CONSTRUCTION PROJECT DELIVERY SYSTEMS
AND PROCUREMENT PRACTICES:

CONSIDERATIONS
ALTERNATIVES
ADVANTAGES
DISADVANTAGES

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APRIL 2007
PROJECT DELIVERY SYSTEMS

Project delivery systems refer to the overall processes by which a project is designed, constructed, and/or maintained. In the public sector, this has traditionally entailed the almost exclusive use of the design-bid-build system, involving the separation of design and construction services and sequential performance of design and construction. In recent years, however, the public sector has begun experimenting with alternative methods to improve the speed and efficiency of the project delivery process.

These alternative systems move closer to the integrated services approach to project delivery favored in the private sector. To illustrate this concept, the innovative delivery systems have been arranged below on a continuum, with the traditional design-bid-build approach appearing on the left and the more innovative systems arranged from left to right according to increasing similarity to the private sector model in terms of greater responsibility and risk shifted to the constructor, and less separation between design and construction services.

![Delivery Systems Diagram]

**Public Sector Model:**
- Separation of services for design and construction
- Fixed-price, low bid (for construction)
- Owner retains majority of risk for performance

**Private Sector Model:**
- Single entity provides integrated services
  - Design
  - Construct
  - Operate
  - Maintain
  - Finance
- Negotiated or target pricing
- Long-term partnerships
- Contractor assumes greater performance risk
Design-Bid-Build

Description

Design-Bid-Build (DBB), or design then bid then build, is the traditional delivery system for the public sector, in which an agency will use in-house staff (or, alternatively, use consultants) to prepare fully completed plans and specifications that are then incorporated into a bid package. Contractors competitively bid the project based on these completed plans and specifications. The agency evaluates the bids received, awards the contract to the lowest responsible and responsive bidder, uses prescriptive or method specifications for construction, and retains significant responsibility for quality, cost, and time performance.

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
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</thead>
<tbody>
<tr>
<td>• Applicable to a wide range of projects</td>
<td>• Tends to yield base level quality</td>
</tr>
<tr>
<td>• Well established and easily understood</td>
<td>• Least-cost approach requires higher level of inspection by the agency</td>
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<td>• Clearly defined roles for all parties</td>
<td>• Initial low bid might not result in ultimate lowest cost or final best value</td>
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<td>• Provides the lowest initial price that responsible, competitive bidders can offer</td>
<td>• Designers may have limited knowledge of the true cost and scheduling ramifications of design decisions</td>
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<td>• Extensive litigation has resulted in well established legal precedents</td>
<td>• Lack of input from the construction industry during the design stage exposes the agency to claims related to design and constructability issues</td>
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<td>• No legal barriers in procurement and licensing</td>
<td>• Tends to create an adversarial relationship among the contracting parties, rather than foster a cooperative atmosphere in which issues can be resolved efficiently and effectively</td>
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<td>• Insurance and bonding are well defined</td>
<td>• Agency bears design adequacy risk</td>
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<td>• Discourages favoritism in spending public funds while stimulating competition in the private sector</td>
<td>• No built-in incentives for contractors to provide enhanced performance (cost, time, quality, or combination thereof)</td>
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<tr>
<td>• As construction features are typically fully specified, DBB provides agencies with significant control over the end product (however, this may come at the expense of increased agency-inspection efforts)</td>
<td>• Greatest potential for cost/time growth (in comparison to other delivery methods)</td>
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<td>• Often prone to adversarial positions that lead to disputes and claims</td>
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Indefinite Delivery/Indefinite Quantity (ID/IQ)

Description

With ID/IQ contracting (also referred to as job order, task order, area-wide, county-wide, city-wide, and open-ended contracting), the agency will identify and develop specifications for task items. Contractors then competitively bid these task items based on unit prices for task items for a specific contract term. The total quantity and exact location of the work are not provided at the time of bid. After awarding the contract, the agency will issue individual work orders as services are needed at specific locations.

The uncertainty associated with the scheduling of the work and the quantity of work that will ultimately be let has led some agencies to guarantee a minimum value of work to ID/IQ contractors.

Objective

- Time savings in engineering and procurement

Project Types/Selection Criteria

- Clearly defined, standardized, or repetitive work items
- Minor construction, maintenance, pavement marking, signing, and repair contracts that can be classified into small task orders

Advantages

- Reduces overall procurement time by allowing agencies to eliminate separate bid processes for repetitive work items
- Structuring work in small tasks may offer increased opportunities for smaller or disadvantaged businesses
- Provides flexibility in when to let portions of an overall construction program
- Awarding multiple ID/IQ contracts will ensure competitive pricing of work orders
- Long-term contracts can foster a spirit of cooperation/partnership between contractors and the agency

Disadvantages

- Large packages could exclude smaller contractors from bidding
- Without minimum work guarantees, the possibility that selection for award may not necessarily lead to work orders may discourage potential bidders
- Without advance knowledge of the timing and duration of task orders, it is more difficult for ID/IQ contractors to manage resources
Agency-Construction Manager (Agency-CM)

Description

Agency-CM (also known as Program Management for multiple contracts or programs) is a fee-based service in which the construction manager (CM) is exclusively responsible to the agency and acts as the agency’s representative at every stage of the project. The CM is selected based on qualifications and experience, similar to the selection process for design services. CM responsibilities may include providing advice during the design phase, evaluating bids from prime contractors, overseeing construction, and managing project cost, schedule, and quality. The CM may work with the designer or contractor to reduce the cost, but does not guarantee price or take on the contractual responsibility for design and construction.

