



CLEARWATER CONSULTING PARTNERS

Owner's Engineering Services

Every project contains relative risks in terms of general ideas, capital expenditure, operation, safety, and performance. As with any capital-intensive project, it is important to understand all facets and identify risk areas to institute appropriate control measures. An initial, qualified review or feasibility phase for any project lays the groundwork to identify not only the opportunities available, but also the risks that will endure with the project once it begins. Continued, effective project management and monitoring ensures the project success.

Value Provided by Owner's Engineering

Owner's engineering is the work an owner would and should do in support of all phases of process development and project execution if they had the appropriate staff and resources to do so. The owner's engineer is an advocate of the owner's business objectives from the inception of the project, independent of the interests of other commercial parties and public authorities. This improves project definition, minimizes scope changes and enhances the results of transactions and interactions with contractors, suppliers and public agencies throughout the course of the project.

Owner's Engineering Scope

The scope of the owner's engineer can vary depending upon the specific requirements of a project and the owner's ability to execute various tasks. Initially, owner's engineering should include proper project definition, process assessment, preliminary engineering, a feasibility study and, ultimately, a detailed scope and estimate. These front-end engineering activities are of vital importance to the overall outcome of the project.

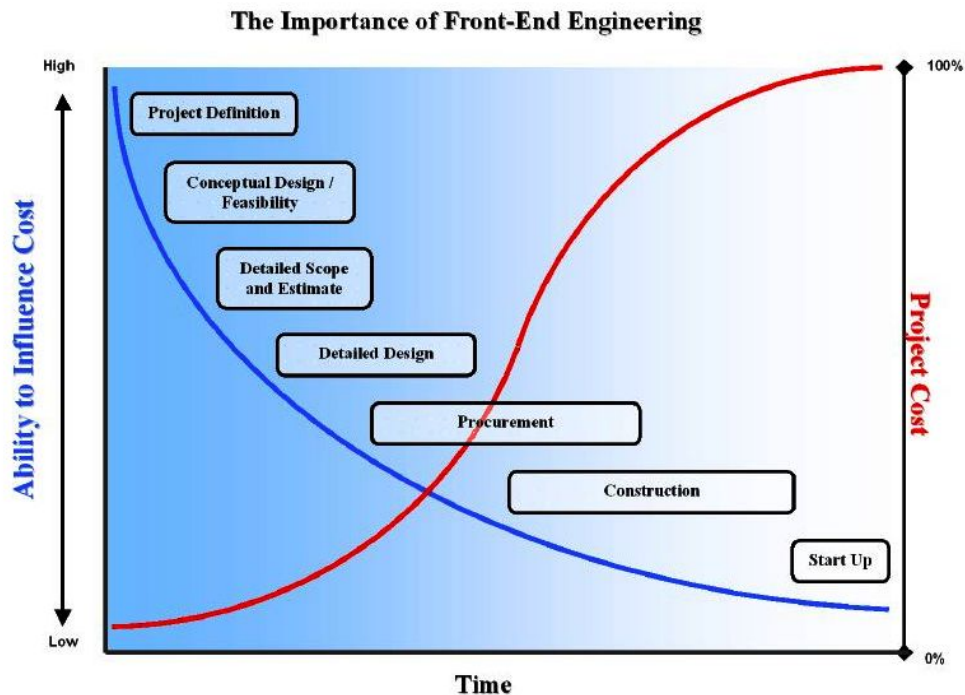
In addition, owner's engineering usually encompasses project planning, overall project management, estimating, and contract administration. Depending on the type of construction contract, owner's engineering may also include detailed design, procurement, construction management services, and assistance with plant commissioning and start-up.

Front-End Engineering

Front-end engineering is about aligning an owner's business objectives with a perceived marketing or technical opportunity and turning this into a well-conceived capital project. It is also about establishing process and project feasibility and a concrete scope of work. As shown on the following chart, it is these activities that have the most profound effect on determining the overall project cost.



According to Chemical Engineering magazine, 80% of project capital costs and 98% of operating costs are typically committed by the completion of front-end engineering design.



[source: Chemical Engineering magazine]

Initially, front-end engineering seeks to translate marketing and/or technical opportunities into a project definition. Process viability may need to be assessed and economic feasibility of the process and/or the project in general must be determined. Once preliminary feasibility has been established, a more detailed project scope is defined and an estimate is produced. Preliminary engineering documents, project schedule, site selection, and permitting activities are a part of this detailed scope and estimate. These help further sharpen the project focus and define the project sufficiently to secure capital appropriations or debt financing.

Although this front-end engineering is preliminary in comparison to the detailed design phase that comes next, it is critical for controlling costs. Independent studies have determined that "funds expended in front-end planning, design, constructability, etc...resulted in lower costs for construction, start-up, long term maintenance and operability." Why? Because the scope is well-defined and less susceptible to costly design changes and scope creep and because a well-conceived plan of execution has been established. Furthermore, long-lead activities such as process development, site selection, and the acquisition of environmental and operating permits will be well underway and, thus, will not result in project delays.



