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The applicability of the construction manager technique to Navy contract construction.

Klimmek, Charles Andrew

University of Colorado

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by

Charles Andrew Klimmek

A.B., Dartmouth College, 1969

B.E., Dartmouth College, 1970

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CHAPTER 1

INTRODUCTION

There exists a great variety of management techniques which will adequately direct the transformation of a concept into a building. No one method befits all projects or all owners. An owner's function and quality requirements vary from one project to the next, as do his assets of time and money. Yet in the end an owner seeks to obtain the most building for the least money in the shortest time. An owner must, therefore, be flexible and able to adapt to various management techniques as the situation dictates.

As project size and complexity increase, many owners discover they need management assistance in delivering their projects. One management technique which has established a good record of reducing cost and shortening project duration is "Construction Management." The realm of this term itself has many variations, but they are all based on the concept of an owner hiring a professional construction manager to assist in the management of his project.

The success of Construction Management led the author to question why the U.S. Navy has never used this technique. The quite simple answer is that the Navy's

construction administration organization feels its in-house technical and managerial forces provide equivalent construction management services and to hire a CM would be redundant.

From this premise evolved the purpose of this study: to compare the services provided by a civilian Construction Manager (CM) with the functions of the Navy construction administration organization. From this the author determined whether the Navy can benefit from CM services, either through direct hiring of a CM, or by modifying its own organization and practice.

To accomplish this it was first necessary to determine services CMs are providing. Much has been written on this topic in recent years. In addition to an extensive literature review, the author interviewed nine practicing CM firms in the Denver, Colorado, area. Appendix A lists the CMs interviewed.

Chapter 2 defines Construction Management in more detail and describes the type of organizations performing CM services. Chapter 3 counters with the organizational description of Navy construction administration as it operates today. This information was obtained primarily through a series of interviews with individuals involved in construction administration for the Navy. Appendix B lists these individuals.

Chapter 4 describes the services provided by a CM, while Chapter 5 presents CM selection procedures and

additional items to consider when hiring a CM. Also in Chapter 5 the author has presented his views on the variety of firms entering the Construction Management field.

The in-house functions done by the Navy are compared to CM services in Chapter 6. The conclusions of this comparison and recommendations to the Navy are contained in Chapter 7.

CHAPTER 2

CONSTRUCTION MANAGEMENT

2-1 Introduction

The term Construction Management has a variety of interpretations. They range from the all-encompassing concept of applying professional management techniques and procedures to direct and control the construction industry, to the much narrower concept of a person or firm contracting to provide professional construction oriented services working co-equally with the design firm for the owner of a project.

Although the overall subject of this report may be classified under the first definition, the specific technique being analyzed is Construction Management by the latter interpretation. George T. Heery, president of Heery & Heery, Atlanta, provides a more explicit definition of Construction Management as referred to in this report:

> Construction Management is that group of management activities over and above normal architectural and engineering services related to a construction program, carried out during the pre-design, design, and construction phases, that contributes to the control of time and cost in the construction of a new facility. (30)

A construction manager is then a person or firm which can provide the owner of a building project an array of services that will enable the owner to receive more building for his money. The construction manager (CM) may be likened to a consultant firm, who can be hired by the owner to provide all or any combination of the technical, managerial, and economical services offered.

CM firms have come from the ranks of general contractors, architects, and various consulting firms. It has been a continuing argument as to who is best qualified to be a construction manager. This author presents his own views on this subject in Chapter 5. For now let it suffice to say that in order for an organization to be a "full service" construction manager it must be knowledgeable in all facets of current building construction practices and be able to provide estimating and cost control, value engineering, scheduling control, plus construction administration, supervision, and quality control.

As defined the primary objectives of a CM are to save the owner time and money. Time is conserved through more efficient planning and management of the project, the forte of a CM, and through phasing the design and construction, a technique entitled fast-tracking. The shortening of project duration may lead to cost savings during inflationary times because of less material and labor price escalation. Additionally, design phase services provided

by a CM can result in more efficient design and tighter control of the owner's money.

2-2 Fast-Tracking

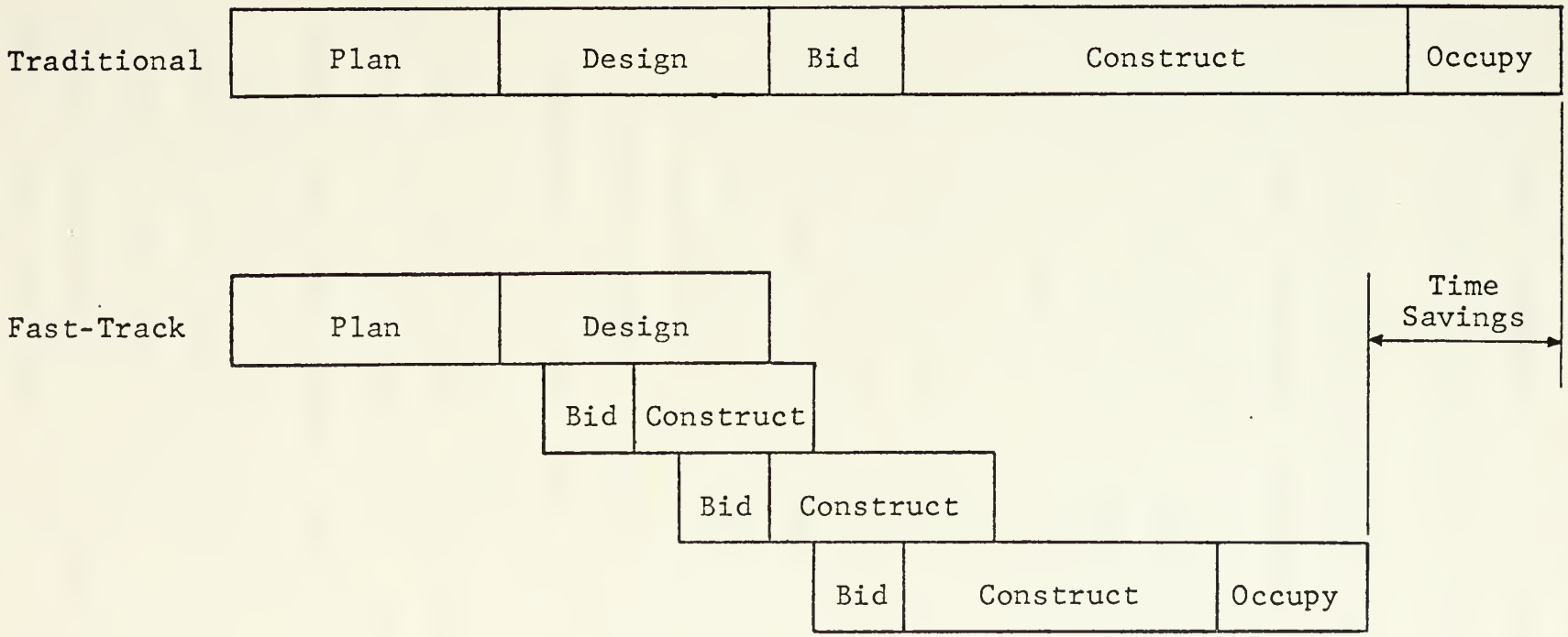
The traditional approach to a building project is sequential in nature. First, all plans and specifications are completed, then the project is put out for bids, and finally it is built. Under the fast-track approach the building is purchased and constructed a little bit at a time. The project is broken into several bid packages which are let and awarded as each section of the design is completed. In this way, as shown in Figure 2-1, design, bid, and construction phases overlap, and total project time is reduced.

For example, an eleven building complex of offices, laboratories and classrooms at New York State's Stonybrook campus was completed in nine months versus the three and one-half years estimated for completion under the sequential approach. (16, 40) The cost savings is estimated to have been $7.8 million. About $4.25 million was saved through avoidance of construction cost escalation, and the remaining $3.55 million represented rental income gained by early completion of the project. There is variance in the amount of time saved on each fast-track project. This example represents an unusually high time savings. A more realistic average is around 30 per cent.

Additional cost savings results from having several

FIGURE 2-1

TRADITIONAL VERSUS FAST-TRACK APPROACH (36)



prime contracts with various sub-trades rather than one contract with a general contractor. The lowest general contractor bid is seldom the combination of all the lowest sub-contract bids.

There are disadvantages to the fast-track technique. Tight schedules and early commitment to design decisions are the major ones. Once a decision has been turned into concrete and steel, it is expensive to change.

Fast-tracking is not a requirement when utilizing a CM, but rather an additional cost-saving advantage. The utilization of a CM lends itself to the fast-track approach in that a single manager for the entire building process can provide a coordinated, comprehensive scheduling system incorporating both design and construction activities. By having knowledge of design, bidding, and construction practices the CM is able to give design sequence input, identify design deadlines, arrange bid packages in accordance with local trade practices, and finally let the bids in a timely manner.

The question arises whether a CM is necessary to effectively fast-track a building project. For either of the other two building team members, the architect and the owner, to manage such a project properly, they would need the construction experience to divide the work into bid packages and the scheduling capacity to coordinate the effort of everyone involved. Few architects meet these requirements, and those that do are well on their way

to becoming construction managers. Some owners, such as large corporations or governmental organizations, may have the in-house capability and knowledge to manage their own fast-track projects. This possibility with respect to the U.S. Navy is addressed in Chapter 7.

2-3 The Building Team

The advent of Construction Management has led to what is called the "team approach" in the construction industry. The owner, architect, and CM are the primary team members, and it is their cooperative working relationship and coordinated efforts which make the construction management approach successful.

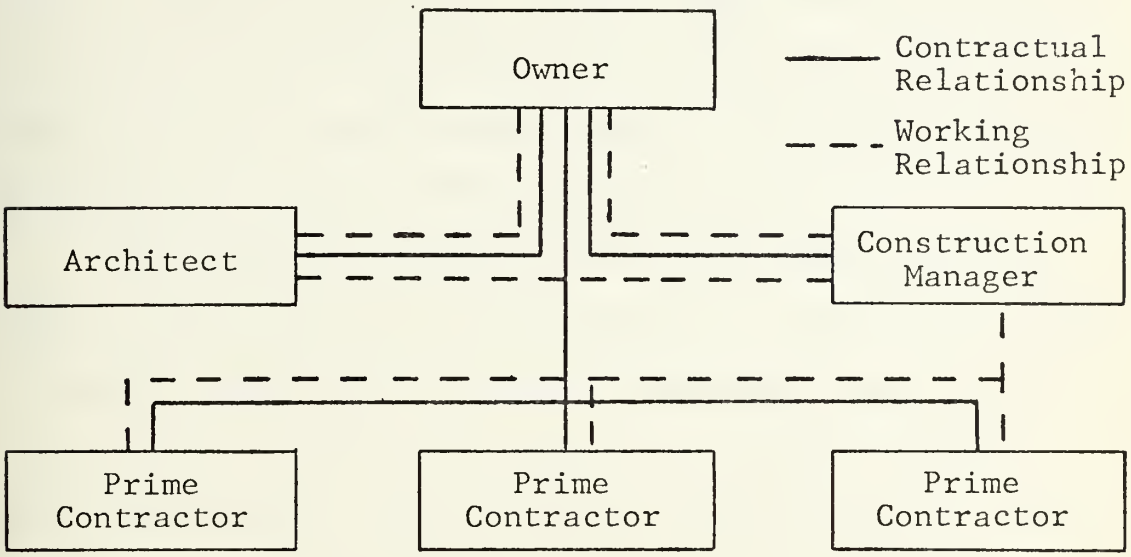
Figure 2-2 illustrates the contractual and working relationships of the traditional and CM approaches to the building process. Because the public sector is less able to negotiate contracts, owing to public bidding laws, the construction manager role has evolved as a professional service which is contracted for much the same as professional design services are. (48) This is depicted in part A of Figure 2-2.

