HIGH-FIDELITY SIMULATION-BASED TRAINING FOR CONTROL ROOM AND FIELD OPERATORS

HONEYWELL FORGE

TABLE OF CONTENTS

EXECUTIVE SUMMARY

1

The evolution of process and automation technology has made operator contribution to safe, reliable and profitable process operations even more important.

Control room and field operators are called upon to perform increasingly skilled and complex tasks including handling abnormal situations to performing proactive prevention, detection and mitigation activities. This involves working with an increasingly complex variety of processes and assets.

Operator Training Simulators (OTS) are one of the most effective tools to safely, quickly, and consistently develop and maintain competent operators. OTSs substitute for operations training and combined with sound strategies provide a clear path towards the development and sustainment of competencies. In this framework, the accuracy and fidelity of simulations play a significant role to ensure that presented scenarios truly reflect what operators will see in the control room and the field. Additionally, to maximize the benefits derived from the simulator, the provision of timely assessment and feedback during training sessions and the extension of solutions to include immersive scenarios and team-based training is paramount.

Operator Training Simulators must be part of a broad frame approach to operations training that explicitly takes competencies into account. This requires organizations to reimagine their training approaches to combine high fidelity simulations with comprehensive training programs that can be applied at scale.

THE NEED FOR FLEXIBLE TRAINING APPROACHES

2

To remain resilient and competitive, organizations in process industries need to introduce digital and automation technologies that aim to optimize their production levels, lower cycle times, increase output quality, and comply with regulations. Such efforts tend to focus on optimizations for processes and assets; however, it is important to acknowledge that the human factor also plays a critical role for these strategies to be successful. While automations systems take care of routine day-to-day activities, operators still need to handle abnormal situations and non-routine proactive analysis, diagnosis and decision making.

Operators are now tasked to control and manage an ever-increasing variety of complex processes and assets. This requires intimate understanding of production units including regular and non-routine procedures. The productivity of the plant directly depends on the ability of the operator to perform these tasks in a skilled and safe manner. This takes special importance as a new generation of practitioners joins the ranks of operations organizations and need to rapidly ramp up to efficiently perform their critical roles. With this in mind, organizations have started investing in training approaches that provide relatable, accurate experiences to boost the competencies and engagement of their workforce.

These training approaches need to be comprehensive and flexible enough to cover plant processes during their entire life cycle and rapidly scale their scope as organizations evolve. It is at this point where digital technologies marry training programs to give operators the ability to interact with processes in a safe, accurate, and repeatable environment where they can learn by doing. At the center of this approach we have OTSs - a collection of dynamic digital twins including first principles process models and integrated controls systems used in the design, validation, commissioning and optimization phases of processes as well as training operating teams at facilities.

THE SIMULATION BASED TRAINING ADVANTAGE

3

Operator Training Simulators use dynamic simulation models of control systems and processes of the plant and are tightly integrated with an emulator or real instance of the Distributed Control System (DCS). Dynamic simulation models typically consist of a collection of process unit operations modules, high-precision thermodynamic and hydraulic packages and rich databases of physicochemical properties of substances and compounds, and reliable numerical solvers for differential and finite equations. OTSs leverage such models to help operators learn the skills they need to run a plant safely, efficiently, and profitably.

However, for dynamic simulation models to be effective in terms of building workforce skills, they need to be complemented by training frameworks that allow the development and assurance of competencies. This means wrapping the models around comprehensive training programs that allow the proper capturing and propagation of organizational knowledge while tracking the progress and needs of individual trainees. Such training programs allow instructors to leverage simulation models to teach and evaluate core operating workforce competencies through pre-configured scenarios.

Operator Training Simulators in combination with sound training frameworks help organizations develop and sustain competencies. Process models and simulation environments practice non-routine scenarios like shutdowns, startups, and abnormal conditions in a safe environment so operators can build confidence and responsiveness in real life.