Often, the sheer number and complexity of interrelated tasks during this front-end phase seeming like a daunting and complex puzzle. Furthermore, owner-operators, entrepreneurs and project developers often do not have the staff necessary to handle these myriad tasks in a timely manner.

This is the right time to bring on an owner advocate such as the owner's engineer. However, an owner's engineer is often overlooked in this critical front-end phase. Owners are often lulled into the apparent simplicity of sole-sourcing all project activities from front-end engineering through project completion to an engineering, procurement, construction (EPC) contractor.

This often results in less than optimal project definition. Published reviews of more than 2,000 projects representing more than \$300 billion in investment, concluded that the penalties for such projects increase rapidly with poor definition. Where the owner does not have sufficient expertise or engineering staff, it is critical for the owner to engage an owner's engineer to perform front-end engineering.

Following front-end engineering activities, the project then enters the detailed design and construction phase. A comprehensive range of activities for an owner's engineer would include the detailed design, procurement, construction management, plant commissioning and start-up. At a minimum, owner's engineering should include project planning, overall project management, site support, estimating, and contract administration.

Often owners elect to award most of these detailed design and construction project activities to a single EPC contractor in the form of a lump-sum contract. However, historical project analyses indicate that it is not always beneficial to do so without significant owner involvement or an owner advocate such as an owner's engineer. It has been demonstrated that EPC lump-sum contracts are frequently "significantly more expensive than average."

The contracts are constructed so as to attempt to transfer project cost risk from the owner to the contractor. The net result, however, is that the contractor will do everything to overestimate the job, or the contractor is going to risk major losses. If the decision is made to engage an EPC contractor, the owner's engineer can support the qualifying and selection process and define standards of performance and criteria for the execution of the project.

The owner's engineer can further define quality standards by specifying materials, fabrication standards and equipment for procurement, qualifying vendors, and supporting the bidding/selection process. The owner's engineer can then review the EPC contractor's detailed design and track progress against the project schedule. The EPC contractor's work and that of any third party vendors can then be monitored and documented for conformance to defined quality standards. Finally, the owner's engineer can engage in factory acceptance tests, execute commissioning and start-up activities, and design and carry out plant performance trials.



Typical Owner's Engineer Activities

During the early stages of a project Clearwater's engineers can provide added value when acting in the role of Owner's Engineer. Such activities may include:

- Review the project scope (if defined)
- Define the project scope (if not defined)
- Review the scope with the business objectives
- Conduct site selection and assessment studies
- Assess capital budgets.
- Identify Health, Safety and Environment (HSE) issues
- Identify and evaluate technological alternatives.
- Research additional technology development
- Prepare owner's design criteria for use in detailed engineering
- Prepare project schedules

These initial activities define the project scope and help minimise costly changes and define a path for effective project management, coordination, and monitoring.

To manage the project, the owner's engineer can:

- Provide part or all of the engineering development
- Provide detailed engineering,
- Oversee the work of other engineers/contractors
- Identify and manage SH&E projects
- Represent the owner's interests

This keeps the project true to business objectives, schedule, and budget—increasing the project success and profitability.

Maintaining a diverse engineering department that includes design, analysis, safety, and quality engineers can be expensive. Consequently, many companies today do not maintain their own engineering staff. But they still need the engineering services, so owners turn to contractors for design and construction assistance.

Clearwater Consulting Partners offer a diverse, added-value approach to engineering. We work with clients to identify, manage, and/or provide engineering and project management services at each stage of a project with qualified professionals.

Clearwater engineers review completed work packages and designs for HS&E, constructability, and compliance including:

Initial Project:

- Feasibility studies
- Site selection
- Preliminary engineering



- Design reviews - architectural, civil, structural, mechanical, electrical, and instrumentation
- Plan reviews
- Inspections
- Structural design and review
- Building permit reviews
- Detailed engineering and procurement
- Prelim design and cost estimate to scope project
- Life expectancy evaluations

HS&E Analysis and Monitoring:

- Serve as focal point on safety policy
- Manage comprehensive safety oversight plans
- Perform line management assessments
- Compile, review, analyse, and monitor safety performance data
- Develop & coordinate technical standards
- Conduct design and safety system oversight
- Provide technical leadership in safety disciplines
- Maintain awareness of site safety
- Review/approve safety basis documents and design analyses

Project and Construction Oversight:

- Construction & project management
- Review/monitor the detailed engineering, construction, commissioning and plant start-up efforts
- Start-up and ongoing operations
- Project development
- Consulting engineering
- Environmental permitting and licensing (and Environmental Impact Assessments)

Summary

Various published studies have concluded that those companies that have managed to perform above average in capital project efficiency have “all maintained some form of central organization that is responsible for providing the organization of the work process for front-end loading” and “a skilled resource pool in a number of core competencies.”

Many companies do not have these central organizations available to them. That is where retaining an owner’s engineer to provide these services on behalf of an owner can enhance the definition and management of capital projects and the outcome of EPC contracts all the way down to the bottom-line.