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Controlling Costs: The 6-3-5 Method—Case Studies at NAVSEA and NATO

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Panel 18. Forecasting and Controlling Costs in Weapons Systems Procurement

Thursday, May 5, 2016	
1:45p.m. – 3:15 p.m.	**Chair: Todd Calhoun,** Director of Program Assessment & Evaluation, Programs & Resources Department, Headquarters Marine Corps ***Costing Future Complex & Novel Projects*** Michael Pryce, Centre for Defence Acquisition, Cranfield University ***Controlling Costs: The 6-3-5 Method—Case Studies at NAVSEA and NATO*** Bruce Nagy, President/CEO, Catalyst Technologies Morgan Ames, Senior Advisor, Catalyst Technologies ***Costing for the Future: Exploring Cost Estimation With Unmanned Autonomous Systems*** Ricardo Valerdi, Professor, University of Arizona CPT Thomas Ryan, Jr., U.S. Army, Professor, U.S. Military Academy

Controlling Costs: The 6-3-5 Method—Case Studies at NAVSEA and NATO

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Abstract

This paper discusses a critical gap in the U.S. Navy acquisition process. This gap is caused by the absence of workforce alignment metrics and metadata algorithms in two areas: (1) As applied to determining estimated cost per work breakdown element as part of the bid analysis process; and (2) after the award is granted, as part of the task management functions to ensure expectations associated with the original estimate can be reliably fulfilled. In this paper, the integration of workforce alignment metrics that are processed by a statistically-based, metadata-driven algorithm is referred to as the 6-3-5 Method. The 6-3-5 Method was specifically engineered using results from numerous case studies from NAVSEA- and NATO-based programs focused on creating adequate cost control measures in support of the acquisition process. Based on these case studies, it is shown that the Department of the Navy's acquisition process has a significant gap in its ability to adequately provide cost control. The case studies demonstrate how the 6-3-5 Method fills this gap, ensuring the future financial health and competitive status of the U.S. Navy to adequately address emerging threats to U.S. national defense.

Introduction

The need for Navy leadership to evolve its current cost control solution has become even more pressing with current discussions about financial uncertainty, talent management and better use of workforce innovation. For example, the cover of the August 2015 issue of National Defense magazine reads, "Pressure Mounts to Fund Ohio Replacement." At the Navy League's Sea-Air-Space (SAS) 2015 Symposium, Admiral James A. Winnefeld, Jr., Vice Chairman of the Joint Chiefs of Staff, during his banquet address, stated that "budget cuts are causing significant uncertainty" (Winnefeld, 2015). *Defense News'* August 2015 interview with Brad Carson, acting Department of Defense (DoD) personnel and readiness chief, focused on the need to take advantage of the unique talents of military and civil service employees (Carson, 2015).

Secretary of the Navy (SECNAV) Ray Mabus' recent speech at the same Navy League event stated a need for "innovation" as an inherent part of Navy culture to combat these troubling economic times more effectively (Mabus, 2015). These insights from DoD and Department of the Navy (DoN) leadership are supported by research findings led by Google, Inc. These finding reveal the need for an organization to create a culture that uses talent more effectively through collaborative processes that promote workforce innovation (Duhigg, 2016).

This paper introduces the 6-3-5 Method that integrates metadata statistics and assessment heuristics to promote better use of "big" data and workforce collaboration as applied to defense acquisition and related management activities. The 6-3-5 Method consists of a metadata-based algorithm, statistical analytics, a heuristic methodology, various measurements, and a visual approach to display results. Three case studies, demonstrating the use of the 6-3-5 Method, add proof to the need to address the challenges described by DoD and DoN leadership, as well as validate Google research results regarding the benefits from collaboration processes that promote workforce innovation.

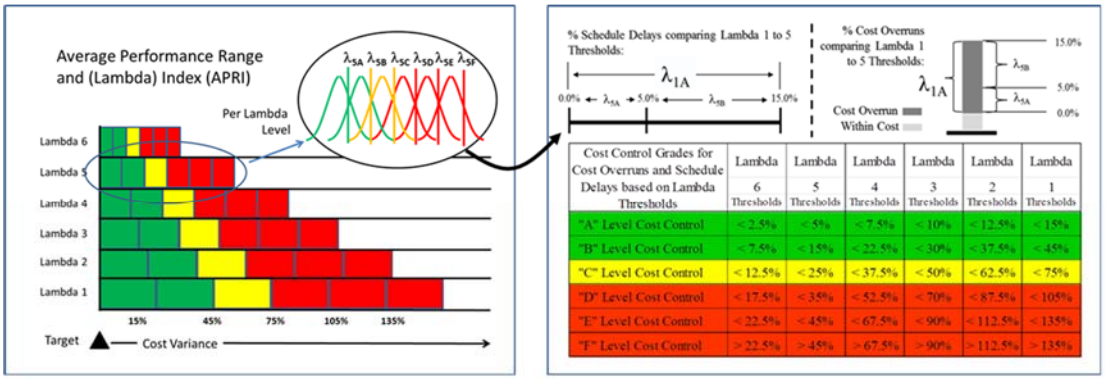
The case studies demonstrate how the 6-3-5 Method uses performance data to align more effectively workforce talent to goals, reduce cost variances and improve cost control. The methodology provides that ability to assess strengths and weaknesses in the architectural framework of an organization's cost control approach. Also, it provides specific recommendation solutions and clear direction to fill identified gaps or weaknesses in the framework to increase the likelihood of successful outcomes (i.e., actuals equaling estimates without compromise), whether in the form of Task Planning Sheet (TPS) deliverables assigned to government civil service employees or Ships Work List Item Number (SWLIN) deliverables for overhaul/new construction performed by prime contractors/shipbuilders.

The paper presents the 6-3-5 Method and related case studies in the following order:

- Overview of the 6-3-5 Method
- How the 6-3-5 Method supports the acquisition process based on a Program Executive Office (PEO) Carriers Case Study
- How the 6-3-5 Method supports workforce management based on a NATO Program Case Study
- How the 6-3-5 Method supports the workforce management based on a Naval Warfare Center Case Study

The first case study involving PEO Carriers provides examples of two significant cost control issues that are addressed using the 6-3-5 Method. This case study exemplifies how the 6-3-5 Method can be applied to any DoD request for proposal (RFP) process involving the review of bids for cost estimation accuracy. In this case study, the 6-3-5 Method emphasizes a better use of the cost control data that is required by programs that are required contractually to provide earned value analysis.

The mathematics is based on Van Trees's work on "Detection, Estimation and Modulation Theory" (Van Trees, 2001). The application is based on viewing data to identify an average performance range, where reliable performance reduces cost variances. The algorithm implementing the 6-3-5 Method processes the data, determines the highest/maximum likelihood that the average performance is true and not a false positive. The algorithm's mathematical basis has been peer reviewed and supported by California State University faculty. This analysis provides an accurate cost analysis of a bid or financial estimate. This paper introduces how detection and estimation mathematics can be applied to metadata (data about data) and algorithm processing based on an Average Performance Range and Index (APRI) table, as described in Figure 1.



Cost Control Grades for Cost Overruns and Schedule Delays based on Lambda Thresholds	Lambda 6 Thresholds	Lambda 5 Thresholds	Lambda 4 Thresholds	Lambda 3 Thresholds	Lambda 2 Thresholds	Lambda 1 Thresholds
"A" Level Cost Control	< 2.5%	< 5%	< 7.5%	< 10%	< 12.5%	< 15%
"B" Level Cost Control	< 7.5%	< 15%	< 22.5%	< 30%	< 37.5%	< 45%
"C" Level Cost Control	< 12.5%	< 25%	< 37.5%	< 50%	< 62.5%	< 75%
"D" Level Cost Control	< 17.5%	< 35%	< 52.5%	< 70%	< 87.5%	< 105%
"E" Level Cost Control	< 22.5%	< 45%	< 67.5%	< 90%	< 112.5%	< 135%
"F" Level Cost Control	> 22.5%	> 45%	> 67.5%	> 90%	> 112.5%	> 135%

Figure 1. Average Performance Range and (Lambda) Index Structure Used by 6-3-5 Method

There are two challenges for an acquisition management team that are discussed in this paper. The first challenge involves bid assessment.

Bid assessment is challenged not only when assessing new technology costs, but also when applying it to upgrades to existing technology already deployed within the fleet. In this paper, past performance analysis of a bid is turned into metadata and algorithmically analyzed using an APRI table. The analysis results in determining statistical confidence intervals, more conventionally discussed as statistical confidence, as a more effective means to determine the accuracy of a bid or estimation cost. Specifically, a PEO Carriers case study is reviewed involving an aircraft carrier overhaul, where SWLINs within the bid are statistically analyzed to determine the likelihood of issues not meeting contractual cost control requirements in compliance with the Nunn-McCurdy Amendment (Nunn-McCurdy Act, 1983). In this case study, the 6-3-5 Method provides analysis to the acquisition management team before bid acceptance based on past performance history using the same “actuals” as compared to estimated data that supported earned value calculations. (Albeit outside the scope of first case study: the 6-3-5 Method also can provide analysis using heuristics that can later be verified with performance data.)

The first case study demonstrates how applying a feature of the 6-3-5 Method provides an accurate gap analysis for each SWLIN cost estimate described within the bid, where each line item is described by a statistical confidence interval, having both an upper bound and lower bound. This interval can be mapped to the contractual cost control requirements needed to be satisfied by the offering prime contractor. The 6-3-5 Method also provides a structured approach to ensure the offeror is responding adequately to issues to ensure the proper due diligence necessary to fill those identified gaps before bid acceptance.

The second challenge for an acquisition management team involves the need to ensure that there is adequate due diligence by the offering prime contractor to resolve issues identified as statistically not meeting cost control contractual requirements. This due diligence is essential to complete before the contract award is granted to ensure minimal cost variance during implementation. The first case study emphasizes this key concept.

Providing a structured due diligence approach that can be statistically analyzed in terms of confidence is a necessary government procedure that can no longer be left, “at best,” to ad hoc processes. All too often, prime contractors increase their profits when Engineering Change Orders (ECOs) are generated. Each ECO causes a decrease in cost control for the government acquisition management team, which can result in significant cost overruns and schedule delays. The size of the cost the government must pay for an ECO is proportional to the size of the profit gained by the contractor and inversely proportional to decrease in cost control for the program. The only exception is with Fixed Price contracts, which have other issues this paper addresses in terms of quality compromises needed by the government versus contractor profit margin targets (FAR, 2016).

Applying the 6-3-5 Method allows the acquisition management team to determine objectively the rigor of due diligence that was applied to minimize potential impact to the government, thereby reducing the use of ECOs or minimizing their effects on cost variance and potential schedule delays. This first case study shows how this type of rigorous statistical analysis fills a critical gap in DoN's cost control solution, and should be considered as the first step to manage acquisition costs adequately.

The second case study demonstrates the required cost control objectives (CCOs) within a program and the procedural management steps needed to achieve adequate due diligence using the 6-3-5 Method. Specifically, this case study involves a NATO-sponsored development and acquisition program. It outlines key aspects of the 6-3-5 Method in terms of workforce management, alignment and innovation. This NATO case study views use of the 6-3-5 Method from the prime contractor's point of view, focusing on risk analysis of the project plan and validation of an effective mitigation strategy to reduce ECOs. It introduces the use of workforce alignment metrics and a metadata-based algorithm, compliant with the 6-3-5 Method, to promote and enable workforce innovation as an effective solution to addressing unknowns during task assignment and implementation. The workforce alignment metrics and metadata-based algorithm provide the acquisition team with a measurable, objective way to ensure adequate due diligence is being performed before an ECO needs to be generated or alternatively, a mitigation strategy is implemented.