However, incorporating OTSs and comprehensive training frameworks represents a significant challenge. On one hand, organizations need to consider the extend of the coverage, quality and fidelity of the models used to make sure they accurately reflect the reality of the plant. On the other hand, organizations need to prioritize the training experience to ensure maximum engagement and effective absorption of knowledge by control room operators, field operators, supervisors, and process control engineers.

MODEL FIDELITY MATTERS

4

The effectiveness of simulation-based training is highly dependent on how close the models represent the dynamics of plant processes. Thus, it is important to consider how these models are created and validated before they can be part of the OTS. Typically, the creation of models involves simulation experts in charge to ensure the robustness, accuracy and adequate simulation speed of models. This is a time-intensive process that requires significant data, expertise and an intimate understanding of the production units.

While models can be templatized to accelerate their deployment and scalability, they still need to be tailored to the particular dynamics of the plant. As an example, think about mass produced suits off-the-rack. The predetermined size of the suit might fit you alright, but it will never feel as good as a custom-made, tailored suit. Similarly, models can part from templates, but ultimately need to be tailored to guarantee their robustness and accuracy of their outputs.

This way, the validation of process model responses against a wide range of conditions is a must. This demands strong collaboration between simulation experts and console operators to measure the quality of the model and how well it represents a process. This step is not trivial and does require significant effort before the model can be called good to be included as part of the OTS. Given this process, organizations need to carefully evaluate the modeling expertise and experience of vendors before adopting OTS solutions.

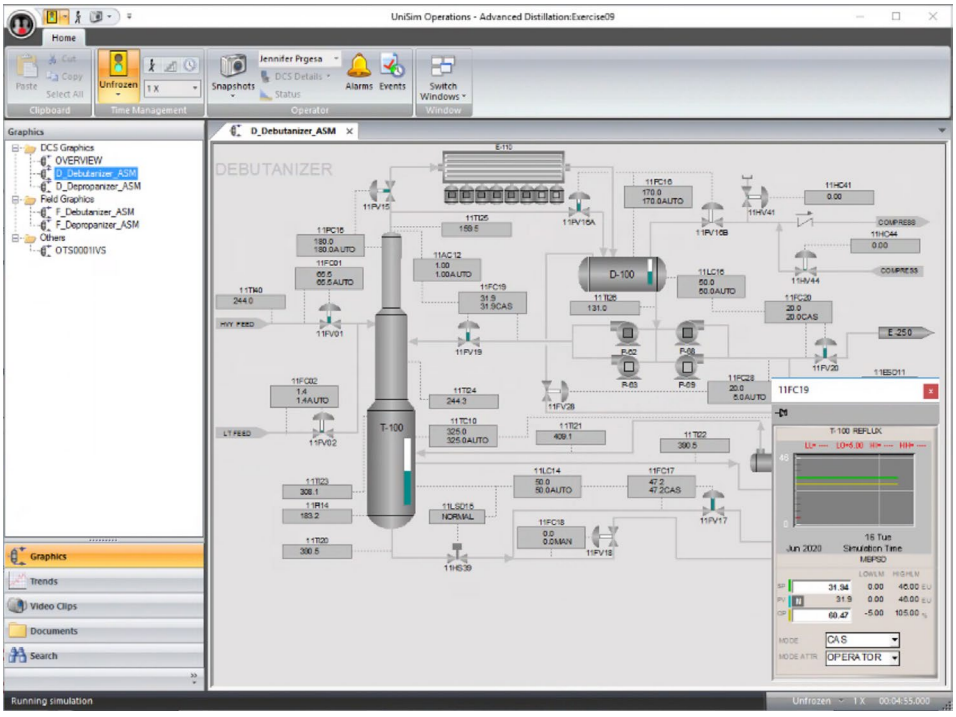

Fig 1. The fidelity of models used in OTSs is critical to properly serve the simulation and training needs of process industries

That said, the development of high-fidelity models is just one part of the workforce competency equation. Models need to be wrapped around the training environment and experiences for them to fulfill their expected purpose. Here is where the ecosystem around the model can truly deliver realistic and engaging training experiences.

