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Naval Facilities Engineering Systems Command (NAVFAC) currently employs design build and design-bid-build project delivery methods for military construction projects in support of U.S. military administrative, operational, and training priorities. Few studies have been conducted regarding the cost, schedule, and quality impacts of integrating other types of delivery systems into NAVFAC business processes. This report finds that adding the early contractor involvement (ECI) delivery method would reduce construction timelines and provide superior quality in comparison to both design-build and design-bid-build. The results of this paper are intended to encourage NAVFAC design and construction officials to expand the use of ECI throughout the organization by incorporating the U.S. Army Corps of Engineers' version of ECI with modifications specific to how NAVFAC provides services to U.S. Navy systems commands (SYSCOMs), service branch installation commands, and other Department of Defense agencies.

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Alternative Project Delivery Methods For Naval Facilities Engineering Systems Command Military Construction Projects

SCHOLARLY PAPER

Paul E. Simpson

May 2021

A. James Clark School of Engineering
Civil and Environmental Engineering
University of Maryland
Glenn Martin Hall
College Park, MD 20742

Abstract

Naval Facilities Engineering Systems Command (NAVFAC) currently employs design-build and design-bid-build project delivery methods for military construction projects in support of U.S. military administrative, operational, and training priorities. Few studies have been conducted regarding the cost, schedule, and quality impacts of integrating other types of delivery systems into NAVFAC business processes. This report finds that adding the early contractor involvement (ECI) delivery method would reduce construction timelines and provide superior quality in comparison to both design-build and design-bid-build. The results of this paper are intended to encourage NAVFAC design and construction officials to expand the use of ECI throughout the organization by incorporating the U.S. Army Corps of Engineers' version of ECI with modifications specific to how NAVFAC provides services to U.S. Navy systems commands (SYSCOMs), service branch installation commands, and other Department of Defense agencies.

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Executive Summary

The U.S. Federal Government has contracted with private industry since inception. In that time, the government-contractor relationships have evolved significantly. While we can look to the past for guidance, the U.S. federal procurement system is well beyond the days of a promise and a handshake to acquire supplies and services from private industry. An examination into the field of construction illustrates this fittingly. The manner in which large-scale construction projects are solicited, designed, and built can be complex and dynamic. The intricacies between the government and general contractors heavily influences whether a project is successful or not. To understand this further, the methods used by U.S. federal agencies, specifically the U.S. Navy, to procure facilities will be reviewed and evaluated. Focus will be placed primarily on project delivery methods utilized by the U.S. Navy's authorized construction execution agent, Naval Facilities Engineering Systems Command (NAVFAC). Based on the results of literature review and data analysis, recommendations for consideration are provided. The key conclusion from this report indicates that NAVFAC does not adequately leverage a construction manager at risk (CMAR) type of delivery method in military construction (MILCON) projects and must consider integrating the early contractor involvement (ECI) approach utilized on large-scale construction projects by the U.S. Army Corps of Engineers (USACE).

Motivation for the Study

The motivation of this study is to compare private sector, federal agency, and NAVFAC construction project delivery methods to provide areas of improvement and new practices to adopt in NAVFAC processes moving forward.

As the U.S. Navy's technical and acquisitions authority for shore infrastructure management, Naval Facilities Engineering Systems Command is charged with serving as authority for construction and facility engineering programs for Navy and Marine Corps military construction projects (Naval Facilities Engineering Systems Command, 2020). To do this, NAVFAC is committed to three primary lines of effort that support U.S. national defense priorities:

Figure 1 - Service Branch Installations

1. Enabling warfighter lethality
2. Maximize Naval shore readiness
3. Strengthen our Systems Command (SYSCOM) Team

The first priority is an expectation the Department of Defense has placed on all service branches and defense agencies (Department of Defense, 2018). Shore readiness is specific to NAVFAC, and has been the primary mission of the organization dating back to the early days of the Bureau of Yards and Docks in the 18th century. NAVFAC's primary focus with regards to shore readiness is Navy Installations Command (CNIC) and Marine Corps Installations Command (MCICOM). Other supported organizations include Air Force installation commanders, Army Installation Management Command (IMCOM), federal defense agencies, and federal non-defense agencies.

The third line of effort references the other U.S. Navy SYSCOMs. Those include:

- *Naval Sea Systems Command (NAVSEA)* – Responsible for Navy above and below surface ships and piers.
- *Naval Air Systems Command (NAVAIR)* – Responsible for Navy aircraft and airfields.
- *Navy Information Warfare Systems Command (NIWC)* – Responsible for Navy communications and intelligence gathering.
- *Navy Supply Systems Command (NAVSUP)* – Responsible for Navy supply and services (non-construction) procurements.
- *Marine Corps Systems Command (MCSC)* – Responsible for Marine Corps supply and services (non-construction) procurements.
- *Office of Naval Research (ONR)* – Responsible for science and technology programs within the U.S. Navy and Marine Corps.

Figure 2 – U.S. Navy SYSCOMs

In order to promote these three lines of effort from a MILCON procurement perspective, NAVFAC relies heavily on two forms of project delivery methods, design-build (DB) and design-bid-build (DBB). A closer look at private construction industry practices and other U.S. Federal agencies reveals that relying solely on these two project delivery methods needlessly increases MILCON project costs and schedule growth (Rich & Bartha, 2012). Considering other project delivery method types – not just DB and DBB – would offer more flexibility for NAVFAC project managers and, consequently, optimize project costs and schedule. Other federal agencies and Department of Defense components have investigated other delivery systems and found cost, schedule, and quality benefits. Leveraging those efforts for consideration as viable options will enhance NAVFAC's ability and capacity to provide products and services to supported organizations and agencies over the status quo. This report will show this by comparing private and public sector data for currently available project delivery methods.

Objectives of the Study

Why something different? NAVFAC Roundtables

Since assuming command in 2018, Rear Admiral John Korka has made it a point of emphasis to foster mutually beneficial and cooperative relationships between NAVFAC and the construction contractor industry in the United States and abroad (Naval Facilities Engineering Command, 2019). To that end, he holds annual NAVFAC roundtables with leading construction contractors and architectural engineering firms. The goal is to get feedback regarding areas of success, areas of marginal performance, and areas of improvement on large-scale MILCON projects. This is of particular interest to NAVFAC stakeholders as delays, cost overruns, and poor project quality can degrade military readiness and, accordingly, U.S. national defense capabilities (Naval Facilities Engineering Systems Command, 2020).

During the 2019 NAVFAC Industry Roundtables with leading general contractors and architectural engineering design firms, RADM Korka asked for ways that NAVFAC could better collaborate with those groups to reduce inefficiencies and deliver projects quickly to the end-user. Both contractors and designers responded distinctly that early contractor participation in project development was a crucial component missing from NAVFAC contracts. Many of the delays, cost overruns, and poor quality conditions could be avoided if more collaboration between the principle stakeholders (constructor, designer, and ownership team) would occur during the selection, planning, and design phases of project implementation (Naval Facilities Engineering Command, 2019). While DB and DBB do have a degree of contractor-government exchange during the negotiations phase of contract pre-award, it is not much and often the contractor is not fully aware of all the project risk, which can lead to unnecessary cost increases and breach of contract claims.

As an example of successful contractor and government projects that incorporated companies into the project development process, industry leaders cited the early contractor involvement project delivery method as an optimal option given the constraints that federal contracting officers must follow when procuring construction services due to the requirements imposed by the Federal Acquisition Regulation (FAR). Currently, only the U.S. Army Corps of Engineers regularly uses ECI as a MILCON project delivery method (United States Army Corps of Engineers, 2009), which has incorporated measures to make ECI compatible with FAR constraints on competitive bidding and incentive-based contracting.