Use of workforce alignment metrics and the related metadata-based algorithm becomes the focus of the third and final case study involving deliverables listed in Task Planning Sheets and assigned to a branch within a NAVSEA naval warfare center of excellence. The case study emphasizes the need for workforce innovation at the task execution level, when daily challenges by the workforce are encountered and their ability to succeed relates directly to the quality of service provided. This type of government environment in which a branch of civil service employees must do assigned work can be equated to a firm fixed-price contract between the branch and related PEO to provide the agreed upon service and meet the expectations described within the Task Planning Sheet.

Methodology Overview

The 6-3-5 Method consists of a metadata-based algorithm, statistical analytics, a heuristic methodology, various measurements, and a visual approach to display results.

Fundamentally, there are only two types of metrics, *a priori* and *a posteriori*, that apply to decision-making. Using the 6-3-5 Method, these metrics are used to create six metadata tags. A metadata tag provides intelligence in terms of what a data value means. The 6-3-5 Method requires a total of six metadata tags to support the acquisition effort's task management process, from estimation to product/service delivery. All six metadata tags ensure leadership is making informed decisions that have the highest likelihood of having successful outcomes and maintaining cost control. Each metadata tag is created from either an *a priori* or *a posteriori* metric type. The metadata tagging for *a priori* or *a posteriori* metric types are described in Figure 2.

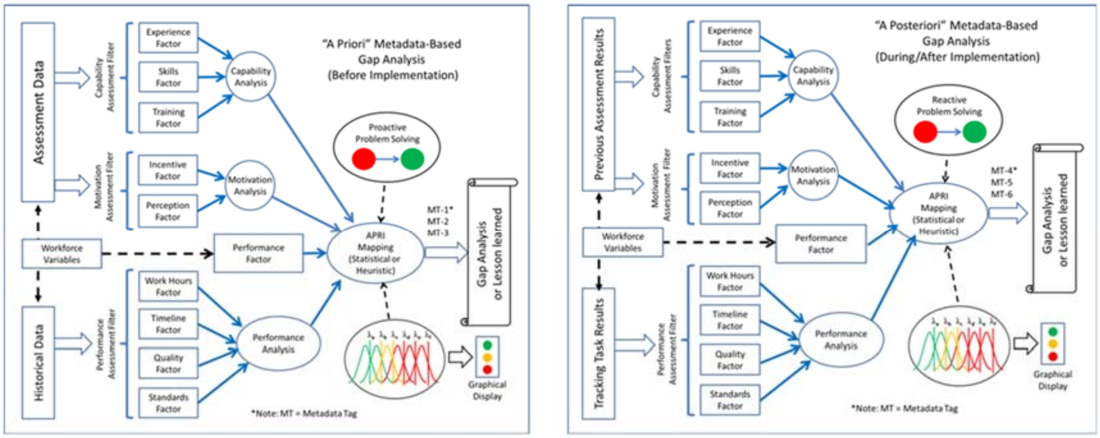


Figure 2. ***A Priori*** **and** ***A Posteriori*** **Metadata Tagging Used by the 6-3-5 Method**

The first three metadata tags (MT) support *a priori* (proactive) measurements. These three tags focus on providing intelligence to uninterpreted raw data values in order to (1) prevent forecasted issues, (2) eliminate impact of existing issues, or (3) when prevention and elimination cannot occur, minimize cost variance factors:

> MT-1. Statistically-Based Lessons Learned Metadata: This is metadata that supports the analytics to do a statistically-based gap analysis. This analysis determines whether there are any lessons learned before proceeding forward in implementing an action. That action could be accepting a prime contractor's bid or allowing tasks to be implemented, during which time and money are consumed. The 6-3-5 Method uses past performance measurements or characteristically similar data (determined by an algorithm's process flow described in Figure 6) mapped to an APRI table via MT-4 that are converted into higher level tagging that support statistically-based lessons learned metadata. These metadata tags are then analyzed mathematically to perform gap analysis on the statistical likelihood of success in meeting cost control expectations. Low statistical confidence identifies potential for cost overruns. If the statistical confidence is in the red zone of the APRI table, significant cost overruns with statistical confidence are forecast. This metadata measurement forecast provides management with actionable data that can be used to proactively prevent/mitigate cost variances using the proactive due diligence (MT-3).
>
> MT-2. Proactive Assessment Metadata: This is metadata that supports the analytics to do a heuristically-based gap analysis. The workforce self-assessment answers are mapped to an APRI table that is converted into metadata. The metadata is analyzed heuristically to provide a gap analysis of potential cost overrun issues, independent of MT-1 results, again based on the likelihood of successfully meeting cost control expectations. When performance data is mapped to the assessment metadata tags via MT-4, the measurements are, once again, tagged respectively with a statistical confidence of the gap identified and each's impact to cost. This metadata assessment measurement provides actionable data for management to use to proactively prevent/mitigate cost variances using the proactive due diligence, addressed by MT-3.

MT-3. Proactive Due Diligence Metadata: This is metadata that validates "best" solution selected for resolving an issue. When *a priori* metadata tags, either from MT-1 (statistics-based) or MT-2 (heuristics-based), indicate a gap in achieving reliable results, this issue initializes the due diligence process when following the 6-3-5 Method. Due diligence metadata tags are used to ensure adequate rigor is achieved in resolving these cost control issues and preventing/minimizing cost variance. The metadata from either MT-1 or MT-2 is inserted into a problem-solving format in accordance with the 6-3-5 Method Problem Solving Collaboration Approach later described (Case Study 2). Using these constructs results in solutions that are mapped into an APRI table and converted into due diligence metadata.

The due diligence metadata determines the degree to which the solution fills the gaps originally identified. If the gaps are not adequately filled (i.e., complete prevention of the cost variance issue), then the due diligence metadata highlights those core areas of concern, where a mitigation strategy is identified to minimize impact. If gaps are filled as validated by the metadata tags, then management also receives validation from the measurement via a recommendation as to the best corrective action to preclude/mitigate cost variance. When past performance data becomes available, this data gets mapped to the due diligence metadata using the APRI table via MT-4. The result provides a higher level tag that determines statistical confidence of the corrective action, specifically forecasting the likelihood of success when implementing the determined solution.

The final three MTs, based on *a posteriori* (reactive) metric types, focus on providing intelligence to untagged (or "raw") data values in order to recover or minimize factors that have been measured as having impact (i.e., increasing cost variance during or after implementation).

MT-4. Performance Tracking Metadata: This is metadata created from performance tracking measurements. Specifically, these are estimates compared to actuals regarding Full Time Equivalent (FTE) hours and schedule start and finish dates. Performance data collected is mapped into an APRI table, where the results are converted into metadata tags that support both heuristic- and statistic-based analysis used by MT-1, MT-2, MT-3, MT-5 and MT-6. In support of the DoN's cost control decision-making, use of intelligently tagged performance tracking measurements that can lead to higher level tagging constructs is recommended. Even earned value management techniques have significant limitations in helping decision makers know core issues and "best" corrective actions to provide highest probability of success. All the other MTs are statistically dependent on this MT-4's APRI tagging, which can be translated to core issues via tags, to provide insights into "best" corrective actions and reveal the statistical confidence, again as metatags, of a potential solution for success. Metadata tables displaying APRI tagging and statistical confidence are shown in the NAVSEA case studies (Case Studies 1 and 3).

MT-5. Reactive Due Diligence Metadata: This is metadata that validates "best" solution selected for resolving an issue. When *a posteriori* metadata tags, either from MT-4 (performance data) or MT-6 (lessons learned data), indicate an issue, the due diligence process is initiated when following the 6-3-5 Method. It is similar to MT-3, with the exception that this is a reactive or after the fact. Due diligence metadata tags are used to ensure adequate rigor is achieved in resolving these cost control issues and recovering/minimizing cost variance. The metadata from MT-4 or MT-6 is inserted into a problem-solving format in accordance with the 6-3-5 Method's Problem Solving Collaboration Approach. Using these constructs results in solutions that are mapped into an APRI table and converted into due diligence metadata.

The due diligence metadata determines the degree to which the solution fills the gaps originally identified. If the gaps are not adequately filled, then complete recovery of the cost variance issue, the due diligence metadata highlights core areas of concern, where a mitigation strategy is identified to minimize impact. If gaps are filled as validated by the metadata tags, then management also receives validation from the measurement as to best corrective action to recover cost variance impact. Using MT-4, a statistical confidence can forecast the likelihood of success for the identified corrective action.

MT-6. On-the-Job Lessons Learned Metadata: This is metadata that supports the analytics to do a heuristically-based gap analysis. This tag can be translated to organizational learning, both heuristically and statistically. The workforce lessons learned assessments are mapped to an APRI table that is converted into metadata. The metadata is analyzed heuristically or statistically, based on MT-4, to provide objective lessons learned. Because of the metadata tagging constructs, the lessons learned can be translated for use throughout the organization and is not limited to the project or team generating the learning. The on-the-job lessons learned metadata focuses on "what worked" and "what didn't work" with regard to the (1) customer, (2) organization, (3) teams, and (4) individuals performing the work. This metadata is also valuable in identifying a need for solutions to proactively prevent future cost control issues throughout various projects and activities within the organization. The main difference between MT-6 and MT-3 is that MT-6 involves the archiving of lessons learned for others to use at some future date, where MT-3 is lessons learned to address an immediate tactical need.

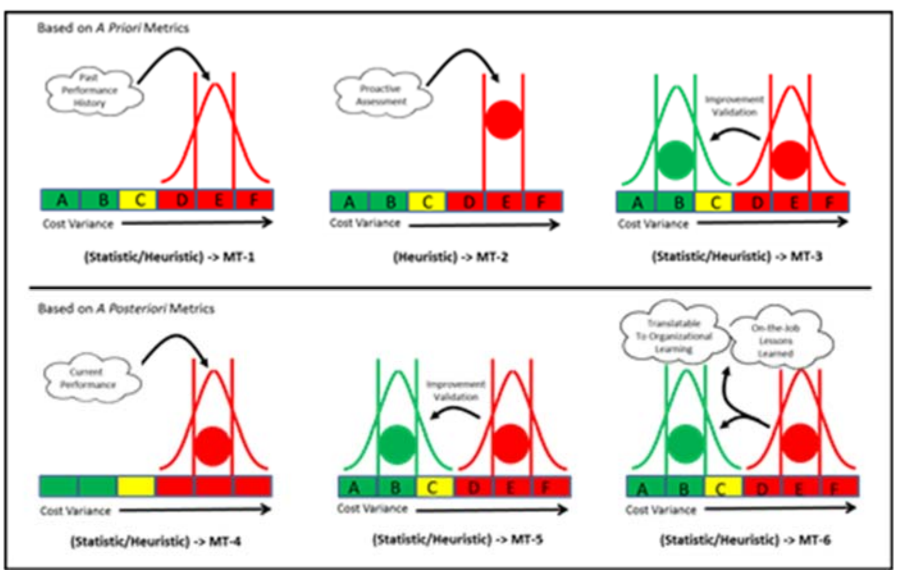


Figure 3. Metadata Tags From APRI Mapping Examples

Figure 3 graphically describes how MTs use APRI mapping. The six MTs require context for use. The three Cost Control Objectives (CCOs) provide a context in which the previous six metadata tags are used. Providing this context ensures management knows how to deploy and maintain the previously described six metadata tags to optimize spending control and reduce cost variance.

> CCO-1—Set and manage customer/business expectations: The first CCO ensures expectations are sufficiently defined based on seven categories. The first five categories deal with productivity needs and the last two focus on efficiency needs for acquisition programs and operational workflow management. The categories are: (1) Requirements, (2) Quality, (3) Process, (4) Technology, (5) Culture, (6) Cost (Including Workforce Allocation Hours), and (7) Schedule/Timeline
>
> CCO-2—Reliably achieve those expectations: The second CCO ensures that those defined expectations are reliably achieved, without compromise. Steps within this CCO include gap analysis and due diligence before, during and after implementation to ensure cost variances are minimized during the life of the project.
>
> CCO-3—Learn to continually do better: The third and final CCO focuses on Continuous Process Improvement to ensure the workforce is continually learning to be better at providing reliable, quality services/products, including how to better collaborate and innovate when overcoming challenges. There are four categories that represent accumulated lessons learned. Those categories are: (1) customer, (2) business/organization, (3) team, and (4) individuals associated with the quality and reliability of the work performed.

