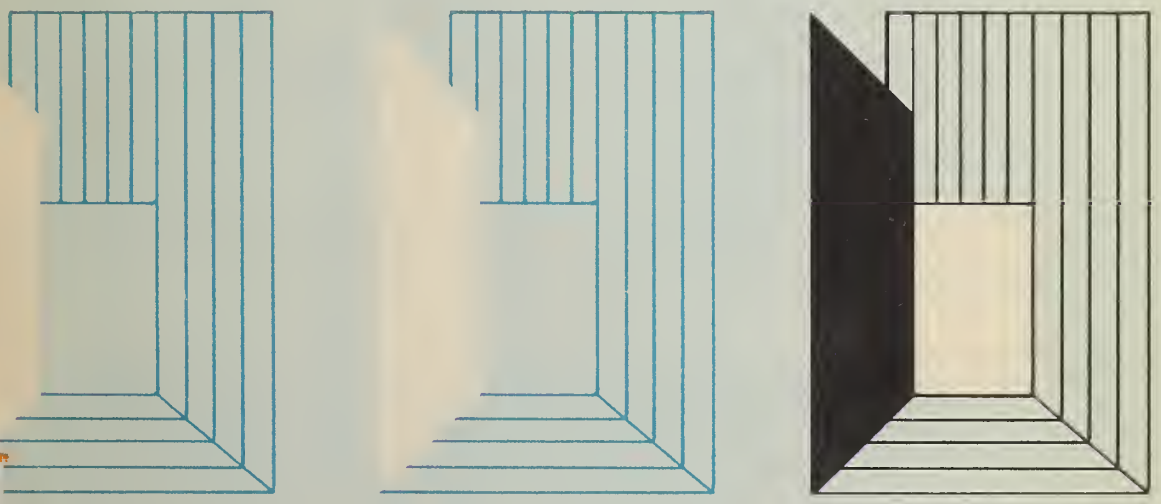
NBS SPECIAL PUBLICATIONS 476

OPENING THE DOORS TO BETTER BUILDINGS

CHOICES FOR THE BUILDING COMMUNITY



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[2] Located at Boulder, Colorado 80302.

OPENING THE DOORS TO BETTER BUILDINGS

CHOICES FOR THE BUILDING COMMUNITY

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OPENING THE DOORS TO BETTER BUILDING
Choices for the building community

A review of findings developed at three workshops—"The New Connection: Owners and Manufacturers" (University of Wisconsin, Sept. 10–12, 1975); "Long-Term Economy: A Systematic Basis for the Construction, Operation and Reuse of Buildings" (Harvard University, Nov. 3–4, 1975); "Alternative Processes in Building Procurement" (University of Illinois at Urbana-Champaign, Nov. 16–19, 1975)—and a national symposium "Answers for the Building Community: Optimizing the Choices" held at National Bureau of Standards March 24–25, 1976.

Report prepared by Stephen A. Kliment AIA
December 29, 1976

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FOREWORD

This report has been prepared to document the essence of the discussions and findings that emerged from the four conferences (see page iii). The National Bureau of Standards organized the program, though the findings do not necessarily reflect the Bureau's opinions.

While this document does not make any formal recommendations, the reader will find in it a number of important courses for action which he is urged to follow up through formal and informal efforts.

The choices are many; so are the opportunities. But time is short.

Stephen A. Kliment AIA
Editor

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TABLES

EXECUTIVE SUMMARY

A series of three workshops and a national symposium was held to pinpoint choices open to the building community in the cause of improved building procurement practices.

Organization/ regulation

Several problem areas were identified. In the area of organization and regulation, weak linkages among industry segments—owners, architects and engineers, builders, manufacturers and lenders—are intensified by lack of consistency among building codes and standards and by restrictive public bidding laws. In the area of project management especially, there is a critical lack of adequate bridges between the design and construction phases of a project. In the post-construction phases, there is a wealth of useful building performance data and this should be gathered and disseminated to future owners and their design and construction consultants. To serve owners' interests through a precise definition of his needs, a strong association of owners should be formed.

A key tool furnished to or developed by such an association should be a manual listing the various project delivery options and their implications in terms of cost, time, risk, and staffing requirements. These options include traditional process, modified traditional, construction management, building systems and design/ build. To help owners in planning, a region-by-region plotting of future construction supply and demand could be developed.

A greater role for the manufacturer is needed to bring into the building process his creative and management expertise and his financial capacity to conduct intensive research and development. This applies especially to the area of developing performance based building systems and improved energy-conserving products.

Long-term economy

Long-term economy should be consistently included in the facility procurement planning of owners. It is not enough to select design solutions on the basis of first costs alone. Owners must also consider such long-term costs as maintenance and operating materials and labor, taxes, interest, space rearrangement and even the salaries of employees using the building. Over a 40-year building life, such salaries can amount to 92 percent of the total outlay, compared to 2 percent for initial costs and 6 percent for maintenance and operation. As part of their financial planning, owners must pay special heed to the cost and manner of allocating risk, whether it be through the low bidder on competitive jobs, or assumed by the owner, or apportioned in some manner among owner, construction manager and prime contractors.

Technology

Technological innovation was discussed at the four conferences, with special focus on the performance concept as a means to stimulating innovative products and product systems. Under this concept, which has been tried successfully on a number of large building programs, suppliers respond to performance specifications geared to owners' specialized needs, by developing building systems that often emerge as technical and management breakthroughs.

Information/ communications

Serious gaps exist in the development and dissemination of information. These gaps are especially grave in the area of reliable building performance data, the cost implications of design decisions and the arrangement of findings in a form and language understandable by the intended user. A needed target of communications programs is the occasional, small or first time owner who lacks informational resources of the recurring owner.

Training/ education

In the area of training and education, interdisciplinary curricula could well be developed at professional schools so as to create a common ground of building industry knowledge among all parts of the building community.

Attitudes

Finally, there is a great need for a change of attitude, for an approach to overcoming the natural inertia of men and women who have mastered methods of practice and are reluctant to change them. To counteract this inertia, the advantages of improved building practices need to be documented and forcefully disseminated, in terms of their financial, scheduling, aesthetic and social benefits.

Only by broadening the impact of pioneering breakthroughs in design, management and technical content of buildings will the nation's owners and users, in the public and private sectors, obtain the full yield from their huge financial outlays.

INTRODUCTION

The built environment can be upgraded only if all participants in the construction industry—manufacturers, distributors, contractors, construction managers, designers, code officials, and legal representatives—perform better and cooperate more fully.

At the heart of the complex network linking these participants is the owner/client. It is the owner/client who determines the pattern of contractual linkages which control the purchase procedures required to build new construction, lease/rent, or the adaptive use and/or renovation of historical and other existing buildings.

These processes of building are too often merely routine or traditional. Owners fail to exploit potential savings of cost and time available through closer connections with manufacturers, more complete economic analyses and careful choice of bidding/management processes.

