White Paper
June 2018

Business Case for Dynamic Simulation

Introduction

The growth in oil and gas is driving the renaissance of the North American process industries. With low cost Natural Gas comes low cost feedstock, such as Ethane, Propane, and Butane, providing an economic boost for the chemical industry.

The American Chemistry Council predicts a capital investment of $72 BB, by 2020 in more than 100 new chemical plant projects. This investment will result in 500,000 additional jobs, many of them in plant operations.

Due to this growth, operations managers at process plants have greater challenges than ever before. Worker safety, environmental stewardship, process uptime, and conservation of plant resources have been common goals for plant operations over the last several decades. In addition to those common goals, new challenges are stretching the limits of plant operations making the job of running a process plant more difficult than ever before.

Challenges for Plant Managers

The Demographic Time Bomb

Who is going to run the process plant of the future? The term “Demographic Time Bomb” is used to describe the upcoming crisis in the process industry in finding experienced operations personnel. The U.S. Department of Labor reports the average age of energy industry workers to be over 50. Half of the current work force (500,000 workers) is expected to retire in the next 5-10 years, taking with them irreplaceable knowledge and experience.

Older operators relied upon mechanical skills and experience, while younger operators, are adept at utilizing technology. The operators of the past who could diagnose compressor health by sound are being replaced by a new generation more comfortable behind a computer display.

7 Years to Operator Competency

How long does it take to develop a competent operator? A study from Oil and Gas Journal states that it takes an of average 7 years for new employees to be competent enough to make or recommend appropriate risk decisions. This 7-year figure conflicts with the average employee’s expected duration of 5 years in one position. In many process plants, the operations staff is looking for their next position before they are completely competent in their current one.

Already, petrochemical and energy plants have been compromised due to their lack of qualified operators. For example, a fertilizer plant in the Midwest claimed if they lost one more of their experienced operators, they might not be able to run the plant. They were one experienced operator away from plant closure.

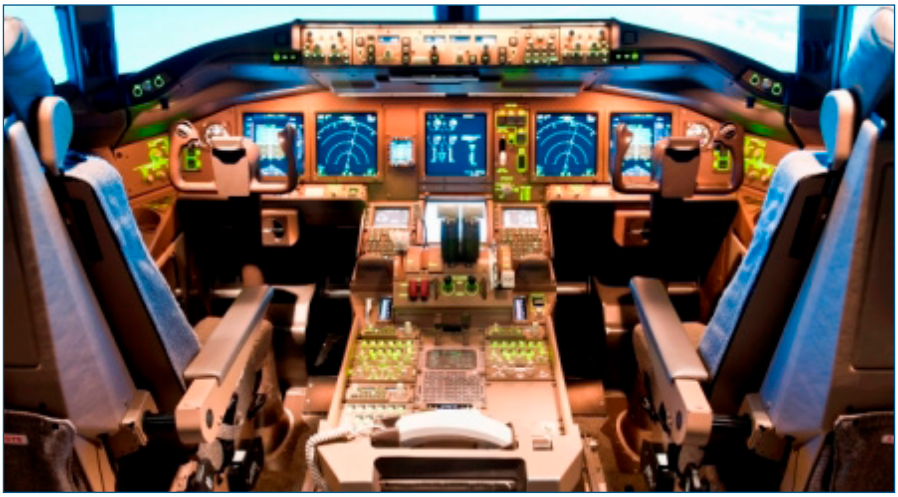
Automation Saves Money and Adds Complexity

Can we apply automation to address these challenges? Implementing modern automation technology provides excellent return on investment and can be used to operate process plants more efficiently. However, in highly automated plants, the role of the operator changes and becomes more difficult. The operator must monitor a sophisticated system and make decisions about the health and performance of the process based solely on information from the operator console. By removing the operator from the dangerous process area, the control room becomes the only window to the process.

Also, as the system and process are more reliable, operators seldom or never see upset conditions. They can quickly lose critical skills necessary to respond correctly, often resulting in compromised operating conditions. Studies show that the greatest cause of operational loss in the process industries is due to operator error.

Flight Simulation - Why Not Operations Simulation?

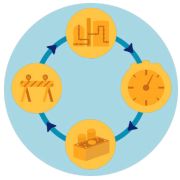
No one would want to get on an airplane with an untrained pilot. To prepare a commercial airline pilot to operate a new airplane, weeks of training in a flight simulator is required, as well as hours of instruction and study.