Background Information

NAVFAC Project Types

With an annual MILCON budget of over $6.8 billion, NAVFAC has a broad array of projects in numerous civic and military-related categories. Naturally, the primary focus of U.S. Navy facilities will always be piers, ports, and shipyards. The support that NAVFAC delivers to CNIC and NAVSEA in support of maritime operations is vast and wide. In key fleet concentration areas (i.e. San Diego, Norfolk, and Hawaii), pier-side infrastructure is critical to ensuring that ships are serviced while in port. That means readily available shore power, well maintained docks and piers, housing for bachelor enlisted sailors, as well as fuel and ordnance storage facilities.

Second to NAVSEA, with regards to size and scope of NAVFAC projects, are NAVAIR and CNIC airfield installations. With an ever growing list of technological developments in various military aircraft, NAVFAC must continually be prepared to upgrade runways, fuel depots, and maintenance hangers to supply an array of expanding aviation support capabilities. Recently, the F-35 Joint Strike Fighter program required close coordination between NAVFAC, CNIC, and NAVAIR to ensure that these multibillion dollar aircraft have all the hangar space and facility systems upgrades needed to host these state-of-the-art aviation platforms (Hand, 2020).

The third major agency receiving NAVFAC support is not so much a SYSCOM, but rather another branch of the military. Since Marine Corps facilities are managed by the Department of the Navy, NAVFAC is the execution agent for all construction contracts for projects on Marine Corps installations, and works closely with MCICOM in planning and project development. Within the past 10-15 years, there have been significant initiatives to improve

Marine Corps facilities, particularly at Camp Pendleton, CA and Camp Lejeune, NC. More recently, Camp Blaz was stood up in Guam as part of the Defense Policy Review Initiative to relocate a portion of III Marine Expeditionary Force (III MEF) troops from Okinawa to Guam (Ortiz, 2020).

The last group that NAVFAC provides construction and facility support services are a conglomerate of other DoD branches and agencies. Those include – but are not limited to – the Air Force, U.S. Army, Defense Health Agency, Naval Research Laboratories, Special Operations Command, and DoD Education Activity. Each organization has its own unique requirements and agency mission objectives to fulfill. NAVFAC tries to tailor project services to meet the specific needs of the client. Two examples that come to mind are the Naval Special Warfare Coastal Campus in Coronado, CA ($1.2 billion in new facilities) and Naval Support Activity Bethesda Recapitalization Project at Walter Reed National Military Medical Center ($550 million in renovations and new construction) (McCurdy, 2019).

State of NAVFAC Military Construction

Recently, NAVFAC reexamined its core mission, functions, and tasks to reaffirm alignment with Secretary of the Navy and DoD guidance regarding near and future threats. A major element of the current U.S. National Defense Strategy relates to the doctrine that the U.S. has entered a great power competition with China and Russia for dominance across a series of strategic domains, of which includes freedom of waterway navigation and global maritime operations (Department of Defense, 2018). In order to better adapt and respond to provocations, acts of aggression, and the potential for escalated conflict, NAVFAC has leaned forward on key areas of shore infrastructure support that will further enable U.S. Naval Force capabilities and speed of response. Part and parcel of that effort is establishing streamlined procurement actions

and with reliable contracting partners throughout areas of U.S. strategic interests. In the field of design and construction of military facilities, this means maximizing project delivery methods to the fullest extent. DB and DBB have been the go-to approaches in NAVFAC MILCON projects for the past 20-years, and continue to supply the Navy with sound frameworks to conduct business as usual (Gott & Griffin, 2012). But as can be seen throughout any industry sector across the business world, innovations cannot be ignored. Over the past two decades, the speed of private industry project planning and execution has accelerated substantially, and NAVFAC has struggled to keep up. In order to meet current military readiness expectations, fulfill U.S. national defense long-term strategic goals, and utilize the latest tools and methods available, NAVFAC must give consideration to expanding project delivery methods to include options. Currently, other U.S. Federal construction procurement agencies – for instance the U.S. Army Corps of Engineers (USACE) and the General Services Administration (GSA) – utilize more than DB and DBB for project delivery (Tabb, 2020). Remaining idle may potentially disadvantage NAVFAC in future projects, which may consequently impact U.S. Navy operational readiness.

DB and DBB in NAVFAC

Up until the mid-1960s in the United States, there was only one widely accepted method of construction delivery in the business, design-bid-build. This was customary in federal contracting dating back to the mid-1800s in which selecting the lowest bidder was required to "protect the taxpayer" from corruption and illegal procurement practices (Khan, 2015). An owner pursuing a construction project would obtain financing, purchase a facility design from an architectural engineering firm, and then have a construction contractor build the facility based on the AE design. DBB gets its name from the fact that there is no contractual relationship between

the AE firm and general contractor. The owner contracts with both groups independently, and all communication regarding the design must go through the owner first. In a DBB project, the owner accepts a significant portion of the risk since they are providing the designs for construction. If there are any errors or omissions in the drawings and specs, then the owner is responsible for providing the general contractor with a remedy. Despite risks associated with mistakes in the project design, DBB can be an attractive option for owners who want to retain total control over the project's design.

As transformations in business practices, technological developments, and changes in federal contracting laws began to influence the construction industry during the late 1960s, another project delivery method started to gain prominence (Khan, 2015). Design-build emerged as a delivery system in which the owner contracts with one prime contractor, for both design and construction services. Eager to capitalize on innovative industry trends, the federal government investigated ways to incorporate this new method into government contracting. Design-build was first adopted for use by the DoD in 1986 through the Military Construction Authorization Act (Rosner, 2008). Projects solicited before then were design-bid-build. Congress's authorization allowed USACE and NAVFAC to award DB construction contracts on a trial basis, testing out whether DB was compatible with contemporaneous Federal Acquisition Regulation (FAR) requirements. After validating its successful use in federal procurements, Congress incorporated DB as a permanent option for construction project delivery via the Clinger-Cohen Act of 1996 (Heisse, Gadbois, & Kovars, 2011).

NAVFAC began widespread use of DB as a project delivery method in 2001 with the creation of design-build master request for proposal (RFP) documents. Implementation of DB throughout NAVFAC came well later than most other federal agencies (Reid, 2010). The reason

for this centered around NAVFAC's hesitance to embrace changes in proven practices and approaches. Up to that point DBB was ingrained in the institutional mindset and acquisition constructs had been in place that exclusively supported DBB-type projects. Additionally, NAVFAC underwent an organizational realignment from 2001 to 2004 and the process of adopting new project delivery practices was an involved transition that required precious attention and effort away from stakeholders while they were acclimating to new organizational roles within NAVFAC. As was the case prior to 2001, NAVFAC is again in a period of stasis with regards to project delivery types. In order to optimize the benefits and opportunities of new procurement techniques, NAVFAC should evaluate recent innovative approaches and broaden the means by which project planning and development are accomplished in MILCON contracts.

