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june 1977

effective use of systems building technology

by
tibor d. csizmadia

Open Systems Catalog

volume I: open systems guide

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Relatively recent advances in building technology and in the application of innovative procurement methods make it possible to introduce precoordinated subsystems into military construction. Existing data suggest that the time-cost-quality advantages of applying such technology and methods to military construction are significant.

To facilitate the use of alternative technology and procurement methods,

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Block 20 continued.

current and practical information must be made available to project personnel. This report provides such information on available products, processes, and methods, along with guidelines for their effective use in military construction.

A review of product data revealed that the products integrated into most systems were not universally interchangeable (i.e., a completely open system), but rather that their "openness" was largely limited to each particular program. While there are common elements for most, if not all, of the products, the fact remains that not all of the products are freely interchangeable; consequently, a guide for completely open systems is not possible at this time. As an interim measure, a guide was developed which is based on the current state of the art of the open systems industry in the United States. Given acceptable interpretations of existing rules, the Corps can immediately apply today's technology of preengineered, interchangeable building subsystems without resorting to legal or regulatory change.

This guide is the first adaptation of open systems technology to the MCA process. As standards are developed for the coordination and interchangeability of subsystems at the national level, other expansions are anticipated.

foreword

This report was prepared for the Directorate of Military Construction, Office of the Chief of Engineers (OCE) under Project 4A762719-AT02, "Development of Industrialized Construction for Military Facilities"; Task 01, "Guides on Using Industrialized Buildings for Military Construction"; Work Unit 002, "Open Systems Guide." The OCE Technical Monitor was W. Johnson. This is the final report from this work unit. Work in this area is continuing under Project 4A762731AT41, "Design, Construction, and Operation and Maintenance Technology for Military Facilities"; Task T2, "Development of Industrialized Construction for Military Facilities"; Work Units 006, "Computerized Information on Industrialized Building"; and 007, "Design Documentation Procedures."

The report was prepared by the Master Planning and Systems Building Branch (HPM), Habitability and Planning Division (HP) of the U.S. Army Construction Engineering Research Laboratory (CERL). Contributing CERL personnel were Dale A. Bryant, Michael G. Carroll, Tibor D. Csizmadia, Thomas A. Kenney, and Richard L. Schneider of HPM. Dr. D. Gordon Bagby is Chief of HPM and Dr. Robert M. Dinnat is Chief of HP.

COL J. E. Hays is Commander and Director of CERL, and Dr. L. R. Shaffer is Technical Director.

THIS VOLUME IS PART OF A SERIES OF DOCUMENTS DESIGNED TO HAVE THREE MAJOR FUNCTIONS:

1. CONTRIBUTING TO THE UNDERSTANDING OF THE IMPORTANT PRODUCTS, PROCESSES, AND POTENTIALS OF TODAY'S BUILDING TECHNOLOGY.

2. PROVIDING GUIDANCE FOR THOSE WHO EITHER WANT TO OR MUST APPLY THE COMPARATIVELY NEW AND ADVANCED PRODUCTS AND PROCESSES FOR MILITARY AND OTHER REAL CONSTRUCTION.

3. SERVING AS A BASIS FOR CONTINUING DEVELOPMENT OF THE SYSTEMS APPROACH AND ITS EFFICIENT PRACTICAL APPLICATION FOR THE BENEFIT OF THE OWNERS AND USERS OF NEW AND EXISTING FACILITIES.

contents

section I

introduction

BACKGROUND:

Traditionally, each new project is treated as a unique procurement problem and is designed, detailed, and specified by architects and engineers prior to the selection of its builders: contractors, subcontractors, and suppliers/manufacturers. This process results in a custom design for each building which, after bids are taken, is built (mostly at the building site) under the direction of the selected contractor and subcontractors by craftsmen, laborers, and technicians from materials and parts provided by their suppliers/manufacturers.

Changing Building Procurement Processes. The expanding industrialization of the building process provides building purchasers with ever-increasing alternatives to the present materials and methods used to obtain a building. Depending on their size and type, buildings may be procured in stages of prefabrication ranging from those completely manufactured in a factory and delivered to the site ready for installation, to those whose segments (usually called subsystems) are manufactured in a factory and delivered to the site ready for assembly. Alternatively, buildings may be erected partly with manufactured subsystems and partly with on-site methods. The many alternatives to what might be called "conventional construction" are referred to collectively as "industrialized building," since they usually embody manufactured products of varying complexity and sophistication.

A number of pioneering building programs have demonstrated that industrialized building can be effectively obtained on the North American continent; some of the systems/subsystems that have resulted from these programs are now available in the marketplace. Although the degree of success varies by program, little doubt remains about the cost- and time-saving potentials of this method of building.

The Role of Research. The technology for industrialized building products is readily available, and some products are already on the market; however, the normal procurement processes of building purchasers do not readily accommodate incorporation of the complex assemblies available from the industry. The task of research and development is to provide building purchasers with likely vehicles for the cost-effective use of industrialized building.

Incorporating Industrialized Building Into the MCA Process. As a large and continuing purchaser of buildings, the Army has undertaken a research and development (R&D) program to incorporate the use of industrialized building into its military construction (MCA) process whenever it is the most cost-effective method of obtaining buildings. This R&D program contains five major elements which must be developed:

a. The capability to predict when industrialized building would be more cost-effective than conventional building.

b. A source of rapidly available, current information on the characteristics of the industrialized building industry and its products.

c. Guidance documents for incorporating the use of industrialized building into the MCA process.

d. Suitable organizational groups and equipment for carrying out the guidance.

e. A feedback mechanism to insure that the process continues to function properly.

OBJECTIVE: The objective of this work unit is to develop the information and guidance required for a cost-effective incorporation of "open" building systems into the MCA process.

A building system is a collection of subsystems capable of being connected without major modification to form all or part of a building. A given building system will prescribe the necessary subsystems which must interconnect to form a building. A building system is "open" if each subsystem can be supplied by more than one manufacturer and if each manufacturer's subsystem will interconnect, without major modification, to all other required subsystems.

APPROACH:

The approach taken in this guide suggests a three-stage expansion of the MCA process, using an Open Systems Catalog as the vehicle for orderly expansion. (This expansion, discussed in detail in Appendix A, involves developing catalogs of increasingly predetermined design elements.) Expansion 1, the initial catalog, provides information and guidance for incorporating current open systems technology into the existing MCA process on a single-project basis. Succeeding catalog development may involve precertified subsystems and precontracted subsystems for various facility types and geographic locations.

The tools considered essential for incorporating current open systems technology into the MCA process on a single-project basis are product information, performance specifications, and procurement guides.

Product information on available subsystems is an integral part of the catalog. Under authorization of the Office of Management and Budget, detailed information has been obtained from the entire building component manufacturing industry and has been stored at CERL in a computerized data bank accessible by remote terminals.

This catalog contains only that portion of information necessary for selection of compatible subsystems. The maintenance and refinement of an up-to-date and accurate product catalog and data bank is considered to be the keystone for efficient procurement of open systems construction.

Performance specifications can be a necessary part of open systems procurement. The initial catalog (Expansion 1) contains examples of performance specifications used for successful open systems projects in the United States and Canada. These are intended to be guidelines for the Army in preparing performance specifications for its own projects. As projects are completed, Army-specific specifications will evolve and become part of the second catalog (Expansion 2).

A procurement guide is necessary to assist MCA project personnel in the use of the open systems approach. Alternative procedures and options are presented which may be used during the various phases of the MCA cycle when the open systems approach is used. The guidelines deal with selected essential considerations and steps where traditional procedures might be effectively revised to accommodate the open systems process.

It can be seen that industrialized building is a continually emerging industry, offering a constantly changing array of products and techniques. Problems and solutions of the various systems can be discovered only during field demonstration and repeated use. The first catalogs must, by necessity, be issued as "prototypes" to be tested and revised on the basis of practical experience for military construction. Since much of the material has been assembled from the experience of a variety of public and private agencies, there is already credibility for the guide's recommendations; however, this does not guarantee a successful application to Corps uses. Field experience in military construction is an essential part of the open systems catalog project.

INTENT OF REPORT:

This report contains a preliminary prototype of the guidance portion of the initial *Open Systems Catalog* and an exposition and discussion of a proposed three-stage expansion (Appendix A). The initial *Open Systems Catalog* should be field-tested on a current MCA project. This report is intended primarily as a vehicle to solicit review and comment on the guidance portion from potential users before field testing. The exposition and discussion of the proposed three-stage expansion is presented so that the initial catalog will be seen in its proper perspective.

FORMAT OF REPORT:

The initial *Open Systems Catalog* consists of three volumes under the general title: "Effective Use of Systems Building Technology: Open Systems Catalog." The individual volumes are:

Volume I *Open Systems Guide*

Volume II *Prototype Performance Specifications*

Volume III *Building Products Information*

This volume, *Open Systems Guide*, is structured along the phases and activities of the Military Construction Army (MCA) process. The major divisions, following an introductory chapter, are (a) project *initiation*, (b) project *development*, (c) project *contracting*, (d) project *delivery*, and (e) project *use/maintenance*. All three volumes are interdependent for purposes of implementation.

This guide is part of an initial adaptation of current MCA processes to accommodate open systems technology.

section II

open systems guide: expansion 1

GENERAL:

The subsystems presented in Volume III are adaptable to a variety of building types and can be procured in various ways.

Following are descriptive and graphic expressions of the MCA process. Two things should be noted. First, rather than ending when construction is completed, the MCA process as discussed here includes the entire life-cycle of a facility--from the "idea" stage to the destruction of the building. This report's premise is that every decision, communication, or activity somehow affects the time-cost-quality factors of the completed facility. Second, the MCA process has been attached to major activities, with the major subactivities listed thereunder. Every facility is initiated, developed, contracted, delivered, and then used and maintained. The subactivities listed under each major activity are more vulnerable to under- or over-inclusiveness.

Following are descriptions of the activities comprising each of the six divisions of the MCA cycle application. Activities are numbered in the sequence of their performance when carrying out the six phases of the MCA process. Following these descriptions is a detailed, practical delineation of activities necessary to successfully apply open systems to meet U.S. Army needs while conforming to the Army's regulatory constraints.

mca cycle

a. PROJECT INITIATION

1 Identify need for facility
2 Prepare masterplan (all facilities for 20 years)
3 DA SRCP guidance
4 Determine intermediate range needs
5 Prepare budget estimates
6 Provide guidance on SRCP
7 Prepare 1391's and line drawings for SRC, IRC, LRCP, and PDB's
8 Design directive/3086
9 Provide guidance on SRCP

b. PROJECT DEVELOPMENT

10 Appoint project manager
11 Review SRCP
12 Select/hire A/E
13 Prepare concept design
14 Review, approve concept, authorize final design
15 Prepare final design
16 Review/value engineer
17 Execute revisions
18 Authorize funds

c. PROJECT CONTRACTING

19 Choose procurement options/prepare bid package
20 Review, approve bid package
21 Finalize bid package
22 Advertise bid
23 Select contractor
25 Obtain authorization of expenditures
26 Award contract

d. PROJECT DELIVERY

27 Monitor construction
28 Inspect construction
29 Certify completion
30 Authorize payments .
31 Turn over facility to user

e. PROJECT USE/MAINTENANCE

32 Receive reports on use and maintenance
33 Arrange for followup work

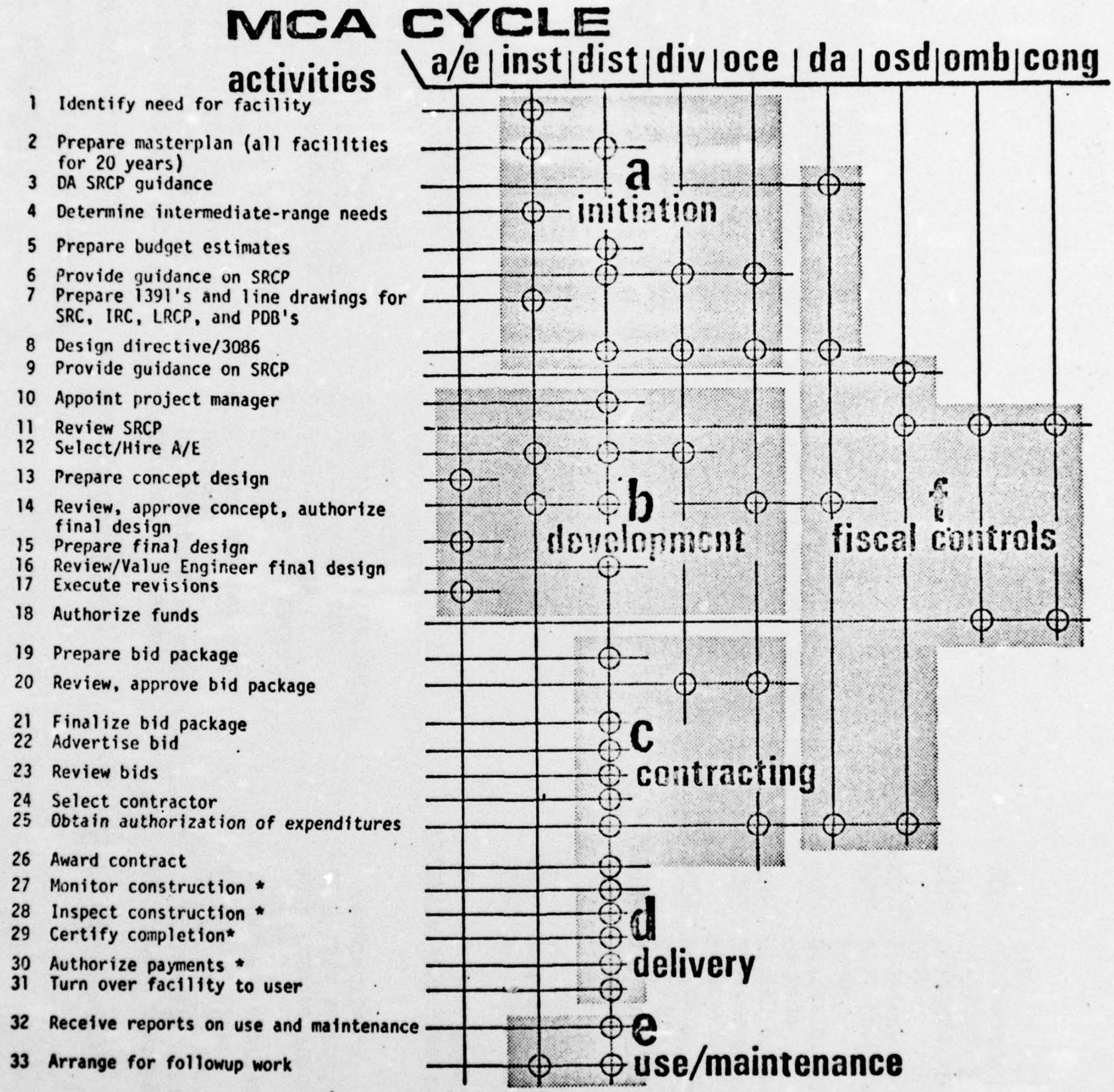
f. FISCAL CONTROLS

3 Approve masterplan
8 Review all plans
9 Provide guidance on SRCP
11 Review SRCP
14 Review, approve concept design
18 Authorize funds
25 Obtain authorization of expenditures

ABBREVIATIONS (See chart No. 1 "MCA CYCLE")

MCA: Military Construction Army
A/E: Architect/Engineer
INST: Military Installation
DIST: U.S. Army Engineers District
DIV: U.S. Army Engineers Division
OCE: Office of the Chief of Engineers
DA: Department of the Army
OSD: Office of Secretary of Defense
OMB: Office of Management and Budget
CONG: U.S. Congress
SRCP: Short-Range Construction Plan
IRCP: Intermediate-Range Construction Plan
LRCP: Long-Range Construction Plan

Chart No. 1


MCA CYCLE
activities
a/e | inst | dist | div | oce | da | osd | omb | cong
1 Identify need for facility
2 Prepare masterplan (all facilities for 20 years)
3 DA SRCP guidance
4 Determine intermediate-range needs
5 Prepare budget estimates
6 Provide guidance on SRCP
7 Prepare 1391's and line drawings for SRC, IRC, LRCP, and PDB's
8 Design directive/3086
9 Provide guidance on SRCP
10 Appoint project manager
11 Review SRCP
12 Select/Hire A/E
13 Prepare concept design
14 Review, approve concept, authorize final design
15 Prepare final design
16 Review/Value Engineer final design
17 Execute revisions
18 Authorize funds
19 Prepare bid package
20 Review, approve bid package
21 Finalize bid package
22 Advertise bid
23 Review bids
24 Select contractor
25 Obtain authorization of expenditures
26 Award contract
27 Monitor construction *
28 Inspect construction *
29 Certify completion*
30 Authorize payments *
31 Turn over facility to user
32 Receive reports on use and maintenance
33 Arrange for followup work
a
initiation
b
development
f
fiscal controls
c
contracting
d
delivery
e
use/maintenance

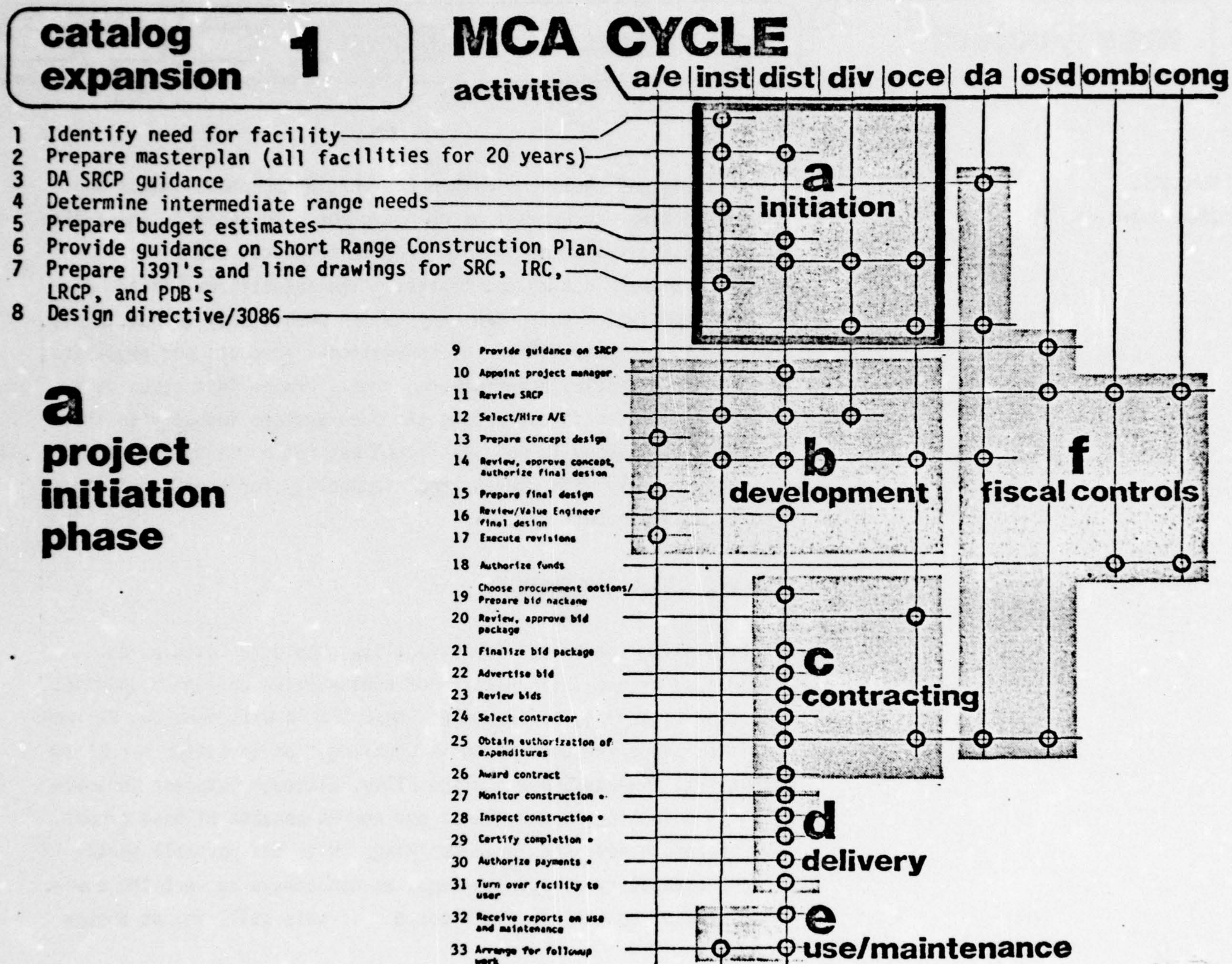
SUMMARY:
(See Chart No. 2)

Activities and decisions within the initiation phase impact on the effective procurement of open systems. In general, these are planning decisions and initial project requests, which should avoid arbitrary design constraints. The suggestions listed below in the initiation phase are easy to implement; they do not in any way limit the competition of conventional products and processes, and their potential benefits are large. Proper initiation is a fundamental step in coalescing the open systems industry so that the new technology is not restricted but rather encouraged to compete equally with conventional technology for the Corps' time-cost-quality needs.

