SimSci™
by Schneider Electric

Drive Workforce Optimization in Oil & Gas

by Livia K. Wiley, SimSci Product Marketing Manager

Executive summary

Operator Training Simulators (OTSs) have been available in the marketplace for a long time. However, over the last five years the improvements in technology — the computers, the software and the market understanding — have meant that the use of OTSs has become a reality for many processes. No longer are Training Simulators primarily the realm of airline pilots, nuclear systems and astronauts, but now they are available across the process industries, including oil and gas. Plant management has found that a relatively small investment in OTSs can save hundreds of thousands of dollars with paybacks measured in weeks or months. Operator Training Systems have been used to uncover any control system configuration, graphic or logic errors that might lead to unit trips, equipment damage, or other events that would result in an extension of the planned outage window associated with the upgrade effort.

Productivity and the Retirement Conundrum

In today's oil market, the environment of "doing more with less" has never been more obvious. Boosting productivity means investing in new innovation and technology, accelerating careers through sophisticated training methods, and empowering personnel to drive operational excellence throughout their organization.

In addition to regulatory compliance, operators must understand how to efficiently and safely operate the plant and its control system. In a typical plant, operations personnel must deal with several thousands of operating limits and operating parameters, which requires a high level of knowledge and practice. But while the enterprise tends to draw highly skilled and experienced professionals, the plant operates in an environment of higher attrition; often replacing departing personnel with inexperienced workers or new graduates.

This aging and changing workforce [Figure 1] presents the need for a training methodology that can boost careers and keep the next generation of workers more engaged and invested with updated training tools that speed training time. Well-trained employees perform better and, in turn, create a better performing business and an improved bottom line.

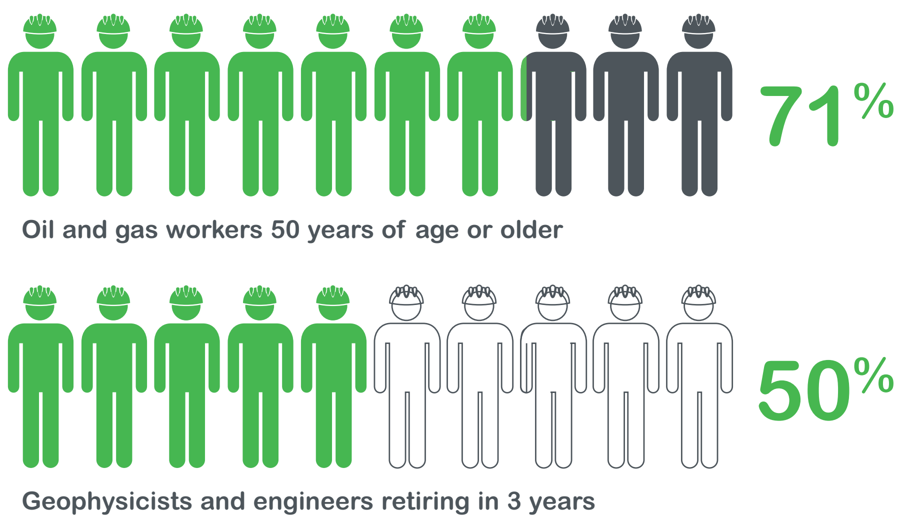

Figure 1
Aging and changing workforce.

Workforce Optimization Methodology

Workforce Optimization looks at maximizing employee productivity and efficiency through operational insight and automation. This is achieved through equipping and empowering highly skilled and agile operators to persistently evaluate and improve processes. In order to deliver complex OTS solutions on time and on budget, a precise, detailed approach is required, tailor made for each project but based on our comprehensive experiences over the past 15 years. Each OTS Project incorporates a detailed execution plan for the Simulator.

Typically, a unit-specific, high fidelity dynamic process model is built to match a client's requirements and against a delivered steady state Simulator or heat and mass balance. The subsequent process model simulation is then connected to the various control systems required for the OTS. Once these connections are made and tested internally on the Project and then externally with the client both at the Schneider Electric location and site (Factory Acceptance Test (FAT) or Site Acceptance Test (SAT)). After these testing periods are completed to the client's satisfaction, the Simulator is then used actively throughout the Project lifecycle, typically over a period of 20 years or more.