The purpose of this document is to give the reader, whether he be a recurring or occasional owner, in the public or private sector, the chance to absorb a mass of fresh thinking that could lead to the improved procurement of buildings. Most of the material stems from three workshops and a national symposium arranged by the National Bureau of Standards between September 1975 and March 1976. These conferences zeroed in hard on the areas of long term economic analysis, owner-manufacturer relations and project procurement alternatives. Many other relevant topics were also raised during the formal and informal parts of the sessions, and the gist of these too is included in this document.

Readers who would like to follow up the main topics in more detail are directed to the transcribed and edited record of the conferences cited at the end of this document.

WHERE THE PROBLEMS ARE

Before exploring the choices, let us take a good look at some of the main problem areas as identified by the participants at the four conferences.

ORGANIZATIONAL/ REGULATORY

First among these problem areas is the absence of any strong, coordinated form of doing construction business. The process of producing automobiles, airplanes and appliances is organized and regulated by a few large "vertical" companies in each field. These companies, solidly financed and run by managers trained to manage, see a product along from planning, research and development through manufacture and marketing.

Indeed, the importance of the built environment to mankind is enormous:
—enormous in terms of resources consumed in providing and employing the materials of construction;
—enormous in terms of resources consumed by operation and maintenance of the structures during their life cycles;
—enormous in the implications of how well the built environment serves its intended functions.

—Elmer B. Staats

The building industry on the other hand is still largely legatee to the old crafts, "cottage industry" approach. At every phase, the building process is under different sponsorship and control. With a few exceptions, the products that go into a building are designed and manufactured not, as in the automobile industry, under contract and to specifications of the auto manufacturer, but independently, based at best on intelligent market research. Early planning by the owner is often done without professional advice. Design usually proceeds without the benefit of experience from the contractor. Financing, both construction and long term, has come from lenders who cover the special risks of an uncoordinated building process by charging above minimum interest rates and insisting on tough, conservative conditions for design and construction.

Linkages between the various actors in the building process, tenuous at best, tend to be weakened further by a lack of consistency among building codes. Codes are still prescriptive in most jurisdictions. That is due largely to the greater ease of enforcing such codes (it is simpler for an inspector to measure two inches of insulation than to test it for thermal conductivity as required under a performance code). But one effect is to stifle product innovation, because each new product or technique entails a change in the code.

These and other kinds of problems falling under the area of organization and regulation have been assembled in table 1.

PROJECT MANAGEMENT AND COORDINATION

A second major problem area emerges directly from the first. The chopping up of a building's procurement into separate phases puts any kind of single control out of reach in most typical project situations. At each phase—initiation, development, delivery and evaluation—a different group takes over the direction, and the "bridges," usually in the person of the owner, often lack the necessary strength and expertise. Continuity is lost. The contractor often enters the scene only after the design and construction details are settled. This deprives the owner of valuable experience in the project's critical early phases.

What is worse, as contractors bid against each other for the contract, they cut back on their costs and profit margins. As a result, the low bidder inevitably emerges in an inflexible, adversary role as he works to eke out a modest profit on his contract.

TABLE 1. ORGANIZATIONAL AND REGULATORY PROBLEMS IN THE BUILDING INDUSTRY

WHO	WHAT
All	Weak linkages (fragmentation)
Code writing groups	Lack of uniformity
	Prescriptive nature of most codes
Law enforcement agencies	Restrictions on bidding method on public work
Public construction agencies	Short term commitments hamper long term planning
The "occasional" owner	Disregard for his special problems
Small product manufacturers	Handicapped in large scale systems procurement
Large owners	Overstaffing when supervising outside professionals
Elected public officials and The banking community	Neglect of their role as potential supporters of innovative procurement, design and construction
Construction labor	High degree of local autonomy leads to above-average stoppages and widely fluctuating productivity
All product manufacturers	Ill-defined role as installer

The lack of bridges between the phases creates other hitches. Quality control becomes harder as active project direction passes from the architect and engineer to the builder and his subcontractors. And, after the building is occupied, contracts are rarely signed with the suppliers of major systems (such as mechanical) to maintain such systems, due to the legal intricacies of such arrangements.

Aside from the trouble caused by the traditional lack of continuity from phase to phase, other problems are unique to the phases. A common source of late phase difficulty is disregard of the distinctive nature of the first phase, initiation. It is then that feasibility is studied, the space program analyzed, prospective costs and the overall time schedule reviewed, and alternative project delivery options assessed. Too often, owners move on with development without that initial deliberate review of basic decisions.

Building industry problems in the development phase vary with the group concerned. Table 2 briefly summarizes this information.

The key problem areas during project delivery are shown in table 3.

Among the more serious problem areas that mark the final or project use stage is the widespread lack of concern for how a building performs for the user. Since the user often has had little or no role in the owner's decision making (as, for instance, an apartment renter, high school student, or clerical worker), their needs as users are often subordinated to economic and aesthetic considerations. Much of the trouble is caused by the lack of any body of behavioral knowledge from which owners and designers could draw as they shape a project. Project funds are rarely allocated to post-occupancy research. If they were, the findings could be fed into subsequent projects. Owners often hesitate to publicize such findings, however, especially if they show them or their designer up in a bad light.

TABLE 2. PROBLEMS DURING PROJECT DEVELOPMENT PHASE

WHO	WHAT
Owner	Non-uniform procedures for selecting architects/engineers and construction managers.
	Hesitation in aggregating individual projects (by large owners) to save time and costs in design and bidding.
Owner, architect/engineer	Not enough regard for cost implications of design decisions.
Owner, architect/engineer, construction manager	Absence of building component and assembly certification programs.
Architect/engineer	Ambivalence in using "off the shelf" building system components.

TABLE 3. PROBLEMS DURING PROJECT DELIVERY PHASE

WHO	WHAT
Owner	Need for improved allocation of risk.
	Need for more equitable contractor retainage practices (under which percentages of the contractor's billings are withheld subject to satisfactory completion of a project).
Contractor	Need for improved tailoring of innovative schedule management concepts (such as critical path method) to needs of on site labor.
All	Need for improved manpower planning.

User satisfaction is only one aspect of project-in-use investigations. The other aspects are strongly tied to economics and are therefore discussed under that heading.

ECONOMIC AND FINANCIAL

The economic and financial problems of the building industry have proven to be among the most intractable. For generations, through tradition and because of legal requirements, owners, especially those in the public sector, have bought buildings with an eye to minimizing first costs. Concern for the long-term costs of operating and maintaining the buildings has been sparse. In an era of rapidly rising energy costs and escalating salary scales of unionized building maintenance labor, this is bad economics. Yet it remains a built-in way of doing business in most segments of the building industry.

The low-first-cost syndrome is tied to other difficulties. The industry goes through continuing series of boom-bust building cycles, and this places obstacles in the way of sound financial planning. Interest rates and the rate of inflation fluctuate widely across these cycles, adding to the problems—both of the owner who is building for his own use and of the investment builder. Still another unknown is the cost of energy, which at this writing is still largely outside the control of U.S. government and private sector forces.

The actual long-term costs of building are further distorted by not taking into account owner's costs such as employee salaries, which can be sharply affected by the nature of the building's architectural and engineering design concept. Thus, a study by the National Bureau of Standards showed that, over a building's estimated 40-year life span, salary costs may absorb up to 92 percent of the owner's total life cost of operations in the building.[1] Compared to this, operating and maintenance costs take up only 6 percent and initial costs a paltry 2 percent of the total.

