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## Process simulation improves commissioning validation, enhances operating training

Process plants are embracing digitalization to integrate design, engineering and operations. Punch lists are replaced with evolving technology, bringing more ease to daily operations.

In a typical process plant project, approximately 20 percent of the project costs are tied up in commissioning. Ninety percent of that cost is for validating the automation system, and an eye-opening 70 percent devoted to

correcting errors. If you didn't complete a validation of your project you could have an expensive mistake. For example, a motor was burned up because an interlock wasn't verified prior to startup. In the past, the high costs associated with commissioning and error corrections were generally accepted. A commissioning team may include operators, field crew, engineers, plant managers and contractors.

Correcting errors, like a burned up motor, takes these professionals out of service for hours and in serious cases, days.

The most efficient way to validate the automation program is to use simulation for a virtual commissioning. Virtual commissioning gives the engineer the capability to test and evaluate processes outside the plant environment. Additionally, process plants are now leveraging simulation in operations. This enables training for inexperienced operators to efficiently handle routine procedures and abnormal situations. In both engineering and operations, simulation reduces costs and time as well as eliminates unprepared operators. The end results include faster time to market and being right the first time.

### Virtual commissioning in a nutshell

Virtual commissioning is an end-sharing programming platform that allows plant personnel to check out the operation before startup. Simulation validates the control logic in one or more process controllers, mirroring the identical logic and controllers used in the plant, but completely decoupled from the automation program.

The same human machine interface (HMI) and associated graphics used by operators are used as well. Simulation provides the ultimate transparency, giving operators the ability to view a 'digital twin' of their operation from anywhere.

The virtual controller acts as a physical controller in the field, as well as simulating the I/O, motors, drives and valves. The virtual controller also supports distributed architectures for engineering and operator stations. It ties into the simulation framework of the plant, so if a valve into a tank is opened and an outlet valve is closed, an operator could virtually watch the level of the tank rise and monitor pressure increases.

Since the virtual controller and simulation are decoupled from the automation program it eliminates the risk of leaving unwanted code behind after testing is eliminated. Using the automation system's controller for simulation requires manually deleting code from the controller. There is always the risk of unintentionally manipulating the process and leaving components in the program that could cause errors or unsafe conditions in the plant.

After the simulation programming is complete, a reciprocal of the automation program tells the I/O what to do and monitors what the I/O is doing. The simulation gives feedback from the I/O back to the automation program. The results include fewer components, eliminated startup issues and no one wasting time standing by performing unnecessary checks on interlocks, starts and wiring.

### Real-life simulation successes

Recently, a large, greenfield, chemical manufacturing facility in Brazil used Siemens simulation program (SIMIT) to achieve a 95 percent level of configuration accuracy and 100 percent of I/O connections. The chemical company improved design on the front end and shortened factory automation testing (FAT) time. It also reduced commissioning costs by limiting the amount of manpower affected by changes or making corrections.

Another application of simulation involves a U.S. hydrogen plant that is the first plant of its kind to be operated from a remote location. The plant is expected to run continuously for several years before shutting down. Siemens Solution Provider Pigler Automation, used SIMIT in pre-FAT testing with two virtual controllers on-time, over a two-week period.

A gulf coast chemical company started their first use of SIMIT to support the migration from the former DCS system to SIMATIC PCS 7 to meet the challenging timeline for a

shutdown. The whole SIMATIC PCS 7 implementation had been validated against the SIMIT model. And coming back to the high hazard processes they needed to ensure that the safety systems were thoroughly tested.

"The benefit of SIMIT is that you don't have to modify the project. With our former systems we had to modify our configuration sheets and tested it out and once we have finished we had to delete all this to make sure that everything was fine. SIMIT was external, you just got the files, and it seemed like a perfect match," said the lead project engineer.

SIMIT also plays a very important role in user training. Owens Corning wanted a training system that was self-contained and capable of mimicking dynamic process conditions as closely as possible. Simulation "narratives" were developed and programmed in SIMIT. The goal was to have a user sit at a computer viewing the same graphics used in the real environment and interacting with identical versions of the real PLC programs. The user would be able to go through the same start-up procedures and witness the realistic dynamics of the glass veil process. The operator also asked for additional specially designed user screens for training purposes. Users can select any one of 10 unknown process "disturbances" that are introduced into the system via SIMIT, and they are then required to identify the nature of the "disturbance" and take the necessary corrective action.