Today, many OTSs are not used for more than a few years for a number of reasons, including costs of ownership and maintenance, ease of maintenance, and flexibility of solution for upgrades. Workforce Optimization addresses these problems comprehensively by:

- Reducing costs of ownership and maintenance
- Improved ease of maintenance
- Easier upgrades capability
- Capture of best practices
- Higher, enhanced transfer of knowledge
- Improved safety, operator agility, and process flexibility

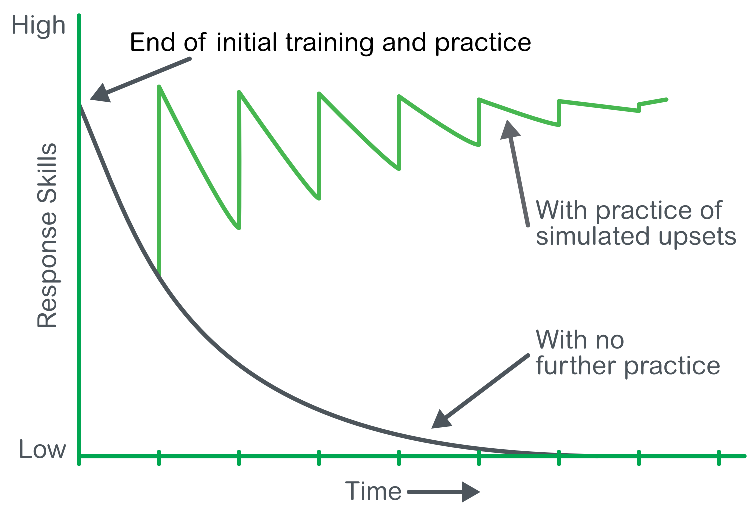

Figure 2

Operator Response with and without Appropriate Training

Simulator Objectives

OTSs have been used primarily for the training of operational staff prior to and following the start-up of the main facilities, with the aim of training the operational staff in:

- Procedures for plant start-up and shutdown situations
- Handling of utility system and process unit trips, turndown and other upsets
- Fault diagnosis, alarm handling and corrective actions in case of process equipment malfunction during normal operation
- Steady state operations
- Reduced start-up and shutdown times
- Increased safety
- Reduction in environmental concerns
- Increased unit up-time
- Increased operator awareness, skills and readiness
- Assess operator competence

Additional uses of the OTS have been:

- Testing and validation of operating procedures
- Testing and validation of control strategies and logic
- De-bottlenecking
- Investigation of engineering solutions
- Sharing of incident and operating scenarios across shift teams

The SimSci approach allows the following plant lifecycle objectives to be met:

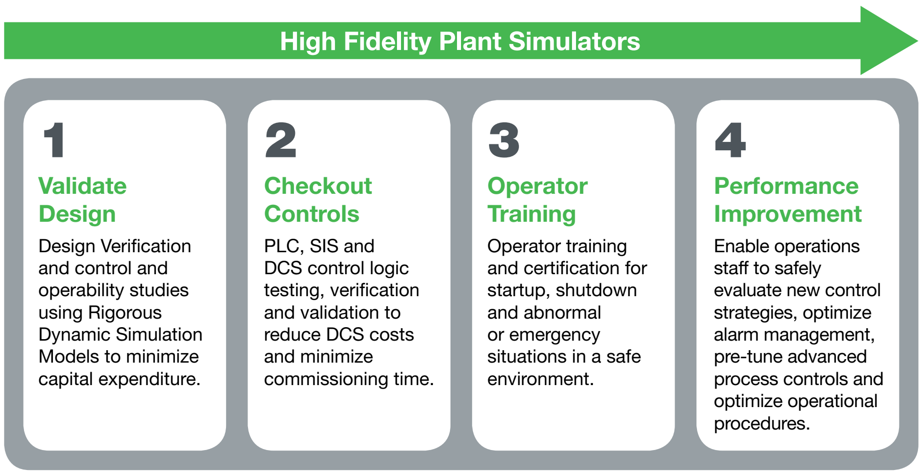

Figure 3
Uses for Dynamic Process Simulation

Validate Design

A rigorous Simulator based on first principle heat and material balances, hydraulics, equipment design, and controls is provided. The Simulator will have comparable steady state accuracy to that of steady state simulation such as SimSci PRO/II® software. However, the training Simulator will extend the solution to also include constraints that are not always included in steady state simulations such as hydraulics, control valve sizes, pump and compressor curves, column flooding, and heat exchanger surface areas and fouling.

