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DESIGN BUILD DELIVERY AND THE AIR FORCES' APPLICATION OF THE CONCEPT

by

DAVID F. DEMARTINO, BS

REPORT

Presented to the faculty of the Graduate School of
The University of Texas at Austin
in Partial Fulfillment
of the Requirements
of the Degree of

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CHAPTER I INTRODUCTION

1.1 Impetus

Owners entering into new construction projects are traditionally guided by three major considerations: quality , cost and time. Decisions concerning construction contract methods are dominated by these considerations. the prudent owner evaluates the performance of different methods with these items in mind. In situations where a project is very time sensitive, the owner may decide on fast-tracking to ensure early completion. In this situation a design-build contract may be desired because it is an effective delivery method for this type work.

The military owner should be no different. Quality, cost and time must still be evaluated when determining contracting strategies. However, the Air Force traditionally limits itself to using a lump sum contract at the end of a design-bid-build process. This process has been favored because it is easy to apply competitive bidding techniques. it is fair to the public and the competing contractors. it avoids subjectivity, and limits the possibility of corruption and political influence. On the other hand, concentrating on one strategy ignores a wide spectrum of potentially successful contractual instruments and delivery strategies.

Realizing that there are other strategies successfully used by private owners Congress challenged the Air Force Engineering community to examine the process by which facilities are acquired through the Military Construction Program (MCP). The "Design Delivery and Construction Strategies" report was the result of this self-examination process as it looked into potential changes to the MCP process. One of the recommendations originating from this was the consideration of a design-build strategy

is some MCP work. The focus of this study will be to review design-build delivery. The report will then look at the Air Forces application of the design-build concepts.

1.2 Scope of Work

Design-build work has been performed for many years by a variety of owners, A-Es and contractors. This study will begin with a brief discussion of "What is design-build" including related terms and typical uses. Advantages and disadvantages will be reviewed to see if design-build favors either the owner or the contractor. Included in the discussion will be any additional requirements for the owner and contractor when performing design-build work.

The ultimate goal of the report is to review the Air Forces application of design-build. The report will begin by looking at any previous use of design-build for military projects. This will include a discussion of government imposed limitations that did, or still do, affect the use of design-build. Finally, the report will look at the Air Forces' application and how it has been applied to recent projects. Have these projects been successful? Is there a future for design-build construction in the military?

1.3 Purpose of Study

This study is done to better understand the design-build process. In doing so, the report will also look at the Air Forces application of design-build concepts. By observing how it is done and how well it is working, changes may be made to improve government contracting strategies.

If a design-build approach allows for improved quality, cost and time, its continued use is essential. By reviewing the results of some completed Air force design-build projects, conclusions may be drawn as to its future applications and success.

CHAPTER II GENERAL--THE DESIGN-BUILD PROCESS

2.1 DEFINITIONS

What is design-build? Before jumping into a definition of the design-build process, it is important to make sure everyone is speaking the same language. Although design-build concepts are widely used, the terms are not always universally accepted. For the purposes of this paper, the following definitions will be used.

1. **Fast-track**--the process where a portion of the project is under construction while the remainder of the project is still being designed. The design may be completed in separate packages (phases). As each package is completed it is released for construction while the designer continues to work on the remaining items. This method has seen some recent use by owners trying to save time on the constructed project (will also save on financing and other costs). Fast-tracking works very well with design-build work, it is not advisable in more traditional forms of contracting where the design has to be completed prior to bidding and contracting the project construction (Tieder).

2. **Turnkey**--the process where an owner delegates all responsibilities of design and construction to an entity (contractor). The contractor agrees to provide a completed facility on the basis of performance specifications provided by the owner. This entity assumes responsibility for providing all services associated with developing and, designing and constructing a project until the consumer "turns the key in the front door". The contractor may even assume responsibility for project operation. In order to be successful, a turnkey project must begin with a complete, detailed performance specification provided by the owner. The owner loses project control after this point

and therefore must have a lot of confidence in the contractor. For this paper the terms turnkey and design-build will often be used interchangeably (Lovejoy 1989).

3. **Traditional**--also called the conventional method. An A/E is hired to design the project. After design is complete, the project is advertised for construction. A contract is awarded for construction based on low bid (Levy 1987).

4. **Predesign-Design build**--a process where the owner prepares a preliminary design but the final design and the construction is completed by the contractor. Preliminary design is little more than a detailed scope or description. Less risky than one-step for both parties. More detail is put into the owner requirements, there is less chance for conflict (USAF/LEE 1989).

5. **One-step procurement**--a process where the request for proposal (RFP) is usually based on performance specifications and general description. The owner tells how he wants equipment/facility to perform, the contractor designs to these standards. Proposals are detailed and evaluated on technical merit and cost (USAF/LEE 1989).

6. **Two-step procurement**--a process by which the solicitation is requested without price information. The proposals are then evaluated on merit and applicability/compliance with the RFP. Bids are invited/requested only from those companys that submitted acceptable proposals. Awards are then based on low bid. This process allows a design-build process to be competitively bid without using price as the sole consideration (USAF/LEE 1989).

7. **Full service company**--a company that is capable to perform both the design and construction within itself. No outside company needs to be hired or joined to perform the main functions of the contract (Wideman 1989).

8. **Joint venture**--a process where the designer and the contractor (prime) form a joint venture for a specfic project. They come together (form a team) to provide the design-build services (Wideman 1989).

9. **Prime-sub arrangement**--a process where either the designer or the contractor hires the other to perform the required services as a subcontractor. One party is contracted by the owner and they hire the other to help provide the design build services (Wideman 1989).

10. **Construction Management**--a process where an entity is hired to administer the work. The construction manager (CM) performs little or no construction work. Contractors are hired to work as primes for the construction manager (Tieder).

11. **Design/CM**--a process in which a construction manager performs design and then manages trade contractors to build the project either as an agent for the owner or as an independent contractor (Lovejoy 1989).

12. **Single prime contract**--a process where a single contractor is responsible for all the construction work. There is only one contract with the owner for construction. On almost all such projects, a portion of the work is subcontracted to various subcontractors (Tieder).

13. **Multi-prime contractor**--a process where several contractors perform the construction work, all have contracts with the owner. Many of the prime contractors typically perform as subcontractors (Tieder).

The construction project delivery methods discussed above (items 1-6) are shown in FIGURE 2.1. Some of the contractual arrangements discussed above (items 10-13) are shown in FIGURE 2.2 and FIGURE 2.3

FIGURE 2.1

CONSTRUCTION DELIVERY METHODS

(USAF/LEE 1989)

