An Introduction to Value Propositions for your Chemical Industry Project

Conceptual Project Development

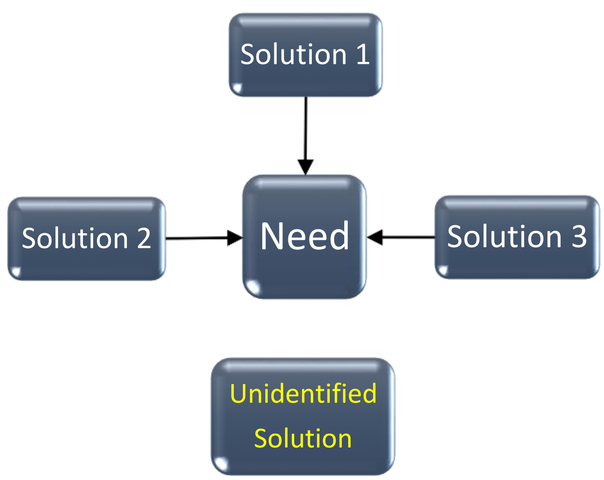
Chemical engineers create ideas for value-generating projects in all phases of the industry: operational improvements, new process technologies, new products, and the list goes on. Some nascent concepts are dismissed after discussions with stakeholders, some move incrementally towards realization at the discretion of the managing department. But projects of any size will eventually need an economic justification. And understanding the value proposition is key to making an informed and wise decision on the fate of any significant project.

This article discusses concepts to keep in mind as you develop the basis for an economic evaluation. A comprehensive evaluation will include sensitivities to important variables discovered along the way, including both costs and benefits.

Need-Based vs. Opportunity Seeking

Most projects arise out of a recognized need, such as:

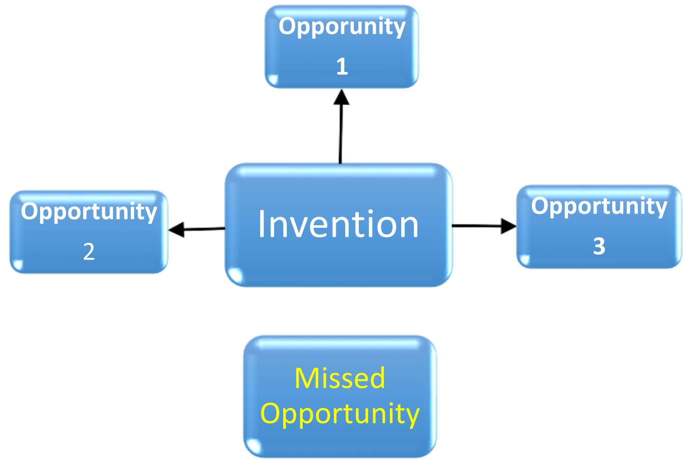
- Improve production on-stream reliability
- Lower raw material consumption through increased reaction selectivity
- Reduce energy costs
- Meet growing demand through capacity expansion
- Develop materials or processes to satisfy new markets or specifications



The broader the team charged with addressing the need, the more likely solutions will be uncovered. It may be that a novel solution, or “invention” is needed.

There are times when a good idea is just looking for the right home. Some generic examples are:

- Novel catalysts that create new chemical routes
- Bio-processes or chemistry from renewable resources
- Materials or products with unique properties
- Products that may substitute in existing markets at lower cost



Again, the broader the team, the more opportunities may be identified. The value proposition will depend on the specific opportunity.

Occasionally an invention is discovered to fill an existing need, but that invention also has opportunities in other areas.

Shutdown Economics

The term “shutdown economics” is used when a new process comes along that is so cost effective that new capacity can be built profitably, while reducing the market price for the product below competitor’s cash cost. One historical example of this is the carbonylation of methanol to make acetic acid, which in the1960s and ‘70s, shut down older plants making acetic acid from acetaldehyde.