With the three CCOs, a context for using the six metadata tags is described. Yet, MT-3 and MT-5 require the use of the 6-3-5 Method's problem-solving constructs. The 6-3-5 Method's problem-solving approach is in the form of five Due Diligence Steps (DDS) to metrically ensure rigor in handling the issues identified as cost control gaps. The sequence of how these steps are described is in Figure 4. These steps are structured to ensure that a team is integrating the appropriate MT into one of the three CCOs previously discussed. Following these steps not only ensures the proper used of *a priori* and *a posteriori* metrics, but also that the three CCOs are continually achieved and due diligence is being rigorously applied when necessary.

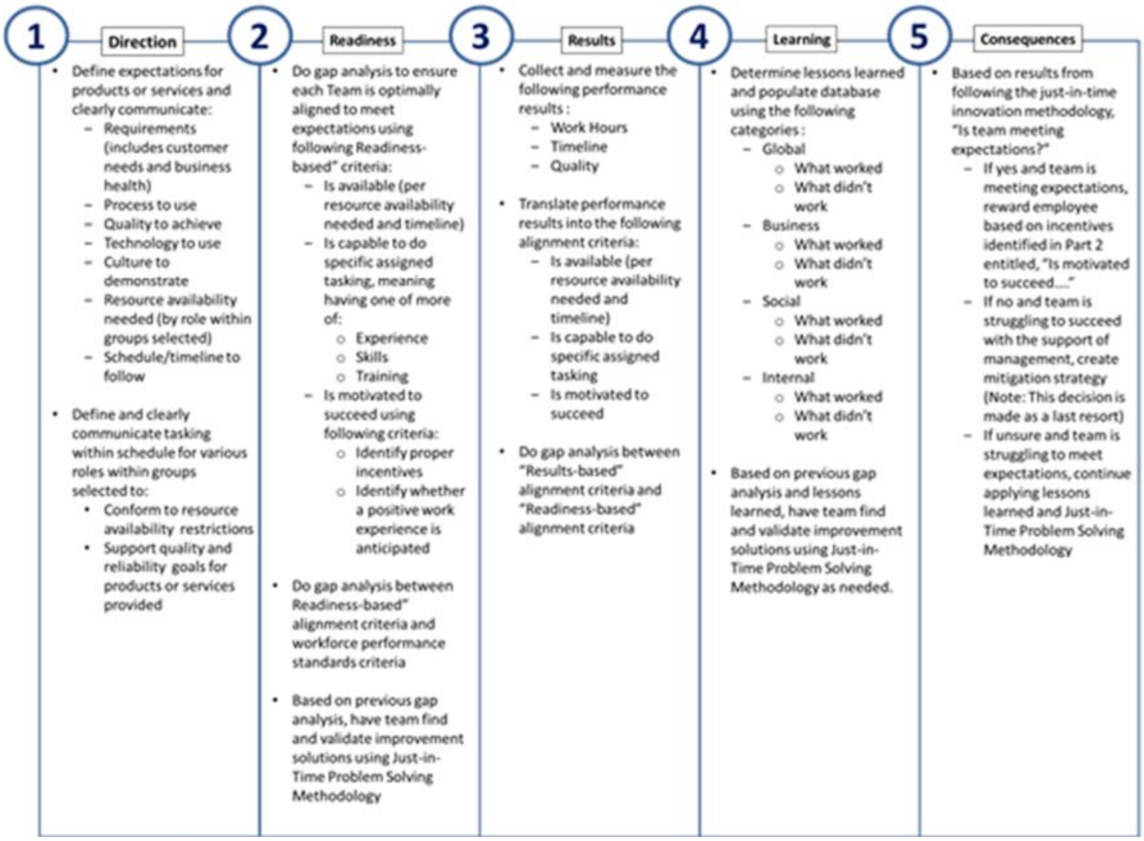


Figure 4. The 6-3-5 Method's Due Diligence Steps

These five steps also establish and maintain an environment that catalyzes the workforce to collaborate and discover innovative solutions to uncovered challenges that would have impacted/compromised the reliability and quality of the products/services being delivered.

> DDS-1: Provide Direction—Step 1 focuses on having management use a checklist to make sure that adequate direction is provided for any follow-on assessments and analysis. It also includes using lessons learned, either statistically or assessed heuristically, to identify weaknesses in the direction. Step 1 is crucial to include if CCO-1 is to be achieved. Metadata tags will use MT-1 for statistic-based gap analysis and MT-3 to validate problem-solving solution.
>
> DDS-2: Readiness of Workforce to Succeed—Step 2 is the due diligence process to ensure, within reason, that the workforce is (1) set up to succeed, (2) handle the unexpected, and (3) able to support each other when faced with severe challenges. Once Step 1 involving direction is complete, where strengths and weaknesses of the direction provided are known based on lessons learned, the implementers need to proceed with due diligence is resolving issues. A detailed due diligence process is described in Case Study 2 focused on workforce innovation and alignment. Even if no lessons learned issues arise from Step 1, to ensure "best chance to succeed," the 6-3-5 Method supports workforce self-assessment of assigned tasks in terms of their experience, skills, and other factors associated with reliable, quality results. (Specific factors and algorithm structure for this self-assessment

process is outside the bounds of this paper.) Step 2 is crucial to include if CCO-2 is to be adequately achieved. Use of metric visibility regarding due diligence rigor will be provided within the case studies. Metadata tags will use MT-2 for heuristic-based gap analysis and MT-3 to validate problem-solving solution.

DDS-3: Measure Results—Once tasks are completed, typical performance results are measured, including Full Time Equivalent (FTE) hours and schedule (calendar duration of tasking) comparing what was estimated to what actually occurred. Step 3 is crucial to include if CCO-2 is to be achieved.

DDS-4: Learn from Results—This step is another form of due diligence focused on learning from results. The 6-3-5 Method requires that due diligence include deliberate learning. The goal to Step 4 is to shift the focus of the learning from cost overruns and schedule delays to internal factors (i.e., ways to better provide direction, more accurate workforce alignment assessments that solve cost variance issues, including performance). Step 4 is crucial to include if CCO-3 is to be achieved. Metadata tags will use MT-4 for data understanding, MT-5 to validate problem-solving solution, and MT-6 to capture learning.

DDS-5: Apply Consequences—In the real world or a classroom, consequences are part of the educational process. Step 5's focus is to use what is learned in Step 4 to determine rewards for success and next step learning for those failed expectations. Step 5 is crucial to include if CCO-3 is to be achieved. Metadata tags may use MT-5 to validate problem-solving solution and MT-6 to capture learning.

Given the statistical processing and heuristics involved within the 6-3-5 Method, it was necessary to develop a metadata-driven "Workforce Alignment to Business Expectations" (WA2BE) Algorithm incorporating all 6 MTs, 3 CCOs, and 5 DDSs. The algorithm has been applied to waterfall project management and Agile software development styles. Independent of the version, the algorithm consists of two parts. The first part (Figure 5) uses *a priori* metrics to identify gaps in a proposed cost. The first part is before task execution but can be run up until the time tasks are assigned for the resource talent. The second part (Figure 6) of the algorithm uses *a posteriori* metrics that are applied after the resource talent is performing the assigned task. The algorithm uses performance data during and after implementation.

Uniquely, the WA2BE Algorithm knows how to translate "similar" historical data and make it relevant to a current project or operations. "Similar" is based on various types of complexity parameters of skill set and workload. The following three case studies demonstrate how various aspects of the 6-3-5 Method incorporating the metadata-based algorithm is applied to the acquisition and management process, and the results achieved from the application.

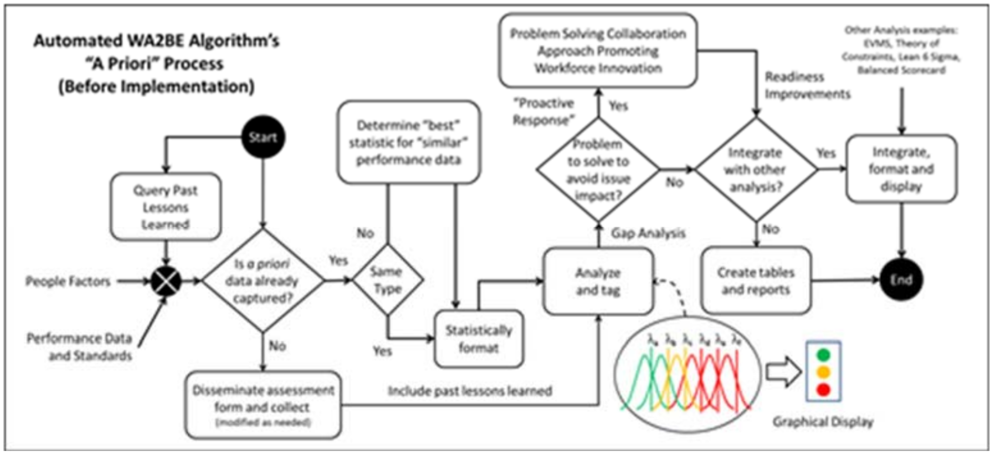


Figure 5. WA2BE Algorithm Process Flow Before Implementation

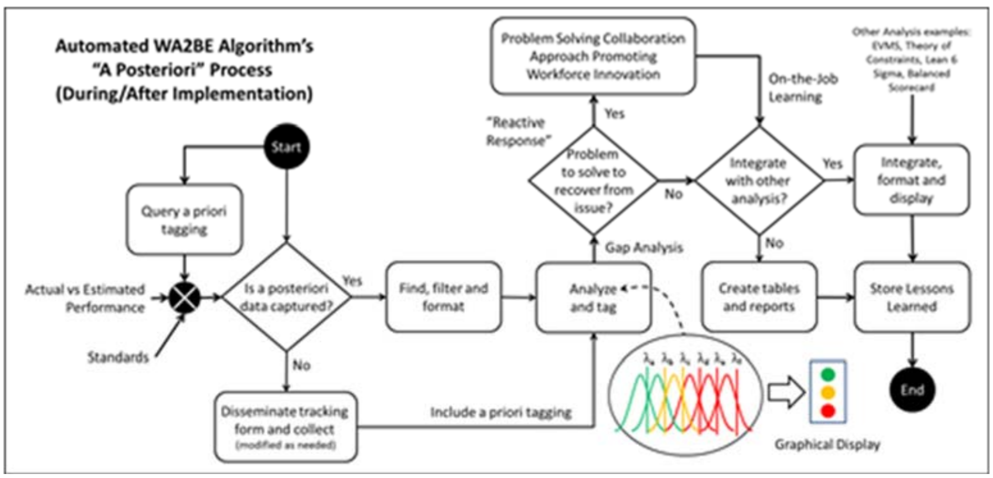


Figure 6. WA2BE Algorithm Process Flow During/After Implementation

PEO Carriers Case Study

In this NAVSEA-aligned PEO case study, statistically-based lessons learned metadata is used to support CCO-3. In this case study, previous RCOH data allowed the WA2BE algorithm to compare identical SWLIN types resulting in gap analysis of contract performance reliability. Note that in cases where the same type of data is absent for past performance analysis, then the WA2BE algorithm can translate and use "similar" past performance data to identify issues prior to contract award with statistical confidence.

The statistical analysis, implemented by the WA2BE algorithm, analyzed various permutations within the historical performance data to determine "best" estimation characteristics. A Lambda Level 6 (Figure 1) was selected for the algorithm's analysis. An important note: Once the statistically-based lessons learned are applied to identify gaps, the five steps involving due diligence discussed previously can then be applied to eliminate or mitigate cost control issues.

