



EMPLOYING RISK MANAGEMENT TO CONTROL MILITARY CONSTRUCTION COSTS

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Systems acquisition inherently contains elements of uncertainty that must be effectively managed to meet project cost, schedule, and performance objectives. While the U.S. Department of Defense has a record of employing systems engineering technical management processes (including risk management) to address these uncertainties for major weapon systems acquisition, the application of risk management to Military Construction (MILCON) projects is a recent development. This research studies the use of a formal risk management program on a MILCON project and assesses whether such use influences the project's total cost growth relative to that of U.S. Army Corps of Engineers' historical data. A case study methodology is employed assessing the National Geospatial-Intelligence Agency (NGA)'s multibillion dollar NGA Campus East program.

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Risk on a Military Construction (MILCON) project has generally been addressed through the use of contingencies/reserves, specified bonding and insurance requirements, and inclusion of appropriate contract clauses at the onset of a project (Khadka & Bolyard, 2010). The design, construction, and commissioning of a facility is, however, a dynamic process engaging numerous parties. Adhering solely to relatively static measures could adversely constrain the project team's ability to achieve overarching cost, schedule, and performance objectives.

While DoD has provided its acquisition professionals ample guidance on the need for implementing risk management throughout a project's life cycle, it does so in the context of major weapon and automated information systems (Bolles, 2003). As was noted by a former Director of Military Program, U.S. Army Corps of Engineer Joe Tyler, this guidance has only recently been adapted in the realm of facility acquisition accomplished through MILCON projects (J. J. Tyler, personal communication, July 13, 2009).

Additionally, a structured approach to risk management from a cost, schedule, and performance perspective has recently been incorporated into the Defense Acquisition University (DAU)'s Level III certification course for the Facilities Engineering career field (DAU, 2010).

A 2008 survey of construction industry professionals revealed that respondents are managing project risks roughly 61 percent of the time, and it may be interpreted to mean that the corner may have been turned regarding use of formal risk management processes (FMI Corporation, 2008). But with billions of dollars committed annually to MILCON projects, one must ask not only if DoD's current level of formal risk management processes is adequate, but also if it is relevant.

The authors of this research used a case study format in assessing the application of risk management processes on the National Geospatial-Intelligence Agency (NGA) Campus East program. In doing so, they sought to define the process that was employed and to assess whether it was effective in controlling the cost growth of the facility component of the NGA program.

Background

NGA is a combat support agency in the Department of Defense (DoD) and a member of the Intelligence Community. NGA's mission is to provide geospatial intelligence in support of U.S. national defense, homeland security, and safety of navigation. Presently headquartered in Bethesda, Maryland, with principal facilities based in the St. Louis, Missouri, and Washington, DC, metro areas, NGA

is in the process of consolidating its National Capital Region facilities to comply with a Base Realignment and Closure (BRAC) 2005 decision.

BRAC 2005 Recommendation 168, which was enacted into law in November 2005, directed the following activity:

Close National Geospatial-Intelligence Agency (NGA) Dalecarlia and Sumner sites, Bethesda, MD; Reston 1, 2, and 3 leased installations in Reston, VA; Newington buildings 8510, 8520, and 8530, Newington, VA; and Building 213, a leased installation at the South East Federal Center, Washington, DC. Relocate all functions to a new facility at Fort Belvoir, VA. Realign the National Reconnaissance Office facility, Westfields, VA, by relocating all NGA functions to a new facility at Fort Belvoir, VA. Consolidate all NGA National Geospatial-Intelligence College functions on Fort Belvoir into the new facility at Fort Belvoir, VA. (DoD, 2005)

NGA responded by establishing an NGA Campus East (NCE) Program Management Office (PMO) early in 2006 and immediately developed a plan to meet this BRAC mandate (NGA, 2010). While these initial efforts were underway, Fort Belvoir updated its facility Master Plan and completed an Environmental Impact Statement to address how NGA- and other BRAC-impacted organizations would be accommodated at Fort Belvoir (U.S. Army Corps of Engineers [USACE], 2007). Both called for locating NGA at Fort Belvoir's Engineer Proving Ground (a site adjacent to I-95 in Springfield, that has since been renamed the Fort Belvoir North Area [FBNA]), and with the signing of the Record of Decision on Aug. 7, 2007, FBNA was officially designated as the future home for NGA.