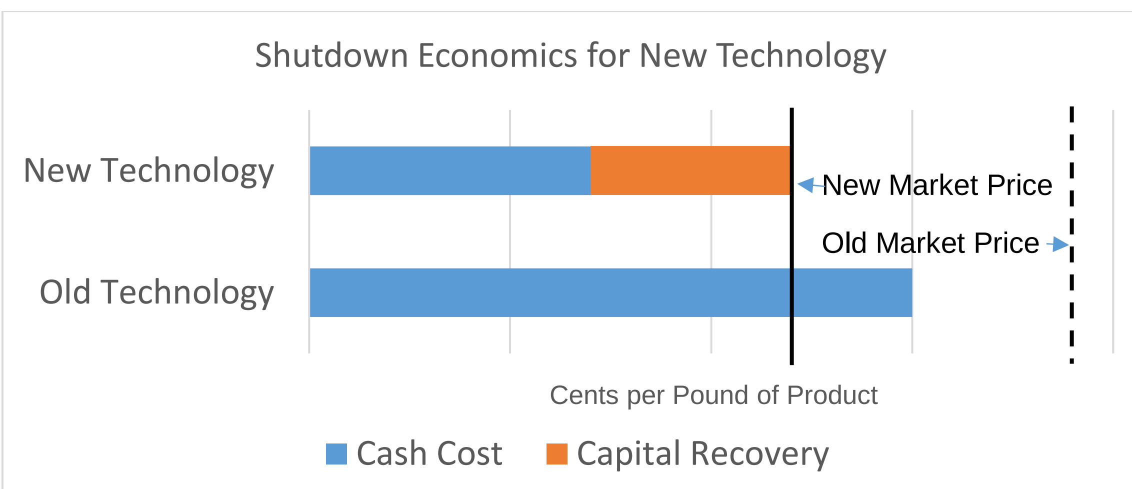


Figure 1 New Technology Shutdown Economics

Take all the credit you can find

Make a list of all the potential benefits, and how to best quantify them. Consider the "ripple effect" up and down the process chain.

- Will a yield improvement debottleneck a facility?
- Will a reliability improvement project reduce energy costs? Working capital?

Of course, recognize the down-sides to any change as well. For example, an improvement in yields may mean a decline in byproducts used as fuel.

Value Metrics

Project values can be quantified in a number of ways. Some value metrics that don't involve the time value of money include:

- Annual savings or incremental revenue, $/yr.
- Cost savings per unit of product, $/lb
- Capital cost savings for new plants

Complex projects involve expenditures and savings or revenues that change with time. Cash flow models consider the time value of money, taxes and depreciation, and project life. Some metrics from this larger project picture include:

- Net Present Value (NPV_x), calculated at some standard interest rate x
- After Tax Rate of Return, ATROR, the interest rate for which NPV is zero.

Operational Improvements

Identifying Needs

Production engineers are knowledgeable of the shortcomings of plant equipment or processes. A wish list of plant improvements is likely to include some items from the diagram in Figure 2. For example, reliability issues may arise out of:

- Equipment outages in fouling service
- Catalyst deactivation or attrition
- Frequent inspections or maintenance for corrosive environments

These reliability issues are likely to increase maintenance costs and reduce plant capacity. They may also impact operation in secondary ways, such as operating at less than optimal conditions in order to increase on-stream time.

