Design-Build:
Delivering Success

Time savings, cost savings and control make the delivery method attractive for all types of projects.

The benefits of design-build delivery touch all types of projects. Some recent Burns & McDonnell examples (clockwise, from top left): membrane filters at the new water treatment plant in Westminster, Colo.; Bosque Units 1 and 2 simple-cycle exhaust duct and stack (foreground), with the Unit 3 heat recovery steam generator addition in Laguna Park, Texas; robotics equipment at the Lockheed Martin coatings facility for the F/A-22 Raptor in Marietta, Ga.; interior of the high bay with special coatings that houses the process system for the Electric Boat Controlled Industrial Facility in Groton, Conn.

"It's nice to have that single point of responsibility."

The designer and the construction manager point fingers with the aplomb of two 8-year-olds placing blame for a broken vase.

"It's his fault we're behind, not mine."

That's a scenario that has owners eyeing the design-build method of delivery with interest. A single source of responsibility eliminates finger-pointing and keeps a project on track better than any other delivery method.

Owners also like knowing the full cost of their project early in the process – generally when just 30 percent of design is complete. They can also establish their level of involvement in the project – deciding whether to be hands-on or not, or whether to focus on design instead of the day-to-day supervision of subcontractors.

First Steps

Wheaton College, Wheaton, Ill., needed a new central heating and cooling plant. The project required a 10,000-square-foot facility designed to house four chillers (totaling 3,600-ton capacity) and four steam boilers (2,550 hp in all).

Design-build allowed the owner more time for key decisions – such as the controls design – because the entire design didn't have to be complete before contracts were awarded. That creates cost savings because potentially expensive change orders, often a part of traditional construction delivery methods, are avoided.

"At Wheaton, the owner wanted to be very involved with the design process. He was part of it throughout the construction process," says Rich McKown, BMcD project manager. "The owner also appreciated the increased control over the selection of subcontractors. By using design-build and awarding multiple bid packages, we were able to use subcontractors the owner had worked with and trusted and still provide a competitive price."

The owner, who was new to the delivery method, also benefited from having a single contact to call for information.

"If the engineering firm and the construction firm have disagreements, we as the owner can be in the middle of that. It's nice to have that single point of responsibility," says Jack Swanson, project manager for the Wheaton College Physical Plant. "It has worked well as a team concept between Wheaton and Burns & McDonnell."

A new central heating and cooling plant for Wheaton College, Wheaton, Ill., incorporates a plate and frame heat exchanger (above) and two 600-ton centrifugal chillers (below left).

"Integrated approaches allow for 'best field practices' to be incorporated into the design, making the process more efficient over time."

Wheaton College's central plant features chilled water pumps (top) and a surge tank and boiler feed water pumps.

"All contractors participate in the design process. It's value engineering all the way."

Quantifiable Benefits

The benefits of design-build were examined by Penn State University and the Construction Industry Institute (CII). Design-build outperformed the design-bid-build and construction management at-risk delivery methods in the key areas of cost, speed and quality.

Design-build projects on average cost 6 percent less than design-bid-build and were delivered 33 percent faster.

"When you have a fully integrated engineering and construction team experienced in working together under one roof, it eliminates communication problems between designers and constructors," says Ed Beeman, BMcD manager of estimating and preconstruction services in the Construction Group. "Integrated approaches allow for 'best field practices' to be incorporated into the design, making the process more efficient over time."

Additionally, design-build delivery isn't restricted by project size.

"Burns & McDonnell does all sizes of design-build projects," says Ed Mardiat, BMcD director of combined heat and power development. "The project methodology is the same. But the approach is tailored to the client's specific needs. That's the advantage of design-build."

The Penn State/CII analysis also showed that design-build exceeded quality expectations at all levels of the study, which examined 351 projects in six market sectors.

Consistency and Quality

Quality and precision are important in most construction, perhaps most of all in military aircraft engineering.

