

The Modular Advantage: Accelerating Industrial Projects with Greater Certainty and Control

How Advanced Off-Site Execution is Redefining Industrial Project Delivery

By Dhaval Patel | May 2026

INTRODUCTION

Building Smarter in a Market Defined by Uncertainty

In today's capital project environment, owners and EPCs face unprecedented pressure to deliver complex industrial facilities faster, safer, and with greater cost certainty, amid constrained labor markets and volatile supply chains. This is even more critical for technology companies providing novel solutions to sustainable and circular-economy projects. Traditional stick-built construction relies heavily on field labor, sequential work paths, and site-specific productivity variables. As projects grow more complex and labor markets tighten, this model increasingly exposes owners to schedule risk, cost escalation, and safety concerns.

Modularization has emerged as one of the most effective execution strategies to address these realities. By shifting construction scope from the field to controlled fabrication environments, modularization eliminates site permitting requirements as a predecessor to construction mobilization and enables parallel execution, higher labor productivity, reduced site risk, and measurable cost savings. When integrated early into project planning and engineering, modularization is not simply a construction technique - it becomes a strategic differentiator for project delivery.

At The Shaw Group, modularization is integrated into project strategy from the earliest phases of engineering and project development. By combining multidisciplinary engineering, estimating, fabrication, and constructability expertise, Shaw delivers optimized execution strategies that improve project performance while reducing total installed cost, schedule exposure, and execution risk.

Shaw's proven modularization framework is reinforced through detailed engineering and estimating case studies that highlight measurable improvements in project efficiency and predictability. The results demonstrate how optimized modular design can reduce module count and overall volume, increase fabrication completion, lower total installed cost, and enhance both safety performance and execution certainty.

WHY MODULARIZATION?

How Modularization Improves Safety, Productivity, and Predictability

Today's project developers consistently prioritize three critical outcomes within their capital projects:

1. Safety performance
2. Cost Certainty; likely a Lump-Sum Execution Strategy
3. Schedule certainty and predictability

Increasingly, licensed technology providers and data center developers want to understand how to develop a product with a “design once - build many” approach to minimize recurring engineering and design costs and scale their implementation accordingly.

Modularization directly addresses these priorities through:

- Controlled fabrication environments that reduce weather-related disruption and improve productivity by 15-50%
- Lower cost of labor compared to on-site craft, especially for projects with challenging labor availability near project sites.
- Reduced requirement for site labor.
- Reduced laydown area requirements - module deliveries can be planned based on the site schedule.
- Parallel path execution for shop and field activities, thereby reducing the schedule.
- Up to 30% reduction in material waste.

However, modularization delivers the greatest value when project owners and EPCs incorporate it early in the engineering process, ideally during FEL-2. Integrating modularization from the outset ensures the facility is strategically designed to maximize fabrication efficiency, constructability, and overall project performance. If modularization is introduced later in FEL-3 or during detailed design, projects can still realize modular execution benefits; however, additional engineering, layout, and constructability challenges may impact overall efficiency and cost optimization. Late-stage modularization often results in skidded equipment packages, unoptimized pipe rack configurations, and increased pipe and cable routing, all of which can add material quantities, complexity, and installation costs. Simply placing “module” boundaries around conventionally designed field-installed systems does not fully capture the strategic value of modularization and may limit the overall benefits the approach is intended to deliver.

While modularization offers significant advantages, it is not a one-size-fits-all approach. Logistics play an important role, and the maximum transportable envelope to the site is an important factor to consider. At Shaw, the modularization strategy for a project balances maximum allowable dimensions, site labor availability, and cost and schedule requirements. Typically, each project executed by Shaw incorporates a hybrid design and approach, thereby leveraging the benefits of both modular and stick-built approaches.

Successful modularization follows a structured process that prioritizes equipment placement, defines shipping envelopes, optimizes tie-in locations, and integrates constructability and operability reviews throughout design.

MODULARIZATION CASE STUDY

Optimizing a Gulf Coast Carbon Capture Project

Shaw performed a modularization study for a well-known international EPC for a planned CCS on the US Gulf Coast. The EPC had developed its own modularization philosophy and contacted Shaw to further optimize the layout. Shaw required only PFDs, P&IDs, a Size Equipment List, and a Site Plan with any potential transportation restrictions on site. For the study, Shaw developed the following:

- Plot Plan
- 3D Model
- Desktop Transportation Study
- Bill of Materials
- Detailed Module List
- AACEI Class 4 Estimate
- Constructability Reviews
- Maintenance Access Review Sessions

The results of the modularization study are provided in Fig. 1 below. Shaw's optimization approach demonstrated significant modularization benefits, improving execution efficiency while enhancing cost and schedule certainty for the project developer and EPC.

