Section IV

The Design-Build Cycle

How many facility managers understand how a large architectural-engineering firm designs a major project? How many understand, from a builder's perspective, how a manufacturing facility is constructed? Unless you have a working knowledge of these dynamics, you will continue to get suboptimum projects, even from the most reputable of firms. As the industry has become increasingly specialized, the facility manager must take a more active role to ensure a satisfactory final product.

Perhaps more than any other facility management function, the design-build cycle has been studied, codified, and automated. Facility projects are planned, programmed, designed, reviewed, constructed, and evaluated similarily, whether they involve a new manufacturing site or an alteration.

I start this section with a discussion of project management, then proceed sequentially through the life of a project, including evaluation.

9

Project Management

Pulse Points

- *Project management is not facility management.*
- *The facility manager must control, if not manage, all large capital projects for which he will become responsible.*
- *Life-cycle costing should be used for project decisions.*
- *Partnering provides an opportunity to avoid litigation during major projects.*

In general terms, *project management* means managing a distinct piece of work to be completed on time and within budget. For the facility manager, project management means taking a project through the design-build schedule to ensure that operational requirements are met within the budget and on schedule.

Often projects are defined by a dollar value ($5,000 being a good line of demarcation), by the level of effort required (one man-day per trade not to exceed two man-days total, for example), or whether they require planning or design effort. In those ways, projects are differentiated from routine work and preventive maintenance. In fact, the management of projects is but one function of facility management. Yet one common failing is a tendency to view all facility management activities as separate projects, each justified at set costs with discrete start and end dates. This is the situation that causes walls to be demolished for alterations only a week after they were painted for maintenance. This mind-set builds a facility at the least capital cost that makes the project manager look good, but has increased operating and maintenance costs over the life of the facility. As I say many times in this book, the essence of facility management is cost-effectiveness, quality of service, and operational efficiency for the life of the facility. Project management, improperly applied and with the wrong incentive and evaluation system, can be extremely harmful to good facility management.

Unfortunately, because capital projects are so visible, there is always great pressure to minimize initial costs and bring the project in at the earliest possible date. Often this almost ensures suboptimizing the life-cycle costs, which typically are three times the capital costs. Annual budget pressures ("The money disappears on September 30") cause the same type of costly thinking on smaller projects. Many governmental facility managers have their favorite story of poor-quality projects funded in an end-of-the-year spending binge.

There certainly is a place for project management in facility management. Capital projects, discretionary annual projects, and repair projects are programs best managed in a project mode. (Project management is inappropriate for utilities, custodial work, leasing, preventive maintenance, and administration.) As a general rule, nonroutine services, those that require high user contact or discretion, and those that coordinate multiple functions are candidates for project management.

Definition and Organization

In most organizations, capital expenditures—with the exception of furniture and furnishings—are developed, justified, and executed as projects. Within the annual budget, however, only certain work, with these characteristics, is handled as projects:

- Largely discretionary (or could be delayed)
- Design is involved
- Cost exceeds a floor cost ($5,000, for example)
- Multidisciplinary
- Requires high user involvement

As a facility department moves to midsize, it is essential to define (normally in coordination with the budget department) what work will be handled as projects.

Large capital projects, particularly if they are rarely done, are often handled by a separate project team whose manager reports to the facility manager. When the capital project is run out of the chief executive officer's (CEO) or chairman's office, there is a built-in propensity for long-term disaster. Unfortunately it is also common to appoint a retiring or "spare" vice president as project manager. The project manager for a major capital project must not only be competent. He must also have the trust of and be compatible with the facility manager. The facility manager must control, if not manage, all capital projects.

When faced with managing a major project, the facility department can manage the project itself, hire its own project team, or hire a development team. If a department manages the project itself, at least in theory, it controls the project. This approach probably has the lowest overhead. However, most organizations do not have the depth or breadth of skills to manage a large project. Even when both design and construction services are contracted, a large project is incredibly time-consuming. Someone must be a full-time project manager. In addition, it will probably be necessary to dedicate one full-time contracting officer, one architect, one engineer, one interior designer, and one project accountant to the project for its duration. Few facility managers can spare these people from their normal departmental duties. Specialized support, like legal support during permitting, will have to be sought from an outside source. Finally, this approach represents the greatest technical risk if the department is not used to managing major projects.

If individuals are hired to form a project team, it should be possible to get a team that is both technically proficient and loyal to the department. The extent to which individuals feel that they are a member of the facility department team is directly proportional to the degree to which they are welcomed and trained. Initially, the team will not be used to working with one another or with the department, and there may well be difficulty assessing how this situation is developing until it is too late. The success of this approach is highly dependent on the project manager's being able to pull the team together. Finally, the cost of the project team has to be funded out of project costs.

Hiring an already assembled project team should make it possible to have a team with all of the skills and with team members who are used to working with one another. They may even have worked on a similar project. This team should be able to hit the ground running. Although this approach presents the least technical risk of the approaches mentioned, it is also the highest cost because the department is paying a management fee to the employer. Choosing the development firm can get political; everyone has a favorite developer. It is still probably desirable to have an internal project manager to work with the team since the facility manager tends to be the most distant from daily happenings on the project under this approach.

Most organizations accept the need for using a design-build team (architect, engineers, interior architects, consultants, and builder), but companies commencing large capital projects should also consider augmenting their internal facilities, legal, accounting, and purchasing staffs with the following:

- Construction accountant
- Estimator
- Construction procurement specialist
- Inspectors
- Scheduler

Before contacting consultants, however, the facility manager should organize the internal staff so it can control the design-build team. Especially critical are procedures to establish requirements and formal reviews by in-house experts.

The Design Phase

Crucial to completing any project on time and within budget are the proper program, plan, and design. These are developed during the design process (see Chapter 11). These aspects of a project set the tone and fix the available resources as well as its form and function. Too often facility managers neglect design. It's unclear whether this is out of deference to architects or because they are unaware of the design cycle or how design firms work. Perhaps it's because large projects are often handled outside the department, and by the time the facility manager takes control, the project has been designed.

Devote special attention to the project management organization—both the project management team and the committees for user and technical input or communication with users and management.

Chapter 11 discusses the selection of an outside design team and the proper relationship between the facility manager and the design team. The team should not only bring technical competence to the project but also mesh well with the facility department.

During the design phase, look not just at the architect's work but also the work of major consultants. Participate in major design decisions.

Experienced facility managers soon learn the importance of good estimators to the design process. Without a reliable estimate at every step of design, the project cannot be properly controlled.

Also, extensively and rigorously review the schedule at each stage of design.

The Construction Phase

The contracting and construction of a building can be managed in many ways. This is perhaps why, of all portions of the design-build cycle, construction is the most studied and the aspect about which we know the most. Exhibit 9-1 shows the advantages and disadvantages of four common ways of contracting for construction.

If possible, the design firm and the project manager should help select the builder. However, if the contracting method is construction management, then select the construction manager first and have him assist in selecting the design firm. (Caution: In some markets, architectural-engineering (A-E) firms and builders are so tightly linked that impartiality may not be possible.) Also, though certainly not required, it is preferable to use local builders, particularly in areas with complicated codes and permit processes. In some ways, the developer is a captive of the system, but fighting local codes, permit offices, and customs with a "foreign" builder is likely to cause both grief and delay.

Anyone who has been involved with the project approval process appreciates the complexity of issues and frequent frustration involved in obtaining the necessary permits and approvals from local government. This is such a prevalent problem in some jurisdictions that some law firms have developed a reputation as expediters to ensure relatively fast permit approvals. Silicon Valley facility managers, many of whom were faced with fast-track projects to meet the business needs of booming technology companies, met with local government officials to develop permit streamlining practices, programs, and policies. The result is a set of guidelines that should be emulated across the profession.[1]

Direction and control of major projects is best exercised on two different levels. Policy issues are decided by a *policy commitee* composed of a responsible vice president or chairman, a facility manager, a project manager, a design team project manager (or construction manager), legal counsel, and a controller representa-

Exhibit 9-1. Contracting construction methods.

Lump Sum—Sequential Design and Construction	*Construction Management or Cost-Plus-Fixed-Fee*	*Guaranteed Maximum Price*	*Turnkey*
Advantages			
Complete plans for bidding available.	Impact of escalation reduced.	Complete plans not necessary.	Complete plans not necessary.
	Foundations and structure can be bid in advance.	Foundations and structure can be bid in advance.	Foundations and structure can be bid in advance.
Fixed price at start of construction.	Impact of escalation reduced.	Maximum price known during design process.	Price fixed at start of project.
		Escalation impact reduced.	Impact of escalation reduced.
Single responsibility of contractor.	Construction manager working as owner's agent, not in adversary position with owner, designer.		
Quality and O&M aspects of design under control of owner.	Quality and O&M aspects of design under control of owner.	Quality and O&M aspects of design under control of owner.	
	Advice of contractor available during design period.	Advice of contractor available during design period.	
	Design-construct period reduced.	Design-construct period reduced.	Design-construct period reduced.
	Changes to plans discouraged due to telescoped design period.	Changes to plans discouraged due to telescoped design period.	Changes to plans discouraged owing to telescoped design period.
Disadvantages			
Lengthiest process.			
Length of design period encourages modifications.	Total cost of job not known until after foundations and frame underway and plans complete and bid.	Any owner changes affect guaranteed price.	Ability of owner to make changes severely restricted.
Advice of contractor for effecting economies not available during design.			
Impact of escalation most severe.			
Contractor placed in adversary position with respect to owner and designer.		Contractor placed in adversary position with respect to owner and designer.	Contractor placed in adversary position with respect to owner.
Contractor may seek change orders and loopholes.	Extra costs may arise from modifications needed after plans are completed.		Aesthetic and O&M quality of design may be questionable because they are not directly under control of owner.
Contingency and profit factors higher than CM/cost-plus-fixed-fee method.		Contingency and profit factors much higher than for lump-sum and CM/cost-plus-fixed-fee methods due to great risk involved.	Contingency and profit factors higher than CM/cost-plus-fixed-fee and guaranteed maximum price. Total cost may be highest of all methods.

tive. This committee normally meets monthly but may meet as often as weekly. In addition to policy, the committee considers and approves all major changes, communicates to the CEO and board, and takes under advisement issues forwarded by the experts committee.