Greater contracting freedom in the private sector has resulted in a larger variety of contractual and working relationships between the team members themselves and between the team members and the contractors. Often the CM, rather than the owner, will have contractual ties with the contractors. In such cases the CM becomes a general

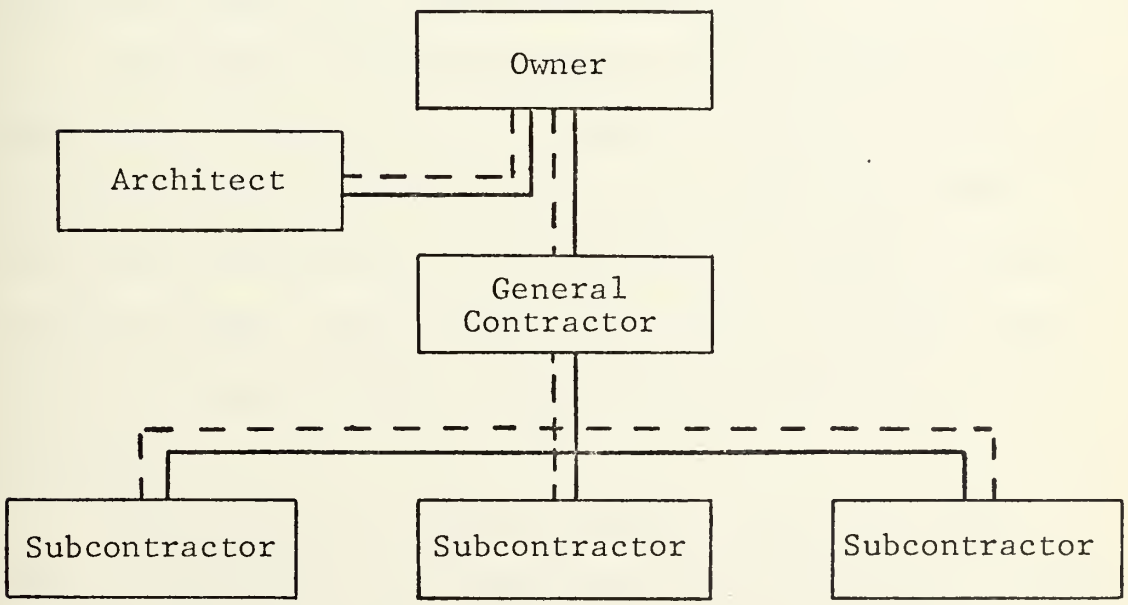
FIGURE 2-2

CONTRACTUAL AND WORKING RELATIONSHIPS OF THE

CONSTRUCTION MANAGEMENT AND TRADITIONAL APPROACHES (23)



A. Construction Management



B. Traditional

contractor once construction begins, identical to part B of Figure 2-2.

Construction Management has affected the architect and his mode of operation. In the team approach he has a new source of information to aid his design, the CM, but with it he also has a new critic. The architect must be willing to accept and work with the CM.

The fast-track design and construction has also had a drastic effect on the architect. Not only is there an earlier commitment to design decisions, but also the construction schedule determines the design schedule. Once construction begins remaining design decisions must meet deadlines established to allow smooth, continuous construction sequencing. In addition, the architect must often identify long-lead items much earlier under fast-track than under the traditional approach.

The team approach and fast-track technique have also affected the role of the owner. He must be much more involved than in the design-bid-build approach. Timely decisions are essential to maintaining a smooth flowing design process. This requires the owner to commit himself to design decisions before design is 100 per cent complete.

Many CMs feel public projects, where the owner is often represented by a committee, are hindered by red-tape and the absence of clear, timely decisions. Private owners are able to more clearly define their needs and

make cleaner compromises when necessary.

The degree of involvement varies from one owner to the next. Most owners more or less wait for the architect and CM to present the information to them for a decision. More active owners actually take charge of the project and direct the CM and architect. Some large corporations with continuous construction programs and large in-house engineering staffs fall in this latter category.

2-4 Construction Manager Backgrounds

As mentioned in the introduction to this report, the author conducted interviews with nine Construction Management firms in the Denver area. These nine by no means cover the entire range of backgrounds from which CMs have developed. A cross-sectional look at these firms will give the reader some insight as to similarities and differences of the organizations calling themselves construction managers.

Just as there is a great variety in the make-up of CMs, so too is there a variety in the requirements of the many owners using CMs. It is this author's opinion that this variation in CMs is good for the industry. The owner is left with the task of determining which CM best fulfills his needs.

Because CMs come from different segments of the construction industry, they vary somewhat in organizational structure and mode of operation. Of the nine firms

interviewed six were or still are general contracting (GC) firms, two have evolved from cost consultant firms, and one is a subsidiary of an architectural design firm.

Five of the general contracting CMs limit their business to the Colorado area, while the sixth is an international organization. This international firm and one of the local firms have split from their respective parent GC firms and now operate independently. The remaining local GC/CM firms conduct their CM functions in the same office with the same personnel with which they conduct their GC work. The amount of CM work done by these latter firms varies between 50 and 80 per cent by dollar volume of their total work. The local GC/CMs are doing a significant portion of the actual construction work on their CM projects. In many cases they are hired as GC during the construction phase.

Both of the cost consultant CM firms do business nationally, and one has entered the international market. For one the Denver office is their main office, while the other's Denver office is one of many branch offices. Neither of these firms consider themselves cost consultants any longer, but rather strictly CMs. They will, however, provide cost consulting services only, if a client so desires.

The Denver office of the architectural CM firm interviewed is a branch office that has joint-ventured with a local general contractor. The main CM office,

which has split operationally from the parent design firm, is not a joint-venture but has in several instances, when entering a new geographic location, joint-ventured with a local contractor. Both the design firm and its CM subsidiary are international organizations.

All CMs interviewed use similar project staffing. During the design phase a "project manager" with a construction and/or design background is in charge of the project. He may have one or more assistants depending upon the size of the project. In addition the firm will have estimating, accounting, and engineering staffs to assist the project manager as needed. The size and capability varies considerably among the firms, as does the size, type and number of projects in which they are involved. The range was from one to over a dozen projects by a single firm, with a total dollar value ranging from two to fifty million.

Once field work begins a construction supervisory staff of one or more people is assigned to the project. These field personnel generally come from the ranks of the construction industry. An inspection staff may also be used.

It is generally agreed that construction managers and fast-track construction become of increased benefit to the owner as the size of the project increases. When asked the minimum size project on which their CM services would be economically beneficial to the owner, the replies

ranged from 1.0 to 2.5 million dollars. It was frequently stated that projects of a complex design or inflexible time frame will benefit the most from CM services regardless of size.

It was also determined from the interviews that construction managers are being used primarily on building projects. These include health and educational facilities, commercial buildings, industrial complexes, and some housing and development projects.

CHAPTER 3

NAVAL CONSTRUCTION ADMINISTRATION

3-1 Introduction

In order that a military organization be able to maintain its readiness and accomplish its assigned mission, it must continually evaluate its facility inventory. To update facility deficiencies the Navy has a continuing program for the acquisition of facilities. This program can be divided into planning, programming, budgeting, and execution functions. Although the primary concern of this paper is with the execution function, some knowledge of the other functions is beneficial. In this chapter the Navy organization responsible for administering this program will be discussed.

3-2 Naval Facilities Engineering Command

The responsibility for the design and construction of naval public works, utilities, and other shore facilities is that of the Naval Facilities Engineering Command (NAVFAC). The Commander of NAVFAC is designated by the Secretary of the Navy as the "Contracting Officer" for all NAVFAC contracts. The Commander in turn designates several subordinate officers as Officers in Charge of

Construction (OICC) and delegates specific contract authority to each of them.

The contracting field organization is based upon six Engineering Field Divisions (EFD) located throughout the continental United States. The Commander/Commanding Officer of each EFD is designated as an OICC and has authority to award most NAVFAC contracts within his geographic area without prior approval of NAVFAC Headquarters. In addition special OICC organizations are established as necessary for large, one-time projects where the primary mode of contracting is fixed price. There are currently two such projects in existence.

The Commanders/Commanding Officers of the EFDs can further delegate contractual authority to certain Civil Engineer Corps officers located at established naval stations or other geographical areas in which NAVFAC has Department of Defense contract responsibility. Within the continental United States this third type of OICC is generally the Public Works Officer at large naval stations. Their maximum contractual authority seldom exceeds $300,000 per project and may be less depending upon the workload and staffing of the Public Works Department and the experience and rank of the Public Works Officer.

The major Navy construction projects (i.e. those above $300,000) are administered at the EFD or special OICC levels. Consequently, the concern of this report is directed at these organizations, and little more will

be said concerning the third category of OICCs.

The planning, programming, and budgeting functions of the construction program are accomplished at NAVFAC headquarters, while the execution function consisting of design and construction phases is performed by the EFDs and the other OICC organizations. Design is obtained at the EFD level, and although the OICC is responsible for controlling contract performance and maintaining constant awareness of the work progress, the actual construction control function is performed by a field organization subordinate to the EFD. OICCs appoint Resident Officers in Charge of Construction (ROICC) as necessary to administer construction contracts. ROICC offices are generally established in locations where there is a high concentration of the Navy's capital investment and a historical record of, or a definite plan for, significant contract workload. (60) If workload declines, ROICC offices may be disestablished or combined.