Objective

- Supplement in-house staff with independent professionals having expertise in project management, scheduling, and cost control
- Time savings by fast-tracking construction

Project Types/Selection Criteria

- Agency must supplement its internal resources and management expertise given the project’s size or complexity
- Large, complex (multi-season) projects with multiple phases or contracts
- Fast-tracked construction (using phased packages) is possible
### Project Delivery Systems

#### Advantages
- Earlier involvement of CM (constructor) bridges design and construction phases
- Furnishes construction expertise to designer
- Provides the opportunity for “fast-tracking” or overlapping design and construction phases – faster than traditional design-bid-build system
- Augments the agency’s own resources to help manage cost, time, and quality
- Procuring separate design and construction contracts is less change for agency
- Provides an independent point of view regarding constructability, budget, value engineering, and contractor selection (No inherent bias towards design or construction)
- Potential to fast-track early components of construction prior to completion of design
- Reduces the agency’s general management and oversight responsibilities

#### Disadvantages
- Added project management cost for CM services
- Agency cedes much of the day-to-day control over the project to the CM, adding a level of bureaucracy in the field
- CM not at risk for construction cost
- Agency continues to hold construction contracts and retains contractual liability
- Unlike CM at-Risk, Agency-CM services are not regulated by state licensing laws for contractors or A/E firms
- High agency involvement (in comparison to other innovative delivery systems)
Construction Manager at Risk (CM at-Risk)

Description

With CM at Risk, the agency engages a construction manager (CM) to act as the agency’s consultant during the pre-construction phase and as the general contractor (GC) during construction.

During the design phase, the CM acts in an advisory role, providing constructability reviews, value engineering suggestions, construction estimates, and other construction-related recommendations. At a mutually agreed upon point during the design process, the CM and the agency will negotiate a Guaranteed Maximum Price (GMP). The GMP is typically based on a partially completed design and includes the CM’s estimated cost for the remaining design features, general conditions, a CM fee, and construction contingency.

The construction contingency can be split into CM and agency components. The CM contingency will cover increased costs due to unavoidable circumstances, for example material escalation. The agency contingency would cover cost increases from agency-directed or agency-caused changes. The construction contingency can be handled in different ways under the contract. Unused CM contingency can be returned to the agency, shared by the agency and CM, or given to the CM.

Agencies are increasingly experimenting with sharing the contingency pool with the CM to provide the CM with an incentive to control cost growth associated with change orders to meet the GMP. The agency may elect to remove pricing of some material or work items as part of the GMP if pricing of these items results in an excessively high CM contingency or GMP. For example, if the price of steel were too volatile to achieve an acceptable GMP, the agency could establish a separate bid item and pre-pay or pay for the steel directly under this item at actual cost.

After the GMP is established, the CM can begin construction, allowing for the overlap of the design and construction phases to accelerate the schedule. Once construction starts, the CM assumes the role of a GC for the duration of the construction phase. The CM holds the construction contracts and the risk for construction costs exceeding the GMP.

Objective

- Time savings by fast-tracking design and construction in phased packages
- Transfer performance risk to CM

Performance Outcomes

According to a CII/Penn State University comparison of delivery systems for buildings used in the U.S., CM at-Risk costs 1.5% less than DBB, completes 5% faster than DBB, and performs equal to or better than DBB in most quality measures. (Sanvido and Konchar 1999)
### Project Types/Selection Criteria

- Large projects with multiple phases and contracts
- Fast-tracking – Staged construction
- Limited internal agency management resources and expertise
- Limited time or funding constraints

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<th><strong>Advantages</strong></th>
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<tbody>
<tr>
<td>Allows for innovation and constructability recommendations in the design phase, yet the agency still retains significant control over the design</td>
<td>Once construction begins, the CM assumes the role of a general contractor, leading to possible tensions with the agency over project quality, budget, and schedule</td>
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<tr>
<td>CM holds construction contracts, transferring performance risk to GC</td>
<td>Use of a GMP may lead to disputes over the completeness of the design and what constitutes a change to the contract</td>
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<td>GC puts more investment in cost engineering and constructability review than with CM-Agency</td>
<td>Agency retains design liability</td>
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<td>Fixes project cost and completion responsibility earlier than Design-Bid-Build</td>
<td>CM input may not be included by designer</td>
</tr>
<tr>
<td>Potential to fast-track early components of construction prior to complete design</td>
<td>Incentive split of savings scheme may create perception of inflated GMP</td>
</tr>
<tr>
<td>Reduces agency’s general management and oversight responsibilities</td>
<td>GMP approach may lead to a large contingency to cover uncertainties and incomplete design elements</td>
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<tr>
<td>Use of a GMP with a fixed-fee and opportunity for shared savings provides an incentive for CM to control costs and work within funding limits</td>
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The Portland Method

Description

The Portland Method, named after the City of Portland, Oregon where it was used, is a hybrid CM at-Risk delivery method using a cost-reimbursable, fixed fee approach to compensation. The delivery is structured into three phases, procurement, pre-construction, and construction.

In the first phase, the agency procures the contractor using a best-value process. The proposer is selected based on qualifications and a fixed fee “bid” covering the contractor’s off-site and onsite overhead, including superintendents, management staff, other general conditions costs, and profit, for the life of the project. In the event that differing site conditions increase overall contract time or extra work is ordered in writing by the agency, this fixed fee may be renegotiated accordingly.

During the pre-construction phase, the contractor provides design reviews and construction planning, with a focus on constructability, value engineering cost and time reductions, and joint risk assessments. These efforts culminate in the development of an estimated reimbursable cost (ERC). The intent is to establish reasonable construction costs for labor, equipment, and materials, which factor in the costs of unknowns without establishing a separate contingency. After comparing the ERC with the “Engineer’s Estimate,” the contractor and agency negotiate a final ERC and combine this with the fixed fee to establish the contract amount. Finally, the contractor will submit a cost control program and subcontracting plan for construction.

The Portland Method differs from conventional CM at-Risk in that it uses an ERC instead of a GMP. The ERC shifts less risk to the contractor to meet set funding limits. Also, the Portland Method places no limits on the amount of work that the prime contract or may self-perform, a common restriction found in CM at-Risk contracts.

