preprocessinc

Chemical Engineering for Entrepreneurs

Chemical Engineering Basics for Investors

The United States is exploding with chemical engineering opportunities. The unlocking of feedstock reserves and the need for critical material technology has opened the perspective of many investors and technical leaders to the possibility of a sustained run in the next round of investment in the American chemical industry. This time around, deals are done with the environment and the non-conventional methods of extraction, reaction and separation at the forefront of the action.

The evaluation of the financial merits of a chemical engineering opportunity is directly tied to the claims and performance of the proposed system. Routinely, investment due diligence teams bring industry experts to the team to evaluate the process and design details. Most times however, members of the evaluation team are not familiar with the definition of terms, nor some of the basic ground rules in the chemical engineering application world. Many times teams can be enthralled with an idea off the bench that has all the merits of a valuable investment, but not having the familiarity with the terms and methods being discussed, the team sometimes loses the ability to have a richer discussion which may lead to better approaches or might save the team from recommending an investment that has little merit on a large scale.

Topics to discuss and questions to ask come from years of chemical engineering experience, and the need for seasoned evaluators for the due diligence teams will not be replaced. The value in having a basic understanding of the terms and methods of chemical engineering even though not being actively practiced by the financial and legal colleagues on the team is the ability to engage in the conversation and confidently ask the critical questions of the team so that better evaluations and more collaborative discussion can evolve.

Investors must have a basic vocabulary and basic understanding of mass and energy balance and analytical methods as these items translate directly to the capital expense and operating expense of any chemical engineering venture.

There are many forms to gathering this information and developing this familiarity. Courses can be attended, and symposiums can be presented. PreProcess has found that a parallel path for a team doing an evaluation of a particular technology is particularly strong in developing a collaborative conversation on the technical merits of a candidate investment.

The team does not replace the technical consultants who dive into the details, but they parallel path a series of "coaching" sessions that review the topics that should be covered in a chemical engineering evaluation. This enables the team to conduct business with the right confidence and confidentiality while applying the principles directly to the evaluative effort at hand.

The content of the evaluation can be modified and tailored for the specific unit operations that might be encountered. The specific equipment and unit operations for a mining processing play in critical material market entry might be different in scope of a biotech fermentation system, however the similarities in the methods of chemical engineering practice that should applied to both are very similar.

Applications of cost estimating, financial connection to the mass and energy balance, the understanding of schedule driven realities and the need to evaluate technical contingency all are very important conversations that must go beyond just the technical evaluation consultants that are brought in to support the due diligence team.

Components of an evaluation to consider include the following.

1. Project Information
    a. Project Specifications
    b. Schedule Milestone
    c. OpEx
    d. CapEx
    e. Project Execution Team Structures
    f. Front End Loading
    g. Program versus Project Leadership
    h. Elements of Chemical Entrepreneurial Projects
    i. Chemical Mega Projects
2. System Safety
    a. Product Safety
    b. Process Hazard Analysis
    c. Safety Risk Evaluation and Mitigation
3. Product Information
    a. Product Chemistry
    b. Theoretical Material and Energy Balance
    c. Raw Material Information
    d. Chemical Safety Information
4. Measurements and Methods
    a. Product Specifications
    b. Reagent Specifications
    c. Utility Specifications
    d. Sampling and Validation Requirements
    e. Analytical Method Qualification
5. Process Information
    a. Process Description

    b. Mass and Energy Balance
    c. General Processing Steps
    d. Order of Operations
    e. Sequential System Inputs
    f. Critical Control Points
    g. Safety Limits
6. Equipment Information
    a. Unit Operation Equipment Specifications
    b. System Design Basis
    c. Common Design Basis
    d. Platform Systems
7. Scale-Up
    a. Experience versus Model
    b. Scale Up Basis of Design
    c. Technical Feasibility and Risks
    d. Process Studies
8. Manufacturing Information
    a. Nameplate Production Rate
    b. Manufacturing Performance Metrics
    c. Cross Contamination Considerations
    d. Cold Start, Warm Start Procedures
    e. Normal Stop, E-Stop, and Warm Stop Procedures
    f. Reclaim Blending Procedures
    g. Out of Spec Rework Procedures
    h. Troubleshooting Guide
    i. Failure and Emergency Recovery Procedures
    j. Regulatory Compliance
    k. Operational Safety
9. General Reference, Information Sources and Access
    a. Process Flow Diagrams (PFDs)
    b. Piping and Instrumentation Diagrams (P&IDs)
    c. General Arrangements and Layouts
    d. 3D Models
    e. Cost Models
    f. Issue For Construction (IFC)
    g. Inspection and Quality Control
    h. Lab Notebook
    i. Codes and Standards