1. IDENTIFY NEED FOR FACILITY

Articulating the "need" for a facility should be based on an awareness of the full spectrum of construction options available. Instead of saying, for example, that "Ft. X will need two PX facilities since the population is doubling," an initiator might say that "Ft. X needs a new bowling alley, although interest in bowling is dwindling, and at least one new PX because of base growth. We therefore need one large building. With the portable partitions capability of open systems, we can always convert the bowling section to additional PX space. If this still is not enough

Chart No. 2


catalog expansion 1
MCA CYCLE
activities
a/e
inst
dist
div
oce
da
osd
omb
cong
1 Identify need for facility
2 Prepare masterplan (all facilities for 20 years)
3 DA SRCP guidance
4 Determine intermediate range needs
5 Prepare budget estimates
6 Provide guidance on Short Range Construction Plan
7 Prepare 1391's and line drawings for SRC, IRC, LRCP, and PDB's
8 Design directive/3086
9 Provide guidance on SRCP
10 Appoint project manager
11 Review SRCP
12 Select/Hire A/E
13 Prepare concept design
14 Review, approve concept, authorize final design
15 Prepare final design
16 Review/Value Engineer final design
17 Execute revisions
18 Authorize funds
19 Choose procurement options/ Prepare bid package
20 Review, approve bid package
21 Finalize bid package
22 Advertise bid
23 Review bids
24 Select contractor
25 Obtain authorization of expenditures
26 Award contract
27 Monitor construction
28 Inspect construction
29 Certify completion
30 Authorize payments
31 Turn over facility to user
32 Receive reports on use and maintenance
33 Arrange for followup work
a initiation
b development
c contracting
d delivery
e use/maintenance
f fiscal controls
a project initiation phase

space for the PX, or if interest in bowling does not dwindle, another PX could be erected quickly, given the short delivery time of open systems."

The only practical guideline for this particular activity is simply awareness of the various technological and procurement options available. The state of the art of building science could and should affect the decision.

2. PREPARE MASTERPLAN

The decisions and activities of this step should also be influenced by the availability of additional technological options. For example, instead of programming 200 BOQ spaces in 2 years, 300 more a year later, and an additional 300 after another year, master planners could consider grouping the projects into one large bid package to stimulate industrial response, increase learning curve and amortization efficiencies, and perhaps generate volume discounts.[1]

If the industrialized systems are "off-the-shelf," aggregating projects could serve to achieve all of the previously enumerated goals. While not critical, aggregating "off-the-shelf" systems enhances the potential success of the project. However, where available systems are scarce or require some revision, it is

[1] In October 1974, the Ohio River Division, with the assistance of CERL, decided to aggregate 80 comfort stations/sanitary facilities on civil works reservoir sites into one bid package. Bid response was heavy (13 bidders). The final low bid was 52 percent of the government estimate. One key of this success was the aggregation of projects into a sufficient buy-package.

critical to aggregate projects, even if it means crossing traditional District boundaries.[2] Capital commitments necessary for a healthy industrial response arise only if there are assurances--real or potential--of a market. Grouping projects encourages these commitments.

Aggregation of projects, however, is not the only consideration. A successful aggregation may yield impressive data, but industry--especially small business concerns--cannot easily survive on an uncertain diet of large, one-time buys. Even more fundamental is a pattern of continuity and repetition, in which industry can become ready for production, invest in R&D, and perform other such necessary industrial activities, knowing that their final products will have at least one large buyer (the Corps) over a period of time sufficient to justify the risks of the investment.[3]

Long-range planning must take into account the rapidly changing technology in building. In 10 years, availability of materials, labor, construction procedures, and procurement options may force traditionally conceived master plans into drastic revisions. By aggregating projects in a continuous, repetitious manner, master-planners are not only encouraging building innovation, but also allowing the industrialization process to develop more efficient responses to building requirements.[4]

[2] The previously mentioned Ohio River Division projects were grouped among four Districts within the Ohio River Division. Also in a 1972 Air Force project for industrialized building, the package was based on groupings of 18 projects among 16 bases.

[3] "We have heard a lot of comments at this meeting about the need for aggregating the market. But people in production are not necessarily interested in large orders, whether it is 3 million sq. ft., 5 million sq. ft. or 10 million sq. ft. of project. What we are interested in is the opportunity for continued production for a long period of time with no changes in the ground rules. Don't give us a great big building but just a lot of little buildings, all the way along the line. Just keep repeating and don't change the ground rules....

"We have also heard comments about people in government being disappointed that no new technological revolution was realized by the manufacturers, after the government had introduced new elaborate forms of procurement procedure. I have got news for those people; as far as we, as material manufacturers, are concerned, there is not going to be a revolution in building materials. It takes us about seven years to introduce a new product. This is the time it takes us to develop the product, to build the facilities and to reach what we call the optimum marketing production level. This is a long time, so if you are talking about basic materials, there is going to be an evolution not a revolution in the market place." From *Building Procurement: Proceedings of a Workshop*, IF Occasional Paper No. 1, page 23 (Dan Morgenroth, Owens-Corning Fiberglas Co. (Dec. 1974).

[4] Legal Comments: Techniques available to aggregate proj-
[4] Continued on next page

* Continued
ects are the grouping of projects not only within an installation, but between/among installation and even Districts (multi-base procurement), and among years (multi-year). These techniques are permissible by existing regulations. See Michael G. Carroll, *Procuring Today's Building Technology*, Special Report D-72, Vol II (CERL, 1976) for a more detailed analysis.

Note: Aggregating projects and the practice of continuity and repetition in planning in no way injures the competitiveness of conventional building products and methods. It merely increases the competitiveness of alternate products and methods.

* Legal Comments: Until an appropriate formula is developed, or until sufficient historical data have accumulated, industrialized systems solicited ad hoc, via the *performance concept*, cannot be accurately estimated like conventional technology. While there is precedence for a very general estimate when using the performance concept (see ASPR 18-108.1(a),"... However, the estimate is *not* required to be detailed if the plans and specifications are not detailed.") most regulation seems to require an accurate estimate based on some descriptive requirements (see: TM 5-800-2, AR 415-20, ER 1180-1-1 [1-372]).

3. DA SRCP GUIDANCE

Advisors and approvers of the masterplan should be guided by the same considerations enumerated above in activity #2.

4. DETERMINE INTERMEDIATE RANGE NEEDS (IRCP)

The same considerations of activity #2 apply here. Note that this is a more detailed, firmer planning stage and it should, therefore, attempt closer coordination with industry regarding industry's capabilities and planning.

5. PREPARE BUDGET ESTIMATES

Estimating the material, labor, and associated costs can be greatly simplified by the catalog approach. Since subsystems today are commonly supplied and installed under prime contracts with the owners, their current-installed, lump sum, cost can be available for the estimate. Personnel who continually update the catalog can be requested to monitor the market to supply up-to-date information to estimating departments.[5]

The catalog circumvents the estimating problems. Since the systems in the catalog have been used in other projects, historical data are available; in addition, the appropriate manufacturer can be asked for his present selling price and installation requirements. As discussed in Appendix A, Expansion 3 largely eliminates any cost/budget estimating problems.

6. PROVIDE GUIDANCE ON SHORT-RANGE CONSTRUCTION PLAN (SRCP)

Guidance should be consistent with the consideration enumerated in activity #2. Also, since SCRP represents activities and decisions immediately preceding individual project requests, coordination with and/or knowledge of the open systems industry should be increased. During this step, a detailed determination of the feasibility of market aggregation and the appropriate grouping of projects should be achieved; guidance for facilitating this determination should be made available for preparing the SRCP.

7. PREPARE 1391's AND LINE DRAWINGS FOR SRC, IRC, LRCP, AND PDB's

The DD Form 1391 submitted by the installation contains the information needed to determine the feasibility of using the open systems approach for a particular project. The key items of information are building type (Item 13) and the description of work to be done (Item 19). Short of a feasibility study, no decision should be conveyed in the 1391 Form which effectively excludes the competition of the full range of today's building technology. For this purpose, specifications must be worded in terms of performance so that different manufacturers can submit their most feasible design and material/technical solutions. If the wording of Item 19 is restrictive regarding materials and methods to be used for constructing the project, it not only may exclude some of the most advanced technical solutions but may also cause difficulties in developing an economical and satisfactory design. For example, if the description of the work is as follows: "...unit masonry walls and partitions, steel roof framing, rigid slab roof insulation and built-up composition roofing; hot water heat from gas fired boiler and evaporative cooling...", the item should be rewritten in more functional terms, for example: "Provide a fireproof, insulated building including foundations, structure, exterior enclosure, interior space division and finishes, HVAC, electrical, plumbing, lighting, and communication. Include functional spaces for offices, classrooms, briefing rooms, a communications area, vault, and necessary auxiliary support spaces. Provide complete storm drainage, parking spaces for 100 vehicles, sitework, and utilities. Use natural gas for heating and domestic hot water."[6]

The Project Development Brochure (PDB) should aid in articulating the functional requirements of the needed facilities for the Form 1391. The PDB looks at user requirements largely in terms of the functions sought and is, therefore, an excellent basis upon which to formulate performance specification. However, where the PDB becomes descriptive and discusses a particular solution(s), effort

[6]Samuel T. Lanford, Tibor D. Csizmadia, and Dale Bryant, *An Interim Guide to Industrialized Building Systems, Volumes I and II*, Technical Report D-70 (CERL, 1976).

Legal Comments: Since the control of specific performance is the underlying reason for every descriptive specification, descriptions of "building type" and "work to be done" using the performance language should be acceptable. In fact, it is a better way to describe needs since it refers to what is really sought--performance--rather than one solution to it. Therefore the performance language is less restrictive than the descriptive identification of one solution. (See Michael G. Carroll, *Procuring Today's Building Technology*, Special Report D-72, Vol II (CERL, 1976), for a legal analysis of the use of the performance concept.)

should be made to determine what function(s) were being sought when the PDB drafter listed the solution(s). Concerning restroom facilities, for example, if the PDB says "partitions cannot be metal," investigation would probably reveal that the drafter was attempting to communicate "whatever material is used for partitions must be impervious to corrosion and resist denting."

8. DESIGN DIRECTIVE 3086

Activities involved in issuing the design directive should not affect the methods suggested here as long as the projects are grouped prior to the design directive, and the design directive does not violate the internal integrity of that project (e.g., "begin design on four of the eight hospitals in Project A").

SUMMARY:
(See Chart No. 3)

The development phase requires the most effort for executing the guidelines contained in this catalog. There are three basic design strategies delineated for Expansion 1. The first--a conventional detailed, descriptive design--is not a favored method but could possibly be successful. The two preferred strategies are: using the performance concept to "bid out" one contract; and using a combination of the performance concept and descriptive strategy to "bid out" multiple contracts. Both are feasible, practical strategies. The first strategy--performance concept for one contract--implies that the subsystems manufacturers must form a joint venture or consortium. This, in turn, requires a longer bid period for their partnership formation and requires that they be responsible not only for the "in systems" portion which they manufacture but also for the "out of systems" portion. The second strategy--multiple contracting via performance and descriptive specifications--offers the most potential time and cost benefits but presents, perhaps, the most risk. With multiple contracting, the "out of systems" portion can be bid separately with conventional, descriptive specifications and drawings. The "in systems" portion can be bid either to each subsystems manufacturer or to a consortium of subsystems manufacturers. This requires an interfacing of the different contracts both at the contracts stage and during on-site construction. For this reason, a construction

Chart No. 3

catalog expansion 1

b project development phase

10 Appoint project manager
11 Review Short Range Constuction Plan
12 Select, hire Architect/Engineer
13 Prepare concept design
14 Review, approve concept, authorize final design
15 Prepare final design
16 Review/Value Engineer final design
17 Execute revisions

MCA CYCLE

activities	a/e	inst	dist	div	oce	da	osd	omb	cong
1 Identify need for facility		O							
2 Prepare masterplan (all facilities for 20 years)		O	O						
3 DA SRCP guidance						O			
4 Determine intermediate range needs		O							
5 Prepare budget estimates			O						
6 Provide guidance on SRCP			O	O	O				
7 Prepare 1391's and line drawings for SRC, IRC, LRCP, and PDB's		O							
8 Design directive/3086				O	O	O			
9 Provide guidance on SRCP							O		
10			O						
11							O	O	O
12		O	O	O					
13	O								
14		O	O		O	O			
15	O								
16			O						
17	O								
18 Authorize funds								O	O
19 Choose procurement options/ Prepare bid package			O						
20 Review, approve bid package					O				
21 Finalize bid package			O						
22 Advertise bid			O						
23 Review bids			O						
24 Select contractor			O						
25 Obtain authorization of expenditures			O		O	O	O		
26 Award contract			O						
27 Monitor construction •			O						
28 Inspect construction •			O						
29 Certify completion •			O						
30 Authorize payments •			O						
31 Turn over facility to user			O						
32 Receive reports on use and maintenance			O						
33 Arrange for followup work		O	O						

Phases: a initiation (1–8); b development (10–17); c contracting (19–26); d delivery (27–31); e use/maintenance (32–33); f fiscal controls

*The masculine pronoun is used in this document to represent both genders.

manager (CM) having experience in interfacing open systems should be used.

Creating these design strategies so that the competitiveness of the products in Volume III is maximized requires an Architect/Engineer (A/E) experienced in open systems. Clauses to insure adequate open systems design performance from the A/E should be used in selection and contracting.

Enclosed in Appendices B and C are narratives concerning how to use the master performance specification of Volume II and a sample design guide. These are intended to be beneficial to the contracted A/E if he* so desires, and to aid in-house personnel in their execution and understanding of an open systems procurement.

9. PROVIDE GUIDANCE ON SCRP

This topic is not discussed in this catalog, and may be considered in future editions of this publication.

10. APPOINT PROJECT MANAGER (PM)

PM QUALIFICATION REQUIREMENTS:

The Project Manager must be qualified and motivated to take optimum advantage of the open systems approach. The PM must have the ability to insure that each phase of the process is planned and executed on the basis of open systems principles, rules, and guidelines. He must be able to obtain, evaluate, and interpret industry formation and to coordinate it with user/owner requirements. He must be able to work with a number of specialists and organize them into a responsive project team. If the PM has no previous systems building experience, he will require the services of a system expert on his staff or as a consultant. The PM must be well-informed about the new products, processes, and management techniques of the industry.[7]

[7] Note: Since the Project Manager must assume duties and responsibilities which go beyond the traditional roles, these must be specified at the time of appointment. Considering the broad spectrum of his operations, the PM must, of necessity, be a highly qualified and exceptional person with a prime interest in the management of complex technical projects. He must be analytical and decisive with an ability to successfully work through others. The many contractual, technical, and administrative problems he will encounter will severely test his leadership, knowledge, and sensitivity.

PM ROLES AND RESPONSIBILITIES:

For example, in the Public Building Services of GSA, the *Project Manager*, a top government executive, plays the role of owner with unprecedented managerial, contractual, budgetary, and administrative authority over the project as follows:

- He has total operating authority and responsibility for the project;
- He is the final point for major decision making;
- He controls and administers the project resources, including personnel, funds, and property;
- He prepares and operates under a comprehensive project masterplan tailored to a life cycle plan with activities, milestones,

[8] The GSA System for Construction Management, pp 2-3.

[9] The CM should be employed as early as possible but not later than the A/E. Note also that, as used with systems building, the term Construction Manager denotes a specialty, and thus is different from the common interpretation of the Corps which is: Construction Management is the management of the entire building process from initiation to use and, ultimately, destruction.

and networks for the specific project from inception, through planning, design, and construction, to occupancy;

- Among his many functions are approving any major revisions in the project scope or schedules, and controlling the overall decision-making processes of the project;
- He oversees a project support team of key government representatives from within the agency who provide close technical, administrative, budget, legal, and procurement support;
- He is the Contracting Officer or the designated representative of the Contracting Officer;
- His agency's Resident Engineer directly represents the Project Manager at the jobsite during construction;
- He executes inter- and intragovernmental agreements as required.[8]

APPOINTMENT AND ROLES OF CONSTRUCTION MANAGER (CM)[9]

The diverse groups and individuals involved in the building process have varied, often opposing, objectives; each claims expertise concerning today's technology in dealing with the complexities of present-day project requirements, thereby creating a monumental management challenge. It is recommended that a professional Construction Manager (or CM firm) be appointed for each open systems project (or a group of aggregated projects); his employment is especially critical if the procurement option of multiple contracting is used.[10]

The Construction Manager is a new professional who is now being employed by private and governmental agencies to handle complexities of the new technology and project requirements. Meeting the basic objectives requires not only an in-depth and up-to-date knowledge of costs, market conditions, labor conditions, and supply, but also expertise in the newly developing efficient and economical construction systems and associated techniques. The Construction Manager is selected to play a key role on the basis of his experience and proven accomplishments in using innovative techniques.