The *experts committee* closely approximates the design-build team and makes the day-to-day decisions that keep the project on time and within budget. Committee members typically are the project manager, the design team project manager, the builder's project manager, an in-house design chief, in-house engineering chief, in-house operations chief, project accountant, legal counsel, chief inspector, a staff representative or line manager, and a security or safety representative. Of these, the project accountant, legal counsel, chief inspector, and design team project manager are nonvoting. This committee usually meets weekly with an agenda approved by the chairman. Members of the design-build team make presentations, the team reviews the progress, they resolve the problems, and the team recommends issues for the policy committee.

In large projects, the project manager spends an inordinate amount of time in meetings. This must be both realized and appreciated. The team builds the project while the project manager is concerned with these issues:

- Managing the team
- Keeping management informed and transmitting policy to the design-build team
- Keeping the design-build experts "tuned in and turned on" to organizational requirements and perceptions
- Handling public relations

This seems as if I am advocating management by committee, and to a certain extent I am. Large construction projects are, by their nature, collaborative. The project manager must be skilled in guiding the project through these committees.

These two committees should not steamroll issues, but majority membership should ensure that the project manager controls the truly critical issues. Particularly on the policy committee, he should have done his homework so that there are no surprises at meetings.

The project manager prepares an agenda and distributes it for each meeting. A good format has these items:

1. Update
2. Comparison to budget and schedule
3. "Get back to ya's" from the project manager
4. Old business
5. Other problems
6. New business
7. Review of tasks assigned

There is a different emphasis on these items in either committee.

The agenda should be circulated at least twenty-four hours in advance, and it should be reviewed by the project manager personally. Meeting minutes should be circulated within forty-eight hours of the meeting, with corrections required within an additional forty-eight hours.

Preparing for and going to meetings is the single greatest demand on a project manager's time. The successful project manager knows how to manage these activities.

Common Pitfalls

Major construction projects are, by their nature, complex. However, there are truly outstanding designers, architects, engineers, and builders to assist. Thousands of things can go wrong; some problems will crop up despite your best efforts. That is why it is important to have a strong team. Once the mistake is found, the team can correct it quickly and cheaply.

The number of problems can be lessened or minimized by avoiding the following pitfalls:

- Not contracting with an experienced A-E firm; using the chairman's favorite architect.
- Failing to provide the design team with important requirements.
- Allowing the A-E firm to pick its own consultants without your review or approval.
- Hiring a builder who has never built in the market.
- Failing to have work inspected or operational tests performed.
- Failing to establish a budget, fiscal controls, or proper construction accounting.
- Approving changes before they are designed and costed.
- Failing to schedule fixed reviews or progress meetings.
- Not observing the work of the builder's subcontractors.
- Failing to agree on procedures for punch list, operational tests, beneficial occupancy, training, warranties, and project turnover.
- Failing to define documentation (type, quantity, and format) required at turnover.
- Failing to budget for contingencies.

Partnering

I have never participated in a project where partnering was used. However, my observation of two projects and a review of research indicate that partnering is a concept that needs to be developed.[2] There is too much litigation in major construction; some projects end with everyone suing everyone else. Facility managers, as the consumers of construction services, pay for this litigation, so it is to their advantage to seek ways to minimize it.

There are many definitions for partnering, and, in practice, it tends to vary from project to project. Partnering is a structured process that obligates the partners (hopefully all members of the design-build team) to foster innovation, teamwork, continuous quality improvement, and team problem solving. The following characteristics of a partnering agreement are common:

- Clarifying the role of each partner in the process.
- A commitment to information sharing with the establishment and a procedure to do so consistently.
- The sharing of lessons learned and formalized postmortems of major or repeating events.
- Formalized trust building and training.
- Establishing common goals, objectives, and priorities for the project.
- Defining risks and establishing procedures to manage them.
- Fostering innovation.
- Establishing ways to measure success.
- Developing mechanisms to resolve differences quickly.

These elements are often placed into a single document, called the *partnering charter,* which all major decision makers on the project sign.

Does partnering work? In one study, the U.S. Army Corps of Engineers, Kansas City District, found that partnering reduced modifications by 39 percent, time growth by 55 percent, and cost growth by 38 percent.[3] Not everyone is enthralled with partnering. The breaking down of some of the "firewalls" in normal contracting by which adversarial relationships kept the various parties honest disturbs some traditionalists. However, it appears that partnering can offer savings to all concerned where there is a genuine desire to cooperate and all parties are roughly equal in experience and political power. Traditional project management has been so rancorous and litigious that any process that goes counter to that tradition is welcome.

Large and Small Projects

Most facility departments handle work over a certain dollar value (such as $5,000 each requirement), or which requires substantial design input but is small and is part of an annual project program. Often projects are broken down into move projects, maintenance and repair projects, or other alterations.

Some large organizations accomplish 200 to 250 of these projects annually, averaging one start-up and one close-out each working day. The scale of work projects can be daunting. Requirements, therefore, are gathered by project managers assigned regularly to work with certain customers or in particular geographic areas. In smaller organizations, project designers gather the requirements and manage the process from beginning to end.

After the requirements are costed, they are prioritized and met according to priority. Often the priority list is reviewed semiannually. Because these projects are so popular, there is almost never enough funds to do all the work. Large organizations often institute steps to control and prioritize the funds. There are three ways to do this:

1. Establish administrative approval levels for varying levels of projects (e.g., $10K, manager; $50K, director, $250K, VP).
2. Delineate between new work (construction, alterations) and maintenance and repair, and put a ceiling on the amount that can be used for new construction.
3. Establish a joint user-facility department review committee to set priorities for project accomplishment and then review those priorities at midyear.

In small organizations, definitions and approval levels are less of an issue because the volume of work is much smaller. Even fairly small projects (less than $10,000) are well known to company management before even planning is set in motion.

The difficulty in managing small projects is gathering requirements and costing the projects early enough so that the facility manager can submit his estimated budget. This can best be accomplished by having an annual requirements-gathering process with a midyear review to pick up changes. Management then approves this list, in aggregate for design and construction.

Highly sophisticated project management systems have been developed, many of them within the U.S. Department of Defense. And now computers have automated almost all of these systems. Using software such as Microsoft Project, the facility manager has a project management tool formerly available only to project management firms. There are systems for mainframes as well as PCs. There are systems for handling multiple small projects. No other function of facility management has been as well developed as project management.

Some of the more common project management methods are:

1. Critical path method (CPM)
2. Program Evaluation Review Technique (PERT)
3. GANTT charts
4. Precedence method (PM)
5. Resource constrained scheduling

Critical to all these methods is the ability to estimate time and resource use accurately. A quality estimator or estimating team is extremely important because these estimates must be made initially, when only a project estimate exists. Both CPM and PERT use "not more than and not later than" estimates to help set realistic budgets and schedules.

Because a change in one project—especially the need for additional resources—can affect other department resources and programs, the facility manager must carefully assess these changes before they are made. It is not enough to view how the changes will affect the particular program budget or schedule, but how they will influence leasing needs, maintenance and repair programs, and the like. This is one of the major factors that separates facility management from project management. The facility manager must understand the total picture. Any failure to do so puts both the project and the department in jeopardy. In conclusion, I recommend two books on project management: Steve Binder's *Corporate Facility Planning,* which places project management in a corporate context, and Carole Farren's *Planning and Managing Interior Projects,* which discusses in detail the kind of project management performed by most facility managers.

Notes

1. *Permit Streamlining* (Santa Clara, Calif.: Santa Clara County Manufacturing Group Facility Managers Committee, 1994), pp. 1–13).
2. Jeffrey W. Hills, "Partnering: Does It Work?" *The Military Engineer* (December 1995): 45–47. By permission of The Society of American Military Engineers (SAME).
3. Ibid., p. 45.

10

Programming and Project Development

Pulse Points

- *Planning for major projects nearly always understates engineering requirements.*
- *The facility manager should program for maintainability as well as functionality, and place special emphasis on support areas.*
- *Project planning integrates information from the facility plan with requirements gathered through programming.*
- *The facility manager plans with care but always retains flexibility.*

The project programming process involves gathering the requirements for a specific project and examining the relationships of individual tasks. The program is a tool for managing the project and a guide to anticipated results. Its essence is (1) an understanding of what is needed and expected by the user and (2) the establishment of performance expectations at specific time intervals.

It is not possible to develop an aesthetically pleasing or functional work environment without first defining the overall objective for the space to be used. Many textbooks regard the establishment of project objectives as the first stage in the design-build cycle. For example, Manuel Marti, a prominent theoretical space planner, indicates that the overall organizational framework shapes the entire process.[1] I interpret this more literally to mean that the structure, culture, and philosophy of the parent organization establish the parameters within which any project is identified, prioritized, and executed. The organization's philosophy may be modified by circumstances that develop during the design-build cycle; however, the initial assumptions and resource allocations are always determined by corporate philosophy.

Often, the only stated objective is the number of individuals to occupy a specific space. The planner then is asked to offer solutions within the constraints of that space and budget. In such circumstances planning activities are likely to be suboptimal. The project can be accomplished, but not necessarily as effectively or efficiently as it could have been. But if complete requirements are collected and analyzed, the results can be more than satisfactory. This is what programming can and should do.

The project programming process involves gathering the requirements for a specific project and examining the relationships of individual tasks. The program is a tool for managing the project and a guide to anticipated results. Its essence is (1) an understanding of what is needed and expected by the user and (2) the establishment of performance expectations at specific time intervals. We discussed macrolevel space programming in Chapter 5; in this chapter, we apply the programming process to define and gather the requirements for a specific project.

Aspects of Programming

The task definition stage of programming defines the project expectations. It is a statement of what should be able to happen as a direct result of successful completion. One of my favorite sayings describes the results when this step is not properly performed: "If you always do what you've always done, you will always get what you've always got." Don't validate obsolescence.

The feasibility analysis stage of any project is conceptual. In general, programming means that the company has determined that the overall project is feasible. However, as requirements are gathered, solutions will come to mind, and the feasibility needs to be verified. Feasibility analysis should go deeply enough to ensure reliability of expenditure and profitability projections. A fully developed program permits the facility manager to plan effectively and eliminate unwanted surprises. The following specifics should be included in the feasibility analysis:

1. *Technological feasibility,* including employee training and organizational resources such as machinery, equipment, computers. In planning major projects, don't understate engineering requirements; later deficiencies are costly to correct.
2. *Operational aspects,* such as employee morale, adaptability, organizational policy changes, modifications to facility, and anticipated success.
3. *Economic aspects,* to determine whether the completed project will return a greater dollar benefit than the expenditure in staff and resources.
4. *Communications aspects,* which give insight into both needed communications links and contiguity of location for various units. The Quickborner organization, pioneers in the concept of the office landscape, is normally credited with looking at organizations as dynamic entities, particularly at how units within the organization communicate with each other.