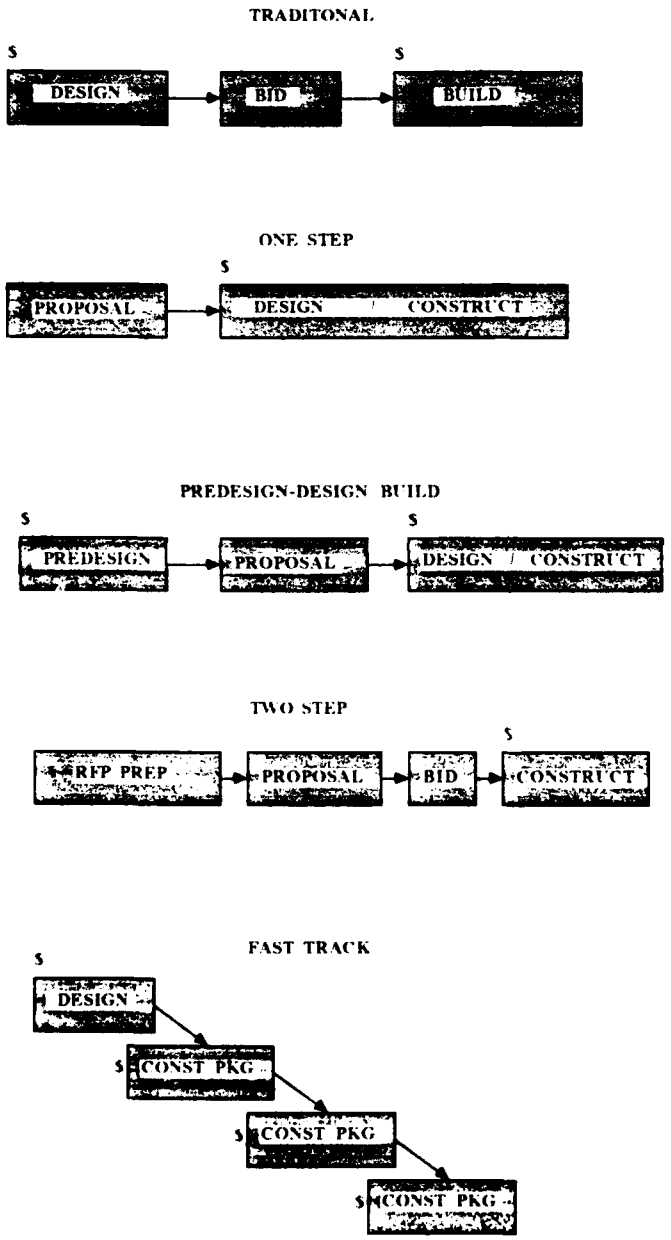


FIGURE 2.2

CONTRACT ARRANGEMENTS

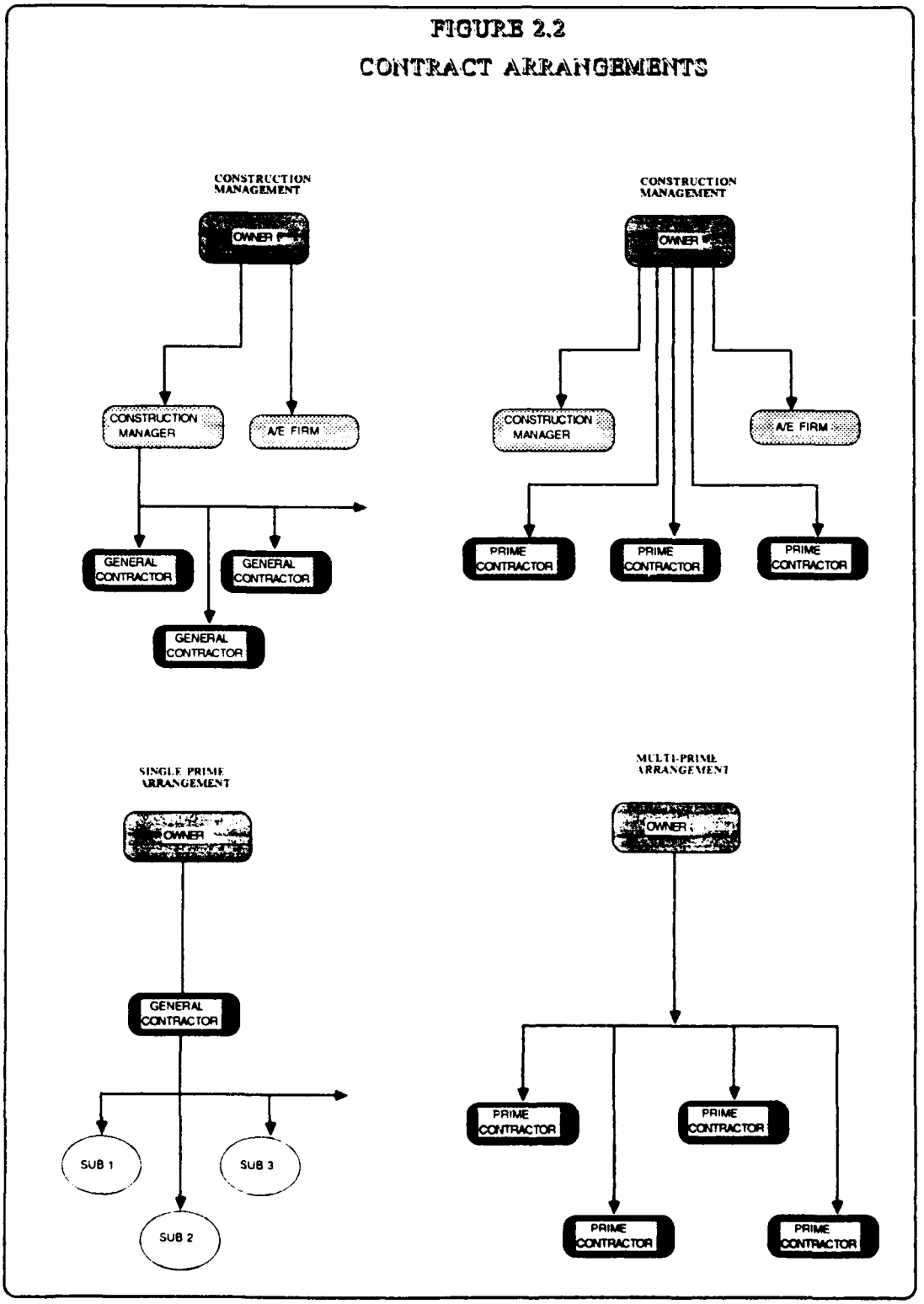
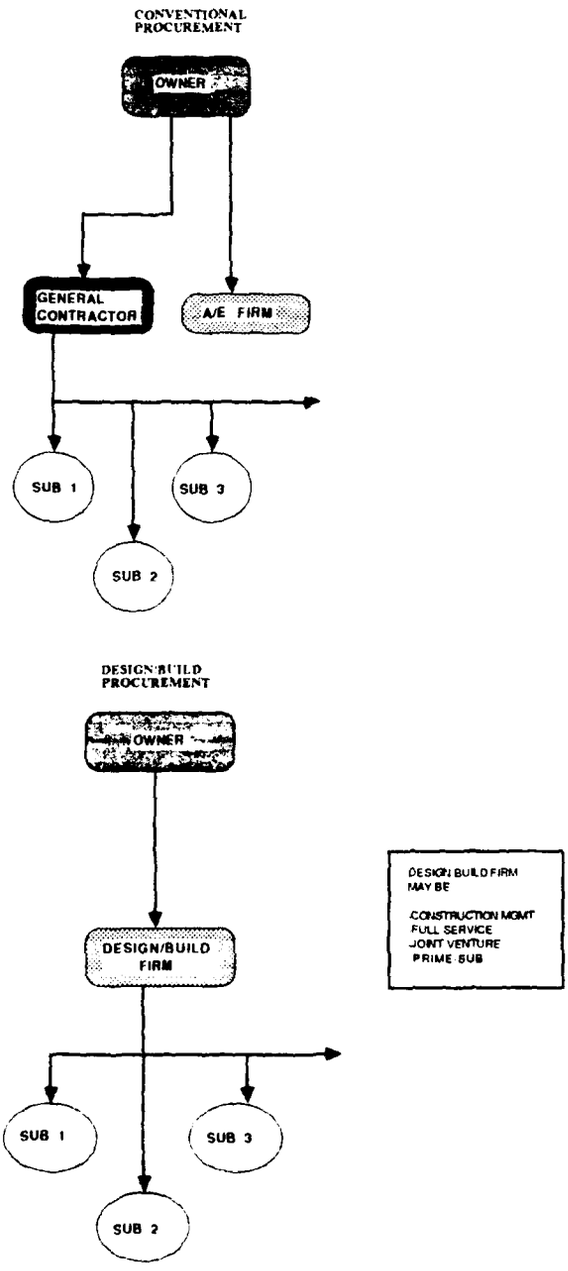


FIGURE 2.3

TRADITIONAL vs DESIGN-BUILD



2.2 WHAT IS DESIGN-BUILD

Design-build has been practiced by builders since the 15th century in one form or another (Dugan 1989). The earliest records of design-build describe a man called "Hamurabi" who was asked to move a large monolith about two blocks in a short period of time. The request came from a ruler who wanted the work done by one responsible party.

The concept behind single source responsibility has evolved to what is termed today as design-build. Design-build that utilizes fast-tracking, cost control and construction management allows the client quicker recovery on capital. This method, in most instances, provides a nonadversarial relationship through the single source contract.

In simple terms, design build is the process where both the designing (preparation of construction plans and specifications) and the construction of a project are controlled by one entity. The entity may be a construction manager (design/CM) who does not get involved in any of the building but just manages the work. On the other hand, the entity may be a general contractor (GC) that performs or subcontractors much of the construction. The key difference is there is no traditional architect/engineer (A/E) who contracts separately with the owner for design services; the A/E is managed by the same entity as the contractor(s) [FIGURE 2.3]. The entity may be the result of a joint venture, a full service company, or a prime-sub arrangement. The construction work itself may be performed by a single prime or multi-prime contract. For purposes of this paper, the design-build entity will be referred to as the design-build firm or just the contractor.

2.3 TYPICAL USES OF DESIGN BUILD

Turnkey construction in the United States dates back to 1913. Cleveland's Austin Company designed and built a lamp factory for the nation's first industrial research park. This approach to construction was very simple for the organization since the elder Austin was a contractor and his son was an engineer. Not all construction companies have the available resources to perform both design and construction so design-build did not catch on right away. The U.S. petroleum industry was one of the first to adopt the approach. The idea behind its use was that the industry would find the oil and process the petroleum products while someone else was responsible for putting the refinery into operation. Since then, many other industries have started using the design-build process including some public utilities and agencies (Greenfield 1982).

The Engineering News Record (ENR) annually identifies a list of the top 50 contractors in construction and design. This list identifies contractors that work both design/construct and design/CM. According to ENR (1989), of the top 50 contractors, design/construct accounted for 23 percent of the revenue earned and design/CM represented 18 percent. This is a total of 41 percent of the revenue of these firms. The list is primarily private work geared towards manufacturing plants, chemical process plants and power plants (Lovejoy 1989).