In conjunction with introducing this new professional, it is expected that the Corps will build up its own experience and in-house staff to manage future open systems projects.[11]

The CM Role

The Construction Manager's role should not be limited to the site construction phase of the project. The Construction Manager also can be an important member of the project team during the project

[10] Note: Of course if the Corps can and is willing to perform the following tasks of the CM, it can serve as the CM in the "specialty" sense of the word.

[11] Legal Comments: There appears to be *no* legal/regulatory prohibition to the Corps' employment of a CM. PBS of GSA does this as a matter of routine. However, it is *recommended* that he be hired as a *consultant* and *not* as the general contractor warranting the project against defects in materials, workmanship, and conformance with requirements. Many CM's may not be able to meet the ASPR 18-104 requirement that the general contractor perform a "significant part of the project (e.g., not less than 15 percent on housing or 20 percent on other projects) with his own forces." Also if a CM is to aid the A/E in the design and technical solution; this might disqualify him for any contract dealing with the *construction* of the project per ASPR 18-115. Even if CM's could satisfy ASPR 18-115, they presently do not evidence a desire to insure the final product. Hiring the CM as a consultant requires the awarding of multiple prime contracts for construction of the project. There is no legal prohibition for this practice. There exists, however, a general Corps policy not to award multiple prime contracts unless "in the best interest of the government." If, in fact, hiring a CM as a consultant is the most efficient, effective way to procure open systems, and if the benefits of doing this

Continued on next page

design activities, during development of bid documentation, and during evaluation of bids. In some situations, the same person/firm can also assist the Project Manager in the capacity of system expert. A current definition of the Construction Manager follows:

> *The Construction Manager* is an experienced, multi-disciplined organization or joint venture under a contract for construction management services, who will work with the Project Manager and the Architect/Engineer from the beginning of design through construction completion. He will furnish the A/E with information and recommendations on construction technology and market conditions to insure that the building design stays within the budget, control scheduling of design and construction, manage the procurement effort, superintend and inspect the construction of the building, and provide a wide range of other related services as required by his contract.[12]

The Performance of CM (See Chart No. 4)

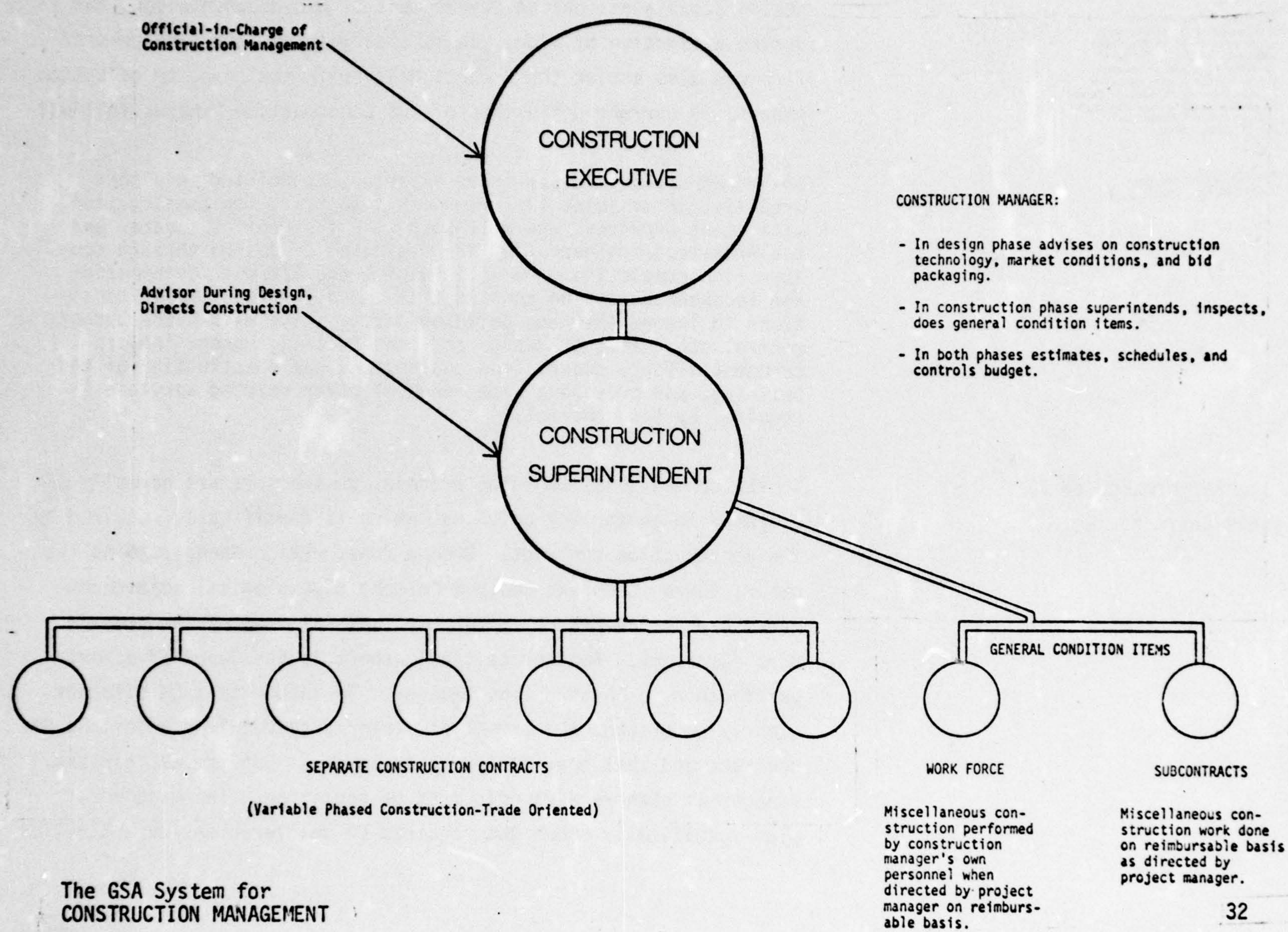
In the conventional building process, contractors are normally oriented to performing only that which is specifically required by the construction contract. When a Construction Manager joins the owner, there is an extremely important psychological adjustment necessary--*to cooperate, think, and act in terms of the owner's best interests*. Another critical aspect is the *level of effort* put forth by a Construction Manager. To insure that CM offerors clearly understand the extent of performance required under the CM contract and that they fully intend to carry out the obligations, management plan requirements must be specified. The management plan specifically shows the required CM deliverables, by activities

[11] Continued outweigh any concomitant disadvantages or risks, then it appears to be in the "best interests of the government" to award multiple prime contracts. (For a more detailed discussion, see Michael G. Carroll, *Procuring Today's Building Technology*, Special Report D-72, Vol II (CERL, 1976).

[12] The GSA System for Construction Management, p. 4.

Chart No. 4

construction management



CONSTRUCTION MANAGER:

- In design phase advises on construction technology, market conditions, and bid packaging.
- In construction phase superintends, inspects, does general condition items.
- In both phases estimates, schedules, and controls budget.

The GSA System for
CONSTRUCTION MANAGEMENT

and dollar amounts, both as tangible indicators of CM performance and as a mechanism to provide payment only for CM work actually accomplished. The management plan is used to monitor the CM performance throughout the life of the CM contract. The government expects the Construction Manager, with his sophisticated array of expertise and electronic data controls, to be self-actuated, to anticipate the project needs and problems, to arrive at practical solutions, and to take effective and timely action, so that construction conflicts, cost overruns, and delays in completion are avoided or minimized. CERL is developing selection criteria and contracting documents for CM's which both satisfy Corps regulations, and allow for the proper interface of the CM with the other team members (e.g., A/E, Prime Contractors, Project Manager).

11. REVIEW SHORT-RANGE CONSTRUCTION PLAN (SRCP)

OCE is well aware of the important characteristics of effective application of new technology and of the bid-design/build process. One example is the recent requirement that a project development brochure support the DD Form 1391 when a building project is placed in the Short-Range Construction Program. The purpose of the Project Development Brochure (PDB) is to "delineate the 'functional requirements' of the Using Service" (AR 415-20). It will contain functional data needed by the design agency before initiating design of military construction projects. A crucial element

[13] Note: The sources of all data contained in the *Open Systems Catalog* are identified in the three open systems volumes. This will enable the user to evaluate data reliability when preparing the Project Development Brochure (e.g., data derived from completed building projects are deemed more reliable than a manufacturer's verbal declarations).

of a bid-design-build process is to share the design effort with the bidders. The tool to accomplish this is the performance concept in which performance or functional properties, rather than the more exacting detailed drawings and descriptive specifications, are solicited. The emergence of the PDB reflects an awareness that what is really sought in a building is performance. Detailed drawings mean little if the required functions are not feasibly accommodated through these drawings. Project information to be supplied to controlling authorities includes: masterplan, functional designation, scheduling, and budget estimate. Such material will be affected by using the open systems approach.

MASTERPLAN

Product availability/ geographic location:

Travel distances from manufacturing plants or product distribution points affect the feasibility of using certain products. The *Open Systems Catalog* contains the addresses of manufacturers' plants. In addition, the CERL computerized data bank contains the economical travel distances and feasible delivery locations by zip code. This data bank is accessible through time-sharing arrangements to Corps Districts and other authorized agencies. If the proposed facility is within the feasible delivery zone of the prospective suppliers/contractors, the masterplan can anticipate the possible use of the open systems approach for the project.

Labor availability/ geographic location:

The majority of manufacturers listed in the catalog[13] are accustomed to providing their own trained crews for site installation and/or making special arrangements with appropriate local labor groups where necessary. In areas where skilled labor is not available, the feasibility of using subsystems manufacturers as prime contractors or subcontractors increases.

FUNCTIONAL DESIGNATION

The functions, activities, and equipment that the planned facility will house will limit the range of applicable catalog items; i.e., certain products presented in the catalog are feasibly only for buildings which require air conditioning and a high degree of space planning flexibility. The most rational way of checking the feasibility is by the performance concept. Use of cataloged items may be planned if the products can perform the range of functions required of certain elements of the building (i.e., partition or ceiling/lighting subsystems). To facilitate checking, the catalog's products are listed according to their performance attributes; a list of recent projects is attached when possible. In addition, a data bank containing information on more than 200 completed open systems projects is available at CERL to authorized catalog personnel.

The project timetable (see Figure 1) is not affected if the conventional design-bid-build process is used. On the other hand, if the fast tracking option is chosen, the site construction/erection time and the building documentation design and contracting time can be considerably reduced, although suitable phasing/

tracking requires that authorization of certain work be arranged before the final design of the entire facility is completed. "Fast tracking" or "phased construction" is also often called the "construction management" approach, because a management professional, rather than a general contractor, is coordinating and controlling the site activities. (See: Appointment and Roles of Construction Manager.)

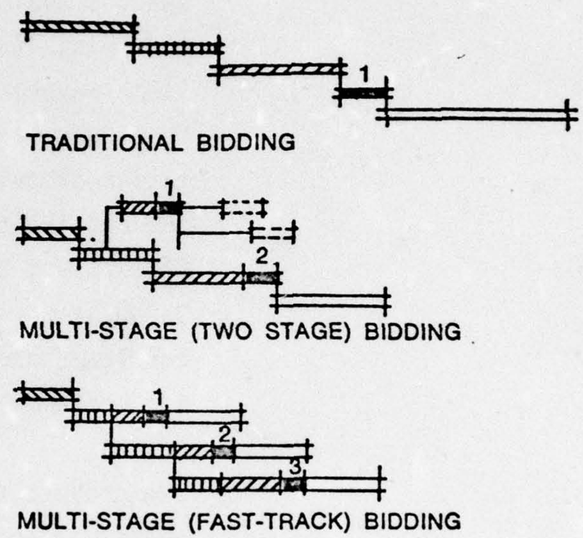


Figure 1. Scheduling timetable.

The subsystems requiring the longest lead time can be bid first when the construction management approach is used. By using fast tracking, fund authorization begins at the early phase of project development.[14]

Presently, regulatory waivers must be requested to "fast track." CERL is presently preparing regulation change-requests to make "fast-track" a viable technique in situations conducive to its use.

"Fast tracking," while often used in conjunction with a CM, is not prerequisite to using a CM and vice versa.

BUDGET ESTIMATE:

Comparable, traditionally constructed buildings can form the basis of the estimates, with the probable advantage that the installed cost of cataloged items can be determined more accurately than the cost of traditional materials and labor. For example, if 50 percent of the building is expected to be constructed with open systems components, 50 percent of the estimate will be highly reliable, thereby reducing by 50 percent the uncertainty of the entire budget.[15]

On the other hand, it is not recommended that budget requests be reduced for open systems building until sufficient experience and empirical data are accumulated within the construction/client

[14] Legal Comments: The phasing of bids or "early bidding" appears to be acceptable only after completion of the "final designs." (See: AR 415-20 4(d), 5(d); and ER 1110-345-100 17 (a). This delay negates many of the time efficiencies generated by phased bidding. "Fast tracking" embodies not only the phasing of bids but also the overlapping of activities. The Corps' separation of design and construction activities restricts this.

[15] Note: In certain recent examples, the construction cost of systems projects has been reduced by about 14 percent in comparison with fully conventional construction, thereby practically wiping out the effect of inflation in building costs.

agency. Rather than reducing the first cost of the building contract, efforts should be made to convert any potential savings on first cost into savings in life-cycle costs, e.g., saving on energy, repair, and maintenance. This can be effectively accomplished when the *performance* of the cataloged items is specified rather than the items' material characteristics, e.g., energy efficiency of HVAC system, insulation value of wall, etc. When the Construction Manager is used rather than the General Contractor, all the savings are passed on to the owner. Some sources of cost information are: Dodge Report, Practicing Construction Managers, Systems Building Clients, Systems Experts.[16]

[16] Legal Comments: ASPR 18-108.1, "Government Estimates: Construction Contracts" states that... "However, the estimate is not required to be in detail if the plans and specifications are not in detail ...." Therefore, design strategies using the performance concept do not have to have the detailed estimate as the conventional process. Increased use of the performance language and/or the creation of reliable formulae for estimating the costs of open systems, will provide better estimating techniques and data for design alternatives other than conventional detailed drawings and specifications.

Architect/Engineer Qualifications/Roles:

12. SELECT/HIRE ARCHITECT/ENGINEER

The steps of the A/E selection and approval process are not affected by use of the information catalog. The criteria of selection and the kind of tasks to be performed, however, are different from the traditional approach.[17] Some firms which are competent in the use of conventional materials and processes might be unable or unwilling to apply the open systems approach effectively. The A/E must be able to interface with a project team which includes administrative, management, and production specialists. The architect might become any or several of the following, depending on the composition of the project team: planning/design

[17] CERL is developing A/E selection criteria and contract clauses to include: experience with open systems; proper relationship with the Construction Manager and other "new" or revised team members; and sufficient direction to insure design solutions conducive to the open systems products in Vol III.

specialist, coordinator, performance specifier, bid evaluator, programmer, etc. The firm's capabilities, experience, and past performance with systems building projects and/or the firm's adaptability to new methods and processes must be examined, and competitive selection based on set criteria must be made.[18] The conditions must spell out specific duties, responsibilities, and procedures associated with the use of the open approach, i.e., the A/E must select the products from the catalog or accommodate industrialized subsystems of appropriate performance on a competitive basis. The A/E must follow the rules of the system which permit the inclusion of a range of competitive preengineering subsystems. The architect must verify product data in such a manner that the user's requirements and the owner's objectives are reasonably satisfied. Using the subsystems in the catalog does not relieve the architect of the traditional responsibilities for planning, design, and the performance of the complete building.

[18] CERL is drafting selection criteria and contract clauses to insure that the A/E can execute an open systems project using the cataloged products. For example, criteria and clause would require either actual open systems experience via the performance concept, or the employment of a consultant with such minimum experience.

A/E liability:

The A/E, however, is not made liable for the design and performance of individual subsystems selected on the basis of standards prescribed by the client (i.e., performance standards). When the fast tracking/construction management method is used, the design work must be efficiently coordinated with bidding and construction activities. The A/E must be liable for construction delays caused by his default on the schedule.

A/E fees:

[19] Subject, of course, to maximum fee limitations.

Fees of the A/E and the Construction Manager should be determined on the basis of project duties and responsibilities negotiated for each project (or aggregation of projects).[19] Time saved on efficiencies of catalog use and standardization should be invested in increased programming to update and improve the catalog; the concomitant reduction in fees should be included in each A/E contract, or the savings in A/E fees could be used to finance additional duties such as the evaluation of user satisfaction. The nature of the information expected and method of reporting should be specified. It is not anticipated that A/E fees will exceed 6 percent when the catalog is used. Conversely, the availability of valuable data should reduce A/E efforts and therefore reduce his fee.

A/E's role and the construction management approach:

The A/E is in his normal design role, with the additional valuable input during the design development phase of the Construction Manager (or systems consultant) and with the close support of a Project Manager who has the real and final authority for the government agency. Although the CM has primary responsibility for the construction estimates, the A/E is required, by contract, to design the project so that the bidding is within the established construction cost limitation. In addition, the A/E firm in this system must package the output of working drawings and specifications to fit the most advantageous packaging and grouping of

[20] In cases where new product development or important modification of existing products in the catalog seem necessary to satisfy the design requirements, a feasibility study must be carried out.

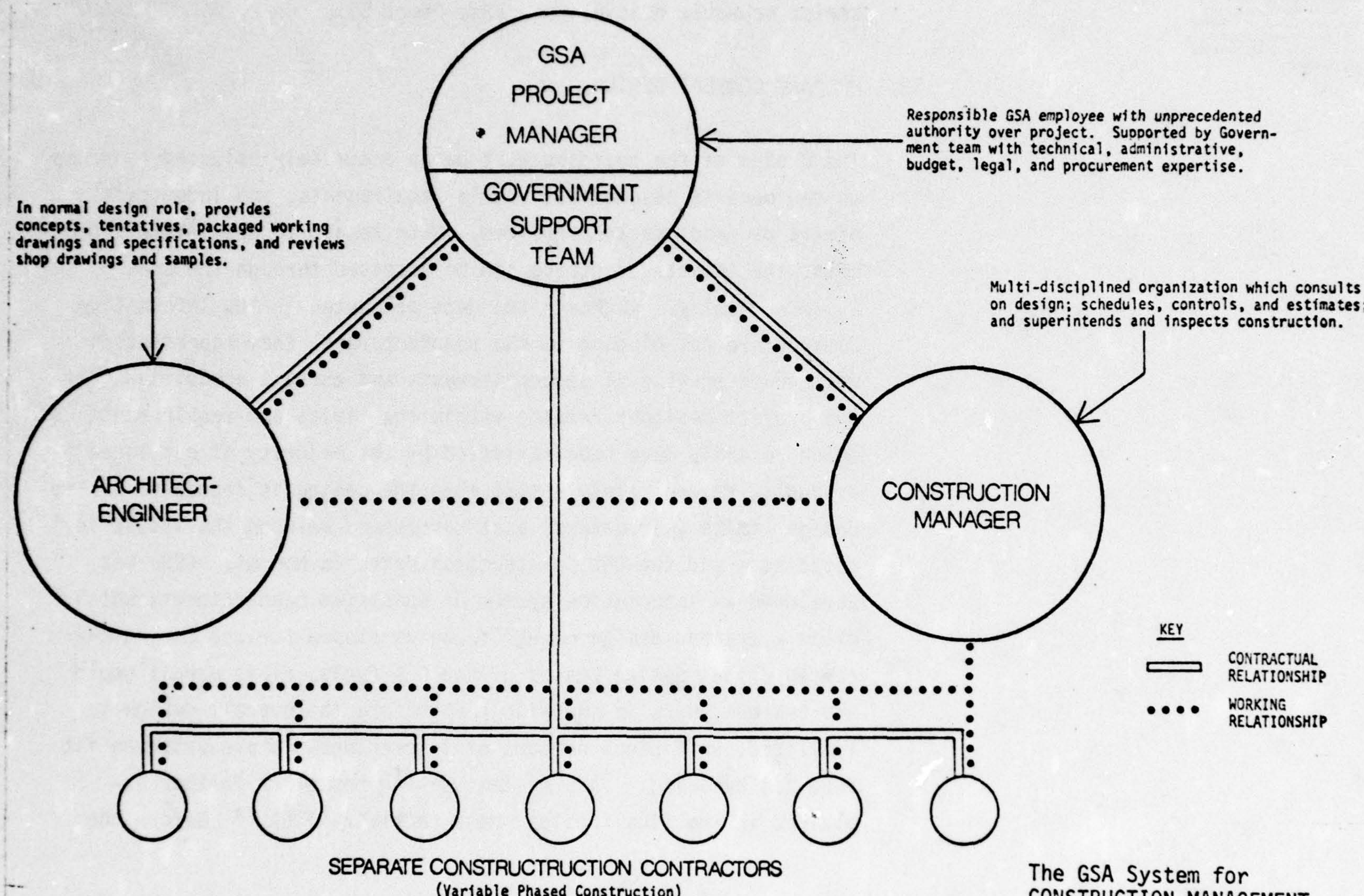
separate construction contract selected while working within a strict schedule discipline. (See Chart 5).