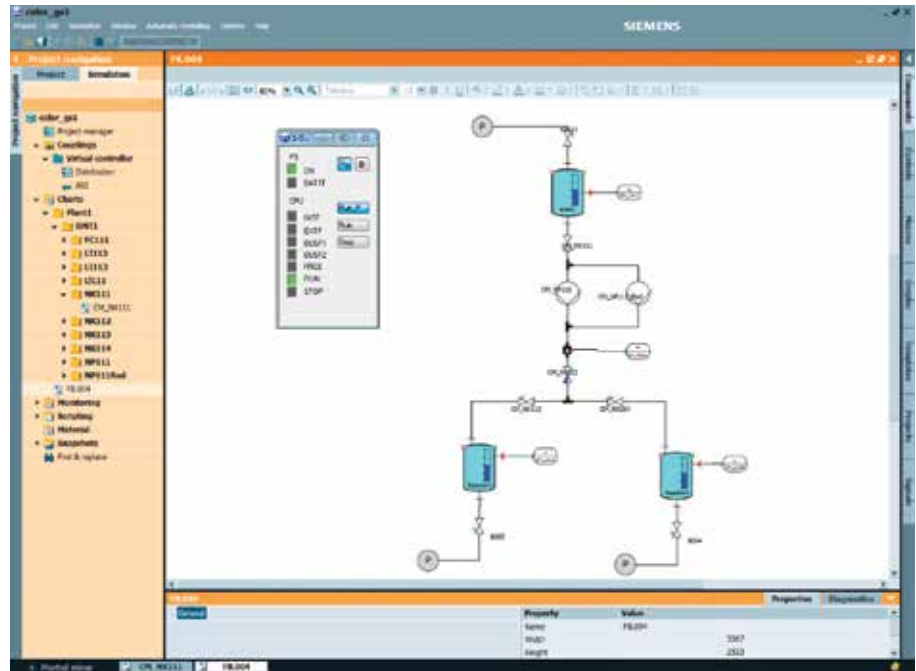
## Operator training through virtual time management and snapshots

The importance of solid operator training in process plants has perhaps never been more important than today due to the well-publicized 'talent drain' from retirement and employees moving to competitors. New operators with far less experience than their predecessors are still responsible to maintain the plant through start-ups, shutdowns, and even through abnormal and emergency situations. Control systems today are more sophisticated than those from 30 years ago, increasing the need for up-to-date education.

Virtual time management is a new development and benefit of the virtual controller technology. Some processes are very slow, such as filling up a tank. Now operators no longer have to sit and wait at the station for the filling to complete while in a training environment. The simulation can be sped up as needed. Conversely, in a very fast chemical reaction process, the simulation can be slowed as needed to understand the process better.

Another popular feature of simulation programs is snapshot management where all the states of the controller are captured and saved to a file. By double-clicking on the file, the chemical reaction goes to a specific point where all the controller values and simulation values are preset to times before the snapshot was made. Making a wrong move is no longer an operational issue, it is a learning experience.

If training requires returning to the beginning of the program, the operator does not have to reset all of the devices. By double clicking a snapshot, the operator returns to the beginning of the training, simplifying repetitive testing. Additionally, scenario training is a key component of simulation training and includes plant startup, shutdown and product changeovers. This gives operators a great deal of offline experience and confidence when the real plant is operational.



## Libraries, tools and templates save time

Standardized libraries help build models, thematics and PIDs to simulate components for gasses and liquids including pressures, temperatures and flow. These libraries allow operators to choose a tank, valve or motor and link them together. They also update behaviors with assumed values. A process specialist, for example, can modify those values to be more specific to the application.

These libraries offer a number of tools that can help export files that automatically as and provide all I/O signals and devices. One-for-one templates are available as well. For example, if a plant has 100 motors the blocks would be drug one-for-one. Since a template of the motor is available, a one-for-one may be created in the library. When an import from the automation program is required, the simulation program selects the motor template allowing operators to lay down 100 motor instances all at once, for example.

In fact, the latest simulation technology reduces the simulation engineering effort. Just open up the simulation program and select the virtual controller or radio button. The program will automatically access the application, choose the project and indicate how

many controllers there are in the project. Operators decide which controllers to use for simulation environment testing.

Additionally, simulation programming changes may be made online, making virtual commissioning ideal for working with a team of engineers who otherwise would wait around while simulation testing was down, much like the downtime avoided by the commissioning example.

## Getting started in simulation

A misconception is that a high degree of process knowledge is required to execute even a low fidelity simulation program. That is not the case. The tools in the library simplify the effort. Automation system providers like Siemens offer a wide array of training, online and telephone support and other assistance to simplify any simulated project. In any case, the supplier should work in close collaboration with plant engineers to provide the correct levels of virtual commissioning and training for project.

Where libraries don't quite match the simulation you are looking to implement, you can create your own custom simulation components. Your custom components can be a part of your library, which can be a combination of what you created and the default libraries provided.



## Conclusion

When evaluating the justification of simulation, it is important to calculate the costs of a shutdown or a delayed startup due to commissioning errors. Simulation reduces the number of shutdowns because of its enhanced validation capability. It ensures better operators' involvement and faster reaction times. When operators know what they are doing, ramp up times are shortened and product changeovers are faster.

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