Objective

- Early contractor involvement (design and planning) to reduce cost and schedule.
- Time savings by fast-tracking construction

Past Experience

This approach was developed by the City of Portland’s Bureau of Environmental Services (BES) for the West Willamette River Combined Sewer Overflow (CSO) project. The project consisted of constructing a combination of near surface pipelines, a soft ground tunnel, and a pump station to transport CSO flow to the City’s existing wastewater treatment plant. The selected contractor worked closely with the BES to develop a baseline project cost, which included both the fixed fee and an estimated reimbursable cost. The contractor was also tasked with developing a project cost control program to track actual costs against budget and to make projections based on learned history. BES had review and approval authority over subcontracts and subcontract modifications, and of all purchases over $50,000. BES also conducted periodic field audits of contractor activity and biweekly audits of cost reimbursement requests. (Gribbon et al. 2003)
Performance Outcomes

The City of Portland reported that the contractor’s early involvement with design review, value engineering, and risk analysis prior to design completion (tunnel and pipelines were 85% complete; pump station was 50% complete) contributed to significant cost and schedule savings on the West Willamette River project. (Gribbon et al. 2003)

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<tr>
<td>• Allows for innovation and constructability recommendations in the design phase, yet the agency still retains control over the design</td>
<td>• Once construction begins, the CM assumes the role of a general contractor, setting up traditional contractual relationships with agency and designer, and potential for disputes over project quality, budget, and schedule</td>
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<tr>
<td>• Fixes project cost earlier than Design-Bid-Build</td>
<td>• Best suited to specialized work (e.g. tunneling) with significant risk of cost and time growth</td>
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<tr>
<td>• Potential to fast-track early components of construction prior to complete design</td>
<td>• Agency retains design liability and greater risk of differing site conditions</td>
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<td></td>
<td>• In comparison to CM at-Risk with a GMP, reimbursable cost basis shifts less performance risk to the contractor</td>
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<td>• Provides no added incentive to motivate contractors to control costs</td>
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Design Sequencing

Description

With design-sequencing, the agency sequences design activities in a manner that will allow the start of each construction phase when the design for that particular phase is complete, instead of requiring the design for the entire project to be complete before allowing construction to begin. The agency delivers the remainder of the design by predetermined dates after construction has started.

To implement design-sequencing, the agency develops plans and an estimate to a level sufficient to define the project scope and to allow the contractor to select anticipated subcontractors. The bid documents must contain all anticipated items necessary for the complete design, regardless if final quantities have been determined.

Due to the potential for agency-caused delays in releasing subsequent design sequences, design-sequenced projects typically do not incorporate other time-saving contracting techniques, such as A+B bidding or Incentive/Disincentive provisions.

Objective

- Accelerate project delivery by allowing the agency to award a project based on plans that are, on average, 30 percent complete

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Faster project delivery</td>
<td>- The agency retains the risk for variations in the bid quantities</td>
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<td>- Potential for construction inefficiency due to conflicting or overlapping work between the initial sequence and subsequent sequences</td>
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<td>- Unanticipated site conditions or third party conflicts during construction may impact ability of a design-sequenced project to generate time savings</td>
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Design Build

Description

Design-build is a project delivery system involving a single contract between the project owner and a design-build contractor covering both the design and construction of a project. The design-builder performs design, construction engineering, and construction according to design parameters, performance criteria, and other requirements established by the agency.

Design-Build has been implemented in the highway construction industry in a variety of ways based in part on how the state statutes are written and on how much responsibility is transferred to the design-builder for the design and other aspects of project performance.

Several highway agencies have used an approach called Modified Design-Build, also called Low Bid design-build or Draft/Detail-Build, where the agency completes a significant portion of the design before selecting the contractor using a low bid solicitation or qualified low bid process. The design-builder then completes the remainder of the design work and constructs the project under a single contract. Modified Design-Build is primarily used in cases where state law prohibits the procurement of construction services using a method other than low bid or before the design is substantially complete, and the agency administers the project using traditional practices and retains greater responsibility for project performance.

Highway agencies with statutory authority and more experience have increasingly implemented design-build consistent with approaches recommended by the Design-Build Institute of America (DBIA) and other practitioners, where the agency completes the conceptual design to a lower level and then procures the design-builder under a two-step best-value proposal process. This two-step best-value approach allows for much earlier involvement by the design-builder and shifts greater control and responsibility for the design and project performance to the design-builder.

A design-build contract may also include responsibilities that extend beyond the design and construction phases of a project, shifting more performance risk to the private sector. These have included:

- **Design-Build-Warranty.** A single entity designs, constructs, and warrants specified components over a prescribed time period (e.g., 5, 10, or 20 years). Warranty requirements shift quality responsibility to the design-builder and reduce the agency’s need to inspect during construction and maintain the facility during its service life.

- **Design-Build-Maintain.** A single entity designs, builds, and maintains the project works for a specified period of time under a single contract. Payment beyond completion of construction is typically tied to meeting certain prescribed performance-based standards for a period of years.

- **Design-Build-Operate.** A single entity designs, builds, and operates the project (e.g., a toll road) for a specified period of time under a single contract.

Design-build delivery has been expanded to a Public-Private Partnership concept, where a private entity or developer takes part in financing and leasing a transportation project in return for monetary compensation based on contractual authorization to collect toll revenues, or pursue development rights with the contracting agency. The private entity will be responsible for financing, design and construction, and often will operate and maintain the roadway or bridge for a specified duration. The public-private contract may give full or partial contracting authority to the private entity.
Objective

Streamline and enhance project delivery by contracting with one entity to provide design, construction, and other pre or post-construction services.

Past Experience

Forty-four states allow the use of design-build on public works projects. The states that have most actively use design-build include Florida, Michigan, Ohio, and Pennsylvania.

Performance Outcomes

There have been multiple studies on the effectiveness of using design-build as a delivery method. However, due to variations in project scope and difficulty in identifying comparable design-bid-build projects for use as baselines, these studies have produced highly variable results.

A recent and fairly comprehensive study on design-build effectiveness focusing on design-build projects completed under SEP-14 reported the following (SAIC, AECOM, and University of Colorado 2006):

- An average 14 percent time savings for design-build projects when compared to design-bid-build schedule estimates and a 3 percent reduction in total cost (based on survey respondent estimates). Actual data for the surveyed design-build projects indicated an average reduction of 1 percent between planned and actual total project duration and no appreciable change in total cost.
- A comparable level of quality to design-bid-build delivery. For agency satisfaction as a quality measure, the use of best-value procurement, lower level of design, and larger projects with design-build yielded higher satisfaction ratings.