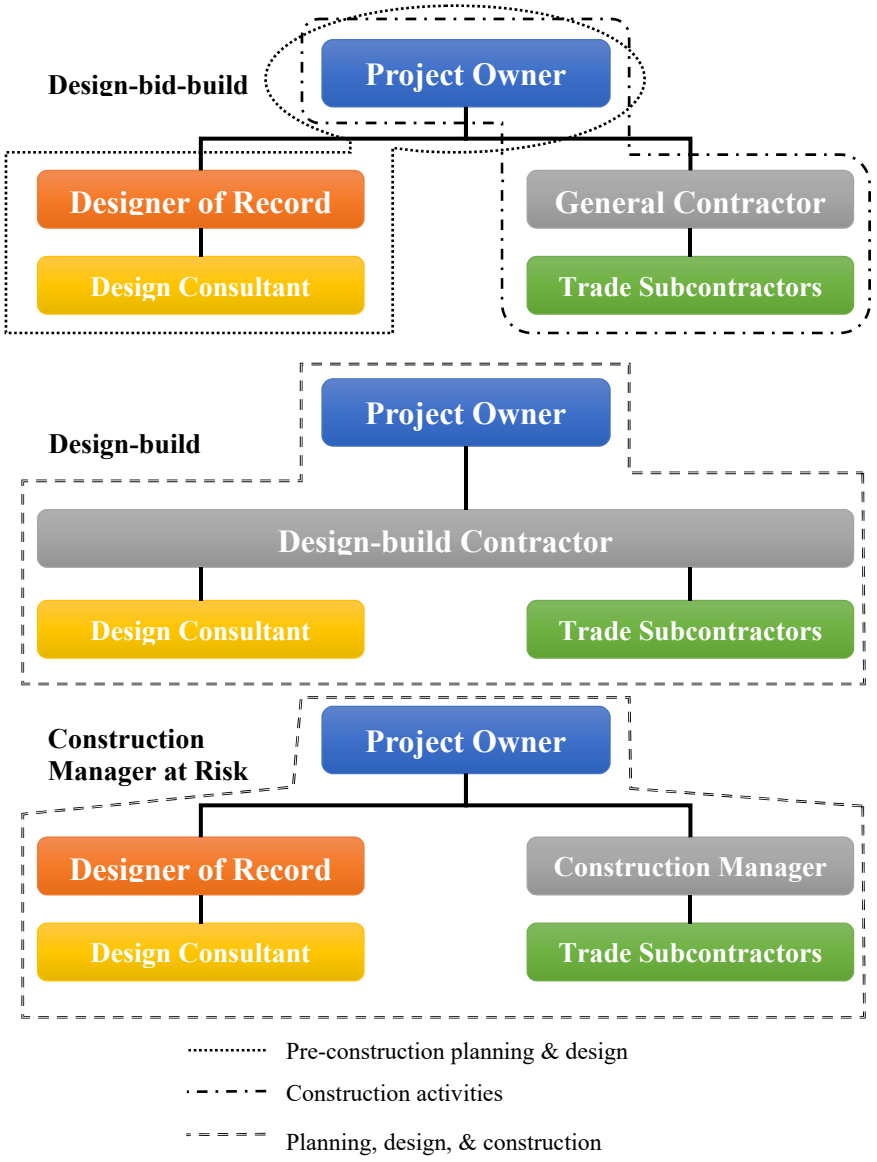


Figure 3 – Typical Project Delivery Relationships

As shown in figure 3, the DB relationship involves a project owner working with only one contractor. For NAVFAC contract awards, this is done using a two-step acquisition process. Bidders will typically be required to submit conceptual designs and their performance pre-qualifications in the initial step submission, followed by a competitive cost bid in the second step submission. This ensures that bidders exhibit all necessary capabilities to perform each aspects of design and construction to satisfactorily complete the project, or at least have the ability to subcontractor in areas of deficiency. While this has protected NAVFAC from subpar construction contractors in the past, it has not always ensured the end-product perfectly meets the user requirements. There are often differences in what the tenant requires in a facility and what the performance specifications in the contract entail. For example, unless specifically stated somewhere in the contract, construction contractors will build an office building in much the same manner as they would for a private developer. Not much consideration would be given to enhanced security measures unique to military planning, training, and execution activities. More than once, NAVFAC has turned over a facility to a supported command and then received feedback that certain security measures were missing. That would fall into the 'poor communication during planning' category which is more prevalent in design-build projects. The owner, supported command, and NAVFAC have less control over the project design in a DB relationship, and as a result there are many instances on any given project in which misunderstandings or differences in contract interpretation hurt the Navy. As a general rule in federal contracting, DB contracts require a higher level of front-end planning than DBB or CMAR-type delivery methods.

Multiple Prime

Another type of project delivery method is something called Multiple Prime, which involves the owner foregoing services via a general contractor and contracting directly with construction trades through individual contracts and managing those contracts directly. This strategy can offer huge savings in fees and expenses, but puts all of the risk on the owner. Employing the Multiple Prime project strategy requires the owner to amass a substantial number of staff and administrative support dedicated to daily oversight of each specialty during construction execution and through until closeout. If insufficient manpower and managerial assets are available, the project can run into difficulty in resolving schedule delays and cost overruns. NAVFAC is not currently resourced to properly exercise Multiple Prime in a manner consistent with other organizations that have adopted a Multiple Prime as a productive project delivery system. There are few instances in which the Federal Government has successfully completed construction projects using Multiple Prime. At this point, there are many indicators signaling that this is not a viable solution for NAVFAC MILCON projects.

Integrated Project Delivery (IPD)

Integrate Project Delivery is another system available for situations in which a government entity would like to shed risk to project stakeholders through a multi-party contract arrangement. A notable example of a U.S. IPD project is the Autodesk Inc. AEC Solutions Division Headquarters in Boston, MA. Although somewhat small in project size, $12.2 million total, the enhanced integrated contracting and sustainability goals demonstrated the degree of success that IPD can provide owners and builders committed to a mutual goal (Cohen, 2010). One huge benefit to IPD is the opportunity of shared cost savings and superior team unity, which

results in high level of project coordination and rapid resolution of challenges through collaborative problem solving. Considering the level of resource required to maintain sophisticated partnerships and project monitoring, IPD is more ideal for long-term projects in which stakeholders will be involved well past the project closeout and into the lifecycle operations and maintenance phase of the venture. Currently for Federal Government construction projects, IPDs are considered by exception only. The amount of time, funds, and personnel required by an agency to successfully execute an IPD arrangement is often in excess of what many organizations can support. NAVFAC has not embraced the use of IPD on projects and would require a good deal of ramp-up time to prepare conditions such that future projects would have the opportunity to flourish.

Public-Private Partnerships PPP

Somewhat similar to IPD, Public-Private Partnerships are contractual relationships in which a government body enters into an agreement with private corporations to provide a construction project of value to the general public in exchange for a long-term revenue stream and/or tax benefit for the private company. A noteworthy example of a U.S. PPP project is the Alameda Corridor Project that created a 21-mile express railway system between the port of Long Beach near Los Angeles and main transportation hubs for Union Pacific and BNSF in Southern California (Balducci & Grote, 1997). One of the primary reasons for the government to enter into a PPP relationship typically involves insufficient funding for the government to execute the project themselves. If a major highway requires a secondary relief artery to reduce daily traffic congestion, often budgeting and appropriating funds in a timely manner are a challenge for city officials. The community consequences may be too severe and turning to a joint venture group to build the roadway may make the most sense, depending on what type of

toll or economic incentive is presented to the execution agent. The U.S. Navy has entered into PPPs for base family housing, but not for MILCON projects (Commander Navy Installations Command, 2021). In instances where a developer constructs, manages, and maintains on-base homes, it is often referred to a Public-Private Ventures. Through complex contractual terms and conditions, a joint venture developer will provide all the services to construct and oversee a select number of houses in exchange for service member monthly basic allowances for housing. Typically, in these situations, the developer sees this as a lower risk proposition considering that monthly payment checks come directly from the Department of the Navy, not individual renters.

