# Process Plant Design: The High Cost of Slow Decisions

## Using Risk Analysis Software to Confidently Speed the Design Process


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Risk analysis is generally performed in the later stages of design to prove that the plant will deliver what it's supposed to. However, some clever practitioners are now employing it much earlier to speed up decision-making and lock in superior design choices when they really matter — at the beginning of the project.

When it comes down to it, designing and engineering a new process plant or upgrade is essentially a series of decisions. These decisions, grounded in the objectives of your client, are made based on tradeoffs between cost and the ability of the plant to deliver on the objectives: throughput, quality, uptime and safety.

Careful evaluation of these tradeoffs fundamentally determines whether the project will succeed, meet its objectives and result in satisfied customers. But considering so many alternatives, tradeoffs and decisions can also be time-consuming and fraught with risk. What's needed is a way to move through these decisions quickly, keeping the project on track, with the confidence to know that the design will meet its objectives.

## The Big Cost of Slow Decisions

Thousands of decisions, big and small, arise throughout the course of a project. From where to build the plant to how to size a recirculation pump, and all of these decisions affect the outcome for the customer and the success of your firm. But with each decision there is uncertainty and risk and implications for the budget and schedule.

- How much redundancy do we need to engineer into the design to ensure 90 percent uptime? Is it worth it?
- How much buffer storage capacity is enough to ensure production if supply is disrupted for a week?
- Will the plant meet production targets if the ambient temperature drops below 20 degrees?
- What happens if a specific pump fails?
- Should we use more expensive components or increase the planned maintenance frequency?

# Quantification Equals Confidence

Given that each of these decisions has some level of uncertainty, how can we quantify the risk to help make the best decisions — and do so in a timely manner? We can, in fact, predict the probability of future events and use that information to more confidently make decisions.

Based on historical industry data as well as our own experiences, we can predict the likelihood of an outcome and use the data to justify a chosen solution to a design problem. This gives us confidence that some future outcome, based on a decision made today, will be within our expectations and tolerances. This allows for faster decisions, grounded in data, that give us the confidence to move forward.

In addition, we need the ability to quantify impacts on a holistic level. Solving design challenges concerning a specific piece of equipment or unit may well optimize one area of the plant, but it could introduce inefficiencies or problems elsewhere. That's why such decisions are best made in context of the rest of the system.

For example, understanding the result of decreasing buffer storage capacity on plant uptime could help you save money on CAPEX or you may decide that the potential savings are not worth it because it increases the risk of more downtime beyond an acceptable limit.

# System Reliability Modeling

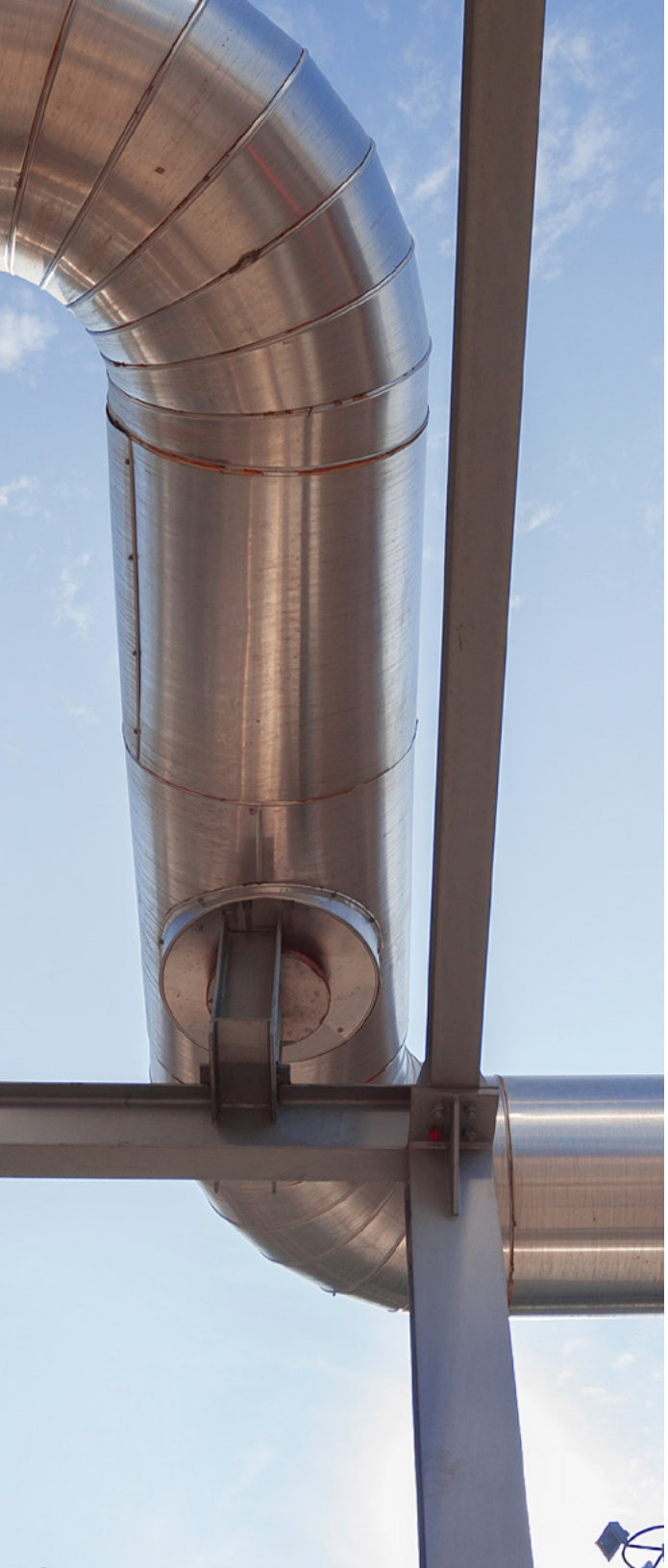
Aspen Fidelis Reliability™ provides the solution to each of these important challenges. Fidelis uses a systems approach to reliability. It allows you to quantify the true value or cost of any design or improvement project, maintenance change, operations improvement or supply chain constraint.