Program Scope

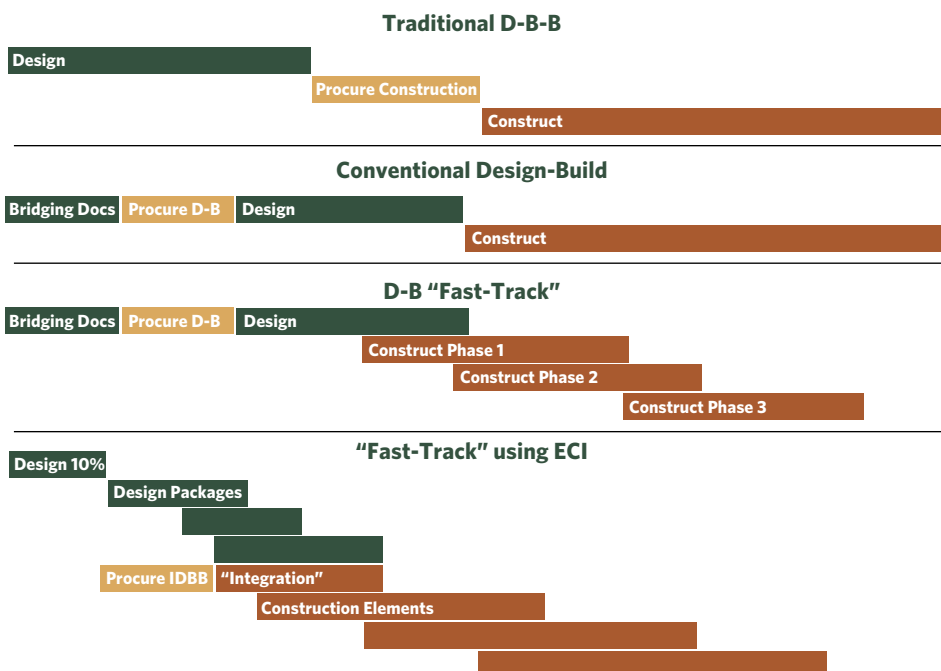
The NCE effort included facility, information technology (IT), security, and deployment as primary executing elements. Focusing on the facility component, its scope called for the design, construction, and commissioning of a 2.4 million gross square foot (gsf) campus able to accommodate 8,500 personnel. As the initial design took shape, these requirements were satisfied with a Main Office Building (MOB), Central Utility Plant (CUP), Technology Center (TC), Garage (structured parking), Visitor Control Center (VCC), and Remote Inspection Facility (RIF) (NGA, 2009a). The MOB (indicated as structure "1" in Figure 1) consists of two 8-story office buildings, each roughly 900 feet long with 1 million gsf of capacity, and connected by an enclosed atrium structure. The CUP (structure "4")

FIGURE 1. NGA CONSOLIDATION

is approximately 89,000 gsf and houses the utility services that are distributed to the campus facilities. The TC (structure “2”) is a 4-story structure roughly 140,000 gsf in size. The Garage (structure “3”) is a 6-level pre-cast concrete structure providing 5,100 parking spaces (in compliance with the National Capital Planning Commission guidelines). The VCC (structure “5”) is an 8,300 gsf facility located on the campus perimeter and allowing access control over visitors. The RIF (not depicted in Figure 1) is a separate 10,000 gsf structure located adjacent to a main access point to FBNA; it allows for security screenings of all inbound deliveries to the NCE.

Facility Acquisition Strategy

The NCE effort is an enormous undertaking, and due to the language of the BRAC directive, not only did the facility need to be designed, constructed, and commissioned by the mandated

FIGURE 2. FACILITY ACQUISITION STRATEGIES

deadline, but the requisite enterprise IT architecture and security management systems had to be designed, installed, tested, and placed into operation; and NGA had to deploy 8,500 personnel and the missions they performed at the NGA legacy sites to the NCE by the September 15, 2011, suspense. Assessing early schedules of the program's activities revealed that the facility effort was on the critical path and key to the program's success. As the program's other efforts were dependent on the facility being in-place, an acquisition strategy had to be determined that would deliver the facility component as rapidly as possible.