Construction Manager at Risk (CMAR)

Incorporating elements of both DB and DBB, a hybrid project delivery method called construction manager at risk (CMAR) gained consideration throughout the construction industry between the mid-1970s and late-1990s (Strang, 2002). CMAR is similar to DBB in that there are two contracts, one for design and one for construction services. The biggest difference, and which aligns it more closely with DB contracts, is that a construction management firm is integrated into the project during the early stages of planning and design. The advantage to having the construction managers involved from the beginning allows the design team to identify value opportunities as the design develops. In traditional DBB, the general contractor has no voice regarding project plans and specifications. This can often lead to delays and cost overruns when design errors and omissions are encountered. Also, general contractors typically have substantially more familiarity with material and subcontractor costs. Leveraging the general contractor's cost and pricing data during project development can inform owner decisions and reduce risk. At a certain point during the design, when most of the project unknowns have been

clarified, a guaranteed maximum price (GMP) is agreed upon by the construction manager and owner and the CM transitions to the role of general contractor.

Owners that prefer CMAR point to two areas of strength: speed of delivery and control of design (McGraw Hill Construction, 2014). In DBB, the process is multi-staged, which can extend the overall project duration. CMAR allows for fast-tracking in much the same manner as DB. Second, control of the design can be an issue for some ownership groups, and may be a reason to choose CMAR over DB. For instance, in specific government procurements the design is very unique and must follow rigid guidelines. NAVFAC quite often must be heavily involved in the construction oversight of NAVAIR and NAVSEA prototype system facilities that have non-standard requirements. In those occasions it would be inappropriate to allow general contractors and their designers to select materials and building configurations based on performance specifications. A more prescriptive approach, in which system-tailored materials and installation procedures are specified, would be needed.

The manner in which CMAR is currently implemented in the private sector is not compatible with U.S. federal acquisition regulations (United States Army Corps of Engineers, 2009). Since a final GMP is not decided upon until after the contractor is selected, there are several FAR provisions that bar this from being implemented in federal contracts equivalently to private industry. Nonetheless, the utility of CMAR is valued by government officials and federal agencies have identified workarounds in order to tap into the beneficial aspects of CMAR. GSA has incorporated a method known as construction manager as contractor (CMc) and USACE uses a delivery method known as early contractor involvement (ECI) (Rich & Bartha, 2012). The two are different, but still try to emulate CMAR concepts as best possible. At a state level, numerous governments use CMAR in its conventionally imagined form, with small devious

based on individual state laws. Use of CMAR in large-scale transportation and infrastructure projects is common (Gransberg & D, 2020).

Analysis: Comparison of Public/Private Sector Delivery Methods

DB vs CMAR vs DBB in Public/Private Sector Projects

Over the years, contractors and owners have identified numerous features of DB and CMAR projects that make them better options than DBB. By the numbers, speed of delivery is the leading incentive for owners to prefer DB and CMAR projects (McGraw Hill Construction, 2014). With DB and CMAR, when the general scope of the project is known and can be delineated, the owner and general contractor can agree to fast-track the project, which essentially means starting construction while the AE firm is still working on the drawings and specifications. This can shave off significant schedule time from a more traditional DBB approach. From Design-build Institute of America (DBIA) research comparing project delivery methods in private sector construction, DB projects complete 36% faster than DBB during construction execution and 102% overall (Molenaar & Franz, 2018). When comparing CMAR to DBB, CMAR also completes earlier – at a rate of 20% faster during construction and 25% overall. Consistently, independent research has shown that DB and CMAR are significantly faster project delivery methods than DBB (Molenaar & Franz, 2018).

Table 1 - Schedule Performance Comparison

Schedule Performance Comparison – Public/Private Sector Construction Projects				
Performance Measure	DB vs CMAR	CMAR vs DBB	DB vs DBB	R^2
Schedule Growth	3.9% less	2.2% more	1.7% less	21
Construction Speed	13% faster	20% faster	36% faster	88
Delivery Speed	61% faster	25% faster	102% faster	89
R^2 is the percent variance in the performance measurements as predicted through regression modeling. The greater the R^2, more certainty is expected. Adapted from: (Molenaar & Franz, 2018)				

While schedule is extremely important for project success, the primary delivery system for cost-conscience owners to use is DB. It performs much better than DBB and CMAR in terms of initial price and cost control. By allowing general contractors to meet nationally recognized building standards rather than prescriptive design requirements, contractors are able to reign in

cost by using the most efficient assembly methods available. While this is generally a benefit, there are many owners – particularly government owners – that have unique requirements that cannot be addressed with a one-size-fits-all approach. In those instances, CMAR and DB are necessary project vehicles. From past project research, DB projects are 0.3% less in per square foot price than DBB and 3.8% less in project cost growth. When comparing CMAR to DBB, CMAR is 1.6% more in per square foot price and 1.4% less in project cost growth (Molenaar & Franz, 2018).

Table 2 - Cost Performance Comparison

Cost Performance Comparison – Public/Private Sector Construction Projects				
Performance Measure	DB vs CMAR	CMAR vs DBB	DB vs DBB	R^2
Unit Cost	1.9% less	1.6% more	0.3% less	99
Cost Growth	2.4% less	1.4% less	3.8% less	21
R^2 is the percent variance in the performance measurements as predicted through regression modeling. The greater the R^2, more certainty is expected. Adapted from: (Molenaar & Franz, 2018)				

Research data from other sources generally confirms the numbers from DBIA with the exception of CMAR schedule growth. The below table shows a 2017 case study analysis separate from the DBIA research, which compares cost and schedule growth for DB, CMAR, and DBB (Sullivan, El Asmar, Chalhoub, & Obeid, 2017).

Table 3 - Cost & Schedule Aggregated Growth

Cost & Schedule Aggregated Growth – Public/Private Sector Construction Projects			
Descriptive Statistics	DB	CMAR	DBB
Weighted Average of Cost Growth	2.8%	5.8%	5.1%
Weighted Average of Schedule Growth	10.7%	10.2%	18.4%
Adapted from: (Sullivan, El Asmar, Chalhoub, & Obeid, 2017)			

In this study, it was shown that CMAR performed better than DB and DBB in reducing schedule growth, but still lags in cost growth. On balance, DB performs best if accounting strictly for cost and schedule. Many owners see benefit in the design control, project involvement, and risk management that CMAR offers, even if it comes at increased cost growth (McGraw Hill Construction, 2014). Since NAVFAC already employs DB and DBB, particular interest is put towards CMAR and how it performs currently on federal projects.

Application of CMAR in Federal Projects

GSA and Construction Manager as Constructor (CMc)

In December 2019, GSA finalized a provision to their General Services Acquisition Regulation (GSAR) that allows for use of construction manager as constructor (CMc) as a form of project delivery services. General contractors for years had been lobbying GSA to allow for CMAR-type contracts, arguing that they provide added value for the U.S. federal government and a more balanced level of risk for builders. Seeing this as an area to exploit opportunity, GSA piloted a handful of projects using CMAR-based contracts, with notable contract adjustments such as added options and capped fee prices. They generally found success using this approach and embarked upon a whole scale review of CMAR-type delivery systmes. In early 2018, GSA performed an extensive economic analysis that forecasted an annual savings of $270,000 and 71 calendar days on each GSA administered construction project using a CMAR-type government-contract relationship (Elliott, 2018). In order to differentiate the GSA version of CMAR from what the private construction field understood CMAR to be, GSA labelled their adaptation 'construction manager as constructor,' or CMc. Following an in-depth review by Congress, GSA was approved to begin using CMc as a standard project delivery method using 48 CFR Parts 501, 536, and 552 and GSAM 552.236-79 (Office of Acquisition Policy, General Services Administration, 2018).

