A sound communication plan contributed to the success of the Claude "Bud" Lewis Carlsbad Desalination Plant project in Carlsbad, Calif., which used a design–build–operate model. *Image courtesy of Poseidon Water.*

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Contracting Models Shift Dynamics of Engineering and Construction

ALTERNATIVE PROJECT DELIVERY MODELS CAN POTENTIALLY SHORTEN A PROJECT'S SCHEDULE AND LOWER THE OVERALL PROJECT COST.

Layout imagery courtesy of Poseidon Water

Whether it's construction of a new treatment plant or a water main replacement project, successfully delivering capital projects in the water industry requires utilities, engineers, and construction experts to work together effectively. Faced with the need to address aging infrastructure and challenged by restrictive regulations, concerned citizens, and attention to budgets, the water industry needs to explore efficient and innovative models for engineering and construction now more than ever.

Compared with other (less risk-averse) industries, water and wastewater utilities have been slower to adopt alternative project delivery models, including design–build (DB), progressive design–build (PDB), construction manager at risk, and public–private partnerships (P3). Legal and regulatory hurdles may have partially slowed broader acceptance of these models, but utilities have also been hesitant to move away from the traditional design–bid–build (DBB) approach typically used in the past. Over the years, the potential cost- and time-saving benefits of alternative project delivery models have been well documented. Extensive available resources, such as those provided by the Design-Build Institute of America (DBIA 2016, DBIA & WDBC 2015, WDBC 2014), can help utilities navigate the procurement process. However, guidance on project execution—that is, how utilities, consulting engineers, and construction firms work together to design and build the work successfully under these newer contract models—is not widely available.

This article identifies some of the best practices and tools for alternative project delivery that have been tested in a variety of markets, including power generation and water. Successful alternative delivery projects always involve stakeholders who are adaptable and open to collaboration. In addition, the success of alternative project delivery often depends on integration of advanced tools and technology that create efficiencies in tracking and identifying opportunities to avoid project pitfalls.

ADAPTING TO CHANGE

As contract models shift from the traditional use of DBB, so do the roles and relationships among utility, engineering, and construction stakeholders. Under the DBB paradigm, the utility works directly with a consulting engineer, commonly referred to as the owner's engineer, to develop the design. Once the design is complete, the utility engages a construction contractor who is often managed by the owner's engineer or another construction management firm.

Within alternative project delivery models, especially DB and P3, the owner's engineer assumes the critical role of developing the scope of work and setting out the performance requirements, key technical requirements, and utility preferences and must-haves. The scope of work defines the "guard rails" that the delivery team must work within, and a well-written scope ultimately ensures the utility's expectations are met at the end of the project.

The scope of work is competitively bid through a request for proposals, and once the contract is awarded, the owner's engineer serves as a reviewer and auditor, as the design progresses, to ensure compliance with the scope of the work. However, unlike a traditional DBB model, the owner's engineer does not develop a detailed design, instead focusing on the pertinent codes and the goals for service and operation. In general, a more performance-driven design includes more flexibility, which may add cost to the project but also may create the best value for the owner over the lifetime of the assets.

Developing a detailed project design is the responsibility of the engineering partner of the DB, PDB, or P3 entity. An engineering partner is typically a subcontractor or minority partner to the main construction group, but with more advanced providers, these roles may be vertically integrated within the same company. The engineering partner focuses on completing the design to ensure compliance with the scope of work, codes, laws, and sound engineering practices in a manner that supports the construction of the project. This approach tends to result in a more construction-driven plan, but to be successful, it often requires more fluid execution of the design than is typical of DBB. For example, buried infrastructure like pipes and duct banks may be designed, approved, permitted, and built before work on some of the aboveground design elements has begun. There may be a learning curve for utilities accustomed to receiving complete design packages in 30/60/90% stages well in advance of involving the construction group, so changes or additions to utility staff to help in this regard may be a key element to the project's success.

Another shift is that the construction contractor is the key contact for the utility throughout the project, meaning that construction and buildability issues are addressed as they are identified. This review process also provides insight into where potential cost savings can be achieved by optimizing pipe layouts and building designs. In addition, the utility benefits from ongoing constructability reviews that can reduce or eliminate project delays or rework. This forward-looking management can help avoid cost overruns, which can be significant, considering that construction labor and major materials account for roughly 60% of total project costs in North America. For example, a specific amount of space is needed to get a crane on site, so accounting for this space through either sequencing the work or spacing in the project layout could avoid the costs of having to bring in a more expensive crane with a farther reach at a later stage. The construction team also has input into the level of prefabrication of major equipment, which can be a key cost item, depending on the labor market for the project.