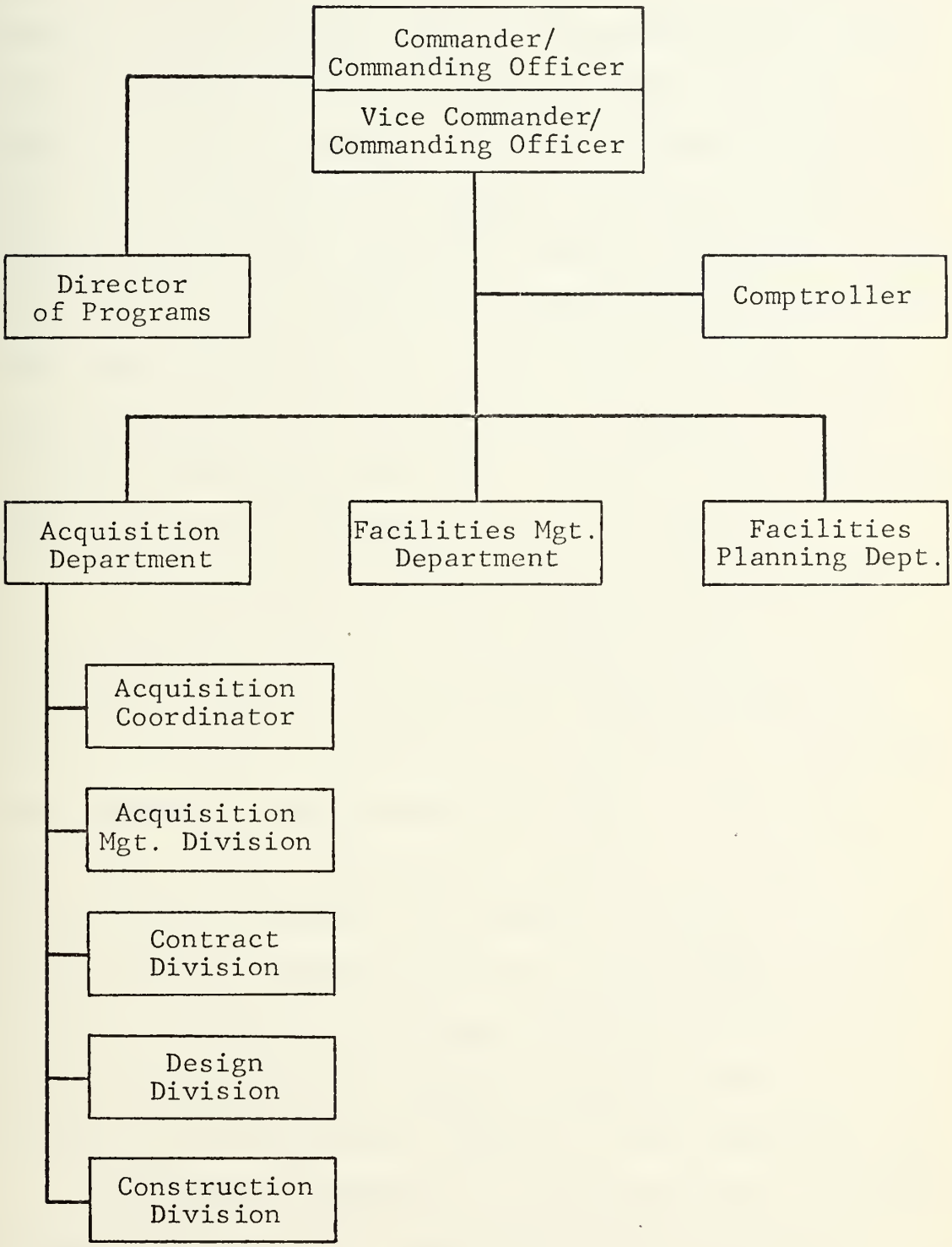
3-3 Engineering Field Division Organization and Function

The EFD can be likened to an architect-engineer design firm of several hundred people. Figure 3-1 is a simplified diagram of the typical EFD organization. There may be slight variations in each EFD.

The contract administration functions are consolidated in the Facilities Acquisition Department, consequently it is presented in more detail in the diagram.

FIGURE 3-1

ENGINEERING FIELD DIVISION ORGANIZATION (61)



This department, which alone may contain over two hundred people, contains four divisions as shown. When a project comes to the EFD the Acquisition Management Division handles the preliminary work of establishing the project scope, design criteria, preliminary budget, and time frame. A project manager, who will stay with the project until it is completed, is assigned from this division. The EFD then decides whether to design the project in-house or to contract the design to a private architect-engineer (AE) firm. If the project is to be done in-house, the synopsis prepared by the Acquisition Management Division is sent to the Design Division. If it is to be contracted out, the Contract Division receives the synopsis.

The decision to design in-house is based almost solely upon the workload of the Design Division. The division is staffed with engineers and specialists in civil, structural, mechanical, and electrical engineering; cost estimating; specification writing; and fire protection engineering. Consequently, small as well as multi-million dollar projects are designed in-house. About 13 per cent of all NAVFAC designs are accomplished in-house, either at the EFDs or at large Public Works Departments. The technical review of projects designed under private contract is an additional function of the Design Division.

The Contract Division is responsible for the advertising, the negotiation, and the award of the AE and construction contracts. The types of contracts utilized

and the procedures involved are discussed in a later section of this chapter.

The Construction Division has two major functions. The first is to review plans and specifications during design development from a construction aspect, establish contractor quality control requirements, and determine what type of network analysis, if any, should be utilized and who should provide it. On different projects it is provided by the AE, the general contractor, or an outside consultant. Infrequently the EFD itself will do the scheduling. The Construction Division provides all this information to the organization doing the design before the 30 per cent design milestone is reached.

The second function of the Construction Division is to provide assistance in the form of personnel, equipment, and information to the ROICCs for the administration and management of the construction contracts. The functions of the ROICCs is the topic of the next section of this chapter.

Most EFD Construction Divisions have Area Managers which provide both these functions for projects within their assigned geographic area. This person is then the contact between the ROICC field organization and the EFD. He will solicit assistance from the other EFD divisions, if required by an ROICC.

3-4 Resident Officers in Charge of Construction

For major Navy construction projects contract award and change order authority generally remains with the OICC. The actual construction supervision is performed by the ROICCs, who are located at the job sites. The ROICC's responsibilities include monitoring the construction progress; checking the compliance and effectiveness of the contractor's quality control plan; resolving conflicts in contract documents, as well as other requests or questions by the contractor; insuring change orders are promptly initiated, negotiated, and issued to the contractor; and conducting the final acceptance inspection. (60) The ROICC is also the liaison with the customer, who is generally the Commanding Officer of the station on which the project is located. It is the ROICC's responsibility to keep the customer informed of construction progress, major delays, and the expected completion date.

The staffing of a ROICC office is comprised of both military and civilian personnel. The military billets include the ROICC and his assistants (AROICC). It is the AROICC who is responsible for the day-to-day administration of the project. His office may be within the ROICC office or at a remote location within the administrative area of the ROICC. In general, every naval station has at least one AROICC. Civilian personnel

perform the technical and clerical functions. The number and their grade levels depend upon the dollar value of the work-in-place, the number of construction sites, and the distance between sites.

3-5 Types of Contracts

Professional Services: Navy contracts are required by law to be formally advertised and competitively bid whenever feasible and practical. In those cases where it is not practical the contracts are negotiated. The most frequent use of the negotiated contract is for architect-engineer services.

When the decision is made to contract for the design of a project, the EFD Construction Division will post the project in the Commerce Business Daily, allowing AE firms a reasonable amount of time to express interest in obtaining the design contract. At the end of the posting period a formal selection procedure is initiated. (57, 60) A Preselection Board is established by the OICC for the purpose of compiling a slate of qualified design organizations. Prior to considering individual firms the board reviews the project description and scope. It then reviews the required prequalification statements submitted by each AE, plus any other written information the AE may desire to submit. Performance evaluations of those AEs having prior government contracts are also reviewed. The board's primary effort is to determine each AE's

capability to accomplish the work under consideration. Upon completion this preselection board recommends to the OICC at least three and preferably more AEs found to be fully qualified.

The actual selection is then done by another board, the Selection Board. This board takes the recommendations of the Preselection Board and, after their own review and an interview with each of the firms recommended, ranks them in order of preference. A report of such is then submitted to the OICC. It is important to note that no discussion of fee takes place during any reviews or interviews up to this point.

If the OICC accepts the Selection Board's recommendations, the first AE on the list is requested to submit a price proposal with a view of entering into a contract. This proposal is then negotiated by the Selection Board, now titled the Contract Award Board. Law limits AE contract fees for the production and delivery of designs, plans, drawings, and specifications to six per cent of the estimated construction cost. (57) It is not the purpose of the Board to put major emphasis on price, but rather to negotiate a fair and reasonable price within the limitations set by law.

Construction Contracts: Law requires that all new military construction be performed under private contract. Within this framework, it is NAVFAC's policy to formally advertise and competitively bid construction contracts.

Fixed-price, lump-sum contracts are used most frequently, although unit price and cost-plus-fixed-fee are used occasionally. Negotiated contracts for construction are used by NAVFAC only when it is impractical or disadvantageous to use formal competitive bidding, such as in the case of national emergency.

There are four different fixed-price contracts based upon the dollar value of the contract: (60)

(1) Long form, unlimited amount

(2) Limited long form, up to $50,000

(3) Short form, up to $10,000

(4) Informal, up to $2,000

The long form is the basic contract used throughout the Federal Government. The other three forms were developed to facilitate more efficient handling of contracts in the respective dollar value ranges.

The first three forms require formal bidding procedures. The informal contract enables work to be done quickly on minor projects requiring few drawings or specifications. Proposals from contractors may be solicited and negotiated over the telephone or by letter.

Formal bidding procedures employed by NAVFAC are typical of Federal Government procedures. The primary variance from private sector procedures is the requirement for open advertising of bids.

3-5 Special Project OICCs

As was mentioned previously, special OICC organizations are occasionally established to handle large, one-time projects. This OICC reports directly to NAVFAC and has no affiliation with an EFD. These special OICC organizations are staffed on a smaller scale but identical to an EFD, except they do not have a Facilities Management Department, which in the EFD is responsible for maintenance.

Because of the single job site location the Construction Division personnel can be located within the ROICC office at the site, providing additional expertise during construction. The ROICC generally wears a second hat as Assistant OICC and heads the Construction Division from the onset of the project.

When the special project is completed the OICC and ROICC organization are disestablished.

CHAPTER 4

CONSTRUCTION MANAGEMENT SERVICES

4-1 Introduction

Many guidelines on Construction Management have been published which list the services provided by a CM. (1, 2, 19, 22, 23, 49, 56) Generally the services are divided into design phase and construction phase. GSA, who has been the leading proponent of Construction Management in the public sector, has published undoubtedly the most comprehensive list of possible services a CM can provide. (23) This list is reproduced in Appendix C.

It is this author's opinion, and that of most of the CMs interviewed, that the major benefits of using the CM technique are realized during the design phase. Construction procedures, except for the increased coordination and scheduling requirements on phased projects, are pretty much the same. It is simply a new entity doing the management. Likewise bidding procedures have not changed much from the traditional approach, except that there are several bid openings during a phased project.