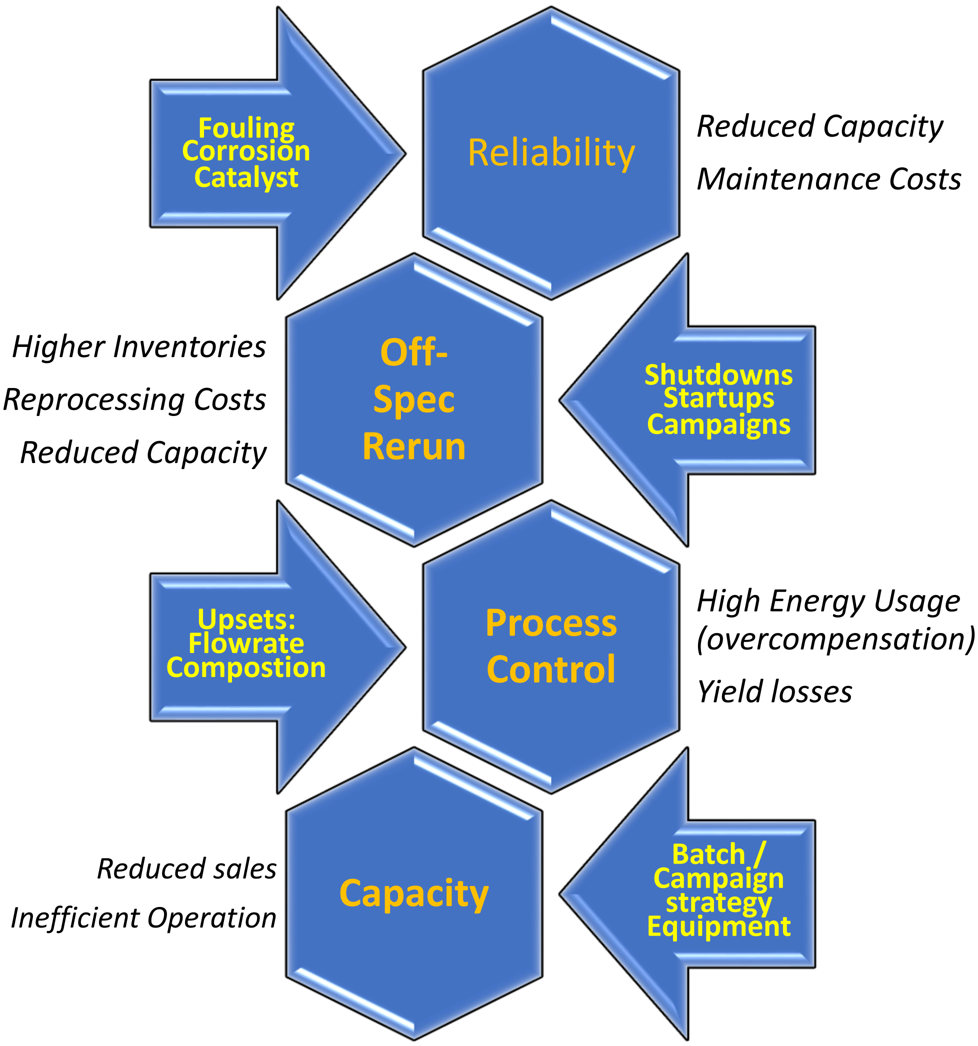


Figure 2 Some Operational Needs, their Root Causes, and Consequences

Identifying and Quantifying Value Propositions

Be specific about what value is to be gained. Tap into other resources to get the necessary data to quantify each value to the extent possible. Recognize that this may take time. The following discussion highlights some typical target areas for operational opportunities.

Reducing Maintenance Costs

Aside from the direct costs associated with replacing catalyst or equipment, there are other maintenance costs to consider:

- Contractor services
- Home office engineering / project management
- Equipment rental
- Startup / Shutdown material losses
- Operating overtime

Reduced Working Capital Inventory

For reliability issues, multiproduct campaign facilities, off-spec reruns, and similar non-uniform operation, inventories need to consider:

- Spare parts on hand
- Spare inventory to meet customer demand during outage
- Run-down inventory of material from shutdown

The inventory carries with it a working capital cost, similar to the cost to stock shelves at the store.

Lower Energy and Raw Material Losses

Process improvements that target variable costs are often part of a larger technology improvement effort. Plant data and process modeling can help quantify potential benefits.

Increased Capacity

Incremental sales from increased capacity can be assumed if the unit generally runs in a sold-out condition. In that case, use the *variable margin* of the sales on incremental capacity. If the increased capacity derives from a process improvement, there may be additional margin to account for – a reduction in energy consumption, for example.

Technology Improvements

Many of the targeted value opportunities discussed for operational improvements overlap with technology improvements, particularly with regard to energy, raw material consumption, and capacity improvements. Technology improvements are often thought of as the “next generation” idea for a new facility, with possible retrofit opportunities in existing facilities. These improvements typically arise out of a recognized need, but some are true discoveries waiting for the right opportunity to shine.

Identifying Technology Goals

Figure 3 generalizes some of the more common goals that inspire technology improvements, and the types of achievements that realize them. For example, asset flexibility could include:

- Feedstock flexibility (such as with olefin steam crackers)
- Efficiently accommodating seasonal changes in demand, or changes in product ratio from a co-product facility.
- Expanding the offerings of a multi-product, campaign facility

When setting technology targets, be as specific as possible. Recognize what tradeoffs might need to be made so that they can be quantified during the design. For example, adding another product to a campaign facility might require reduced production of another product made there, perhaps shedding sales to the least profitable customer.