13. PREPARE CONCEPT DESIGN

The design of the building must be an accurately balanced response to the owner's objectives, user's requirements, and industry's offers of products and services. With regard to open systems projects, the industry's offers can be assessed through the *Open Systems Catalog*. Although the data presented in the Information Catalog are not binding to the manufacturers, they represent an up-to-date profile of accomplishments and current activities. If the project designer remains within the limits and requirements which recently have been satisfied by the majority of cataloged products, he can safely assume that the design is feasible. These design limits (parameters) must correspond between the industries' capacities and the DOD Construction Criteria Manual. CERL has developed an information system of subsystem manufacturers which allow a systems design manual to be developed for use during the concept/final design phases of the MCA cycle. This manual would aid the designers in insuring that before the overall design is finalized, sufficient numbers of interchangeable products can fit into the building. This systems design manual is further explained in the final design phase (activity #15).[20] Before the

Chart No. 5

organization for phased construction



The GSA System for
CONSTRUCTION MANAGEMENT

concept design is completed, the following questions must be answered:

1. Can project requirements be modified so that the products currently being offered by the industry reasonably satisfy the owner's/user's objectives?

2. Is the project and potential market large enough to warrant the risks and investments inherent in product development?

3. Is there sufficient lead time to allow for research, development, testing, and evaluation of newly developed products?

4. Once the products have been developed, can they be procured legally for the project, i.e., through competitive bidding or a "sole source" justification? (The requirements and the criteria for bidding, testing, and evaluation must be unambiguously specified and explained in advance of invitation to bid.)[21]

5. In conclusion, is it realistic to expect that the new product will satisfy the objectives of the project?

The answers to questions 1, 2, and 3 depend on the extent of the innovation, size of the project, and the flexibility of the

[21] If the answer to question 4 is "no," the government's project requirements must be satisfied through conventional materials and methods (out-of-system items), while the private client can proceed through and contract with the company of its choice.

project requirements. These must be assessed in each case by industrial and programming experts.

The catalog, because of its performance approach, facilitates innovation to the benefit of potential customers. Since unessential details are not presented, the cataloged products compete only on qualitative issues.[22] Thus, the only important future change recorded for the products will be change in quality, i.e., performance. The project designers can therefore assess the suitability of products during the early design and budget phase, and can estimate the costs without examining irrelevant details.

14. REVIEW AND APPROVE CONCEPT DESIGN

Since reviewing authorities process several projects for a variety of prospective users, they have an opportunity to coordinate them with respect to the catalog use.[23]

The review personnel can and should apply common criteria based on the best information available through the catalog activities, open systems experts, and the systems design manual. They have an opportunity to apply high-level industrial expertise to a series of projects, and to evaluate the feasibility of market aggregation for the industrialized products in order to save on manufacturers' costs and on approval and purchasing/contracting

[22] Legal Comments: Note that variations from the cataloged items, which do not add to performance but rather represent arbitrary design restrictions requiring costly retooling and reducing competition, run the risk of violating the most basic procurement rules. Solicitations should state only the *minimum needs* of the government and should encourage competition to the maximum extent practicable. (See: ASPR 1-300.1; ASPR 1-1201(2); and 10 USCS2304).

[23] Legal Comments: The grouping of common projects, even to the extent of multidistrict efforts, appears to be within the regulatory discretion of OCE. In 1972, the Fort Worth District was tasked with executing a single contract for grouped projects over a multidistrict area.

24 Ideally, the aggregation of projects of similar performance requirements begins with the master-planning (activities 2 through 7) when 1391's and SRCP's are prepared and reviewed. Ideally, the concept designs, cost estimates, and feasibility studies are made for the aggregated projects, rather than for the individual building. However, it is not too late to decide on aggregation after the concept designs are completed, if they are based on the same systems rules, or at least do not contradict the systems principles, i.e., use of the performance concept, modular discipline, and coordinated management-design-production team.

arrangements (i.e., in cases where product requirements are similar for several simultaneously constructed projects, the specification, response development, testing, evaluation, and contracting can be aggregated to the benefit of the owner).

Cost comparisons can be made at the District and Division levels for aggregated projects, using coordinated or aggregated contracting as opposed to procurement on an ad hoc, project-by-project basis.[24]

Additional advantages of aggregation are potential savings on the cost of design fees and the cost of information handling.

15. PREPARE FINAL DESIGN

Depending on the bidding and contracting arrangements, several basic alternatives can be considered for organizing and carrying out the design process:

a. Designs are finalized, and a complete description of materials and methods is given to the potential contractors.

b. The basic requirements are communicated in descriptive terms (i.e., drawings and specifications) and the requirements, which can be satisfied with more than one technical solution, are specified in performance terms.[25]

c. Only the functional and performance requirements are specified; the design and technical solutions are prepared by the contractors. In this case, the bid evaluation and selection process controls the outcome.[26]

First Alternative:

The first alternative is the most common in today's practice and the least efficient from the public owner's point of view. Its use is not recommended when preengineered subsystems are involved, except that all other alternatives have been examined and deliberately rejected.

For the first alternative, the following steps are taken:

a. Determine what performance is expected from the subsystems.

b. Identify the products in the *Information Catalog* which offer the most suitable performance.

c. Obtain design and specification details about the selected (candidate) products.

[25] Legal Comments: There appears to be sufficient precedence for performance specifications, even to the extent of revision descriptive guide specifications into performance specifications. To insure regulatory compliance, a waiver should be sought. (See Michael G. Carroll, *Procuring Today's Building Technology*, Special Report D-72, Vol II, CERL 1976).

[26] Legal Comments: It is unclear whether or not drawings must be included when using the total performance concept. If used, it is recommended they be of a nonrestrictive nature, such as a "footprint drawing," or a graphic matrix showing "functional room relationships."

d. Select three to five offerors who have the most acceptable or desirable design solution. Repeat this process for each subsystem type used in the building, and include the subsystem type in the design and specification. If the design and specification of the selected subsystems are markedly different, alternative design and specifications must be drawn up to accommodate the competing candidates.[27]

The above process is cumbersome, time-consuming, expensive, and replete with redundancies. The solutions and choices (both design and technical) determined by the design professional or firm are normally uncontested during the project. The designer's information originates from his own experience and from casual communication with some manufacturers (mostly sales representatives).

The vast majority of design professionals do not have the resources to be fully informed about complex product development issues and achievements. Consequently, the A/E's will either choose to specify only those products which are well known to them through past experience, or since they cannot fully evaluate the new products, will take unreasonable risks when specifying them. At the same time, the full expertise of the industry (e.g., manufacturers) in design, development, and delivery of hardware remains unused for the projects, since the producers remain uninvolved until the detailed decisions are made.[28]

[27] The "or equal" clause does not help in this case unless it is accompanied by a performance specification. Since the subsystem was originally chosen for its performance, another product that is 'equal' (or equalized) only in design features is not essentially an equal competitor. If the subsystem must also be equal in performance, this must be specified in advance, and the solution must also be evaluated on the basis of performance.

[28] Performance specifications, when applied appropriately, permit the use of the best expertise of industry in providing the technically most advanced and most feasible solution to the owner's/user's requirements. The effective use of performance specifications, however, requires considerable expertise.

Second Alternative:

Until further development of the industry and owner organizations, it is recommended that the *second alternative* be used to organize the design of open systems projects. This alternative requires that the building project be divided into industrialized (or system) and conventional (or nonsystem) portions. The nonsystem portion can be designed prior to the systems procurement process or following the selection of bids for the systems portion. In both cases, the systems rules must be followed, but in the latter case, more choices are left open for the manufacturers regarding interfaces with the nonsystem portion (i.e., the conventional details can be designed to receive the preengineered subsystems after all their features are known). Until the bids (or technical proposals) are received, the subsystems are defined only through their performance characteristics and, if unavoidable, through certain physical constraints (e.g., overall height, modular increments, etc.).[29]

[29] The fewer physical constraints imposed on the manufacturer, the more he can concentrate on his product's performance and the efficiency of his processes to the benefit of the building project owner/user. Value engineering and competition on an equal basis is automatically built into the arrangement. To minimize unnecessary constraints imposed on the manufacturer, certain subsystem rules or parameters must be met.

For this reason, a systems design manual will be developed incorporating industries' current capacities and acceptable DOD Construction Criteria.

Third Alternative:

The only difference between the second alternative and this alternative is that the project is not divided between the "in systems" and "out of systems" portions. Rather it is bid as one contract based on the performance concept. In this way, either (1) subsystems manufacturers can form a joint venture and agree to design and deliver not only the "in systems" portion but also the "out of systems" portion, and a conventional general contractor can agree to design and deliver the entire building; or (2) any individual, such as one subsystems manufacturer, can agree to design and deliver the entire building. The advantages to this are the reduction or risk and of the effort required by Corps contracting personnel. The disadvantages are that it is inefficient and possibly discourages competition, because most bidders are required to do more than they normally would. Because of this, there will be extensive subcontracting and/or the formation of partnerships to execute the entire project. This, in turn, requires a long bid period to carry out both the logistical and legal tasks necessary to execute a project beyond the normal roles of an individual bidder.

This option, while superior to the first option of bidding descriptive documents, is considered inferior to the second option (multiple contracting). This third option should be carried out only when it is determined that multiple contracting is not feasible.

Following are discussions of a design manual and a master performance specification which aid the experienced open systems A/E and CM, if needed, and guide the inexperienced A/E, whether "in-house" or "out-of-house." The suggested design guide and performance guide are equally helpful for the second and third design options but not for the first one.

BUILDING SYSTEMS DESIGN/ PLANNING MANUAL

[30] Appendix B includes an example of such a manual, the *Building Systems Planning Manual* by BSIC/EFL.

The building systems design/planning manual will consist of necessary information to aid the A/E (Corps) during the preliminary and final design of a project.[30] Such information as dimensional coordination, configuration, tolerances, subsystem function, and performance characteristics of the subsystem will be included as described below:

- Subsystems

  Verify which subsystems are included in a given building system and which are treated as nonsystems. Also identify any combination of traditional trades involved in one system, e.g., lighting/ceiling or electric/electronic subsystems.

- Dimensional Coordination

  Identify the dimensional rules of the system, e.g., planning grid dimensions, bay sizes, room heights, and floor/ceiling sandwich depth.

- Configuration

  Identify those rules of the system which will affect the building shape, including such information as:

  -- maximum number of stories permitted;

  -- slopes and diagonals;

  -- maximum/minimum spans and overhangs;

  -- split levels and offset capabilities.

- Tolerances

  Identify both positional and manufacturing tolerances for each subsystem and where possible, for nonsystem work. For example (relative to the nominal floor-to-floor height), determine the maximum/minimum:

  -- manufactured height of the partitions;

  -- deflection of the floor.

- Subsystem Function

  Identify precisely what each subsystem provides (e.g., does the lighting/ceiling subsystem include accent as well as general lighting?). Also identify precisely where one system ends and another begins (e.g., under what section of the specifications should the final power connection to the lighting/ceiling be specified?).

- Subsystem Performance

  Obtain typical technical data comparable to the information normally obtained by A/E consultants when incorporating a proprietary product in a building design.

For example, data for the structural subsystem should include:

Spans and load capabilities;

Openings (how large and where they can occur);

Bracing required;

Fire protection required or provided.

PROTOTYPE PERFORMANCE SPECIFICATIONS/USE AS GUIDE SPECIFICATIONS

The *Prototype Performance Specifications* (Volume II in the present expansion of the *Open Systems Catalog*) are actually master specifications for a specific facility type (administrative/classroom), and a specific grouping of subsystems (structure; partitions; lighting/ceiling; heating, ventilating, and cooling; and electric/electronic). These specifications are intended to be used as guidelines in conjunction with definite design programming information to establish the facility's definite final performance specifications. Further expansions of the catalog will include master specifications by subsystem for additional facility types identified as applicable to Army use, as well as an expansion to other applicable and available subsystems. The expanded master specifications will follow the same format at the current prototype.

The prototype specifications could provide the A/E experienced in systems work with all necessary design criteria, while still allowing him to complete the project by his own methods. For the A/E having no experience in systems building or for in-house A/E's, the specifications can be used directly for a project. For further details on the descriptions of the specifications, see Appendix C.

16. REVIEW VALUE ENGINEER FINAL DESIGN

The review organization will vary according to the design and contracting alternative used.

In the case of the first alternative (design-bid-build), the review process is like that of the conventional MCA procurement process, except that several--rather than one--design solutions must be approved to allow sufficient competition between subsystems with different design features.

The second alternative will include performance specifications of the industrialized subsystems, their approximate positioning, unavoidable dimensional and design constraints, and the outline design and specifications of the nonsystem portion. Since detailed design will depend on the design of the winning preengineered subsystem, the project must be reviewed on the basis of the abovementioned information and the data in the *Open Systems Catalog*. (The catalog can serve to demonstrate that the project requirements can, in fact, be satisfied with the use of available subsystems.)

The third alternative would be the same as the second, except that the descriptively detailed out-of-systems portion would be absent in the third option.

Approval of the design, as with traditional construction, takes place in several phases. The main difference with the systems approach is that apart from the drawings and descriptive specifications, the performance specifications for the subsystems must also be approved as part of the bid documents. Furthermore, the final drawings and descriptive specifications for the subsystems and the interfaces are approved after selection of the contractors but before the contracts are signed.[31] Approval of the shop drawings proceeds as it normally would. It is important that, unless there are compelling reasons, no change be demanded of the chosen system which adversely affects either the design details of the product, manufacturing processes, and installation costs. The contractor must be assured that the preengineered products are acceptable to the client, and that they meet the original requirements set forth in the bid documents (i.e., performance, interface, and environmental design requirements).

[31] Past IB projects (e.g., 1972 Air Force Relocatable IBS; 1972 Fort Knox Industrialized Comfort Stations) have analyzed bids and awarded contracts based on the offeror's concept design. The winner then submitted his final design after the contract award. Contract award in no way relieved the winner from his promise to satisfy the performance specifications of the RFP (one-step) or RFTP (two-step).

Value Engineering:

Instead of reviewing a detailed solution, value engineers will review performance specifications and nondetailed drawings with design alternatives 2 and 3. With option 1, and the out-of-systems portion of option 2, they can exercise their functions traditionally.

When reviewing performance specifications, value engineers must be aware of the performance parameters of the cataloged items and the

[32] In one-step procurement, unlike TSFA, low-acquisition cost is not the sole criterion for award.

disruptions that could follow any change. In a sense, then, value engineering is inconsistent with the economies of preengineered buildings. However, this is not a significant problem, since the performance process itself is an exercise in value engineering. Traditionally, value engineers analyze a solution for a building; if they discern another solution which lowers cost without impairment of function, then value engineering has succeeded. In this sense, value engineering is a cost safety valve for the arbitrariness of a set solution. The performance concept obviates the need for such a safety valve, since it bids out the performance sought to industry. The winning solution will be the lowest priced solution to Corps needs that the free marketplace can provide.[32]

Therefore, the performance concept obviates the traditional necessity for the value engineer, but replaces it with the necessity to reexamine the performance specifications to insure (1) that they are not excessive or (2) that another level of performance can suffice and probably cost less. This task requires that the value engineer be aware of the performance capabilities of the cataloged products so that his revisions, if any, will not be unfeasible or increase cost.