What these figures tell us is that a design and construction approach that succeeds in reducing users' salary costs by a modest 2 percent over the 40-year life span, will in fact pay for the entire first cost of the building.

Life cycle analysis like other tools used by the professionals does not have any compelling impact on the public. Unlike private and Federal decision-makers who to some extent can satisfy themselves as to the adequacy of their analysis, the decision-maker in a school district must appeal to the public on the basis of his analysis. Public pressures either through the board, or by refusing to approve rate levies and bond issues, often result in the removal of any additional expenditure no matter how well justified. To ensure good performance of design professionals on school buildings, it appears to be a good idea to establish targets and guidelines for each project, not necessarily binding, but at least something to aim at. The very existence of this problem indicates that leaving this responsibility to a school district and its consultants will not necessarily work. Some research on an industry or nation-wide level is needed. Finally, the role of life cost analysis and its variations must be kept in mind. For a school district, these analyses do not produce decisions, rather they provide information useful in the decision-making process.

[1] "Performance Specifications for Office Buildings," by David B. Hattis and Thomas E. Ware, NBS Report 10527, January 1971, p. B8.

Another troublesome factor in the owner's financial planning is the management and cost of risk. Under competitive bidding, the low (or winning) contractor accepts all the risk of keeping within a building's budget limits. This, as noted earlier, puts him in an adversary position with the owner and contributes in no small way to the fragmentation of the industry. If he accepts a share of the risk inherent in construction—by negotiating a contract, by working through a construction manager, and/or by prequalifying and prebidding some of the building's subsystems—the owner may reduce his costs but at the price of far greater involvement in the procurement process.

One other financial factor that is underrated by many owners rests on the current framework for compensating architects/engineers and construction managers. The prevailing percentage-of-construction cost basis does nothing to encourage the architect/engineer or construction manager who wants to cut project costs. Such a cut in costs merely ends up reducing the fee. Better ways are needed to successfully reconcile the professional's right to a fair fee and the owner's right to match the fee to the services rendered.

TECHNO-LOGICAL

The technological problems facing today's building industry stem directly from the fragmented nature and short-term economic outlook of the industry. For example, owners often discard renovation as one solution to a facility need because of a lack of highly efficient techniques and the obstacles in the way of accurate cost estimating and control.

Product development, with a few notable exceptions, is still largely conducted on a piecemeal, systemless basis. Sizable architectural and engineering design time still goes, on each project, into inventing and reinventing connections between products and product groups. Yet the desire of manufacturers to innovate, develop and market new products and systems is often set back by code requirements that vary widely from one community to another. This can cause long delays before enough code jurisdictions approve the product to justify full-scale production.

The first-cost mindset is often carried over into design, so that a design that works well for a building's first user or occupant may be technically tough or impossible to adapt as uses change. Such flexibility often raises initial costs, if only modestly, but is vindicated by lowered operating and maintenance costs and higher user satisfaction and productivity.

TRAINING/ EDUCATION

From a technological viewpoint, nonetheless, America's building industry is among the most advanced in the world. It will respond, and rapidly, to most demands made upon it. The difficulty has been a tendency among most segments of the industry to rely too heavily upon technology to resolve basic problems that are better tackled through management and design—through "software" rather than "hardware." This is due in part to the fact that the training of professionals, builders and construction labor has not always responded fast enough to the demands made upon it. In the professions, for example, the new proefssional must be equally versed in design, management and technology; yet the main focus in most schools of architecture and engineering is still on design skills.

A no less grave gap exists in the training and education of the owner. Many of the large or recurring owners have professional staffs to help make and carry out decisions. On the other hand, the large numbers of owners who build only occasionally (such as schools and hospitals) are often in the dark when it comes to selecting and dealing with an architect, engineer or construction manager, or when choosing the most suitable form of project delivery.

INFORMATIONAL/COMMUNICATIONS

One way to undergird such an effort of training and education is to employ the tools of information and communications. Problems exist both in filling certain informational gaps and in communicating the findings to the proper audience in the appropriate form.

As to information, gaps exist in several areas. All segments in the industry, for example, suffer from the inadequate quality of statistics used to measure the performance of a building in such areas as its energy consumption, maintenance and operating costs, and productivity. There is not even a satisfactory classification system to organize the collection of life-cycle cost data. As for reliable comparative product information, this exists in the files of manufacturers, but despite efforts at uniform reporting of product characteristics, much needed information is still withheld from the owner, designer and builder.

Alongside the gap in comparative product information, there is the spotty status of regional construction market data to guide owners, construction managers and builders who are planning and scheduling projects. The few attempts to provide such data have run into a cold shoulder from the chief sources of such information—which are the very owners and builders who could most profit by it.

Poor communications rivals information as a trouble area. Much useful information exists, but it is often too technical or too unsuitably organized for ready use by the owner, designer or builder. And, despite frequent conferences and occasional publications, there is still too little exchange and documentation of firing-line experience in the realms of management, design and technology.

ATTITUDES

Attitudes to innovation, whether they are the cause, result or symptoms of the problems troubling the building industry, must be singled out as a separate area of attack. With a few notable exceptions, inertia to change cuts across the whole spectrum of the building procurement process. This is perhaps based in part on lack of information (especially the cost impact of new methods), in part on man's natural reluctance to abandon methods of practice which he has mastered over the years. Also, motivation for energy-efficient design is lacking in facility types where higher operating costs may easily be passed on to tenants or customers (apartments, hospitals). Designer fees, as noted earlier, are too often geared directly to construction costs, whittling down the incentives to aim for lower costs through design. Similarly, restrictive public bidding and inadequate contract retainage practices tend to discourage an open attitude to innovation.

CONCLUSIONS

The sum total of these problems may seem insuperable to the concerned reader. But a discerning eye will quickly reveal a spiderlike network of linkages between the different kinds of problem areas. Project management problems are closely tied to problems of training, communications and technology. All areas are connected by the rigors of financial planning.

Therefore, well thought out sets of solutions must be brought to bear on pressure points in this web in a way to reap the greatest benefits. The four conferences from which this document is derived raised several such sets of solutions. The following section of the report offers the essence of these findings.

There should be a big effort on the part of all building professionals to convert their success stories into lay terminology, to produce a kind of "Reader's Digest" of all approaches that have cost implications. This would help professionals to get a greater understanding of the problems and solutions.

—Peter Lawrence

CHOICES FOR THE BUILDING COMMUNITY

The stated themes of the first three workshops were the ties between the owner and manufacturer; long-term economy as a systematic basis for construction; and alternative building procurement processes. A final symposium brought together panelists from the workshops for two days of reporting and free discussion.

Much of the focus of this section will parallel the stated themes of the workshops and symposium. But the discussions ranged far and wide, often crossing the borders of the assigned matter to uncover useful material elsewhere in the building community's field of interest. These too are recorded here.