As mentioned previously, not all use is limited to private owners. The State of Massachusetts is one example of a public entity using design-build methods. Due to severe overcrowding in prisons, fast and economical means of constructing new facilities were sought. A design-build method was established with goals of minimizing the length of time for construction, assuring cost effective high quality

design and construction and maintaining critical public protections (Lee 1985) .

The process to this point has received mixed reviews. The state Inspector General (IG) published a report in March 1988, The Commonwealth Design-Build Experiment (Barresi 1988), reviewing the process to that point. There were four projects under construction and per the report, the design-build system was not achieving the goals of reduced project time or maintaining public protections. The Deputy Commissioner of the Division of Capital Planning and Operations (DCPO) published a report in response to the IG's. This report painted a totally different picture showing success with the design-build method. Other than typical learning curve problems, the DCPO was convinced the system was working. A contractor from one of the projects also submitted a report in May 1988. This report generally concurred with that of the DCPO stating that there was merit in the design-build methods employed, as the parties became more familiar then more efficiencies will be realized.

Historically, turnkey construction has been much more popular in Europe and South America. The French have been using a design-build system for years. In their system, the contractor is responsible for detailed design which must be approved by a commercial National Technical Control Bureau (Australia 1988). This Bureau assures design compliance with any laws or regulations and also provides the contractor with any technical assistance the contractor may require. This system relies heavily on the expertise of the contractor, it also puts a lot of risk on the contractor. In spite of this, one particularly impressive feature is the assertion that 95% of this construction is claims free.

The United States has nowhere near the level of use or the success rate of the French with design-build. There are, however, signs of growing acceptance of design

-build here in the United States. One positive sign is both the Associated General Contractors (AGC) and the American Institute of Architects (AIA) have published standard forms for design-build projects (Tieder). Both the owner and the contractor benefit when using these standardized forms. The contractor benefits because he can become familiar with the contents of the form and because the owner has less opportunity to shift project risk. The owner also benefits because the contractor does not need to increase his bid to offset the additional risks and uncertainties.

The establishment of standard forms and the previous examples of design-build work should raise some questions. Why use design-build at all? In what way is a design-build contract better or worse than a traditional contract. What are the risks, what are the benefits (advantages/disadvantages) realized when using a turnkey type contract. Should all entities expect to be 95% claims free? Will an owner have problems maintaining public protection? What should the parties expect?

2.4 ADVANTAGES AND DISADVANTAGES OF DESIGN BUILD

What makes design-build work any more or less desirable than traditional delivery methods? Are there certain advantages and disadvantage that are associated with it? When you evaluate methods of delivery for construction, the main considerations must be quality, cost and time. How does design-build compare when comparing these factors? In many articles published on the design-bid-build (traditional) method of delivery, it is said "TIME, COST, QUALITY..... .Chose any two." Design-build, on the other hand, is thought to bring the opportunity to achieve all three: reduced schedules, lower costs, and improved quality (Dugan 1989). This is accomplished using fast tracking for schedule improvements, having earlier completion

and therefore quicker capital recovery, and maintaining quality through a single-source contract for quality assurance/quality control from project inception to project completion. At this point it is important to take a closer look at some of the specific advantages and disadvantages associatied with design build work.

2.4.1 ADVANTAGES of DESIGN-BUILD:

1. **CONSTRUCTABILITY IMPROVEMENTS.** Design-Build allows the contractor more creativity and permits use of "constructability concepts". The construction contractor knows what the men and equipment in the field are capable of accomplishing. When this knowledge is coupled with the designers technical knowledge, a more buildable (constructable) design is produced (Dibner 1983). This will save time and money and improve project quality. Both the owner and contractor benefit.

2. **PERMITS PHASING OR FAST TRACK WORK.** As mentioned in the definition, D/B is very compatible with fast-track work. As the designer finishes portions of the design (foundation etc.), the contractor can begin construction. This results in earlier completion times. If the beneficial occupancy date of a facility is critical, design-build and phasing offers the opportunity to overlap the design and construction and shorten the delivery process. During a price escalation, money is saved by buying materials and completing construction before the prices rise. The fast track process is a fundamental element of design-build and is one of the major aspects of its marketability. This advantage will save time and possibly money. The owner benefits more than the contractor (Dugan 1989) (Wideman 1989).

3. **ONLY ADVERTISE PROJECT (AND PROCURE) ONCE.** You

do not need to advertise the project again after design is completed as with a traditional design/construct project. This saves time and may save money for the owner (Dugan 1989).

4. **CHANGES AND CLAIMS CONTROL.** Since a turnkey project is designed and constructed by a single firm, it leaves little room for claims. Typically the owner is in a bad spot because he has contracted designer and constructor separately. Claims from one party always go through the owner. This is not the case with a design-build contract.

Changes are very similar. Since the designer and builder are working together, if one of them makes a change it does not go to the owner and turn into a cost increase. The only changes that will affect the project are those ordered by the owner. If the scope or request for proposal (RFP) is sufficiently detailed, changes by the owner will be minimal. This key advantage saves everyone time and money (Dibner 1983).

5. **SINGLE SOURCE CONTRACT. (NON-ADVERSARIAL)** This contract should develop a win-win approach between the parties facilitating closer cooperation and similar goals. The parties form a design-build team that fosters a relationship of professionalism. Design-build requires that all parties share the same goal even if for totally different reasons. All parties want to manage and minimize costs. The owner minimizes cost to stay within a restricted budget. The design-build firm manages costs to reduce risks and increase project profits. Although most traditional projects control cost for similar reasons, more benefits are achieved from the design-build team approach. Since both parties are managing them, costs should be lower, time and quality may also be positively affected. Both parties benefit (Australia 1988).

6. **SOLE RESPONSIBILITY FOR DELIVERY.** The design and construct entity is responsible for the design and therefore places more focus than usual on cost implications of the design. This will include buildability (constructability), alternatives, coordination of design and timely documentation. There is also a reduction of contractor interface problems, jurisdictional disputes and delay claims. (Dibner 1983) Any design problems affecting cost, time or errors are usually problems (liabilities) for the contractor, not the owner. This idea is not universally accepted as many professional societies feel if the contractor is in control of the project, designer professionalism may be compromised. (McGinnis 1990) The owner probably benefits more from a contract with single responsibility for delivery.

7. **ONE-STOP SERVICE TO THE OWNER.** For the uneducated owner, design-build allows them to contract with only one source. This is helpful to owners who care less about how the work is accomplished and more about the final product. Can be a big timesaver for the owner (McGinnis & Tucker 1988).

8. **TIME/COST INFLUENCE CURVE** [FIGURE 2.4]. Successful design-build work demands the project scope be developed very early and that it be very detailed. After project definition, the owner should do his best not to make any "design related" changes. At the very least, the owner must not make changes after the design is completed. Once construction begins, any changes severely hurt job progress, things become much harder and more expensive to change. Once construction has started, changes cause work stoppage, rework and low morale of workers. You negate all the benefits of time and cost realized with the turnkey process. Both parties benefit when time and cost influence concepts are used effectively. (Hendrickson 1989).