When acquiring facilities through new construction, the acquisition strategy (Figure 2) typically follows one of two forms: a Design-Bid-Build (D-B-B), or a Design-Build (D-B). In the case of a D-B-B, a facility designer is contracted, a design is completed, and then a construction contract is awarded to build the facility. A D-B-B strategy employs sequential activities and usually represents the longest amount of time to deliver a usable facility. A D-B strategy calls for a single contract that awards both a design and construction scope. The project time (duration) savings occur not only from a single contract source selection (vice two in a D-B-B), but also potentially from the selected contractor's ability to integrate its design and construction efforts (this second variant is sometimes referred to as a D-B "Fast Track").

At the onset, the NCE PMO settled upon a D-B facility acquisition strategy. As the architect progressed toward a 35 percent level of design that would be used to secure a D-B contractor to complete the project, the NCE PMO recognized that if it were to maintain this course, the facility might be completed in time, but even with incremental acceptances of completed work, minimal time was allotted to complete the remaining scope of the program prior to the BRAC suspense. The NCE PMO and the Baltimore District of USACE agreed upon an alternate strategy—that of Early Contractor Involvement (ECI). Similar to the Construction Manager at Risk (CM @ Risk) strategy gaining usage in the private and commercial sectors, ECI calls for the awarding of separate design and construction contracts, with the construction contract award occurring very early in the design development (at a 10 to 15 percent development of the design). This strategy maximizes the construction contractor’s ability to influence the design itself and the packaging of design elements to facilitate a rapid initiation of construction efforts (Peck, Stuban, Bagshaw, & Calloway, 2010).

As for the construction contract type, given the relative immaturity of the design and a need to control cost, a “Fixed Price Incentive with Successive Targets” format was chosen in accordance with Federal Acquisition Regulation 52.216-17. Doing so allowed for establishment of target and ceiling prices for the various elements of work and incentivizing cost containment (Peck et al., 2010).

Program Governance

The NCE PMO managed the totality of the program effort, but executing prime contractors were controlled by an assortment of contract management teams, many of which were external to NGA. The facility efforts were managed by the USACE Baltimore District; the security management system and construction surveillance technician contracts were managed by the U.S. Navy Space and Naval Warfare Systems Command; and the site security, IT, and deployment contracts were managed by NGA.

In addition to these efforts internal to the program, the program was also dependent on the substantial efforts of a number of elements external to NGA and the NCE PMO: the Virginia Department of Transportation for a number of roadway improvements adjacent to the FBNA; the Fort Belvoir Garrison staff for infrastructure improvements to the FBNA; commercial utility providers for gas and electric service improvements to the FBNA; and several telecommunications providers for wide area network connectivity.

To enhance communication and coordination between these various parties, the NCE PMO established a 3-tiered management

structure termed the “One Team” (NGA, 2009b). At the foundational level, the Project Leadership Teams (PLTs) are focused on efforts underway at their discrete project level (the MOB, CUP, TC, etc.). The PLT membership consists of representatives from all elements engaged in delivering a completed, occupied, and operational project, and includes facilities (design and construction), IT, security, deployment, Ft. Belvoir Garrison, and operations and maintenance staff. Mid-level governance is provided by an Executive Leadership Team (ELT), co-chaired by the PMO’s Deputy Program Director—Site and Baltimore District’s program manager for the NCE effort. ELT membership is comprised of the PMO’s deputy and assistant program managers, and the program/project managers (both government and contractor) of each executing element. Top-level governance is provided by a Program Board (PB), co-chaired by the NCE PMO’s program director and the Baltimore District commander. Like the ELT, membership consists of executives (both government and contractor) of each executing element (Figure 3).

FIGURE 3. NCE GOVERNANCE STRUCTURE



PLTs meet on a weekly basis (or more frequently depending on emergent issues), the ELT meets biweekly, and the PB meets once a month. Each PLT has its own decision space and authority. So long as the PLT’s decisions do not adversely impact another program element, perturb a program-level milestone, or exceed their budget authority, they can directly manage their project’s effort. Activities that may adversely impact other program elements, or are outside the PLT’s decision space, are elevated to the ELT (or PB if necessary) for resolution (NGA, 2009b).