Fidelis is a Monte Carlo-based discrete-event simulation program that utilizes statistical sampling techniques to predict the future performance of a system. The behavior patterns for events involving the plant and its equipment (pumps, motors, weather impacts, operational upsets, etc.) are represented by probabilistic distribution functions. Fidelis takes samples from these distribution curves and derives a "time to failure" estimate.

When an event leads to a failure of a piece of equipment, there will likely be impacts to the wider system, including the unit to which the piece of equipment is attached and other units or equipment that are upstream and downstream. Fidelis can also model flow through the pipes, tank levels, as well as the utilized and available capacities of all units.

In addition, any required custom logic — such as dynamic batching, seasonal changes, alternate flow paths, non-time-based failures, conditional logic and equipment aging — can be incorporated into the model. If you can describe it in words, Fidelis can model it!

Fidelis provides a comprehensive bad-actor list and quantifies maintenance and downtime costs as well as potential lost revenue. As a result, you can more effectively perform lifecycle analyses on assets, including asset utilization, maintenance effectiveness, overall equipment effectiveness and much more. With Fidelis, decision-makers can maximize the ROI with models and predictions for individual pieces of equipment as well as the whole system.



# Key Benefits for Your Business

With Fidelis, you can bring a unique set of benefits to your customers and your bottom line. In short, you can realize new revenue streams across the lifecycle of every asset.

During the design phase of any project (greenfield or brownfield upgrades), you can utilize Fidelis as a design aid to ensure that the right decisions are made from the beginning. In addition, Fidelis can be carried forward into operations. During this phase, customers need to continue making optimization, debottlenecking and maintenance decisions, including setting spare part inventory levels. Fidelis can be used throughout the entire lifecycle to maximize production, minimize risk, create new revenue streams and build longer, stronger relationships with your owner-operator customers.

**Figure 1: Using Fidelis Throughout the System Lifecycle**

| DESIGN / AQUISITION | IN SERVICE / MID-LIFE UPDATES | SUSTAINMENT OF AGING SYSTEM |
|---|---|---|
| • Design Aid<br>• Life Cycle Cost Evaluation<br>• Supplier Selection<br>• Initial Maintenance Concept<br>• Initial Spares Provisioning | • Living Models<br>• Maintenance Optimization Debottleneck Analysis<br>• Evaluating Operating Procedure<br>• Ongoing Sparing Decisions Identification of Key Coast and Performance Impacts<br>• Logistics<br>• Establish Priorities for Analytics Deployments | • Cost/Benefit Analysis of Proposed Engineering Changes<br>• Evaluate Proposed Changes in Usage<br>• Effects of Aging on Continued Support |

In addition, by using Fidelis to model the design requirements, your firm can minimize CAPEX while also abating the risk associated with process guarantees. Model-based decision making can also help minimize disruptions to the project schedule and budget.