ORGANIZATION AND MANAGEMENT

Defragmenting the industry

Perhaps the single most promising instrument for greater cohesiveness in the building industry is the management process. By developing and testing various management models for different situations—by size of owner, size of project, volume of construction activity, etc.—well defined roles and functions could be spelled out and agreed on by owner's groups, architects/engineers and construction managers, builders and manufacturers. Such a series of management models would be especially helpful to the owner, who is usually the least experienced of the industry's several actors.

An association could be created to further advance the owners' collective interests. Such an association would help analyze user needs for the various facility types; identify sub-systems that would simplify the design and construction process; prepare the necessary performance specifications; serve as a powerful link with designers, builders and manufacturers; pre-qualify subsystems; and collect, assess and disseminate technical literature.

These and similar measures would serve to bring the owner on the same footing of experience as the other segments in the industry.

Such an organization could also furnish guidance to the smaller or first-time owner on ways to recast his internal organization so he can do a better job when directing the procurement of a project.

Another segment of the industry that should be woven more tightly into the management process is the manufacturer. His special know how lies in creative product planning, product performance, intimate acquaintance with modern industrial production processes, and management of costs.

One of the most promising vehicles for unifying the management of the building procurement process is the construction manager. The construction manager has in a few years carved out for himself a definitive niche in the procurement process,

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> In the past, there was no way of *combining* owners' separate interests to put them before the industry. Owners all acted individually and only found that they were unhappy when the building was finished, by which time all the participants of the "team" were working on other problems with other owners. The owner's discontent with the whole construction process was coming into focus *after* he had used the process—and was not going to be using it again.
>
> —Walter Meisen

one that is helping to strengthen many of the linkages (between design and construction, between the owner and his design professional, between owner and builder) whose traditional weakness has fostered fragmentation.

Finally, improved contractor—on-site labor linkages should develop through a strengthening of the collective bargaining process. One aspect of such a strengthening would be a lower degree of bargaining autonomy for craft locals. Such autonomy has often brought turbulence and high costs to the local building climate.

Architects/engineers and contractors already have their established professional organizations. To reduce fragmentation, these organizations should not be weakened, but form part of a strong single voice that would represent the construction industry. To respond to the needs of such a one-voice industry, an office has been proposed in the Federal government (most likely in the Dept. of Commerce) that would represent the interests of building construction in government councils.[2]

Any plans for a single building industry monolith must be made with care, however. Any attempt to reverse the fragmented state of the building industry should make a point of not destroying that broad pattern of choices afforded by traditional industry connections.

Regulating the building process

Closely tied to efforts to bring greater unity to the building industry is the need for a new look at the various codes, standards and regulations that shape the building process.

One of the most pressing changes needed is in allowing the public owner greater statutory flexibility in how he procures his project. With current stress on competitive bidding, and the award mandated to the low bidder; the requirement in many states for separate prime bids from major subcontractors; and long series of regulatory approvals before actions may be taken, denies the public owner (and hence the taxpayer) access to more cost efficient methods of procurement.

One way public agencies could well innovate without a time consuming fight for change through the statutes, is to adjust *existing* administrative practices to allow for change. Too often, laws are used as an excuse for not trying out innovative methods and practices.

In the private sector, insurance industry regulations governing bonding of contractors could be amended to make for a tighter check on contractors before they are bonded. Contractors without a good track record would pay higher bond rates. Such a move would help make a dent in current contract retainage practices under which substantial percentages of the contract amount are withheld to ensure good performance by the contractor, no matter what his record.

In the field of energy, standards are required to encourage use of materials and methods of construction that not only contribute to a lower energy consumption of a building but also require the least amount of energy to be manufactured.

Project procurement

The phases of procuring a project are key points of attack in causing management changes in the building industry (see table 4). To begin with, the first phase, project initiation, must be recognized as a distinct phase on every project rather

[2] The Construction Program and Policy Coordination Committee was chartered on December 20, 1976. It is chaired by the Under Secretary of Commerce and the Executive Director is Aaron S. Sabghir, Program Manager, Construction Building Materials Program.

than a mere appendage to the front end of project development. During this stage, the owner with his consultants should make a point of exploring all channels for meeting his facility objectives (including renovation, adaptive re-use, and even no project at all). If he decides to proceed, he must be sure to review all possible delivery methods (see below), and pay special heed to what impact each such option will have on schedules, costs and quality. Next, he should apply cost/benefit analysis in justifying his decision to begin a project.

A project moves into the development phase once several basic initiation steps have been made, including site selection, conceptual design, tentative scheduling and basic budgeting. Typical steps and decisions required in the development phase are shown in table 5.

During this phase several technical and management innovations could come into play.

The Facilities Development Corporation of the State of New York is a public benefit corporation, charged with the ability to finance, design and construct facilities for State Departments within the State of New York and also for Municipalities, in the health and health-related area. The Corporation was founded with a limited amount of ad-hoc legislation, meaning that it had to follow the State finance laws and the public bidding laws.

The Corporation has had to face an extremely large and complex construction program, namely large general hospitals in underprivileged areas, where the outpatient services are much more prevalent than in the local regional hospitals. The complexity of the program (four hospitals worth some $280,000,000) and the urgency of needs have suggested not to follow the traditional route of design and construction, but rather use fast-track, because we could not wait three years to do the drawings and another five years to complete a $100,000,000 project.

Within the legislation that created it and within the State statutes, the Corporation had no authority to use construction management; an administrative decision turned out to be sufficient to allow its use.

Many of the State controlling authorities challenged this procedure; they were told that this was the best way to proceed and that it would have time and money; eventually, the justification was accepted. When the Corporation looked to hire construction managers in the State, it found out that the architects that were interviewed could not provide the services that the contractors could! This lead to the decision by the Corporation to use reputable contractors as its construction managers, because they have proved to be capable of getting better contractors to the job.

The Corporation has also interpreted public bidding laws differently; it has been looking for ways of benefiting from contractors' ingenuity to bring jobs in at lower costs (and still make money). In 1969, when a lot of projects came in over the budget, the Corporation sat down with the low bidders and asked them what they would do to reduce costs. In many instances, the contractors suggested ideas of their own, which had nothing to do with the specifications, but rather with cheaper ways of managing the building process, resulting in significant cost savings for the owner.

In 1970, we decided to put together a team for each of the projects, consist of architects, construction managers and our own staff of five professionals. We do not employ any design staff, but rather administrators who are skilled professionals in the architectural and engineering fields. As owner's representatives, they monitor both the design and the construction process, which, in a fast-track system, are going on simultaneously.

At this point, the records are in, the audit is on, and despite (or because of) the risk that we assumed, we have been led to the conclusion that we have saved for the tax-payers of the State of New York over $40,000,000 in cost, just due to escalation of prices, in building 2,000 hospital beds in a fast-track system.

Now, assuming the risk meant that we had to be prepared to make decisions on a timely basis, we relied on the experts on our team to do this; the architects, construction managers and others (including the users) participating in making decisions. If the users did not give us a decision when we needed it and if we were in the ground or were under a contract, instead of delaying a contractor, the Corporation ass*umed* a solution for that problem, knowing that we might have to spend additional money later to make a change-order or revision. However, it was less costly to do that than to delay the construction process in a time of rapidly escalating prices . . .

