Engineer–Procure–Construct (EPC) Delivers a Complete Project Solution

EPC is the widely used acronym for the project delivery method known as engineer-procure-construct. It has much in common with design-build, including single source responsibility for design and construction, fixed price contracts, and broad assumption by the contractor of the risks of cost, schedule and performance.

However, EPC has certain unique features which render it highly applicable to a distinct cohort of project types and distinguish it from other delivery methods. It is particularly applicable to manufacturing facilities, those whose purpose is to produce a specific product or products from raw or unfinished materials. Traditionally, the principal industries served have included chemicals and petrochemicals, oil and gas, electric power, metals, mining, and pulp and paper; however, pharmaceutical, automotive, aerospace, food and beverage, consumer goods, and paper converting, among others, are facility types appropriate to EPC contracting. It is to this latter group of project types that this paper is oriented.

The three most important differentiators distinguishing EPC from mainstream design-build are first, the EPC contractor is generally responsible for process design, including specifying, procuring, and installing all process and packaging equipment; second, the EPC contractor provides guarantees as to the performance of the completed facility, usually in terms of quantity and quality of the product; and third, EPC delivery provides even greater time and cost savings by integrating more design and construction activities into the process.

The preliminary design phase in EPC is process intensive, with process technology and design driving that phase. Although they may vary widely in scope and duration depending upon process type and scope, certain elements are common to this phase. Performance requirements are set, major equipment items are evaluated and selected, conceptual design is prepared, schedule is established, and guaranteed maximum cost may be determined. Equipment manufacturers are often important participants, and long lead time equipment may be purchased during this phase. At the completion of this phase the owner and contractor will enter in to a lump sum or guaranteed maximum price contract, if design is sufficiently complete.

Subsequently, building design and construction proceed much as in conventional design-build, but the design, procurement, installation, and startup of process equipment drive the project. Careful coordination among equipment vendors is required, as usually there is not a singular vendor for all of the critical process equipment. Detailed design is based upon the process equipment selected and purchased, and equipment requirements must be reflected in the areas of structural loading, electrical loads, water and wastewater quality and quantity, lighting requirements, indoor air characteristics, and requirements for refrigeration and other process utilities such as chilled water, steam, vacuum, and compressed air. In many cases, air pollution requirements and permitting must be addressed.

Building design is usually secondary to system design in EPC projects, and is developed following the process engineering; however, it is not to be unduly subordinated. The building's architecture may indeed express the processes contained within it. In any case, building design should be thoughtfully and creatively carried out, optimizing cost, sustainability, and finished aesthetics.

Negotiation and preparation of EPC contracts with the owner require a higher degree of sophistication than ordinary design-build contracts. This is primarily due to the performance guarantees which EPC contracts contain. Performance targets and corresponding penalties are often staggered, i.e. multiple dates are established for achieving increasingly higher output until the final target is met. Often, performance must be sustained for a specified period of time.

Accordingly, performance guarantees and penalties should be reflected in contracts with vendors and subcontractors to the extent possible, a process which must begin at the early stages of vendor selection and negotiation. Performance requirements should be

rigorously defined and fully understood by equipment manufacturers and vendors. As a single piece of process equipment can affect performance of an overall line, interface, interconnection and buffering of the various elements must be carefully coordinated.

Startup and commissioning are more demanding in an EPC environment. Equipment startup and testing should begin at the earliest point possible, including factory acceptance testing (FAT) and site acceptance testing (SAT) for individual machine centers. For an entire process system, startup and commissioning begin after mechanical completion (defined as all physical elements installed and statically tested) is achieved and continue until commercial operation (meaning specified production performance) is achieved. Mechanical completion, commercial operation and intermediate performance milestones must be carefully understood and defined in EPC contracts, as they will represent triggers for liquidated damages, and often milestone payments.

Personnel-wise, the position of project director is the lead position under an EPC contract and is critical to project success. The incumbent must possess the usual skills in design, construction and management, but also must have experience and knowledge in process engineering. The process design leader must possess deep knowledge of the technology, processes and equipment of the specific industry. Engineers leading the design disciplines must have appropriate process experience, must understand how equipment requirements affect their disciplines, and must be skilled in working with equipment suppliers. Construction project managers must manage more "moving parts" and be keenly aware of the interconnectedness of building, utilities and equipment components. Superintendents must be able to step well beyond building construction, and be able to supervise and coordinate a larger number of trades, and more complex ones, than usual.

Additionally, there are a number of other positions required for EPC projects, including procurement managers, expeditors, testing and inspection specialists, millwright supervisors, mechanical and electrical supervisors, and startup technicians. Generally speaking, the sheer number and complexity of dedicated management, supervisory and technical staff on EPC projects will significantly exceed that of a similarly sized design-build engagement.

A related topic is that of EPCM, which stands for engineer-procure-construction manage. This delivery method is being promoted by certain interests, particularly engineering firms which lack the financial capacity to guarantee firm cost. EPCM is essentially design plus agency CM, promoted as an EPC variant. The owner enters into contracts for all equipment purchases, construction materials, and trade packages upon recommendation of the EPCM contractor, who has no contractual liability for schedule, cost or performance.

EPCM may be appropriate for foreign country engagements, where it is often practiced, or where circumstances make it impractical to guarantee cost and/or process equipment performance.