Risk Management

The PMO has from the onset of the program employed standard program management and systems engineering technical management processes to execute the program within established cost, schedule, and performance constraints. Many of the techniques

Starting with the upper left quadrant and moving counter-clockwise, an “If-Then” formatted statement is utilized to identify the root cause of a potential future situation, which, if mitigated, would preclude a potential adverse consequence. The “Decision/Trigger Points” line notes when decisions may need to be made between alternative courses of action or in furtherance of the intended mitigation plan. The “Closure Criteria” define what constitutes successful mitigation of the potential risk. The “Mitigation Plan” section chronologically outlines the discrete steps to be taken in mitigating the potential risk. The “Context” line provides for further background information as to the development of the potential risk. The “Status” line allows for entry of relevant recent information. The “Risk Score with Analysis” allows for entering the assessed “probability” or likelihood of the risk occurring as well as the consequence or adverse impact assessments from a cost, schedule, and performance perspective.

The Risk Scoring is based on a standard 5x5 matrix and probability definitions/percentages (DoD, 2006). The consequence definitions are specific to the NCE program.

Similar quad charts and scoring rubrics were developed for assessing “opportunities” (potential future conditions that, if exploited, could result in positive consequences for the program) and “issues” (existing conditions that were having an adverse impact on the program).

With development of the ROMP and tool sets, and conduct of refresher training, the PLTs were allowed to manage risks, issues, and opportunities at their level. If the PLTs determine that additional resources may be required to successfully mitigate a risk or if mitigation is outside their defined decision space, the risk has to be coordinated via the Risk IPT and elevated within the program.

The Risk IPT meets on a biweekly basis and serves as the forum in which anyone associated with the program could suggest an NCE program-related risk, issue, or opportunity. The IPT considers suggested matters and aids in drafting an associated quad chart. Once drafted and coordinated across the IPT’s membership, the IPT determines what recommendation should be made to the program’s Risk and Opportunity Management Board (ROMB). The ROMB meets monthly and is chaired by the NCE PMO PD. The PD is briefed on the proposed risk and the IPT’s recommendation, and then renders a decision as to whether the risk should be placed in a “watch” status (to allow for validation of the potential conditions that are suspected), “opened” and actively mitigated, elevated to NGA’s enterprise-level risk management board, or returned to the IPT for further coordination. Risks that are opened, elevated, or placed on a watch status are then tracked in a Risk Register (a



FIGURE 5. COST GROWTH

NCE Facility Project	Baseline Contract Value (Base + Options)	Cost Growth Amount	Final Contract Amount	Cost Growth (%)
CUP	\$99,961,243	\$7,503,144	\$107,464,387	7.51
TC	\$77,996,108	(\$5,645,069)	\$72,351,039	(7.24)
Garage	\$76,729,943	(\$4,443,661)	\$72,286,282	(5.79)
VCC	\$5,880,734	\$79,397	\$5,960,131	1.35

spreadsheet chronologically detailing every mitigation step of every risk) and statused monthly at the ELT and PB sessions.

To date the NCE PMO has handled nearly 150 separate risks, issues, and opportunities above the PLT level.

Cost Growth Record

Have the NCE program's active risk management activities made any difference in the cost growth realized on the MILCON component of the program? To assess this possibility, a t-test for independent samples was performed (Salkind, 2009). In this test, a comparison was made between the cost growth realized on several of the NCE program's facility projects that were at or near a substantial completion point and the cost growth realized on a sample of USACE MILCON projects completed prior to FY06 (a timeframe when active risk management as employed on the NCE program was not practiced) (J. J. Tyler, personal communication, July 13, 2009).

MILCON projects completed by USACE in FY04 and FY05 were assessed (earliest complete fiscal year data available from USACE) (USACE, 2010). From this sample set, projects completed outside the continental United States (CONUS) were excluded due to external impacts that could influence the true cost growth (material shipping costs, material and labor availability, currency exchange rate fluctuations, construction in military theaters of operation, etc.). This yielded 15 projects completed in FY04 and 38 projects completed in FY05 (a total sample size of 53), ranging in value from roughly \$1.4 million to nearly \$45 million. Comparing each project's baseline contract and options amount to its final contract amount (determined after all construction was complete and the contract was financially closed-out) revealed the cost growth realized on the projects. Assessing the cost growth on all 53 projects revealed a sample mean cost growth equaling 7.493 percent, with a standard deviation of 9.728.

Four NCE facility projects were included in the comparison sample: the CUP, TC, Garage, and VCC. The financial details for these projects are shown in Figure 5.