Political considerations are an important part of any program. Senior executives should be consulted early to determine their "hot buttons," those program aspects that either must be in the project or that can't be in the project. Identify those issues early on. They often form the performance envelope within which all other programming is done.

Also, a maintainability program should be developed. This is not commonly done, because in-house and consultant programmers appear to have little interest in the subject. By carrying out good maintenance programming, not only can the life-cycle costs of a building be reduced substantially but maintenance can be made easier.

Sources and Methods

The depth and breadth of the programming effort varies somewhat. Exhibit 10-1 is a list of possible areas. It goes beyond the normal areas of programming investigation but may be a good model as companies concern themselves not only with adequate and safe workplaces but ones that allow for individual expression and a sense of control. It is important to realize that some requirements will be in direct conflict with other requirements. For example, the organization may want to maximize productivity by expecting specific behaviors from its workers, but workers may not be perceive that behavior in their best interest. Under such circumstances, you may find yourself having to advocate a specific strategy to management.

A program is likely to establish expectations on the part of top management and might be used, at least, in part, to judge the effectiveness of the facility manager. It is in your best interests to use the most reliable information possible. If there's faulty information, disastrous results may follow. If top management's expectations are overly ambitious, that may be equally damaging. A program may also be expected to assist in the planning for contingencies as well as in the normal management of a project.

There are at least four sources to query for requirements for a major renovation or new facility:

1. Top management
2. Operating staff
3. Support staff
4. Regulations and codes

The requirements of top management often need to be gathered before a decision can be made to go ahead on a project, so this step may already be complete before you start programming. For example, a 1997 National Construction and Development Survey by the International Association of Corporate Real Estate Executives (NACORE) states that 46 percent of building decisions are made by CEOs.[2] These are the most political of requirements; thus, this initial level of programming is extremely important and cannot be assigned to an inexperienced architectural programmer. I favor the facility manager's either doing the interviews personally or controlling the participating consultant. In either case, there should be agreement on the questions to be asked.

Typically interviewed are the chief executive officer (CEO), chairman of the board, all senior vice presidents, the budget director, and the vice presidents of affected units. Their comments must be treated individually, no matter who gath-

Exhibit 10-1. Possible areas for programming.

Natural Compliances
- Site
- Surroundings
- Region
- Urban location
- Functional placement
- Accessibility
- Natural conditions
- Elements
- Weather
- Seasons
- Energy and resources

Environmental Compliances
- Temperature
- Light
- Sonic conditions
- Shelter
- Environmental impact
- Preservation
- Pollution

Functional Compliances
- Purpose
- Activities
- Movement
- Flexibility
- Scale
- Use
- Manpower

Physical Compliances
- Measurement and scale
- Sex
- Health
- Hygiene
- Security
- Hazards
- Disability
- Comfort

Psychological Compliances
- Ego
- Privacy
- Authority
- Aesthetics
- Style
- Scale
- Habits
- Phobias
- Status
- Image
- Character
- Individuality
- Impact
- Isolation
- Behavior
- Territory
- Personalization

Sociological Compliances
- Culture
- Creed
- Race
- Demography
- Economic status
- Class
- Impact

Regulatory Compliances
- Government
- Private policies and systems
- Legal and contractual conditions
- Codes
- Related agencies
- Commissions
- Associations
- Special interest groups
- Violations
- Variances

Economic Compliances
- Quality
- Cost
- Purpose (function)
- Investment
- Return
- Interest
- Depreciation
- Capital plan
- Economic trends
- Projection
- Operating costs
- Maintenance
- Marketing
- Sales
- Budget
- Land acquisition
- Taxation

Temporal Compliances
- Historic value
- Preservation
- Schedules
- Change
- Growth

Source: Manuel Marti, Jr., *Space Operational Analysis* (West Lafayette, Ind.: PDA Publishers, 1981).

ers them. If those interviewed express concerns or state strong positions, the issues must be addressed (not necessarily validated) and the results conveyed back to the individuals. When you ask questions of this group, you must deal with the answers.

Gathering requirements from operating staff depends on two basic issues. If standards are in place, less programming needs to be done. Normally, interviewing every employee is unnecessary. In large companies a 10 percent sample, subject to some minimum level and distribution, is more than adequate. Also, if management will not fund workplace functionality, there is no sense expending the effort to accommodate it.

Usually the requirements of support departments are not systematically and uniformly well gathered. Exhibit 10-2 is a list of functional areas that should be investigated. In developer-originated buildings, there may be a rationale for skimping on support facilities. In corporate or public buildings, this skimping is an invitation to both higher operating and higher maintenance costs. Most design firms are unable to program for support facilities, and too often the support managers cannot realistically state their requirements. Frequently the use of an industrial design consultant can prove helpful in getting this information into your programming.

Programming implies a series of projects within a time frame.[3] All the information gathering and problem identification in the world will not make a program. Thus the programming must also establish schedules. Completion schedules, along with project criteria and quality controls, will differ from project to project, but you should not lose sight of the fact that they are essential to the success of the project.

When the information gathering is completed, the results of all surveys and data should be combined, interpreted, and approved before they are passed on to the design team. The gathered data can also be used to start a facility database. Data definitely should be retained as the base document for a postoccupancy evaluation.

Annually one program should be the subject of an intense review by the facility manager. The questions asked are:

1. What is the mission of this program? The goals? The objectives? How well are they being met? Is change needed?
2. Is the program adequately resourced? If not, how can this requirement be accomplished?
3. How effective is the program? How cost-effective? How did the units produced measure against historical production figures?
4. How is the program perceived? By the manager? By the facility manager? By the users?

It is readily apparent that data are needed in order to perform an adequate evaluation. The facility manager should be conscious of future program evaluation requirements and structure the program monitoring systems so that they will provide those data.

Exhibit 10-2. Support activities to be considered in programming.

Shipping and Receiving

- Loading dock space
- Temporary storage
- Secure storage
- Berthing space
- Access to dumpster
- Centrality
- Proximity to freight elevators
- Proximity to primary users

Security

- Operations center location
- Guard posts
- Personnel access system
- Vehicular access system
- Executive access system
- Access by visitors and nonsecure personnel

Mail and Distribution

- Access to national mail system
- Distribution/collection schema
- Secure storage
- Access by external messengers

Motor Vehicle Pool

- Overnight storage
- Daytime parking
- Pick-up/drop-off points

Shops

- Access to materials
- Sizing
- Access to freight elevators
- Locker room
- Security

Food Service

- Layout
- Access to staff
- Centralized or decentralized coffee bar
- Access for foodstuffs
- Egress for garbage
- Locker room
- Vending locations

Conference Services

- Stage
- Audiovisual requirements
- Acoustics
- Lighting and lighting controls
- Recording capability
- Seating (fixed or movable)

Vertical and Horizontal Transportation

- Personnel elevators
- Freight or service elevators
- Escalators
- People movers
- Robots
- Location
- Access by people and goods
- Access to garages and roofs
- Security

Miscellaneous

- On-site furniture storage
- Custodial closets

Communications

- Closets
- Duct systems
- Location of file servers and network command elements

Benefits of Programming

Since programming is an orderly and systematic process, it would appear logical that facility managers would embrace it enthusiastically. That's not always true. The reluctance seems to stem from the following reasons:

1. Lack of familiarity with the programming process.
2. A view of programming as a luxury or an unneeded design cost.
3. Impatience to get to a design solution.
4. Time pressure to complete the project.

Every manager probably has his favorite programming horror story, but Doug Lowe of 3D International has a great one: A dramatic, award-winning headquarters for a new business segment of an international corporation was ineffective almost immediately because there was no programming to detect the flexibility necessary for this new, rapidly expanding business. Therefore, a unique floor plan suitable for a mature company with little growth and few moves was designed. The building was obsolescent when built.[4]

Some interesting results come out of programming. My organization found that its population did not fit the anthropometric model (a model of the average office worker, used to design commercial furniture). To meet specific needs, furniture was designed for greater adjustability.[5]

Doug Lowe offers this argument regarding the value of programming:[6]

1. Programming is a logical process that works.
2. Programming is separate from other services offered by architectural-engineering (A-E) firms.
3. The FM can use a good programmer to lead the A-E and wind up with a project that meets his needs.
4. A good program will cause a building to be designed from inside out.
5. The FM can use a good programmer to take control of the decision-making process.
6. The FM and programmer will probably become allies, further strengthening the FM's position in the information chain.
7. A good programmer can help the FM set up procedures to deal with repetitive or other types of data that are better processed in-house.
8. A good programmer will produce a program that will be truly usable by all of its targeted audience.
9. A good programmer will develop a procedure to update the program, thus incorporating future changes.
10. Programming has many uses, and a facility manager has many uses for programming.

Project Planning

Project planning is the next step in the seamless progression that turns a set of requirements into a useful, productive facility. It is the bridge between the program and the design. Like the other steps in the design-build cycle, there is some spillover during planning. Some requirements will become modified or sharpened during planning; some elements of design may even need to be predetermined. The end result of planning, however it is done, is a project schedule and budget that the project team, particularly the project manager, can accept so that design can proceed with confidence.

The planning process for facility projects requires identifying a problem and then applying the resources necessary to solve it. In his book *Problem Finding and Problem Solving,* Alfred Schoennauer outlines techniques for two kinds of problem solving: after-the-fact and before-the-fact.[7] Many problems fall into that after-the-fact category, and these must be attended to daily.

A facility manager must plan effectively so that the operations of the company can proceed with few interruptions regardless of any emergency. The planning must consider available resources, specific aspects of a potential disaster, and corporate culture. Alas, the average facility manager reacts to things rather than anticipates them because it is not possible to make FM a continuum of before-the-fact processes. The balance of this chapter deals with aspects of the interior planning process, which represents a nearly perfect example of before-the-fact problem solving.

Most projects should evolve from the midrange facility plan, or at least from the annual work plan. That implies that some planning—perhaps a concept and a preliminary cost estimate—has already been done. Realistically, however, probably one third of even major projects will arise ad hoc. With luck, there will still be enough time to plan so that before-the-fact processes can be applied.

Once the company commits to a project, the programming will have defined the company's needs and identified the physical and resource requirements to meet those needs. Now the company will expect the facilities manager to meet those stated requirements (the program) within available resources and according to schedule. This is where the planning process steps in.