Lockheed Martin called on Burns & McDonnell in 1999 for the first of many projects related to the F/A-22 Raptor. The 78,500-square-foot Robotics Coating

The conversion of Bosque Unit 3 from simple cycle to combined cycle was completed in just 14 months, shaving three to five months off a typical schedule and allowing Mirant to meet peak summer demand.

Facility, completed in December 2000, was designed to house a robotics system for applying coatings essential to the fighter jet's stealth capabilities. The facility, which won a 2001 national Design-Build Institute of America Excellence Award, includes heating, ventilating and air conditioning systems. The required levels of precision and control are practically unheard of in this type of industrial facility.

"Design-build allows us as engineers to ensure that design specifications and construction work together to meet project demands. In design-build, you don't have any excuses because you are in control of the job – all the issues, all the processes, all the subcontractors," says Bill McCully, project manager in the BMcD Aviation & Architecture Group.

"With the Robotics Coating Facility, we were required to guarantee temperature and humidity controls, almost like a lab or pharmaceutical facility. We met those requirements with little or no trouble. The project would have struggled under other delivery methods."

Shortened Schedule

And those struggles would have led to a lengthened project delivery period.

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The design-build delivery method works well for Lockheed Martin," says Jim Julo, project manager in the BMcD Construction Group. "The value we bring through design-build is that we have been able to deliver projects ahead of Lockheed's aggressive schedules. A few months after design is started, we're already breaking ground."

The allure of a shortened project schedule catches nearly every client's eye when considering the design-build method of delivery. Most owners cite that as the major advantage of design-build. The idea of being in a new facility earlier – particularly if it involves earlier production on a revenue-generating product or process – is appealing.

That's why design-build was the solution for energy company Mirant when it saw an opportunity to boost

It's the seemingly small things that can cause big trouble

That's the point of a new design-build service offered by the Burns & McDonnell Environmental Studies & Permitting Group (ES&P). Storm Water Pollution Prevention Plans (SWPPPs) and associated storm water permits are required for any construction or development project that disturbs one or more acres.

The traditional ES&P role has been to prepare the SWPPP – spelling out how erosion and sediment discharge will be managed at the job site. Then, construction personnel familiarize themselves with the plan and implement it.

"Now, with the additional design-build option, we have the ability and staff to implement the plan," says Jimmy Smith, project manager for ES&P and a Certified Professional in Erosion Sediment Control. "This allows construction personnel to focus on production while we focus on regulatory compliance. We provide an environmental inspector to see to it that we adhere to permit conditions from construction through final stabilization."

The risks to the client are minimized, relieving concerns about increased regulatory inspections coming as a result of burgeoning public awareness about environmental laws designed to protect water quality.

"Construction projects contribute more sediment to water resources than any other activity," Smith says. "This design-build service allows our clients to satisfy environmental regulations and still keep productivity high."

output of its Bosque Unit 3 in Laguna Park, Texas. To do that, it would have to convert the simple-cycle GE 7FA unit to a combined-cycle process. The catch: It had to be done in 14 months, rather than the typical 18 to 20 months, for Mirant to capitalize on peak summer demand.

Flexible scheduling was key to meeting that timetable, with limited opportunity for off-line work. The adaptation of three-dimensional modeling technology enabled designers to jump-start construction and optimize space.

"We were able to do it because there was no finger-pointing," says Rich Carvajal, project manager in the BMcD Energy Group. "When problems came up, we fixed it as a team. We also were able to be more flexible in our process because we were a complete team."

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The project was completed on schedule, allowing Mirant to provide power to the grid as planned. The adjustments to the schedule even allowed Mirant to minimize the impact of a water quality problem that arose during the process. A closed cooling water system minimized costs by eliminating the need for an extensive water treatment facility.

Lower Costs

All clients are concerned about overall project costs, but municipalities may be among those most sensitive to dollar amounts.

When the city of Westminster, Colo., requested proposals for a new water treatment plant, it was working on a 30 percent design estimate of about $27 million for a 10 million-gallons-per-day facility. That was up from a preliminary cost estimate of $18 million.

