

# Dividing The Pie: Organizational Models For Major Rail Projects

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## ABSTRACT

Multiple procurement strategies are available to agencies today for implementing large transit infrastructure projects. These strategies fall into two broad categories: design-bid-build and design-build. Within these broad categories, variations and alternatives are numerous. As an agency proceeds to develop a major new project, it must plan for and assemble an organization that accounts for management not only of its own staff but for procurement and management of a myriad of outside contractors including designers, design support consultants, construction companies and manufacturers. The needs of outside parties whose interests are directly affected by the project must also be addressed. Among others, these parties will almost certainly include local public works and traffic departments, utility owners, and adjoining property owners. Major rail projects are immensely complex, and the organizational structure to implement these projects requires careful design that considers both the skills and needs of all implementing parties.

No single detailed organizational model is appropriate for every project. This paper provides a broad comparison of the basic organization charts of 15 recent major transit projects in order to give the reader an understanding of the variations in response that these program implementers used to meet the needs as they assessed their situation. These organization charts have been highly simplified, and consistent terms have been applied so that comparisons in procurement philosophy can be illustrated. Furthermore, on any large project, the procurement organization changes over time and not all elements are held consistent throughout the entire design and construction period.

## DESIGN AND CONSTRUCTION PROCUREMENT STRATEGIES

Multiple procurement strategies are available to agencies today for implementing large transit infrastructure projects. These strategies fall into two broad categories: design-bid-build and design-build.

The main characteristics of each procurement strategy are summarized below:

### DESIGN-BID-BUILD

- Authority (owner) hires services of an engineering and construction management team.
- Authority's engineering team prepares detailed designs.
- Authority solicits construction and systems hardware bids and awards contracts.
- Authority obtains regulatory permits and approvals.
- Construction management team monitors construction and manages the change process.
- Authority operates the new system.

### DESIGN-BUILD

- Authority hires services of an engineering and program management team.
- Authority's engineering team prepares preliminary designs, design requirements and performance specifications.
- Authority solicits bids at typically 30% level of design.
- Authority pre-qualifies bidders. (This is an optional step.)
- Authority solicits final bids and awards contract.
- Contractor's engineers prepare detailed designs for which contractor is responsible.
- Authority's engineering team performs construction oversight.
- Authority (or contractor under a design-build-operate-maintain (DBOM) contract) operates the new system.

It is critically important to carefully evaluate the risks associated with both procurement methods. Often, design-

build is characterized as a way to save time and obtain an up-front guaranteed cost for project construction. Under the right circumstances, such time savings and cost assurances certainly are possible. However, many change situations can arise on these projects that often can be resolved much less expensively in the design-bid-build environment. Once major procurement and construction contracting has begun on design-build projects, the cost of changes and delays is likely to increase exponentially over the cost of changes during the design phase. For example, an alignment change may be readily and inexpensively made by designers, but once a contractor has scheduled and committed to construction equipment, manpower and materials for the affected area, that change can be highly disruptive, even if construction on the changed section has not yet started. The owner is usually responsible for the increased costs of such disruptions.

Some important questions an Authority should consider concerning design-build procurements are:

- Is the project well-defined and do all local agencies support the locally preferred alternative?
- Will necessary approvals be forthcoming in a timely manner?
- Does the public support the project or is it possible they will require changes during final design?
- Will all rights-of-way necessary for construction be available to the contractor in a timely manner?
- Are enforceable cooperative agreements in place with both local agencies and private parties for utility relocations, easements, street reconfigurations and the like?
- Are the final environmental impact statement (FEIS) and Record of Decision (ROD) completed?
- What permits are required and can these permits be obtained in a timely manner?
- Does the Authority have an organization in place to coordinate the design-build process?
- Is the Authority willing to minimize changes by relying on its performance specifications and relinquishing significant control over subsequent design decisions?
- Can the Authority's use of the contracting process for public policy purposes (e.g., use of local consultants and contractors or minority subcontracting goals) be adequately defined in advance of procurement?

If the answers to these questions are generally affirmative, then the design-build project implementation structure offers prospects for time savings and cost control. Serious detailed evaluation should be undertaken. If the answers are mixed or generally negative, then the Authority may be better advised to use the traditional design-bid-build method as its primary procurement mechanism and to use design-build mechanisms only for those specific contract packages that involve low risk of changes.