Planning involves determining the general design-and-build solutions and general sequence of the design-build cycle so that the following is possible:

1. It can be determined that the project is feasible.
2. A schedule can be developed.
3. A not-to-exceed budget can be developed.

Although it can be very detailed, planning is generally that last low-cost (staff) step before costly design, purchasing, and construction processes begin. As such, good planning has great potential for magnifying cost savings.

Establish Purpose and Scope

Like most other human endeavor, and certainly most all facility department efforts, a project is best achieved when there is focus on purpose and scope. The first step in planning is reviewing the project's purpose. The *purpose* clearly states the goal of the project and perhaps the problem it will solve. The *scope* describes the limits (financial, spatial, functional, and time) of the project. Spend time and effort now to ensure that you share an understanding of the scope and purpose with management. After all, it will be your task to transmit that understanding to the project team.

Organizing the Plan

The single common element when planning a white-collar work environment is the space to be occupied by the workers. That space may be owned by the company or leased. It may be divided, decorated, pierced, shared, filled with objects, heated, cooled, powered, illuminated. Stephen Binder calls space "the first frontier" for facility managers.[8]

In our business, planning most often is driven by space and funds, so an assessment of each is necessary. Planning is frequently formatted in terms of space, with the costs an output of the plan.

Resources and Methods

In facilities projects, the planner normally does not lack for information resources. Many projects have had a former life, and information should be available. As a minimum, the following should be available:

- The midrange facility plan
- The annual work plan
- Facility standards
- The program
- Information on like projects done recently
- For capital projects, the project evaluation calculations
- Information on how space needs will be met—for example, by leasing, building, altering, or renovating
- Concept design
- Concept budget
- Concept schedule
- Serviceability study

Depending on the size of the project, the last three items may be provided or you may be asked to proceed without them. Most planners do better-quality work if they are not totally unconstrained. Conversely, the best planner in the world cannot do well if necessary information is not forthcoming.

In Chapter 9, I listed several planning methods (e.g., critical path method, GANTT charts). All of these methods are good planning tools, so it is a matter of picking the proper tool for the project. For example, because our company did so many small interior alteration projects in a year, most of which had a life of from one to four weeks, we used a manual management system that tracked only four events per project. For large projects, we favor automated systems that calculate minimum and maximum values for completion dates and can budget for each event.

It is important to have an organizational database that can produce design and construction unit costs for planning (see Chapter 6). Any organization altering over 50,000 square feet, doing over ten projects, or moving over 100 staff annually should have a database of unit costs that is constantly being updated. If a small to medium facility department cannot invest in a planning or estimating staff, it should consider hiring a cost or estimating consultant to keep applicable unit costs updated. Initially the consultant can provide typical costs for the work the department plans, designs, and executes. Eventually, this will build a unique database for the facility manager.

At the risk of beating a dead horse, I reiterate the importance of standards to cost-effective planning and design. By using standards, and assuming that the design team will use them, the facility manager can reduce planning complexity and time by 50 to 70 percent. I suspect that this is why many facility departments have standards even though they are not officially accepted. Allow the facility designer to plan and design the vast majority of any project quickly (this is accelerated when standards for space and furniture can be fed into a computer-assisted design and drawing system) so that design time and effort can concentrate on unique spaces.

Fiscal Matters

It is very difficult to state hard and fast rules for the fiscal portion of project planning, but if possible, have a finance representative participate in the project planning. If, during the planning process, you exceed the budget used to calculate the projects' net present value or internal rate of return, you should report that to the chief financial officer (CFO). Other than that, it is difficult to provide specific guidance. While a not-to-exceed figure arrived at too early or too arbitrarily may preclude planning and design options, it's unrealistic to think there will be no fiscal constraints.

While there is always concern that overstating the front-end costs will kill the project, be conservative in your estimates until at least 70 percent of the design is complete. Provide a range for the project estimates at the planning stage and state clearly a contingency based on the final probable cost. As always, use life-cycle costing when making decisions about various aspects of the project.

Approval

Within the department, three staff functions must buy in to the plan: the planner, the project manager, and the facility manager. In some cases, all of these functions may be performed by the same individual. A CFO representative should be a party to all major project planning, as should an appropriate business unit representative and the design manager. Ultimately, you must either approve the plan or recommend it to the level having the proper approval authority so that design can commence.

Notes

1. Manuel Marti, Jr., *Space Operational Analysis* (West Lafayette, Ind.: PDA Publishers, 1981).

2. National Construction and Development Survey 2000 as quoted in "Survey Shows Growth in Building, Outsourcing, and the Dakotas," *Facilities Design and Management*, December 1997, p. 10.
3. Douglas H. Lowe, "Why You Should Find a Good Architectural Programmer," in *Facility Management—Meeting the Need of Tomorrow* (Houston: IFMA, 1988), p. 204.
4. Ibid., pp. 211–212.
5. Maree Simmons-Forbes, "J" building mockup and staff demographic results for The World Bank, undated.
6. Lowe, "Why You Should Find," pp. 211–212.
7. Alfred Schoennauer, *Problem Finding and Problem Solving* (Chicago: Nelson Hall, 1981).
8. Stephen Binder, *Corporate Facility Planning* (New York: McGraw-Hill, 1989).

11

The Design Process

Pulse Points

- *Even when design is outsourced, the facility manager must control the design process.*
- *Good design starts with a good concept and a good program.*
- *Complex projects are best designed by a team.*

In this chapter we progress to the point where others in the company see drawings, renderings, perhaps even a model. Because these are the first tangible portions of their project, it is commonly believed that a project begins with design. Nothing is further from the truth; good design must be based on good programming and project planning (Chapter 10). However, those functions remain either hidden or are misunderstood by others in the company, so the expectation level at the design stage is high.

Fortunately, design expertise is a common quality, in North America at least. Local licensing and membership in major professional organizations (e.g., American Institute of Architects, multiple engineering associations and societies, American Society of Interior Designers) ensure a high standard among design professionals. The metropolitan Washington, D.C., Yellow Pages alone has over 300 architectural and 250 interior design listings. That means that any facility manager, whether or not his department has an interior design capability, has access to competent design. It's merely a matter of finding the correct fit among the facility manager, the company, and the design team. There is growing awareness that the best designs are a collaborative effort,[1] but the facility manager and project manager must remain firmly in charge.

The Design Scene

Design firms of all types have accepted facility managers as their principal contacts with companies and agencies to a much greater degree than was true ten years ago. I think that is a sign of the maturity of the FM profession and that the relationships among designers, builders, and facility managers are becoming better defined. The instances where the chief executive officer's (CEO's) golfing buddy becomes the architect for the new headquarters facility seem to be occurring less and less.

First, a word to people on both sides of the user-designer equation. Certain business restrictions and contracts define the envelope within which both parties can operate. There must, however, be more than a contractual relationship. I strongly advocate a team approach with open and frank discussion. Time is better spent discussing design options than maneuvering for a better position. I rarely enter into a contract with a firm that I cannot treat as part of a team. If the fit is not good, both parties are probably better off not doing business together.

Facility managers need design firms (architects, interior architects and designers, engineers and special consultants). No facility manager does 100 percent of the design in-house, 100 percent of the time. Design, in fact, is the most frequently outsourced FM service.[2] Facility managers at small organizations in particular need the skills of contracting with and managing design firms. Therefore, the designer must demonstrate that his firm is unique and best suited to a company's needs. I admit to a bias for full-service firms, in that the design project manager manages all design elements on his side of the table while all user requirements and owner input are funneled through the facility manager. That way the facility manager can use a design firm to its best advantage.

The good facility manager knows the capability of local design firms and tries to match the design resources to the project. He maintains a file of potential firms for small, medium, and large projects. Unfortunately, some companies with strong, centralized purchasing departments take a dim view of negotiated or directed procurement of design services, and therefore make matching difficult.

The design firm's project manager must realize that the facility manager has internal clients who must be satisfied. The facility manager is responsible to his management, to see that the project is completed on time and within budget. The company's employees look to the facility manager to safeguard their health, provide a productive environment, and maintain facilities that are efficient and economical. In essence, the facility manager must live with and operate the building long after the design firm has moved on. A good design firm understands that environment and helps the facility manager with those internal considerations.

Selecting a Firm

In medium and large companies, design teams are selected by an evaluation committee of knowledgeable, in-house experts. The committee should be structured—or packed, if you will—so that the facility manager controls final selection; but committee experts in security, telecommunications, networking, life and safety, and building operations add significantly to the facility manager's ability to select the right design firm for the project. A typical evaluation schema (two-step) is shown in Exhibit 11-1. Other desirable members on the evaluation panel are:

- The corporation's project manager (chairman)
- In-house design representative
- In-house engineering representative
- In-house security or safety representative
- In-house communications representative
- User representative
- Purchasing agent (nonvoting secretary)

Although there are drawbacks to the beauty-contest aspects of evaluation panels, there is a great advantage in having a wide range of expertise and corporate political views. Further, there is a balance to be struck between objectivity of selection and the need for a firm that is a good team player. One of the tenets of the quality management movement is that corporations establish long-term relationships with organizations like design firms.

Perhaps the most difficult factor to evaluate in a design firm is its cooperativeness. Experience and technical capability are readily verifiable, but the fit on the project team is difficult to assess. In an ongoing relationship, of course, this is a known quality.

Some facility managers may be restricted by corporate procurement regulations in their selection of the design team. This is most often to the detriment of good team selection because it bureaucratizes what should be a personal process. A facility manager should work hard in the organization to establish rapport with in-house experts so that the experts will give their technical evaluation without insisting on hiring only "name" firms.

While there may be disincentives, it is essential that the design firm attempt to assess corporate decision-making procedures of potential clients before submit-

Exhibit 11-1. Design firm selection criteria.

Phase I (Determining Short List)	
	Percentage Allotted
Project management qualifications	25
Qualifications of key staff	20
Like project experience	25
Approach to request for proposal	15
Financial and insurance capability	15
Phase II (Evaluating Short List)	
	Percentage Allotted
Project manager qualifications	25
Qualifications of key staff	20
Like project experience	25
Approach to request for proposal	10
Presentation	20

ting a proposal. Also, designers should talk in depth to the operators of current buildings where the client resides and to the operators of similar buildings. These investigations contribute greatly to a firm's ability to submit a knowledgeable proposal. Some firms flounder because they fail to understand the politics in an organization. While a good project manager can and should expedite decision making, he is no guarantor for all corporate decisions—or their timeliness. A wise design firm reinforces the information capability of the project manager and helps him solve internal decision-making problems.