Because the design services are for the most part new functions, the author has divided them into five areas for discussion: administrative control, design

input, value engineering, project scheduling, and cost control.

4-2 Administrative Control

Administrative control is a catch-all title for miscellaneous activities such as assisting in project strategy and establishing procedures, responsibilities, and lines of communication. The amount of this done by a CM depends upon the type of owner. A very active owner will conduct most of the administrative control himself. The CM need only execute his responsibilities as the owner directs. On the other hand a "decision-making-only" owner will give the CM free rein to institute administrative control. In such cases there is little variance in the manner in which this function is handled among the CMs interviewed.

4-3 Design Input

The role of the CM in project design is to provide the architect and the owner with information from the construction industry, such as material quality, cost, and availability and construction time requirements, sequencing, and practicality. This information helps all parties to recognize costs in making design decisions, for example aesthetics versus costs.

Obviously the CM must not only have experience in the construction industry, but he must also continually

update his information. This would not seem to be a problem for CMs associated with or still practicing general contracting. Those with an architectural or consulting background have more difficulty obtaining this information.

When questioned on this point CMs from non-general contracting backgrounds agreed that maintaining current construction information is a major effort and cost to them, but they are able to acquire sufficient information through direct communication with subcontractors, material suppliers, and venders; through participation in construction conferences and seminars; and through their own project experience.

It remains the author's opinion that for construction information no one knows more than the man who started with pick and shovel and has worked his way up to contractor, however, simply having the information is not enough. A CM must be able to communicate his information to the owner and architect and at the proper time.

4-4 Value Engineering

Some CMs consider value engineering (VE) part of their design input. This author considers VE a means to making the design input decisions for the CM.

Two approaches to VE were observed from the CMs interviewed. The larger firms tend to have a structured, systematic VE program which is applied continually

throughout the design phase to each element of the design. Rather than being an after-the-fact corrective function during the construction phase, requiring the architect to redesign, these CMs brainstorm the project piece by piece as the design progresses. Most CMs do the VE themselves, presenting the best alternative to the owner and architect. Some conduct their VE sessions with representatives from all building team members. One CM interviewed only collects and packages the alternative information, then presents it to the architect for evaluation and decision.. This firm has a cost consultant background.

The second approach to VE is a less formal, non-structured type practiced by the smaller, local GC/CM firms. Their whole process of selecting and evaluating alternatives by relying upon past experience, a practice most have been doing for years under design-build or negotiated contracts, is what they call VE. In a broad definition of the term this probably is VE. It is probably less expensive than the formal approach and will undoubtedly result in cost savings for the owner, however, the consistency and completeness afforded in the systematic approach is lacking.

4-5 Cost Control

Many authors on Construction Management feel cost control is the backbone of the concept and the key to its success. Cost control is more than just estimating.

Charles B. Thomsen, founder and President of CM Associates, Houston, describes cost control as including: (50)

(1) Knowledgeable, realistic budgeting

(2) Good engineering economics

(3) Precise estimating

(4) Intelligent, skillful purchasing

(5) Comprehensive, timely accounting

Thomsen goes on to say that only through proper management can cost be controlled. The managers must pay attention to detail, as well as to concepts. They must know what the owner wants and how much money he has to spend. The building team must be provided with a budget upon which to make their decisions throughout the design. A continual process of comparing, analyzing, and updating the estimate of each segment of the design is necessary. Each package of the building must be purchased in line with the estimate, and those unavoidable changes which always occur must be handled within the bottom line figure by making adjustments elsewhere in the design. This process begins before design and continues until project completion. (50, 52)

Although all the CMs interviewed are able to provide cost data and early estimates, the larger firms with complex computerized systems provide a cost control process similar to the one described above. These firms are able to provide estimates and budget breakdowns as early as the performance specification stage. CMs not using

computerized cost data systems are generally unable to provide complete cost estimates without preliminary drawings. The extent of budget monitoring done by the smaller firms tends to be limited to advising the owner when the project cost is varying significantly from the budget, then suggesting alternative solutions.

4-6 Schedule Control

The advent of fast-tracking has increased the need for accurate schedule control and has made it necessary to incorporate design and bidding activities into the project schedule. Centralized scheduling during design has the added advantage of forcing all team members to know and meet their deadlines.

Most of the GC/CM firms interviewed are continuing to use the same scheduling technique they employ as GCs and have simply adapted it to include design and bidding activities. The majority of these firms use manually calculated and drawn bar charts; however, a few are using some type of network schedule. In every case the firm's main concern is to have a system which is easy for everyone concerned to understand and use.

The larger CM firms tend to have a variety of scheduling methods. Bar charts are generally used for early project schedules and design and bid schedules. Detailed PERT or CPM networks are utilized once the first construction contracts are awarded. The complexity of the

network is generally adjusted to meet the complexity of the project. Again one of the main concerns of the CM is to use a scheduling technique that is easily understood by all members of the team and contractors. Consequently most CMs have developed their own variant network system.

Feedback from all parties and a timely updating procedure are additional considerations recognized by most CMs. The computer of course supplies the fastest method of compilation, but it also requires considerable data input time. For this reason many of the smaller CMs prefer updating by hand. Updating time frames range from weekly to monthly.

4-7 Bidding Procedures

The responsibility for bidding procedures in the traditional design-bid-build approach is that of the architect. With phased construction these procedures have become more time consuming, and although the architect may be involved, the lead is generally taken by the CM.

Phased construction has also led to the requirement for "packaging" of job components. A bid package consists of one or more separate contract offers which will be let for bid at the same time. A contractor may bid on one or any combination.

How to package optimally and who is best qualified are questions over which much discussion has taken place. Architect J. Karl Justin of Evans, Delehanty & O'Brien has

described "optimum" packaging as that which will achieve the maximum number of quality bidders on each contract group, the minimum number of total separate prime contractors to reduce the interfacing between them, plus an early completion of construction. (35)

Justin goes on to explain a three step process to accomplish optimal packaging. First, one must study the bidding history of the local area, paying particular attention to the trades on which bids were taken, the size of contracts, number of bids received, quality of bidding firms, and similarity of work to the project under consideration.

The second step is to determine the best dollar size for each sub-trade from the data collected, then divide the project into similar estimated units.

Third, one should group the units of step two into bidding combinations in line with the data obtained, and scrutinize their practicality.

Of the CMs interviewed those with general contracting experience feel they are best qualified to formulate the bid packages because of their experience in taking and analyzing sub-contractor's bids. They already know what items subcontractors tend to bid. CMs from other backgrounds feel they are able to obtain the necessary information through direct consultation with contractors in the local area. In any event it is important that care is taken not to omit or duplicate any bid items.

Prequalification of bidders is another service provided by the CM, primarily on private sector jobs. Most CMs recommend performance and payment bonding of all prime contractors, however, one CM interviewed, because he is able to prequalify all bidders, does not require any bonding on private jobs. This results in additional cost savings for the owner.

Pre-bid and post-bid conferences are general practice of all CMs interviewed. Pre-bid meetings are primarily to clarify the bid package and outline procedures and forms to be used, since many of those bidding were formerly subcontractors and have never held a direct contractual relationship with an owner.

4-8 Construction Phase Services

The basic role of the CM during construction is to manage and supervise the construction. There are many contractual relationships that can exist on a construction management project during the construction phase. Most will fall into one of four basic formats: (30)

(1) The single-responsibility general contract is one similar to what has been termed the traditional approach. A single contract is competitively bid or negotiated between the owner and a contractor. The CM during the design phase often becomes this contractor on a negotiated contract. The author found this to occur almost exclusively on private sector projects of the local

CMs having general contracting backgrounds.

(2) Separate early contracts awarded for long lead-time items with a subsequent award of a general contract for the remaining work. The early contracts might be for such things as structural frame, electrical switch gear, demolition and site clearing, or systems components. Quite often there is provision to incorporate one or more of the early contracts into the general contract. This contractual relationship is also found predominantly in the private sector with general contracting CMs.

(3) Separate prime contracts which remain separate throughout project duration. The separate contracts are often divided along the lines of the major components, such as mechanical, electrical, structural, and site work, but these may be sub-divided even more. Often projects with long construction time will have a general contract for the majority of construction, and have later separate contracts for such things as carpeting, lab equipment, landscaping, which are difficult to bid early in the project. Some CMs will have these items purchased as early as design permits, then have them stored until installation.

This type of contractual relationship occurs most often on fast-track projects in both the private and public sectors.

(4) Direct management of separate trade contracts and field crews. This may lead to thirty or forty

contracts on one project. A trade contract can include a portion as large as the mechanical system or as small as the window glazing. Field labor crews are contracted directly by the owner for clean-up or other unskilled work.

This type is also used on fast-track projects in both private and public sectors.

CMs without a construction background claim to have found little difficulty in supervising and managing the construction operations. Their opinion is that superintendents perform as superintendents whether their boss is a GC or a CM. Most CMs hire their construction supervisory personnel from the construction industry.

All but one of the CMs interviewed maintain some construction personnel on site to perform indirect labor items such as clean-up and general condition items. The one variant, which is from a cost consultant background, contracts one of the prime contractors on the project to handle these items.

Inspection of the work during construction is another area in which opinion and practice differed considerably. Some CMs said their role is similar to that of the architect, and his role has not changed any from the traditional approach. Some CMs claim the responsibility for inspection, while others solve the problem by having the owner contract with outside inspectors.

In addition to fulfilling many of the functions of

the general contractor, the CM has inherited other functions formerly the responsibility of the architect. These include procedures for shop drawings, change orders, and applications for payment.

CHAPTER 5

CONSTRUCTION MANAGER SELECTION

5-1 Introduction

Because the size, background, capability, and experience of CMs vary greatly, selecting the right CM for an owner's exact needs can be a difficult and involved process. Fortunately big users of construction management have published selection procedure guidelines. The professional agencies, AGC and AIA, have developed contract documents specifically for CM contracts. With these aids CM selection can be easier for the owner using the concept for the first time.

Although the experience and qualifications of a CM are probably the primary concerns during selection, CM fee, guaranteed maximum price, and the point in project development at which the CM is hired are other considerations.

5-2 Selection Procedures

Owners who utilize CM services frequently have established procedures for evaluating and selecting CMs. Frequently these procedures are similar to those used in selecting AE firms. The General Services Administration

and the Department of Health, Education, and Welfare have published their procedures. (23, 56)

The first step is normally to develop a source list of firms providing construction management services. This can be done prior to solicitation for proposals on specific projects. A standard qualification form is frequently used to obtain background information.