The Construction Industry Institute (CII) and Penn State University found a 33 percent project delivery time savings and a 12 percent construction time savings for design-build versus design-bid-build projects based on data obtained from 351 projects delivered in the building sector using design-build, design-bid-build, and CM at-Risk techniques. (Sanvido and Konchar 1999)
**Advantages**

- Single point responsibility for design and construction
- Accelerated project delivery by:
  - Fast-tracking design and construction
  - Close coordination between designer and contractor
  - Early contractor involvement to enhance constructability of plans
- Cost containment by minimizing owner’s exposure to design errors and omissions
- Earlier schedule and cost certainty
- Innovation and quality improvements through:
  - Alternative designs and construction methods suited to the contractor’s capabilities
  - Flexibility in the selection of design, materials, and construction methods

**Disadvantages**

- Reduced opportunities for smaller, local construction firms
- Fewer competitors and increased risk may result in higher initial costs
- Elimination of traditional checks and balances. Designer is no longer agency’s advocate. Quality may be subordinated by cost or schedule considerations.
- Less agency control over final design
- Higher procurement costs
- Traditional funding may not support fast-tracking construction or may require accelerated cash flow.
- Accelerated construction can potentially overextend the workforce.
Early Contractor Involvement (ECI) and Target Pricing

Description

Early Contractor Involvement (ECI) is a hybrid design-build project delivery method from England involving qualifications-based design-builder selection and an open-book target pricing system.

With the ECI delivery method, the agency uses a qualifications-based approach to select a contractor early in the project development process, when the agency has only conceptual plans and an approved budget price. Once the contractor has been selected, additional design and planning is performed with the input of the entire delivery team to establish a target price for the project from that point forward. Various mechanisms are incorporated throughout the design and construction process for the contractor to share in savings, and participate in any losses, realized when actual costs are compared to the target price.

The agency compensates the contractor for actual costs, based on open-book accounts and records, plus a fee. In addition, an incentive structure, similar to that described below, is established to motivate the contractor to design and construct the project within budget.

**Design Bonus** – If the contractor designs the project within the project budget, as indicated by comparing the forecast total project cost to the project budget, the contractor is paid a design bonus. If the forecast costs are greater than the project budget, the contractor does not receive a bonus, but likewise does not suffer any reduction in payment. If the agency elects to proceed with the project, the contractor still has the opportunity to earn incentives during the construction phase of the project.

**Construction Bonus** – During the construction phase, the contractor is paid actual construction costs plus a percent fee. If, at the end of construction, the total of actual costs plus the contractor’s fee is less than the estimated cost (i.e., initial target price adjusted for any additional compensation paid out during design and construction), the contractor is paid a share of the savings, as calculated using a formula set out in the contract. Similarly, the contractor would pay a share of any cost overruns.

**Final Bonus** – At the completion of the project, the agency will calculate a final bonus based on a comparison of the contract budget to the total project expenditures incurred by the agency, including any design and construction bonuses already paid to the contractor, as well as an estimate of future costs not yet incurred. If the total expenditure is less than the contract budget, the contractor is paid a bonus percentage of the savings achieved on the contract budget. If the contract budget is exceeded, no final bonus is payable to the contractor; however, the contractor does not share in any additional cost overruns (other than what they may have already incurred in the construction cost share).

Objective

- Align team goals through the early establishment of the contractor’s role in the project development process and through the rational and equitable sharing of project risks

Past Experience

ECI was first developed and used by the Highways Agency in England. The Highways Agency now recommends use of ECI on all publicly funded major projects (i.e., contracts valued at over £5 million) as a standard procurement strategy.
Washington DOT (WSDOT) used a form of target pricing to resume work on the $204 million construction project to reconstruct and widen the SR 104 Hood Canal Floating Bridge, after the discovery of unexpected tribal burials interrupted construction. WSDOT proceeded with an altered project scope using the original contractor, with which it negotiated a target price for the remaining project work. The target price included the estimated construction cost plus the contractor’s fixed fee, with the potential for shared savings to reward good performance. Note that this project did not embody pure target pricing techniques because the target price had to be negotiated in response to an emergency condition, when all subcontractors and suppliers were already engaged on the project. The project also lacked a formal partnering process (although the agency and contractor are working collaboratively) and a specific assessment of major risks and associated contingency budgeting. (Molenaar et al. 2007)

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<tr>
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<tbody>
<tr>
<td>Allows contractor’s expertise to be introduced earlier in the project</td>
<td>Absence of direct price competition can lead to overly conservative and easily achievable</td>
</tr>
<tr>
<td>development process</td>
<td>performance targets</td>
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<tr>
<td>Bonus structure provides an incentive for contractor to control costs and</td>
<td>Open-book accounting structure and the risk of sharing in cost overruns may deter</td>
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<tr>
<td>work within the target price established for the project</td>
<td>potential bidders</td>
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<tr>
<td>Open book target pricing system requires contractor to operate in an open</td>
<td>Increased procurement costs</td>
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<td>and collaborative way</td>
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<tr>
<td>Potential for overlapping design and construction phases may allow for</td>
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<tr>
<td>faster project delivery</td>
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<tr>
<td>Encourages better communication between contractor and agency</td>
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Project Alliancing

Description

Under project alliancing, an agency and one or more service providers (constructors, consultants, designers, suppliers, or a combination thereof) collaborate on the delivery of a project. In contrast to partnering, another relationship-based approach to project delivery, alliancing uses contractually established financial incentives to encourage superior project performance and cooperation among the alliance participants.

Typical characteristics of a project alliance include the following:

- The alliance team members jointly develop and agree to a target cost, which is then verified by an independent estimator.
- At project completion, the target cost is then compared to the final cost, and the under-runs or overruns are shared equitably (through pre-agreed ratios) among the participants based on their relative contributions to the leadership, performance, outcomes, and overall success of the alliance. In this manner, all participants have a financial stake in the overall project performance.
- Project risk and responsibilities are shared and managed collectively, rather than allocated to specific parties.
- All participants have an equal say in decisions for the project, with decisions made unanimously on a “best-for-project” basis, rather than to further individual interests.
- All participants provide “best-in-class” resources. Full access is provided to the resources, skills, and expertise of all participants.
- The alliance agreement creates a no-fault, no-blame, and no-dispute culture. No legal recourse exists except for the limited cases of willful default and insolvency.
- All transactions are open-book.