In the April 2015 online edition of the Navy League's *Seapower* magazine, The Honorable Frank Kendall, Under Secretary of Defense for Acquisition, Technology, and Logistics, stated, "We will not start programs we cannot afford" (Kendall, 2015). The U.S. Government Accountability Office (GAO) recommends cost control methods described in its

Defense Major Automated Information Systems: Cost and Schedule Commitments Need to Be Established Earlier (2015) report. That study emphasizes the need to have programs establish their initial acquisition program baselines (APBs) involving cost and schedule within two years of officially reporting that work has commenced. Industry's response to comply with this study is to create smaller, more manageable programs or program segments. Unfortunately, as this white paper describes through its case studies, even establishing an APB within two years to comply with these findings is still not an adequate cost control approach. This becomes obvious when coherent metadata tagging is created as a basis for comparison between past overhauls and a planned or in-process overhaul, as is described below.

To understand why a two-year APB approach will not fully satisfy Under Secretary Kendall's stated need, this case study examined a Nimitz-class aircraft carrier class refueling and complex overhaul (RCOH) of USS *Carl Vinson* (CVN-70). The RCOH occurred in 2005 as reported in the July 14, 2009, issue of *Defense Industry Daily* (DID) (CVN 70, 2009). That article stated, "In November 2005, [at that time] Northrop Grumman Newport News [Shipbuilding (NNS)—now Huntington Ingalls Industries] in Newport News, VA was awarded a $1.94 billion cost-plus-incentive-fee [CPIF] contract for accomplishment of the FY 2006 mid-life refueling and complex overhaul (RCOH) of the Nimitz Class aircraft carrier USS *Carl Vinson* [CVN 70]." As that article further states, "NAVSEA's official cost figure for the CVN 70's entire RCOH is $3.1 billion. As of April 2007, they [NAVSEA/PEO Carriers] told DID that the program was on budget." Thus, within less than a two-year period (November 2005 to April 2007), the cost had increased by over $1 billion.

Timeline for the USS *Carl Vinson* RCOH:

- 4th Quarter CY2005—"Workforce Alignment to Business Expectations" (WA2BE) Algorithm was applied and used a grading system of an "A" through "F" for each of the CVN-70 Carl Vinson's RCOH Ships Work List Item Number (SWLIN). Grades of C, D, E, and F indicated that cost overruns would potentially exceed contract RCOH goals. Using a stoplight dashboard, C is represented as "yellow," where D, E, and F are displayed with "red." The grades are color-coded in Table 1. The algorithm had an overall statistical confidence of 99% that the RCOH's costs would exceed its contract goals (coded "red"):
    - Sample Source: The statistical analysis was based on 684 SWLIN forecasted grades using CVN-68 and CVN-69 RCOH historical data that was provided by PEO Carriers. There were seven SWLINs that had no values available for analysis.
    - Metadata Summary (Contributors to cost overruns—Cs, Ds, Es, and Fs are tags to indicate the degree in which actuals will potentially exceed contractual agreement—the lower the grade, the higher the potential): Table 1 is a simple example of metadata analysis using previous overhauls per SWLIN categorization as linked to shops assigned, trades assigned, and related management/operations. These types of analytical summaries based on *a priori* metrics allow for better bid negotiations.

Table 1. CVN-70 RCOH Metadata Summary Analysis of Bid From Newport News Shipbuilding

Performers \ Grades	A	B	C	D	E	F
Management and/or Operations	0%	0%	31%	8%	40%	21%
Shops	0%	0%	41%	59%	0%	0%
Trades	0%	0%	57%	41%	2%	0%

- 4nd Quarter CY2005—Newport News Shipbuilding (NNS) Awarded $1.94 Billion CPIF Contract
- 2nd Quarter CY2007—NAVSEA/PEO Carriers' Official [Actual] Cost is $3.18 Billion [Reported by DID], obviously exceeding the original contract goals.

Figure 7 shows three figures, where each figure represents a row in Table 1. The three figures describe probability density functions determined using the APRI analytics and maximum likelihood criteria to statistically reduce false positive results. The RCOH bid contractually needed to be within +/- 10%. 684 SWLINs had a statistical confidence of 80% or greater that they had either a marginal or poor estimate in terms of meeting the contractual 10% threshold. This analysis involved shops, trades, and management. This is why the WA2BE Algorithm determined with a statistical confidence interval of 99% that the costs would exceed the contractual threshold. Use of the WA2BE Algorithm demonstrated that this RCOH bid should not be accepted without all 684 SWLINs reviewed for improvement. Starting with the "F" graded SWLINs, the review needs to use the algorithm's analytics to determine if any changes were effective (creating an "A" or "B" grade) in having the U.S. Navy avoid getting "stuck with the bill"—again!

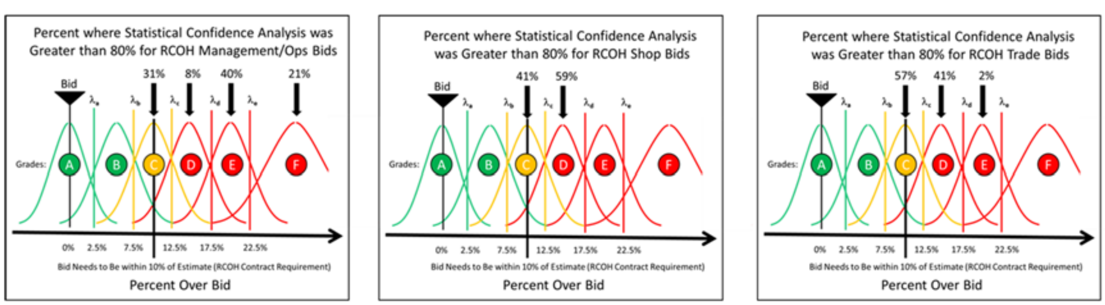


Figure 7. Probability Density Function View of Metadata in Table 1

Figure 8 provides an example of how the results from using five due diligence steps within the methodology are statistically validated. The key is to be able to graphically view the results of the due diligence efforts with stoplight displays before proceeding with bid acceptance or task management. PEO Carriers did not follow the five due diligence steps. Therefore, it is difficult to determine whether they accepted the bid under Figure 7 conditions or those of Figure 8.

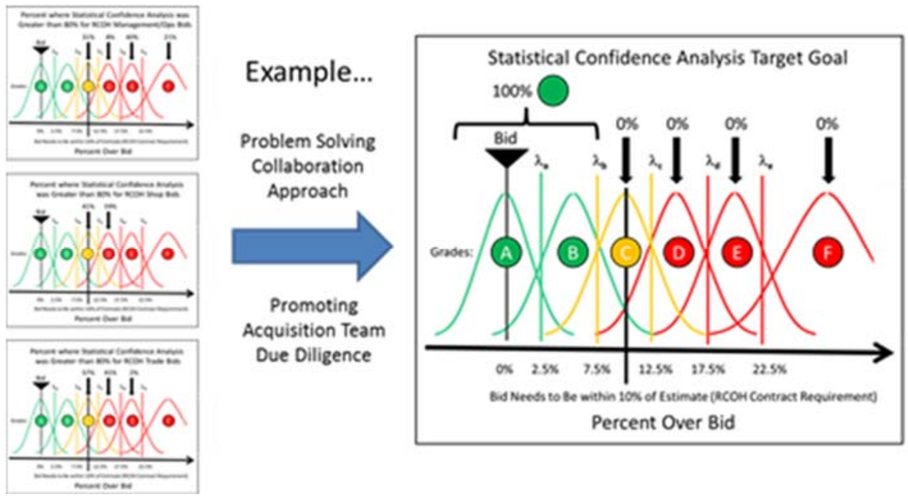


Figure 8. Target Goal of a Bid Statistical Analysis

To emphasize when using the 6-3-5 Method, Figure 8 provides an example of what the statistical analysis of any RCOH bid must be before the contract is accepted. The following case study describes how the 6-3-5 Method supports the achievement of this goal when given issues represented in Figure 7.

NATO Program Case Study

The 6-3-5 Method's WA2BE Algorithm applied heuristic processing to a NATO-sponsored program developing Air Traffic Control Systems (ATCSs) for various nations, including Belgium. The prime contractor developing the systems was a Hughes Aircraft spinoff company. The ATCSs being developed required the use of touchscreens (a new technology at the time) and had the complexity of integrating new hardware development with complex software coding. As described below, the prime contractor encountered many difficulties creating an accurate baseline for the Belgian-variant ATCS acquisition—until the WA2BE algorithm was applied. These problems were addressed using a formal workforce collaboration problem-solving approach supported within the 6-3-5 Method as described in Figure 9.

The 6-3-5 Method's collaboration problem-solving approach was successfully used by the prime's management team to reduce cost overruns dramatically from 35% to 3%. When following the 6-3-5 Method, first the implementation of the metrics allowed for visibility into issues. The key problem discovered was a requirement document that did not provide enough detail for the workforce to assess their alignment. That means that there was no alignment, which caused more than 80% of the task to be in the red, as described in Figure 10.

After the requirements document was written to allow the workforce being assigned tasks to self-assess, the following corrective actions were taken based on the results from the workforce applying the 6-3-5 Method's collaboration problem-solving approach (Figure 9) to improve cost control (i.e., workforce alignment):

- Increase the team's confidence, knowledge, or training about performing the Tasks per management's productivity and efficiency expectations (a) informal training, (b) formal training, (c) completing similar Tasks.
- Modify the resources (e.g., internal resources, external resources, time, labor-hours) or working environment defined for use with the assigned Tasks.

- Modify the way the team is accomplishing their Tasks by using a different approach.
- Modify the support group/other team members to assist each other in doing assigned Tasks more reliably.
- Increase incentives for the team to perform the complexities of the Tasks.

It is important to note that had the Nunn-McCurdy Act applied to this NATO program, it would have been well within the 15% requirement, and even when the Amendment was at 10% (Nunn-McCurdy Act, 1983). The DoN would not have been stuck with another unexpected bill, as described in Case Study 1. Instead, this program used all six MTs as they continually cycled through the five DDSs, achieved all three CCOs, enabling NATO prime contractor management to realize greater cost control by meeting budget, schedule, and quality expectations more reliably. The NATO program was being due diligently supported (see Figure 10).

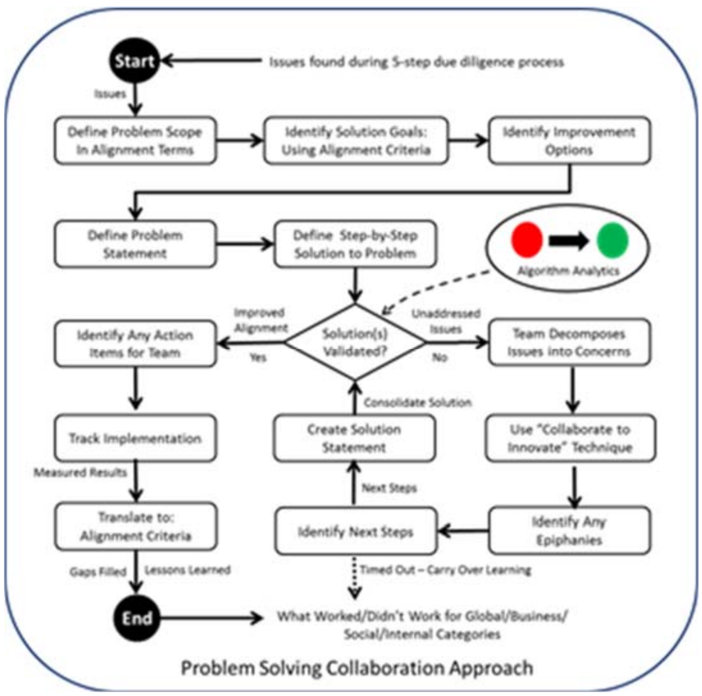


Figure 9. Problem Solving Collaboration Approach

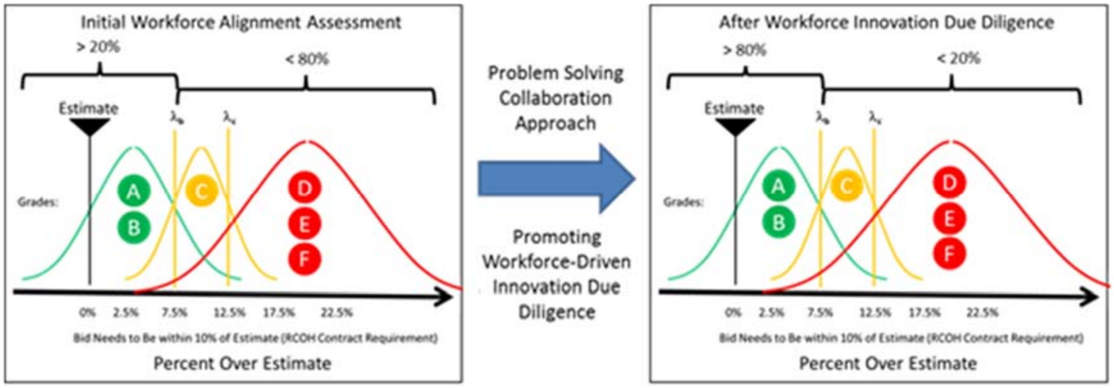


Figure 10. Heuristic Assessment Analysis Statistically Mapped to APRI Table Before and After Problem Solving Collaboration Approach Validating Improved Cost Control Resulting in Cost Overrun Reduction From 35% to 3%