COLLABORATION AND COMMUNICATION ARE KEY

Collaboration and communication are paramount to the success of projects using alternative project delivery. As everyone gears up for the accelerated work pace, the project team needs to acclimate quickly to their roles and understand their responsibilities and those of others. From the outset, a communication plan is necessary to effectively navigate overlapping elements of the design and construction processes. The communication plan should be a foundation for future discussions, problem-solving, and decision-making, and

The project team for construction of the Carlsbad Desalination Plant used a three-dimensional model to design the plant's reverse-osmosis building and consequently could ensure adequate spacing and safe access to machinery and instruments. *Photo courtesy of Poseidon Water*

it will likely lay out the scopes and schedules for weekly model reviews, weekly open-item meetings, special-topic task forces, and monthly management meetings.

For example, the Claude "Bud" Lewis Carlsbad Desalination Plant project in Carlsbad, Calif., which followed the design–build–operate model for project delivery, was a schedule-driven project in which tackling early construction was critical to the project's success. Essentially no gap existed between design and construction at the beginning of the project as work packages specific to procurement were released; this no-gap approach continued through the project's completion, and the continuity continued once construction began on-site. Critical underground piping was procured before detailed construction drawings were finalized, and concrete was poured within days after the first structural drawing was approved. Management of these moving parts required stakeholders to review and understand how the project elements would fit together before they had all the design information—this required not only open minds but also qualified designers and contractors capable of working collaboratively.

The shifting dynamics of project delivery represent a significant change, so utilities pursuing alternative models need to exercise flexibility and likely allocate more resources up front to facilitate the type of ongoing open dialogue needed for success. The DB entity is relying on timely reviews from the owner and its engineer, and delayed reviews signal communication problems and may indicate the project team is out of sync. Conflict won't be avoided; in fact, an environment with open, transparent dialogue will likely create ongoing tension between the construction and engineering teams as they struggle to balance cost and performance. However, this kind of creative tension can be productive, possibly leading to innovative solutions that might not have otherwise been proposed—and to meaningful cost savings for the owner.

OVERLAP INHERENT IN NEW MODELS

Simply put, the activities on a DBB project are linear, whereas for alternative delivery models, parallel and overlapping activities regularly take place. For alternative delivery, technology such as three-dimensional (3-D) modeling and real-time project management tools are incredibly important to manage and track everything occurring both on site and en route. To track all of the moving pieces, stakeholders need to update their progress and have access to the progress of the rest of the team throughout each stage of the project. In this way, the latest project management technologies and strategies can streamline the overall processes while tightening control and oversight.

3-D modeling provides an in-space platform for feedback and refinement because the project team won't have to wait for 2-D drawings to be developed before evaluating the design. It is an effective way to communicate design status because it provides a big-picture view of the entire project while efficiently collecting constructability, operations, and maintenance feedback. A good 3-D model serves as the foundation for discussion, problem-solving, and decision-making.

For example, for the Carlsbad Desalination Plant project, the designers, builders, operators, and owners frequently reviewed the 3-D model for opportunities to improve construction and long-term operations. The site was very tight (i.e., spatially constrained), so the team optimized the general arrangement and underground utilities to maintain necessary access while protecting the permanent work from potential impacts created by construction equipment and installation methods. In one case, the project team decided to encase certain portions of underground supply and treatment plant fiberglass piping in concrete to protect them during construction and from cranes and trucks moving equipment during future operations and maintenance; this strategy was identified through a collaborative environment in which the project stakeholders discussed their needs and used them to make project decisions. In reviewing the 3-D model for the reverse-osmosis building, the team was also able to visualize how construction and operations personnel would access and maintain the facility with equipment (membranes inside the building are shown on page xx). Through this process, the team was able to provide sufficient spacing, access stairs, and platforms to safely reach the facility's various pumps, valves, and instruments while also performing clash detection to eliminate costly rework in the field.

Beyond 3-D modeling, other state-of-the-art tools allow engineering, construction, and utility owners to track project costs, schedule in real-time, and make data-driven projections. When adjustments are made to such models, the changes are almost immediately reflected in the cost, quantities, and schedule. Moreover, as construction is executed, these advanced claiming systems accurately reflect the progress of the job and allow superintendents and foremen to understand not just where delays might blossom into change orders, but also how to potentially avoid them. For example, if an additional 100 lin ft of pipe is added to the design, the system will automatically adjust the project's budget and schedule, generating short- and long-term forecasts to ensure the project stays on track while providing an early warning of potential risks or delays.

A PROMISING NEW PATH

Shifting away from a traditional DBB approach can be daunting; however, the water industry has proved that the switch to alternative project delivery models can potentially shorten a project's schedule and lower the overall project costs. Further optimization in alternative project delivery is expected as more utilities, consultants, and constructors adopt and improve these innovative approaches.

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