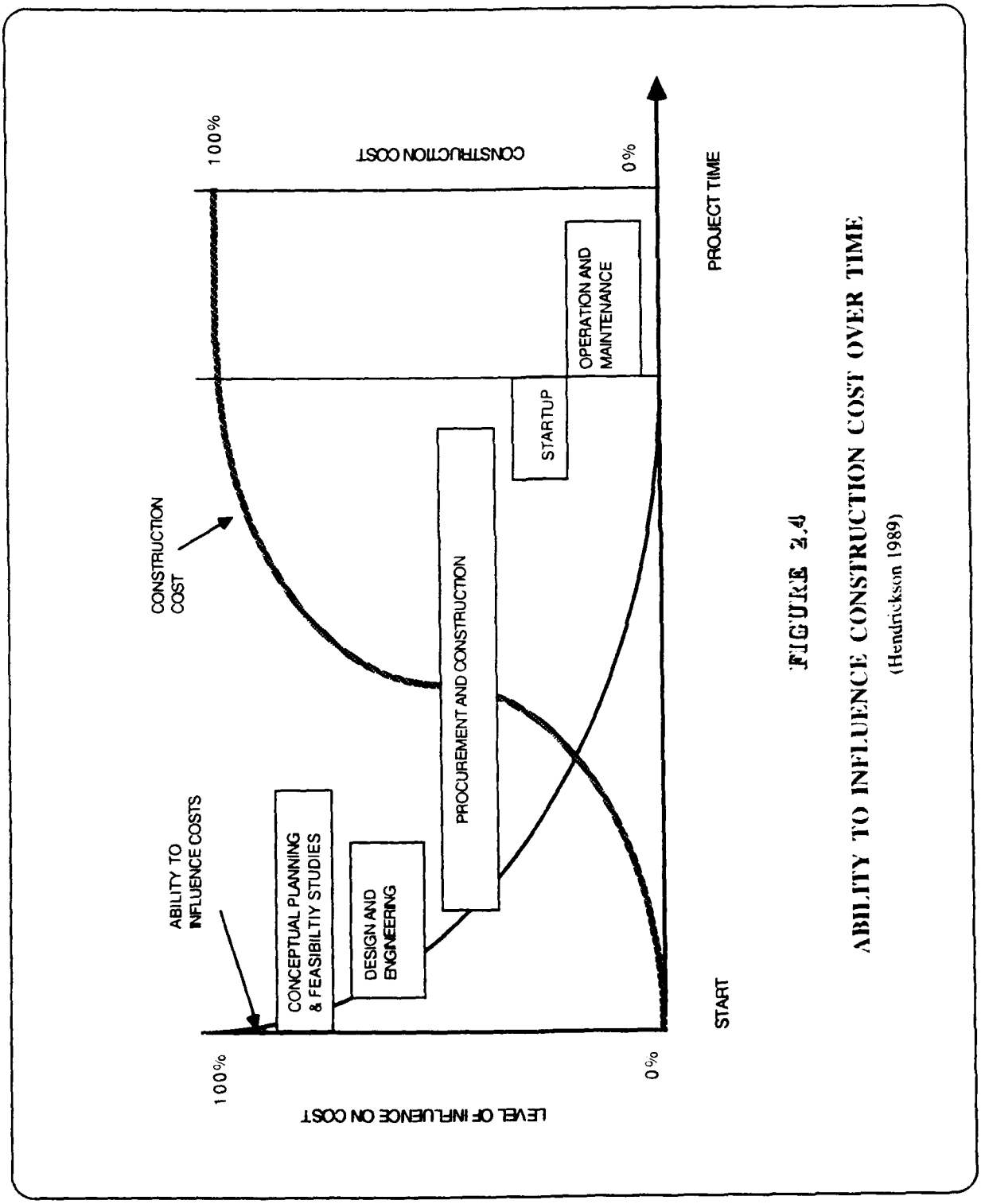


FIGURE 2.4

ABILITY TO INFLUENCE CONSTRUCTION COST OVER TIME

(Hendrickson 1989)

2.4.2 DISADVANTAGES OF DESIGN BUILD:

1. **TOUGH TO APPLY COMPETITIVE BIDDING PROCEDURES.** More frequently design-build work is awarded through negotiation. On the other hand, most public/military construction is competitively bid. It is difficult for a contractor to prepare a bid on a project that has not been designed. Creative bidding techniques, including two-step procurement, can help here. This disadvantage applies more to owners than contractors (Dugan 1989) (Dibner 198

2. **COMMUNICATION.** POOR COMMUNICATION BETWEEN OWNER AND DESIGN-BUILD FIRM CAN CAUSE BIG PROBLEMS. A lot of money is allocated by what is written in the predesign (RFP). A misunderstanding by either party can lead to big problems, possibly even litigation. Traditional projects contain more written details and specifications and leave less to interpret. There is less chance a misunderstanding between parties will result in problems in the field. Communication problems will lead to losses in time, cost and quality. Both parties are potentially at risk (Dugan 1989).

3. **CHANGES DURING DESIGN ARE DIFFICULT TO ASSESS AND PRICE DUE TO LACK OF DETAIL.** Since detailed drawings and estimates are not complete at time of award, when changes occur they are difficult to price. The owner does not have a detailed design to refer to price change items. Again, this may negatively affect time, cost and quality. The owner is definitely more at risk (Greenfield 1989).

4. **NOT MANY FIRMS ARE FAMILIAR WITH/CAPABLE OF PERFORMING DESIGN BUILD.** Most firms are more capable of doing conventional (design/bid/build) work. Design-build is not widespread enough at this

time to present many qualified choices (contractors) for the owner. Few entities currently have the ability to perform both design and construction (Greenfield 1989). Although joint ventures and prime-sub contractor are possible, there still exists a lack of experience by the parties. Also, many contractors see these arrangements as too risky. This lack of qualified companies affects project cost, time and quality.

5. **INDUSTRY IS NOT YET PRODUCING GOOD DESIGN -BUILD MANAGERS.** Similar to #5 because it is due to lack of use. If a company is performing both design and construction, management must be able to handle both operations. Design managers typically manage with white collar (knowledge) workers, construction managers manage blue collar workers. Firms need to groom people that are able to effectively work/manage both of these groups (McGinnis & Tucker 1988).

6. **DESIGN CRITERIA IS GENERAL, MAKES IT DIFFICULT TO JUDGE OR DISQUALIFY LOW BIDDERS.** During a competitive bidding process, it is tough to disqualify low bidders because the criteria (scope) that they are designing to is so general. It is difficult to prove the contractor did not satisfy the project requirements when submitting his bid (Greenfield 1982). As a result, the owner may contract with an inferior firm and receive a poor quality facility.

7. **VERY COSTLY TO BID/COMPETE.** A lot of work must go into a bid. If the contractor does not get the job, this work is all for nothing (very risky). This is sometimes offset by a client that pays upfront for preparation of RFP to ensure minimum cost risk to competing teams (Greenfield 1982). Either way it is costly to bid, costly and risky for both parties.

8. **OWNER GIVES UP SOME PROJECT CONTROL.** After a project is awarded to a design-build firm, the owner becomes less involved. He has awarded a

project to a contractor after determining a scope and some facility requirements. The owner must now leave all the details up to the contractor (Greenfield 1982). By doing this, the contractor has more project control and the owner has less.

TABLE 2.1

DEGREE ADVANTAGE OR DISADVANTAGE AFFECTS ENTITY

OWNER		CONTRACTOR
	ADVANTAGES	
HIGH	CONSTRUCTABILITY	HIGH
HIGH	FAST TRACK/PHASING	LOW
HIGH	ADVERTISE/PROCURE ONCE	LOW
HIGH	CHANGE/CLAIMS CONTROL	HIGH
MEDIUM	SINGLE SOURCE CONTRACT	HIGH
MEDIUM	SOLE RESPON. FOR DELIVERY	MEDIUM/LOW
MEDIUM	ONE-STOP SERVICE	LOW
HIGH	TIME/COST INFLUENCE	HIGH
	DISADVANTAGES	
HIGH	ADDITIONAL COMMUNICATION	HIGH
HIGH	TOUGH TO COMPETIT. BID	LOW
HIGH	CHANGES DIFFICULT TO PRICE	LOW
HIGH	NOT MANY QUALIFIED D/B FIRMS	LOW
MEDIUM	FEW QUALIFIED D/B MANAGERS	LOW
HIGH	TOUGH TO DISQUALIFY LOW BIDS	MEDIUM
MEDIUM	COSTLY TO BID	MEDIUM
HIGH	OWNER LOSES CONTROL	LOW

TABLE 2.1 is a summary of the advantages and disadvantages discussed above and shows the degree to which they affect the owner and design-build contractor. There are many things that can change the degree to which these advantages and

disadvantages are realized. One item that will greatly influence the benefits realized with design-build work is the type of contract employed by the owner. A fixed price contract will produce different results or benefits than a cost plus type contract. It is not within the scope of this report to discuss this in detail, but it does deserve mentioning. As shown in the text and in the table, both parties realize benefits and both parties are taking risks when working design-build projects. In the same way, there tends to be a shift in some responsibilities for the owner and contractor.

2.5 RESPONSIBILITIES

Like the advantages and disadvantages associated with design-build, there are also additional responsibilities or obligations that accompany this work. For the purpose of this discussion, these responsibilities will be broken down into three categories: project definition, communication and liabilities (Dugan 1989) (Lovejoy 1989) (Wideman 1989).

2.5.1 PROJECT DEFINITION

Project definition is a very important responsibility during design-build work. It is not a simple task, because without a clear and difinitive scope of work there is a great possibility of contract dispute. The definition must be established early! It is typically the owner's responsibility, but when the contractor assists, a better project will result. The definition should include schedules, approvals, submittals, milestones, testing, performance requirements, standards setting, life cycle objectives, budget parameters, administrative objectives etc., anything necessary to clarify project goals. As an example, items such as DELIVERABLES should be detailed and specified

during the contract period and then approved by the owner. These deliverables must meet the technical and management performance levels addressed in the RFP. This will offer more control to the owner and will protect both parties.