A number of variations exist on the previously described procurement strategies. Many transit authorities have, for example, traditionally hired one or more general engineering consultants (GECs) to manage the detailed design phase of the project and oversee construction activities. In subsequent phases, an important task is the preparation of contract unit descriptions (CUDs), which break down the project into one or more construction contracts. Numerous CUDs broken down into small bid packages have been previously used to attract small business enterprises (SMBEs) and disadvantaged business enterprises (DBEs) into the bidding process. A tendency today is the award of larger contracts with percentage goals for SMBEs and DBEs established by the Authority as part of the bid documents.

On large projects, the Authority has the option to procure some portions of the project on a design-build basis and other portions on a design-bid-build basis. Almost always, systems contracts (such as train control, power substations, and power distribution systems) supply and installation are procured with preliminary drawings and performance specifications on a design-build basis. The suppliers of these components generally use proprietary elements that cannot be consistently detailed in a generic design. As shown in later sections of this paper, there are many variations in Authority procurement organizations that "mix and match" design-build and design-bid-build procurement methods intended to optimize the process to the needs of each owner.

This paper does not distinguish among design-build variations such as turnkey, DBOM and super turnkey. In each variation, the contracting entity has responsibility for both design and construction or supply. Other, increasing responsibilities are also added for turnkey, DBOM and super turnkey procurement methods. In a turnkey procurement, a single contractor takes entire responsibility for the project up to the point where the owner can simply "turn the key" and begin operations. In a DBOM procurement, the contractor has design-build-operate-maintain responsibilities; in a super turnkey project, the contractor also brings its own financing for the construction program.

Typical top-level design-bid-build and design-build organization charts follow. As shown below, however, there are many variations on these typical organizations.

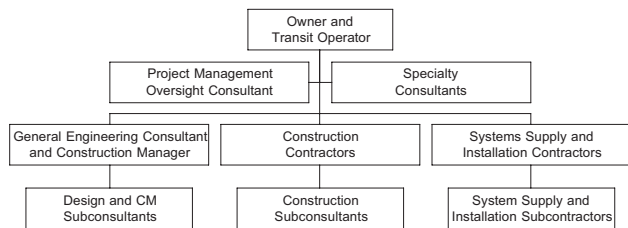


Figure 1. Typical Design-Bid-Build Organization.

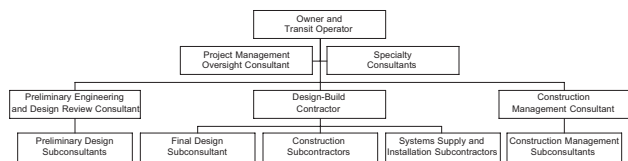


Figure 2. Typical Design-Build Organization.

**OWNER’S STAFFING DECISIONS**

In developing the project organization, an initial decision that needs to be made by the owner is the proportion of total services costs that it intends to perform in-house. Services costs, sometimes called “soft costs,” include project management services, design, construction supervision, community outreach, agency coordination, land acquisition, claims management, and other activities not directly involving construction, manufacturing or installation. Most agencies directly undertake the leadership for inter-agency coordination, community outreach, budget control and land acquisition. Some agencies have elected to self-perform much of the other work themselves, undertaking a significant part of the program management, the design work, the construction services or combinations of the three. Other agencies have elected to perform nearly all services by outside agencies.

Figure 3 shows five recent projects that demonstrate that a wide variety of options have been used in recent projects. At the lower end of the scale, less than 10% of services work was self-performed by the Maryland Mass Transit Administration for the Central Light Rail Line. At the higher end of the scale, Sacramento’s self-performance of nearly 50% of the total work includes the services of Caltrans, an agency with a strong track record in the design and construction management of major public works. In Miami,

although design was performed by outside consultants, the majority of construction supervision and inspection was self-performed by agency forces.

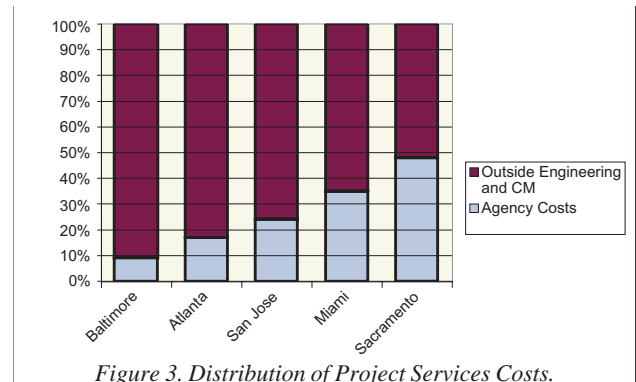


Figure 3. Distribution of Project Services Costs.