THE LEARNING EXPERIENCE MATTERS

5

A key factor for an effective OTS is the realism fidelity of the training experience; that is, how closely the training activities replicate the real tasks encountered at the process facility. The information provided, and the actions required by the trainee must fully duplicate those of the real word setting, in terms of the list of activities, their volume, sequence, and pace. The simulator must impart, reinforce, and enrich the knowledge and skills required for process control and interactions in normal and abnormal situations. In other words, it must reinforce the complete skill set for effective and safe process control.

The learning methodologies and technologies used by training programs play a big role in the experience and effective dissemination of knowledge. Training programs based on OTS need to equip operators with the basic knowledge to support fault detection, diagnosis and troubleshooting skills necessary to effectively respond to plant situations. With this in mind, training programs need to take trainees through a series of exercises that progressively impart these basic skills. Exercises must be designed for operators to detect deviations, deal with alarms and other emergency conditions. The goal here is to get familiar with the underlying dynamics of the plant by understanding the causes and symptoms in different scenarios.

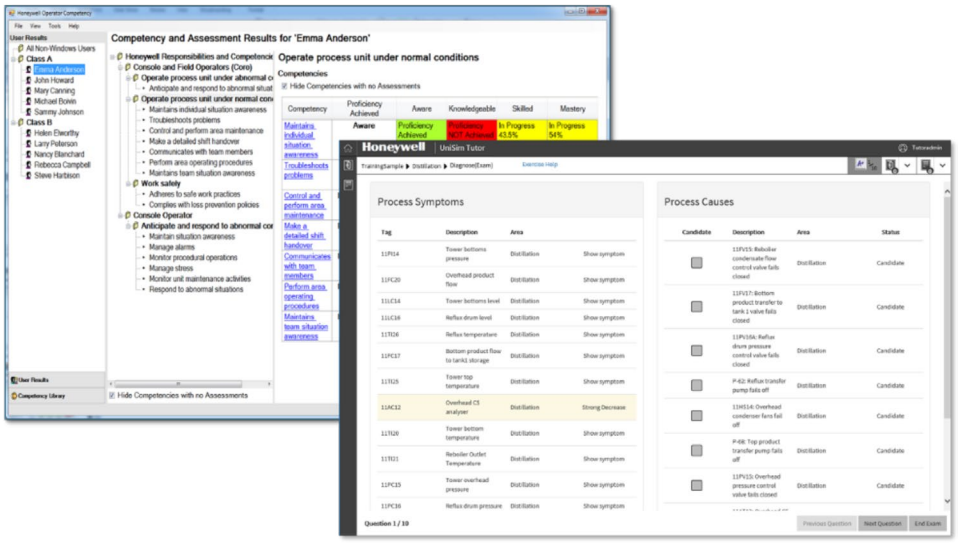

Fig 2. Comprehensive training programs need to be created around OTS to effectively disseminate knowledge, test skills, and keep track of competencies.

While the approach above is very useful for control operators, it is important to acknowledge that OTS can also be extended to field operators through immersive experiences. One alternative is to provide a virtual tour of the plant based on panoramic digital photographs, annotated with dynamic navigational links, and interactive hot spots. In practice, navigable panoramas create a 2D multi-unit space on the computer screen. The user can virtually move around the plant and use hot spots to observe process conditions, and to interact with field devices as required. This approach is useful when the plant has been commissioned already; however, if that is not the case, immersive 3D simulation experiences could be used instead.

Fig 3. Panoramic digital photographs used to create a 3D virtual tour of the plant

Immersive field simulators provide a virtual replica of the physical plant integrated with dynamic digital twins of the process and controls (OTS) to allow field and panel operator to practice different plant operations and safety scenarios in a virtual and safe environment. This promotes synergies between control room and field personnel fostering both technical and collaboration skills. This experiential and collaborative environment makes learning engaging and challenging, truly accelerating the development of competencies for newer generations of practitioners.