Also during definition, PROJECT DELIVERY STRATEGY must be considered. It should be tailored to the level of detail to which the project is defined, the willingness to share risks, procurement regulations, the interest in competition for design alternatives and time constraints. Will the project be NEGOTIATED or should it be BID? What are the bidding procedures, are there any mandates requiring the acceptance of low bids? History has proven low-bid contractors are not always the best choice in accelerated or fast-track project delivery. Another consideration that needs to be established early is an ESCAPE CLAUSE. Escape clauses allow the owner to stop the work when design is complete or get out at specified points during the contract. These clauses favor the owner but by requiring a fixed price for the final design the contractor is protected in case the project is cancelled.

2.5.2 COMMUNICATION

Design-build demands a very fluid and open means of communication between owner and design/builder. The owner must communicate effectively because a lot of responsibility, room for interpretation, is left to the contractor once the project begins. Good communication is a key to project success. Closely tied to this communication is the owners ability to process CHANGE ORDERS and field orders. Changes must be identified and communicated immediately due to the compressed construction schedules and accelerated construction procedures. If the owner delays the process he may be liable for the lost time. The owner is encouraged to PARTICIPATE in all project

meetings through project completion. COORDINATION is also part of the communication process. The owner must ensure all vendors and subcontractors schedule and coordinate their daily work through the design-build entity and not autonomously operate within the design-build entity's project. Total design-build responsibility requires complete control and supervision of all participants. A final part of the communication requirement is good DOCUMENTATION. Both parties need to document all meetings and agreements. This is to include requests of any work required of the design-build entity with time to allow for assimilation into an already tight and fixed schedule.

2.5.3 AWARENESS OF LIABILITY

Awareness of liability is the final responsibility to be discussed. Design-build work results in a shift of risks and shift in liability when compared to a conventional project. It is important that each party is aware of this shift. The owner has agreed to let the contractor design and build his facility according to the requirements in the RFP. Anytime an action of the owner slows project progress or increases project costs he may be liable for damages. If the owner hires an independent A/E for inspection, changes made by the A/E that impact the project cost or schedule are the owner's responsibility.

The contractor also has liability concerns with respect to the design and construction. The design-build entity is soley responsible for the work that is accomplished. Errors with the design, errors with construction materials, errors with construction schedules all come back to the contractor. With increased project control comes increased project risk.

TABLE 2.2 shows these responsibilities listed in tabular form. As mentioned with the advantages and disadvantages, these items can be affected by particulars of the contract. Contracting type will again affect the degree to which the responsibilities are realized. Both the owner and contractor need to be aware of these items when performing design-build work. If the parties involved take the time to understand their responsibilities, everyone will benefit.

TABLE 2.2

DEGREE RESPONSIBILITY AFFECTS ENTITY

OWNER	RESPONSIBILTIES	CONTRACTOR
HIGH	PROJECT DEFINITION	LOW
HIGH	PROJECT DELIVERY STRATEGY	LOW
HIGH	NEGOTIATION VS BIDDING	LOW
MEDIUM	ESCAPE CLAUSE	LOW
MEDIUM	DELIVERABLES	MEDIUM
HIGH	COMMUNICATION	HIGH
HIGH	CHANGE ORDERS	HIGH
HIGH	PARTICIPATE	HIGH
HIGH	COORDINATION	HIGH
MEDIUM	DOCUMENTATION	HIGH
HIGH	AWARENESS OF LIABILITY	HIGH

CHAPTER III AIR FORCE DELIVERY AND METHODS

3.1 AIR FORCE STRATEGY

With the review of the design-build concepts complete, the report will now look at design-build as it relates to the United States Air Force Military Construction Program (MCP). What is the conventional delivery method for MCP projects? Why is it done this way? What limitations or regulations govern the process? This report will also review the limited past use of design-build in the Air Force. Since there has been more use of design-build in recent years, what has happened to permit more use of the turnkey process? Finally, the report will look to see if design-build works for the Air Force. This will include a review some recently completed Air Force turnkey projects to determine their success.

3.2 CONVENTIONAL MCP PROJECT DELIVERY

The MCP process is the way by which the Air Force obtains new facilities and major renovations on existing facilities (USAF/LEE 1989). For simplicity, the process will be broken down into three phases; programming, approval, and execution.

Programming begins with project identification which may be from internal (within the Air Force base where construction will occur) or external (Headquarters A.F., Congress, etc.) sources. Next, the project is programmed which involves determining project scope/definition to include facility requirements and working estimates. This work is generally performed on the Air Force base by an engineer and a user (organization that will occupy the facility) representative. All the project

information is recorded on a programming document (DD Form 1391) to be used during the project approval phase (AFIT-MGT 101) (Buckingham 1989).

In order for a project to receive approval, it must be validated (authorization), and the money must be allocated (appropriation) by Congress after they review project scope and cost. Both the U.S. House of Representatives and the U.S. Senate develop the MCP package (annual approval list). If approved, the project continues to the execution phase.

Execution, design and construction of military construction projects is conducted jointly by the Air Force Regional Civil Engineer (AFRCE), the construction agent, the major command (MAJCOM) and the base. The AFRCE is the project manager for the Air Force and provides total management of major MCP projects. This control includes monitoring cost of design and construction, reviewing project books, performing construction management inspections, and working with the design/construction agent.

The construction agent will be either the U.S. Army Corps of Engineers, the Naval Facilities Engineering Command, or the U.S. Air Force. The responsibilities of this agent may include design, bid advertisement, award, technical inspection, modification, administration of the contract and final acceptance.

The responsibility of the MAJCOM is typically delegated to the base level construction management branch. These responsibilities include project surveillance, interfacing between user and AFRCE, screening proposed user changes and providing any other support as necessary. Also included in the execution phase of the project is transfer and acceptance of facilities, any contract modifications and all inspections.

This MCP process, from project identification to construction completion,

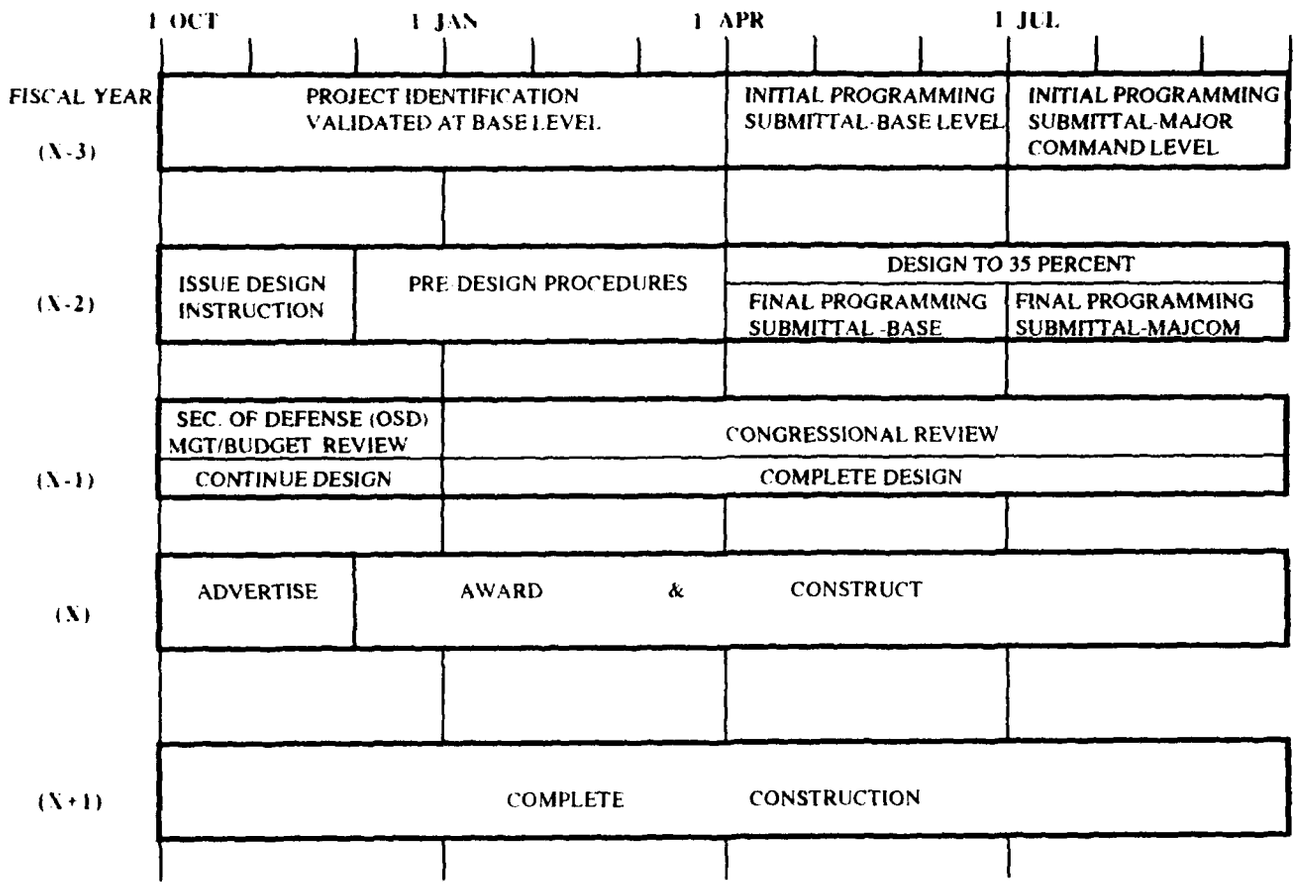


FIGURE 3.1

THE MCP PROCESS

(AFIT- MGT101)

generally takes 5 years to complete [FIGURE 3.1]. This is such a long time that requirements and scope often change before the project is completed.

