean	StDev	Variance	CoefVar	Sum	Sum of Squares
Point_Estimate_(BY)	34	0	2249	2179	4750063	96.93	76449	328648527
PE_CL%_(BY)	34	1	0.3503	0.0921	0.0085	26.30	11.5590	4.3203
50%_CL_(BY)	34	0	2327	2273	5168141	97.71	79105	354597021
CV_(BY)	34	0	0.1285	0.1835	0.0337	142.82	4.3679	1.6719
BY_Contingency_$M	34	0	78.2	121.8	14838.8	155.73	2659.5	697706.5
BY_Contingency_%_(50%CL-PE)	34	0	0.03515	0.04309	0.00186	122.57	1.19523	0.10328
BY_Contingency_(Mean-PE)	34	0	133.4	223.2	49816.9	167.37	4534.0	2248594.1
BY_Contingency_%_(Mean-PE)	34	0	0.04890	0.05706	0.00326	116.69	1.66257	0.18874
Mean_(BY)	34	0	2382	2333	5445137	97.97	80983	372580261

Figure 3A
Contingency Reserve (50%CL) by Component & Program

Figure 3B
Contingency Reserve (Mean) by Component & Program

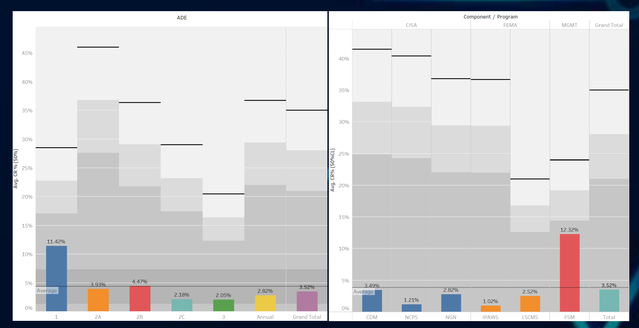

Figure 4A
Point Estimate CL% / Contingency Reserve % by ADE

Figure 4B
Point Estimate CL% / Contingency Reserve % by Component & Program

Discussion

Current guidance states that programs must use a 50% confidence interval as the basis for the objective cost with the Threshold being set up to 15% above the Objective cost parameter; However, the data showed that the cybersecurity portfolio of programs would have been better funded at the Mean instead of the 50% CL. This would have reduced the anxiety about success within budget, allowing them to have better provisions for unknown but likely to appear risks as the project progresses and it would help reduce the probability that they will have to explain overruns or rebase-line because they ran out of contingency reserve.

Table 2
Contingency Reserve Actual Vs. Mean

Component	Program	CR% (50%CL)	CR % (Mean)
CISA	CDM	3.49%	7.34%
	NCPS	1.21%	1.51%
	NGN	2.82%	3.72%
FEMA	IPAWS	1.02%	1.13%
	LSCMS	2.52%	2.61%
MGMT	FSM	12.32%	13.56%
Grand Total		3.52%	4.89%

Conclusion

The proper and correct allocation of the Contingency Reserve ensures that a program's cost, schedule, and performance goals can be met. The analysis also communicates to decision-makers the specific risks that contribute to a program's cost estimate uncertainty. Without this knowledge, a program's estimated cost could be understated and subject to underfunding and cost overruns, putting it at risk of being reduced in scope or requiring additional funding to meet their objectives. Because each program is unique and so are its risks, there are no set rules as to what level of contingency reserve would be sufficient.

This paper served as the beginning of a much larger study into the historical use of the Contingency Reserve within the DHS portfolio of high-level acquisition programs. Further study will be invested in the different commodities of programs (IT, Ships & Aircraft, Facilities, etc.) to determine if the current guidance should be amended.

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