Factors that the implementing agency will wish to consider in determining its own approach will include:

- The size of the project compared to other projects implemented by the agency
- The level of experience and availability of existing staff to undertake the necessary work
- The ability of the agency to hire additional outside staff and the ability to pay competitive salaries
- Expectations for future work for any new employees being hired after the project is completed and potential issues associated with downsizing in a civil service environment
- Desire to employ private designers and engineers for public policy purposes such as MBE/WBE utilization or local economic stimulus
- Desire to limit the exposure of the public agency with regard to responsibility for design errors, cost overruns and construction delays
- Considerations of the cost, quality and control of self-performed work compared to the costs, quality and control of work performed with outside engineers and construction managers.

In summary, it is clear that there is no “one size fits all” solution. The characteristics and circumstances of each implementing agency are different and the organizational solutions regarding split of work among the agency, its support team and its contractors need respond to the situation as presented.

**ORGANIZATION EXAMPLES FOR RECENT MAJOR TRANSIT PROJECTS**

The following organization charts show the variations in project organization for a number of recent procurements of major transit projects. These organization charts have been highly simplified and consistent terms have been applied so that comparisons in procurement philosophy can be illustrated. Furthermore, on any large project, the procurement organization changes over time and not all elements are held consistent throughout the entire design and construction period. Detailed organization charts showing full circumstances for each project phase are beyond the scope of this paper; however, the charts shown below represent the structure of each project at some phase during the course of its implementation. Interpretations of organization structures using the established common terminology are based on the analysis of the author of published organization charts or from interviews with staff involved on the project.

The basic components common to all charts are:

- The Owner
- The Transit Operator (usually the same as the owner, but not always)
- Design Consultants (often split into disciplines or into preliminary and final phases)
- The Project Management Oversight Consultant designated by the Federal Transit Administration (FTA)
- Various other Specialty Consultants
- Construction Management Consultants (often combined with the design consultants)
- Construction Contractors
- System Component Suppliers
- System Installation Contractors (often combined with corresponding equipment suppliers)

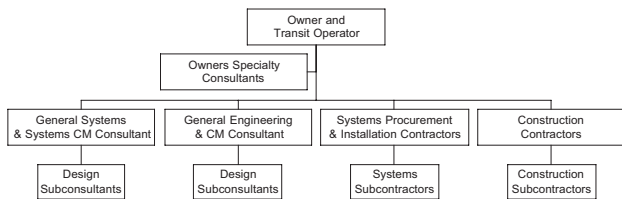


Figure 4. Baltimore Central Light Rail Project, Design-Bid-Build.

Baltimore’s LRT project used two general design consultants, both of which held construction management responsibility. As is typical on major rail projects, systems contracts were procured based upon preliminary designs and performance specifications and the Systems Procurement and Installation Contractors finished the design to these specifications using their own proprietary components. Construction contracts were based on 100% complete design packages. There were multiple systems contracts and multiple construction contracts.

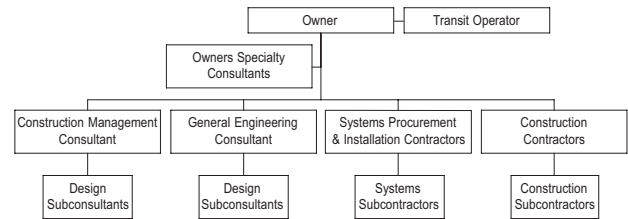


Figure 5. Los Angeles LB-LA Blue Line LRT Project, Design-Bid-Build.

The Long Beach to Los Angeles Blue Line Project used an overall GEC for both facilities and systems engineering. A Construction Management Consultant was initially assigned responsibility for CM on the facilities contracts with systems supply and installation management being within the purview of the GEC. Late in the program, after completion of the design effort, all of these responsibilities as well as the responsibility for design services during construction were transferred to the Construction Management Consultant.

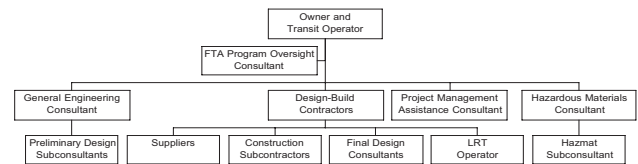


Figure 6. Hudson-Bergen LRT Project, Design-Build.