17. EXECUTIVE REVISIONS

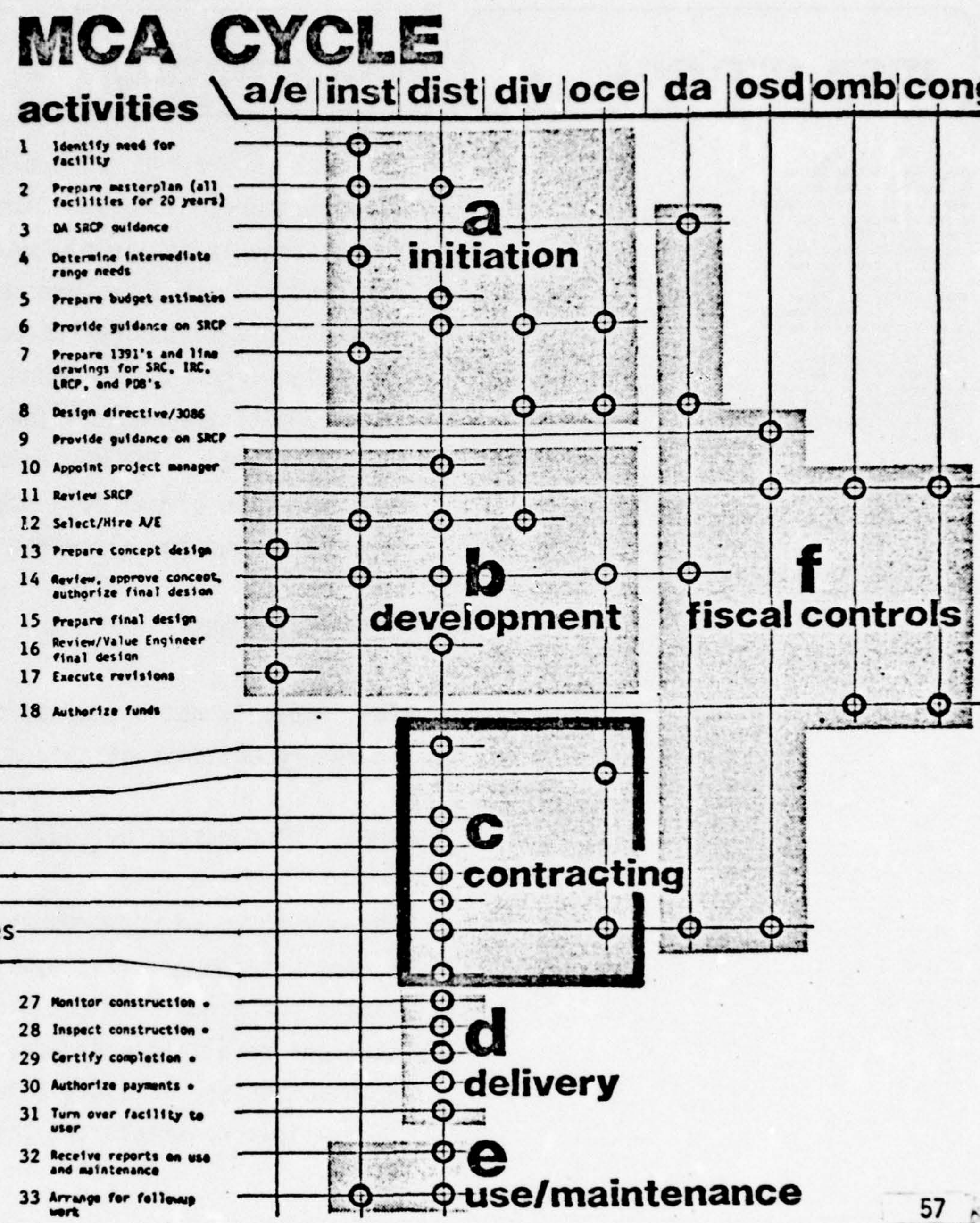
Any revision of detail will probably affect the feasibility (increase cost and decrease competition) of using the cataloged products. After this executive review and appropriate revision, the project personnel should be authorized to prepare bid packages that will facilitate the advance procurement of subsystems or the entire "system portion" of the project. *In all cases, when products are procured on the basis of performance*, the final approval of the design is associated with the bid evaluation and selection process. It is up to the owner to insure that all aspects of his requirements expressed or implied in the specifications have been reasonably satisfied, and that sufficient guarantees or remedies are available before accepting the bid. For this purpose, instead of the customary design review, there must be a systematic evaluation between submission of proposals and authorization of construction (delivery).

Chart No. 6

catalog expansion 1

C project contracting phase

19 Choose procurement options/
Prepare bid package
20 Review, approve bid package
21 Finalize bid package
22 Advertise bid
23 Review bids
24 Select contractor
25 Obtain authorization of expenditures
26 Award contract



[33] Note: ER 118-1-7, 25 Mar 74, limits the use of one-step competitive negotiation to family housing projects. Other facility types need a waiver from ASD (I&L). Two-step formal advertising, also restricted by this regulation, can be used since one of the exceptions for its use is "when *performance* specifications must be utilized to accommodate industrialized construction (building system) components and concepts."

Chart No. 6 provides an outline of MCA project constracting. Three procurement options are available for Corps use. Formal advertising is applicable where specifications and drawings are descriptive, and therefore should be used for the conventional portion in a multiple-contracting strategy. In all other situations where performance specifications are used, only one-step competitive negotiation and two-step formal advertising should be used. The key unique elements for open systems are: the execution of multiple contracting; the elevation of technical proposals; and the allowance of large bid periods.

18. AUTHORIZE FUNDS

This topic is not discussed in this catalog, and may be considered in future editions of this publication.

19. CHOOSE PROCUREMENT OPTION/PREPARE BID PACKAGE

Any bid based on performance specifications mandates the use of a one-step competitive negotiation[33] or a two-step formal advertising technique. If the bid is let as one procurement action with one resulting contract, then only one-step competitive negotiation and two-step formal advertising can be used. However, if multiple contracts are being awarded, then the "out-of-systems" portion can be bid via formal advertising, since the accompanying specifications and drawings will be descriptive. Where projects are aggregated, bidding should be allowed on certain projects of the total package if the total package is divisible. This insures the most economical solution and also encourages participation by small business concerns. Since the cataloged items are in the nature of a supply end-item, it is feasible to request specific warranties.[34], [35]

20. REVIEW, APPROVE BID PACKAGE

Proceed conventionally.

21. FINALIZE BID PACKAGE

Proceed conventionally as discussed in activity #19.

22. ADVERTISE BID

Since either: (a) design and technical solutions will be requested via performance specifications and drawings, or (b) design and technical solutions will be provided with an "or equal" clause, then the period of advertisement should be longer than that of conventional procurements. Cataloged items which have been used previously may in fact be able to provide response

[34] If solutions are being requested instead of provided, the ensuing proposals will need evaluation. Evaluation criteria must be expressed. ASPR 2-503.1 (iv) requires that the criteria for evaluating technical proposals should consist of design manufacturing, testing, and performance requirements.

[35] When the project is bid for only one contract, the current one-step (for family housing) and two-step formal advertising guides are a sufficient basis from which to prepare the bid package. If, however, the multiple contracting approach is used, these guides will need significant modification.

in a shorter period of time; however, the cataloged data are not all-inclusive and by nature, can never be 100 percent "up to date." Therefore, to allow for preparation of potential solutions, a bid period of at least 6 weeks should be allowed. More complex projects (technically and logistically) demand commensurately longer bid periods. This applies for either strategy: one contract for the entire facility or multiple contracts for the facility. However, when the single contract strategy is chosen, additional time should be allowed to give the independent manufacturers time to form consortiums and bid as one entity--a joint venture. Therefore, in the single-contract strategy, there should be not only 6 weeks for creating a technical solution, but also 2 to 4 weeks for the creation of a legal partnership.[36]

A "preproposal" conference should be held midway in the bid period to resolve ambiguities and to answer questions unanswered by the bid package.[37] The resolution of ambiguities and the dissemination of new information at the preproposal conference should be sent to all bidders via an amendment.[38] If a substantial change is made (i.e., one to affect a bidder's solution or possible participation) at the preproposal conference, the bid period should be extended accordingly to accommodate the impact such change will have on bidders. If the descriptive design strategy with an "or equal" clause is employed, efforts should be made to

[36] Note: One advantage of multiple contracting is the ability to save the time needed for the manufacturers to join together. It is more efficient to have a CM contract them together during the project.

[37] ASPR 3-504 and 18-204.

[38] ASPR 3-505.

determine if substitutes are "equal" before bid closing. Otherwise, bidders who are not in the favored position of the given solution(s), must make arbitrary decisions about what is "equal," which might render them unresponsive even though they could easily have responded if they had known what was acceptable. When an alternative is evaluated as "equal" or "not equal," the results should be disseminated to all bidders via an amendment. The performance strategy, however, does not require an "early" determination of responsiveness, since all bidders are equal and no proprietary solution is in a favored position, and since the responsiveness issue runs to a performance criterion rather than a comparison to a given proprietary solution.

23. REVIEW BIDS

Unlike conventional evaluations, the performance concept and any other design strategy requesting a proposal via TSFA or one-step competitive negotiation demands an *evaluation* of responsiveness. Simply put, not only must the conventional considerations of responsiveness be evaluated (e.g., delivery time), but the proposals themselves must be evaluated regarding their compliance with the technical specifications and drawings. In most projects, this demands employment of a team of technical experts (e.g., structural engineer, electrical engineer, etc.) to review the proposals vis-a-vis the specifications and drawings. Their evaluation technique varies greatly depending on the procurement method used.[39]

The method known as two-step formal advertising demands an evaluation of responsiveness of nonresponsiveness. The proposals are placed into one of three classes:

a) acceptable;

b) acceptable with minor modification; and

c) unacceptable.

If there is not adequate competition among class (a) proposals, then class (b) proposals are allowed to make the necessary minor modifications. Those found responsive at step #1 then compete for the award at step #2 solely on the basis of low acquisition cost. One-step competitive negotiation, however, is not a "go--no go" determination. Rather the proposals (either the initial submissions, or the "best and final" offer after negotiations of proposals within the competitive range) are evaluated on a predetermined "points scale." Evaluation factors are items such as technical competence, aesthetics, life-cycle cost factors, etc. These factors, their relative value, and the evaluation criteria should be clearly spelled out in the bid package.

[39] Legal Comment: The technical evaluation will be upheld by GAO "unless there is clear evidence of fraud, abuse of authority or arbitrary action." (See: 48 Comp. Gen. 49 (1968), 10 G.C. 406; B-161513 (Aug. 28, 1967); B-165771 (April 28, 1969).

24. SELECT CONTRACTOR[40]

Unlike conventional projects, the "contractor" for an open systems project might be the manufacturers themselves. There is no legal requirement that the "contractor" be a general contractor. If properly executed, the awarding of multiple prime contracts appears to be more in the "best interests" of the government in many situations than the awarding of a single contract to a general contractor. However, even if a manufacturer is a prime contractor, he must be found "responsible" pursuant to such conventional criteria as bonding, employment practices, etc. Awarding multiple contracts means that there will be many prime contracts. However, there are policy restrictions or at least reluctance to use this practice due to the potential increase in risk.[41]

25. OBTAIN AUTHORIZATION OF EXPENDITURES

Authorization of expenditures is performed conventionally.

26. AWARD CONTRACT

Traditionally, a construction contract is awarded to a general contractor. However, the cataloged systems can be awarded via individual prime contracts to the manufacturer (supplier).

[40] See Michael G. Carroll, *Procuring Today's Building Technology*, Special Report D-72, Vol II (CERL, 1976), for a detailed analysis.

[41] See Michael G. Carroll, *Procuring Today's Building Technology*, Special Report D-72, Vol II (CERL, 1976), for a detailed discussion of the issue of risk in multiple contracting.

Procedurally, separate contracts are let to each subsystems manufacturer. The "out-of-systems" work is contracted conventionally. The on-site activities can be coordinated by the Corps or by a Construction Manager trained in performing complex managerial tasks.[42] The most notable of the many advantages of awarding multiple prime contracts is the ability to phase or "fast track" the bids and activities to reduce delivery time. Government agencies have saved considerable time by "early" bidding certain long lead times items. However, due to the division in time of design and construction activities in the MCA process, it appears that the full benefits derived from "fast tracking" cannot be enjoyed. Traditional considerations guide the selection of the specific contract type.[43]

[42] See Step 10: "Appointment and Roles of CM."

[43] See Michael G. Carroll, *Procuring Today's Building Technology*, Special Report D-72, Vol II (CERL, 1976), for a more detailed discussion.

Chart No. 7

catalog expansion 1

MCA CYCLE

d project delivery phase

activities	a/e	inst	dist	div	oce	da	osd	omb	cong
1 Identify need for facility		O							
2 Prepare masterplan (all facilities for 20 years)		O	O						
3 DA SRCP guidance						O			
4 Determine intermediate range needs		O							
5 Prepare budget estimates			O						
6 Provide guidance on SRCP			O	O	O				
7 Prepare 1391's and line drawings for SRC, IRC, LRCP, and PDB's		O							
8 Design directive/3086				O	O	O			
9 Provide guidance on SRCP							O		
10 Appoint project manager			O						
11 Review SRCP							O	O	O
12 Select/Hire A/E		O	O	O					
13 Prepare concept design	O								
14 Review, approve concept, authorize final design		O	O		O	O			
15 Prepare final design	O								
16 Review/Value Engineer final design			O						
17 Execute revisions	O								
18 Authorize funds								O	O
19 Choose procurement options/ Prepare bid package			O						
20 Review, approve bid package					O				
21 Finalize bid package			O						
22 Advertise bid			O						
23 Review bids			O						
24 Select contractor			O						
25 Obtain authorization of expenditures			O		O	O	O		
26 Award contract			O						
27 Monitor construction*			O						
28 Inspect construction*			O						
29 Certify completion*			O						
30 Authorize payments*			O						
31 Turn over facility to user			O						
32 Receive reports on use and maintenance			O						
33 Arrange for followup work		O	O						

a initiation (activities 1–8)

b development (activities 10–17)

c contracting (activities 19–26)

d delivery (activities 27–31)

e use/maintenance (activities 32–33)

f fiscal controls

*For larger projects, there may be participation in contract administration by higher authorities.

27. MONITOR CONSTRUCTION

Chart No. 7 provides an outline of the MCA project delivery. Construction administration and control differ markedly, depending on whether a general contracting or construction management approach is used.

General Contracting Approach:

In the general contracting approach, the method of quality control is affected in that the preengineered subsystems can be tested and approved at the manufacturer's premises before delivery or construction begins. Since the manufacturers are normally responsible for installation and performance of their subsystems, the site controls are largely limited to aspects of coordination, scheduling, and interfacing with "out-of-system" materials and methods.

Construction Manager Approach:

In the Construction Manager approach, duties begin well before site construction during which the CM is in full charge of scheduling, interfacing, quality control, labor relations, safety, construction changes, claims, and value management.

28. INSPECT CONSTRUCTION

General Contracting Approach:

Since the preengineered subsystems have already been inspected at source, the site inspection will ascertain that the items are installed according to plans and manufacturer's details. The inspection of "out-of-system" portions is like that of conventional MCA projects.

Construction Manager Approach:

The Construction Manager shall coordinate and generally direct the work of the separate construction contractors; he shall inspect the work performed by the separate contractors to insure conformity with requirements of their respective contracts. If any differences arise between the Construction Manager and any separate construction constractor, the Construction Manager shall inform the Contracting Officer promptly in writing, giving both the details of pertinent facts and applicable contract provisions, and his recommendation of action to be taken by the Contracting Officer. Promptly after receipt of the Contracting Officer's written interpretation, the Construction Manager shall transmit it to the separate construction contractor.[44]

[44] The GSA System for Construction Management, p. 19.

29. CERTIFY COMPLETION

Accomplished by Corps personnel or Construction Manager as applicable.

30. AUTHORIZE PAYMENTS

Accomplished by Corps personnel or Construction Manager as applicable.

31. TURN OVER FACILITY TO USER

User operation and maintenance manuals should be provided by the subsystems manufacturer.

Chart No. 8

catalog expansion 1

MCA CYCLE

activities	a/e	inst	dist	div	oce	da	osd	omb	cong
1 Identify need for facility		O							
2 Prepare masterplan (all facilities for 20 years)		O	O						
3 DA SRCP guidance						O			
4 Determine intermediate range needs		O							
5 Prepare budget estimates			O						
6 Provide guidance on SRCP			O	O	O				
7 Prepare 1391's and line drawings for SRC, IRC, LRCP, and PDB's		O							
8 Design directive/3086				O	O	O			
9 Provide guidance on SRCP							O		
10 Appoint project manager			O						
11 Review SRCP							O	O	O
12 Select/Hire A/E		O	O	O					
13 Prepare concept design	O								
14 Review, approve concept, authorize final design		O	O		O	O			
15 Prepare final design	O								
16 Review/Value Engineer final design			O						
17 Execute revisions	O								
18 Authorize funds								O	O
19 Choose procurement options/ Prepare bid package			O						
20 Review, approve bid package					O				
21 Finalize bid package			O						
22 Advertise bid			O						
23 Review bids			O						
24 Select contractor			O						
25 Obtain authorization of expenditures			O		O	O	O		
26 Award contract			O						
27 Monitor construction •			O						
28 Inspect construction •			O						
29 Certify completion •			O						
30 Authorize payments •			O						
31 Turn over facility to user			O						
32 Receive reports on use and maintenance			O						
33 Arrange for followup work		O	O						

a initiation

b development

c contracting

d delivery

e use/maintenance

f fiscal controls

e

project use/maintenance phase

32. RECEIVE REPORTS ON USE AND MAINTENANCE

Chart No. 8 provides an outline of the project use/maintenance phase. Maintenance contracts have been included with the procurement of industrialized subsystems for certain civilian projects. In such cases, the owner has little interest in monitoring the maintenance while the contract lasts (3, 5, or 10 years). Maintenance information, however, is vital in cases of repeated use of standard items and standard specifications for improving the standards and achieving life-cycle economies for future projects. An accurate and systematic recording of use and maintenance information is vital for the government owner.

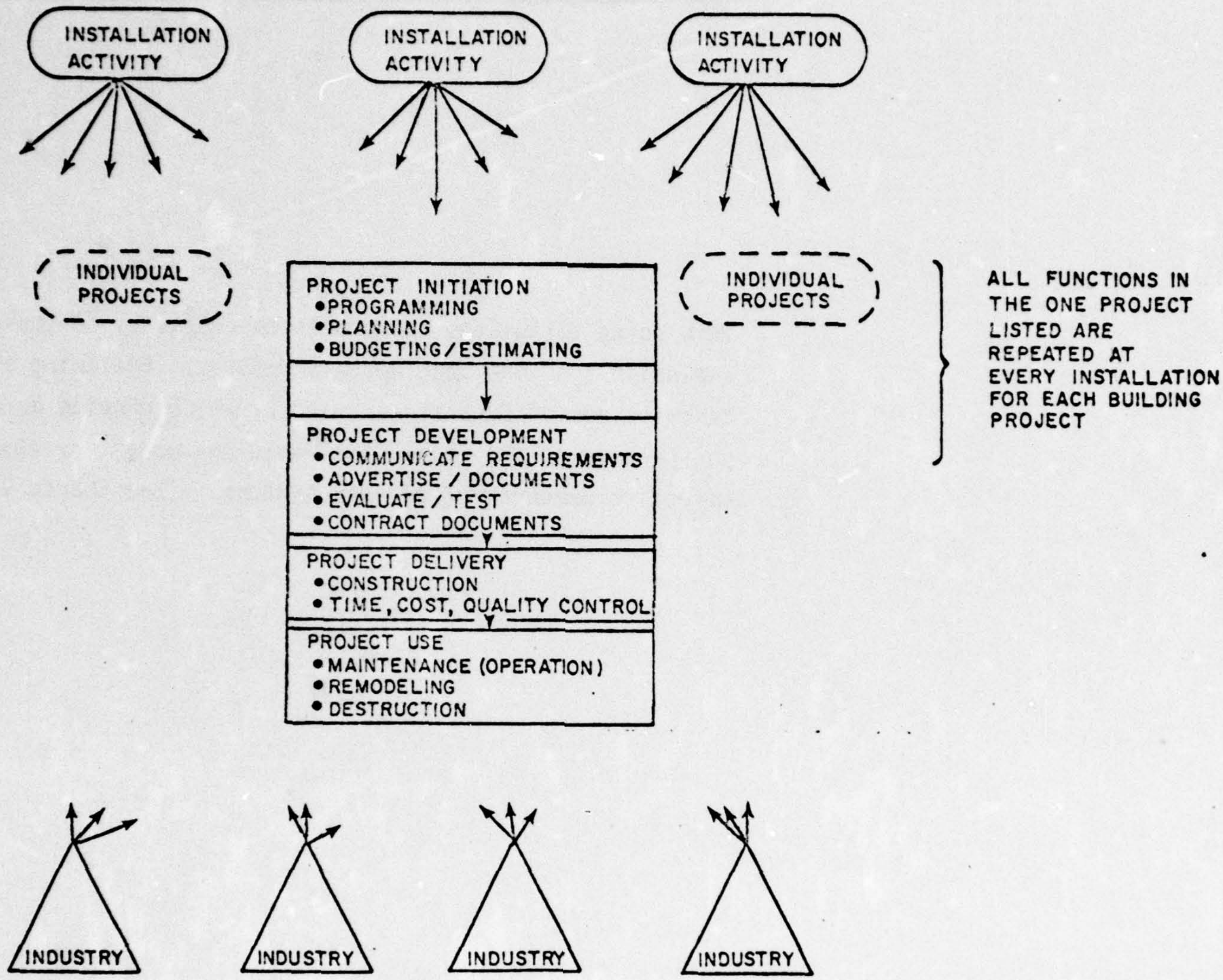
33. ARRANGE FOR FOLLOWUP WORK

The long time span between identifying need for a facility and its final delivery to the user, coupled with certain inflexibilities of the building entity, can necessitate modifying the facility to suit changing requirements. It is essential that the modifications be made in full cognizance of the building system's rules and constraints. Even a minor but inappropriate change might adversely affect the performance of any one subsystem or of the entire building.