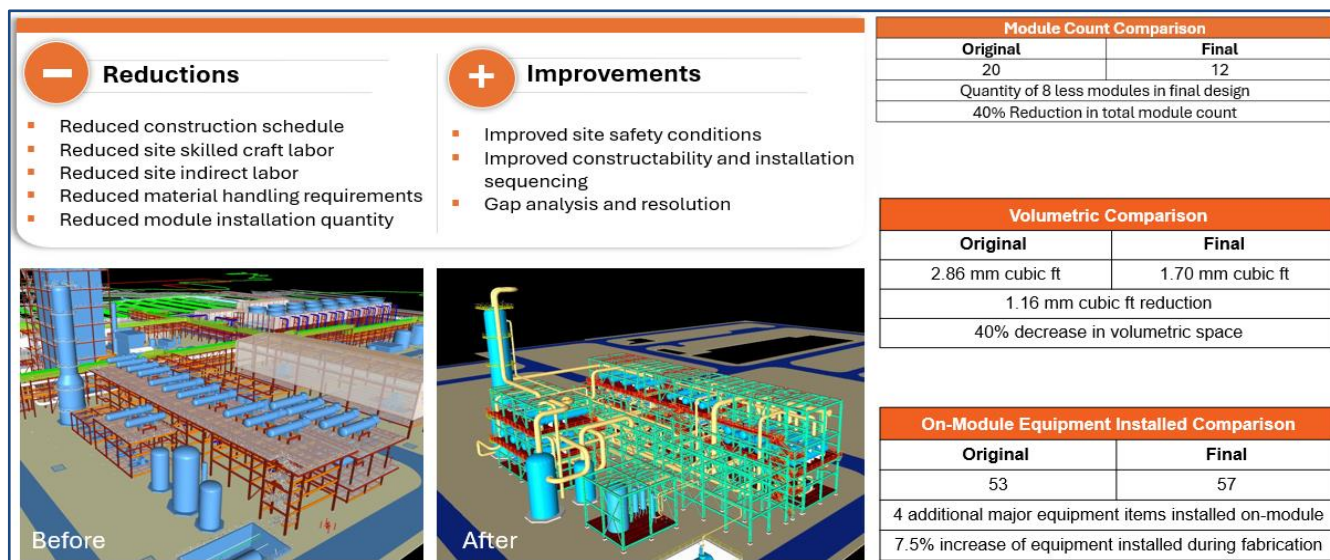


Fig. 1: Modularization Case Study

Across multiple studies performed by Shaw, results have consistently demonstrated reductions in overall pipe and cable quantities, along with schedule compression ranging from three to six months. These improvements reduce site indirect costs and significantly reduce on-site craft labor requirements.

In certain applications, Shaw has achieved plot space reductions of approximately 60% while decreasing pipe and cable routing by up to 20%. These efficiencies can have a substantial impact on overall project economics and, in some cases, may influence the project's overall commercial viability.

ESTIMATING CASE STUDY

Quantifying the Value Beyond the Jobsite

Like in the engineering case study, Shaw performed a comparative estimating analysis for an active project to evaluate the potential costs of stick-building a pipe rack versus modularization. This estimate was developed for a US Gulf Coast project and has been normalized to a total installed cost (TIC) for a 150'L×10'W pipe rack, based on the figure below.