# Rise Above the Competition

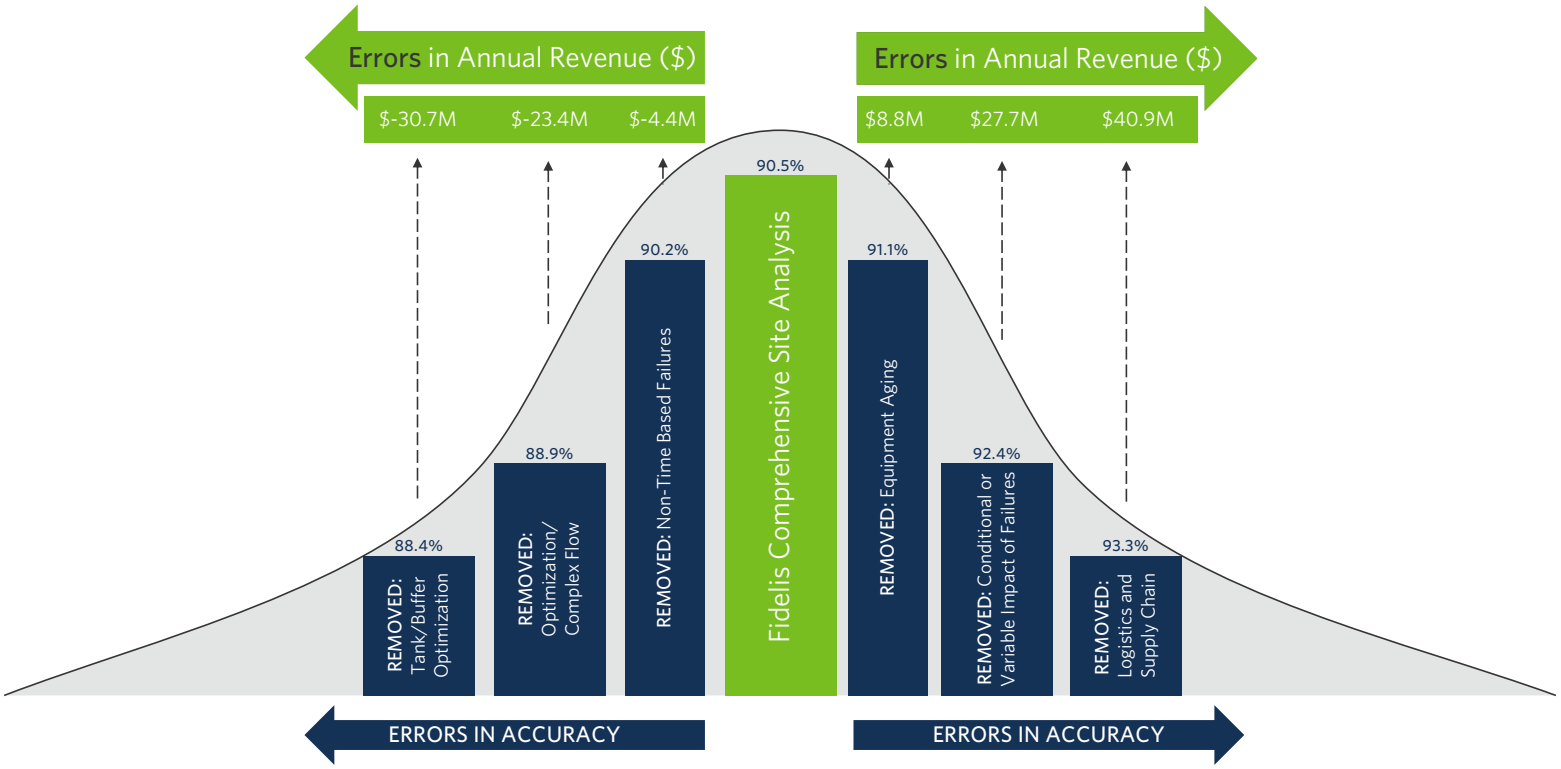
Big design or maintenance decisions shouldn't be left to subjective or over-simplified analysis. Decision-makers need quantifiable, trustworthy answers to make the most profitable decisions possible. In the past, management of your capital assets was done through the "gut feel" of experienced operators, some rudimentary spreadsheet analysis or simplified RAM (reliability, availability and maintainability) tools.