Through a design-build contract with Burns & McDonnell/Garney LLC, the city got a 15-million-gallons-per-day facility at a cost of $20.8 million. The reduced price tag cut the per unit cost from $2.70 per gallon to $1.39.

"All subcontractors participate in the design process. It's value engineering all the way," says Paul Fischer,

The Electric Boat Controlled Industrial Facility, Groton, Conn., is used to maintain and service Navy fleet vessels such as this submarine.

The award-winning Bayer Central Administration Facility, Shawnee, Kan., features 50,000 square feet of offices, conference rooms and cafeteria facilities.

Delivering Excellence: Award-Winning Projects

Austin Energy Cooling, Heat and Power Packaged Plant
Texas Council of Engineering Companies
2005 Silver Engineering Excellence Award

ConocoPhillips Low Sulfur Gasoline Project, Ponca City, Okla.
Design-Build Institute of America (DBIA)
2004 Design-Build Excellence Award

MGP Ingredients Inc. Ethanol Distillery Rebuild
DBIA Mid-America Chapter
2004 Design-Build Excellence Award

Cook Composites & Polymers Polyester Powder Coating Facility
DBIA Mid-America Chapter
2003 Design-Build Excellence Award

Naval Facilities Engineering Command F/A-18 Corrosion Control Facility
2002 Certificate of Commendation

Bayer Central Administration Facility
DBIA Mid-America Chapter
2002 Design-Build Excellence Award

Westminster Northwest Water Treatment Plant
Colorado Construction magazine
2002 Top Infrastructure Project

Lockheed Martin F/A-22 Robotics Coating Facility
DBIA 2001 Design-Build Excellence Award
American Council of Engineering Companies
2000 Nationwide Engineering Excellence Award
Kansas Consulting Engineers
2000 Engineering Excellence Award

SEI-Wisconsin 300-Megawatt Gas-Fired Peaking Plant
American Society of Civil Engineers
2001 Wisconsin Achievement Award

Kansas City International Airport (KCI) Apron Rehabilitation
American Concrete Pavement Association
2001 National Pavement Award
Missouri/Kansas Chapter American Concrete Paving Association
2001 Excellence in Paving Award

vice president of the BMcD Denver office. "There is a tremendous enhancement in quality as well. We get to choose outstanding vendors and subcontractors, while providing a single source of responsibility for the municipal client."

"Value engineering" led to the incorporation of enhanced conventional sedimentation with advanced membrane technology, leading to the increased capacity.

"The city is very pleased with the level of innovation and technology provided at a very economical cost," says Ron Hellbusch, the now-retired Westminster director of public works and utilities. "It's a tribute to the entire project team."

Conflict Resolution

Of course, even the best-laid plans can be thrown off course.

As the design-build contractor for a Controlled Industrial Facility for Electric Boat in Groton, Conn., Burns & McDonnell hit a few stumbling blocks – or rocks – early in construction.

"Soil reports didn't indicate rocks in the ground on the site, but we encountered boulders – Volkswagen size – during excavation. But we were able to meet and quickly have a recovery plan put together, using our scheduling and cost control software," says Charles Sun, project manager in the BMcD Construction Group. "With traditional delivery methods, you could have had a lot of time spent looking for blame. But with design-build, it was simply the project's problem. We addressed it as a team."

The project was completed a month early in February 2004, despite an advanced schedule that had already reduced delivery by as much as four months compared to typical methods.

"I think the design-build concept allowed the project to continue with production while the design team was making real-time changes as the events unfolded," says Paul Aas, Nuclear Operations staff engineer for Electric Boat, a subsidiary of General Dynamics.

"With that kind of team orientation, they were really representing Electric Boat. When they subcontracted, they were really looking out for our interests. This was our first experience with design-build on a facility. We were very happy with the outcome. This is as good as it gets."

For more information, contact Don Greenwood, (816) 822-3118.