Once the model is tuned to match the actual plant performance, the engineering staff can use the Simulator to:

- Evaluate equipment line-up changes
- Perform de-bottlenecking studies by eliminating key constraints
- Evaluate alternative operating procedures
- Perform “what if” studies

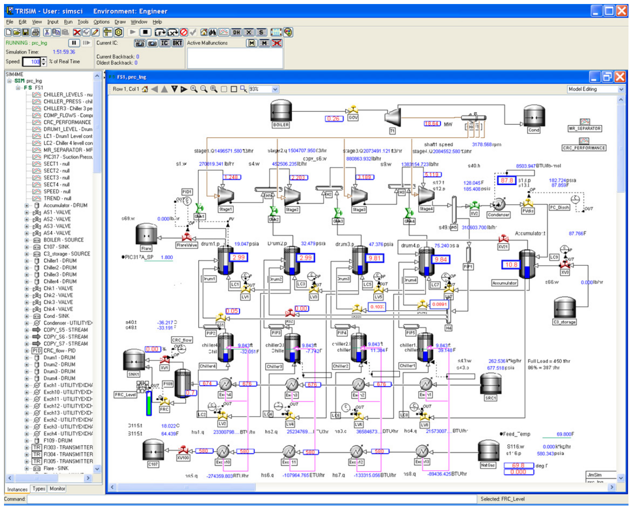

Figure 4
Operator Training Simulators

Checkout Controls

A further objective is to provide a tool that can be used to check the new controls for the plant before the actual initial start-up of the plant. Control system checkout allows the Simulator to be used to:

- Pre-tune control loops
- Test motor start/stop logic
- Validate permissive logic
- Evaluate controls stability
- Check graphics displays
- Implement checkout controls on the plant
- Test shutdown systems and logic sequences

Control modifications that are required for start-up and proper plant operation can be validated on the Simulator and then implemented on the plant. Clients who have taken advantage of this type of testing and pre-start-up training opportunities have experienced nearly flawless first-time start-ups.

The elimination of extra start-up days through control system checkout using a fully rigorous dynamic model is often, in itself, a common justification for the Simulator purchase.

Operator Training

The primary objective is to provide plant specific high-fidelity Simulators for initial training and retraining of control room operators, operating supervisors, and other plant equipment operators.

Based on the specific training plan developed by the instructor, the Simulator can:

- Improve understanding of general plant theory and concepts

- Increase knowledge of plant systems and their function and interaction with other systems
- Enhance understanding of plant control theory and operation
- Gain operating experience, confidence, and accuracy in normal and abnormal plant operations
- Provide practice following specific operating procedures
- Demonstrate recovery from various upsets and malfunctions

Performance Improvement

In addition, another objective is the ability to carry out further personnel training, such as Instrumentation Technicians and I&C Engineers. Simulator controls will be an exact duplicate of the actual plant controls.

This approach allows staff to:

- Develop and conduct control system analysis
- Troubleshoot problems that occur on the actual plant controls on the Simulator
- Test control design changes before implementing them on the actual plant
- Pre-tune new control loops
- Tune emergency control loops without risking plant operation

The Technology

OTSs are created within the SIM4ME environment to recreate accurately, within the defined scope of the customer, the working environment of a process operator.

The OTS will provide a sufficient level of fidelity that allows efficient, repeatable training exercises using Process and Control Simulations.

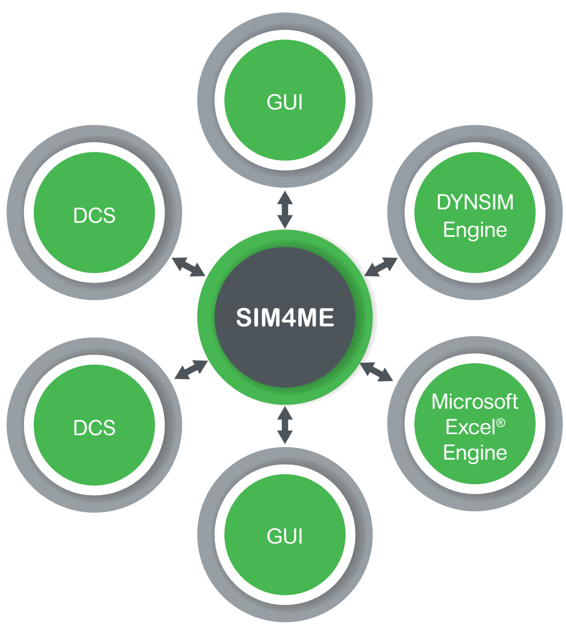

Figure 5
The SIM4ME Solution

Virtual Stimulation

Virtual stimulation permits the development of a Simulator with virtual controller hardware instead of actual controller hardware, which is accomplished by executing the controller software on a simulation workstation.