The WA2BE Algorithm's implementation of the five-step method supports a rigorous due diligence approach involving team problem solving through collaboration that promotes team innovation. Figure 9 provides how collaboration can lead a team to innovative solutions and lessons learned. Using this process flow results in one of three results:

1. A solution that does not require innovation
2. A solution that does require innovation
3. A next step to discover a solution

If the problem is not solved in time, the algorithm supports the team with lessons learned documentation of the steps used and the related outcomes to discovering the solution. In the case where the issue happens again, the workforce can access documentation to use as a running start at finding the solution within the needed time frame. If a solution is found, the lessons learned provides immediate assistance to support the workforce in knowing how to recover from any impact that would increase cost variance. Lesson learned documentation is in the form of what worked and what did not work.

The hypothesis is offered: Can any team be due diligent about reducing impact of unknowns to a project without considering innovative options/solutions to the issues? Would this be considered a significant workforce collaboration goal? The algorithm's implementation of the 6-3-5 Method is based on the assumption that workforce collaboration, and when needed, workforce innovation, is essential to success when attempting to achieve rigorous due diligence.

Highlighting a difference in approach as compared to the CVN-70 RCOH case study, the prime's executive leadership for the Belgian ATCS chose to make the time investment to perform the necessary due diligence—despite already being behind schedule—to address the "red" stoplight issues. First, the algorithm was used to achieve CCO-1 (Setting and managing customer/business expectations for the program). Next, the algorithm was used to support CCO-2 (Reliably achieving those expectations). The algorithm allowed the team to assess their reliability in meeting expectations, with objective, metric precision. Once assessed, the algorithm identified gaps in workforce alignment, prioritizing these gaps in terms of criticality (i.e., greatest budget, schedule and quality impact to the program), allowing the team to focus on worst case scenarios. This was all done through its tagging process. The algorithm facilitated constructive discussions by having tags that provided simpler descriptions of core issues that allowed the performing team to find innovative solutions, when needed. This gave the performing team an advantage in meeting expectations more reliably, producing wiser, more efficient and when needed, innovative solutions.

The WA2BE algorithm's connectivity relationships and related metadata tagging made it easier for the team to innovatively solve issues—turning an average group into a high performance team.

For example, the NATO-sponsored ATCS development program required each system being tailored for various countries be designed with touchscreen user interfaces. Unfortunately for the Belgian ATCS program, the prime's software development team didn't have access to touchscreen user interfaces at their workstations, nor was funding available to upgrade their workstations. For the Belgian team, the touchscreens were only available on the Test and Evaluation (T&E) Test Bed, which was time shared by multiple NATO-sponsored programs for formal integration testing. The algorithm identified "lack of funding to buy touchscreen user interfaces" as a symptom of the Belgian team's inability to meet cost and schedule. Additionally, like all symptoms, it did not present itself as a solvable problem for the team to address. In fact, it caused them to feel victimized given other circumstances associated with the prime's executive leadership. This is a very typical workforce response when they feel that they are set up to fail by management.

The complete symptom presented itself as follows: For the Belgian ATCS software team, workflow involved code development at their workstations, followed by software installation onto the T&E Test Bed. Once installed, they ran their code using the timeshared Test Bed's touchscreens to find "bugs." Once found, they needed to end their Test Bed session to return to their workstations to "hopefully" fix the code. Once potentially fixed, they had to reinstall their updated version onto the Test Bed, again timesharing with other ATCS programs, and check their code using the T&E Test Bed's touchscreens. Then the process repeated to resolve any new bugs found. Until all bugs were fixed, formal integration tests could not be performed. Because of the timesharing challenges, this caused the Belgian team to incur uncontrollable cost overruns and schedule strips.

The algorithm forecasted the number of days these symptoms would push the schedule, thus causing a failure in meeting requirements. The algorithm's metadata process converted these symptoms into workforce alignment gaps that identified core issues based on one of the five alignment factors in meeting business expectations, breaking down the problem into addressable and solvable "chunks."

These problem "chunks," customized to the team's specific workforce alignment needs, were then filtered into a solvable format for the team to more easily and efficiently apply their collective wisdom and innovation. This translation into smaller, solvable issues allowed the team to creatively improve workforce alignment. In other words, the algorithm's use of metadata guided the team to innovate a solution based on their alignment needs in meeting schedule, without affecting cost or quality.

Whether applying the WA2BE algorithm to an S-Curve analysis, Earned Value Management (EVM), etc., the new baseline/target was assessed with the quality of data having mostly "As" and "Bs," with a few "Cs" that were being mitigated, as opposed to its previous lower grades (Earned Value Management Systems, 2007). The "garbage in, garbage out" syndrome was eliminated. The new baseline was significantly different in another way; it conformed to the provided funding, once thought insufficient. The data supporting any type of analysis, S-Curve, EVM, etc., now consists mostly of all "green" lights—indicating, "quality in, quality out." As indicated in this case study, the Belgian team faced and innovatively conquered a common issue in today's development environment, "lack of funding." During the life of the program, they continued to solve issues using the Just-in-Time Problem Solving Collaboration Approach instead of feeling victimized.

The transformation of the Belgian team in its ability to meet expectations was so dramatic that the prime contractor began applying the WA2BE Algorithm to its other NATO-sponsored programs.

Naval Warfare Center Case Study

Performing under Navy fixed price support service contracts, the WA2BE algorithm was applied within various branches of two NAVSEA Warfare Centers of Excellence (COEs). For both centers, since historical data was not available to apply the statistical analyses, assessments were made via MT-2 and heuristically analyzed using the WA2BE Algorithm. MT-2 supported DoN civil service employees and related contractors to create the data that was translated into metadata and mapped to an APRI reference, as was done in Case Study 2. Case Study 3 will compare the use of WA2BE Algorithm by branches from two different COEs.

For both warfare centers, the first challenge was in the achievement of CCO-1 (Setting and managing expectations). At one center's branch, a more effective WBS was created, with a nomenclature that supported greater understanding of the relationships within the branch's organization. At the other center's branch, where deliverables were defined in Task Planning Sheets (TPSs), the focus was on documenting workflow and defining FTE hours consumed. For both branches, once metrically determined as having CCO-1 complete with the appropriate metadata analysis, the algorithm supported management to achieve CCO-2 (Reliably achieving expectations).

Without prior history, the algorithm generated forms based on the metadata for both branches to self-assess workforce alignment to deliver their assigned fleet work products with reliability and quality. In CCO-2, the algorithm used the completed forms to identify gaps in workforce alignment and then used the Just-in-Time Problem-Solving Methodology to guide the groups in addressing their respective issues without compromising time, money or quality. One center's branch manager went through detailed preparation to use the Just-in-Time Problem-Solving Methodology based on the alignment metrics. Another center's branch manager chose not to go through the training. The results were profoundly different in a manager's ability to grasp innovative due diligence performed by his team whenever dealing with challenges.

It is important to note that when a branch manager chose not to receive training, the solutions produced by his team to improve quality of deliverables were suppressed. Presumably, the branch manager was concerned that his senior leadership would view this data as an inability to manage his group effectively. This is another example of SECNAV's comments and concerns regarding a long standing "zero-defect" culture.

Significantly, when the team's solutions to deal with "red" stoplight issues were not supported by management, the identified issues manifested within six months to a year. This resulted in formal negative feedback from the branch's Navy customer. Again, this emphasizes two points: (1) even without historical data, the algorithm assessment using the metadata approach was shown to be able to forecast issues accurately six months in advance, and (2) when "red" stoplight issues are identified and solutions provided within the metadata structure, they need to be addressed and implemented before impact.

Timeline for the branch that did not support team's solutions to "Red" stoplight issues:

- CY2007—“Workforce Alignment to Business Expectations” (WA2BE) Algorithm used a grading system of an “A” through “F” for each of the deliverables called out by the TPSs. Grades C, D, E, and F indicated potential quality issues. Using a stoplight dashboard, C is represented as “yellow,” where D, E, and F are displayed as “red.” The grades are color-coded in Table 2. Using the metadata structure, the algorithm produced assessments that were answered by branch team members and analyzed based on APRI and metadata relationships. (The just-in-time innovation solutions to improve the quality of the work generated by the branch workforce assigned to the deliverables were discarded.)
    - Sample Source: The analysis is based on 181 deliverables and their related assessments. There were four deliverables that had no assessments available. Appropriation source were Operations and Maintenance, Navy (O&MN)—funding 60 deliverables; Other Procurement, Navy (OPN)—funding 40 deliverables; Ship Construction & Conversion, Navy (SCN)—funding 54 deliverables; and Navy RDT&E—funding 31 deliverables being analyzed by the algorithm.
    - Metadata Summary (Contributors to Quality Issues—Cs, Ds, Es, and Fs are tags to indicate the degree in which actual performance will potentially have quality issues—the lower the grade, the higher the potential): Table 2 is a simple example of metadata analysis, where each type of money connects to its related deliverables, related processes, people assigned within the process, and related alignment metrics per tasks/activities along the process. This data is tagged and summarized below. These types of analytical summaries allow for better management of monies within branches, divisions, departments, commands, and various other echelons within the DoN.

Table 2. Metadata Summary Analysis of a NAVSEA CEO Branch’s Quality of Deliverables by Appropriation

Grades / Appropriations	A	B	C	D	E	F	TBD
O&MN	28%	30%	13%	7%	20%	0%	2%
OPN	33%	5%	0%	5%	58%	0%	0%
SCN	28%	13%	17%	24%	13%	0%	6%
RDT&E	0%	65%	0%	0%	35%	0%	0%
All Appropriations:	24%	25%	9%	10%	29%	0%	3%
Work Quality:	49% (Good Quality)		9% (Marginal)	39% (Poor Quality)			3% (TBD)

- CY2008—The NAVSEA/"PEO Customer" had significant complaints involving quality of work performed by that same specific branch that used the algorithm approximately six months earlier but discarded the team's solutions to improve the quality of work.
- CY2014—Executive leadership for the entire Center was replaced due to Navy customer complaints regarding the quality of work.

Significantly, when the team's solutions to deal with "red" stoplight issues were not supported by management, the identified issues manifested within six months to a year. This resulted in formal negative feedback from the branch's Navy customer. Again, this emphasizes two points: (1) even without historical data, the algorithm assessment using the metadata approach was shown to be able to forecast issues accurately six months in advance; and (2) when "red" stoplight issues are identified and solutions provided within the metadata structure, they need to be addressed and implemented before impact.