For each project the owner reviews his source list and selects those CMs he feels are most qualified for that particular project. He then sends each an invitation to submit a formal proposal. Under GSA's two-step procurement procedure fee amounts are not included in this preliminary proposal. After further evaluation based on the preliminary proposals, GSA selects the top five rated firms and invites them to submit a price proposal. (23)

HEW recommends a single proposal format which includes a pre-submittal meeting with the firms receiving invitations. The purpose of the meeting is to brief them in depth on the services required and the specific details of the project. (56)

Most owners allow individual interviews with the CM firms, generally after the proposals have been submitted. The purpose of the interview is to allow the CM to demonstrate his understanding of the contract requirements and to explain his proposal. Final selection is then made.

An item of much controversy is whether the CM's fee should be used as one of the selection parameters, or

whether it should be negotiated after final selection, as is the case for other professional services. GSA has not always selected the lowest fee proposal. (24) It is only one of several determining factors. GSA's successful record and impressive list of top CMs employed indicates their selection process does work and does attract qualified CMs.

5-3 Construction Managers' Fee

In most instances CMs are hired for a fixed percentage of the total project cost with allowances for reimburseable costs. The percentage ranges from about 1.5 to 6.0. Standards have not been established in the young profession, but generally the fee rate decreases as the size of the project increases. Project complexity and duration have direct effects upon the fee rate. Consequently, it is important that an owner obtains a thorough cost breakdown before he contracts for CM services. (16)

The majority of the CMs interviewed are against any form of competitive bidding for CM services. Several refuse to apply for such jobs. Their feelings are that professional services should not be bid competitively, and that CM services are of a professional nature. They believe competitive bidding will lead to a lowering of service to the owner from the winning low bidder. The few CMs who are not opposed to competitive bidding of CM services are those with a general contracting background.

5-4 The Best Time to Hire a CM

The characteristics of the project and the in-house capabilities of the owner influence the point at which a CM should enter the project. (16) If the owner has the capability to handle the administrative control, the latest the CM should be hired is with the AE. If the owner does not have the capability to perform the necessary feasibility studies and program planning, a CM can be hired for such purposes. If so, he should not only be hired before the AE but actually assist in the selection of the AE and other outside professionals.

Almost every CM interviewed prefers to enter the project at the same time as the AE. Most CMs are willing to come on board shortly after the AE, but all feel if their entry is delayed significantly the benefits they can provide at the front end of the project will be diminished greatly. The CM could become an adversary if he attempts to point out flaws in decisions already reached by the other team members.

The only CMs generally willing to enter a project after the design is complete are those associated with general contracting firms. In such cases they feel little can be done to reduce time and money. Their role is primarily one of preventing additional losses by keeping the construction process running smoothly. They are in effect general contractors once more.

5-5 Guaranteed Maximum Price

Much has been written about the pros and cons of a guaranteed maximum price (GMP). Its role as an advantage to owners and as a constraint on professional service has created considerable controversy. (55)

There are owners who are reluctant or prohibited from commencing construction without contractual assurance that the final cost will be within budget. This occurs most frequently in the public sector. Under the traditional design-bid-build approach the guaranteed maximum price was the GC's contract price and easy to get. On the fast-track approach, however, there is no GC, and the owner has turned to the CM for his guarantee.

Most of the CMs interviewed are opposed to providing a guaranteed maximum price under the fast-track approach. The CMs with a GC background are less reluctant but prefer not to do so until the design is 100 per cent. There is unanimous agreement among the CMs that the requirement for a GMP costs the owner money because of larger contingency allowances. This usually results in prime contracts totaling less than the GMP, the owner getting less building than he could have, and ending up with money left over. CMs readily admit that under a GMP they are less open with the owner, and tend to control the owner's money and the project.

Since he is hired as a professional consultant, the

CM feels he will naturally work in the owner's best interest and give the most building for least cost. An owner should base his judgment on the CM's record and not require a GMP.

The author advocates that, since the CM does not have complete control over the design, a GMP should not be required at any point short of 100 per cent design. If an owner wants a GMP earlier in the project, which can be a distinct advantage for him, either the CM should have complete control of further design decisions, or the architect and CM together, or the entire team, should provide the GMP.

George Heery has presented two possible means of putting a handle on costs before extensive design is complete. (55) Both are keyed to proper contractual obligation in the AE agreement. They are: (1) a combination design and construction management contract wherein the AE/CM accepts the obligation to complete the design within an established budget at either the pre-design stage or by the end of schematics. (2) The CM, separate from the AE, works out a compatible budget and program with his client, then puts the AE under contract for the owner with a pre-design obligation on the budget.

5-6 The Best Qualified Construction Manager

As mentioned previously, there is a variety of CM organizations and an equal variety of owners. When

selecting a CM an owner must be careful to match his organization with that of the CM. The backgrounds, project experience, and strong talents are key points to consider.

On smaller, less complicated projects a danger of overkill exists. (16) An owner with large in-house capability may be hiring duplicate or unnecessary services.

The author believes there is no one type of CM for all owners. There are basic requirements a CM must have in order to be able to provide a client with "full service" construction management.

A CM must not only have experience and know the history of construction techniques and practices, but he must also have a vehicle to stay abreast of current trends and changes. If the CM is entering an unfamiliar geographic area, he must secure local cost, labor, and material data. Many CMs are not equipped for operation outside their local area. Additionally, a CM must know bidding procedures, as well as the instincts of the subcontractor trades. He must be experienced in construction estimating and have the required cost data. All these requirements are possessed by the general contractor.

Just having this construction information and experience is not enough. A CM must be familiar with building conceptual and design processes. He must know what information is needed when. He must be able to communicate this information to owner and architect. Naturally the

people most familiar with these requirements are members of the design professions. There is also the group of general contractors whose majority of experience has been with negotiated, design-build projects.

As construction management has evolved, cost control and early estimating have emerged as the most important and beneficial services to an owner. This is probably why cost consultant firms have been drawn into the field. With their elaborate computerized systems these firms are able to give accurate estimates very early in the conceptual and design stages. Another person with the required estimating data is the general contractor, however, his estimating procedures are take-off type. In order to be effective the GC must be able to adjust his information to provide systems and parameter type estimating.

The advantage of using the computer for estimating has already been discussed. The requirements of a CM include the ability to gather and deal with vast amounts of information. The construction industry has lagged far behind all others in the utilization of the computer. If a CM is going to make it big, he is going to have to adopt the computer to do not only his estimating but also his scheduling, cost accounting, resource analysis, and so on.

The term value engineering is a relatively new one, as is the formal systematic practicing of VE. Consequently, there is no type of organization possessing years

of experience in VE, but it is a function the CM must develop.

The final requirement for the CM is construction supervision. No matter who the boss is there is no substitution for the man who has worked in construction all his life and has proven his supervisory ability.

Who then makes the best full-service CM? Any organization who can develop, buy, hire, or joint venture the skills discussed above can become a successful CM. The organization with the most in-house assets initially is probably the GC with design-build experience. The architect or cost consultant who joint ventures with a GC is also well equipped to provide full-service Construction Management.

CHAPTER 6

NAVFAC CONSTRUCTION MANAGEMENT FUNCTIONS

6-1 Introduction

There are several construction programs within the Navy community, however, the only program which contains projects of a magnitude to be considered for Construction Management application is the regular Military Construction Program and any special projects requiring a separate OICC organization. The first half of this chapter will present the cycle a Military Construction project goes through as it evolves from an item on a facilities deficiency list to a completed building.

The remaining portion of the chapter is devoted to comparing the functions performed by an EFD during design and construction to those of a CM.

6-2 Navy Construction Program Planning

The Navy has a program through which facilities deficiencies and excesses are determined by comparing requirements with existing facilities. The details of the program are beyond the scope of this report, however, it is these deficiencies which are converted into specific engineering proposals or projects. This is done by each

naval activity with assistance from the appropriate EFD. The proposal could be new construction, rehabilitation, leasing, or changes in the use of facilities. (59) The proposals are submitted to NAVFAC by the activity.

Through additional processing NAVFAC categorizes and prioritizes the complete list of projects, then selects a set of these projects for proposal to Congress. This selection is again beyond the intentions of this report. Let it suffice to say the number of projects proposed is based upon the funding level established for that year by the Chief of Naval Operations (CNO). Factors which affect project priority include the mission of the activity, where the project is to be located, the degree of the deficiency the project is to overcome, economic aspects of the investment, and the major claimant's priority. (59)

Major claimants are those commands, bureaus, and offices designated by CNO who have a claim on a portion of the military construction programs for the activities under their command. In addition to recommending project priorities, the major claimants are involved much earlier through reviewing, commenting upon and approving the submittal of the activities under their command.

Several levels of review are made on the proposed construction program before it is sent to Congress. The Navy Military Construction Review Board consisting of a representative from each major claimant, the CNO, the Navy Comptroller, and the Office of the Secretary of

Defense all review the proposed program.

These review authorities place great importance on realistic cost estimates and the amount of preliminary engineering done on the proposed projects. Consequently NAVFAC is in the process of instituting a new program called Project Engineering Documentation (PED), whereby NAVFAC will authorize the EFD to proceed to the 30 per cent design stage with projects NAVFAC feels will survive all reviews and budget changes. The design may be done either in-house or by contract, as previously discussed.

A second reason for the necessity of accurate preliminary estimates is that once Congress sets the budget for each authorized project it is difficult to obtain additional funds. If the final estimate comes in much over budget, rather than seeking additional funds, NAVFAC generally cuts the project scope to bring the project within the budget.

The EFDs will receive special instructions concerning projects with marginal review survival probability. These projects are not carried to the 30 per cent design stage, although some preliminary design and estimate work is done on each project.

The Military Construction Program is submitted to Congress in January of each year. It requires two separate acts of Congress to become reality. The first is an authorization law which will list the projects Congress authorizes to be built. The second is an

appropriation law which appropriates the dollars to be spent on the projects. Although both bills are worked on simultaneously, by necessity the appropriations bill must lag the authorization bill. The entire two bill process may take as much as nine months to become law.