Although these methods provide some benefits, they lack a holistic approach to reliability, design and operations. They lack accuracy and consistency! For accuracy in decision-making, the Fidelis difference is eye-opening.

As the real-world case studies in this paper show, errors in accuracy using Fidelis versus simple RAM analysis varied from 0.3 percent ($4.4 million) to 2.8 percent ($40.9 million) in lost production and revenue annually. Simple RAM tools just do not provide the level of accuracy needed to answer the hard questions.

Learn more from the, "**The Aspen Fidelis Reliability™ Difference: Minimize Risk, Maximize Profitability**" white paper.

**Figure 2: Delta Between Fidelis Modeling and the Simplified Alternative**



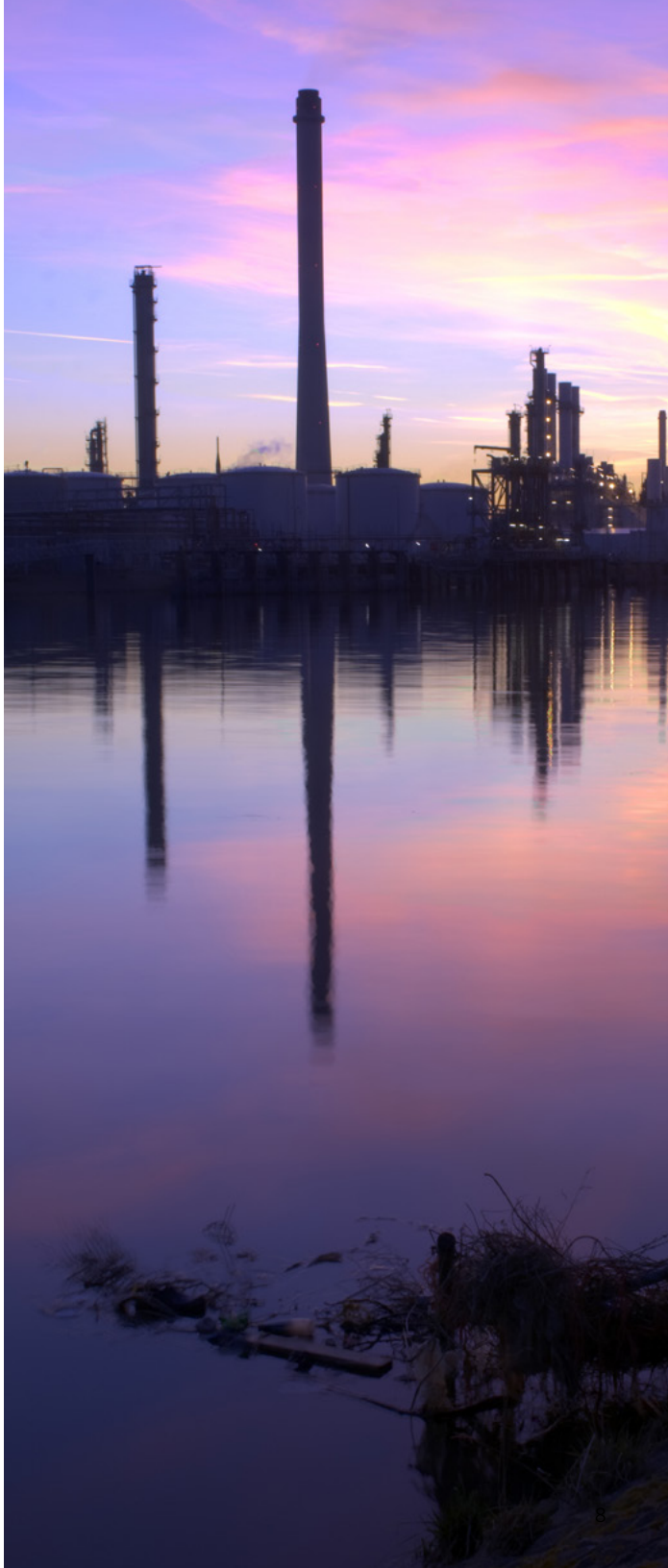

Effect on Site Availability by Removing Real-World Complexities

# AspenTech Synergies

AspenTech is the market leader and gold standard for process optimization software. The synergies that exist between AspenTech's process engineering, supply chain and manufacturing and reliability offerings result in a complete solution for improving ROI.