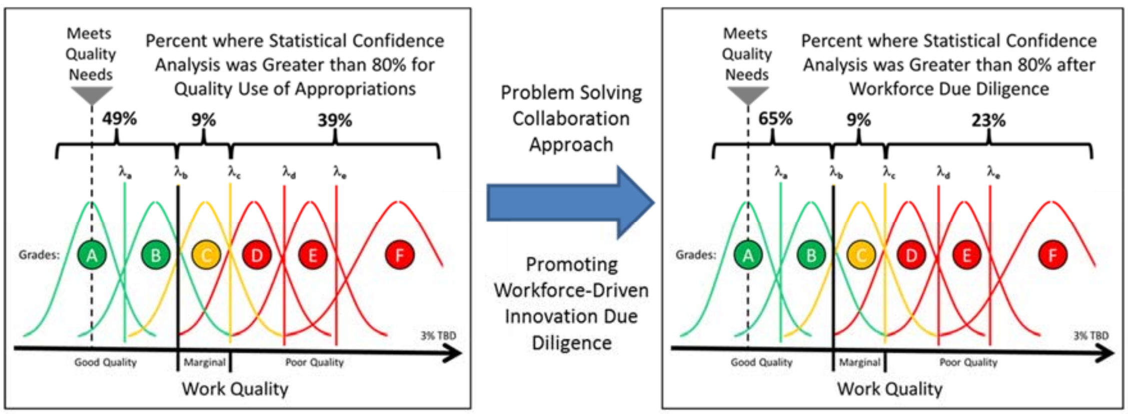


Figure 11. Heuristic Assessment Analysis Statistically Mapped to APRI Table Before and After Problem Solving Collaboration Approach Validating Proposed Solution to Improving Workforce Quality

As Deming (1993) once stated, "A bad system will beat a good person every time." For the branch manager who did not allow "red" stoplight issues to be solved and implemented by their teams, was this a display of a "zero-defect, never failing" mentality, and was it pervasive throughout his chain of command? In support of understanding the culture of the command, there is another instance when the center used the algorithm to support implementing NAVSEA-wide initiatives. In CY2014, when a high-level civil service employee remarked about his group's "red" stoplight issues, "Don't throw me under the bus for my answers." He preferred to avoid stating that "the emperor has no clothes" and any consequences that might ensue.

The algorithm using its metadata structure accurately determined that the workforce alignment was so poor that his implementation team had a very low likelihood of meeting the defined expectations of the command in supporting the NAVSEA-wide initiatives. Once again, in Case Study 3, the concern was what executive leadership might think of his answers. When executive leadership reviewed his assessment, their predominant concern was what impression a visiting NAVSEA admiral might think of their command's organization. This supports the belief that a pervasive "zero-defect, never failing" mentality was being evidenced throughout the chain of command.

Figure 11 demonstrates that while 49% supported by this branch are of good quality, 51% had a statistical confidence of 80% or greater that the work quality would be marginal or poor. When civil service work quality suffers, the impact can seriously hinder the U.S. Navy's readiness to support its warfighting missions.

Failure-focused, "zero-defect" cultures must end if cost control is to improve. Unfortunately, ignoring or at worst, discarding data that accurately forecasts outcomes does not avoid issues; it only delays having to deal with them. Such delays make any corrective action, after the fact, more costly.

The algorithm's metadata approach to identify and overcome issues, instead of being victimized by them, directly contrasts against a non-zero defect mentality. In Case Study 3, one center's branch manager and his supervisory task leads took the training and benefited from the algorithm's analytics. Another center's branch manager skipped the training and rejected the benefits of the just-in-time innovation solutions offered by his team. Can an assumption be made that if the branch manager had chosen to attend the training instead of skip it, would he have allowed his team to follow through with their just-in-time innovation solutions?

This case study emphasizes how the WA2BE Algorithm fills a gap as a needed solution for use by various U.S. Navy shore commands as part of their cost control approach, supporting just-in-time innovation. All commands and programs within the DoN need stabilized budgets, where innovation is used to maintain budget adherence reliably to meet expectations. This algorithm supports this type of cultural change.

Conclusions

The data collected at the SWLIN/TPS deliverable levels, once metadata is tagged and processed through the algorithm, becomes very revealing. The three case studies reveal crucial gaps in the DoN's current ability to achieve an effective cost control solution. Two of these case studies were performed under NAVSEA contracts and the third in support of a NATO program. The case studies demonstrate how the metadata-based algorithm implementing the 6-3-5 Method gave leadership greater proactive control over internal and external factors that affected cost variance. Specifically, the algorithm identifies and collects workforce alignment data, making relevant links between data points, providing heuristics (an approach to achieve Artificial Intelligence) to create tags that summarize the value of those links, and processes analytically the metadata tags to provide statistical confidence and other higher-level metadata related to cost control.

Through application of the algorithm's automated analysis, as shown via tables of cost control data collected from these studies, leadership is able to make more informed decisions and an aligned workforce is encouraged and enabled by management to contribute through innovation and by lending its fully invested and supportive voice to recommend process improvements. These solutions offer management improved decision-making capability to better tailor the program for success.

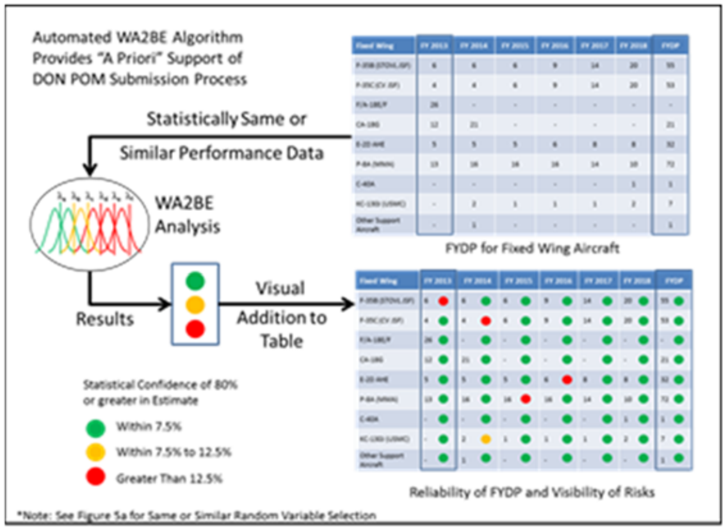
As per H. James Harrington, PhD, president and chairman of the American Society for Quality (ASQ) and president and chairman of the International Academy for Quality (IAQ), "Measurement is the first step that leads to control and eventually to improvement. If you can't measure something, you can't understand it. If you can't understand it, you can't control it. If you can't control it, you can't improve it" (Harrington, 1987, p. 43). Through the 6-3-5 Method's metadata analysis via the WA2BE Algorithm based on either statistic or heuristic assessment measurements for each program and aggregating in the roll-up from lower to higher Echelon command levels, and ultimately Budget Submitting Offices and

OPNAV Resource Sponsors. These 6-3-5 Method-based analyses can feed the related line items in the DoN's POM submission to DoD in support of the federal government's Planning, Programming, Budgeting and Execution (PPBE) process (Office of the Under Secretary of Defense for Acquisition, Technology, & Logistics [OUSD(AT&L)], 2013).

Table 3 provides an example of how a stoplight approach, based on the WA2BE Algorithm's analytics, can support the DoN's POM submission process. The table represents a graphical view of an original estimate submission before and after applying the algorithm's statistical confidence analytics. The WA2BE Algorithm is able to use either same or similar past performance data related to each DoN POM submission line item to determine the statistical accuracy of each item's budget estimate. The statistical accuracy of the analysis is represented by graphical stoplights, where each stoplight represents confidence of 80% or greater with a margin of error, defined by the Lambda value within the APRI table. In an environment where budgets need to accomplish more with less funding, accurate estimation using *a priori* metadata is a vital necessity/capability for all DoD activities. For areas in the "red," the 6-3-5 Method provides a proven problem-solving collaboration approach, as described in the previous case studies and figures. The collaboration approach uses *a priori* metrics and either heuristic assessment or statistical confidence to validate the reliability that the proposed solution will cause "red" DoN POM submission line items to turn "green," assuring accuracy of estimated submission.

Admiral James A. Winnefeld Jr., Vice Chairman of the Joint Chiefs of Staff, during his address to the Navy League SAS 2015 banquet, stated that budget cuts are causing significant uncertainty for our future warfighting capability. More money is always a desired state; yet even with more money, the reliable control of spending needs to be addressed. To summarize many sentiments discussed by speakers at SAS 2015, including Admiral Winnefeld, there is a level of uncertainty with regard to a stable budget that has now become a DoD legacy "posing serious future problems." In Case Study 1, the Nunn-McCurdy Act was discussed (Nunn-McCurdy Act, 1983). The current Act requires that Congress be informed of any major Acquisition Category (ACAT) program running over 15%. Just a decade earlier, the threshold number was 10%. These percentages represent uncertainty in any Program of Record's financial outcome. The goal should be to have less uncertainty, for example, a 5% threshold—not more uncertainty—with regard to the mandate of the Nunn-McCurdy Act.

Table 3. An Example of How 6-3-5 Method Supports DoN POM Submission in Knowing Reliability of Submission/Risks per Line Items



Because of its proven accuracy to use *a priori* metrics to identify and resolve issue well in advance, the WA2BE Algorithm is recommended as an effective means to minimize DoN budget uncertainties. Case Study 2, regarding the reduction of cost overruns from 35% down to 3%, ensures that when an APB is set, it is also stable with a workforce that is aligned with a high statistical confidence of meeting expectations. Case Study 2 also demonstrates the ability for the DoN to establish and maintain a culture of innovation and learning using the WA2BE algorithm throughout its acquisition and in-service engineering/life cycle support programs, as well as its centers of excellence.

The 6-3-5 Method deployed using the metadata-based WA2BE Algorithm ensures that the workforce remains optimally aligned to meet fleet and force capability expectations reliably. As described in Case Study 3, this ability applies to the federal civil service workforce throughout all Navy shore commands and their industry service support partners, as well as major system integrators delivering products. It ensures that just-in-time innovation becomes the new cultural norm. Just-in-time innovation, as established and visible through the algorithm's metadata analytics, will set a standard for adequate due diligence in handling the challenging budgetary issues related to delivering reliably on-time, within-schedule, and at the quality required. As demonstrated in the case studies, the 6-3-5 Method making data more intelligent starting with APRI tagging is a needed solution in today's "keep-up or fall-behind" information-based society in order to sustain our Navy operational capabilities, forward presence and warfighting advantage.

Based on the findings contained in this white paper, it is recommended that DoN leadership evaluate and deploy the WA2BE Algorithm and its metadata constructs, according to the 6-3-5 Method, to estimate and manage expenditures reliably, while improving the quality and health of programs in support of existing Joint Capabilities Integration and Development System (JCIDS); Planning, Programming, Budgeting and Execution (PPBE), including Program Objective Memorandum (POM) submission; and Defense Acquisition System (DAS) processes, including principal Major Defense Acquisition Programs (MDAPS), for example, the Ohio-class SSBN replacement and naval Joint Strike Fighter variants (Secretary of the Navy, 2011).

When combining the results from all three case studies, the SWLIN/TPS deliverable analysis evidence indicates that application of the 6-3-5 Method would improve the health of Navy Programs of Record by supporting the respective Acquisition Program Management Offices and those naval warfare systems' centers of excellence responsible for in-service engineering and life-cycle sustainment support. The case studies demonstrate critical gaps that are affecting the recapitalization and sustainment of the world's finest Navy. This paper demonstrates how the 6-3-5 Method can immediately, effectively, and efficiently satisfy these DoD and DoN needs, addressing these critical gaps through use a metadata-based, statistics and heuristic assessment algorithm resulting in improved cost control capability.