The use of project alliancing to establish and deliver a project generally entails four phases, with the alliance remaining intact until the end of the final phase. A practitioners’ guide published by the State of Victoria, Australia (2006) describes these phases as follows:

- **Alliance Establishment Phase** – The agency will select project participants on the basis of non-cost criteria, such as technical expertise and experience, financial and management resources, quality and time record, and willingness to commit to a cooperative relationship with the agency. The agency may either select each of the key participants (e.g., designer, contractor, supplier, etc.) in separate selection processes, or allow industry to establish its own teams and submit proposals as an integrated team or consortium. Although conducting separate selection processes allows the agency to select the best individual companies, this approach can be time consuming and may not necessarily yield the best overall team. For such reasons, agencies more commonly choose the integrated team approach to alliance participant selection.

  Following participant selection, the agency will conduct a series of meetings and workshops with the selected participants to establish the commercial framework and primary alliance parameters, including the compensation structure, fees for overhead and profit, and the gainshare/painshare arrangement, which are then formalized in an alliance agreement.

- **Project Development Phase** – The agency and the selected alliance participants will work together as an integrated team to develop and agree to a target cost and other performance targets (e.g., timely completion, maintenance costs, quality, etc.).
In response to concerns that the absence of direct price competition leads to overly conservative and easily achievable performance targets, an alternative participant selection model has been developed, although used only sparingly at this time. In this model, the agency enters into interim project alliance agreements with two groups selected on the basis of non-cost criteria. The agency will then work with each group to develop separate costs and other performance targets. The agency selects the winning team based on the lowest or best target cost and other performance criteria. This approach can be particularly useful in cases where the choice of technology can have significant effect on the capital or operating cost of the project.

- **Implementation Phase** – Once the targets are established and agreed to, the alliance team works together to deliver the project with the objective of achieving or exceeding the agreed-to targets.

- **Defects Correction Period** – The participants remain collectively responsible for addressing any defects in the work (typically for a period of about 24 months).

Compensation to the non-agency members of the alliance team is typically based on a “3-limb model” that compensates each participant as follows:

- **Limb 1 Fees** consist of all direct project costs and project-specific overhead incurred by the alliance team members. These fees are viewable by all contracting parties using 100-percent open book accounting.

- **Limb 2 Fees** consist of corporate overhead and profit. These fees were determined during the Alliance Establishment Phase through a series of financial audits of the participants.

- **Limb 3 Fees** are based on a predetermined gainshare/painshare arrangement that is dependent on how the actual cost (Limb 1 fees) compares to the target cost. Losses are capped at Limb 2 fees; therefore, participants are at least guaranteed to recover all direct costs (Limb 1 fees).

**Objective**

- Encourage cooperative behavior among project participants by tying compensation to the final project outcome

- Better value for the money and improved project outcomes through collaboration and “best-for-project” decision making

**Past Experience**

Project alliancing was first used in the early 1990’s by British Petroleum (BP) to develop its North Sea oil and gas reserves. Project alliancing has since been used on multiple public infrastructure projects in Australia and New Zealand.

**Performance Outcomes**

In its initial project delivered using project alliancing, BP realized a £30 million cost reduction in comparison to the target cost and completed the project 6 months ahead of schedule. (Sakal 2005)

Transit New Zealand used project alliancing to deliver its $68 million Graft Gully motorway improvement project well ahead of schedule and under budget. (Transit New Zealand 2006)
Project Delivery Systems

Project Types/Selection Criteria

- Project alliancing should be used to deliver complex, high-risk projects, where risks are unpredictable, inherent to the nature of the project (rather than due to inadequate planning, scoping, or time), and best managed collectively. The project should also derive significant benefit from the involvement of both the owner and non-owner participants in all aspects of project development and implementation.

- Alliancing is not as beneficial for projects having clearly defined and allocable risks.

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Improved ability to manage risks due to the sharing of responsibility and incentive for all participants to proactively mitigate risks</td>
<td>• Absence of direct price competition can lead to overly conservative and easily achievable performance targets</td>
</tr>
<tr>
<td>• Earlier involvement of construction and cost planning expertise in the project development phase</td>
<td>• Absence of legal recourse (with the exception of willful default and insolvency)</td>
</tr>
<tr>
<td>• Reduced need for contract administration (i.e., inspection, dispute resolution) allows resources to be focused on achieving project objectives</td>
<td>• Participants are exposed to a broader range of risks than on a traditional project</td>
</tr>
<tr>
<td>• Less adversarial system</td>
<td>• Participants are liable for the performance of other team members</td>
</tr>
<tr>
<td>• Transparent pricing of the project, including contingencies</td>
<td>• Requires high level of involvement from senior management to establish and maintain alliances</td>
</tr>
<tr>
<td>• Increased efficiency provided by a well-functioning team</td>
<td>• Agency’s ability to make unilateral decisions is severely restricted</td>
</tr>
<tr>
<td></td>
<td>• Increased procurement costs</td>
</tr>
<tr>
<td></td>
<td>• Contractors may be hesitant to enter into a arrangement where risks are shared and selection occurs prior to target pricing</td>
</tr>
</tbody>
</table>
Contract Maintenance (performance-based or traditional)

Description

In Contract Maintenance, the agency will outsource maintenance or rehabilitation tasks to contractors, either through traditional or performance-based contracting methods.

In traditional maintenance contracting, the agency will direct the contractor to perform specific tasks. The agency specifies what work will be done and how it will be done, providing little or no flexibility to the contractor in its selection of means and methods.

In performance-based maintenance contracting, the agency will specify performance standards, and the contractor will select the means and methods that will best ensure that these standards are met. The contractor manages and directs the work, and the agency monitors progress to ensure that the contractor is achieving the desired performance and system conditions.