3.3 PROBLEMS IN THE MILITARY CONSTRUCTION PROGRAM

In addition to a lengthy procurement procedure, the MCP process has other problems that deter/inhibit successful project execution. The Design and Construction Delivery Strategies Report (Dept. of AF 1986) was the result of a study that identified problems and solutions for the MCP. Problems identified included poor project definition, failure to develop a project delivery strategy, length of the facility acquisition process, and poor estimating techniques. The report also identified some recommendations to the identified problems. These solutions include:

1. Considering a design-build procurement strategy;
2. Developing better business practices;
3. Developing a "team" project delivery strategy;
4. Revising application of small business rules;
5. Expanding the use of Title II A/E (Inspection) Services;
6. Prequalifying criteria in the solicitation for construction;

Although this report concentrates on the design-build concepts, it is important to note that the Air Force design-build process that is described later has incorporated all the above recommendations except number 5.

3.4 PAST USES OF DESIGN-BUILD

Design-build is not a totally new idea as noted in the previous chapter, the private sector has been using it for years. There is also evidence of successful use within the public sector including the Federal Highway Administration, the Environmental Protection Agency and the Massachusetts prison work mentioned earlier. The military and the Air Force has had limited exposure with turnkey work since the 1960's. In his Thesis, An Investigation of the Application of the Design/Build Method to Military Construction Program Projects, Captain William W. Buckingham identified seven military construction projects constructed using a design-build (turnkey) approach. [TABLE 3.1] In order to understand more about the situation and circumstances, two of these projects will be reviewed in more detail.

TABLE 3.1

PAST USE OF DESIGN-BUILD
FOR THE MILITARY

PROJECT	COMPARED TO CONVENTIONAL METHOD			
	TIME	COST	QUALITY	YEAR
TUY HOA AIR BASE	80 PERCENT LESS	SIMILAR	SIMILAR	1967
TACOM FACILITIES	80 PERCENT LESS	SIMILAR	HIGHER	1980
FORT DRUM HEADQUARTERS	50 PERCENT LESS	28 PERCENT LESS	SIMILAR	1982
FORT HARRISON GYM	25 PERCENT LESS	27 PERCENT LESS	SIMILAR	1982
FORT STEWART FIRE HOUSE	SIMILAR	32 PERCENT LESS	SIMILAR	1982
FORT BLISS GYM	35 PERCENT LESS	28 PERCENT LESS	HIGHER	1984

3.4.1 PROJECT TURNKEY

During the Vietnam conflict, the Air Force decided to use a turnkey approach to construct a new air base at Tuy Hoa. This project was commonly refered to as Project Turnkey. Project Turnkey requirements included the ability to provide interim operations by no later than the end of December 1966 and sustained operations by mid 1967. The Air Force realized that a turnkey contract was very conducive to this time sensitive type work. The project was awarded to a private contractor in May of 1966. Work progressed very quickly and the interim airfield was completed six weeks ahead of schedule. The completed facility was finished two weeks early (Buckingham 1989).

3.4.2 TACOM

The next project is the Army Automotive Tank Command (TACOM) facility completed in 1980 in Warren, Michigan. This project included design and construction of two 196,000 square foot buildings. Once again, the project was limited by time constraints. It was decided that a fast-tracked, turnkey approach would be used. A one-step delivery method was used and four proposals were received and considered. The project was awarded and progressed very quickly. Using the phased construction method, the Army was able to benefically occupy the first building only 16 months after contract award and within three months the second building was occupied. Project quality was considered excellent (Buckingham 1989).

Both of these jobs were very successful. Refering back to TABLE 3.1 time, cost and quality appears excellent with all the turnkey projects. The question to ask then is why are there so few examples of design-build use in the military?

3.5 WHAT LIMITS MILITARY USE OF DESIGN-BUILD?

Since design-build has been very successful for military construction in the past, why is it not used more often? In addition to the list of disadvantages listed earlier, there are other reasons the military may resist using design-build. Some of the reasons are strictly behavioral (resisting change) yet many others are due to government imposed regulations

3.5.1 RESISTANCE TO CHANGE

Resistance to change is fact of life in any organization, public or private. This resistance to change is only natural. There is a degree of efficiency and comfort when doing things the same way. When trying something new or less familiar, things usually do not run as well (Hellriegel 1989). The change may be viewed as a threat to power. This is very applicable to design-build because the owner is losing some project control and may feel threatened. Organizations need stability and continuity to function effectively. The traditional design-bid-build system is very safe and stable because it has been used for so long. Many people and organizations fear the unknown, design-build is still "unknown" by many. According to one contractor in the April 14, 1988 issue of ENR: "Our biggest hurdle to overcome has alway been in explaining what design/build is, how it works, and how the owner's interests are protected by it. Only recently have the owners become familiar enough with the process to understand and appreciate it." (Lovejoy 1989) Familiarity is the key. As design-build methods become more popular, both public and private owners will be less likely to resist using it.

3.5.2 RULES AND REGULATIONS

The military has some other considerations besides the behavioral items listed above. There are a few laws and regulations that limit(ed) the military from performing design-build work (Dibner 1983) (AFIT-Contracts). The first item is from the Federal Acquisition Regulation that states "no contract for construction shall be awarded to the firm that designed the project...except with the approval of the head of the agency..." The intent of the clause is to ensure the delivery of good, efficient facilities and to protect against fraud, waste and abuse. Before the exception, this prohibitive clause negated any chance for design-build work. The clause now allows turnkey work, but only after Congressional approval.

Next we notice the competitive bidding requirement for Air Force work. It may be helpful at this time to review the Government policy on procurement which is ".....to promote economy, efficiency and effectiveness in the procurement of goods, services and facilities for the Federal Government by establishing policies, procedures and practices which will require the government to acquire goods, services and facilities of the requisite quality and within the time needed at the lowest reasonable cost, utilizing competitive bidding to the maximum extent practicable...." Competitive bidding is a way of life for military construction. It ensures every contractor equal chance to get a contract, again minimizing fraud, waste and abuse. This is not unreasonable for every owner wants good, quality facilities for the lowest reasonable cost. Unfortunately, many owners only think of the cost of design or the cost of construction and not the project life cycle cost. Low bid construction often minimizes initial construction cost for the sake of high life cycle costs. Another problem, as discussed before in the disadvantages, is the difficulty in applying competitive bidding

to design-build work. For turnkey contracts, it is easier to negotiate than bid. It is difficult to develop an accurate bid on a project without a complete design.

Another problem with a competitive bidding requirement is the idea of choosing a designer (A/E firm) by low bid. The use of price as a selection factor immediately raises a concern with design professionals. It is contrary to the belief of professional societies that "price should not be a factor in their selection". It should only be considered after the most qualified firm has been chosen. This is the idea behind the Brooks Act for A/E Services for it mandates a nonbidding system for Federal A/E contracts. Since a design-build contract is a contract for both A/E services and construction services, competitive bidding should not be allowed. With the use of creative bidding procedures this problem may be avoided. As described previously in the two-step procurement method, designs may be judged first on merit before price is discussed. Once all the qualified designs are identified, then the low bidder is chosen.

As design-build has become more popular in recent years, there have been a few changes to permit its use on military projects. The Military Construction Authorization Act of 1986 specifically authorized military agencies to use "one-step, turn-key procedures". This authority is limited to three projects for each military agency through October 1, 1990.

Both Congress and the Director of Engineering Services for the Air Force challenged the Air Force community to examine the process by which facilities are acquired through the Military Construction Program. The design-build process that follows is a result of these examinations.

3.6 THE AIR FORCE DESIGN-BUILD PROCESS

The Air Force has structured it's design-build process to ensure maximum competition and has included escape clauses in case of problems during design or mission changes before project completion. By learning from private owners and contractors that employ design-build, the Air Force has taken steps to limit the disadvantages normally associated with this work.