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THE 6-3-5 METHOD: IMPROVING COST CONTROL BY TAGS, OBJECTIVES AND STEPS…

Construct

Six (6) Metadata Tags (MTs)	Three (3) Cost Control Objectives (CCOs)	Five (5) Due Diligence Steps (DDSs)

Elements

Statistical Algorithm	Methods & Measurements	Visual Representation

Purpose

- Assessing Bid Offers to Find Cost Variance Issues using Metadata
- Resolving Cost Variance Issues Before Contract Award using Metadata
- Resolving Cost Variance Issues During Contract Execution using Metadata

THREE CASE STUDIES DEMONSTRATED...

Methods & Measurements

Resolving Cost Variance Issues Before Contract Award using Metadata

1

PEO Carriers RCOH

Assessing Bid Offers to Find Cost Variance Issues using Metadata

Statistical Algorithm

2

NATO Air Traffic Control Program

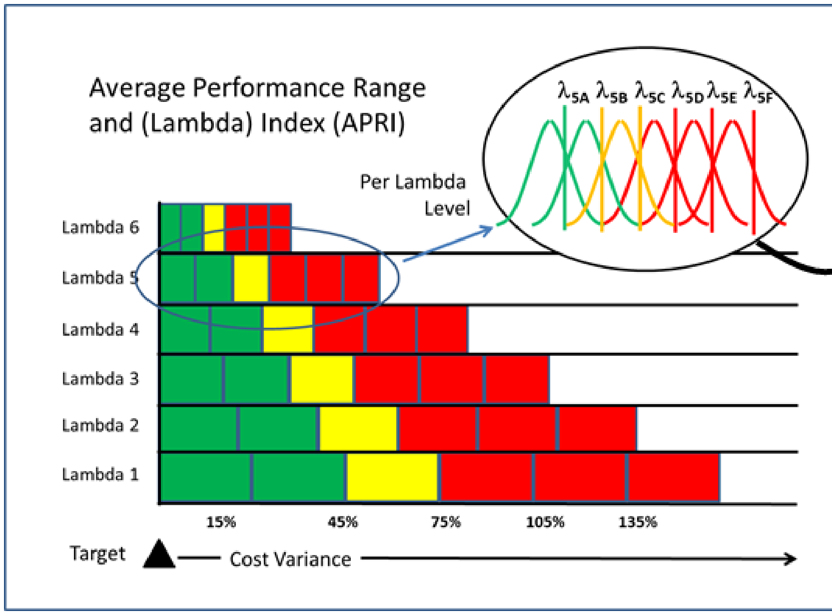
3

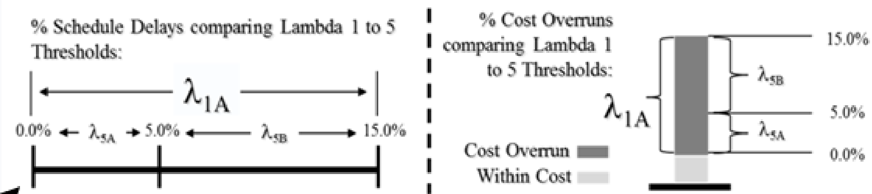
NAVSEA Centers

Resolving Cost Variance Issues During Contract Execution using Metadata

Visual Representation

AVERAGE PERFORMANCE RANGE AND INDEX (APRI)





Cost Control Grades for Cost Overruns and Schedule Delays based on Lambda Thresholds	Lambda 6 Thresholds	Lambda 5 Thresholds	Lambda 4 Thresholds	Lambda 3 Thresholds	Lambda 2 Thresholds	Lambda 1 Thresholds
"A" Level Cost Control	< 2.5%	< 5%	< 7.5%	< 10%	< 12.5%	< 15%
"B" Level Cost Control	< 7.5%	< 15%	< 22.5%	< 30%	< 37.5%	< 45%
"C" Level Cost Control	< 12.5%	< 25%	< 37.5%	< 50%	< 62.5%	< 75%
"D" Level Cost Control	< 17.5%	< 35%	< 52.5%	< 70%	< 87.5%	< 105%
"E" Level Cost Control	< 22.5%	< 45%	< 67.5%	< 90%	< 112.5%	< 135%
"F" Level Cost Control	> 22.5%	> 45%	> 67.5%	> 90%	> 112.5%	> 135%

6-3-5 Method
- Statistical Algorithm
- Methods & Measurements
- Visual Representation

Assessing Bid Offers to Find Cost Variance Issues using Metadata

Resolving Cost Variance Issues Before Contract Award using Metadata

Resolving Cost Variance Issues During Contract Execution using Metadata

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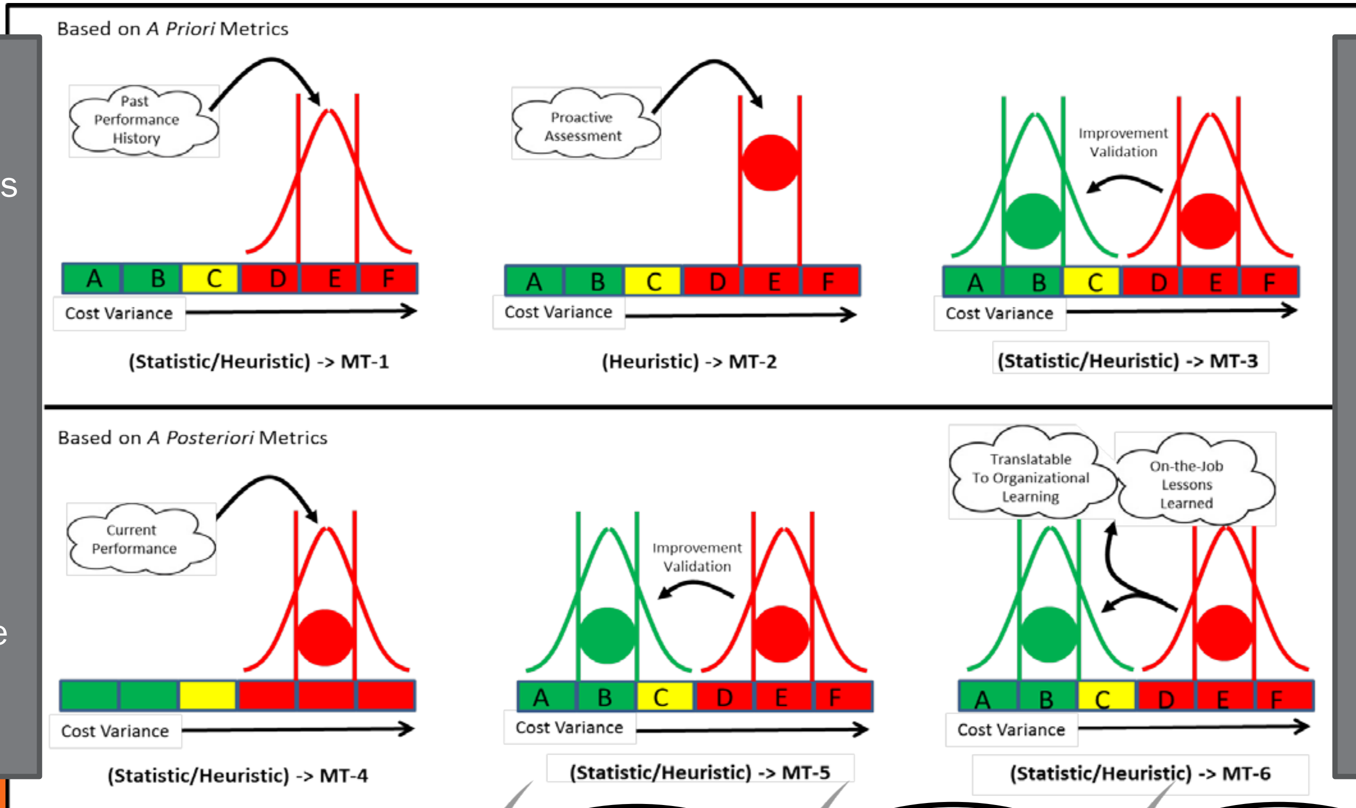
THE 6-3-5 METHOD: 6 MTs SUPPORTING 3 CCOs AND 5 DDSs

MT-1: Statistically-Based Lessons Learned Metadata

MT-2: Proactive Assessment Metadata

MT-3: Proactive Due Diligence Metadata



MT-4: Performance Tracking Metadata

MT-5: Reactive Due Diligence Metadata

MT-6: On-the-Job Lessons Learned Metadata

6-3-5 Method	
	Statistical Algorithm
	Methods & Measurements
	Visual Representation

Assessing Bid Offers to Find Cost Variance Issues using Metadata

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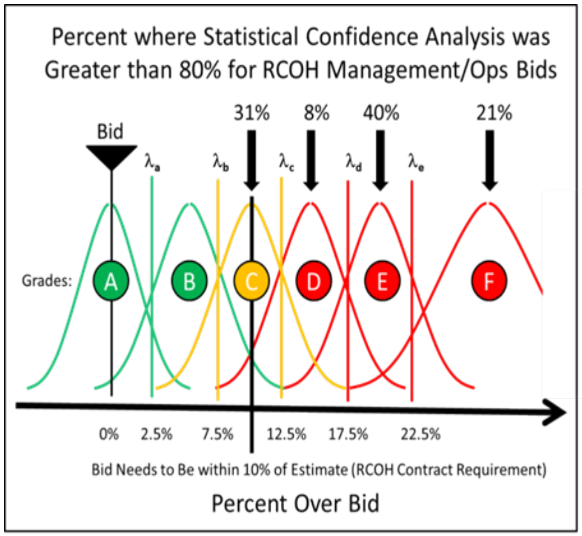
PEO CARRIERS CASE STUDY DEMONSTRATED…

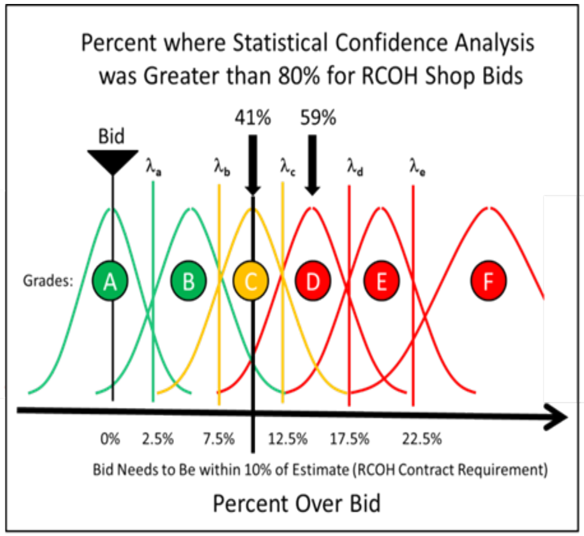
6-3-5 Method
Statistical Algorithm
Methods & Measurements
Visual Representation

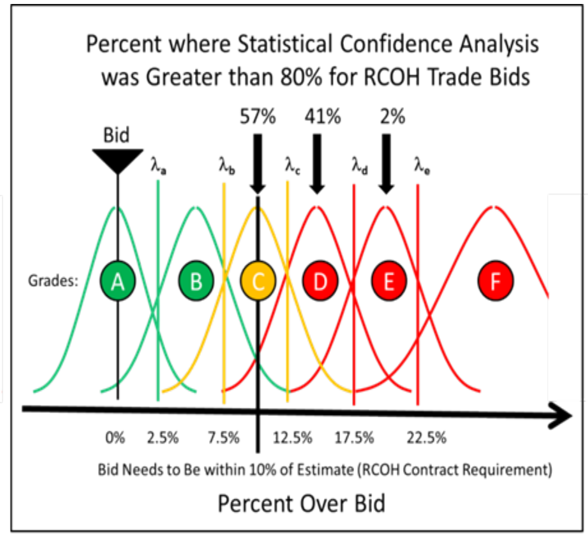
☑ Assessing Bid Offers to Find Cost Variance Issues using Metadata