In a virtual stimulation-based Simulator, the control configuration and graphics will be identical to the actual DCS as it is configured from the same files as the actual DCS and uses actual operator console hardware.

The result is that a virtual stimulation-based OTS dramatically reduces the commissioning and the start-up of the control system and allows accurate analysis and troubleshooting of the system performance and response. Moreover, a virtual stimulation-based OTS provides the ability to generate a wide range of simulation models for testing, validation and training purpose.

All these benefits are achieved in a completely non-destructive environment.

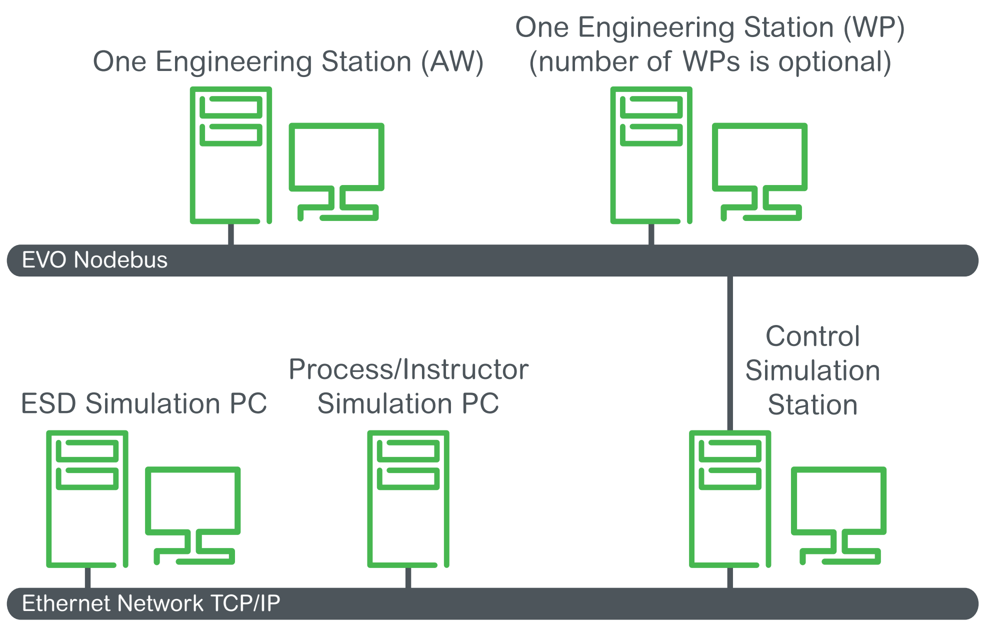

Figure 6
Typical Simulator Architecture

Customer Applications

Chevron	BP
Challenges • Efficient controls upgrade across the field • Effectively train operators	**Challenges** • Safety and operational improvement of the hydrocracker/hydrotreater & hydrogen plant, two reformers, delayed coker and SRU/amines unit • Retiring personnel
Benefits • No need for field programming and all the errors that often accompany it • Cut commissioning time in half, saving about $840K • Cut training from months to weeks, saving about 4 weeks of time over course of project • Reduced field commissioning time by 20% for instrument technicians & system integrators • Increased production capacity by 20% through testing new control strategies to debottleneck facilities	**Benefits** • Declared value of $10M – $30M based on one decision support study for Hydrocracker OTS • Process and training knowledge prior to Coker startup, minimizing risk • Recreated abnormal operating issues in the OTS and implemented an improved control strategy on Reformer

Conclusion

Workforce Optimization looks at maximizing employee productivity and efficiency through operational insight and automation. Operator training simulators have been used for thoroughly checking the control system configurations in integrated systems before they are applied to the actual plant, as well as, for training the operators, instructors and plant management in how to best operate their facilities. Plant management has found that a relatively small investment in an OTS can save hundreds of thousands of dollars with paybacks measured in weeks or months.

About the author

Livia K. Wiley is the Product Marketing Manager for SimSci software at Schneider Electric. She is responsible for expanding SimSci brand awareness and marketing of its design, simulation, training, advanced control, and optimization software. She has more than 18 years of experience in process simulation; assisting clients model, troubleshoot, and optimize their processes through technical and economic studies. She holds a B.Sc. in Chemical Engineering from Queen's University, and an M.Eng in Chemical Engineering from the University of Houston.

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