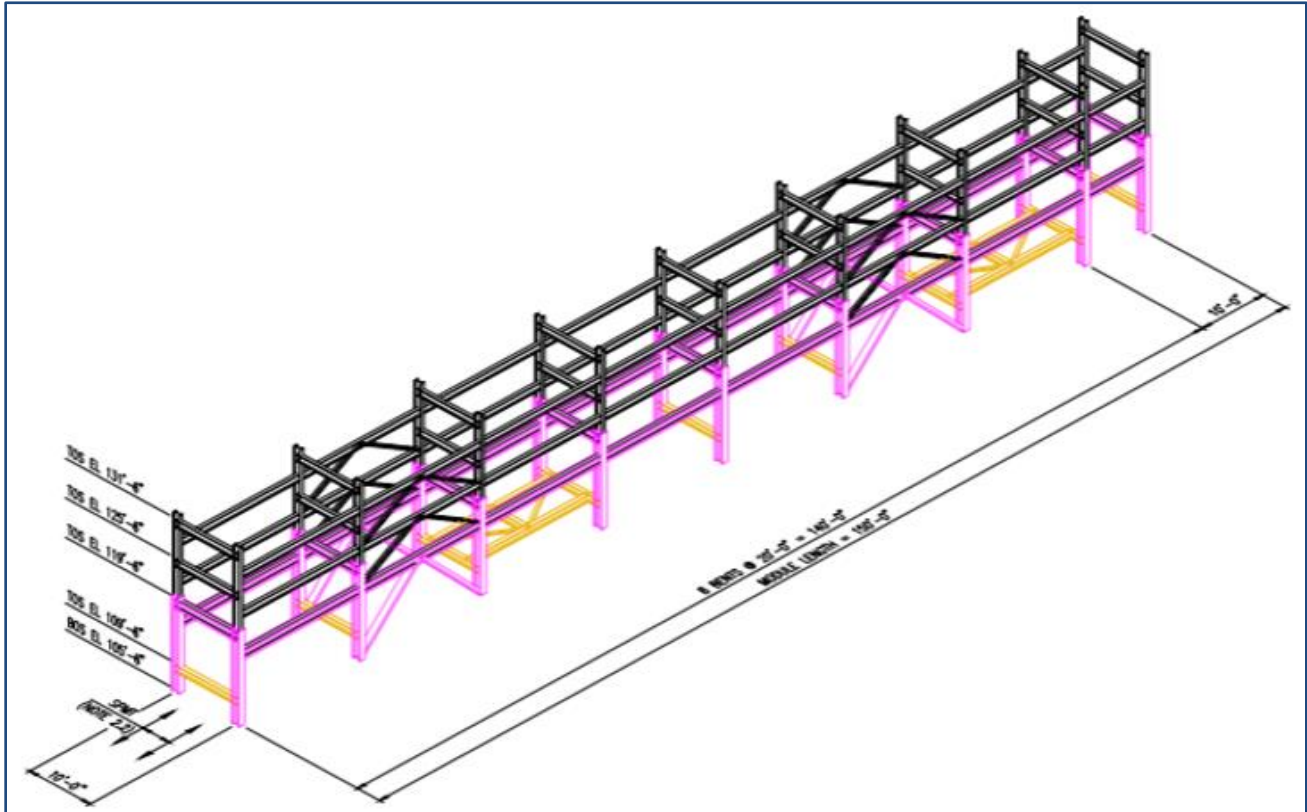


Fig. 2: Pipe Rack Estimate Reference

The table below highlights the results from this study by comparing TIC for a stick-built pipe rack versus a modular pipe rack. While a modular pipe rack typically requires additional structural steel than a conventional stick-built design, the increased material cost is offset by gains in fabrication productivity and the resulting efficiencies achieved in a controlled shop environment.

Stick-Built		Modularized	
Total Tons	928	Total Tons	1,032.2
Total Cost	\$22,637,576	Total Cost	\$18,785,548
\$/Ton	\$24,394	\$/Ton	\$18,200

The study demonstrates that the TIC for a stick-built rack is over 20% higher than the modular rack. For fully preassembled process modules, the potential savings are significantly higher, as the amount of site equipment and craft required to install process equipment is much greater than that for pipe racks.

MODULE DESIGN OPTIMIZATION FRAMEWORK

Designing Facilities for Repeatability and Growth

Successful modular execution is driven by a disciplined and strategic engineering approach that integrates constructability, operability, and fabrication requirements throughout project development.

Key elements of Shaw's modularization methodology include:

- Defining maximum and preferred module envelopes
- Performing modular optimization reviews on PFDs or P&IDs
- Prioritizing equipment and utility systems based on modular suitability
- Strategically integrating rotating equipment within process modules
- Optimizing tie-in locations to simplify field installation
- Validating maintenance access and operability with operations teams
- Conducting continuous constructability reviews throughout design development.

This framework ensures that each module is engineered to maximize fabrication efficiency, streamline installation activities, and maintain long-term operational flexibility and reliability.

CONCLUSION

Modularization as a Strategic Competitive Advantage

Modularization is no longer an alternative delivery method; it is a strategic execution choice for project owners seeking schedule certainty, cost control, and reduced risk. When applied early and executed with discipline, modularization:

- Improves safety performance
- Lowers total installed cost
- Compresses schedules
- Enhances predictability across the project lifecycle

The results throughout this analysis demonstrate that strategically optimized modularization consistently outperforms traditional construction on both technical and commercial grounds.

Backed by extensive experience in modular facility execution, The Shaw Group provides fully integrated engineering, procurement, and fabrication (EPF) solutions supported by highly experienced multidisciplinary engineering, design, estimating, and fabrication teams. From early concept development through fabrication and final project delivery, Shaw delivers turnkey execution strategies focused on safety, quality, schedule certainty, and cost efficiency.

In addition, Shaw's ISO 9001-certified fabrication facilities reinforce our commitment to quality assurance, execution excellence, and successful project outcomes.

To learn more about Shaw's modularization capabilities and integrated project delivery approach, please contact:

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