Objective

Proponents cite numerous objectives for using contract maintenance, including reducing costs, increasing efficiency, improving quality, promoting innovation, enhancing risk management, and overcoming a lack of in-house expertise.

Project Types/Selection Criteria

Examples of maintenance activities that agencies have outsourced include mowing, snow and ice removal, sweeping, catch basin cleaning, sign installation, fence and guardrail repair, pothole repair, and roadway patching and sealing.
### Advantages
- Potential to provide cost savings*
- Supplements agency resources or provides specialty skills or equipment not otherwise available in-house
- Promotes efficiency, optimization of resources, and innovation (if performance-based)
- Competing with private sector firms can increase the efficiency and effectiveness of agency’s own staff
- In contrast to ID/IQ maintenance contracts, the contractor can respond immediately to safety-critical items (e.g., fallen trees, displaced light poles, large potholes) without having to wait for a task order.
- Provides a planned spending schedule for the agency

### Disadvantages
- Agency must actively monitor the contract, requiring allocation of appropriate personnel and monitoring equipment
- For performance-based contracts, the desired results might not be achieved if performance criteria are not fully or adequately described
- Long-term contract awarded to just one contractor forces the agency to put “all of its eggs in one basket”
- Outsourcing maintenance may be met with resistance from agency personnel
- Political motivations could turn maintenance contracting into a contentious issue
- Potential for negative publicity if the public’s expectations regarding levels of service are not met

* Difficulty in calculating the true overhead burden borne by agencies for in-house maintenance staff makes it difficult to obtain an objective and appropriate comparison of the cost of doing the work in-house versus using private contractors.
Procurement practices are the procedures agencies use to evaluate and select designers, contractors, and various consultants. Evaluation and selection can be based solely on price, solely on technical qualifications, or on a combination of price, technical qualifications, time, and other factors.

An alternative procurement method uses a method other than the traditional fixed-price, sealed bid procurement process to award a construction contract. By considering factors other than cost alone, the alternative procurement practices move closer to the qualifications-based selection and negotiated procurement process used in the private sector. To illustrate this concept, the alternative methods considered in this section are arranged below on a continuum, with the public sector model (i.e., fixed price sealed bidding) and the private sector model (i.e., sole-source selection) located at the two extremes. As one moves from the public toward the private sector model, additional factors, other than cost alone, are considered in the evaluation and selection process to improve the long-term performance and value of construction.

![Procurement Methods Diagram](image-url)
Lump Sum Bidding

Description

In lump sum bidding, a contractor is provided with a set of bid documents that do not contain detailed quantity tables. The contractor develops quantity take-offs from the plans and estimates a lump sum price based on this take-off.

Objective

- Reduce costs design and contract administration costs associated with quantity calculation, verification, and measurement
- Reduce quantity overruns due to errors in quantity calculations or changed field conditions

Project Types/Selection Criteria

Lump sum payment methods are appropriate for relatively simple projects having a well-defined scope, low risk of unforeseen conditions, and low possibility for changes in scope during design and construction.

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>• During design development, reduces the effort spent by design staff on</td>
<td>• Contractors may add more contingency to bid prices, particularly if there is</td>
</tr>
<tr>
<td>obtaining detailed computations or quantity take-offs</td>
<td>uncertainty in the estimated quantities for the lump sum items</td>
</tr>
<tr>
<td>• During construction, reduces the time spent by field inspectors on</td>
<td>• Potential that the agency will pay the lump sum price when total quantities</td>
</tr>
<tr>
<td>measuring quantities and preparing invoices, allowing staff to</td>
<td>under run estimated amounts</td>
</tr>
<tr>
<td>concentrate on monitoring the quality of the work</td>
<td>• For contracts with multiple lump sum items, there is the potential for front-</td>
</tr>
<tr>
<td>• Streamlines unit items into bundled items, reducing the administrative</td>
<td>end loading</td>
</tr>
<tr>
<td>burden</td>
<td>• Less control by the agency over quality and safety when the contractor’s</td>
</tr>
<tr>
<td>• Creates a built-in incentive for contractors to control costs and work</td>
<td>primary focus is on cost and schedule</td>
</tr>
<tr>
<td>more efficiently</td>
<td>• Changes that affect lump sum price require more effort than simply</td>
</tr>
<tr>
<td>• Eliminates requirements for detailed quantity measurements, allowing</td>
<td>adjusting the quantity of a unit-priced item.</td>
</tr>
<tr>
<td>for faster processing of payments, which can lead to improved</td>
<td></td>
</tr>
<tr>
<td>coordination and cooperation among all the project parties</td>
<td></td>
</tr>
</tbody>
</table>
Cost-Plus-Time Bidding (A+B)

Description

Cost-Plus-Time Bidding uses a cost parameter (A) and a time parameter (B) to determine a bid value. The cost component (A) is the traditional bid for the contract items and is the dollar amount for the work to be performed under the contract. The time component (B) is the total number of calendar days required to complete the project, as estimated by the bidder, multiplied by an agency-determined daily user cost (DUC) to translate time into dollars.

\[ A + B(DUC) = \text{Total Bid} \]

The total bid value is used only to evaluate bids. The contract amount is based on the bid price (A), not the total bid value. The number of days bid (B) becomes the contract time. Note that the lowest combined bid may not necessarily result in the shortest B time. A+B bidding relies on the contractor to provide the optimal combination of cost and time.

Many states use A+B bidding with incentive/disincentive (I/D) provisions as an additional motivation for contractors to save time.