As a side note, the terms CMc and ECI are synonymous with CMAR-type contracts, but for federal application. Both GSA and USACE have adopted unique provisions that allow for general contractor input and influence early in the design process. CMc and ECI are similar, but not the same. USACE contracting officials were much more concerned than GSA with incorporating a guaranteed max price during the design phase.

Considering that NAVFAC and GSA must abide by many of the same regulations for construction contracting, CMc lends itself well as an option for NAVFAC to consider. GSA has structured the newly adopted contract clauses such that construction management firms may be contracted for preconstruction design services via a firm-fixed-price contract, which can then transition into a guaranteed maximum price construction option once the design reaches an agreed upon stage of completion. This approach allows the federal government to gain benefit from early construction manager involvement, while maintaining a level of risk protection by making the commitment to the involved CM optional. If the government and CM firm cannot satisfactorily come to terms on an agreed upon GMP, GSA may walk away and find another builder, setting up a DBB relationship for the construction execution phase of the project. Since many of NAVFAC's contracts have a moderate to high level of technical complexity (i.e. dredging, pier placement, airfields, and dry docks), having the general contractor involved during design, yet still maintaining the option to walk away if terms cannot be agreed upon, seems to offer NAVFAC incredible value. A number of large dry dock projects are being planned for Navy fleet concentration areas, and adding the fast tracking capability and design management of CMc would greatly enable project teams at those locations (Meeks, 2020).

USACE an Early Contractor Involvement (ECI)

The final delivery method to explore, and one which is of most relevance to NAVFAC as a future option, is something called early contractor involvement (ECI). Similar to CMc, ECI is a variation of CMAR, but is more closely associated with USACE procurement practices.

With the advent of CMAR in the mid-1990s, USACE viewed the delivery system as an intriguing model for MILCON projects. Often, they had been debating internally about how to implement DB contracts that allowed for more end-user involvement during design.

Additionally, USACE had observed the success that state and local governments had with CMAR in transportation projects and wanted to find a similar project approach for their dam and waterway projects that would fall in line with FAR provisions.

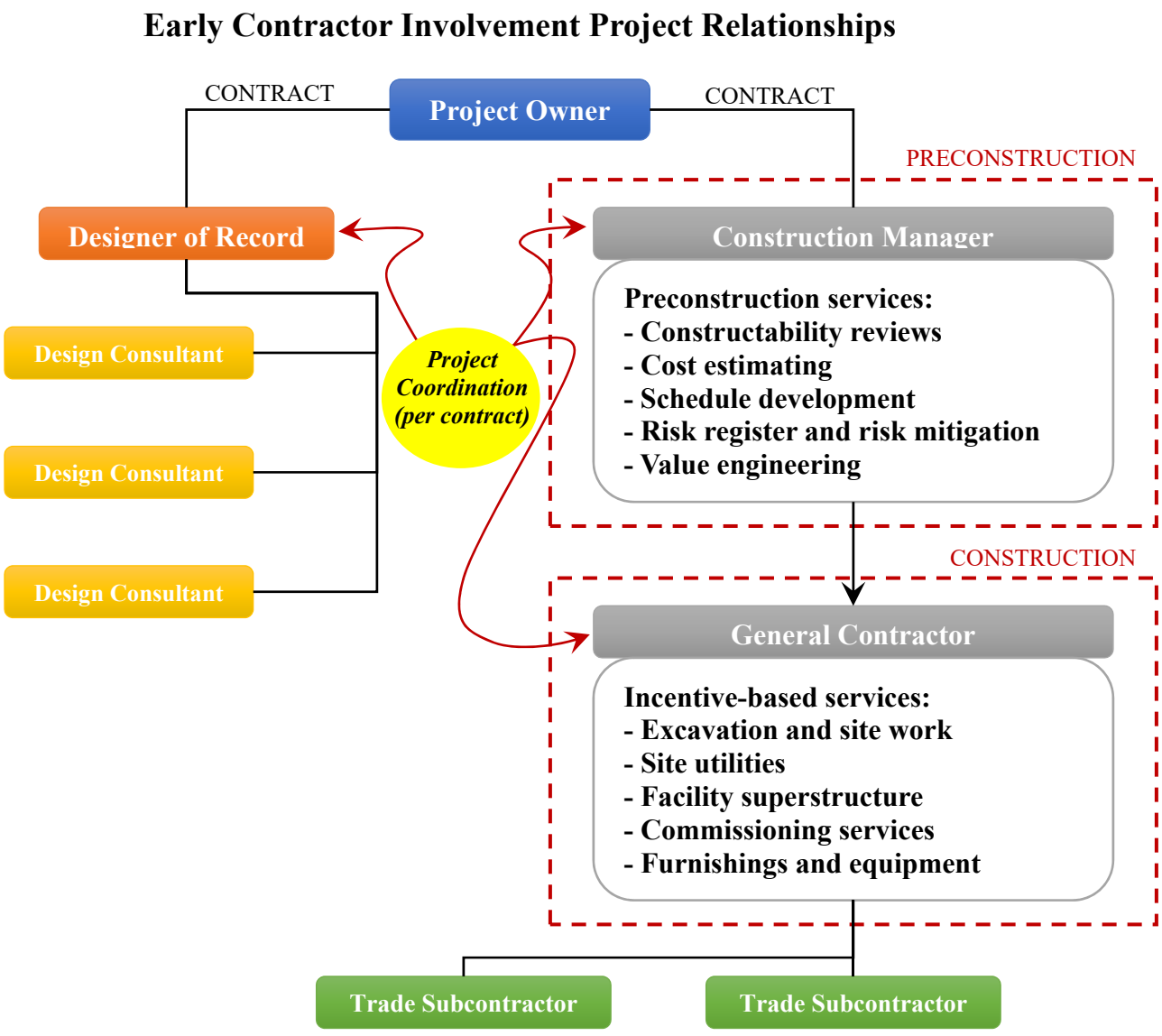


Figure 4 - ECI Relationships

The first opportunity that USACE explored implementing CMAR through pilot projects came in 2004 during design and award of the Lewis and Clark Center for Command and General Staff College in Fort Leavenworth, KS. At the time, the Kansas City District of USACE tried to

directly apply CMAR concepts in awarding several construction contracts throughout their area of responsibility. While their intentions were well grounded, the Army Corps contracting legal community found several stark conflicts between how the Kansas City branch contracts were written and how the FAR requires limitations on incentive-based construction agreements. There were also some concerns with how funding was applied for pre-construction services. As an alternative to directly applying CMAR, the Army Corps acquisition community devised integrated design-bid-build (IDBB). This method essentially took select benefits from the CMAR concept, and adopted them into a DBB contract compatible with FAR provisions. In particular, USACE emphasized including the ability to fast-track and construction contractor constructability reviews during the design phase. At about the same time, USACE was confronted with a large number of base realignment and closure (BRAC) projects as a result of Congressional action in 2005. To accelerate project timelines, USACE implemented IDBB for a select group of projects, anticipating a wide array of benfits by taking this approach (Rich & Bartha, 2012). While there certainly were demonstrable advantages, USACE identified that IDBB was really a subset of a larger model for large-scale project delivery called early contractor involvement, or ECI.