The turnkey process begins much the same as the MCP process identified earlier. A facility is identified from internal or external sources. Programming documents are completed and submitted for approval. The project definition or predesign (phase I) is usually accomplished by an independent A/E who is responsible to develop the conceptual aspects of the project (Broberg 1990). This A/E works closely with the facility user, they meet one-on-one to ensure all requirements are included in the design-build solicitation package, Request for Technical Proposal (RFTP). This close cooperation between designer and owner ensures the early detailed definition mentioned in Chapter II. The solicitation includes requests for two line item bids, one for A/E design and one for construction. Also included in the RFTP is any evaluation criteria the government will use to determine contractor qualifications. The solicitation will state whether the facility will be fast-tracked and will list any relevant escape clauses. These clauses are the responsibility of the owner, as mentioned in the previous chapter they help the owner regain some project control typically lost in turnkey projects.

When the solicitation is complete, part of it will include a specified fee for design services that all bidders are required to include in their proposal. This ensures that the design services are not selected by a low bid. This upholds the terms of the

Brooks Act, the low bid is only differentiating the construction. Bidders submit a firm bid price for construction based on what they learn from the RFTP. In their bid, contractors may be required to include specific information on materials, quality requirements, energy efficiency of equipment, life cycle costing, etc., any data that will help the owner determine which bid is best suited for the specified requirements. If the Air Force does not ask for specific information in the bid, there may be difficulty disqualifying low bids or pricing changes. These bidding requirements, along with contract escape clauses return some project control to the owner.

After the bids are turned in, they are evaluated to ensure conformance with project requirements. Contractor evaluation and selection is based on quality, cost and technical abilities. The Air Force, with the Corps of Engineers, selects the design -build contractor.

After being awarded a contract, the contractor may begin project design. Foundation and site design may be continued through to completion. The remainder of the facility is designed to 50% completion before being reviewed by the owner. At this time, the contractor should identify any required materials that have a long delivery time. The design and the materials list is reviewed by the construction agent and the Air Force. If everything is satisfactory, the contractor is allowed to continue. Construction may begin at this time if the project is to be phased (fast-tracked). If the project is not fast-tracked, the design will be completed and approved before any construction begins. This process (essentially an escape clause), allows the owner some control after the project award. If the project is not being designed according to plans, the Air Force can work with the designer to make the necessary changes. If changes can not be made or if the project is no longer required, the contract may be

terminated at this time.

Another item of interest during the design is the requirement that the contractor furnish a Guaranteed Maximum Price (GMP) for the construction of the facility. This is another escape clause area for the owner. If the contractor's GMP is much greater (how much is percentage of project size) than his bid price, the Air Force may terminate the contract (Buckingham 1989). Termination may occur immediately or the contractor may be allowed to complete the design with construction being finished by another party. Either way the owner escapes from the contract.

When construction begins, the project is monitored by the Corps of Engineers, as construction agent, and Air Force personnel. At this point the project runs much like any other construction project with the exception of the additional owner and contractor responsibilities listed in Chapter II.

3.7 REVIEW OF RECENT DESIGN-BUILD PROJECTS

There are a number of projects operating under the previously mentioned process. The Air Force Regional Civil Engineer located in Dallas TX. is managing the following projects:

1. FY 85 Scott AFB, Illinois, AFCC Headquarters Facility
2. FY 87 Dyess AFB, Texas, B-1B Munitions Equipment Storage
3. FY 87 Kirkland AFB, Texas, Clinic Replacement
4. FY 88 Kelly AFB, Texas, ADAL Cryptologic Support Center
5. FY 88 Lackland AFB, Texas, Student Officers Housing
6. FY 89 Sheppard AFB, Texas, Student Enlisted Housing

7. FY 89 Tinker AFB, Oklahoma, B-1B Avionics Facility
8. FY 90 Lackland AFB, Texas, Student Housing
9. FY 90 Lackland AFB, Texas, Dining Hall
10. FY 90 Lowry AFB, Colorado, Accounting and Finance Center

This list shows that the type of facility being constructed by design-build is varied. Sophisticated avionics and cryptological centers as well as dormitories and dining halls are being built. The Scott Air Force Base AFCC Headquarters facility was the first project the AFRCE administered and completed under this new design-build process.

In order to determine or evaluate how the design-build process is working, two projects will be reviewed in greater detail. The first facility reviewed is the AFCC Headquarters project listed above. The second project reviewed is a dining facility at Robins Air Force Base, Ga. This dining facility is not listed above because it is only one of two design-build projects for the Air Force that is not being administered from the Dallas AFRCE. It was managed by the AFRCE in Atlanta Ga.

3.7.1 AFCC HEADQUARTERS FACILITY

This project included the design and construction of a 218,000 square foot facility. The purpose of this building was to replace obsolete facilities and to allow the Air Force Communications Command to consolidate its activities into one facility. It was suppose to be a "typical office building" , it was designed to use systems furniture. In reality, the facility was not very typical. Building requirements included secure areas, vaults, elevated flooring, a security system, demountable walls, movable floor electrical outlets, special communications requirements and bulletproof glass.

The use of design-build on this project was decided on after two previous design-bid-build attempts had failed to produce successful bids. Both times the bids came in much higher ($5-10 million) than the available funds, $19 million. After making modifications to the design, the project was constructed using design-build for $17 million.

The predesign design or phase I design was accomplished with close cooperation between the owner and A/E. The proposal developed the design to nearly 40 percent. The project was advertised and then awarded to the low bidder after all submitted proposals were evaluated. This evaluation was based on quality and technical merit of proposal. The selected contractor was ranked second before costs were considered.

In order to save time and complete the project quickly, the project was fast-tracked. The contractor was allowed to begin construction when the first phase of the design was approved. Progress was often slow due to owner and contractor disagreements over material requirements and facility requirement changes. The Air Force as owner seemed unaware that its requested changes also slowed construction and increased costs. As it was, all parties worked very hard and the project was completed approximately 5 months behind the anticipated schedule.

Overall, the project was successful. The owner was very involved (communication requirement) to ensure all conflicts were handled in a timely fashion. By doing so, the contractor was able to provide the Air Force with a quality facility, within budget and schedule. Time required for completion was approximately 35 percent of that required for conventional procurement. The project cost was estimated as similar to a conventional procurement. This estimate is questionable since all

previous attempts at conventional procurement resulted in bids much higher than the estimate. (Broberg 1990) (Buckingham 1989).

3.7.2 ROBINS AFB DINING FACILITY

The new dining facility at Robins Air Force Base was built to replace the existing facility that was destroyed by a fire on August 16, 1986. As such, it was very important that the facility be constructed as quickly as possible so food service could resume. In order to accomplish this, the project was issued as fast-track design-build. The Eastern Region AFRCE in Atlanta, Ga. was responsible for managing the project.

The predesign (phase I) and proposal phase were accomplished by Air Force personnel with the first draft being completed two months after the fire. The request for technical proposal (RFTP) was approved by Congress and was advertised in February, 1987. As before, all proposals were received and reviewed, selection was based on cost, quality and technical merit. The contract was awarded on 5 May 1987. The design and construction was contracted in a prime-sub arrangement. The construction contractor hired the designer as a subcontractor to complete the design. Neither party had previous design-build experience.

A number of items made the project difficult. The designers lack of design-build experience proved troublesome in that he did not realize the urgency of finishing the structural and foundation design before continuing. This slowed down the fast-track process. Secondly, communication between the owner and the contractor was poor.

As mentioned in Chapter II, effective communication is very important for a successful turnkey project. During this project, the contractor did not always

understand what the Air Force personnel wanted. There was no specific point of contact between the parties to work out problems. Within the user organization, the Corps of Engineers and the Air Force frequently gave conflicting guidance that further confused the contractor. Finally, as was the case with the AFCC project, the user requested quite a few changes that slowed project completion.

The project was competed on 3 November 1988, six months after the projected completion date. When comparing the project duration of 21 months with that of conventional MCP work, there is approximately a 40 percent time savings. The final price was approximately 25 percent less than conventional MCP work. Thus, the project was considered successful (Buckingham 1989).

3.8 LESSONS LEARNED FROM PROJECTS

There were many lessons learned that may prove useful for future design-build work. When reviewing this list, you may note that many of these items were identified in Chapter II as additional responsibilities of design-build work.

1. **Scope definition is key to project success.** Project requirements should be detailed and specific. This includes the idea that mission changes may affect facility requirements before the project is complete. Every effort must be made to keep this from affecting job progress.

2. **Owner must limit number of changes during construction.** As noted so many times in this report, this is a sure way to elevate project cost and schedule. User requested changes mean more time and money to complete the project.

3. **These contracts have had greater administrative requirements.** Much more time and effort was required by Air Force personnel to ensure projects

were successful. There are additional communication requirements with design-build work. Documentation is very important. (One should expect more difficulty administering a new type of contract as opposed to doing it the "old way").

4. **Design-build is good tool for easily defined projects.** Parties involved with both of these projects thought that the work may have been too complex for design-build. Suggestions were made to use design-build only on simple, easily defined projects. (One would think that an office building and dining hall would be simple enough).

5. **Much of the project success is the result of good people.** Personnel involved worked very hard and a good "team" effort allowed problems to be solved. Time and money is saved if the people work hard and work together. If the people don't want something to work, it will surely fail.