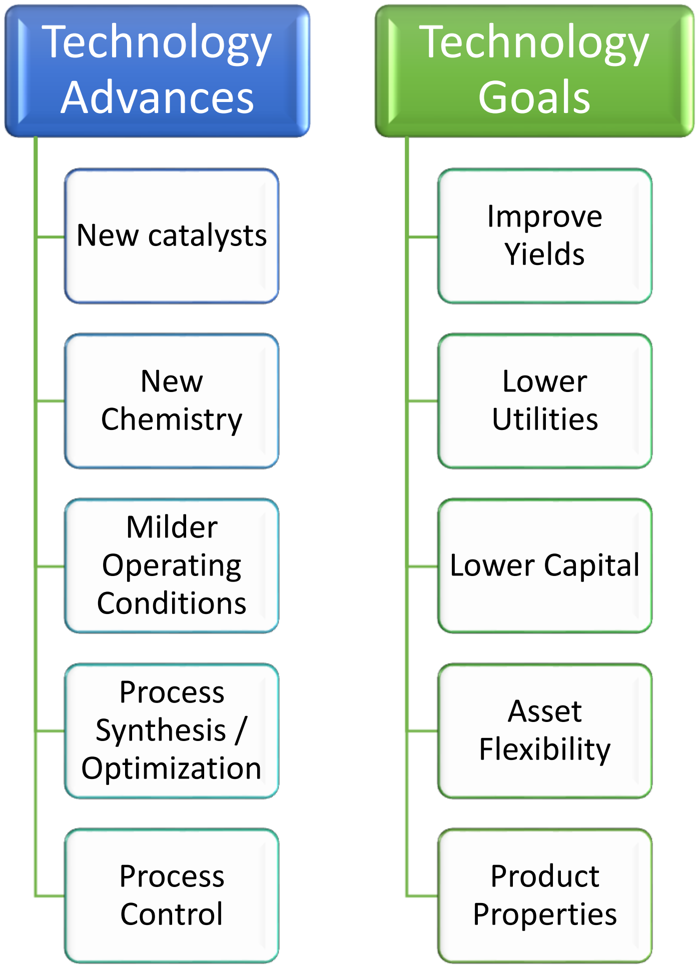


Figure 3 Technology Advances and Goals they Achieve

Identifying and Quantifying the Value Proposition

The value proposition for a technology improvement will vary depending on the context of the entity doing the evaluation. For example:

- A technology licensor considers the global market of potential licensees, and must share in the value the technology offers.
- A producer will evaluate process improvements for their own existing and potential future operations.

Cash Flow Considerations

Projects within a portfolio can be ranked according to various cash flow metrics such as after tax rate of return (ATROR), or net present value (NPV) at some given interest rate. Recognize the time value of money when developing a value proposition for your project.

Timing

Will the project be implemented in the very near term? Will technology or market developments affect the start of positive cash flow? The further out a project is conceived, the less certain are the assumptions surrounding its value.

Market Growth versus Deterioration

World-scale facilities may not sell out their first year of operation. The owner/operator may see a growth in sales commensurate with their share of the market, unless a larger market share is sought with reduced margins. It may take years to realize the full profit potential of a new facility.

If you are bringing a new product or technology to commercialization, will others soon follow? Demands for and margins on “new and improved” materials may initially be high, but deteriorate as substitutes are found.

Repeatability

Perhaps the need identified at one location exists at others. If so, then bundle together the value of fulfilling these needs across the asset base, timed appropriately for their various implementations. The cost of developing a solution, if any, is thus spread across all its applications rather than just the first one in line.

Global versus Regional Reach

Costs for resources such as raw materials, energy, labor, and capital can vary from region to region. What may be attractive in one part of the globe may not be so elsewhere. Markets that are oversupplied in one region can depress pricing in another.

Incremental versus Average Values

Products often service multiple markets. Ethylene glycol, for example, is used in both polyester fibers and antifreeze. When contemplating a debottleneck or capacity expansion, consult with the business lead to determine if the incremental sales will reflect the market as a whole, or will be shifted towards growth in higher or lower value markets.

Suggestions for a Well Framed Value Proposition

It is too often the case that project concepts are painted with a single number that gives an incomplete picture of the value potential. Upside and downside sensitivities are useful in conveying the impact of uncertain inputs to the value proposition. A narrative on technical hurdles, resource requirements, and timing also paints a better picture.

Projects may be partially developed, then shelved until business conditions improve. It’s important to document how that project was valued, as assumptions certainly change with time.

Developing robust model helps evaluate changes as new learning and come in. Model complexity should be commensurate with the stage of development; often simple models will suffice. Also, assumptions and pricing should be consistent with other projects in the portfolio, so that they are more fairly compared.

Table 1 highlights some good practices to follow while developing a Value Proposition.

Table 1 Good Practices in Developing a Value Proposition

Describe the Situation

- Current design or state of affairs
- Begin documentation record

Identify the Need

- Set improvement goals
- Be quantitative

Develop a Model

- Quickly evaluate new data and learning

Probe for Solutions

- Engage a broad team
- Discuss uncertainties

Identify value points

- Details of cost reduction / profitability improvement
- Identify timing for inputs to cash flow (NPV, IRR)
- Identify what is out of scope or for future consideration

Quantify Pricing

- Consistency among other projects

Evaluate Alternatives

- Document Cases
- Sensitivity studies on uncertain inputs

Forthcoming articles will show hypothetical examples of value proposition that demonstrate concepts described here.