Contracting officials at USACE headquarters recognized that ECI was an umbrella concept from which IDBB operated under, each taking pieces of ECI but not the system as a whole. ECI boils down the role of each stakeholder to their simplest form and contours the contract to ensure that the contractor is, indeed, involved at the earliest point in the project as possible. At its core, the USACE ECI contract is a design-bid-build agreement with a series of options based on the progress of project planning, development, design, and procurement. There is a clear contractual separation between general contractor and AE firm to ensure that the owner

is central to all design decisions and potential changes (Gransberg D. , 2016). Additionally, for federal contracts using the fixed price incentive successive (FPIS) target clause, an earned value management (EVM) requirement is introduced. This is normal on federal government supply and services contracts, but not typical for construction contracts, which can be a deterrent for some general contracting firms. Although, it should be said, the EVM requirement – or a variation of EVM – is typical for tracking costs on a CMAR contract in commercial construction; so companies already familiar with CMAR should be capable of submitting invoices to federal agencies in a similar manner as they would with private owners (Rich & Bartha, 2012).

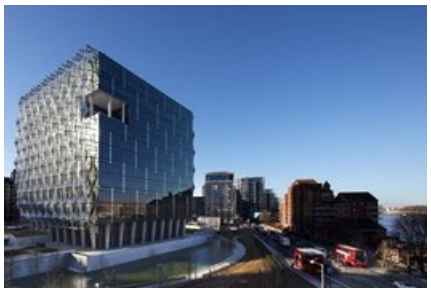
By 2008, USACE headquarters had provided clear guidance to their field offices on how to employ ECI in their project contracts (United States Army Corps of Engineers, 2009). Notable examples of ECI projects are provided in tables 4-6.

Table 4 - Seabrook Floodgate Complex

Source: https://www.wsj.com/articles/how-new-orleans-fortified-itself-against-water-11562981176

Exec. Agent:	U.S. Army Corps of Engineers, Department of Defense
Project:	Seabrook Floodgate Complex
Location:	New Orleans, LA
Contactor:	Alberici
Description:	Constructed a 600 foot-long floodgate to act as a surge barrier against 100-year floods from Lake Pontchartrain into the inner harbor navigation canal. Installed a 95 foot-wide sector gate with diversion wings and 50 foot-wide vertical lift gates as secondary containment protection.
Project Costs:	$165 million (preconstruction plus construction services)

Table 5 - NEC London



Source: https://www.inquirer.com/philly/columnists/in-ga_saffron/trump-london-us-embassy-philadelphia-architect-kierantimberlake-20180223.html

Exec. Agent:	Overseas Building Operations, Department of State
Project:	New Embassy Compound London
Location:	London, England
Contactor:	B.L. Harbert International, LLC
Description:	Constructed a 12-story, 518,050 square foot embassy for U.S. Department of State personnel in London. The building received LEED Gold certification and shortly after construction was completed in 2018.
Project Costs:	$1 billion (preconstruction plus construction services)

Table 6 - NGA New Campus East

Source: https://www.bnd.com/news/local/article69291237.html

Exec. Agent:	U.S. Army Corps of Engineers, Department of Defense
Project:	National Geospatial-Intelligence Agency, New Campus East
Location:	Fort Belvoir, VA
Contactor:	Clark/Balfour Beatty Joint Venture
Description:	Constructed a 2,200,000 square foot government office building complex for 8,500 DoD personnel. Installed a campus power plant, parking garage, and main gate visitor control center. The building received LEED Gold certification and shortly after construction completed was in 2011.
Project Costs:	$1.46 billion (preconstruction plus construction services)

By refining how to manage ECI contracts, USACE has not only seen delivery speed benefits, but also real savings during contract negotiations. Below is a chart from a brief given during the August 2013 Society of American Military Engineers (SAME) monthly meeting in Jacksonville, Florida. On five of their top-performing contracts, ECI saved the USACE $547 million from what was initially planned as project target prices.

Table 7 - USACE ECI Cost Savings

USACE ECI Cost Savings on Large-Scale Infrastructure Projects				
Contract	***Initial Target Price***	***Initial Ceiling Price***	***Final Negotiated Price***	***Difference***
LPV 111.01 Archer, Western, Alberici (TIS)	$294.8M	$411.6M	$342.2M	$69.4M
LPV 145 Chalmette Levee Constructors	$357.2M	$488M	$237.1M	$250.9M
LPV 146 St. Bernard Levee Partners	$280.4M	$452M	$272.2M	$179.8M
LPV 148.02 Cajun Construction	$300M	$380M	$349.9M	$30.1M
IHNC-01 Seabrook Alberici Constructors	$154M	$181.4M	$164.5M	$16.9M
Sub-Totals:	$1,386.4M	$1,913M	$1,365.9M	$547.1M
			Savings to the Government:	**28.5%**
Adapted from: *Early Contractor Involvement: HPO's Key to Success*, Luis A. Ruiz, P.E., Chief, Geotechnical Branch Jacksonville District, 28 August 2013 SAME Post Meeting				

In order to begin looking at how NAVFAC could adopt ECI as a project delivery system, there is a key element that both NAVFAC and USACE confront with regards to MILCON funding. In order to receive appropriated funds from Congress to construct a MILCON project, a DD1391 (MILCON project data form) must be submitted and reviewed by the House armed services committee (HASC) and Senate armed services committee (SASC) (Herrera, 2019). This critical step cannot be ignored since the budget that appropriates MILCON funding for a given fiscal year (called the National Defense Authorization Act, or NDAA), will typically only include projects that have received congressional support from both the HASC and SASC. Once funds are appropriated and then transferred to each military component, the MILCON execution agent for a project – be that USACE or NAVFAC – may begin to develop the solicitation RFP package for release and contractor bidding (United States Army Corps of Engineers, 2009). This process can be accelerated if the construction agency has enough planning and development (P&D) funds set aside for preconstruction design and advisory services. For the most part, MILCON P&D funds are appropriated and allocated separately and apart from any MILCON projects listed in a given year's NDAA. Services will typically plan out how they want to spend

their P&D funds based on the timing of when a MILCON is expected to be awarded for construction. If design of a project takes a year before a general contractor could possibly break ground on construction, then agency planners will ensure that P&D funds are lined up well in advance and at an appropriate time so as not to delay when the end-user would need beneficial occupancy of the facility. In DBB projects, setting aside P&D funds is not an issue. The money is made available for the specific and select purpose of awarding AE design services contracts. When the federal government uses DB to construct facilities, the availability of P&D funds changes. Since DB involves awarding a single contract in which design and construction are provided by a distinct general contractor or joint venture, then only direct MILCON funds (intended for a specific project via a unique DD1391) may be obligated for planning and development for a given project (Herrera, 2019). The below chart illustrates this point further:

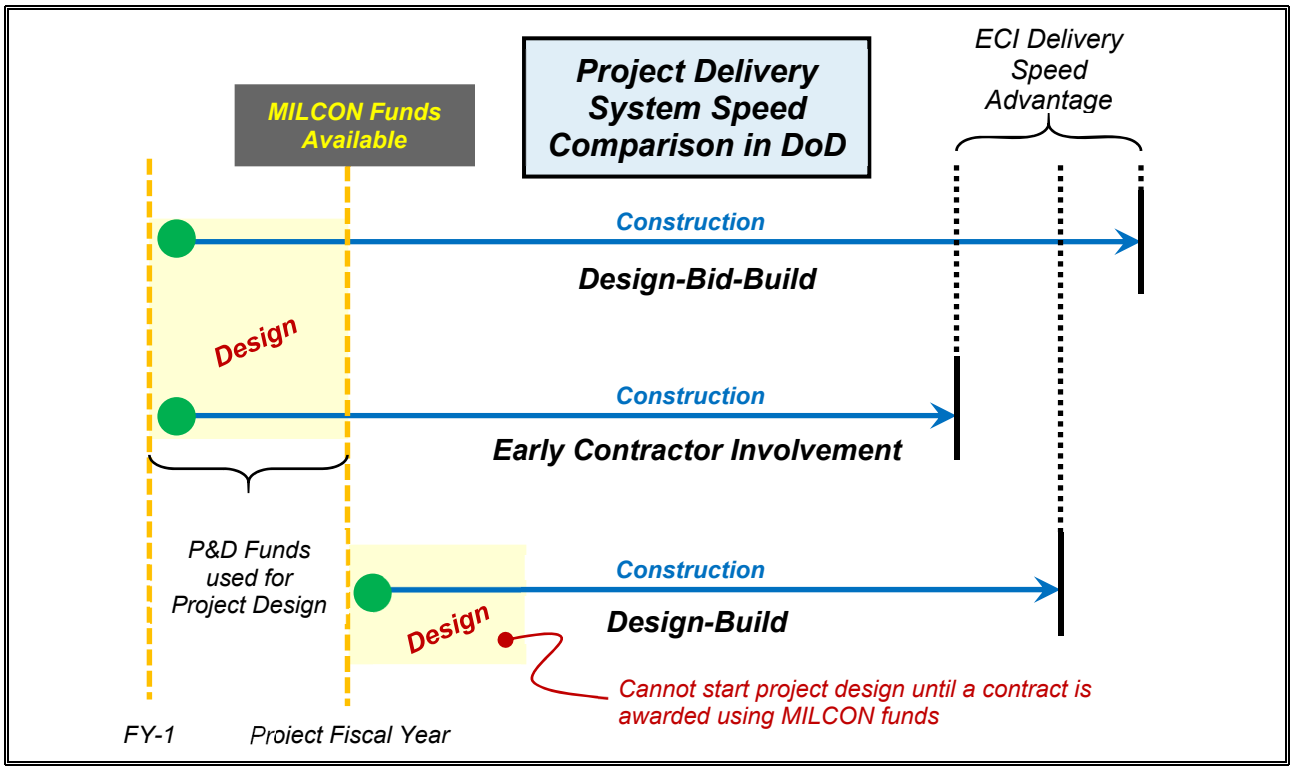


Figure 5 - Project Delivery Speed Comparison

As is shown above, there is actually a difference in DB and ECI in terms of speed of delivery based on the availability of funds for planning and design. Since NAVFAC receives its funding in an identical manner as USACE – unlike GSA – then it becomes apparent that ECI is a more appropriate form of delivery system for MILCON projects requiring accelerated project schedules.

Analysis: NAVFAC and ECI

In 2010, based on USACE reports of successful ECI application in MILCONs, NAVFAC selected two projects to use as test pilots for evaluating the viability of ECI as an option to DB and DBB construction contracts. At the time, NAVFAC had been using DB as one of its primary delivery methods for about nine years; adding a third method was feasible, but would require buy-in from NAVFAC leadership. The two projects selected were:

Table 8 - P-714 Fitness Facility

Source: https://www.hbaonline.com/project/p-714-physical-fitness-center-mcas-new-river/

Project:	P-714, Physical Fitness Facility, Marine Corps Air Station New River
Location:	Jacksonville, NC
Contactor:	Whiting Turner
Description:	Constructed a 45,000 square foot replacement of a deteriorating gymnasium on MCAS New River. The building received LEED Gold certification and shortly after construction was completed in 2013.
Project Costs:	$115,000 (preconstruction services) + $15.7 million (construction services)

Table 9 - P-750 Rotary Hangar

Source: http://www.becksteel.com/portfolio/p750-helicopter-maintenance-hanger/

Project:	P-750, Rotary Hangar, Naval Air Station North Island
Location:	Coronado, CA
Contactor:	Hensel Phelps
Description:	Constructed an 112,000 square foot helicopter maintenance facility at NAS North Island across from San Diego, CA. The facility also achieved a LEED Gold certification after finishing in 2013.
Project Costs:	$190,000 (preconstruction services) + $56.5 million (construction services)

Despite the apparent successful construction of these MILCON projects, the NAVFAC Director of Capital Improvements at the time, Mr. Joe Gott, and Director of Acquisitions, Mr. Bob Griffin, concluded that the same results from ECI projects could be attained from DBB and DB project delivery methods. They ended NAVFAC's interest in the matter and directed subordinate commands to stop using ECI for the time being. The regional and local field offices

that managed and oversaw construction of each project lodged dissenting opinions, but were overruled in the end (Gott & Griffin, 2012). While in the short term, this may have allowed NAVFAC to take a wait and see approach, it ultimately did not return to ECI as a delivery method until 2020 (Tabb, 2020).

In 2017, there was turnover in NAVFAC leadership and Mr. David Curfman took over for Mr. Gott. Interested in revisiting the possibilities of using ECI, the Atlantic region of NAVFAC proposed using it on a FY20 project – using lessons learned from both NAVFAC and USACE about how best to execute an ECI project. Mr. Curfman agreed and P-1120 Mariner Skills Training Center was awarded to RQ Construction as a fixed-price-incentives (successive target) contract (NAVFAC Mid-Atlantic, 2020). Currently, the project is 70% complete without any major delays or cost overruns. Details are provided in table 10.

Table 10 - P-1120 Mariner Skills Training Center

Source: https://www.facebook.com/navfacmidatlantic/videos/2737288213257114/

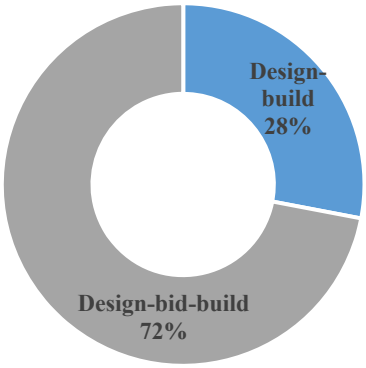
Project:	P-1120 Mariner Skills Training Center
Location:	Norfolk, VA
Contactor:	RQ Construction
Description:	Currently constructing a two-story training facility, with office and administrative spaces. Installing a high-bay area with large bridge trainers to simulate conditions from the bridge of a ship. The facility is also aiming for LEED Gold certification.
Costs	Description of Costs
$375,000	Preconstruction services
$8,634,814	Site clearing, earthwork, and subgrade excavation services
$61,305,304	Building foundation, utilities, superstructure, parking, and landscaping
$70,315,118	Project Total

Based on upcoming solicitation projections, NAVFAC is using DB on 40% of MILCON projects and DBB on the remaining 60%. The ratio of DB projects is in line with commercial industry practices, but the DBB ratio is much higher than the private sector (44% DB, 19% DBB, and 35% CMAR). Below shows this breakdown along with DB vs DBB comparisons for new

construction projects associated with the Defense Policy Review Initiative (DPRI) relocation of 5,000 Marine from Okinawa to Guam (Naval Facilities Engineering Systems Command, 2020).