If possible, and if the project is large enough to justify it, the facility manager should visit a similar project that the proposed design project manager has managed or that the design firm has done. He should talk to the project manager and facility manager alone, asking what the design firm considers good design and seeking examples.

The facility manager should also require designers to prove that they understand designing to maintain, asking them to show examples. No other concept has had so much lip-service (except perhaps life-cycle costing). Finally, the facility manager should pay special attention to engineering. For many reasons, poor engineering design causes great problems, many of which can be mitigated only after the fact. In golf, you drive for show and putt for dough. In design, engineering is like putting; the inadequacies can be extremely costly in both operational and corrective costs.

Select the design firm for its expertise, experience, and demonstrated cooperativeness. Creativity and awards are not necessarily criteria for selection unless those are objectives of the project. Facility projects usually go much smoother when creative egos are not present and when the project objectives are the motivation for *all* participants.

If these suggestions are followed, project execution will be both productive and well controlled. As the design firm commences the design process, the facility manager must ensure that the personnel he was promised are actually on the job. The design firm should design and the project manager should control the management of the total project. The facility manager must ensure that user decisions are available to the design team at the proper time. This, of course, can be a problem in multilayered bureaucracies or when decision making is fragmented.

Design Reviews and Presentations

Early on, formal design reviews should be established. Normally, these reviews are conducted:

1. The feasibility study, if conducted
2. The concept, if done by the design firm
3. The program (if done by the design firm), with user sign-off
4. At 25 to 35 percent developed design (last chance for substantive revision)
5. At 80 to 85 percent developed design (still time for those finishing touches)
6. The final design (before the release for procurement)

On fast-track projects these reviews may be combined, but each time the process is fragmented, the facility manager assumes greater risk for the workability of the total product.

A presentation to senior management is a must, even if not requested. If possible, include the CEO, the senior occupant of the newly designed space, and your boss. It is best if the facility manager or project manager does the presentation, but whoever does so must be well rehearsed. The presentation sells the project.

For projects introducing new concepts or technology, use a mockup. They are expensive, but they can be invaluable for design evaluation and for selling new systems and technologies—or, for that matter, to discover that great ideas won't fly. Vendors do an outstanding job of supplying mockups, which should help reduce costs.

Documentation and Follow-Through

The key to good facility management is documentation. The design firm should be more than willing to update all documentation into a common format at a reasonable price.

It's a good idea to write several important end-of-project procedures into contracts and specifications. They vary from organization to organization, so you must guide the design firm in what should be included. As a minimum, include the following:

- Recommendation on amount and storage of attic stock
- Punch list procedures
- Operational testing procedures
- Documentation
- Furnishing and finish boards
- Training on equipment
- Warranty turnover
- Instruction book turnover

It is now possible for the facility manager to obtain drawings, warranties, and instructions in automated form.

During construction, you will have to ensure that the design team stays involved. How involved the designer will remain is not only a contractual matter but varies widely among design firms. It is likely you will frequently need interpretations of design intent, best given by the designer. How well the firm will support you during construction and how well it will provide pertinent information to make project decisions is a major factor in determining further work with the firm.

Finally, both you and the design team should assess how well the project works three to six months after occupancy. The postoccupancy evaluation should address only those items you are willing and able to correct on-site or as part of downstream projects. Also, the evaluation is not done for academic purposes; the study should fit the size and complexity of the project (see Chapter 12).

Design Practices and Considerations

I do not attempt to provide a design manual. For excellent treatment of the details of interior design projects, I recommend Carol Farren's *Planning and Managing Interior Projects.*[3] However, facility managers need to understand the design process so they can control the process. I also include here some rules of thumb.

Design Outputs

Until good design is put in a form and format where it is useful to contractors, it remains simply a good idea. Historically, a hierarchy of plans for transmitting design into construction has been developed. Each project has unique needs, but some plans are common to most projects.

The *base plan* is a scaled drawing of a specific floor of a building that indicates all permanent and/or structural aspects of that floor. Usually found on the base plan are such items as the building core, lavatories, exits, fenestrations (doors and windows), and support columns. Almost all subsequent plans may be overlaid on the base plan to provide adequate information for each floor without replicating the structural information on each plan. When used in a computer-assisted design and drawing (CADD) situation, all plan-view drawings can be viewed as layers stacked on top of each other. Hard-copy prints (blue line, black line, etc.) may be plotted individually or as a single overlayed plan.

The *demolition plan* is a scaled drawing of a specific floor of a building that indicates the removal of particular walls or partitions, plumbing, telephone and electrical units, and custom fabrications (cabinets, etc.). Demolition plans are used only when remodeling or renovating.

The *installation plan* is in plan view and also in scale with other drawings. This plan identifies the location of modular panels, and indicates the location of sources of power for each series of connected panels (panel runs). Also indicated are individual panels that offer electrical outlets and power, which are not powered and which require power to be passed through to other panels. Individual power circuits are located and noted on this plan too. The plan is used to coordinate the work of furniture manufacturers and installers to ensure proper specification and installation at a later date.

The *component plan* is a scaled drawing related to a specific floor of a building and is a second overlay to the installation plan. On this plan, the components are noted that will be "hung" on the panels shown on the installation plan. Locations of hinges and cabinet door swings are also on this plan, as are indications of lighting specific for each workstation (task lighting).

The *floor plan* (furniture plan) indicates the remaining furniture to be placed on a specific floor. It is completed in the same scale as the drawings of panels and components. Noteworthy in this plan are the files, shared equipment, and seating.

This drawing is often a single sheet, but may be a third overlay, merely adding to the installation and component plans.

The *reflected ceiling plan* (lighting) is a scaled drawing produced from the perspective of looking down on the ceiling from above. This view is the opposite of the view from the floor looking upward in the actual space—thus, the term *reflected ceiling*. The lighting depicted on this plan generally is suspended in a ceiling of acoustic panels (tile) with access openings noted. The lighting is intended to supply an overall lighting condition in the space, sometimes called ambient lighting.

The *telecom/datacom plan* is a scaled drawing of a specific floor, often combining a diagram of placement of data and telephone sources and wires when they utilize structural aspects of the building as avenues of supply. Specific notes are required to identify sources or wiring when plenum or surface supply conditions exist.

The *floor covering plan* is another scaled drawing of a specific floor that indicates the kinds and extent of floor covering to be used in each space. Often this plan is simply a schedule or note.

The *wall covering/finish plan* is a scaled drawing of a specific floor drawn in plan-view, indicating the extent of coverage of a specific paint or wall covering in the space. Often this plan does not completely represent an intended coverage and will require additional information in the form of elevations of specific spaces located on the floor. (The information often is covered by a schedule rather than a drawing.)

Each of these plans requires notations *(schedules)* that refer to additional information found elsewhere in the plans. The schedules may represent a specific piece of information such as color, size, or performance or may be a specific set of instructions or specifications. Common types of schedules found in plan sets include panel size, finish and power capability, lighting, materials and finishes, floor covering, acoustical material, and furniture.

Details and *joinery plans* represent specific, unique circumstances. These plans vary in scale and in information presented. Some common conditions that require special instructions include cabinetry; custom details in ceiling, walls, and windows; or unusual conditions that occur when two dissimilar plans connect or converge.

Perspectives and/or *renderings* are not necessarily to scale. They are not intended to present exact instructions to installers or builders. Rather, these drawings are an opportunity to view an enclosed space in three dimensions. The view captures all furniture and architectural elements in relationship to each other, something that cannot be accomplished in two-dimensional representation. Perspective drawings show space as the user will view it and represent all color and textural aspects that further describe the relationships within the space. Renderings are more expensive to produce than scaled drawings and normally are used to help top management and users understand the intended final product.

Before the design process can begin, it is essential that a facility manager understand the rules of design. Those rules may be divided into three categories:

1. Identification of systems and subsystems
2. Development of standards
3. Regulations and constraints

Systems and Standards

Every project that is interior related must address one or more systems. These systems for interior projects include:

- Building systems
- Floor systems
- Wall systems
- Ceiling systems
- Fenestration systems
- Furniture systems

The systems, to varying degrees, dictate to the designer what can be designed in a particular space. The degree to which these are written standards for various design factors is shown in Exhibit 11-2. Interestingly the data indicate an across-the-board increase in policy writing.

Managers whose major function is to lease space usually develop a set of building standard allowances. That is, each prospective tenant is automatically provided with materials to satisfy wall, floor, and ceiling system needs. If a prospective tenant desires to upgrade from the systems offered by the landlord, he may elect to receive an allowance in dollars toward the purchase of different materials or systems. Nevertheless, the manager or landlord determines a prescribed system for each surface in his building before the leasing process can begin. He must also coordinate all systems beforehand.

A facility manager must also determine standards and coordination guidelines for the systems in the space to be occupied. The ceiling and flooring systems present the best potential variation and therefore have the simplest solutions. For instance, large, open areas are normally capped with a suspended ceiling that universally covers the space. Housed within the suspension skeleton is a configu-

Exhibit 11-2. Design factors covered by policy or standards (percentage of respondents).

	Percentage Written	*Percentage Unwritten*	*Percentage None*
Office types	54	30	16
Space allotments	55	29	16
Artwork/plants	26	41	33
Furniture arrangement	46	33	21
Office locations	31	37	32

Source: *Facility Management Practices, 1996* (Houston: IFMA), p. 25.

ration of lighting fixtures that collectively produce adequate ambient light. (A review of fixture placement should be made later to determine a minimum amount of glare and general quality of the light.) The amount of light required varies according to work performed and whether light sources are also located at the task. Sprinkler systems (when required) utilize either the suspension skeleton or plenum produced by the suspension of the acoustical or reflective panels. Plenums also house air-handling systems (heating, ventilation, and air-conditioning—HVAC) and often serve as air return ducts for the HVAC system. The light reflectance quality of the ceiling is important in calculating the overall performance of the space and is usually presumed to be at least 80 percent reflective. The suspension skeleton is also used to support speakers when sound masking systems are deployed.