appendix A

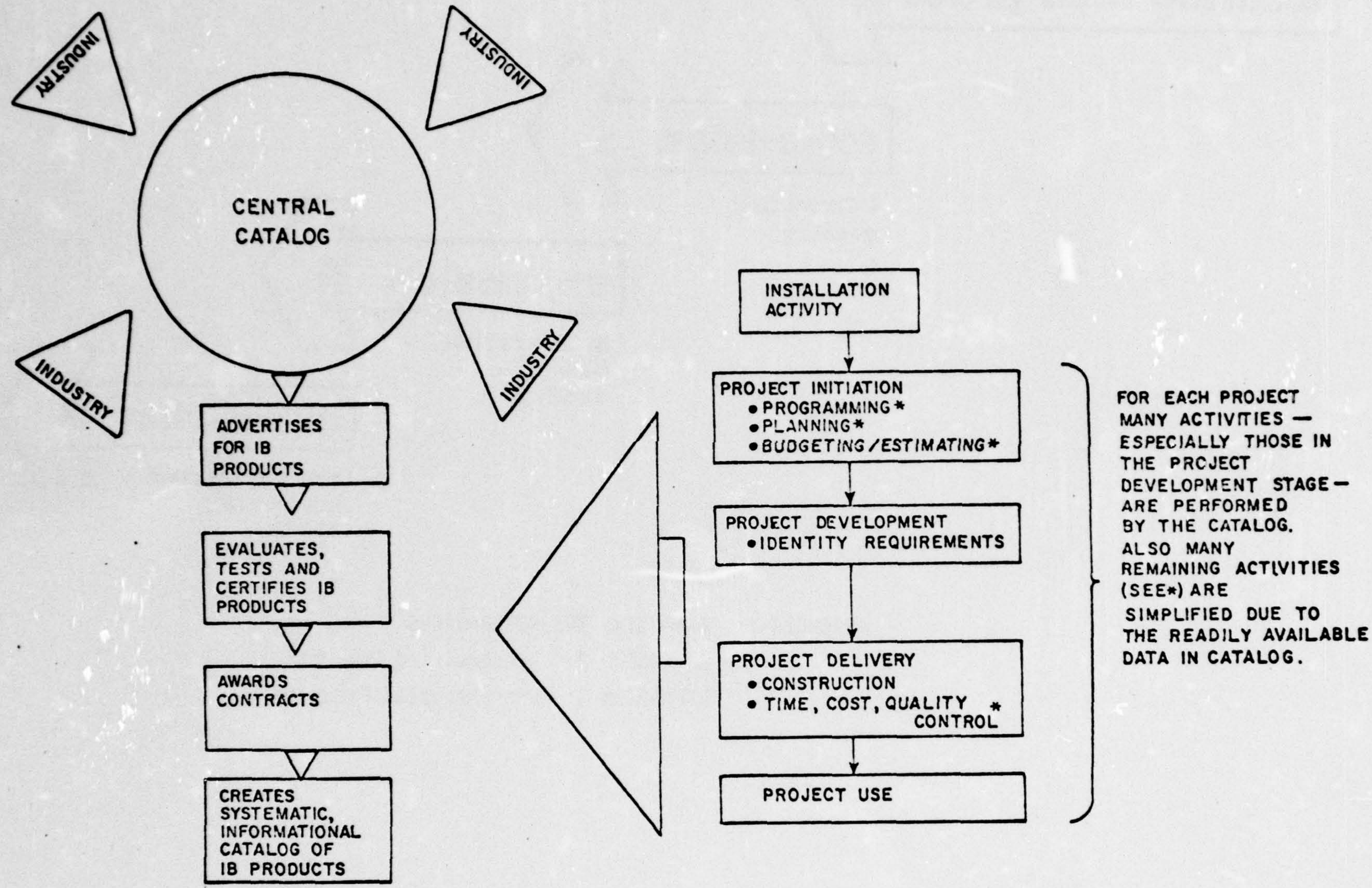
This guide formulates the processes necessary to implement Expansion 1 of the *Open Systems Catalog*. Following are brief descriptions of Expansions 2 and 3, which provide an overview perspective of the final--but evolving--model for the effective procurement of open systems. *(See Charts 9 and 10.)*

Chart No. 9

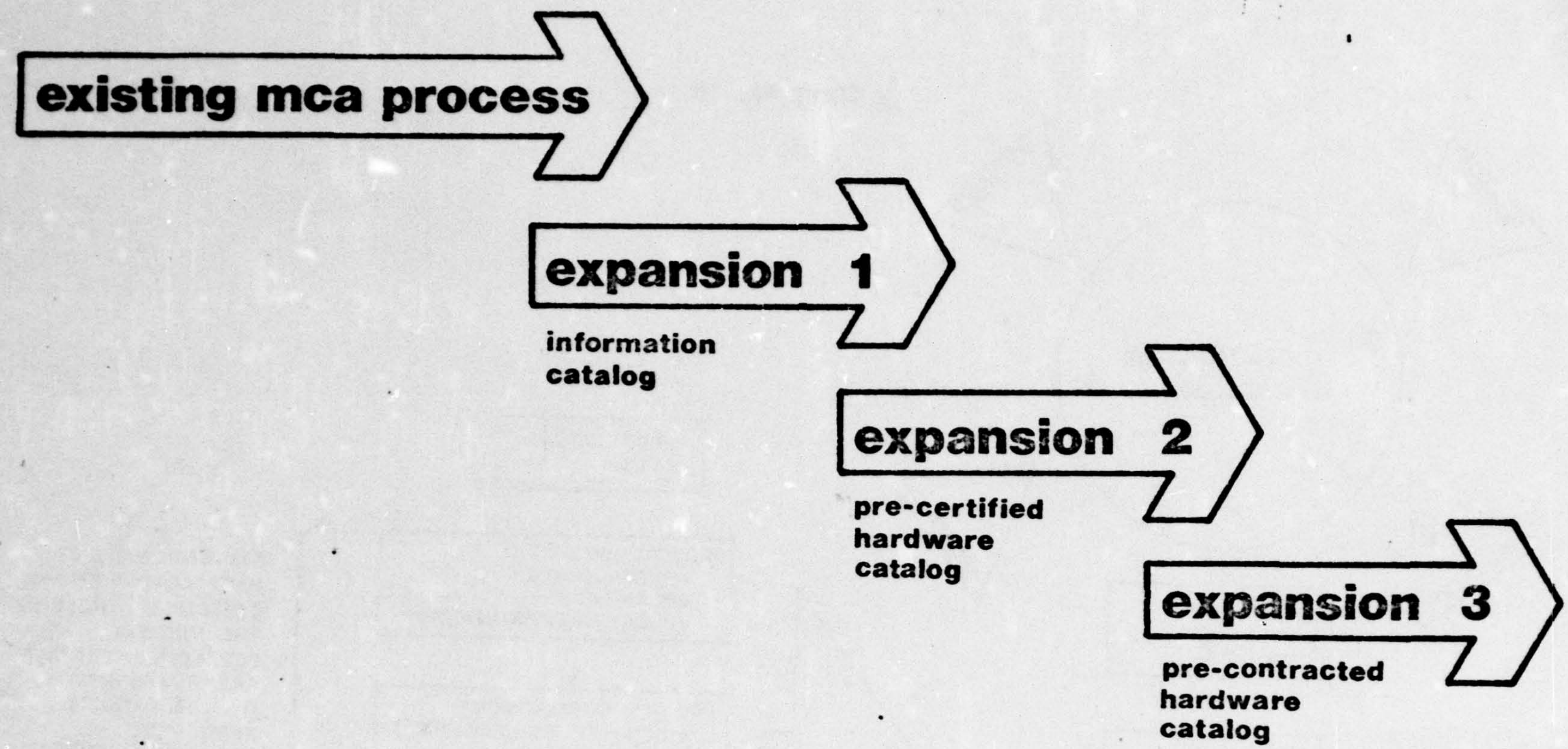


PRESENT PROJECT-BY-PROJECT PROCUREMENT

Chart No. 10



PROCUREMENT ACTIVITIES WITH EXPANSIONS 1, 2, AND 3.



APPENDIX A: EXPANDING THE MCA PROCESS
EXPANSION 2: Precertified Products
EXPANSION 3: Precontracted Products

expansion 2: precertified catalog

INTRODUCTION:

This catalog is planned to assure project personnel that the products conform to specific requirements and standards compatible with military construction. Expansion 2 eliminates the need for product evaluation, testing, and selection for each project, thus reducing the time, cost of project development, and uncertainties of quality.

DESCRIPTION:

This catalog systematically presents verified information about the performance and essential design characteristics of building products selected and certified for use in MCA projects under prescribed conditions. The information will relate to the needs of the military construction process and procedures, and to the requirements of the project personnel in charge of procurement decisions.

IMPLEMENTATION:

This catalog will be developed for a specific facility type group and will include only those products which are essential and common to that group. It will specifically address those conditions found in MCA projects.

Implementing this upgrade requires the establishment of a precertification process, which requires the Army to:

a. Establish a mandate and appropriation for the program.

b. Organize a network of testing facilites and expertise.

c. Establish a team of qualified evaluators having authority to make recommendations on the technical suitability of a defined range of products within prescribed circumstances.

d. Establish a final authority for certification.

e. Issue a regulation which permits the inclusion of cataloged products in technical proposals and bid packages without the necessity of further evaluating performance.

SUMMARY:

The catalog representing Expansion 2 introduces a major change in the conventional MCA process: central approval of the subsystems (or preengineered systems) is centralized not on a project-to-project basis.

Quoting the catalog numbers will be sufficient identification of the products to be incorporated in MCA projects and of those to be procured competitively. Expansion 2 will reduce the time, cost, and many of the uncertainties associated with selecting products for MCA facilities. By its nature, however, it cannot guarantee the availability or the cost of these products for MCA use.

expansion 3: precontracted catalog

INTRODUCTION:

The *Precontracted Products Catalog* facilitates advance bulk purchase of selected subsystems for which there is a continuous demand. It increases the accuracy of construction estimates and, compared to project-to-project procurement, is expected to reduce the cost of products. This catalog, similar to Expansion 2, permits centralized control of testing evaluation and approval of products for military construction.

DESCRIPTION:

The *Precontracted Product Catalog* systematically presents verified design and performance characteristics of industrialized (or pre-engineered) building products which have been offered for military construction under specified conditions of sale/purchase.

In addition to the information contained in the *Precertified Product Catalog*, Expansion 3 includes the purchase price of the products and associated services that is valid for a 2-year (or other defined) period. The catalog contains the conditions of purchase contract and availability, along with guarantees and safeguard conditions necessary to make the use of the catalog feasible and effective. Furthermore,

a. The conditions must be legally binding for both Army and suppliers;

b. Delivery circumstances must be stipulated in advance;

c. Unavoidable modifications to the original contract must be stipulated;

d. All suppliers must be treated fairly (equal protection);

e. Product information must be complete to permit fast, detailed design, accurate costing, timely approvals, and advance orders.

IMPLEMENTATION:

To make use of Expansion 3, design and engineering standards must be compatible with the cataloged information. The design requirements must be specified in performance terms, and the requirements for tests and quality controls must be expressed uniformly.

The project personnel must be given mandate to use the precontracted items in all applicable cases until the planned procurement quota is reached.

The maximum and minimum quantities for the quota will be determined centrally on the basis of short-range construction plans; exceptions will be made only through waivers.

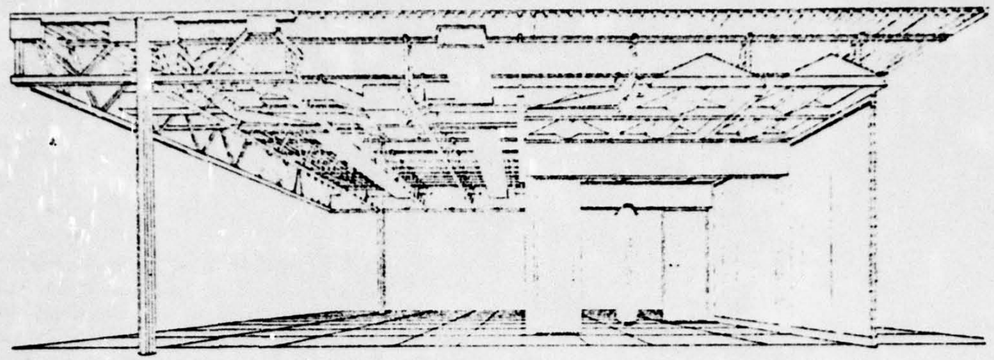
Before each contracting period expires new bids will be sought for the supply of precertified products so that the new edition of the catalog can serve the projects in the new short-range construction plans.

SUMMARY:

The use of Expansion 3 can greatly simplify the work of the personnel of individual projects, while allowing the use of complex processes and products for a variety of small and large construction and remodeling projects. As with precertification, precontracting process can expand starting with facility-types and subsystem group with the most potentials for early success.

appendix B* INTRODUCTION TO PLANNING WITH BUILDING SYSTEMS

* Building Systems Planning Manual, Building Systems Information Clearinghouse, Special Report Number Three (BSIC/EFL, Menlo Park, CA, 1971).



The Building System

A building system is composed of building subsystems manufactured by a number of competing firms and engineered to be dimensionally and functionally compatible with one another (see Table I, p. 16). Four of these subsystems are major contributors to the building's form and function.

1. The *structural subsystem* gives the building its general form and sets the basic modular pattern.
2. The *mechanical, or HVC, subsystem*, provides thermal control and comfort.
3. The *lighting/ceiling subsystem* provides lighting, acoustical control, possible fire protection for the structure, and support for partitions and other subsystems, and may provide for supply and return of treated air.
4. The *partitions, or interior space division, subsystem* provides interior visual and acoustic control with a potential for change of spatial organization.

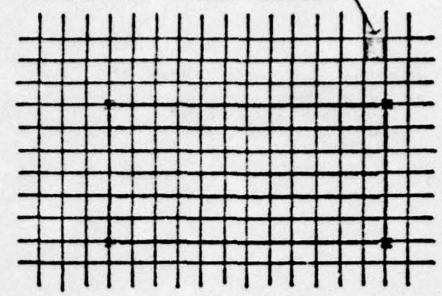
The lighting/ceiling subsystem and the horizontal elements of the structural subsystem create a service sandwich between the top of the deck and the ceiling line. This area is used for the passage of mechanical duct work and electrical and other services. With some types of HVC subsystems the service sandwich forms a return air plenum. In current products the depth of this sandwich varies from 36" to 48".

The building system may contain other subsystems, which are discussed in the section "How To Learn about Building Systems" of this report. Performance characteristics of specific subsystems may be found in *BSIC Special Report Number One: Manufacturers' Compatibility Study.*

Structural Subsystem

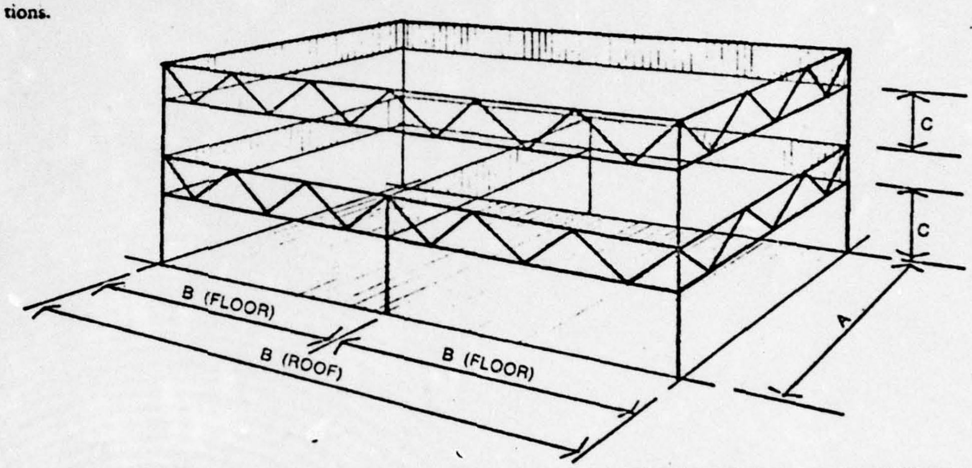
In SCSD-type building systems the horizontal dimensional planning module of the structural subsystem is 5'-0" by 5'-0". Although most structural products allow freedom in vertical dimensions, some introduce a vertical dimensional planning module of 1'-0" or 2'-0".

The center lines of structural components fall on the plannning grid lines in most available systems. With some exceptions, columns are located at the corners of structural bays *and* at the intersection of these grid lines. In some structural systems, the columns fall *within* the structural bay, either on a grid line or within a grid square.



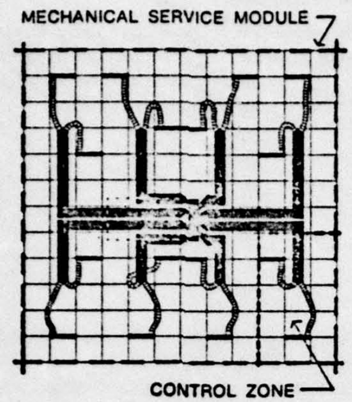
A "supermodule" is a planning module based upon the performance of a building subsystem. In the structural subsystem, the supermodule is the long span structural bay. This supermodule reflects the fact that most of these products were designed to permit large column-free spaces within the building.

The design of structural subsystems considers both the vertical and lateral load conditions normally encountered in schools and related building types. Because the magnitude of lateral loads is the result of the particular building configuration and the requirements *of local wind or seismic codes, it is the responsibility of the* architect and his consulting engineers to investigate the provision of shear walls and/or other lateral bracing to meet these conditions.



	floor			roof			ceiling heights
	A		B	A		B	C
available range:	5'-35'		5'-40'	5'-40'		5'-80'	as req'd.
supermodules:	25'-35'		25'-35'	25'-35'		55'-70'	9', 10'
useful combinations:	30'	x	30'	30'	x	60'	
	30'	x	35'	30'	x	70'	

The geometry of building systems requires that design changes involving the structure be made within the disciplines of (1) dimensional coordination imposed by the planning module and (2) structural bay size and shape imposed by the supermodule. Changes in building size and shape must be made with reference to both the 5'x5' planning module grid and the larger supermodule grid.