Objective

- Provide the optimum tradeoff between time and cost (if schedule is critical, use an incentive clause along with A+B)
### Advantages
- Reduces contract time
- Promotes innovative scheduling on projects that do not require all work to be completed sequentially
- Encourages contractors to maximize efficiency of crews and equipment
- Typically encourages greater coordination between the prime bidders and their subcontractors prior to bid to develop an achievable time component estimate

### Disadvantages
- Potential for increased costs and delay claims due to utility and third party coordination problems or lack of timely agency reviews
- Contractors may sacrifice quality and safety to meet an unreasonably low time component bid to win the contract. Some practitioners recommend specifying a minimum B duration to avoid excessively low bids.
- Without factoring in the potential savings to users, bid prices and other direct project costs may be higher for A+B projects when compared to conventional projects.
- Administrative and inspection costs may be higher as a result of accelerated schedules that increase demands on construction personnel (however, such costs may be offset by the shorter construction duration)
Multi-Parameter Bidding (A+B+C)

Description

Multi-Parameter bidding extends the A+B bidding concept to include an additional cost parameter (C) that may include a quality or warranty parameter. The total bid value is used only to evaluate the low bidder. The contract amount is based on the bid price (A), not the total bid value (A+B+C). The “C” component can increase or decrease the bid value. For example, if “C” is a bid warranty period, a higher “C” value should result in a lower bid value to reflect the added benefit to the agency.

To date, multi-parameter bidding has only been used in conjunction with a warranty parameter (C), which is converted to an equivalent annual cost for bidding purposes. The multi-parameter concept has been more widely implemented in a best-value procurement process using a point-scored, weighted criteria formula. The formula calculates a total technical score (TS) as the summation of technical scores and an equivalent price score as follows:

\[
TS = W_1 S_1 + W_2 S_2 + \ldots + W_i S_i + W_{(i+1)} PS
\]

Where:

- \( TS \) = Total Score
- \( W_i \) = Weight of Factor i
- \( S_i \) = Score of Factor i
- \( PS \) = Price Score

To incorporate a quality parameter into the bidding process, NCHRP Report 451 (Anderson and Russell 2001) suggests using the multi-parameter equation in the form of \((A+B)C\), where C is a quality factor used to adjust the contractor’s bid based on anticipated or bid quality levels. For example, if the agency collects contractors’ historical quality data, this past performance on agency projects could be used with the pay factor equation to determine the quality factor for bid evaluation. Calculating the quality factor as the inverse of the pay factor equation \((1/PF)\) would reduce bids from contractors with high quality levels on past projects (i.e., pay factors exceeding 100 percent), while increasing bids from contractors with poor quality on past projects (i.e., pay factors less than 100 percent). This approach would thus reward contractors for higher levels of quality delivered on previous projects for the agency. Note that under this approach, the “C” quality parameter would only be used to determine the low bidder. Once the project is underway, the agency would assess the quality level actually achieved on the project for payment purposes.

Alternatively, the agency could allow contractors to estimate and bid their own “C” quality value. The contractor would then be held to achieving the quality level bid, or risk receiving reduced payment. This approach could be implemented by applying a factor of \(C_{\text{actual}}/C_{\text{bid}}\) to the results of the pay factor equation. For example, if the contractor were to exceed the quality level bid \((C_{\text{actual}}/C_{\text{bid}} > 1)\), payment would be increased. If the contractor could not meet the quality level bid \((C_{\text{actual}}/C_{\text{bid}} < 1)\), payment would be decreased.

Objective

- Incorporate the value of quality in the bidding and contractor selection process
- Achieve equal or better quality than specified, at optimal cost and time
Procurement Practices

Project Types/Selection Criteria

- Time critical projects that can incorporate QA specifications and/or warranty items with measurable performance criteria
- Projects for which there is a low risk that external factors not within the control of the contractor will affect quality items

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Encourages improved end-product quality</td>
<td>Possible reduction in open competition</td>
</tr>
<tr>
<td>Achieves multiple goals by lowering life-cycle costs while saving time</td>
<td>Accelerated schedules could result in increased demands on agency personnel</td>
</tr>
<tr>
<td>Encourages innovative construction that can improve quality and timely delivery</td>
<td>Difficult to determine appropriate quality parameters and associated measurement methods</td>
</tr>
<tr>
<td>Balances the risk between the agency and the contractor from an acceptance standpoint</td>
<td>Difficult to translate a level of quality into a dollar value and determine an appropriate weighting to combine with other factors</td>
</tr>
<tr>
<td>Could allow the turn over of more testing and inspection responsibility to the contractor, thus reducing demands on agency personnel</td>
<td></td>
</tr>
</tbody>
</table>
Alternate Design

Description

Alternate design is a bidding technique where contractors may propose and submit a bid on an alternate design that is equivalent to the design specified by the agency. Typically, alternates involve pre-engineered features or products.

Alternates are more commonly used in a design-build framework, but have also been applied within a low-bid design-bid-build framework.

Objectives

- Stimulate contractor innovation
- Provide equal or improved performance at lower cost
- Reduce initial costs or life-cycle costs

<table>
<thead>
<tr>
<th><strong>Advantages</strong></th>
<th><strong>Disadvantages</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Potential for lower initial costs or life-cycle costs</td>
<td>Risk of not receiving the desired end-product if minimum requirements are not clearly and completely stated</td>
</tr>
<tr>
<td>Promotes innovation</td>
<td>Review of alternate design submissions may be time consuming</td>
</tr>
<tr>
<td>Encourages contractors to price time saving methods, techniques, and designs</td>
<td>Difficulty evaluating costs of alternates</td>
</tr>
</tbody>
</table>
Alternate Bid

Description

With Alternate Bids, the agency asks for alternate bids on specified designs. At some point before awarding the contract, the agency will decide which alternate provides the best value.

Objective

- Provide equal or improved performance at lower cost
- Reduce initial costs or life-cycle costs

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Potential for lower initial costs or life-cycle costs</td>
<td>• May increase the risk of bid protests if bid documents do not clearly state instructions regarding the alternates (e.g., are bids for all alternates required)</td>
</tr>
<tr>
<td>• Allows agencies to select the alternate that offers the best cost-to-quality ratio</td>
<td>• May reduce the number of capable bidders if the alternates are outside the average contractor’s capabilities</td>
</tr>
<tr>
<td>• Allows competition between products with different maintenance and service life expectations</td>
<td>• May be difficult to evaluate costs of alternates on an apples-to-apples basis</td>
</tr>
<tr>
<td></td>
<td>• Requires development of full plans and specifications for each alternate, increasing the agency’s engineering costs</td>
</tr>
<tr>
<td></td>
<td>• Multiple designs increases the potential for conflicting details, specifications, and quantities</td>
</tr>
</tbody>
</table>
Additive Alternates/Tied Bids

Description

Additive Alternates is a bidding technique that may be used when it is necessary to keep the awarded contract amount within budget. With this procedure, the agency will include most of the project scope in base-bid items, while also specifying additive alternates that may be selected if the base-plus-alternates price is within budget. The bid documents should specify the priority in which the additive alternates will be considered. The contract is awarded to the lowest responsive bidder that is within budget, considering the sum of the base bid and additive alternates.