A typical pilot has over 100 variables to manage from the cockpit. In comparison it is not uncommon for a process plant operator to manage over 1,000 variables. Process plant operators should have a similar amount of preparation before managing the complicated processes.

A World Oil Online survey of dynamic simulation users reported an average increase of 31% operator effectiveness. The same survey attributed an average total savings of $15.3MM due to the use of dynamic simulation.

Barriers to Using Simulation



Traditionally, simulation solutions offered in the process industry are difficult to use and require extensive customization. Maintaining these systems is a nightmare. In that same World Oil Online survey, 52% of the respondents said that they seldom or never updated their simulator because it took too much time and money.

In addition, these solutions are rarely built to support automation system and operational improvement, which is just as important as operator training. Developing an operator training system can uncover potentially catastrophic issues in the automation system or operation of the plant.

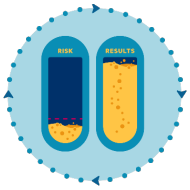
Recently a chemical plant in the Houston area had been running a process for nearly 20 years. The plant was designed so they could conduct maintenance and improvements without shutting down, eliminating the need for a cold start. At the same time, the plant experienced a high turnover in operators and needed to validate their startup procedures. Using dynamic simulation, they could verify all their SOPs, including the cold startup. **During that simulation, they learned that none of the operators could start the plant.** Significant automation issues were found, keeping them from starting up the plant. The dynamic simulation allowed them to correct the control system and verify the startup procedures.

In most cases, the benefits from automation and operational improvements are the same or greater than the benefits from an operator training system.

Process Plants Need Dynamic Simulation

The exact same operator graphics, alarms, and controls used in the online control system are copied into a control system simulator made by the control system vendor. The operator works on the exact replica of the system in the control room. A real-time, dynamic model of the IO and process is used to provide IO signals to the simulated control system. The operator and control system appear to be controlling the actual process. And the entire solution is implemented in a virtual, private cloud environment.

By using dynamic simulation, you have an effective tool for reducing the following risks in automating and operating the plant.



- Hidden errors and issues in the automation system application software undetected until they cause process or operational issues
- Inappropriate operator actions or conversely, operators not acting when they should
- Operating procedures that are in error or incomplete such that they are not used or trusted

By testing the automation system and training operators with dynamic simulation, you mitigate these risks and maximize the profitable operation of the plant.

Lifecycle Results

The virtual plant provides excellent returns for the lifecycle operation of the process plant. Also, by using the virtual plant for capital projects, additional business benefits can be realized. A lifecycle approach provides value across all aspects of running a process plant including safety, environmental, regulatory, operator training, and process optimization.

Process control improvements can be developed, tested, and demonstrated to operations management without affecting the operation or production of the actual plant. When implemented correctly, the control system configuration developed in the lifecycle dynamic simulator can be exported directly to the process automation system, minimizing operational risk. Users report system startup savings of weeks or even months with returns of $500,000 to $5,000,000.

Training new operators on process operations, startup/ shutdown procedures, and hazardous or infrequent process occurrences can be accomplished without affecting the running process. Process plants run well and trip less resulting in operational savings of $1,000,000 per year or greater.

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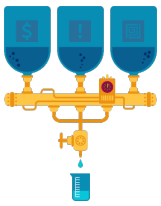
Evaluating new and experienced plant operations can be done on pre-developed training scenarios. Plant operations competency requirements can be established and reinforced with repeatable, measurable, documented training sessions. Trained operators make fewer mistakes. Avoiding process plant upsets or shutdowns can save $500,000 to $1,000,000 per incident.

Process optimization and modification studies can be done on the dynamic simulator providing the process engineers with a tool that accurately models the process dynamics not seen in steady-state design models. Process changes with control improvements can be thoroughly tested before construction begins, reducing rework and startup times. Advanced control strategies are tested, tuned and validated off-line reducing operational losses of $100,000 - $500,000. Evaluating new operating procedures for different conditions can result in operational savings of 1-2% or $1,000,000 to $2,000,000 per year.

Process and regulatory documentation can be developed and tested on the dynamic simulator without impacting the operation of the process. One user claimed operations savings of $1,000,000 per year by using the virtual plant for regulatory documentation development.

Plant Operations Need Dynamic Simulation



The benefits are proven. Plants that incorporate simulation into their automation and operations planning save time and money. In this age of great challenges, plant operations need proven solutions to help survive.

Mimic Simulation Software was developed to deliver the digital twin fast and easy in a flexible, intuitive environment. Our goal is to extend the lifecycle benefits of dynamic simulation across the process industries.

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