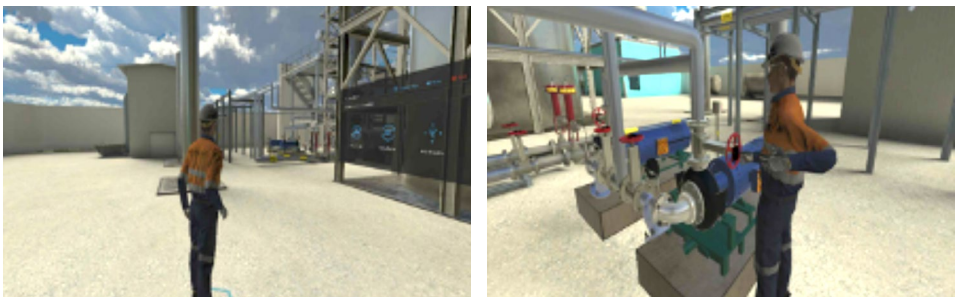

Fig 4. Immersive experiences allow field personnel to familiarize with procedures and plant layout even before commissioning

THE POWER OF PLATFORMS

6

Realizing the value of the synergies between Operator Training Simulators and comprehensive training programs requires of flexible, powerful software solutions to bring these two worlds together. Honeywell has developed the Honeywell Forge Workforce Competency suite, an OTS and competency assessment solution to support plant operations and deliver comprehensive training programs at scale. It is focused on providing operations staff the ability to interact with processes during their entire life cycle and develop competencies in a safe and repeatable environment where they can learn by doing.

Honeywell Forge Workforce Competency is designed to improve the skills and competency of today's industrial workforce. This integrated, holistic solution enables process industry organizations to deliver comprehensive training for console and field operators to help ensure plant reliability and maximize overall performance. Honeywell Forge Workforce Competency offers robust solutions to better train plant personnel for safe, incident-free and efficient startups and operations. This suite of solutions includes:

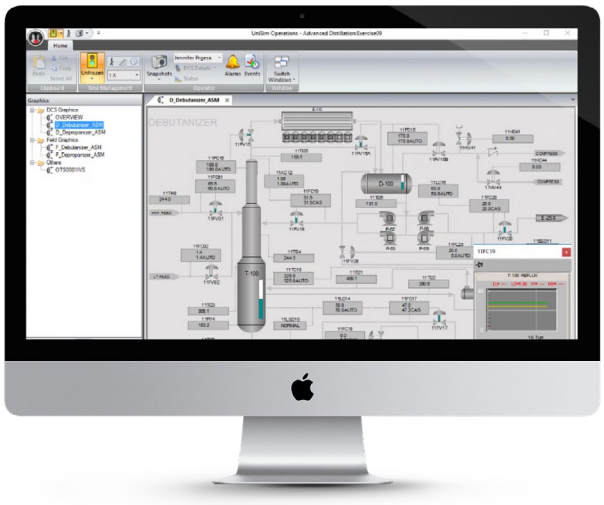

Fig 5. The Honeywell Forge Workforce Competency suite is a one-stop shop for simulation and training in process industries

- **Honeywell Forge Process Training Simulator:** A dynamic plant simulation system that allows users to accelerate knowledge transfer by consolidating an entire lifetime of experience into a concise process training curriculum. Features realistic process, control and safety systems modeling.
- **Honeywell Forge Curriculum:** Customizable competency model that aligns and perfects critical requisite skills and behaviors; tracks operator progress; built from Abnormal Situation Management® (ASM®) Consortium research into operator competency to help businesses define, deploy and manage a structured competency program.
- **Honeywell Forge Tutor:** Knowledge capture and propagation tool that provides a repository for domain knowledge and experiences, teaches and evaluates 'what if' reflexes and diagnostic abilities.

The suite is also compatible with Honeywell's Immersive Field Simulator that combines 3D immersive technology with industry-leading operator training simulation to create a collaborative learning environment. This is a virtual reality (VR) and mixed reality-based training tool that incorporates a dynamic digital twin of the physical plant to provide targeted, on-demand, skill-based training for workers.