—Frank Eliseo

TABLE 4. PHASES OF PROJECT PROCUREMENT

1. Project initiation
2. Project development
3. Project delivery
4. Project use

TABLE 5. TYPICAL DECISIONS DURING PROJECT DEVELOPMENT PHASE

1. Delivery mode selection
2. Design
3. Agreements and contracts
   a. Professional (architects, engineers, construction manager)
   b. Construction (trades or subsystems, material, labor).
4. Documentation
   a. General and special conditions
   b. Plans and technical specifications
5. Bidding procedures
   a. Organization
   b. Evaluation and award

There are a lot of techniques in the weapon systems procurement areas which can be used in the construction area, although in the weapons' industry there is nothing as complex as the building team: the professionals, the manufacturers and the producers are all one.

—Ralph Nash

These may include: use of organizational models, checklists and outline schedules for various delivery methods to guide the owner (especially the occasional owner) as he moves through this phase; computer-oriented specification formats; industry-wide developed subsystem performance specifications; uniform building codes; and a building component certification program.

Every owner should establish a clear-cut decision making authority to carry a project through from first authorization to final occupancy. If possible, the large or recurring owner should examine his *total* building program and link several projects in design and bidding, with resulting economies of capital and time. Assuming he is not barred by statute, the public owner should develop evaluation criteria and procedures for selection of professionals that will allow him to weigh price separately from performance.

Computer-aided design

In addition to computer-oriented specification formats, computer-aided design methods should also be explored as a way to streamline the development phase. Comptroller General Elmer B. Staats, who heads the General Accounting Office, notes that GAO has been surveying the state of the art of such computer aids, with an eye to their potential in increasing the speed at which a design firm can work. Computer aids would permit the design office to test out more design options and enhance the quality of its final "product."

Project delivery

As a project moves from development to actual delivery, the owner is faced with a new series of options. These fall generally into five categories (see table 6).

The *traditional process* has been found to work best where the owner is after design excellence, and time schedules are not critical. By *modifying the traditional process,* the owner may limit competition to selected bidders, obtain early input from a selected contractor, or overlap design and construction, usually by combining this process with the construction manager approach. In other words, the owner can modify his method in order to further his own fixed objectives, which may be price limit, completion date or quality.

Construction management offers the owner the chance to bridge the traditional gap between design and construction through the person of his agent, the construction manager. The construction manager, by also breaking down a project into smaller bid packages, is usually able to obtain more and better bids. He may likewise begin construction of foundations and structure while design details on other portions are still being worked out. This makes for earlier completion dates.

One ought to explain why owners have construction managers in the first place. It seems that many people today have construction managers "because somebody else has a construction manager." The construction managers' role is *time and cost control, within the owner's requirements for quality and function;* if he does not bring to the project better time and cost control than that owner of that building type has experienced in the past, then he does not really serve any purpose.

—Joseph White

Financial risks to the owner are somewhat higher as there is usually no guaranteed maximum price; this risk can be reduced by bidding a large proportion of the work before starting work on the site.

The *building systems process,* combined with construction management, may be used under two sets of conditions. First, an owner (who may be a group of school districts or the owner/operator of a chain of service stations) may use this approach to obtain product systems developed especially to his performance requirements, under competitive conditions. Main drawback is the time required to develop such systems. Second, where several systems or sub-systems with a well-defined level of performance are already on the market, the owner can use a performance specification as a simple and rapid way of choosing from among competing systems. This approach is especially useful when design and construction overlap and sub-systems must be procured before final design details are worked out on the non-system parts of the project.

TABLE 6. PROJECT DELIVERY PROCESS OPTIONS

Traditional	Owner secures design through fixed fee contract with a professional design consultant, and construction through a lump sum contract with a general contractor. Contractor selected via open competitive bidding based on definitive specifications and drawings.
Modified traditional	Owner secures design through contract with a professional design consultant, and construction through a contract with a general contractor. However, design documentation need not have been completed, and contract can be awarded on basis of schematic drawings and general specifications. Also open competition is optional: number of contractors allowed to bid on project may be limited by prequalification or by invitation. Or contract is negotiated between owner and selected contractor. Final contract sum may vary within agreed limits or according to an agreed set of conditions.
Construction management	Control and coordination of the procurement process is by an independent manager. It is usual to divide up construction work into number of bid packages, bid separately. Owner enters into a direct relationship with the sub-contractor now elevated to the status of prime contractor.
Building systems	Design of building is broken down into "systems" work and "non-systems" work; the "systems" work is further broken down into sub-systems (e.g., structure, HVAC, partitions, lighting/ceiling). For each sub-system, a performance specification is prepared which defines function or performance expected. Owner either enters into direct contract with particular manufacturer to supply and install an individual sub-system, or with consortium of manufacturers to supply and install, a group or combined package of sub-systems. Work on site is coordinated by construction manager, or manufacturers become sub-contractors and a general contractor supervises the work under some form of modified traditional process.
Design/build	Design/build process covers several types of contract: turn-key, design/build, developer proposals, package deals and design/build/bid projects. Owner defines requirements in terms of performance. Entrepreneur submits bid for designing and constructing project to conform with owner's requirements.

Design/build is a delivery option that offers different features to the owner in the private and public sectors. In the private sector, design/build works best when an experienced consortium of designer and builder works together from the start for an owner, usually on a fixed price basis that includes design and construction costs, and delivers a completed facility by an agreed on date and to a specified level of quality.

The process is geared to the public owner in those cases where his purpose is to get the most building quality for the available money and within a predetermined time limit. (This is more commonly known as "design/build/bid," since design/build consortia compete for the owner's project). To get the most out of this approach, the public owner should retain a skilled consultant to identify and document the required building performance and to manage the process.

A major drawback of design/build/bid for the public owner is that not only the contractor but the architect are placed in an adversary position.

Besides, the *minimum* acceptable standards contained in the project requirements tend to become the *maximum* provided by the design/build team. Moreover, the public owner, for statutory reasons, cannot hold out to the team the carrot of another job, a strong incentive of good performance used to advantage by the private owner.

For the private owner, design/build carries benefits, especially if he is often in the market for new construction and is able to hand out contracts based on good past performance.

Project use

A gold mine of information for future owners may be found in the review and analysis of a project in use. Post-occupancy evaluations should be carried out to see if completed buildings function as programmed and to make adjustments as needed.

In the private sector, it is done rarely and not systematically and there is no provision for fees for this service. Ethical problems and conflicts of interest are often an obstacle. In the public sector, the Corps of Engineers does criteria feedback and post completion inspections as part of its building delivery cycle; the concern, however, is less with functional use criteria than it is with reporting technical deficiencies.

A depository of building use data and criteria should be established at the national (and international) level, including not only technical performance data, but also criteria and data concerned with health/safety, functional, performance and psychological comfort and satisfaction of building occupants. The depository should not be dependent on any parent organization but rather be a joint venture of agencies/organizations with similar building requirements.