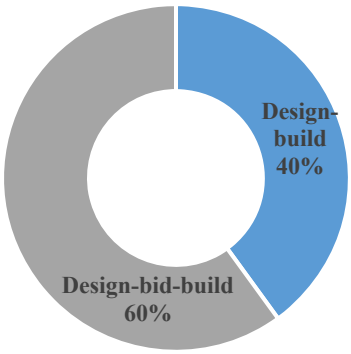
FY21 NAVFAC DB & DBB Utilization for MILCON Projects

Forecasted Project Delivery Types for 53 FY21 MILCON Projects at ***OICC MC Marianas***



Adapted from: (NAVFAC Pacific, 2020)

Forecasted Project Delivery Types for 108 FY21 MILCON Projects ***across NAVFAC***

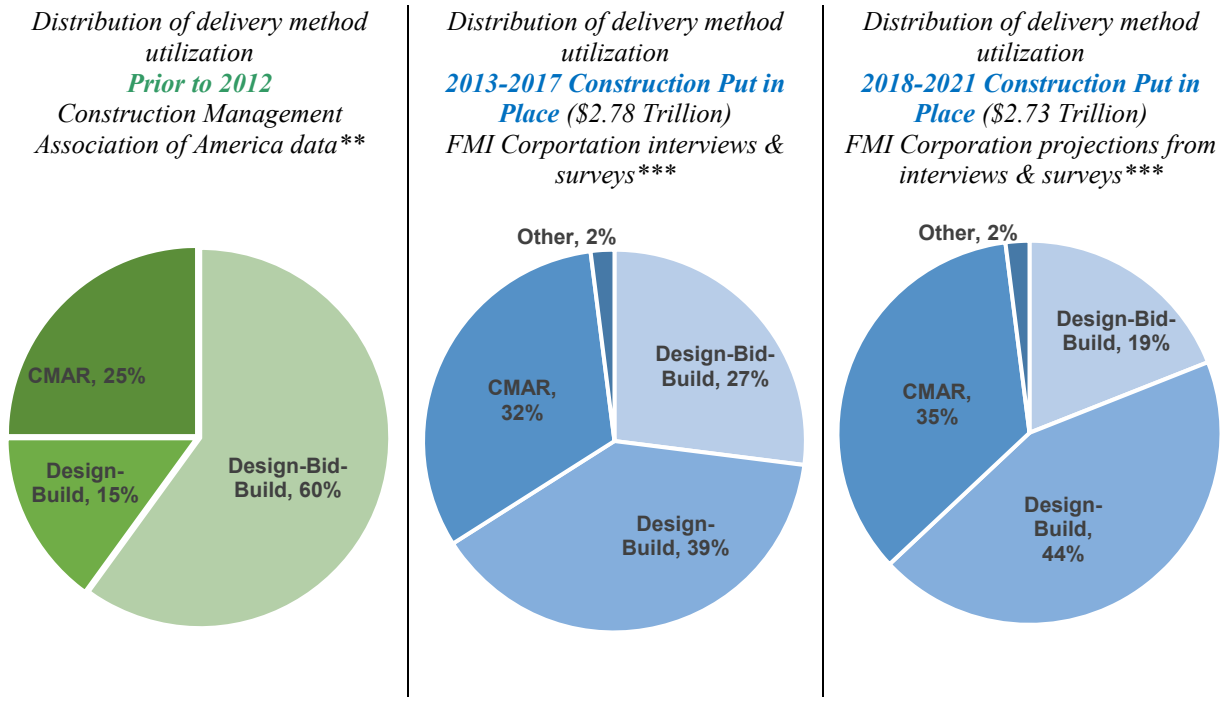


Adapted from: (Naval Facilities Engineering Systems Command, 2020)

Figure 6 - FY21 NAVFAC DB & DBB Utilization for MILCON Projects

This data comparison reveals why leading construction general contractors and design professionals are telling NAVFAC – in roundtable forums – that their project delivery methods are out of step with the overall trends within the construction industry. NAVFAC's heavy reliance on DBB is generating unnecessary cost burden on each NAVFAC project because contractors must adjust their business practices to conform to DBB delivery methods, rather than NAVFAC aligning with widespread construction delivery processes. NAVFAC also disadvantages itself by not utilizing more CMAR-type systems and appearing burdensome to apply for typical contractors, particularly when market conditions are favorable to pursuing private sector project opportunities. The below charts demonstrate that the construction industry has taken a hard turn away from DBB, instead embracing DB and CMAR as the two primary project delivery methods for construction across all sectors.

Project Delivery Utilizations in Private Industry



** *from (Rocky Mountain Region of Design-Build Institute of America, 2018)*
*** *from* (FMI Corporation, 2018)

Figure 7 - Project Delivery Utilization in Private Industry

Getting the lowest price from the best firms is not possible when the best firms refuse to bid on your projects. DBB is not an integrated project delivery method, and the majority of construction firms see the business value of utilizing integrated development teams. Costs for CMAR and DB are generally lower, and schedules timelines are typically smaller. Considering that other DoD and federal agencies are already working in the CMAR arena with CMc and ECI, NAVFAC should absolutely consider getting onboard with expanding use of at least one type of CMAR-based delivery system. Construction industry forecasts estimate that the growing use of CMAR and DB in private sector projects may eventually drive out DBB-type contracts from commercial use within the near future (Loy, 2015). Considering that more than half of their projects are DBB, it is time for NAVFAC to change.

Results: NAVFAC is Losing Execution Time

Based on the data presented, we can conclude that NAVFAC is losing time in project schedules by not using a CMAR-based project delivery method. As was shown in figure 5, there is a lag in the beginning of planning for MILCON DB projects. Until MILCON funds arrive, the design cannot begin. When NAVSEA has a hard date to meet for the opening of a new dry dock and the design is delayed because the project team must wait until the next fiscal year to access funds, the delays can seem inexcusable and deleterious to mission readiness. For this reason, time-critical projects – which are more often the normal than the exception in military construction – must either be DBB or a CMAR-variant (i.e. ECI or CMc). The speed benefits that DB touts as making it the superior delivery system go away when a project team must sit on their hands waiting for MILCON funds to arrive. To illustrate this further, since hard data is not available regarding to what extent DB project designs are delayed due to waiting on the next fiscal year to begin, we can speculate and evaluate a typical DB project. For instance, if it takes 4-5 years to plan, design, fund, and construct critical airfield upgrades, then a 1 to 12 month delay can have significant ripple effects to operational and tactical end-users. Needless to say, any improvements in this area will be greatly welcomed by Navy SYSCOMs and service-level installation management organizations supported by NAVFAC.

Conclusion and Recommendation

By inductively assessing the pros and cons of the three delivery methods (DB, DBB, ECI), it is apparent that ECI adds significant value as the fastest system for construction in DoD, with improved cost performance over DBB and superior quality to DB. To adequately support other Navy SYSCOM, Navy and Marine Corps installation commands, other DoD service branches, and Defense Agencies, NAVFAC must adapt and adjust to the current state of industry delivery business practices in order to provide the fastest, most agile, and most cost-efficient MILCON projects possible. If the status quo is maintained, NAVFAC runs the risk of continued cost increases – both in terms of initial bid price and in-construction cost growth – as well as delays to mission essential functions and national defense priorities. At this point, the research data and trends within both the private and public sectors of the construction industry prescribe that NAVFAC needs to adopt a CMAR-type delivery system. Based on the progress that USACE has made in the last 12 years in developing ECI as a delivery system, it is recommended that NAVFAC partner with USACE to develop and implement the ECI program further. If not that approach, then NAVFAC should directly adopt the advancements already made by USACE and adapt ECI to NAVFAC business practices and policies – modifying the delivery method in areas as needed.

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