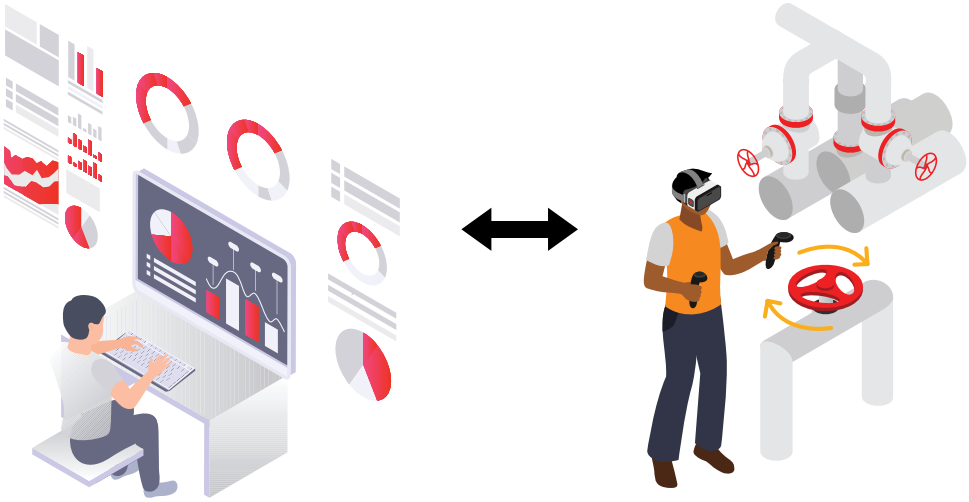

Fig 6. Honeywell's Immersive Field Simulator provides hand-on experiences through a virtual collaborative environment for teams to practice procedures together

Honeywell Forge Workforce Competency can be deployed either on premise or the cloud. In cloud deployment scenarios, the majority of the computing resources are centralized--either offshore in a public cloud or at a central facility in a private cloud. The trainee and instructors access the system from local terminals. In addition to a customized OTS, trainees have access to a range of other resources available through a web browser. For example, generic training on common unit operations without the need to install and maintain additional software or hardware components.

KEY BENEFITS OF CLOUD HOSTED SIMULATOR TRAINING INCLUDE:

- Accessibility not constrained by location – where and when needed
- Training to be self-paced and without the need for instructors
- Ability to scale up and scale down as demands dictate – one-to-many
- Immediate access as required
- The opportunity to leverage economies of scale for wide deployment
- A platform to gather and deploy industry best practices and lessons learned
- Relevant and continuously refreshed curriculum
- Engaging, credible, realistic and safe training experiences

CONCLUSION

7

The productivity of any plant is highly dependent of its personnel and their ability to perform critical jobs in a knowledgeable and safe manner. Simulation based training approaches offer the possibility of developing and sustaining operations workforce's competencies through a combination of modeling techniques and learning experiences. At the core of such synergy, we find OTSs powered by high-fidelity models that accurately represent plant processes. These models are paramount when practicing normal and non-routine plant processes on a regular basis, but also to validate DCS configurations before the commissioning of the plant. Learning programs are used around OTS to provide relatable, immersive learning experiences through realistic technologies that challenge trainees at the same time they build their confidence. Such combination of technologies must be backed up by powerful software platforms to be effective and scalable across the plant and sites regarding of their geographical location. This is the case of the Honeywell Forge Workforce Competency suite, a one-stop shop for simulation and training needs in process industries. This suite effectively integrates Honeywell's best-in-class OTS platform, installed at operational sites of the world's leading process industry companies with companion products and technologies to provide an unrivalled combination of tools and capabilities that deliver a clearly recognizable competitive advantage.

To learn more visit: http://hwll.co/workforcecompetency

Honeywell Connected Plant
715 Peachtree Street
Atlanta, GA 30308
1 (877) 841-2840
www.honeywell.com

THE FUTURE IS WHAT WE MAKE IT

Honeywell