Materials placed on the floor offer the potential for sound absorption and aesthetics but do little to complement the acoustical or illuminated environment. Carpeting or soft floor covering may absorb the sounds of impact (walking) but not represent efficient noise reduction. Hard-surface flooring may contribute to sound reflectance, however. The color and texture of floor covering are often below the presumed 20 percent reflectance formula used to predict illumination levels in a space. Lower performance may require more illumination. The ceiling presents few physical hazards for occupants, while the floor must present adequate footing (nonslip) under all conditions. Several different materials must be used to ease the transition of walking from hostile outside environment into the workplace. Perhaps the most significant aspect of coordinating floor covering systems is understanding the required maintenance for each material or condition. Traffic patterns and intensity may also determine the floor covering.

Walls are often overlooked when considering both illumination and acoustical performance. The illumination predictability formula is 80/50/20: an 80 percent reflectance is expected from a ceiling system, 50 percent from the walls, and 20 percent from the flooring system. Most wall surfaces have assumed a decorative role in the interior design of a space. When dark colors or heavy textures are used, the 50 percent reflectance may be diminished. As with floor coverings, diminished reflectance requires additional illumination in the ceiling.

Footprints of space (potential variations) may be somewhat determined by accessibility standards. A barrier-free environment will have noticeably wider circulation space than is required by standard regulations and codes. Be aware of the philosophy of your organization in regard to accessibility when developing standards of space utilization. Insist on isometric drawings of each workstation to ensure performance needs. Also test on site at least one configuration of the various standards, using employees under conditions similar to those that will actually be encountered.

Furniture systems are usually limited to partitions and componentry of a workstation. In reality, seating must be considered part of the system. Most seating today has adjustable features touted by manufacturers as productivity enhancing and ergonomic. While it is true that the technology of office seating has improved greatly, no significant findings support increased productivity as a result of the new seating technology. You should ensure that testing of seating be completed under work conditions before making the final selection. Exercise care to analyze manufacturers' claims.

Effective and Efficient Space Allocation

After the decisions have been made regarding furniture systems, a facility manager begins the task of dividing up the space for employee use. Effectiveness and efficiency of space are not synonymous. Effective use of space implies that the space function is maximized—that is, each worker at a workstation is provided with maximum functional support for each task at hand. Space efficiency is the ability to achieve maximum density per square foot. The ultimate objective is to provide maximum support in as small a space as possible without constricting the workers.

A second efficiency may be achieved through design of multiple workstation modules. CADD programs use the principles of space planning to help you design a single workstation, then reproduce it as many times as necessary for a single drawing of a multiple workstation module, thus simplifying the planning process.

Office support furniture and equipment continues to change. The most futuristic innovation, developed to meet the need for quiet and privacy within a team environment, is the individual workstation that resembles an airplane cockpit. The cockpit is outfitted with the individual's computer, screen, and ergonomic seating. This workstation can be independently controlled for air quality, lighting, and temperature, and plug in/plug out of existing building systems.

Conventional Panel-Hung Systems

Conventional panel-hung systems require that panels of standard module width be used (most common are two-foot widths and four-foot widths). The most common workstation standards are then expressed in extensions of those modules.

Aesthetics are enhanced with partition strings on 45-degree angles with the horizontal walls in the space, and with radius panels at the termination of panel runs or as entrances to individual workstations. An efficient arrangement is small squares with replicated panel widths in the same side of each workstation. Aisles should be minimized (within code compliance) and circulation space kept to a minimum. To minimize design time on the project, use CADD to design multiple workstations.

Circular Radiating Clusters

The most efficient use is maximum-density clusters (six workstations) arranged as close together as possible. The visual arrangement is similar to "spots" when viewed in plan and will defy a truly aesthetic appearance. While these clustered workstations increase density significantly over conventional panel-hung systems, workstation function may be significantly reduced. It's a trade-off between density and functionality.

Clustered Panel Systems

Providing the modularity of conventional panel systems, clustered panels may even be reconfigured into or interfaced with conventional arrangements. These systems provide maximum function at minimal per-workstation costs with indicated flexibility.

When using CADD, select from a variety of footprints that range from two to eight workstations in a single grouping. Different from other systems, clustered panels can further group up to sixty-four or more workstations for the most efficient design. They maximize circulation space and the efficiency difference between a circle and a square (3.1416/4) to demonstrate the greatest possible functional density.

The aesthetic appeal of this system is unique. Linking patterns of groups form soft organic shapes in a space conducive to departmental communication and interaction. It also provides a significantly greater capability for lateral filing than does any other system.

In a recent survey, nearly 75 percent of senior business executives, government officials, facility executives, and building association leaders queried felt that the government should fund research and development studies of office productivity. Over 93 percent of that same group felt that high-quality work environments can increase worker productivity.[4]

Productivity Information

A number of furniture manufacturers have made claims that their specific product increases productivity. Some studies support the claim that appropriate furniture and other work-support tools also contribute to increase productivity, although those studies do not claim product specificity. Perhaps more important than furnishings in determining productivity are how people view their jobs. According to Robert Nolan, who writes on issues of office productivity, there are five basic expectations of people with respect to their workplace:[5]

1. Job security
2. Sense of community
3. Well-defined job expectations by employer
4. Feedback on performance
5. Opportunity

Sometimes a facility manager or space planner will project productivity increases under certain conditions or using a specific product or technology. Yet it appears that employee perceptions, not specific pieces of furniture, are most important to productivity. You are well advised to discount the productivity claims of manufacturers and establish productivity projections based on established figures.

Product Specifications and Contracts

Many products appear to be similar, but do not take advertised claims at face value. Test a product that appears to approximate the purpose and scope desired, and be sure such testing is done under controlled conditions and as close to actual working conditions as possible.

Guarantees for products should be for at least as long as their tax depreciation schedule. Manufacturers' suggested maintenance programs should be included in every purchase. Each specification package should contain provisions for warehousing the product if the space is not available for occupancy on the projected date. In addition, penalty clauses will be a deterrent for late delivery or faulty merchandise. Finally, all specifications should ensure product replacement availability at a specific future date, to ensure aesthetic and maintenance continuity.

All furniture manufacturers offer dealers standard discounts on their products. When a major company makes purchases over a period of years, the total may be much more than a dealer purchases in a year. Your contract with the manufacturer can be written to cover future furniture needs as well as current ones, thereby including a discount that may significantly exceed the normal wholesale price available to dealers.

Refining the Budget

An economic model is essential to the birth and life of any project. An economic model is a budget, a guide, or sometimes an educated guess. All models presume certain conditions and may achieve a high degree of accuracy if those conditions hold true. It is essential for a facility manager to minimize the variance from the presumed conditions. In other words, a successful project results from well-defined project parameters.

Assuming that attention was given to the data-gathering stage and that the data were thoroughly analyzed, budgetary parameters should be fully understood by this point. The workstation standards will be helpful in establishing the cost figures for purchasing furnishings, warehousing needs, maintenance programs, churn factors, and installation or construction costs. Assuming that the architectural and design fees are hard numbers (not open ended), those numbers may also be safely projected into the budget.

The most difficult numbers to project are costs of internal time to complete the project (estimates of supervision, employee downtime, survey involvement). Those numbers are estimates and come from a number of different sources. Ask for documentation supporting the estimates that come from outside sources.

As the design progresses, the budget should become more specific. Ordinarily, the project budget should be locked in by the time that design is 30 percent complete.

Notes

1. Vivian Loftness, "Research: Fundamentals for Design Professionals," *Construction Specifier* (May 1989): 112.
2. *Facility Management Practices* (Houston: IFMA, 1996), p. 15.
3. Carol Farren, *Planning and Managing Interior Projects* (Kingston, Mass.: R. S. Means Company, 1988).
4. *On-Site Research Findings; National Summit on Building Performance* (Washington, D.C.: Cramer-Krasselt, 1996), pp. 5, 15.
5. Robert E. Nolan, Richard T. Young, and Ben C. DiSylvester, *Improving Productivity Through Advanced Office Controls* (New York: AMACOM, 1980).

12

The Construction Phase

Pulse Points

- *Both design-build and fast-tracking offer opportunities for cost savings but place greater pressure on the design team.*
- *Costs can be minimized by selecting the correct method of contracting and construction process for major projects.*
- *Prequalify design firms and builders.*
- *Award good performers; drop nonperformers.*

One of the difficulties of trying to break an integrated subject like facility management into its component parts is that the reader loses the sense of concurrency and integration that is necessary to manage facilities well. For example, construction cannot be divorced from either planning and design (Chapters 10 and 11) or project management (Chapter 9). In fact, partnering and the trend toward design-build have blurred what distinctions existed between these functions. In most major projects, it is neither desirable nor financially wise to move consecutively from concept, through planning, to design, and then construction.

Particularly in the private sector, once a decision has been made to commit to a construction project, all parties try to compress the schedule as much as possible so that the business purpose of that project can begin as early as possible. I once heard a builder say, "All of our projects are now fast-track!" Since construction is often started before design is complete, there is great pressure on getting all of the "front-end things" right. Business issues drive construction also. For example, for some companies, a scenario where a developer builds a building to their specification and then leases it to them might best meet both of their technical and financing needs.

Construction of new facilities always brings particular attention to the facilities department. At times construction has been called the glory function of facility management, since the programming, planning, and design come to fruition.

Construction is often defined as the installation or assembly of a facility. For practical purposes, most large facility departments handle two kinds of construction, often using a dollar value ($100,000, for example) to differentiate between major and minor construction.

Major construction normally is funded with capital funds, as part of a multi-year capital construction program. Minor construction is similar to alterations, and although it can change the very nature of the facility, it often is funded out of the annual budget.

Minor Construction and Alterations

Almost all organizations fund some level of work that could be capitalized but comes from the annual operating budget. The most common reasons are that there must be funds available to meet reactive needs, and the size of the projects is below the company cutoff for capitalization. Thus, funds for minor construction often are mixed with maintenance and repair moneys, and they compete for priority. In fact, that can become such a problem that the U.S. military has put a ceiling on the total annual dollars that can be used for new work, minor construction, and alterations versus maintenance and repair.

For most companies, a typical minor construction project is related to moves or expansion to accommodate new space or equipment needs. It is typically $10,000 to $50,000 in scope, and can be designed and constructed with in-house resources. This type of job is best managed by a project manager focused on the user. An alternative is the interior designer or space planner who also coordinates design, construction, moving, communications, installation, furniture and furnishing installation, and project turnover.