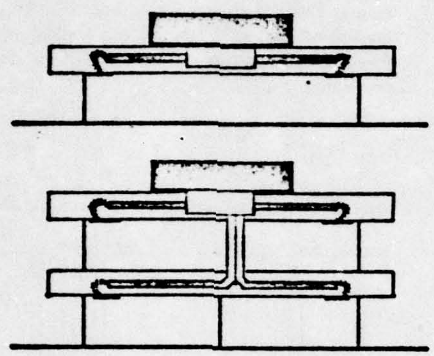


Heating/Ventilating/Cooling (HVC) Subsystem

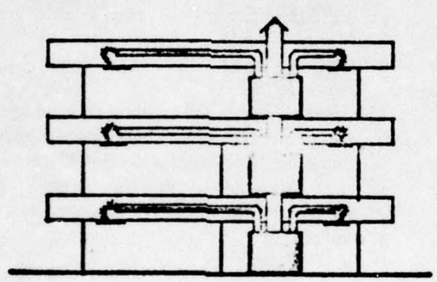
Although virtually all types of mechanical systems have been integrated into building system designs, the most typical HVC subsystem is the multizone air handling type. These units may be full packages designed for location either on the rooftop or in mechanical spaces or they may be satellite air handling units connected to one or more central plants.

The supermodule for many multizone systems is the "mechanical service module" which varies from 2,000 to 10,000 square feet per unit depending on unit size and other factors. The mechanical service module can be divided into as many as 15 "control zones" each with a thermostat or other control device.

To ensure spatial flexibility, the distribution layout—permanent and flexible ducts located in the service sandwich—must be designed so that air may be supplied to and returned from all possible combinations of control zones by relocating only flexible ducts, boots, and diffusers.



The rooftop multizone unit has proven to be an effective solution for one- and two-story buildings. In two-story applications, a vertical chase brings ducts down to the floor-ceiling service sandwich. Beyond two stories the floor space saved by rooftop units is consumed by these vertical chases.

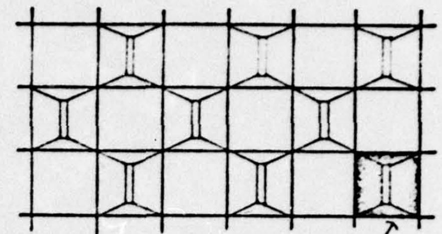


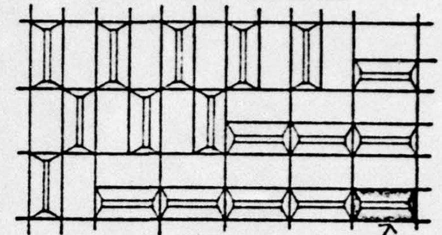
In multistory buildings, the use of multizone air handling units on each floor allows a high degree of flexibility with minimum vertical penetration for ductwork.

Lighting/Ceiling Subsystem

The lighting ceiling subsystem has a horizonal planning module grid which coincides with that of the structural subsystem. In most products this planning module is either 60" by 60" or 30" by 60". Some product lines offer both these modules and may permit them to be used interchangeably.

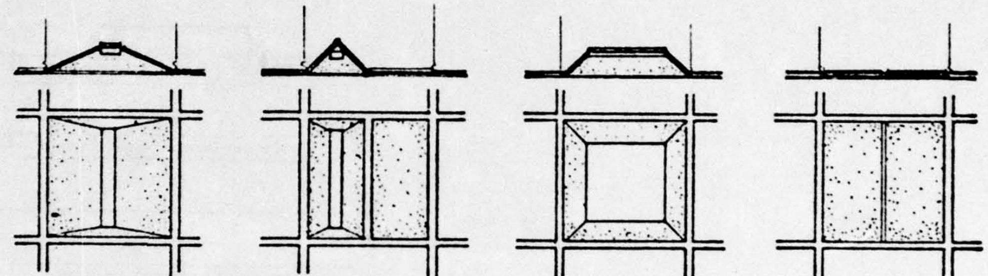
The center line of the ceiling grid runners falls on the planning grid lines. This ceiling grid provides support for other ceiling elements, partitions, and other components, and is often the location of the air supply and return diffusers.



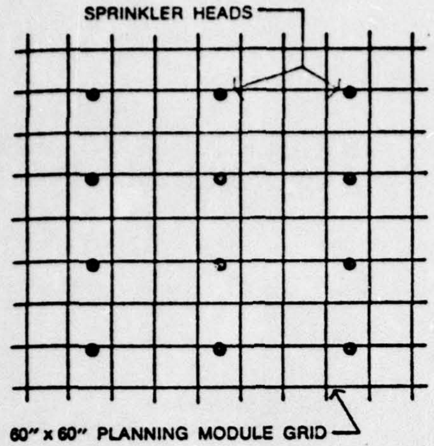


Several types of ceiling infill may be placed on these runners, creating two basic types of ceilings—coffered or vaulted and flat. By combining these ceilings with various types of lighting fixtures—direct, indirect, luminous ceiling, recessed, and surface mounted—a variety of ceiling configurations can be created, some of which are illustrated below.

The fixtures and lenses in most of these products are designed so that, as a rule of thumb, the equivalent of a single two 40W tube lumination level of at least 70 footcandles with relatively low fixfixture in each 60" by 60" module will produce a maintained ilture brightness.



The ceiling is one of the main elements of acoustic control in the building system. Because in many cases sound isolating partitions do not penetrate the ceiling, the sound attenuation of the ceiling is of great importance. In addition, attention to the sound absorbing qualities of the ceiling is necessary, especially in large open-plan spaces.



Fire resistance for steel floor-ceiling and roof-ceiling assemblies is provided largely by the ceiling. In addition to the fire rating required for structural protection, and with concrete structural systems where this rating may not be necessary, the ceiling may have to be rated separately from the total assembly in order to provide fire protection for an air return plenum, if such is used.

Partitions Subsystem

In most cases elements of the partition subsystem are located on the planning module of the lighting/ceiling subsystem. With some lighting/ceiling and/or partition products, however, partitions may be located off the ceiling grid. Several types of partitions are available for use with the other subsystems of a building system. These partitions have varying degrees of flexibility and types should be carefully selected to provide the flexibility actually required by the design. With the development of furniture and casework products which are dimensionally coordinated with the building system, the division of interior space into functional units should utilize a variety of elements and not partitions alone.

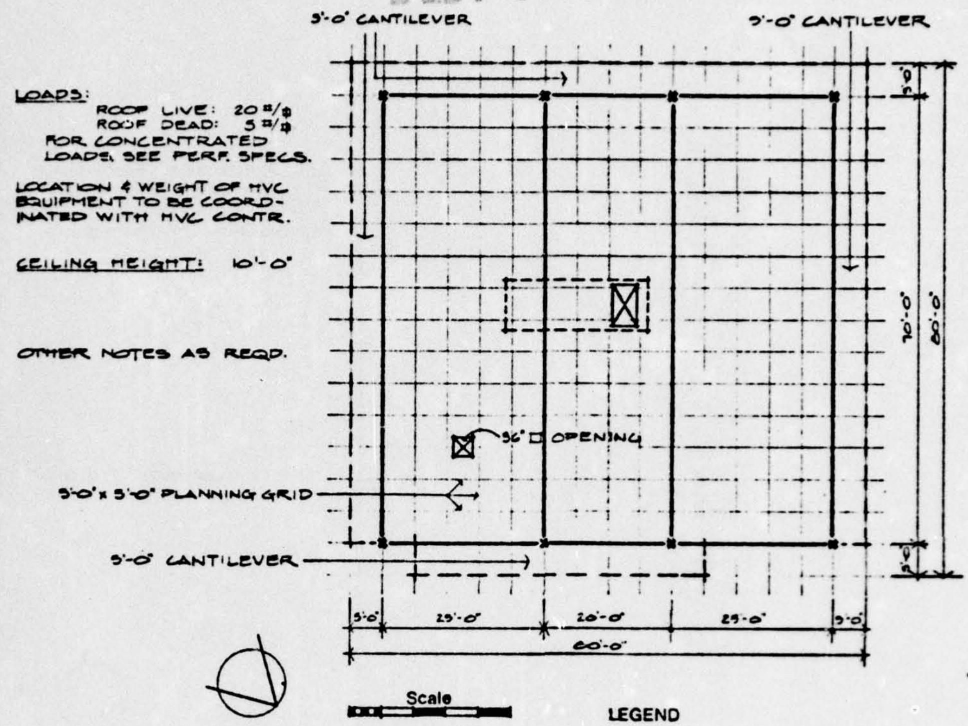
The major types are:

1. *Fixed partitions*, normally a part of the general construction contract, are used where the location of the wall will likely be the same over the building's life, such as fire walls, some wet walls, and vertical shaft walls.
2. *Demountable/movable partitions* are used where long term flexibility is desired and require mechanical attachment to the floor and ceiling.
3. *Portable partitions* can be quickly and easily relocated by relatively untrained persons and are used where short term flexibility is desired.
4. *Operable panel and accordion partitions* are primarily used where spaces are repeatedly divided on a more or less regular basis; the high cost of these partitions and the fact that they are normally underused reduces their usefulness.

SUGGESTED STANDARDS FOR DRAWINGS USED IN THE EARLY BIDDING OF BUILDING SUBSYSTEMS

NOTES TO STANDARDS:

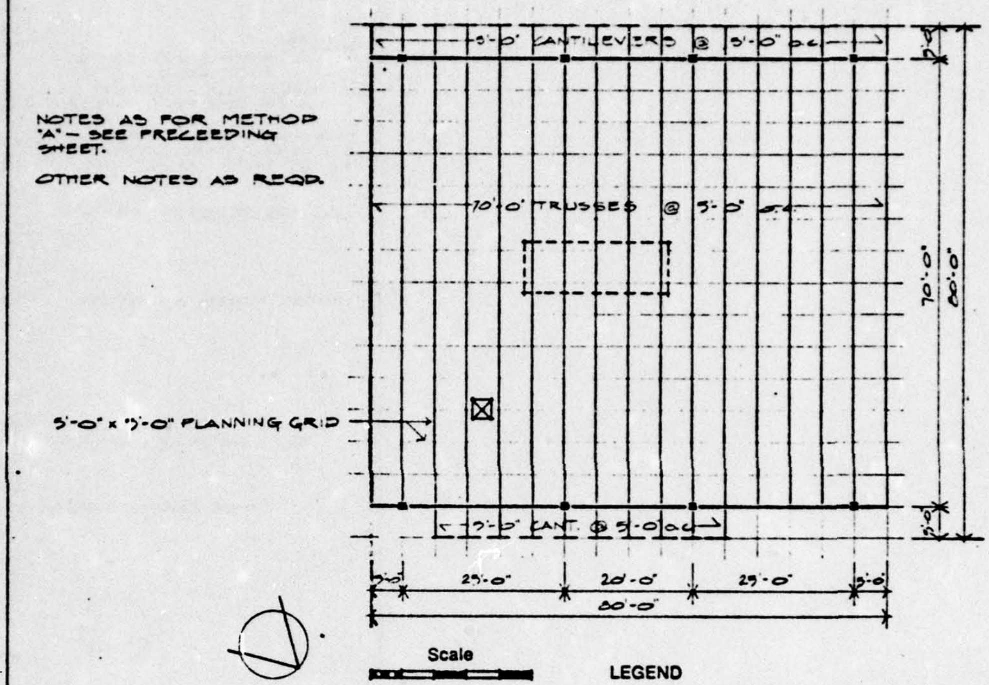
1. These standards are intended to show clarity and completeness of early bidding ("prebidding") drawings. Actual project drawings may include items not shown in these standards or may contain different information.
2. The symbols selected in these standards have been chosen to provide consistency in these drawings only. The set of symbols used on project drawings will have to be selected by the architect. Symbols should be clear, logical, and unambiguous.
3. The early bidding documents consist of, at least, drawings, specifications, and bidding sheets for each subsystem. None of these items should be considered in isolation from the others. Neither drawings, specs, nor bidding sheets present the entire subsystem by themselves.



ROOF STRUCTURAL PLAN

1. Locate columns and outline structural bays. Column location may be indicated by "acceptable column location zones" in lieu of specific location (see page 33).
2. Indicate special structural conditions such as cantilevers, known openings, and special loading conditions.
3. Indicate floor to ceiling heights.
4. Location of rooftop HVC units and required openings may be indicated or may be handled as an interface requirement for bidders.

STRUCTURAL SUBSYSTEM METHOD A OUTLINING OF STRUCTURAL BAYS



ROOF STRUCTURAL PLAN

1. Locate structural elements on five foot planning grid. Column location may be indicated by "acceptable column location zones" in lieu of specific location (see page 33).
2. Indicate special structural conditions such as cantilevers, known openings, and special loading conditions.
3. Indicate floor to ceiling heights.
4. Location of rooftop HVC units and required openings may be indicated or may be handled as an interface requirement for bidders.

LEGEND

- Column
- Primary spanning element
- Secondary spanning element
- Fascia line
- Roof opening
- HVC unit

STRUCTURAL SUBSYSTEM METHOD B
SIMPLIFIED FRAMING PLAN

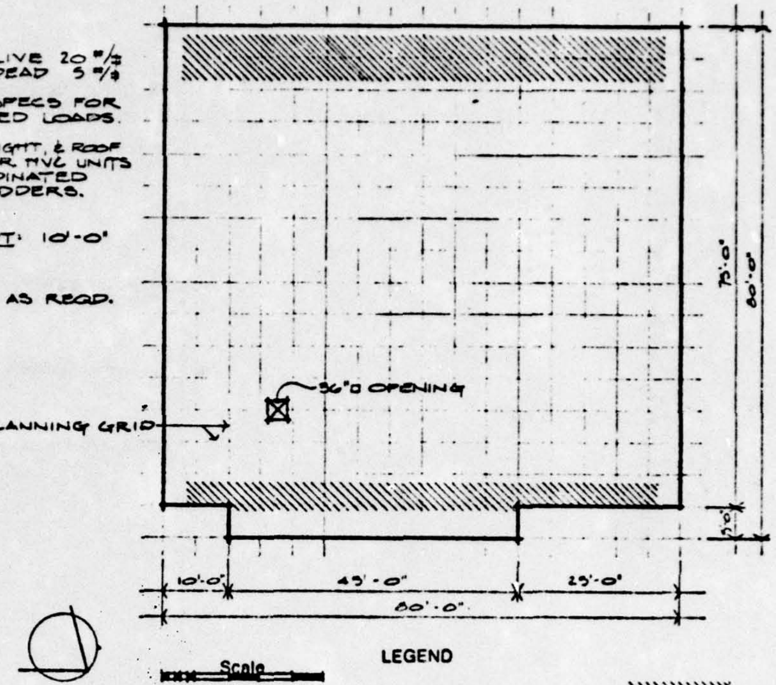
LOADS: ROOF LIVE 20 #/□
ROOF DEAD 5 #/□

SEE PERF. SPECS FOR CONCENTRATED LOADS.

LOCATION, WEIGHT, & ROOF OPENINGS FOR HVC UNITS TO BE COORDINATED WITH HVC BIDDERS.

CEILING HEIGHT: 10'-0"

OTHER NOTES AS REQD.



ROOF STRUCTURAL PLAN

LEGEND

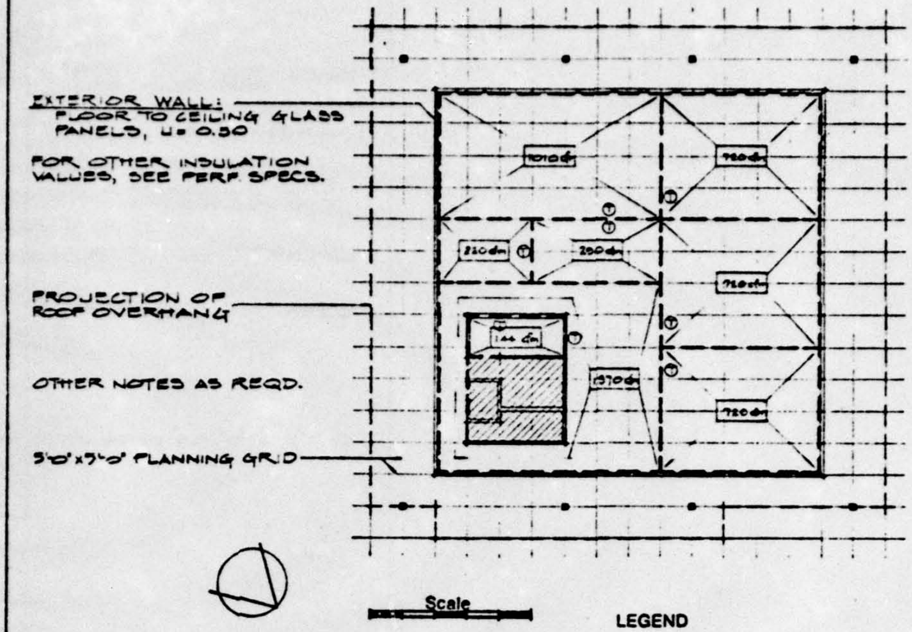
Area in which columns are acceptable

Structural perimeter outline

Roof opening

1. Locate columns or "acceptable column location zones." Outline building structural perimeter.
2. Indicate special structural conditions such as cantilevers, known openings, and special loading conditions.
3. Indicate floor to ceiling heights.
4. Location of rooftop HVC units and required openings may be indicated or may be handled as an interface requirement for bidders.

STRUCTURAL SUBSYSTEM METHOD C
OUTLINING OF STRUCTURAL PERIMETER



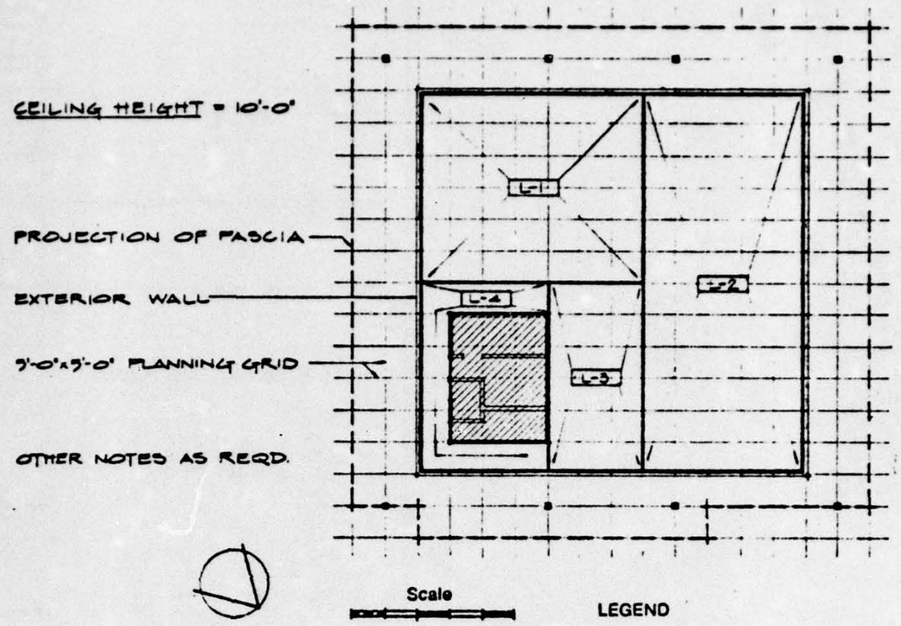
LEGEND

Control zone boundary	— — — —
CFM per control zone	▭
Nonsystems area	(hatched)
Thermostat	⊖

FLOOR PLAN—HVC

1. Locate all fixed elements—column, fixed partitions, exterior wall, etc. on planning grid. Indicate nonsystems areas.
2. Indicate areas of known flexible space and their HVC control zones.
3. Indicate control zones in areas of nonflexible space.
4. If desired, indicate locations of controls.
5. Indicate factors affecting HVC—wall and roof U-factors, ceiling heights, etc.
6. Show CFM for each zone.