During the project use phase, there is a strong need for the development of owner's manuals. These manuals would be developed under the direction of the architect and engineer. They could include not only operating and maintenance

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> Presently, while engineering aspects of evaluating building quality are dealt with to a large extent, the user habitability aspects are not, except for health and safety standards. Because of professional ethical standards, the evaluation should be carried out by outside (or "independent" in-house) agencies.
>
> —Wolfgang Preiser

instructions for equipment, but also serve to guide the owner and user in obtaining the most value out of the facility. An example of this would be a section on rearranging open plan school class space, for use by teachers and administrators.

Part of the purpose of such a manual could be achieved instead by manufacturers, who could provide training institutes for building managers, (e.g., carpet, lighting fixture manufacturers); a continuing planning service (e.g., producers of space dividers), and computer software for monitoring HVAC systems and energy use.

The manufacturer's contribution to procurement

As the owner approaches the project procurement process he should give grave thought to the manufacturer's role, which to date has been limited largely to that of supplier to subcontractors. Yet on important occasions over the past 12 years the manufacturer has become a full member of the project team, contributing managerial and technical know how and ample capital to the development of important product system breakthroughs.

Yet the manufacturer's potential contribution is being restricted because of the limitations of the process within which he has to operate. Although the manufacturer has emerged as a major participant in the building process, this change in status is not reflected in the traditional legal and contractual arrangements which define the building participants' formal roles.

The traditional bidding sequence of design/bid/build has restricted the manufacturer by forcing him into a narrower bidding scope than he is capable of. This has tended to prevent important product or system development. As a result, manufacturers find themselves merely bidding against other manufacturers with similar products, while their potential for innovation lies fallow.

Of the means developed to overcome these obstacles, the most significant are the systems building programs in which manufacturers develop building components and systems in response to sophisticated performance specifications provided by the owner. Contracts often include installation and maintenance, radical departures from traditional methods.

The programmer should evaluate a building just after a building opens to perceive and observe the psychological change that people go through when they move into their new environment. The programmer is observing not how the building works but human and organizational trauma and although it may be a very constructive change, it has very little to do with building.

The programmer should also evaluate the building after three months while the building is still an "issue" and again after about a year, when the building is no longer an "issue".

In our experience, when you move an organization into a different building, even if the organizational structure were to remain exactly the same, which it never does, it would function differently regardless of the organizational charts.

The crucial aspects of building evaluation do not involve the physical aspects of a building but are concerned with how the organization is functioning in the new environment. What are the changes in organization which have occurred in the last year and a half since the move? Which of those changes were aided, abetted or hindered by the new environment?

—Gerald Davis

As building user requirements become more precisely defined, and as the impact of energy and other constraints continues to increase, a larger, more positive role should be found for the manufacturer in the building process; this role should then be reflected in appropriately revised statutes, regulations and formal contractual agreements.

ECONOMIC AND FINANCIAL

In 1972 the General Accounting Office with the help of Westinghouse Electric Corporation made a study of the impact of life-cycle cost accounting on the design, construction and operation of a hospital. By identifying a number of savings in initial and operating costs and subjecting these savings to inflation and discount factors, the study team found that initial costs could be lowered by about 8 percent and operating costs even more, over a 25-year life.

Life-cycle Costing

The study was an example of the potential impact on facility planning, financing and design of the life-cycle cost concept.

In simplest terms, the life-cycle concept states that since certain costs (such as capital, labor, taxes, energy, land and materials) fluctuate over a facility's life span (usually upwards), they should influence the decisions on how that facility is acquired. By giving all his attention to the first cost part of the cost formula when procuring a building and neglecting the long-term economics, the owner risks making design decisions that are short-term, short-sighted and perhaps illogical.

The practical application of life-cycle cost analysis has been hampered by the lack of reliable historical data on the costs of operating various types of facilities. Typical components of life-cycle cost analysis are shown in table 7. What data exists is often not in a form that architects, engineers or construction managers can readily use.

A complicating factor is the difficulty, when doing a life-cycle cost/benefit analysis, of expressing non-economic life-cycle benefits in measurable terms. Economic benefit, such as profit resulting from operating a building, high energy efficiency, or ease of relocation of space dividers, can be described in economic terms. On the other hand, concepts such as comfort, privacy, accessibility, or security from crime—all of which stem from initial design decisions—are not currently convertible on any objective basis. Yet, as Ezra Ehrenkrantz has noted, the owner and his designer need to know the long term impact of decisions such as increasing lighting levels by 5 foot candles or floor transmission loss by 5 decibels.

TABLE 7. TYPICAL COMPONENTS OF LIFE-CYCLE COST ANALYSIS

Initial costs

- Pre-construction
- Construction

Post-construction costs

- Taxes
- Interest Costs
- Utility costs
- Maintenance labor and materials
- Operations labor and materials
- Painting
- Replacements (e.g. lamps)
- Alterations (e.g. partition rearrangement)
- Employee salaries
- Insurance
- Parking

A key factor in shaping long-term building costs is energy. Richard G. Stein has calculated that, as a rough rule, for every dollar of energy costs saved, a building can sustain an extra $10 in construction costs. At the same time, he found that a reduction in long-term energy costs does not necessarily require a more capital intensive, and hence higher first cost building. More likely is a drastic shift in the way the building dollar is spent. For example, the size of present day mechanical systems may be sharply reduced but the controls will become much more sophisticated. Similarly, the amount of copper going into the electrical installations may be reduced but the amount that goes into controls and switches will go up. But new technology may make it possible to reduce the cost of these control and switching systems, according to Stein.

Life-cycle costing has many uses for the building community (see table 8). In the private sector, for example, Gerald Hines, a large, private investment builder, finds he is able to control long-term maintenance and operating costs by zeroing in on areas where skilled trades can be replaced by lower-paid unskilled labor. He accordingly instructs his architects and engineers to design mechanical and electrical systems that require only unskilled labor to operate and maintain, such as simplified electrical plug-in grid systems and low (rather than high) pressure HVAC systems. He feels many modern buildings are unnecessarily over-designed (in terms of finishes, structure, HVAC) because not enough was done to pinpoint the real long-term costs of alternative materials and systems.

Long-term economic analysis is also needed to document the real costs of renovation and rehabilitation work. Calculations by Herbert McLaughlin, an architect and developer, show it is usually possible to offer space in a renovated building profitably at sharply lower rentals than in comparable new space due to far lower construction costs and operating costs. The latter, for example, may run at nearly 30 percent less for renovated than for newly built space. To make these kinds of projections, life-cycle cost analysis is indispensable to the private sector. Available data is sparse, often unreliable and thinly disseminated.

In the public sector, life-cycle costing has been required in recent construction programs of several Federal agencies, including the Public Buildings Service of the U.S. General Services Administration. PBS has stipulated that all bidders responding to its building systems specifications for a series of very expensive

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TABLE 8. TYPICAL USES OF LIFE-CYCLE COSTING

As a management tool to influence procurement decisions and funding requests

As a method for developing data for preparing environmental impact statements

As a way to project future cash flow requirements

As a way to evaluate alternative building sites, or assess existing properties prior to purchase, renovation or adaptive reuse

As a research tool to explore long-term costs of new energy sources

As a management tool when conducting retrofit analysis of an existing mechanical system

As a device for identifying the secondary energy consequences of land development (for such purposes as transportation, water supply and waste disposal)

As a tool for comparing the benefits to a developer of short versus long-term leases

Social Security Administration office buildings must furnish not only a "first-cost" bid price but also long-term operating figures. These include a price for maintaining the systems for periods of three years; energy costs based on a model simulation of one year of operation of the building's HVAC and lighting systems, projected over 40 years; and luminaire relamping costs and space adjustment costs, also over 40 years. The contract awards have gone to those bidders with the lowest aggregate costs, not necessarily those with the lowest initial bid price.