Some of the potential integration synergies include:

- **Aspen HYSYS® or Aspen Plus® –** Leverage existing flow diagrams and automatically populate starting RAM data from Fidelis.
- **Aspen Capital Cost Estimator™ –** Improve cost estimates by incorporating statistical variance with uncertainty. In addition, calculate the high-level cost of any initial design.
- **Aspen Mtell® –** Predict when a real-time failure will occur. Integrate this information into Fidelis to determine the response that will result in the least amount of downtime and revenue impacts.
- **aspenONE Process Explorer™ –** Using data from the process explorer dashboard, Fidelis can be integrated to recommend the best course of action given current plant states (tanks, units), update Fidelis data with live reliability data from any historian and update the dashboard with current threats and the Fidelis criticality listing.
- **Aspen PIMS-AO™ –** Fidelis can assist planners in understanding the likelihood of meeting plans by adding statistical variability and rankings to scenarios.
- **Aspen Petroleum Scheduler™ and/or Aspen Plant Scheduler™** – By accessing the generated schedules, Fidelis can integrate dynamic failures to optimize the schedule and tankage. Fidelis can also be used to quantify the likelihood of success for a given schedule and cause of misses to increase equipment utilization (including logistics).



# Case Studies

Model-based decision-making with Fidelis is used every day across the energy, chemicals and utilities industries. Here are some examples of recent Fidelis projects:

**Fidelis has been used for decision-making on countless capital projects.** As an example, Fidelis was used at an LNG facility to determine the optimal number of liquefaction trains to meet production targets given required maintenance and model predicted unplanned downtime.

**A mega project in the Middle East utilized Fidelis to optimize everything from plant design to tank sizing to spare parts purchasing.** Fidelis was used to model the entire petrochemical site, including process plants, storage, product demand and logistics. This resulted in benefits of over $1 billion USD in reduced capital.

**Typical Benefit in Capital Projects**
**5% saving in Capital Cost and/or ~3% Increase in Production Benefits from $1MM+ to $1B**

**A buffer optimization was completed for a Gulf Coast refiner.** Product moved over water was sold at a premium over deliveries made via truck or pipeline. A study was completed using Fidelis to determine the minimum number of new tanks needed to increase shipments from the docks while minimizing capital costs, dock delays and subsequent demurrage costs.

**Fidelis has been used at several oil and gas platforms to prioritize debottlenecking projects.** At an oil and gas facility, reservoir dynamics create wildly changing capacity needs for facilities over time. The model was used to identify when, where and how much each capacity bottleneck would cost. The customer was able to prioritize capital spending for optimum ROI.

**At a refinery, a Fidelis model was used for a supply chain optimization to increase the product deliverability at the docks.** Given very limited tidal windows, the model was used to determine and quantify the key causes of dock delays, demurrage and wasted utilization.

**A refinery required a revamp to optimize utility needs while minimizing capital costs.** Fidelis was used to model site-wide energy use penalties, emergency rates, maintenance and site production levels. The model identified the most beneficial design case, saving $20 million USD.

**At several petrochemical sites, Fidelis has been utilized for multiple facets of a maintenance optimization.** At one plant, a model was created to determine the key assets to maintain and the optimal frequency of maintenance. This resulted in savings from unnecessary maintenance and planned downtime.

## Large Refinery **Saved $20M** in Energy Costs when Modeling with Fidelis Reliability.

## Conclusion

The engineering, procurement and construction (EPC) business has become highly competitive, and in some ways engineering services are now being commoditized. To rise above the competition, firms need to find new ways to differentiate themselves and add more value for their customers.

Leading firms are now using risk analysis software at the beginning of the design process to streamline risk quantification and make better decisions, faster. EPCs can also use Fidelis to extend engineering services into the operations and maintenance phases of the asset's lifecycle to generate new sources of revenue and to build stronger relationships with their customers.

The Aspen Fidelis Reliability software has helped dozens of EPCs complete projects on time, save CAPEX for their customers and win repeat business. Learn more about Fidelis at **www.aspentech.com**.

aspentech | Technology That Loves Complexity

AspenTech is a leading software supplier for optimizing asset performance. Our products thrive in complex, industrial environments where it is critical to optimize the asset design, operation and maintenance lifecycle. AspenTech uniquely combines decades of process modeling expertise with machine learning. Our purpose-built software platform automates knowledge work and builds sustainable competitive advantage by delivering high returns over the entire asset lifecycle. As a result, companies in capital-intensive industries can maximize uptime and push the limits of performance, running their assets faster, safer, longer and greener.

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