Assessing the cost growth of the four projects listed in Figure 5 revealed a sample mean cost growth equaling -1.04 percent with a standard deviation of 6.824.

Translating this into cost totals, had the NCE program experienced the average cost growth of the historical sample, it would have incurred \$22,234,270 in additional costs.

The NCE program unquestionably managed to better control costs relative to that of the historical sample. To assess whether it was statistically significant—that the NCE sample was indeed different from the historical sample and not simply an outlier—a t-test for independent samples was performed. The NCE sample's t_o was calculated as 1.715 (Walpole & Myers, 1978). This t_o value was plotted on a t-distribution of the historical sample. The distribution's $t_{0.05,55}$ value equals 1.673; this is the point at which 95 percent of the distribution with the appropriate 55 degrees of freedom lies to the left. Focusing on this point revealed that t_o in this case lies to the right (it is in the critical zone). This signifies that the mean cost growth realized on the NCE projects is statistically significant relative to that of the USACE sample of FY04 and FY05 (Salkind, 2009). As the NCE cost growth is lower than that of the USACE sample, it is preferred, and whatever characteristic(s) made the NCE sample distinct from the USACE sample would be preferred as well. It is suggested that an active risk management process is at least one of the characteristics that sets the NCE projects apart from the way historical MILCON projects have been managed, and is a process that should be employed on all MILCON projects (if not already underway) where controlling cost growth is an objective.

Conclusions

Risk, issues, and opportunities are ever-present and require proactive management approaches throughout an acquisition to ensure that a program's cost, schedule, and performance objectives are met. In that DoD acquisition takes many forms, including facility acquisition via MILCON projects, leveraging all the management tools and techniques that may be available appears to be the most prudent course of action. An active risk management program, particularly applied throughout the project's delivery phase (the design, construction, and commissioning of the facility), is one such tool.

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REFERENCES

- Bolles, M. (2003, Spring). Understanding risk management in the DoD. *Defense Acquisition Review Journal*, 10(2), 141-154.
- Defense Acquisition University. (2010). DAU iCatalog. Retrieved from <http://icatalog.dau.mil/>
- Department of Defense. (2005). *Base closure and realignment report, Vol. 1, Pt. 2 of 2: Detailed recommendations*. Retrieved from http://www.defense.gov/brac/pdf/Vol_1_Part_2_DOD_BRAC.pdf
- Department of Defense. (2006). *Risk management guide for DoD acquisition* (6th ed.). Washington, DC: Author.
- FMI Corporation. (2008). *FMI/CMAA ninth annual survey of owners: Beyond the bell curve, a report on managing capital project risk*. Retrieved from http://cmaanet.org/files/shared/Ninth_Annual_FMI-CMAA_Owners_Survey.pdf
- Khadka, S., & Bolyard, C. E. (2010, October). *Hands-on application of qualitative risk management to project performance*. Presentation at the 2010 Construction Management Association of America (CMAA) National Conference and Trade Show, San Diego, CA.
- National Geospatial-Intelligence Agency. (2009a). *DD1391 – FY2011 military construction project data*. Bethesda, MD: Author.
- National Geospatial-Intelligence Agency. (2009b). *New Campus East program management plan*. Bethesda, MD: Author.
- National Geospatial-Intelligence Agency (2010). *NGA Campus East – A case study featuring lessons learned and takeaways*. Unpublished draft, NGA Campus East Program Management Office, Bethesda, MD.
- Peck, J., Stuban, S., Bagshaw, M., & Calloway, R. (2010, October). *Eating an elephant: Techniques for executing a mega-program*. Presentation at the 2010 Construction Management Association of America (CMAA) National Conference and Trade Show, San Diego, CA.
- Salkind, N. J. (2009). *Exploring research* (7th ed.). Upper Saddle River, NJ: Pearson.
- U.S. Army Corps of Engineers. (2007). *Final environmental impact statement for implementation of 2005 Base Realignment and Closure (BRAC) recommendations and related Army actions at Fort Belvoir, Virginia*. Retrieved from <http://www.belvoirbrac-eis.net/feis.htm>
- U.S. Army Corps of Engineers. (2010). Extract of P2 MILCON Database covering FY04 through FY10. Bethesda, MD: Author.
- Walpole, R. E., & Myers, R. H. (1978). *Probability and statistics for engineers and scientists* (2nd ed.). New York: Macmillan Publishing.