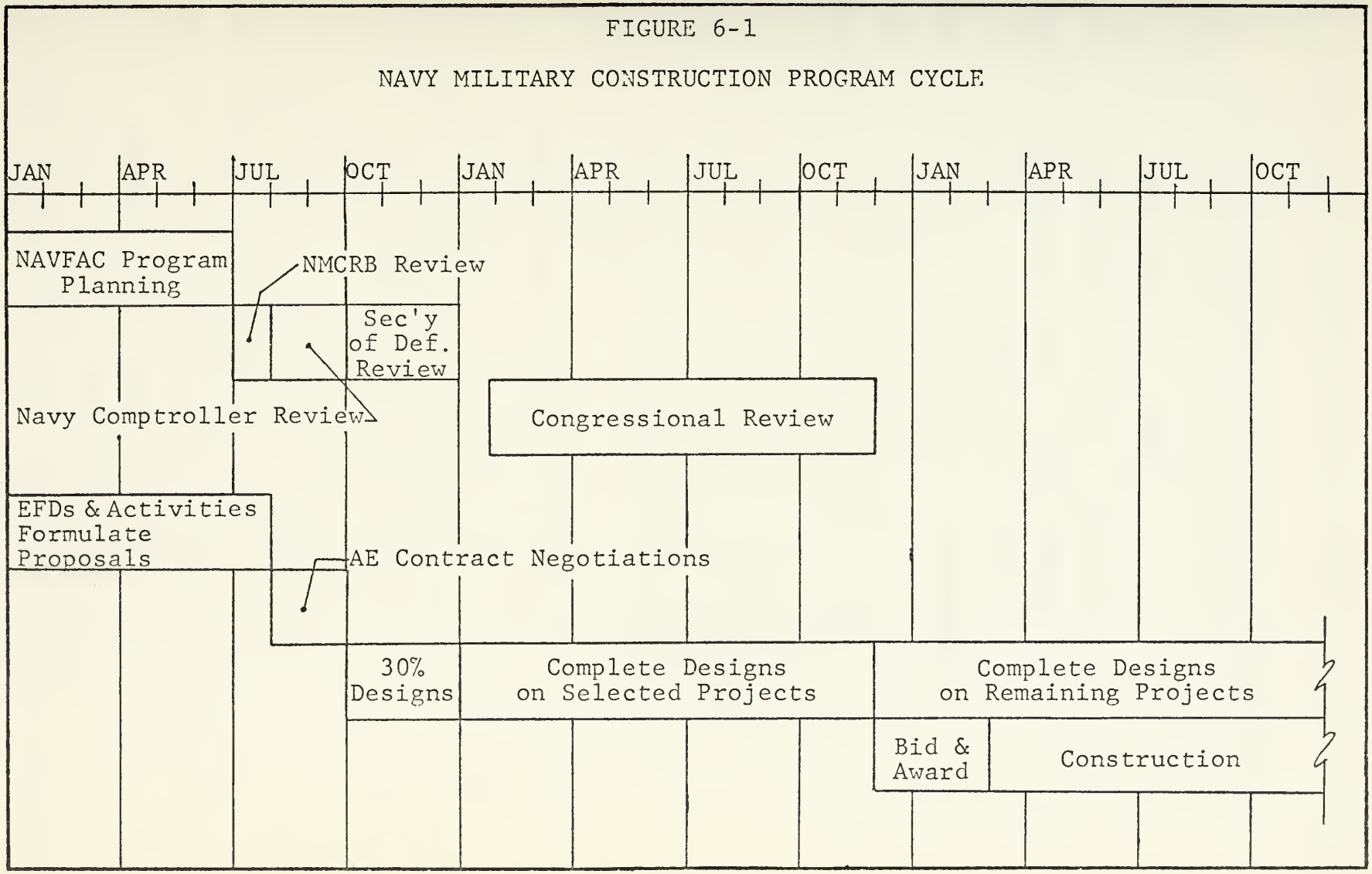
During these nine months the EFDs will continue the design work on most of those projects which were carried to the 30 per cent level. Many are 100 per cent designed before Congress passes the appropriations bill. Occasionally a project is completely designed but not funded, however, NAVFAC is enjoying a good average on their guessing game. Design is not continued on marginal survival projects until the appropriations bill becomes law.

The primary reason for gambling on whether projects will be funded or not is to shorten the overall concept-to-completion time of a project. This not only reduces the effects of cost escalation but also gets the project to the customer sooner. From Figure 6-1 one can see that planning and budgeting of the Military Construction Program takes almost two years. Additionally a project may sit in backlog for several years before it reaches high enough priority to make the Program.

Once the appropriations bill becomes law the EFDs are authorized to complete design or begin construction, as the case may be, on those projects appropriated.

FIGURE 6-1

NAVY MILITARY CONSTRUCTION PROGRAM CYCLE



6-3 Construction Management Functions Performed by the EFD

The Navy construction management system performs several of the functions being provided by civilian CM firms, but falls short on others.

Administrative Control: The Navy is the type of owner who provides almost all the administrative control on its projects. As shown in the previous section, the Navy conducts its own planning and programming. In addition all procedures, responsibilities, and lines of communication are established by NAVFAC. These are standardized for the most part and published in manual form for all concerned to use. For example, each EFD has its "Manual of Instruction to Contractors" which is a guide to assist contractors in the execution of their contract requirements. (58)

Design Input: As discussed previously, an EFD has the technical capability to do its own in-house design. On projects being designed by private contract this technical staff provides to the AE project criteria, technical peculiarities of Navy design, technical developments from Navy studies and research, and any other information the AE may request. The EFD reviews the entire design at the thirty, sixty, ninety and one hundred per cent milestones. Some EFDs will skip the sixty and/or ninety per cent reviews. Although communication between the AE and the EFD is open at all times, the EFD does not generally

follow design progress except when the AE asks for assistance or at the established milestones.

The Construction Division of the EFD, like a CM, reviews the plans and specifications during the design phase from the construction aspect. They concern themselves with construction procedures and practicality, quality control requirements, and test requirements and procedures.

Lacking from the design process is any input from the construction industry such as material quality, cost, and availability or construction time and sequencing requirements. Frequently an AE will contract for CM services on its own. They do so because by contract they are required to design a project within the established budget and may be required to redesign if over budget. The design contract on the special Bethesda Medical Center project is actually with a joint-venture of an AE and a CM.

Value Engineering: The Navy has very active VE programs. VE incentive clauses, which return 50 per cent of the net estimated savings to the contractor, are in all construction contracts. ROICCs and AROICCs are also instructed to review designs during construction for possible cost saving changes.

Design phase VE is also practiced by the EFDs. VE clauses are in most AE contracts. In addition the EFD Design Division conducts VE at the milestone reviews. The approaches to VE vary among the EFDs as much as they do

among CMs. Some EFDs are practicing a structured, systematic VE program with at least one individual highly trained to head the program. Other EFDs have held training sessions for all design personnel and now rely upon each individual to apply VE in his daily work.

It is this author's opinion, and that of several individuals within EFD organizations who were interviewed, that the Navy's VE program could be improved. The VE program should be a systematic, continuous process, not a review process at milestones only. It should be applied to each system as it is designed. Because many AEs tend to apply VE only after they are having money problems, the EFD and AE should conduct a joint VE program. If a standardized, systematic approach were used, the smaller projects, which tend to be value engineered only when they run into trouble, could be handled the same as larger projects.

Cost Control: The cost control procedures of an EFD fall short of those provided by a CM. The responsibility to keep the design within the budget established by Congress is primarily that of the AE. The EFD merely reviews the AE's cost estimate at the design milestones and recommends adjustments if necessary. Again some AEs may contract for cost consultant services to provide more accurate estimates, but they are not required to do so.

The EFDs have good estimating capability. They have the added advantages of being familiar with the

peculiarities of Navy projects. There is, however, little computerized estimating being done by the EFD, a capability which could greatly enhance the quality of early estimates. NAVFAC does have a computerized estimating system, but it is not presently utilized to any great extent by the EFDs.

From the interviews conducted it is this author's impression that one area for improvement in the Navy construction program is to provide more accurate early estimates for submittal to Congress.

Schedule Control: Because NAVFAC does not use the fast-track technique the scheduling requirements are less demanding. As mentioned earlier, many projects are completely designed before the money to construct them is appropriated, thus eliminating a tight design schedule. Design scheduling for the most part is limited to establishing milestone dates.

During construction the general contractor is normally responsible for scheduling. The EFD frequently establishes the type of network schedule to be used. This is a responsibility of the Construction Division. The complexity of the scheduling technique varies with the complexity of the project.

NAVFAC does have computerized scheduling capability, which is known by the author to have been used on overseas construction. It is not known to what degree EFDs are using or are capable of using the system.

Bidding Procedures: As explained in Chapter 3, the EFDs conduct the bidding procedures for all major Navy construction projects. It is doubtful whether a CM could be of additional benefit in this area. If NAVFAC should decide to use separate-contract phased construction, bid packaging would be a new requirement and experience for the EFD.

Construction Phases Services: Law prohibits the use of government personnel for major new construction within the United States; consequently this construction is accomplished through private contract, generally single contract, fixed price. The Navy does supervise and inspect each project. The ROICC staff, as described in Chapter 3, performs the construction administration. Again, it is doubtful whether a CM could be justified in providing construction phase services, unless it were on a fast-track project.

As has been implied several times, NAVFAC has not used the fast-track technique as defined in Chapter 2. A small amount of separate-contract work has been done. In these instances the individual contracts were for separate buildings, or other complete projects within an overall project.

There are two factors working against the adoption of fast-tracking. First, Congress is reluctant to fund only a portion of a project or to commit funds beyond one year. Second, the shear length of Congressional review

permits the majority of projects to be completely designed before funds are available to start construction.

CHAPTER 7

CONCLUSION AND RECOMMENDATIONS

7-1 Introduction

If one studies the Navy Military Construction Program cycle (Figure 6-1) with the intention of finding a way to reduce costs and shorten the conception-to-completion time of the projects, it is apparent there are two times when NAVFAC is in control of the project. First, NAVFAC is responsible for project planning and programming, and second, after the review stages NAVFAC is in control during design and construction.

Since NAVFAC can prepare preliminary designs and estimates on more projects than are eventually funded each year, one can conclude the planning and programming phase is not a bottleneck in the cycle. The large backlog of projects which does exist is a bottleneck in that many routine priority projects must stay in the backlog several years before their priority is high enough to make the program. If money is saved during design and construction, more projects can be programmed in each year and the backlog reduced, or at least its rate of increase reduced.

It has previously been shown that Construction Management and fast-tracking have the potential to save an

owner time and money. The remaining sections of this chapter discuss the applicability of these techniques to NAVFAC design and construction.

7-2 Opportunity for Fast-Tracking

As pointed out in the previous chapter, the simple geometry of the Program cycle permits NAVFAC to complete design on many of their projects each year before the funds for construction are appropriated. This basically eliminates the opportunity for fast-tracking on these projects.

Other projects are only 30 per cent designed when construction money becomes available. Many of these projects are complex and large enough to permit phasing. Those projects which are of high enough priority to demand early completion or which can show cost savings through the phasing of design and construction should be fast-tracked.

If these projects are fast-tracked, the question arises whether the in-house staff of the EFD and subordinate ROICC offices could manage them. The major difficulty would occur during construction when the ROICC would be required to coordinate the work of the various prime contractors. There is no obvious reason that a ROICC office could not be staffed to meet the challenge of a phased project; however, it might be advantageous to learn from an experienced fast-tracker, the CM, on the

first few projects.