The Hudson-Bergen LRT Project started as a traditional design-bid-build project and was reorganized to a DBOM project during the late stages of preliminary engineering. The Northern New Jersey area covered by this project contains a large amount of contaminated soils requiring hazardous materials remediation; hence there is a very high visibility for this specialty service. Construction management is a responsibility of the Design-Build Contractor. The Project Management Assistance Consultant was brought into the program at the time the decision was made to utilize the DBOM approach. This consultant advised on the format and organization of the procurement specifications as well as contracting issues during the construction program.

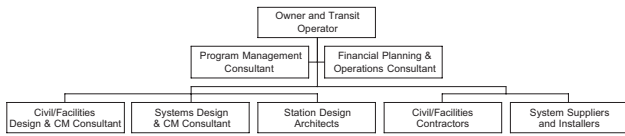


Figure 7. Orlando LRT Project, Design-Bid-Build.

For its now cancelled LRT project, Orlando chose to utilize multiple design consultants and to undertake coordination of these consultants through the use of a Program Management Consultant. Since each of these design entities had a contract directly with the Owner, the contractual responsibility for coordination and interface control rested with the owner. Interface management under such circumstances would have been a major undertaking. Management and approval of changes in the various design contracts was also the responsibility of the owner. While construction did not proceed, the Civil/Facilities contracts were all anticipated to be procured on a design bid build basis and the Systems and Installation work would have been on the usual design-build basis.

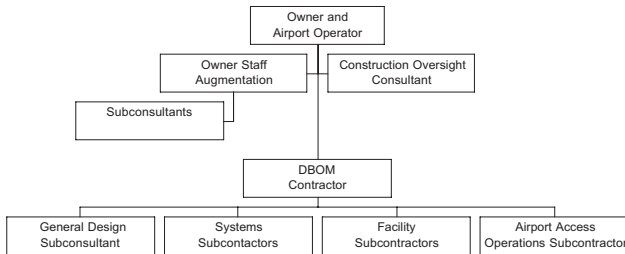


Figure 8. JFK Airport Access Project, Design-Build-Operate-Maintain.

The JFK Airport Access Project is a new rail system being constructed by the Airport Operator, the Port Authority of New York and New Jersey. Although it currently also operates the PATH rail line between New York and New Jersey, it was the Port Authority’s preference to have the Contractor operate this system, hence the use of the DBOM form of contract procurement. This organization also reflects the fact that the Owner has a large and sophisticated engineering organization. It makes extensive use of Staff Augmentation Consultants who work as an integrated team with their existing staff to provide project management. The Staff Augmentation Consultants provide specialized expertise not available to the agency and also additional general staff to meet short-term needs.

The Miami Metrorail (heavy rail) was constructed in the classic design-bid-build format. A GEC provided designs (with systems designs on a performance specification basis)

and these designs were bid by the Agency to construction contractors, system suppliers and installers. The Agency built its own construction management staff to execute the project—somewhat unusual because the staff was disbanded upon project completion. Consultants are generally thought to be more flexible in the assignment of relatively short-term staff. It is typically assumed that public agencies have a more difficult time in reducing staff size upon the completion of a major project.

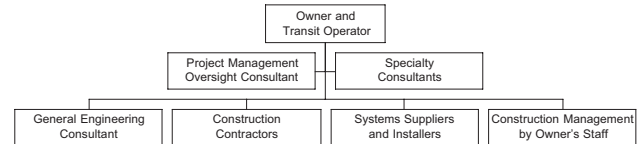


Figure 9. Miami Metrorail, Design-Bid-Build.

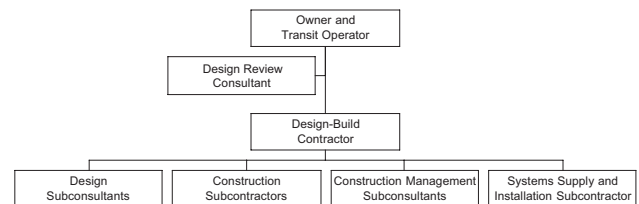


Figure 10. Miami Metromover Phase A, Design-Build.