In general, specialized construction management systems are not cost-effective on such small jobs, though Program Evaluation Review Technique (PERT) and GANTT charts may be used to report to management. Often, off-the-shelf project management systems such as Microsoft Project are used. In medium-size organizations, it is not uncommon to have 150 to 200 such projects going annually, mostly to implement churn. With so many small projects occurring in such a brief time frame, the facility manager is unable to oversee most individual projects and must devote most or all of his time to managing the program as a whole.

Minor construction is fairly easy to reduce to a routine that is highly efficient, providing there are standards and available design and construction capability. The management challenge is to keep this work from absorbing maintenance and repair funds.

Major Construction or Renovation

Some facility managers never manage a major construction or renovation project, while others construct new facilities on almost a routine basis. Most, however, have at least one experience with a major capital project. Because these projects have high visibility in the boardroom, every facility manager should be comfortable with this type project. In fact, because these projects have historically been given to a retiring vice president, seizing the initiative may be one of the biggest challenges for a facility manager.

Initially, the key to managing a major construction or renovation is organizing the design-build team; this is explained in Chapters 9 and 11. Early on, a decision needs to be made regarding the contractual arrangements needed to manage and build the facility. For example, if a structure already exists on the site, you may have to bid the asbestos removal and facility demolition separately from the construction services. The extent to which the in-house staff manages the construction depends on the form of contract employed. The choice is usually between construction management and general contracting.

Construction management (CM) is one popular method of contracting. It is the inevitable result of building more complex buildings and the need for better continuity, at least from design through turnover. In a recessionary period, CM also offers substantial reductions in project cost. CM is different from general contracting:

Construction Management

1. Places premium on the ability of the construction manager.
2. Requires significant participation by the facilities department.
3. Needs better coordination between design and construction.
4. Better for phrased construction.

General Contracting

1. May be the only option for a small facility department.
2. Commits the facility manager to lump-sum contracting.
3. One contractor performs most trade work.
4. The project is not so large that it requires phasing.
5. There is little need for close coordination between the architectural-engineering firm (A-E) and the contractor.

Hiring a construction manager should reduce the total project cost or the time to design and construct. Sometimes the company can fill the construction management function without hiring additional people.

Although the term *construction management* has been used for several years, actually there are three generally accepted CM practices. In one form, the construction manager is retained by the facility manager early in the design stage, then assists in managing the design process, offering his expertise to ensure that the facility manager's interests are represented.

In another form, the construction manager is hired following completion of the design. He then is responsible for the construction process, helping the owner obtain contractors for the various segments of the project, providing project coordination, and expediting the work.

In the third form, the construction manager may actually perform portions of the work with his own crews or contract for the work with other companies if that is less expensive. I have seldom seen this used, for obvious reasons. (See Exhibit 9-1.)

The Construction Process

The most common method for major construction is the conventional construction process. When the design work is completed, the bidding process leads to selection of one or more contractors to handle the construction. There are many alternatives to this process that may be useful under certain circumstances. In the public sector, law often requires that construction projects be awarded by competitive bid.

Following are explanations and definitions of some alternatives to the standard competitive-bid process, based on completed designs for large projects. These alternatives are intended to save time and money but usually increase owner involvement. Thus, the success of these alternative processes depends on the owner's knowledge, ability, and expertise in construction management. Those are only some of the alternatives. Variants seem to appear regularly.

Design-Build Alternative

Under this process, one firm usually has responsibility for both the design and the construction of the facility. The design-build format can be used in a competitive-bid process, but it requires extensive planning and a method of analyzing the proposals submitted by the candidate firms. This method gets the construction underway as the plans for each segment are completed, rather than waiting for the total project design. It saves time and therefore money. It also controls cost in that a price for the project is established early on in the design process. If executed properly, design-build promotes the team concept and encourages integrated problem solving, two other major advantages.

This alternative may, however, be limited by a strong desire for design compatibility among various buildings to be constructed at different times. Thus, heavy programming responsibility falls on the facility manager.

Fast-Track Alternative

Fast-tracking compresses the time between the start of design and completion of construction. This works well on relatively large projects and can be adapted to either competitive bid or negotiated contracts. Many facility managers feel that, given the cost of capital, all major projects should be fast-tracked to some degree.

As with design-build, fast-tracking saves time by starting construction on selected parts of the project prior to completion of designs. The designer must complete segments of the construction documents in a sequence that follows the proposed sequence of construction. Once the design for a phase is finished, work is contracted. Then other portions of the design are completed. This pressures the design team and tests the competency of the designers. The process requires careful cost-estimating allocation to ensure that funds are sufficient for the entire project. Fast-tracking also restricts the designer's ability to incorporate desired changes into the project after the initial construction contracts are awarded.

Turnkey Alternative

A turnkey process has great appeal to small facility departments facing a unique, one-time project. The contractor or developer arranges for and obtains all necessary construction financing and may, in fact, manage the project from concept through construction. Once the project is complete, the contractor exchanges the title of the building for either full payment or future payments.

Selecting a Builder

North America is blessed with many companies that can design and build large, complex facilities. In fact, excellent builders can mobilize at almost any site, some of them elsewhere in the world. Nevertheless, a builder must be chosen carefully, using these criteria:

1. Successful completion of multiple projects at the location selected
2. Successful completion of similar multiple projects
3. Financial stability
4. A qualified and compatible manager

I admit to a certain discomfort with some methods for analyzing the technical capabilities of a builder. The selection often takes on aspects of a beauty contest, compounded by the fact that the references given seldom provide either an "encouragin' or discouragin' word." Most selection processes encourage bureaucratic procedure rather than commonsense evaluation. I favor a two-step evaluation procedure, the second phase involving an interview with the manager of each company.

Construction Contracts

The traditional construction contract is a fixed sum, reached through competitive bidding or negotiation. In recent years, however, other types of contract have been used to meet both market and management needs. The advent of construction management, with fast-track and design-build alternatives, may help companies gain some of the benefits of these innovative construction contracts. Following is a brief explanation of some of the common contract alternatives.

Guaranteed Maximum Price

The guaranteed maximum price (G-max) establishes a maximum project cost. It then provides incentives to the contractor to reduce this cost. The maximum cost can be obtained through competitive bid or negotiation, and the contract provides the means of apportioning the financial savings that are established.

By its nature, this contract shifts considerable design responsibility to the contractor, so the designer and owner must review all cost-saving measures proposed by the contractor. The major difference between design-build and G-max is that in the latter the owner controls the proposed design deviations. In design-build, the contract is for the design, with owner review and approval.

Since the G-max form shifts most of the responsibility for design omissions to the contractor, it is necessary that the company have a strong, detailed design at the beginning of the process. If the design is poor or incomplete, the contractor is likely to inflate the G-max price to cover the ambiguity.

Cost Plus Percentage

In the cost plus percentage contract, the facility manager pays the actual cost of the project but allows a fixed percentage for overhead and profit. There is no incentive on the part of the contractor to control costs.

Cost Plus Fixed Fee

The cost plus a fixed fee contract is structured to remedy the problems associated with cost plus percentage by limiting the cost ceiling. It eliminates any incentive for the contractor to drive the cost upward, since the profit margin is set.

Cost Plus Fixed Fee With Upset Figure

The fixed fee with upset figure contract is a compromise. It establishes a fixed cost ceiling for the completed project, and the contractor realizes a profit as long as costs remain below the fixed ceiling.

Multiple Prime Contracts

Most facilities are constructed with a single prime contract that covers the entire project. An alternative is to award multiple prime contracts, preferred by some large facility management organizations. In these contracts, each of the prime contractors has a direct contractual relationship with the owner. The company must hire a construction manager or must have one of the multiple prime contractors provide project coordination.[1]

Construction Documentation

Many companies suboptimize their ability to execute construction projects—and later, alteration and renovation—because they fail to obtain complete documentation. Exhibit 12-1 presents documents that should be considered as deliverables for every project.

The items most often forgotten or issued too late are move lists, demolition plans (including cable removal), and communications plans. Because all trades

Exhibit 12-1. Construction documentation for experienced in-house renovators.

Item	*Always Needed*	*Remarks*
Demolition plan (includes art relocation)	No	Can be overlay or notes.
Architectural plan	Yes	
Signage schedule	Yes	
Finish plan	No	Can be notes.
Telephone plan	Yes	
Electrical plan	Yes	
Electrical schedule	Yes	
Wire plan	Yes	
Wire labels	Yes	If used.
Cable removal plan	Yes	If cable moving required.
Fire/life safety plan	Yes	
Fire/life safety schedule	Yes	
Cable labels	Yes	If cabling involved.
Furniture plan	Yes	Or reference to a standard.
Furniture schedule	No	Can be notes.
Reflected ceiling plan	No	Only if major ceiling alterations.
Mechanical plan	Yes	Only if major mechanical work.
Specifications	No	Notes normally suffice unless out or major construction.
Details	No	Normally needed for millwork only.
Move (from-to) lists	Yes	

must be coordinated, it is necessary for all plans to be issued and viewed by the construction manager in toto; piecemeal issuance can only cause delays or confusion.

For experienced alteration or renovation crews who regularly work with the same design team and buildings, the volume of construction documentation can be reduced substantially. This is also true when the company uses demountable partitions, standard furniture, standard office layout, and good office and space standards. Document everything that is needed—but *only* what is needed.

Facility Management Concerns During Construction

Besides that the project will be constructed on time and within budget, the facility manager must concern himself with these factors during construction:

1. Building systems
2. Maintainability
3. Operating costs, particularly energy management
4. Staffing and organizing
5. Turnover procedures and training
6. As-built drawings, warranties, and sample books

Paying attention to these issues during construction will help ensure that the company will assume an operable building at turnover and that initial operating problems will be minimized.