A second instance where fast-track is applicable to Navy construction is on the Special Projects, such as the Bethesda and Trident programs now in existence. Because such programs warrant special OICC organizations, one can assume they will be large and will have high enough priority to require the shortest possible duration. The staffs are established exclusively for the one project and could be patterned to handle a fast-track project.

A third possible use for fast-tracking is on projects pertaining to national emergency, where time is quite often critical. If contingency plans did call for utilizing fast-track in such cases, it would be logical to become familiar with the technique before an emergency occurs.

For those projects 100 per cent designed before funds are appropriated there does exist the option of separate-contracts without phasing. There are advantages to this. First, it facilitates more direct communication between the building team and the contractors. Although an owner may hold prebid meetings with perspective subbidders under any contractual system, separate-contracting requires such meetings to discuss the portion of the project covered by each contract offer. These meetings can eliminate many items which could cause contingency increases in the bids.

Second, because subcontractors contract directly

with the owner, their bids are in the open, not hidden within a general contractor's bid. The building team can analyze each bid to determine which components are out-of-line with the budget.

Third, separate-contracts provide the opportunity to delay taking bids on items such as carpeting, painting, and landscaping, which are easier to bid nearer the end of the project. In the same light procuring long lead-time items separately early in the project is a form of separate-contracts.

Separate-contracts does of course have disadvantages. A considerable increase in coordination and supervision by the ROICC office would be necessary. The costs of this increase, plus the costs for additional contractor meetings and bid openings must be weighed against the money saved by eliminating the GC.

Under separate-contracts there is no single party responsible to the owner for the work. Since the Navy cannot use its own forces to do actual construction related work, the clean-up and other general conditions would have to be done by contract. Contingency work requirements, which inevitably appear and are handled by the GC on single contract projects, could cause problems.

The disadvantage in postponing some bid offers is that knowledge of total project cost is delayed until the last bid opening.

7-3 Modifying the EFD to Perform as a CM

In the last chapter it was shown that an EFD is not performing the CM functions of design input and cost control. The EFD's value engineering program should be modified, as discussed in Chapter 4, and if fast-tracking is used, schedule control will need improvement and bid packaging techniques must be developed.

The EFD is not securing local information on costs and availability of labor and materials. The ROICC organization is available and located properly but generally not staffed to obtain this information. The question arises whether the owner, who in the future may have contractual ties with the sources of information, is able to obtain accurate, reliable information as readily as the CM, who will not have contractual ties with these sources.

This is difficult to answer. CMs believe their contractual freedom facilitates more open communication with material suppliers, subcontractors, and trade unions, but those CMs who at times function as general contractors will not have contractual freedom per se. Furthermore, these suppliers and subcontractors may want the owner's business and may be very candid with him. The legality of a public sector owner seeking cost information prior to formal bidding must also be determined.

The computer is the backbone of cost control within

the large CMs. The development of computerized systems analysis and estimating at the EFD level is feasible. Without the design input as discussed above, however, the estimating quality will not be optimal.

If systems estimating is to be used, a closer working relationship between the AE and the EFD is necessary. Then, as the EFD monitors the budget, it can immediately inform the AE when specific components are out-of-line with the budget. The closer working relationship will also facilitate a joint value engineering program to keep the separate components within budget. Estimating and budgeting by systems complements the use of phased construction or separate-contracts without phasing.

In order to use separate-contracts, either phased or unphased, an EFD must develop a comprehensive scheduling control system to coordinate the work of the different prime contractors. This capability is available within the NAVFAC organization. It needs only to be implemented at the EFD level.

Bid packaging would be a completely new experience for the EFD. Proper performance of this function requires direct communication with the trades at the local level for background data. It involves pre-bid meetings to clarify documents and scope of each package. It requires the one doing the packaging to be totally involved in the design process. An EFD might be able to perform these requirements satisfactorily the first time. Certainly

with experience the skills could be developed, but again, there may be definite advantages in learning from an experienced CM on the first applications.

The ultimate question is whether any owner, not just the U.S. Navy, can perform as its own construction manager. This author believes an owner can come close, but because of the contractual tie between owner and architect and between owner and contractors, the owner's in-house section performing the CM functions does not have that arm's length, unbiased freedom of inquisition, deduction, and expression that a CM has.

7-4 Possibilities for NAVFAC to Hire a CM

If one is to assume no change will occur in the Navy Military Construction Program cycle, the practical application of Construction Management for NAVFAC would be to hire a CM for design phase services only. Construction would be accomplished in the traditional single contract manner. Both the CM and the AE should be in the role of consultants with NAVFAC maintaining strong control of the project. The CM should provide design input and cost control. The value engineering program should be conducted jointly by all three team members. Scheduling should remain under the control of NAVFAC although the CM may be able to assist in organizing the system.

A second way to accomplish the same is for NAVFAC to contract with one AE/CM firm or a joint venture of at

least one AE and one CM and require by contract those services listed above. Although the design firm on the Bethesda special project is such a joint venture, it was not required to be, and it is not required to provide those services. The author is advocating a mandatory requirement for an AE and CM combination in order to qualify for award of all design contracts over, say, two million dollars.

Such a contract should further stipulate the firm will obligate at the 30 per cent design stage to provide a completed design which can be built within the established budget. A cancellation clause for such an obligation should be included.

If NAVFAC considers fast-tracking or separate-contracts without phasing, the author feels a CM should be retained to assist in the bid packaging and construction supervision. The single contract with an AE/CM is applicable here also. A special project, as discussed previously, would be a good trial application.

The Trident special project did in fact include a contract with a joint venture of AE firms for a preliminary master plan and environmental impact statement. Several requirements of the contract were similar to Construction Management functions, including recommendations for construction procedures and building material availability. (21)

If the utilization of a CM proved favorable, the

technique should be adopted by EFDs for use on large projects. A shift of in-house design to only projects with an estimated cost less than the minimum established for CM projects, plus the adoption of CM techniques lacking in the current EFD in-house design process would increase the efficiency of the NAVFAC construction program.

As the EFD gained experience and increased its capability to perform all CM functions, it could take on larger projects in-house, possibly eliminating the need for a CM consultant altogether.

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APPENDICES

APPENDIX A

CONSTRUCTION MANAGEMENT FIRMS INTERVIEWED

John R. Pearse	ESPRO Management Corporation 620 Sherman Street Denver, Colorado 80202
R. J. Gragg	McKee-Berger-Mansueto 3913 E. Exposition Avenue Denver, Colorado 80209
John Johansson	Olson Construction Company 840 S. Jason Street Denver, Colorado 80223
David Necker	Petry CM 3970 E. Exposition Avenue Denver, Colorado 80209
Paul Penner	Penner Construction Management 1660 S. Albion Street, Suite 305 Denver, Colorado 80227
Dick Breaker	Gerald H. Phipps, Inc. 1530 W. 13th Avenue Denver, Colorado 80204
Les Hoover	Pinkard Construction Company 1075 S. Yukon Avenue Denver, Colorado
Howard Clunn	Turner Construction Company 1515 Arapahoe Street Denver, Colorado 80202
James Durbin	Weaver Construction Company 2115 S. Valentia Street Denver, Colorado 80222

APPENDIX B

NAVY CONSTRUCTION ADMINISTRATORS INTERVIEWED

Naval Facilities Engineering Command

Commander F. M. Newcomb
Interagency Construction Division, Director

Walter E. Douglas Jr.
Interagency Construction Division, Deputy Director

Raymond J. Murphy
Facilities Planning, Atlantic Liaison Division, Director

Paul Plasaunce
Chief Construction Engineer

Chesapeake Engineering Field Division

Robert A. Hackley
Manager, Acquisition Project Management

P. G. Belcher
Project Manager, Acquisition Department

Robert J. Walsh
Director, Construction Division

Ron. J. Morony
Manager, Structural Engineering Branch

OICC Bethesda

Commander W. J. O'Donnell
ROICC Bethesda

APPENDIX C

GENERAL SERVICES ADMINISTRATION

CONTRACT REQUIREMENTS OF CONSTRUCTION MANAGER[1]

DESIGN RELATED SERVICES.

The services to be performed by the Construction Manager shall consist of consulting with, advising, assisting, and making recommendations to the Project Manager and the Architect-Engineer on all aspects of planning for the project construction. Such services shall include, but are not limited to, the following:

a. Plans and Specifications Recommendations. Participate in the development of architectural, civil, mechanical, electrical, and structural plans and specifications, advising on the site, foundations, selection of systems and materials, and making recommendations with respect to such factors as construction feasibility, suggested economies, availability of materials and labor, time requirements for installation and construction, and costs.

b. Construction Quantity and Cost Estimate. Prepare and submit to the Project Manager a budget estimate at the tentative stage and a comprehensive quantity and cost estimate of construction when the working drawings are 50% complete. The Construction Manager shall revise and refine these estimates at least monthly as the working drawings are developed. The Construction Manager shall advise the Architect-Engineer and the Project Manager whenever the construction cost estimate is tending to exceed the estimated cost or whenever the design is such as to preclude meeting completion schedules.

c. Long Delivery Procurement. Recommend for purchase by the Project Manager and expedite long lead time procurement of machinery, equipment, materials, and supplies needed for the project.

d. Separate Construction Contract Documents. Review plans and specifications with the Architect-Engineer and make recommendations to the Project Manager and Architect-

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[1]General Services Administration, The GSA System for Construction Management. Washington, D. C., Public Building Service, 1974, Attachment A, pp. 5-10.

Engineer regarding the division of work for the purpose of bidding and awarding of separate construction contracts by the Government to permit phasing of construction work during the design development and the project construction. The Construction Manager shall take into consideration such factors as the type and scope of work to be performed, time of performance, availability of labor and materials, community relations and other pertinent criteria, relating to the various trades involved.

e. Interfacing Separate Construction Contracts. Review the plans and specifications with the Architect-Engineer so as to eliminate areas of possible conflict and overlapping jurisdictions among the Separate Contractors on the job so that the work on the project may be advanced and completed as expeditiously as possible.

f. Job-Site Facilities. Review the specifications to assure that they contain (1) provisions for all of the temporary facilities necessary to enable contractors to perform their work and (2) provisions for all of the job-site facilities necessary to enable the Construction Manager, and the Project Manager to perform their duties in the management, inspection, and supervision of construction; provided however, that upon recommendation of the Construction Manager the Project Manager may elect to require the Construction Manager to furnish such facilities or portions thereof, in accordance with paragraphs 32 through 43 of this agreement.

g. Weather Protection. If extreme weather conditions can be anticipated at the site, the Construction Manager shall recommend what temporary enclosures if any, of building areas, are practical to assure orderly progression of the work. The Construction Manager shall also recommend whether these requirements should be incorporated in the construction documents of the construction contractors or accomplished by the Construction Manager in accordance with paragraphs 32 through 43 of this agreement.

h. Bid Documents and Data. Review the construction specifications and drawings and prepare bid packages, with supplementary information as required, to permit the Government to take separate competitive bids for appropriate segments of construction in accordance with Government procedures. Conduct pre-bid conferences to inform Separate Contractors of requirements. Review proposals and make award or rejection recommendations.

i. Construction Management Control System. Implement for design the control system described in Appendix 2 of this agreement.

j. Meetings. The Construction Manager shall take, transcribe, and distribute to all parties minutes of any meetings when requested by the Project Manager.

k. Value Engineering (VE) Services. Provide the Design Phase and Standard Services required of a Construction Manager by Chapter 7 of GSA Handbook, Value Engineering, PBS P. 8000.1.