The original Miami Metromover project (people mover) was one of the very first design-build transit systems procured in the United States. For this contract, the Owner utilized a small staff and a design review consultant and subcontracted all remaining work to the Design-Build Contractor. In a contract format that is no longer utilized, the Design-Build Contractor provided a fixed price only for the Systems Supply and Installation work. Construction work was bid by the Design-Build Contractor, and the amount of the bid was added to the contractor’s price in each instance. Design Subconsultants and Construction Management Subconsultants were provided with cost reimbursable contracts passed on to the Owner with no markup for the Design-Build Contractor. Significant cost growth in cost reimbursable work was experienced on this contract.

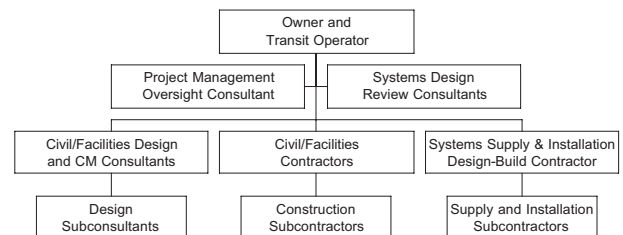


Figure 11. Miami Metromover Phase B, Design-Bid-Build and Design-Build.

When Miami contracted for extensions to its people mover system, it used a traditional design-bid-build approach for all civil works and used a single consolidated design-build contract for the procurement of all systems elements including the supply of additional vehicles for its fleet. Interface between the civil and design-build contracts was handled by the agency with the support of its Systems Design Review Consultants. The Agency felt that moving the Civil/Facilities Contracts to a design-bid-build format would improve its control over costs and schedule for the entire program.

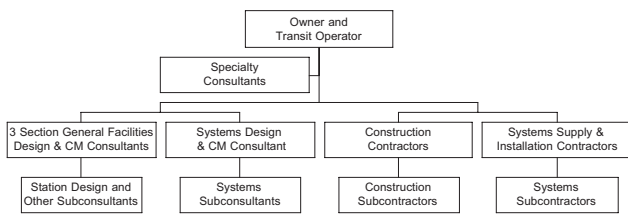


Figure 12. Buffalo NFT Metro, Design-Bid-Build.

The Buffalo LRT system was procured with four General Consultants with responsibility for respective sections of the project. The Agency took upon itself the role of managing interfaces while systems integration was accomplished through the use of a General Systems Design and CM Consultant. The respective responsibilities of the three General Facilities Consultants were tunnel section and stations, cut-and-cover section and stations, and surface section and stations.

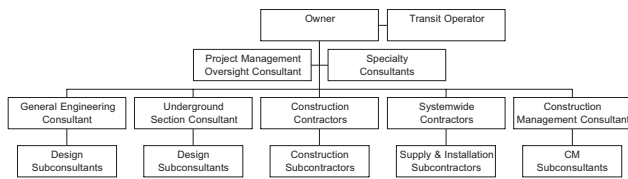


Figure 13. San Diego Mission Valley East LRT Project, Design-Bid-Build.

The Metropolitan Transportation Development Board has previously developed four other LRT projects for the City of San Diego. Its current project contains the first section of underground construction to be built for LRT in the city. Because this special construction was new to the Agency, it decided to control that portion of the project directly. Other design work, including all systems design, was given to a GEC. CM services were procured separately for this work.

Portland’s Tri-Met is another mature agency with experience in the delivery of LRT projects. Primarily because of a 2-year separation in the procurement processes, two

separate Civil Design Consultants were obtained for separate sections of the project. Project management services and CM services were undertaken by Agency staff with the help of substantial Staff Augmentation Consultants. With the staff augmentation approach, the Agency directs staff provided by consultants and there is only a generic scope of services for each consultant. The consultant’s responsibilities (and hence liability) are limited because the Agency is providing day-to-day supervision and making all decisions.

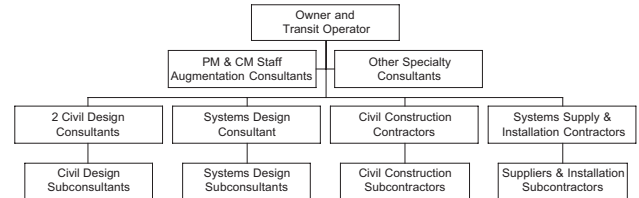


Figure 14. Portland Westside Transit Project, Design-Bid-Build.