In an informal survey of facility managers, several of whom are heavily involved in construction, the following were found to be typical of cost savings or avoidances that could be expected from good facility management related to construction:

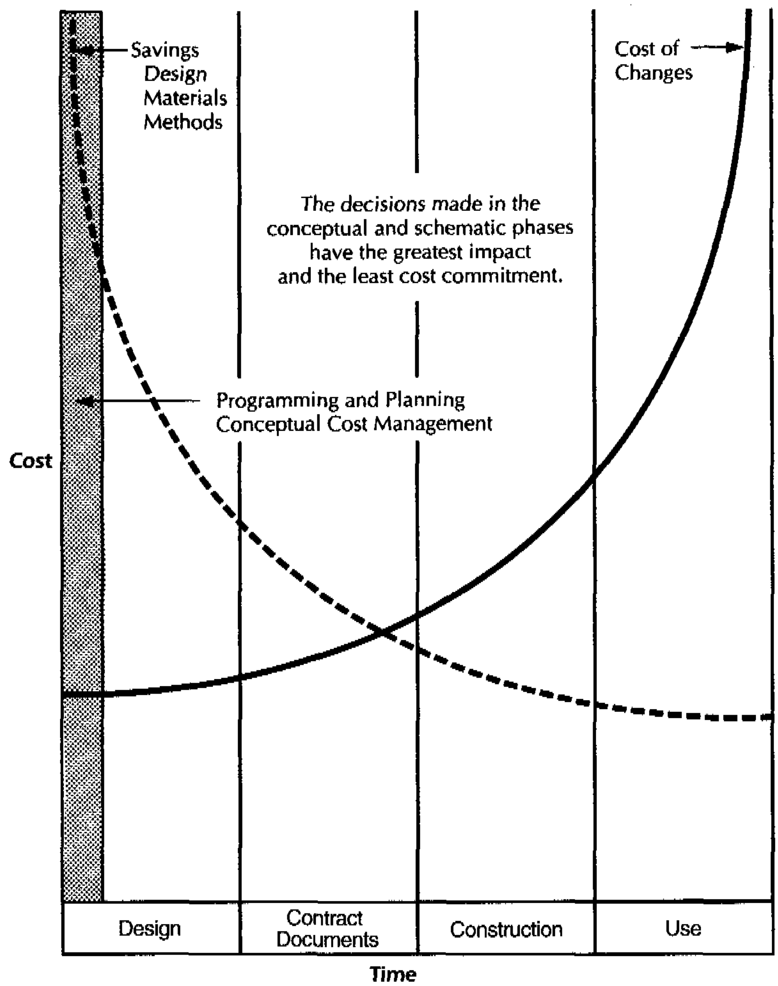
1. *Good programming (5 to 20 percent).* You will save money if you carefully define your requirements up front.
2. *Value engineering (10 to 30 percent).* Your design-construction experts can often recommend different products or methods that will reduce costs and improve quality.
3. *Fast-track construction (5 to 10 percent).* Savings here are in both the cost of capital and the earlier productive use of the site.
4. *Design-build construction (5 to 10 percent).* Design-build saves time and thus costs, and it allows for effective cost control.
5. *Innovative procurement (5 to 20 percent).* Savings here vary from the use of such things as national sales contracts and multiple prime contractors.

Cost Control

I want to stress again the need to do life-cycle costing for all major components of significant construction projects. One of the places where the facility manager should inject himself into the process is to ensure that he sells life-cycle costing to his management. Someone on his team will be able to crunch the numbers (although the facility manager should review and challenge them), but only he is in a position to sell the results of life-cycle costing to management. It is often a hard sell, but an incentive to do so is the fact that the facility manager and his budget will be living with the result for the life of the building.

Because of the high cost of major construction or renovation projects, cost control is always an issue. Unfortunately, it is often misunderstood. Too often, it is viewed simply as driving the initial capital cost down. Also, nonfacilities managers do not realize the cost of late operational decisions that affect design or construction. Exhibit 12-2 is a graphic representation of the effect that timely decision making can have on project costs.[2] Early in the project, the project manager should develop an expenditure profile and should track expenditures against it closely.

Exhibit 12-2. Relation between timing of decisions and cost savings.



Source: Larry Gleason, "Modeling Facility Construction Alternatives," *IFMA Conference, 1987 Proceedings* (Houston: IFMA, 1988), p. 317.

Efficient Management

In construction, there are great advantages to the proper use of computer-assisted facility management. Computers can be especially useful in three areas: payments, schedules, and change orders.

Payments. Computer-generated payments to A-E firms and to contractors are virtually required to administer construction contracts on large projects. This is especially true when using CM techniques or multiple prime contractors. You could have as many as twenty or thirty contracts for a single project. This way, payments are triggered by completion of schedule items.

Scheduling. Monitoring schedules is an area that benefits from automation. Most contractors prepare detailed schedules in order to mesh the work of subcontractors and the delivery of material. Commonly, both construction documents and schedules use the Construction Specification Institute classifications of work as a basis for the computer network, and that information is often shared with the design-build team. By comparing schedules to completion dates, you can spot bottlenecks in the process quickly enough to correct them.

Change orders. Change orders are of two types: *pending change orders* (suggested changes not yet approved by all parties) and *approved change orders* (changes that have been approved). Normally there are more pending change orders than approved change orders. The computerized network can ensure that all parties have a record of these changes and a method to resolve change issues quickly.

Quality Control

I recommend a qualified construction inspector for projects over $250,000. This is in addition to the inspection services normally performed by the A-E firm. Although I am unaware of any major policy change from the American Institute of Architects, my observation is that architects tend to shy away from providing inspection services for clients. I am sure that this is driven by the litigious nature of the construction business. At one time, architects used to be so actively involved that they often were project managers for small owners. Now they provide only the necessary on-site presence to ensure that their design is being generally followed. This is not intended as a criticism but as a situation to which the facility manager of a major project needs to respond by providing inspection and work validation services beyond those provided by the architect. Other services that should be provided on large projects, either with in-house or contracted personnel, are cost estimating and schedule review; construction accounting and auditing; and legal, code, and permit advice.

Control of construction is exercised through the review and change approval process. Major reviews should coincide with major events, but team reviews should be held at least weekly. I favor a two-tiered review approach, with a technical review always preceding a management review.

One quality-control item often ignored, but which can preclude many problems, is operational testing prior to acceptance. If a mechanical system is designed to perform in a certain way, the mechanical engineer should design a test to ensure compliance, and the system should be tested. No manufacturing facility would ever be acceptable without such tests, yet office building systems are frequently accepted without significant testing.

Involvement of In-House Personnel

It is extremely important to keep in-house personnel involved in the construction process. The builder should feel comfortable with them on the construction site, and they should be actively involved in reviews and testing. The facility being constructed is unique, a one-time effort, which in-house personnel will have to operate, maintain, and repair. The best time for these employees to become familiar with the building is as it is built. Some A-E firms, construction managers, and general contractors view involvement of in-house staff as threatening. You can dispel that attitude, making it clear that in-house personnel will be involved.

Turnover Procedures

Too often the turnover of a facility seems almost an afterthought. Here are some considerations for the end of a project:

1. Beneficial occupancy
2. Punch lists
3. Preparation: completion of work, sign-off
4. Operating tests: composition, scheduling
5. As-built drawings: shop drawings, cable management schema, medium (CADD, reproducibles, copies), distribution, completion date
6. Warranties
7. Finish and sample boards
8. Attic stock: inventory, storage method
9. Training

These considerations are frequently handled through a best practice called commissioning. *Commissioning* is the effective and efficient turnover of a major project or building from the builder to the owner and occupants. I strongly advocate the commissioning of major projects. Attention to these details will add inestimable value to a project. If the facility manager is prepared to handle it, the information contained in items 5 and 6 (as-built drawing and warranties) can be supplied in automated format along with pictures and schematics, maintenance schedules, and instruction books for all major equipment. A major project's completion, if properly managed, can provide major impetus toward a complete computer-assisted facility management system. Sometimes the cost of automating can be funded in the project cost.

For all major projects, I attempt to perform a postoccupancy evaluation (POE) six to eighteen months after occupancy. There are now consulting firms that specialize in POEs, but whether you use an outside consultant or your own staff, you should accomplish these objectives:

1. Determine whether there was a correct program for the project.
2. Measure whether the goals of that program were met.
3. Gather input from the staff on overall effect of the program.
4. Determine corrective action for the next similar project.

POEs raise expectations. If you are not willing to make corrections or adjustments, do not bother to conduct them.

Potential Problems With Construction Projects

In recent years, there has been concern about inefficiency and low productivity in the construction industry. While all of these problems may not be applicable to an individual project, being aware of them may help you avoid them:

1. Failure of both parties to understand the project's scope
2. Irrelevant contract requirements
3. Too generous decisions on contract appeals
4. Reliance on negative incentives
5. Excluding the builder from planning and design
6. Inadequate claims processes

There are some suggested fixes, most hinging on a new relationship among the user, A-E, and contractor, whereby teamwork rather than confrontation is emphasized and awarded:[3]

1. Invite the builder aboard early.
2. Use the design-construct approach more often.
3. Read the contract.
4. Seek realism in pricing; do not go blindly for a lump sum.
5. Use value engineering constructively and cooperatively with incentives for active participation.
6. Unless absolutely unavoidable, eliminate sequential procurement.
7. Eliminate cut-and-paste contracts.
8. Use incentives for really good work.

For facility managers who manage large, multiyear construction programs, there are other suggested remedies:

1. Use design standards and standard designs that can be site adapted.
2. Benchmark and document the performance of designers and builders. Award the good performers, and stop doing business with the nonperformers.
3. Prequalify design firms and builders whenever possible.
4. Whenever possible, build flexible facilities that are not unique to your organization. The future is unpredictable, so hedge your company's bets through flexibility. One of my better management decisions was to insist on access flooring and "overdesigned" electrical systems in new buildings in the early 1980s.
5. Keep the operations and maintenance staff on the project team from concept through turnover. Their inputs will often save the company from major errors and operational problems that will cost the company annually well into future.

Some of these measures are probably considered anticompetitive by the public sector, which is a shame. Public-sector facility managers have been given more flexibility to get away from firm, fixed-bid contracts, but there still is a long way to go to give public-sector facility and project managers the tools needed to optimize quality while minimizing resources. As I appealed for flexibility in design, I feel just as strongly that facility managers need flexibility in contracting and then need to be held rigorously to producing results that are acceptable to their customers.

Disputes

I have long been bothered by the litigious nature of construction in the United States. It often seems that everyone on a major project sues everyone else on the project. And ironically, opponents in a lawsuit on one job often are working together on the next. Is this really a system that serves anyone but the lawyers?

I recommend that anyone doing a large amount of construction contracting seriously consider alternative dispute resolution (ADR) both to settle protests and to resolve disputes. Partnering, arbitration, mediation, and minitrials are all examples of ADR methods.

Notes

1. Richard A. Eustis, "Construction Phase," in *Facilities Management* (Washington, D.C.: APPA, 1984), p. v–71.
2. Larry Gleason, "Modeling Facility Construction Alternatives," *IFMA Conference Proceedings* (Houston: IFMA, 1988), p. 317.
3. "Contract Construction Procurement," *The Military Engineer* (November–December 1988): 590–693. By permission of The Society of American Military Engineers (SAME).