Resolving Cost Variance Issues Before Contract Award using Metadata

Resolving Cost Variance Issues During Contract Execution using Metadata



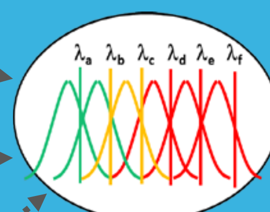




CVN-69 RCOH Past Performance Data

CVN-68 RCOH Past Performance Data

Statistically "Similar" Performance Data



Forecast CVN-70 RCOH Bid Reliability

PEO CARRIERS CASE STUDY DEMONSTRATED…

6-3-5 Method	
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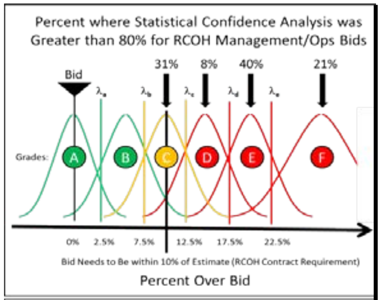
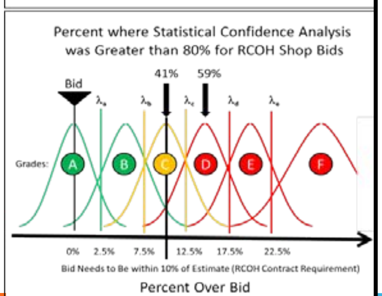
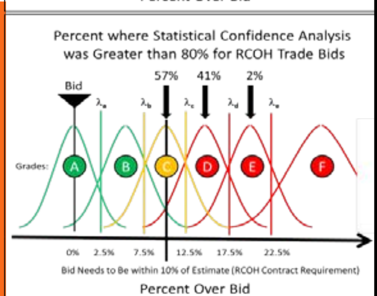
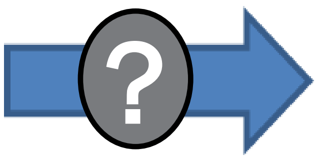




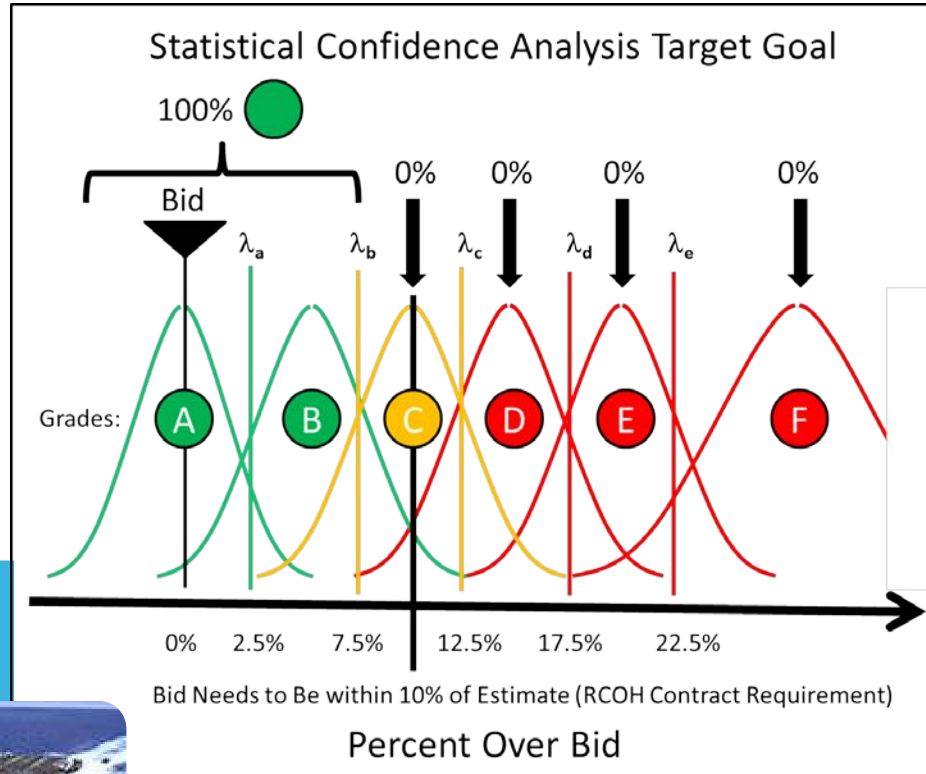


Example…

Problem Solving Collaboration Approach



Promoting Acquisition Team Due Diligence



NATO PROGRAM CASE STUDY DEMONSTRATED...

6-3-5 Method	
	Statistical Algorithm
	Methods & Measurements
	Visual Representation

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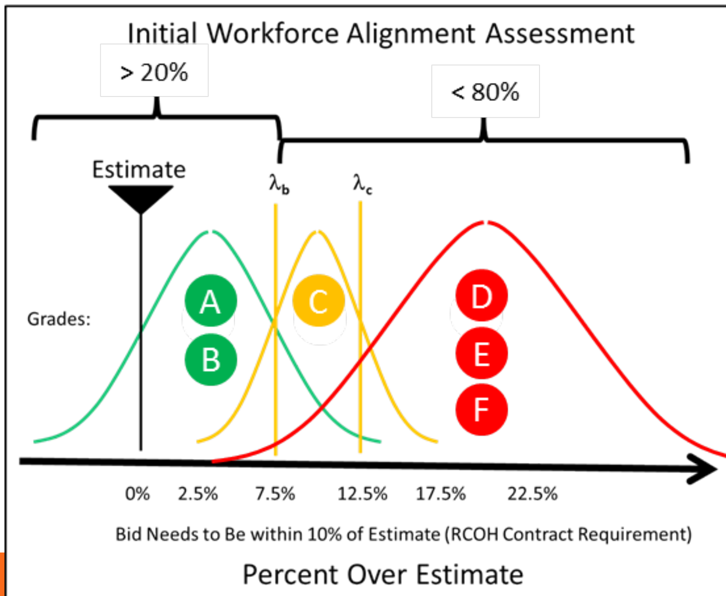
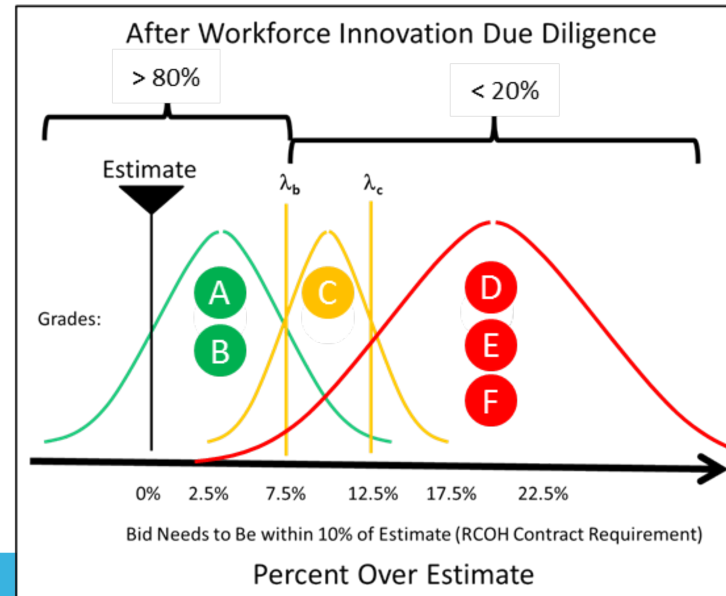


Problem Solving Collaboration Approach

Promoting Workforce-Driven Innovation Due Diligence



Air Traffic Control System (HW & SW)

NAVSEA CENTERS CASE STUDY DEMONSTRATED…

6-3-5 Method	Statistical Algorithm
	Methods & Measurements
	Visual Representation

Assessing Bid Offers to Find Cost Variance Issues using Metadata

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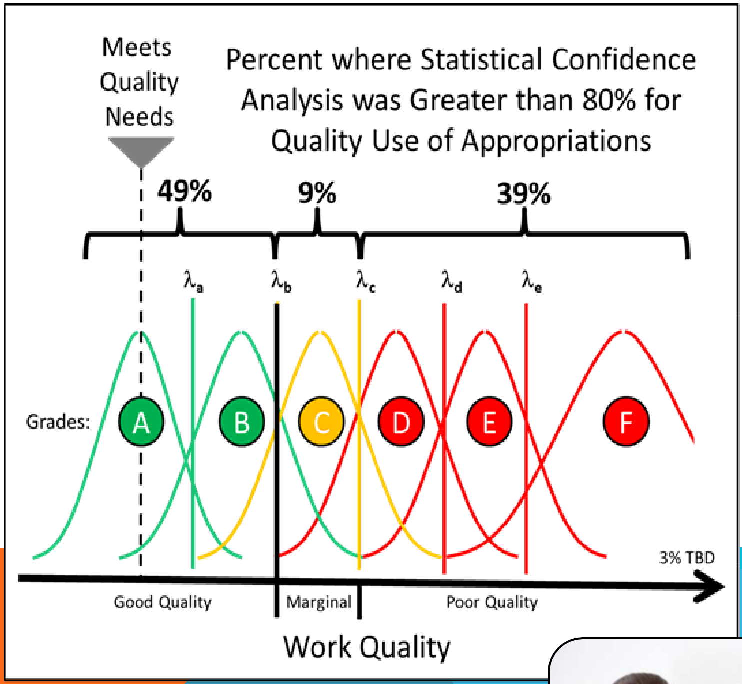


Problem Solving Collaboration Approach

Promoting Workforce-Driven Innovation Due Diligence

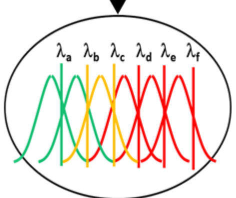
Multiple Branches

Two Centers

THE 6-3-5 METHOD IN SUPPORT OF DON POM SUBMISSION PROCESS

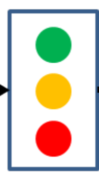
Provides "A Priori" Support of DON POM Submission Process

Statistically Same or Similar Performance Data



6-3-5 Method

Results



Visual Addition to Table

Fixed Wing	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FYDP
F-35B (STOVL JSF)	6	6	6	9	14	20	55
F-35C (CV JSF)	4	4	6	9	14	20	53
F/A-18E/F	26	-	-	-	-	-	-
CA-18G	12	21	-	-	-	-	21
E-2D AHE	5	5	5	6	8	8	32
P-8A (MMA)	13	16	16	16	14	10	72
C-40A	-	-	-	-	-	1	1
KC-130J (USMC)	-	2	1	1	1	2	7
Other Support Aircraft	-	1	-	-	-	-	1

FYDP for Fixed Wing Aircraft

Fixed Wing	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FYDP
F-35B (STOVL JSF)	6 (red)	6 (green)	6 (green)	9 (green)	14 (green)	20 (green)	55 (green)
F-35C (CV JSF)	4 (green)	4 (red)	6 (green)	9 (green)	14 (green)	20 (green)	53 (green)
F/A-18E/F	26 (green)	- (green)	- (green)	- (green)	- (green)	- (green)	- (green)
CA-18G	12 (green)	21 (green)	- (green)	- (green)	- (green)	- (green)	21 (green)
E-2D AHE	5 (green)	5 (green)	5 (green)	6 (red)	8 (green)	8 (green)	32 (green)
P-8A (MMA)	13 (green)	16 (green)	16 (red)	16 (green)	14 (green)	10 (green)	72 (green)
C-40A	- (green)	- (green)	- (green)	- (green)	- (green)	1 (green)	1 (green)
KC-130J (USMC)	- (green)	2 (yellow)	1 (green)	1 (green)	1 (green)	2 (green)	7 (green)
Other Support Aircraft	- (green)	1 (green)	- (green)	- (green)	- (green)	- (green)	1 (green)

Reliability of FYDP and Visibility of Risks

Statistical Confidence of 80% or greater in Estimate

- (green) Within 7.5%
- (yellow) Within 7.5% to 12.5%
- (red) Greater Than 12.5%

Statistical Algorithm

Methods & Measurements

Visual Representation

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