Objective

- Include as many scope items as possible while remaining within budget

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allows agencies to tailor project scopes to include as many items as possible within a fixed or limited budget</td>
<td></td>
</tr>
<tr>
<td>Allows agencies to bid all work in the initial procurement process, and thus ensure competitive bidding on the entire project, rather than increase work using the change order process</td>
<td></td>
</tr>
<tr>
<td>May increase the risk of bid protests or contract disputes if bid documents do not clearly state instructions regarding the alternates (e.g., are bids for all alternates required, priority with which the alternates will be evaluated, etc.)</td>
<td></td>
</tr>
</tbody>
</table>
**Procurement Practices**

**Best-Value Procurement**

**Description**

Best-Value procurement allows agencies to consider price and other key factors (e.g., cost, time, qualifications, quality, and design alternates) in the evaluation and selection process to minimize impacts and enhance the long-term performance and value of construction.

The traditional low-bid procurement is typically a one step process. Under best-value, Agencies may use either a one-step or two-step procurement process. In a one-step best-value procurement, price, qualifications, and other criteria are evaluated to determine the best value in a single step. One-step involves the issuance of an RFP requesting the submission of a two-part bid, composed of a technical proposal and a price for construction. The agency selects a bid based on a technically qualified low bid or a formula combining price and technical score.

In two-step best-value, step 1 involves the issuance of an RFQ in a short-listing process. Step 2 involves the issuance of an RFP to the short-listed contractors. The agency then evaluates the contractors’ proposals and awards the contract based on a technically qualified low bid or through a combination of price and technical score, using a formula to calculate an adjusted price or score, or using a trade-off analysis to determine the most advantageous combination of price and technical score or ability.

**Objective**

- Incorporate into the bid evaluation process parameters considered important to the success of the project

**Project Types/Selection Criteria**

- Highly complex or unique projects that would receive measurable benefit from using an alternative form of procurement
- Projects that required specialized equipment, knowledge of construction, or exclusive technology

Note that an automated web-based project selection tool can be found on the University of Colorado’s website at http://construction.colorado.edu/best-value.
**Advantages**

- Encourages contractor innovation with respect to quality, cost savings, and time savings
- Ensures that the agency can select a capable, qualified contractor
- Allows for project schedule, quality, and/or other parameters to be competitively bid
- May achieve higher quality by open competition
- May result in lower life-cycle costs

**Disadvantages**

- Can be administratively burdensome for both the agency and contractors
  - Requires additional staff time and a different level of training to evaluate best-value proposals
  - Preparing a best-value proposal will likely require a high level of effort, which may discourage smaller or DBE contractors with limited resources from bidding
- Potential for a higher initial cost
- Subjectivity of the evaluation process may result in protests
Reverse Auction Bidding

Description

Under this bidding technique, also called “ebay for construction,” contractors use an online bidding process, incrementally decreasing their bids until all reach their lowest offer.

A typical format for this process is as follows:

- Potential bidders obtain documents electronically.
- A third party conducts the auction online with all bidders participating simultaneously.
- Bid amounts are disclosed to all bidders, but the identity of bidders remains anonymous.
- Bidders can resubmit lower bids until the specified auction closing time.
- Contract is awarded to the lowest bid at the specified auction closing time.

Objective

- Achieve the lowest competitive bid price

Past Experience

Reverse auctions were originally designed to procure commodities and other manufactured goods. It has not gained widespread acceptance in the construction industry.

In 2003, Minnesota considered expanding public bidding laws to allow the use of reverse auction bidding in all applications; however, Minnesota revised the law to exclude public construction contracts due to strong opposition from the construction community. Arizona, Kansas, and Pennsylvania also allow reverse auction bidding in certain public applications, but exclude construction.
### Procurement Practices

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Allows owners to use internet technology to reach a broad pool of potential bidders</td>
<td>• No opportunity for bidders to seek clarification or confirmation</td>
</tr>
<tr>
<td>• Repetitive auction process drives bids down</td>
<td>• May encourage imprudent bidding if bidders are forced to quickly react to decreasing bids without fully analyzing the consequences</td>
</tr>
<tr>
<td>• Provides an even playing field for bidders</td>
<td>• Without some type of pre-qualification procedure to ensure that the participating bidders are qualified to perform the work, the bidders’ work history, experience, and related qualifications cannot be taken into account.</td>
</tr>
<tr>
<td>• Reduces administrative effort associated with the bidding process</td>
<td>• Even though bidders are anonymous, the practice may violate Federal Acquisition Regulations, which include a policy of not disclosing contractor price information.</td>
</tr>
<tr>
<td></td>
<td>• Many contractors refuse to participate in this type of bidding because it is viewed as a form of bid shopping.</td>
</tr>
</tbody>
</table>
Bid Averaging

Description

Bid averaging is a procurement method that awards the contract to the bidder closest to the numerical average of the bids submitted, typically after the highest and lowest bids have been eliminated. After contract award, normal contract administration processes are used.

Objective

- Encourage contractors to submit reasonable bids

Project Types/Selection Criteria

Ideally, bid averaging should be used for projects that attract at least 5 bidders.

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Provides a balance between cost and quality</td>
<td>• Could eliminate viable low bids if the competitive range is narrow</td>
</tr>
<tr>
<td>• Eliminates low bidders with unrealistically low bids buying the project</td>
<td></td>
</tr>
<tr>
<td>• Does not award to contractors below the competitive range</td>
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</tr>
</tbody>
</table>