Elsewhere, the Public Health Service has plans to introduce life-cycle costing into its overall planning process.

Senator Robert B. Morgan (D., N.C.) chairman of the Senate's Subcommittee on Buildings and Grounds, has questioned some common life-cycle cost assumptions. For one thing, he believes energy and labor costs are too volatile to serve as a basis for long-term cost projections. For another, he feels life-cycle costing is mathematically unduly elaborate so "not even the most conscientious public servant can check on it."

On the other hand, some states have enacted public facility procurement legislation that mandates life-cycle costing as part of the planning process. A 1975 Alaska law includes "occupancy" costs under the life-cycle cost definition. The term signifies the cost to the State of the programmed use of facilities, including salaries and supplies, by the occupying agency.

All in all, there is no question that life-cycle cost analysis, performed at whatever level of sophistication, will increasingly become part of the procurement process.

The cost of risk

An ever-present specter in the economics of building procurement is the magnitude, allocation and management of risk. To the owner, risk means cost, whether buried in the contractor's price or spread around by a skillful construction manager.

One way the owner thinks he can keep his risk low is to ask his construction manager for a guaranteed maximum price (GMP). As soon as he does, he creates the classical adversary relationship with his construction manager, who promptly raises his fee to cover his own higher risk.

Where the owner does not request a GMP and uses the construction manager as an agent, he assumes the entire risk, pays a lower fee, but gets from his construction manager the broadest review of alternatives. With a professional rather than adversary relationship, this choice tends to give the owner the most favorable cost results.

Joseph H. Newman brings an intriguing new argument into the risk discussion. The owner, he thinks, must realize that in to-day's socio-economic climate the real risk is not so much whether his project is built at a predetermined price, but whether

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> . . . we developed a computer program which provides us with the data we needed on maintenance costs i.e. what tasks the men perform, how long it takes them to do it and what stores they have to take out of the warehouse to complete the task. The computer program also looks after the men's wages and makes sure that they get paid on time. In other words, to get people to cooperate you've got to identify their problem and then try and solve their problem and yours at the same time.
>
> —Richard Holden

it is the optimum solution to his needs. He feels in most cases a predetermined price is arbitrary and without a real basis. An optimum solution is the best investment.

To reduce some of the risk for the owner, a case had been made for preparing bills of quantities of labor and materials required to build a project. All bidders then compete based on the same bills of quantities. While this so-called quantity survey approach reduces the duplication of each bidder taking off his own quantities, it tends to reduce the bidder's role to one of accountant and lessens his opportunity to become familiar with the project as he develops his bid.

Risk to the owner may also be controlled to some degree by requesting manufacturer's guarantees on the performance of products and systems, and by signing operating contracts for systems and equipment.

A plan that apportions risk fairly among the owner, lender and user has been proposed by Howard Stevenson. In cases where the owner is a developer, he would pass long term costs on to the user, in a variety of ways. One way is by means of a net lease. Another is via some kind of index geared to operating costs. The index would be written into the lease, or the owner would give short term leases where each lease as it expires is rewritten to market value.

A final issue of a financial and economic nature concerns the method used to compensate the architect/engineer. The traditional method of tying compensation to the cost of construction tends to *penalize* rather than *reward* cost-cutting designs. By following the lead of some federal agencies and private owners, architects/engineers would be paid on the basis of their actual costs of providing services, plus a negotiated figure for profit. This more advanced method is still in many cases imperfect, especially in the matter of owner-allowable indirect costs and reimbursables; yet a broad look at this problem could place the owner-architect/engineer relationship on a much healthier footing.

Conclusion

Of all the financial facets of building procurement, the concept of long-term economy or life-cycle costing is perhaps the one with the greatest potential impact on the cost and quality of construction. As the owner looks into the details of this concept, he should remember, however, that life-cycle costing does not in itself produce decisions. It is merely a tool for pinpointing the implications of alternate choices. It provides the owner with decision-making information. It does not make his decisions for him.

With exceptions here and there. I often wonder why the private sector takes more risk than the public sector. The public sector is supposed to serve the public interest; it is in the public interest to innovate, to solve the broad problems of the economy and society. Perhaps it is the fear of making mistakes . . . I recommend it should be public policy to legitimize making mistakes by rewarding prudent risk-taking and penalizing those who do not change when change is justified. Also, I recommend that the building team mobilize to persuade the architects of public policy to change it to help those who need such a crutch.

—Joseph H. Newman

It is interesting to note that, in this country, we use the quantity survey system for most of our civil engineering work and the lump sum method for most building work, whereas in the U.K. their approach is just the reverse.

—George Heery

One of today's most promising technological advances is the performance concept and its use in developing improved building products and systems. The concept is a key ingredient for more creative linkages between owners and manufacturers.

Under the performance concept, owners procure building systems that conform to performance requirements as identified for different facility types. The process consists of a now classical cycle, as shown in simplified form in table 9.

To stimulate manufacturers to develop such systems, there must be a large enough market. Such a market is created either when a group of owners commits itself to a substantial building program over a specified time; or when manufacturers see a broad-based market over and beyond a modest, initial program of construction. Usually both conditions prevail.

Several outstanding examples of the performance concept exist in the U.S. and Canada. They have covered a number of building types. A pioneer was the School Construction Systems Development (SCSD) program in California, where 13 school districts combined their facilities programs and stimulated manufacturers to develop integrated systems geared to the school's needs. Other programs have included University Residential Building Systems (URBS) in California, Study of Educational Facilities (SEF) for Toronto's school system, and Recherches en Aménagement Scolaires (RAS) for Montreal schools.

The latest and largest building program using the performance concept to engender a building system suited to the owner's special needs is that used by the Public Buildings Service of GSA to erect the previously mentioned series of office buildings for the Social Security Administration. When complete, the program will total over $250 million of construction. A unique feature of this program was the two-stage procurement used to purchase the systems portions of the buildings—about 40 percent of the total budget. Under stage one, a technical proposal was submitted by each consortium of manufacturers in response to a thick volume containing the performance specifications.

TABLE 9. PERFORMANCE CONCEPT DEVELOPMENT CYCLE

1. Identify user needs
2. Convert to performance requirements
3. Translate requirements into a performance specification
4. Formulate evaluation criteria
5. Aggregate a market
6. Solicit bids
7. Evaluate bids
8. Award contract

> The technique known as life cycle costing while no panacea, can assist us in proposing, deciding and executing public policy, because it provides a comparative tool, because it is amoral and because it can accommodate our political process.
>
> —Richard Holden

Technical proposals were then evaluated for their technical as well as management features, and qualifying consortia were invited to proceed to stage two and submit price proposals. These were in turn evaluated in line with life-cycle cost criteria described earlier. The organization submitting the lowest net system price for the 40-year estimated life-cycle of the buildings was considered low bidder and awarded the contract.