HEATING / VENTILATING / COOLING SUBSYSTEM		



LEGEND

Lighting type boundary

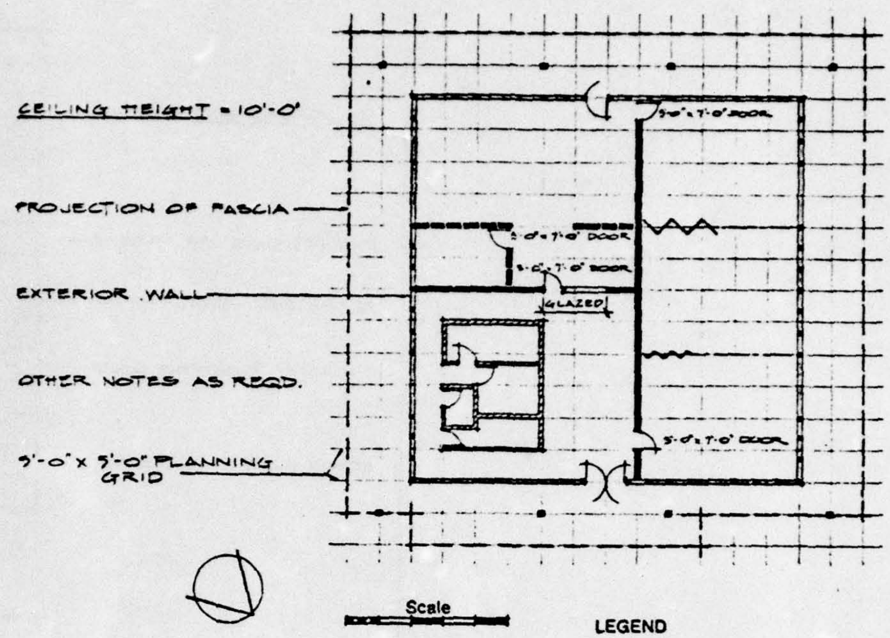
Lighting type indicator

Nonsystems area

REFLECTED CEILING PLAN

1. Locate all fixed elements—column, fixed partitions, exterior wall, etc. on planning grid. Indicate nonsystems areas.
2. Outline lighting type areas.
3. Enter lighting type designation in each area.

LIGHTING / CEILING SUBSYSTEM



LEGEND

Exterior wall (nonsystems)
Fixed partitions (nonsystems)
Demountable partitions
Glazed demountable
Portable partitions
Special surface
Operable panel partition
Operable accordion partition

FLOOR PLAN—PARTITIONS

1. Locate all fixed elements—column, fixed partitions, exterior wall, etc. on planning grid. Indicate nonsystems elements.
2. Locate all elements of partition subsystem.
3. Indicate floor to ceiling heights.

PARTITIONS SUBSYSTEM

appendix C

PERFORMANCE/GUIDE SPECIFICATIONS:

The Prototype Performance Specifications were written to conform with both the DOD *Construction Criteria Manual* and with systems rules or building systems principles. The DOD Manual prescribes broad technical criteria and policy guidance for the design and construction of functional facilities, and is further supported by an extensive list of technical manuals, regulations, and guide specifications, all of which are increasingly restrictive.[45] Criteria for the design and organization of systems building projects are determined by studying the results of similar public and private projects. Further information is directly available from Appendix B of this guide and Volumes 2 and 3 of the *Open Systems Catalog*. Specialized problems of systems technology include subsystem/subsystem and subsystem/nonsystems interface, dimensional/modular discipline, identification of subsystems scope, etc., all of which are important attributes not typically considered in nonsystems work. Specification performance requirements for each subsystem and its attributes were derived directly from the above information sources; any subsequent use of the specifications as guidelines or revisions of the specifications should pay close attention to the same restrictions.

[45] See Michael G. Carroll, *Procuring Today's Building Technology*, Special Report D-72, Vol II (CERL, 1976).

[46] *The Use of Subsystems in Building Construction for BRAB & FCC*, Marvin E. Goody, John M. Clancy & Associates, Inc., with Dublin-Mindell-Bloome Associates, P.C. Vol. 1, pp. 89-93.

ORGANIZATION:

The master format for these specifications, taken directly from BRAB/FCC,[46] is an expandable listing of performance attributed for all subsystems. Each subsystems section of the prototype specifications includes its own format which is comprised of applicable attributes taken directly from the master format.

The master format itself is divided into three major parts: GENERAL, DELIVERY PROCEDURES, and PERFORMANCE REQUIREMENTS. GENERAL includes a definition of the subsystem; describes local conditions, offeror requirements and qualifications; outlines subsystem evaluation criteria; and provides requirements for offeror submission or proposal. DELIVERY PROCEDURE deals with site and special project conditions. The PERFORMANCE REQUIREMENTS section is divided into three major categories: SAFETY, FUNCTIONAL, and PRACTICAL. Each subcategory is further divided into performance attributes, which are an outline or checklist of important items to be considered for each subsystem. For each attribute there can be a requirement, criterion, test, and evaluation, although not all of these occur in every case.

SPECIFICATION:

When a specific facility is needed, two methods of specification formulation are possible when the prototype performance specifications are used as guidelines. (1) The first and most preferred method is adoption of the specifications in entirety, completing the documents by filling in all missing information. In later expansions involving multiple facility types and subsystems (although subsystems, performance attributes, criteria, and tests

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applicable to all identified facility types will be included), a notation system will identify the facility to which any item applies. If facility requirements vary from the master specifications, subsystems groupings and performance requirements could be altered as needed to meet those specific requirements. This second method uses more of a "guidelines" approach, following the master format and either adopting various performance attributes, or altering them. (2) The second method requires that each alteration be confirmed for compatibility with both DOD and Building Systems criteria, making it imperative to have personnel or consultants highly trained in systems technology.

When using either of the above methods to formulate specifications for a specific facility, there is a need for definitive design information as well as prototype specifications. The Design Manual of the *Open Systems Catalog: Open Systems Guide* offers guidelines on the type of information needed to finalize the specifications, while the information itself comes from the design program for the specific facility.

Certain information outlined in the specifications can only be determined on a project-by-project basis, and therefore must be compiled when using either method to develop the final performance documents. The following information, if applicable, must be

[47] Note: The unnumbered attributes of this format represent a flexible listing which can be freely added to or subtracted from as needed.

obtained and assimilated into the specifications following the guidance of the master format.[47]

1.2 LOCAL CONDITIONS
1.21 Available Inputs
Energy
Raw Materials
1.22 Available Labor
Technical Skills
Resolved Jurisdictional Disputes

(The above information should be available from the individual facility design program.)

1.3 OFFEROR REQUIREMENTS & QUALIFICATIONS
1.31 Reliability
Economic Stability
Production Capacity
1.32 Existing Installations
1.33 Documentation
1.34 Vendor Guaranty or Warranty

(Refer to ASPR's)

1.4 EVALUATION PROCEDURE
1.5 PROPOSAL PROCEDURE

(Refer to Open Systems Catalog: Open Systems Guide)

2.0 DELIVERY PROCEDURE
2.1 TRANSPORTATION
2.2 HANDLING
2.21 Equipment Required
2.22 Labor Required
2.3 STORAGE
2.4 PROTECTION
2.5 SCHEDULING EFFECTS

(Dependent on both design programming for the individual facility, the Design Manual of the *Open Systems Catalog: Open Systems Guide*, and Subsystem Criteria.)

In the formulation of performance requirements, criteria and tests for many attributes, and for certain quantitative and dimensional information was left to be determined for the individual project. This is noted by the occurrence of ( ), empty parentheses, in the Performance Specifications. Necessary information is available from the individual project design program.

Specification by method 2 involves a close understanding of systems building technology and the writing of performance specifications by attributes. Varying from the predetermined prototype demands a wide information base for making the necessary decisions, depending on the degree of deviation. The major decisions that might be involved are as follows:

a. Determination of the subsystems necessary to meet the needs of a given facility;

b. Determination of in-systems vs. out-of-systems work;

c. Determination of interface;

d. Choice of applicable attributes and performance levels;

e. Creation of criteria and tests to prove performance.

Performance specification by attribute, for use with method 2, can be accomplished by following the master format. When attributes are numbered in the format, each one must be considered. If there are no requirements for a numbered attribute, it should be specifically stated as "no requirement." The finest subdivision of the format consists of unnumbered attributes, so that the list may be expanded or reduced as needed. Each attribute is broken down into *requirement, criteria, test, and evaluation* subdivisions, although all are not needed in every case. The presence of *criteria* implies the presence of a test; however, a *test* may or may not need further clarification by an *evaluation*. Any *criterion* is generated by *requirement*; however, the *requirement* need not be stated in cases where it is implicitly stated by the *criteria*. Conversely, the *requirement* may state a section's essential needs. In this case, the *requirement* may or may not be followed by a *criterion* or include a *test*.

definitions

AGGREGATION:

The treatment of a group of similar building projects (possibly at several installations, or to be built in several different years) as a single project.

BID-DESIGN-BUILD:

A general category for a procurement process whose distinguishing feature is that a design and/or technical solution is being bid for as well as its ultimate execution.

BUILDING SYSTEM:

An arrangement which permits many detailed decisions about a method of construction to be determined for a range of building situations in advance of any particular building project. (See *System*)

BUILDING SUBSYSTEM:

A predesigned, functionally integrated series of parts which function as a unit within prescribed performance characteristics.

CLOSED SYSTEM:

A building system--normally proprietary--of such unique design, or so controlled by the supplier, that parts outside the system can be substituted only with substantial modification or not at all. (See *Open Building System*)

COMPATIBLE (BUILDING SYSTEM):

Two or more building subsystems whose every point of functional and physical interface matches and is congruous. (See *Interface*)

COMPONENT:

An industrial product, as an independent unit for installation as an essential element of a building subsystem. Factory-finished product designed to be part of the complete building or system without modification on site.

CONSTRUCTION MANAGEMENT:
The combined operations for the authorization, purchasing, supervision, accomplishment, and acceptance of a construction project. These activities do not normally include economic feasibility studies, programming/planning, or industrial management, which would be a part of many IBS projects. The coordination of multicontract projects may be required.

CONSTRUCTION MANAGER:
A professional usually retained as an owner's agent, who performs construction management.

CONTRACTING OFFICER:
A military officer or Corps employee authorized to administer contracts and make determinations and findings thereto.

CONVENTIONAL CONSTRUCTION:
Site-coordinated construction, utilizing a combination of field-crafted and factory-fabricated components which are not generally precoordinated. These components therefore often require modification at the building site to provide workable joining conditions.

DESIGN-BID-BUILD:
A general category for procurement process which bids out a detailed design for construction. (Also referred to as the "conventional process.")

DIMENSIONAL COORDINATION:
The establishment of a range of related dimensions for common use in sizing the components which make up those buildings.

FAST TRACK:
A scheduling technique involving overlapping (or simultaneous), phased design and construction (as opposed to sequential operations) to speed the building process, and often requiring multiple contracts.

FOOTPRINT STRATEGY:
An administrative strategy in which the building is proper-designed within an area (the "footprint") defined in RFP/FRTP plans; this requires the postponement of the design of that portion of the site within the footprint and its submission with the proposal, though the main portion of the site is prescriptively defined. Probably a single contract, this approach defines functional relationships and area requirements while allowing unique systems response.

HARDWARE:
The components, assemblies, and subsystems of which a building is constructed.

INDUSTRIALIZED:
Organized to convert raw materials into products by capital-intensive activities, such as mechanization and automation, as opposed to labor-intensive activities, such as organized handcraft.

INDUSTRIALIZED BUILDING:
The process of construction involving capital-intensive processes such as mechanization and automation, as opposed to organized handcraft, a labor-intensive activity. Industrialization may apply to process-oriented activities as automated information transfer.

INDUSTRIALIZED BUILDING SYSTEM: (see *Industrialized Building* and *Systems*).

INTERCHANGEABILITY:
Part of the technique of mass production, which is the ability to control the dimensions of components so that they can be assembled without selection and without any attention to mating surfaces, such as cutting, fitting, butting up, etc.

INTERFACE:
A common boundary or dimensional fit between components. The act or process of assuring a positive and functional fit at that common boundary. The point of contact of construction activities.

LEAD TIME:
That length of time preceding an event required for its implementing activities.

LIFE-CYCLE COSTING:
A method of economic building analysis which considers costs --such as maintenance, insurance, operation (including energy), repair, and replacement--which will likely be incurred throughout the life of the building, as well as initial construction costs.

NONSYSTEM (OR "OUT OF SYSTEM"):
All *conventional* portions of a building, e.g., that which is hand-crafted or conventionally constructed.

OFF-THE-SHELF:
Available as a marketed stock product.

ONE-STEP PROCUREMENT:
A procurement option in which competing technical proposals, together with dollar bids, are evaluated according to a predetermined scoring scheme, the contract being awarded to the proposal having the highest score, not necessarily the lowest bid.

OPEN SYSTEM:
A building system whose subsystems or components are compatible with other subsystems or components, including those of other manufacturers, for interchangeability. Also, a catalog of parts--factory-finished, standard components of varied origin--selected by independent designers and assembled in an infinite number of ways. Wide variety.

OUT-OF-SYSTEM: (See *Nonsystem*).

PANEL:

A prefabricated planar product, often story-height or room-width, sometimes loadbearing, and sometimes containing integrated utilities.

PERFORMANCE CONCEPT:

The performance concept is an organized procedure or framework within which it is possible to state the desired attributes of a material, component, or system in order to fulfill the requirements of the user without regard to the specific means to be employed in achieving the results.

PERFORMANCE SPECIFICATION:

Expression of the functions required of an object, corresponding to clearly determined use. A written description of requirements and criteria in terms of a product or a system's desired behavior (rather than in terms of its makeup and the way it should be constructed) e.g., not what a system is, but what it does. (See *Prescriptive Specifications*).

PRECUT:

Factory cut and labeled materials, with little assembly work.

PREENGINEERED:

A building satisfying a standard set of engineering requirements rather than user requirements; often a gable-roofed clear span, metal building, available "off-the-shelf."

PREFABRICATION:

The fabrication of building elements before they reach the building site.

PRESCRIPTIVE SPECIFICATION:

A precise, written description of requirements for construction, indicating materials, shapes, sizes, and methods used to establish standards and to provide a product. (See *Performance Specification*).

PROCUREMENT PROCESS:

All the communications, decisions, and activities that occur when procuring a building from initiation to use.

PROJECT:
A collection of one or more buildings under construction, along with necessary support facilities (i.e., paving, utility lines). Since the feasibility of IBS may be a function of the number of structures involved, as well as their locations, it may be necessary to aggregate buildings of the same type into different groupings, herein called "projects"; a line item in a military budget, designated for construction in a fiscal year.

PROJECT MANAGER:
A professional, usually retained as an owner's agent, to coordinate a project from inspection to completion, including such activities as feasibility studies, programming, designing, scheduling, fiscal control, and construction; in the Corps, that officer responsible for administering a project; exercising full line authority over planning, research, development, procurement, production, distribution, and logistics.

PROPOSER:
Any individual, firm, contractor, or building manufacturer that responds to a request for proposals on a building project.

PROPRIETARY PRODUCT:
Produced by one manufacturer for one sponsor only, to his own standards. Made and marketed by one having the exclusive right to manufacture and sell, sometimes involving guarded information.

REQUEST FOR TECHNICAL PROPOSAL:
A solicitation for proposals containing design and technical criteria plus administrative and legal provisions.

SOFTWARE:
The rules and procedures for utilizing hardware to form a complete building; e.g., a program or design; the nonphysical elements of a system.

STRATEGY:
The method of communicating the government's requirements for a facility to potential proposers or bidders. Design strategies differ in the degree of detail which is completed by the government or left to the proposers.

SUBSYSTEM:
Part of a building system performing a specific function; a subordinate set of building system components, as well as the principles or rules which logically link those components together to form a functional whole which is, in itself, an indispensable entity within a construction complex. Example: The HVAC subsystem would include the chillers, fans pumps, ducts, and controls.

SYSTEM:
An interdependent set or assembly, consisting of the arrangement of building components or subsystems, as well as principles or rules which logically link those components together to form a functional building whole. Normally these components are mass produced.

SYSTEMS APPROACH:
A process stressing the interrelation of problem elements within an overall context.

SYSTEMS BUILDING:
The organization of programming, planning, designing, financing, manufacturing, constructing, and evaluating of buildings, under highly coordinated management into an efficient total process. The use of proprietary building systems, usually highly standardized; industrialized building, a process featuring a) user requirements, b) performance criteria, c) subsystem integration, and d) testing (or certification) of subsystems.

TECHNOLOGICAL INNOVATION:

An advance attributable to a technical method or a new product which achieves a particular purpose. It can also be a significant change in the means employed to achieve a superior system of service.

TWO-STEP PROCUREMENT:

A procurement option where--as step 1--technical proposals are received without dollar bids, and evaluated against predetermined criteria. Those firms whose proposals were deemed "responsive" are then asked to submit a bid--as step 2--to construct the facility according to their own proposals. The contract is awarded to the lowest bidder.

acronyms

A/E	Architect/Engineer
APP	Army Procurement Procedures
AR	Army Regulations
ASPR	Armed Services Procurement Regulations
CERL	Construction Engineering Research Laboratory
CM	Construction Manager
Comp. Gen.	Comptroller General
DOD	Department of Defense
ECIs	Engineer Contract Instructions
ER	Engineering Regulation
FY	Fiscal Year
GAO	Government Accounting Office
GSA	General Services Administration
HUD	Housing, Urban Development
IBs/IBSs	Industrialized Buildings or Industrialized Building Systems
OCE	Office of the Chief of Engineers
TSFA	Two-Step Formal Advertising
PBS of GSA	Public Building Service of GSA
RFP	Request for Proposals

RFTP	Request for Technical Proposals
TSFA	Two-Step Formal Advertising
USC	United States Code (Federal Law)

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