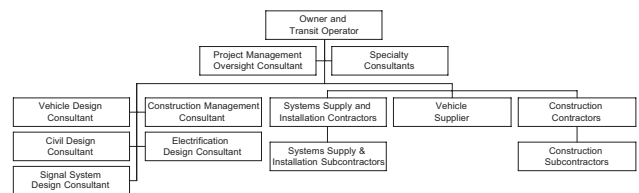


Figure 15. Sacramento Light Rail Project, Design-Bid-Build.

Sacramento holds direct contracts with designers for each project component. Systems Integration (making sure all of the components work together seamlessly) is the responsibility of the agency. This system works for Sacramento because the project involves the expansion of the existing system. In a new system, this Systems Integration task is much more complex because the designer does not have a reference of existing designs to form the basis of the work. The separation of design contracts by project component for a new project is not recommended unless a substantial additional effort is to be provided for systems integration.

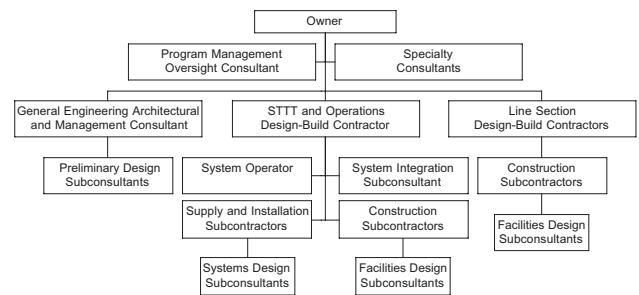


Figure 16. Tren Urbano, Multiple Design-Build.

Puerto Rico is developing a new grade-separated transit system in San Juan. To accomplish this task, it has undertaken an innovative design-build approach using multiple design-build contracts. This approach gives the fixed price certainty of the design-build contract while working to minimize some of the risk of changes that occur after the contracts have been let. In the case of the San Juan project, there are six line section design-build contracts. Thus there is limited risk that a change in one contract will have consequences in other portions of the line. Systemwide work such as track installation, electrification and signals is provided by the Systems and Test Track Team (STTT) Design-Build Contractor, who is also responsible for system integration of all contracts and, ultimately, for system operations.

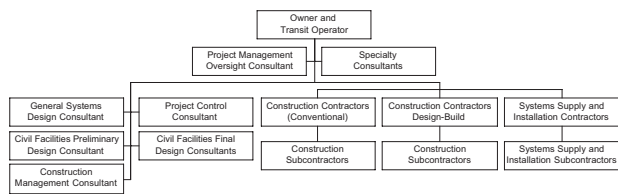


Figure 17. Seattle Metro Light Rail Project, Design-Bid-Build and Design-Build.

Seattle Metro intends to utilize the design-build contracting method for one of its civil facilities contracts to build a tunnel section. In this case, the contractor’s selection of equipment can have a significant effect on the final design. These procurement documents are being managed by the Civil Facilities Preliminary Design Consultant, who is also responsible for coordinating the final design efforts of numerous Section Designers. These Section Designers, however, will hold contracts directly with the owning agency. Thus, the agency will hold increased responsibility for interface coordination.

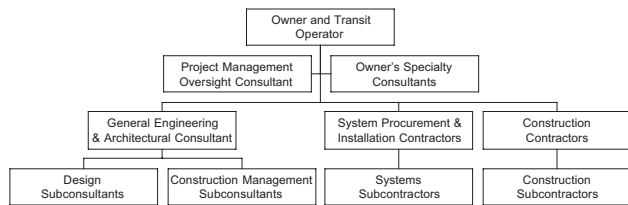


Figure 18. MARTA Heavy Rail Project, Design-Bid-Build.

The MARTA approach to project delivery is one of the most straightforward of all organizations. A General Engineering and Architectural Consultant procures all design and construction management services and takes responsibility for systems integration. Contracts let for construction and systems supply and installation are issued

in the usual manner. Construction contracts are design-bid-build as are some of the systems contracts. Where appropriate, system procurement and installation contracts are issued on a design-build basis.

## CONCLUSIONS

As the above examples illustrate, though similar projects were implemented, very few (if any) used exactly the same organizational model for major components of procured efforts. In a similar fashion, the owners’ organizations showed similar variations. Clearly no single “right” way has emerged, and local project-specific considerations and staff preferences appear to always result in a customized approach.

Experience with dividing up the capital budget among multiple entities has led to a high degree of sophistication in managing the physical and operational features of the evolving project. The specialized project disciplines of Configuration Management, Systems Integration and Interface Management must be closely addressed by owners when they hold direct responsibility for multiple procurement contracts.