CONSTRUCTION RELATED SERVICES—OPTION.

At the sole option of the Project Manager, to be exercised in writing within one year of the date of this contract, the Construction Manager will provide management and related services for construction stages of the project. Such services shall include, but are not limited to the following:

a. General. Coordinate and provide general direction of the work and progress of the Separate Contractors on the project.

b. Supervision and Inspection. Maintain a competent full-time supervisory and inspection staff at the job-site for the coordination and direction of the work of the Separate Contractors. Conduct factory inspections as required.

c. Inspections and Interpretations.

(1) Inspect the work of the Separate Contractors on the project as it is being performed until final completion and acceptance of the project by the Government to assure that the materials furnished and work performed are in accordance with the working drawings, specifications, and other contract documents and that the work on the project is progressing on schedule. In the event the interpretation of the meaning and intent of the plans and specifications becomes necessary during construction, the Construction Manager shall make recommendations to the Project Manager, obtain the Project Manager's interpretation in writing and transmit same to the appropriate Separate Contractor.

(2) The Construction Manager is encouraged to employ personnel of the design Architect-Engineer to supplement his inspection staff.

d. Organization. Establish on-site organization and lines of authority in order to carry out the overall plans of the Government and the Architect-Engineer in all aspects of the project on a totally coordinated basis.

e. Job-Site Staff. Prepare and submit to the Project Manager an organization chart, showing the Construction Manager's proposed job-site staff. Include a brief resume on each individual on the staff. Such organization chart, the size of such staff, the job classifications and salaries of staff personnel and any subsequent changes shall be subject to the prior written approval of the Project Manager.

f. Procedures. Establish procedures for coordination among the Project Manager, the Architect-Engineer, the Separate Contractors and the Construction Manager with respect to all aspects of the project and implement such procedures at the direction of the Project Manager.

g. Job-Site Meetings. Conduct pre-construction conferences with successful bidders. Schedule and conduct job meetings to be attended by the Separate Contractors and representatives of the Project Manager to discuss such matters as procedures, progress, problems, scheduling, and equal employment opportunity. The Construction Manager shall take, transcribe and distribute to all parties minutes of such job meetings.

h. Construction Estimate Revisions. Revise and refine construction estimate as construction proceeds, and as required to incorporate approved changes to the project as they occur. The Construction Manager shall advise the Architect-Engineer and the Project Manager whenever construction costs are tending to exceed the estimated costs.

i. Subcontractor—Material Vendor Recommendations. Make recommendations to the Project Manager regarding the approval of subcontractors and material vendors where required by the specification.

j. Shop Drawings, Materials, and Samples. Establish and implement procedures to be followed for expediting the processing and approval of shop drawings, catalogs and samples, and the scheduling of material requirements.

k. Labor and Materials. Determine the adequacy of the Separate Contractors' personnel and equipment and the availability of necessary materials and supplies; take the action necessary to maintain the job schedule.

l. Safety. Review the safety programs as developed by each of the Separate Contractors, make recommendations to the Project Manager regarding a comprehensive project safety program, and require each Separate Contractor to adhere to such program. (The performance of such services by the Construction Manager shall not relieve the Separate Contractors of their responsibilities for the

safety of persons and property, and compliance with all statutes, rules, regulations and orders applicable to the conduct of the work.)

m. Labor Relations. Make recommendations and render assistance as necessary for the development and administration of an effective labor relations program for the project and the avoidance of labor disputes during construction.

n. Construction Management Control System. Implement for construction the control system described in Appendix 2 of this agreement.

o. Job-Site Records. Maintain at the job-site on a current basis records of all contracts including: shop drawings; samples; purchases, subcontracts; material; equipment; applicable handbooks; Federal, commercial, and technical standards and specifications; and any other related documents and revisions thereto which arise out of this contract or the construction work. Prior to final payment, the records will be delivered to the Project Manager.

p. Time and Material—Unit Cost Records. Maintain cost accounting records in accordance with the Government's procedures with respect to portions of the work to be performed by change order or otherwise on a time and materials, unit cost or similar basis requiring the keeping of records and computation therefrom.

q. Progress Reports and Records. Keep accurate and detailed written records of the progress of the project during all stages of construction; submit monthly written progress reports to the Project Manager including, but not limited to, information concerning the work of each of the Separate Contractors, the percentage of completion and the number and amount of change orders. Maintain a daily detailed log of all events occurring on the job-site or connected with progress of the project. The log shall be open to the Project Manager at all times and shall be turned over to him at the completion of the construction.

r. Contractor's Payments. Review and process all applications by the various contractors for progress payments and final payments and make recommendations to the Project Manager for approval thereof in accordance with the current printout of the Construction Management Control System.

s. Change Recommendations. Make recommendations to the Project Manager for such changes in the work as the Construction Manager may consider necessary or desirable.

t. Change Requests. Review all requests for changes including the drawings and specifications therefor and submit recommendations to the Project Manager.

u. Change Orders. Implement the Government's procedure, document, and administer the processing of change orders, including applications for extensions of construction time from the Separate Contractors.

v. Claims. In the event any claim, including appeals to the GSA Board of Contract Appeals, is made or any action brought in any way relating to the design or construction of the project, the Construction Manager shall diligently render any and all assistance which the Government may require, including preparation of written reports with supporting information necessary to resolve disputes. Such services shall be rendered by the Construction Manager without additional fee or other compensation except for the costs and expenses of personnel who were assigned to the project as job-site staff. Payment for the services of such personnel shall be in accordance with the provisions of paragraph 13 of this agreement.

w. General Condition Items. Furnish general condition items as required in accordance with paragraphs 32 through 43 of this agreement.

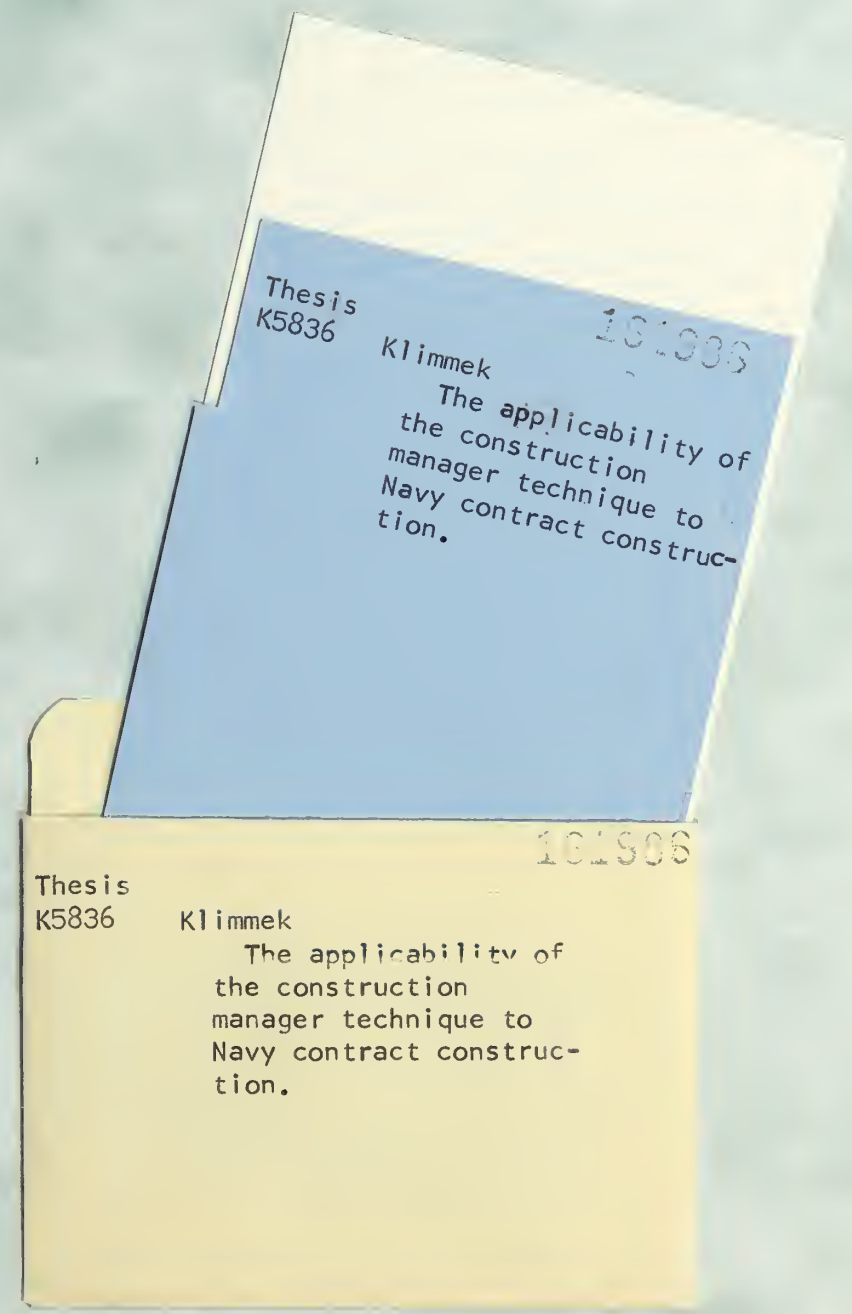
x. Overall Dimensions and Elevations. Furnish certified records in duplicate of building and approach lines; elevations of bottoms of footings, floor levels, and approaches made as the work progresses. Each record shall be certified by both the Construction Manager and the Resident Engineer.

y. As-Built Drawings. Maintain at the job-site a current marked set of the working drawing prints and specifications. Upon completion of construction, turn over the marked set to the Project Manager.

z. Assist Government Inspections. Assist Government personnel when they perform 25, 50, and 75 per cent; pre-final; and final inspections. At pre-final and final inspections, furnish a detailed report to the Project Manager of observed discrepancies, deficiencies, and omissions in the work performed by any contractor.

aa. Long Delivery Procurement. At the direction of the Project Manager, accept delivery and provide on-site storage, protection, and security on items procured under paragraph 4c, until such items are turned over to the Separate Contractors for installation.

bb. Value Engineering (VE) Services. Provide the Construction Phase and Standard Services required of a Construction Manager by Chapter 7 of GSA Handbook, Value Engineering, PBS P 8000.1.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