The performance approach has been found to work well for large facility programs. It has been questioned by Senator Morgan, among others, on three counts: for favoring large manufacturers with plenty of capital for R & D, over smaller suppliers and contractors; for the high cost of the process; and for leaving somewhat fuzzy the problems of liability and accountability. It is perhaps too early to tell.

A refinement recently introduced into the GSA/PBS program consists of a prequalification clause. Systems offerors who meet the technical and management criteria of the performance specification will have their systems listed as "pre-qualified." This way they may submit price proposals directly on subsequent projects planned by the same owner.

An important aspect of technical innovation is the need to develop energy-efficient products and systems, along with accompanying documentation on energy-consumption and costs, preferred design and installation methods. Side by side with this, simpler, easy to use computer programs are needed for analyzing energy use patterns in existing buildings.

With the huge and growing premium on fossil-based fuels, research and development should continue on a large scale to explore the cost saving potential of long neglected energy sources such as the sun, wind and tides. Systems using solar energy have scored some notable economic breakthroughs, and recent findings indicate that solar energy is competitive with electric heat (though not oil or gas heat) for residential and non-residential heating in the northeastern United States.

INFORMATIONAL/COMMUNICATIONS

Broad-based acceptance of cost-conserving technology and management has been slowed by a lag in developing useful information and in communicating it in suitable form to the users. A national depository for building use information has been suggested. It would contain technical performance data for various product systems and building types. Several clearinghouses already exist in special areas. Educational Facilities Laboratories (EFL) operates such a resource for school building systems. It includes records of systems components and the degree of compatability between them. GSA is developing a technology library which is to document design and construction procurement findings on its multi-billion dollar

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I objected to the assumption that only a huge corporation could produce the necessary innovation. It seemed to me that we were putting too many eggs in one basket, and putting such a huge project out for bids, that we would discriminate against relatively smaller contractors, who might be quite efficient, but unable to win the financing battle. I recognize the argument for the supposed abilities of big corporations to do research—we see it frequently enough in the advertising on our television sets, usually on behalf of big corporations. Yet, I cannot but think that the electric light, and the airplane, and the automobile—the very items which got these corporations started—were invented in laboratories not better than barns.

—Sen. Robert B. Morgan

construction program. GSA has asked other Federal, state and city agencies to contribute more of the same kinds of information.

A critical early task for the fledgling National Institute of Building Sciences (NIBS) would be to undertake such a national clearinghouse role.

Ways must be found to make the resulting wealth of information available in *practical* form for the user. The occasional owner does not have to know how to extract from detailed performance data the information he needs to guide him on modest projects. A popular breakthrough would be to develop for use by all owners—but especially by the small or first-time owner—a manual describing available project delivery options and their impact on his organization and on costs. Too often, the owner is given only one delivery option, fully priced, and incomplete information on other candidate options. To be even more useful, such a manual should come equipped with appropriate model bid and contract forms to cover innovative procurement processes.

Finally, there exists a continuing information and communications gap in the area of updating prospective owners on short and long-term construction demand. Such market profiles are badly needed so owners can plan their facility construction programs in a rational way. In the absence of such an information system, these situations can occur:

—A large, important project attracts but one or two contractors willing to bid it.

—Work on a large building complex is held up because there are too few skilled craftsmen available to perform a critical task.

—An influential owner decides not to build in a given location because he feels that the construction market there is saturated, when actually it is not.

—Two large building owners independently decide to advertise for bids on similar projects in the same region during the same month, and become concerned when contractor response is not what they expected it would be.

—A business agent is constantly pressured to develop an apprenticeship program even though he has little indication of the potential demand for these men.

In the early 1970's the New York State University Construction Fund asked Rensselaer Polytechnic Institute to develop such a pilot project information system for a five-county region around Binghamton. The study team ran into some obstruction when they requested manpower information from labor, and future plan information from owners; and architects would not complete forms on time.

The effort was suspended for lack of funds, but it remains a critical goal country-wide if facilities planning is to be placed on a rational footing.

TRAINING/ EDUCATION

Closely tied to improved communications is the serious need to update the training of those who will own, manage, design and build this nation's inventory of facilities. One aspect of preparing owners for the complex task of facilities procurement was touched upon earlier in the proposal to develop an owner's manual on project delivery options.

The problem goes deeper than that, however. Needed is a versatile building professional who, though specializing in one area, has a working knowledge of all sides of the business. Along these lines, Carnegie Mellon University in Pittsburgh has begun a graduate interdisciplinary curriculum which will expose architects and engineers to financial, economic and contractual aspects of a building, and managers and contractors to the design facets.

In the architectural schools, Gunter Schmitz has noted that the current complexity of offerings, conflicting philosophies and wide range of quality levels have proved an obstacle for the curriculum innovator. Another, more recent difficulty is the current no-growth policy imposed on many of the schools. Under such conditions, those in favor of new course material find a cold reception on the part of administrators. In many cases, curricula have been "frozen." Yet the need is grave. Such innovative ideas as the systems approach to building procurement must be recognized as major management tools and included in architectural and engineering curricula.

Moreover, owners and their staffs, architects, engineers, builders and manufacturers' key planning persons should take advantage of a plentiful offering of high quality continuing education programs at many colleges and universities and at management seminars.

ATTITUDES

What will motivate the building community to exploit the choices in procuring better buildings? Procurement methods should be encouraged that call for collaborative rather than adversary contractual relationships between owner, architect/engineer, construction manager, contractor and supplier. In addition, information on the outcome of these choices should be methodically documented and the findings aggressively disseminated to the various segments of the building community. A sound vehicle for this would be the national depository of building use information referred to earlier.

Facts on the ability of new methods to control the impact of inflation, to ensure flexibility and high quality, provide fair compensation and meet social obligations should be relentlessly recorded and distributed.

Too often, the owner lacks the chance to make real choices because he is not given all the options, fully documented. Yet the building industry today has reached a point where the owner has many more opportunities than he did a dozen years ago. There is an "opening up" of the whole building procurement process. This has enabled the owner to see the *whole* process and to work with a team to try out the one that is best *for him*.

The owner wants to be assured that any process is going to be in his best interest. Whatever system he puts together for procuring a building, he wants to be sure that the team has been structured to act on his behalf.

This has to happen if the owner is to overcome his traditional dissatisfaction with the building industry and the way it has been performing.

From our experience as owners, there is a great lack in the industry of a jack-of-all-trades, who knows all the tasks involved in developing a project.

—Vance Torbert

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Several problem areas were identified in three workshops and one national symposium which was held to pinpoint choices open to the building community for improved building procurement practices. Some of the problem areas identified are: inconsistency in building codes and standards; inadequate bridges between design and construction; and the dissemination of post-construction information. Other problems which were addressed were: long-term economy; technical innovation; performance data; interdisciplinary training and education; and traditional attitudes in building practices.

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