6. **Design-build projects are riskier for both parties.** Within design-build contracts, the contractor must assume greater responsibility and control for project completion. This can be a risk for the contractor. The owner, on the other hand, is at risk because he has less control of the project. Both parties are at risk. Risks is worth it if only parties work together (and trust one another) to successfully complete the project.

7. **Communication is a key to design-build success.** Communication needs to be clear and frequent to ensure the project is going according to the plan. The communication should be limited to top people with the authority and responsibility to do the work. This was not established well in either of the example projects and was the cause of numerous problems.

8. **Experience with design-build work will benefit both parties.**

In both projects, lack of familiarity with design-build work by one or both parties was noted as a problem. As the Air Force continues to use and learn design-build, it should look for contractors with this type of experience. (Lessons Learned 1988) (Broberg 1990) (Buckingham 1989)

This list greatly resembles the requirements list from Chapter II. It's possible the Air Force did not know so much was required of an owner during a turnkey project. Being new to design-build procurement, the Air Force probably expected there would be a few problems but they were not sure what type of problems. As they continue to use the design-build process, the Air Force must learn from its mistakes and learn all it can about design-build. Looking at the advantages/disadvantages, risks and requirements helps to make any necessary changes to the process before making any more mistakes.

CHAPTER IV CONCLUSION AND RECOMMENDATIONS

4.1 CONCLUSION

Every military turnkey project reviewed within this report was considered successful. The Air Force, with its newly established turnkey method, has been able to develop a design-build process that takes into account most of the advantages, disadvantages and responsibilities associated with this type of work. While doing so, the Air Force has been able to maintain its required public protections. Close cooperation and communication between designer and owner has been stressed. Early, detailed project scoping is also a key. Prequalification of contractors has allowed contracting competent firms to accomplish the work. Escape clauses have safeguarded the military owner in case of conflicts or changes in requirements

The process is not without problems. Confusion with communication, user related changes and various administrative concerns have made the design-build projects difficult to administer. In spite of this, all personnel involved have worked hard and have been able to work through the conflicts. Considering that the Scott AFB and Robins AFB projects were successfully completed using this new process, the future of design-build looks good. The learning curve is bound to improve the process as personnel become more familiar with the process.

4.2 RECOMMENDATIONS

Design-build or turnkey use should be continued on military construction projects. Design-build is an attractive, nonadversarial, contracting method that is gaining more acceptance each day. The benefits of improved quality, reduced cost and

shorter construction schedules cannot be overlooked. The educated, aggressive owner can successfully employ design-build and save time and money while maintaining or improving quality.

The MCP projects reviewed were successful at reducing both cost and time compared to traditional contracting strategies. There are a few thinks that should be done to improve the process. The concepts and benefits of design-build work should be passed on to all the parties involved in the construction of such projects. Knowledge of the system will help make it more successful. Everyone from the AFRCE personnel down to the base level construction management personnel must know the details of design-build so they can perform their job more effectively. They should know the impact of changes, the impact of not processing changes promptly and the shift of liability associated with design-build work.

The Air Force must continue to work on establishing a good, clearly defined scope as early as possible. The scope must be well defined as the result of extensive early planning. This is necessary for all contracts, but with design-build it is even more important. The more time spent developing the requirements, the less time and money wasted on changes later. Owner requested changes must be limited. The military is in a constant state of change and it is very difficult to keep mission changes from affecting a facility, but the owner must try. Change orders during a design-build (fast track) project negate many of the benefits realized in these contracts. Changes forwarded to the owner for processing must be responded to as soon as possible.

Many of the contractors and owners say that design-build work is not conducive to all work. It benefits are greatest when the facilities involved are easily defined or when the facilities are repetitive. The military tends to construct facilities

that have many unusual requirements as noticed in the Scott AFB example. As such the military needs to ensure design-build work is limited to facilities that fall into this easily definable category. Find out what type of facility is most conducive to design-build contracts. This will probably include gyms, dormitories, hangers and simple administrative buildings. If a more complex facility is contracted this way, a lot of time needs to be spent establishing the predesign and scope.

The Air Force must continue to learn from companies and owners that have design-build experience. Much of the information for this report was the result of lessons learned by contractors and owners using design-build. There is no need to continue to reinvent the wheel, learn from the mistakes of others. Many of the problems with the military turnkey process so far have been the result of inexperience. As design-build work continues, a greater part of the contractor prequalification should include design-build experience. Whether the design-build entity is a joint venture, prime-sub, or a full service company, the experience factor is very important.

Finally, the Air Force as owner must work towards maintaining a positive client relationship. With the loss of project control during a design-build contract, the owner must ensure there is a "team attitude" between himself and the contractor. If the relationship is positive there is a greater chance for successful project completion.

Successful application of design-build to the Military Construction Program is very encouraging and is a step in the right direction. As these experimental turnkey projects (three per year through October 1990) are completed and evaluated, the previously experienced success should continue. In the future the military should expect more freedom in turnkey project application, the limit of three projects per year should be raised or removed. There is no need to limit the number of projects if it is

successful.

In addition to this, the military must continue to look for strategies to stretch tax dollars spent on construction. Do not stop the learning. Design-build is not the final answer to the MCP process just as design-bid-build was not. The Air Force must continue examining the acquisition process to look for additional procurement strategies applicable to the MCP process that maximize quality, cost and time.

BIBLIOGRAPHY

1. Hendrickson, Chris and Tung Au, Project Management for Construction, Prentice Hall, New Jersey, 1989

2. Levy, Sidney M., Project Mangement in Construction, McGraw-Hill Book Company, New York, 1987

3. Dugan, James R. PE., "An Overview of the Design/Build Concept", PEC Reporter, Vol. XI, No. 9, August/September 1989.

4. Lovejoy, Norman B. PE., "Special Advantages of Design Construct", PEC Reporter, Vol. XI, No. 9, August/September 1989.

5. Department of the Air Force Study, Design & Delivery Construction Strategies, Report published for the Engineering and Services Center, Tyndal AFB Fla., January 1986.

6. Moore, William B. etal. Changing the DOD Construction Guide Specifications, Bethesday, Maryland: Logistics Management Institute, 1985.

7. Broberg, Joe, Performance Strategy: Analysis of Air Force Design/Build Procurement Concept, Engineering Science, Inc., Austin, Texas, September 1989.

8. Wideman, Curtis L., Design-Build A Contractor's Point of View, Pasadena California: The Ralph M. Parsons Company, October 1988.

9. USAF/LEE, United States Air Force Project Manager's Guide for Design and Construction, USAF, Washington D.C., June 1989.

10. McGinnis, Charles PE., Tucker, R.L. PHD, PE., The Design-Construct Management Challenge, February 1988.

11. Tieder, John B, The Special Risks Inherent in Design-Build and Fast Track Projects.

12. Austrailina Construction Services, Strategies for the Reduction of Claims and Disputes in the Construction Industry-A Research Report, November 1988.

13. McGinnis, Charles PE., "Contract Construction", The Military Engineer, November-December 1988.

14. Dickman, James and Nelson, Mark, Construction Claims-Frequency and Severity

15. Broberg, Joe, Preliminary draft-Analysis of the United States Air Force Design -Build Procurement, Engineering-Science, Austin Tx., May 1990.

16. AFIT STUDY GUIDE- MGT 101, Department of the Air Force, Air University, Air Force Institute of Technology, School of Civil Engineering, Wright Patterson AFB Ohio.

17. AFIT STUDY GUIDE-CONTRACT PREPARATION AND MANAGEMENT, CE GUIDE TO THE ACQUISITION REGULATIONS, Department of the Air Force, Air University, Air Force Institute of Technology, School of Civil Engineering, Wright Patterson AFB Ohio.

18. Cole J.B., "TQM: Recipe for Quality", The Military Engineer, No. 536, July 1990.

19. Dibner, David R., "Construction Management and Design Build: An Owners Experience in the Public Sector", Law and Contemporary Problems, Vol. 40, No. 1, Winter 1983.

20. Lessons Learned, Phase I Design/Build Program, USAF December 1988.

21. Lee, Tunney F., Alternative Methods of Design for Correctional Facilities, Deputy Commissioner of Division of Capital Planning for the Commonwealth of Mass., October 1985.

22. Buckingham, Captain William W., An investigation on the Application of the Design-Build Method to Military Construction Program Projects, Department of the Air Force, AFIT, Wright Patterson AFB, Ohio, September 1989.

23. Hellriegel, Don and Slocum, John., Organizational Behavior, West Publishing Company, New York, 1989.

24. Barresi, Joseph, The Commonwealths Design-Build Experiment, Communwealth of Massachusetts, 1988.

25. McGinnis, Charles PE., Associate Director, The Construction Industry Institute, The University of Texas. Personal Interview. December 1990.