

Making Confident Decisions in Operations: 7 Secrets to a Well-Run Plant

A Guide for Plant Managers and Operations Staff

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Have you ever received a call in the middle of the night because of a plant operational crisis? The production engineer responsible for the process is already onsite but they really need your advice and will likely also need support from the process engineering team. You can almost see the lost revenue growing as the plant drifts further from its Key Performance Indicators (KPIs).

Detailed simulation models are likely already used by the process engineering or modeling team who support your plant in solving these kinds of complex process issues. Your production engineers certainly don't have the time to learn new software to build detailed models. What you may not know is that sophisticated modeling technology can be accessed by your team through an easy-to-use, Microsoft Excel® interface. Model-based decision-making can apply to plants of nearly every type ranging from ethylene to polymers, fertilizers and specialty chemicals. The following seven secrets explain how building a model-based culture in your plant will bring clarity and continuous improvements to plant operations.

1 Secret #1: Conceptual design models can assist plant operations.

Do you know how or where the design work was done for your chemical plant? If you are able to find the conceptual design work that was completed with process simulation software, you're already one step ahead. If it's been decades since the plant was built and there is no design work to be found, start with asking for simulation models of problematic pieces of equipment or a section of your process that can be unreliable. If you have existing conceptual models of your plant, your team can use these models to simulate operational scenarios and make better decisions that will help save on energy and operating costs.

SCG Chemicals, a Thai Petrochemical company, designed a new high-density polyethylene (HDPE) manufacturing plant and saved over \$300,000 from eliminating plant trials for new HDPE grades using the same simulation model they used to design the plant. They continue to use this same model for debottlenecking similar plants.

2 Secret #2: Sophisticated simulation models can be used through a familiar interface.

How can a conceptual simulation model be turned into a useful tool for your plant? There are easy-to-use Excel-based tools that connect the simulation model to plant data for an accurate representation of your plant processes. Imagine your plant engineers opening up Excel to find a model of their process and pulling in plant data historian tags to see if the plant is behaving as expected. Wouldn't it be great for them to be able to visualize those variables that you wish you could measure, such as the composition of your bottoms stream in the distillation column?

3 Secret #3: Simulation insights enable more effective troubleshooting.

Empower your production engineers with a tool that gives them insight — and confidence — into equipment malfunction to troubleshoot faster and to prevent recurring issues. Brazilian chemical manufacturer Oxiteno had a mysterious pipe vibration issue in their ethanolamines plant. Because Oxiteno had already built a model for this section of their plant, engineers used it to find the root cause, which was unwanted vapor in the pipe. Increasing the flowrate of the bottom stream of a nearby column fixed the problem. This was not an intuitive solution as the vibrating pipe was not directly connected to the column. To gain buy-in as to why this solution would work from the engineers in the plant, a process engineer built a look-alike Distributed Control System (DCS) screen in the Excel-based tool.

For troubleshooting more challenging process issues, pulling in plant data to match what you are seeing in the plant helps find possible root causes without needing to rely solely on the modeling team's expertise.

4 Secret #4: Run the plant closer to its optimal setpoints with process simulation.

All chemical assets are designed and operated with constraints. Rigorous process modeling capabilities can help your engineers understand how to operate optimally within the limitations of the asset. When operational changes occur, production staff can develop an improved workflow by using simulation models to quickly predict the impact of changes. Running the plant as close as possible to optimal setpoints improves efficiency and can generate significant savings for the plant, boosting the bottom line.

5 Secret #5: Model-based decision-making builds confidence and improves plant uptime.

This Excel-based process simulation tool can go beyond helping your team meet production targets and help you achieve continuous process improvement. Model-based decision-making will help you fine-tune your processes and give your engineers the confidence to suggest further plant improvements. Your team will start coming up with innovative ways to run the plant more efficiently and improve your bottom line.

Innovation typically comes at a price, but in this case the production engineers can run operational tests or process improvement studies within the simulation tool, not in the plant itself. So the risk of having unintended negative consequences by changing process setpoints is much smaller. Without a model, it's difficult to know what effect changing process variables will have upstream or downstream of the process. By doing case studies within the model, you can find these correlations without risk and find innovative ideas to positively affect plant productivity and uptime.

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6 Secret #6: Calculating and tracking inferential variables can lower plant maintenance costs. When important variables can't be measured, plant maintenance needs to happen more frequently to ensure reliable operations. Measuring the temperature at different points inside different unit equipment, or even just a piece of pipe, can be challenging. But what about those variables that are practically impossible to measure? Wouldn't it be nice to be able to monitor the fouling in your heat exchanger to know the best time to service it instead of guessing? What about the ability to see whether or not your column efficiency is up to snuff? Using the right software tools you can monitor these inferential variables to gauge equipment performance and determine the optimal maintenance schedule.

7 Secret #7: Make the most of revamps and debottlenecking projects. By using process modeling software to aid the manufacturing and operations teams, plant personnel can develop a very good sense of optimal operating setpoints and where the plant bottlenecks exist. When it comes time for a revamp or debottlenecking project, the models and knowledge are readily available, making it a more straightforward exercise to identify which projects would bring the most value to the plant. These models will allow you to quickly screen the alternatives to help you focus your efforts on projects with the most impact.

Reliance Industries, an Indian conglomerate holding company, demonstrated how much money can be saved from a revamp project. Reliance had an issue with their benzene-toluene separation unit, and the vendor was unable to offer a solution to the underperforming column. Poor tower efficiency (55% vs. 76% in design) was found to be the root cause, and they also found the column to be hydraulically limited. Reliance used their simulation model to confirm that reconfiguring a spare column to be in series with the underperforming column was a viable solution, which resulted in a savings of \$2.4 million dollars a year. Another benefit they saw was being able to solve this problem in-house, avoiding costs and delays associated with getting help from an outside expert.

Solve more problems in-house,
avoid costs and delays
associated with getting help
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Selecting Software for Model-Based Decision-Making

Based on these seven secrets, you now know process simulation software can help you build a model-based culture to improve plant operations. Multi-national polyolefin manufacturer LyondellBasell used such software to achieve its corporate goal of a 2% energy reduction per year through modeling its utilities. Likewise Hanhwa Chemical, a Korean company experiencing low production rates and suboptimal product quality in their low-density polyethylene (LDPE) process, increased their production rate by seven percent through better plant insight. Clearly, there are good commercial reasons behind the rapid adoption of building a model-based culture in plant operations.

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Here is a list of suggested features to look for when searching for the right software for model-based decision-making in plant operations:

- A process simulator which can accurately model all of your processes (consider physical property databases, custom modeling, gas/liquid/solids modeling as applicable)
- A simulator integrated with safety (ability to model Pressure Sizing Valves and Flares)
- Simulations that can be linked to plant data, live or on-demand
- Easy-to-use interface for production engineers and operators
- The ability to hide any proprietary information around the models (if needed for your process)
- Custom tables for easy reporting

The tool of choice used by 19 out of the top 20 chemical companies for chemical process simulation is Aspen Plus®. Aspen Plus has a Microsoft Excel-based tool which links process simulation models to plant data. The tool can be used to deploy process simulation models to non-engineers and no programming knowledge is required to use it. The benefits are hard to miss: Model-based decision-making enables a level of collaborative decision-making between process engineers and production personnel that is both efficient and innovative.

To learn more about using Aspen Plus models in operations through an Excel interface, check out this blog series starting with the [7 Secrets to a Well-Run Plant: Part 1](#).

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