

Operator Training by OmegaLand OTS Enterprise: New Trends for Training Systems

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Omega Simulation Co., Ltd. (OSC) has developed OmegaLand OTS Enterprise, an operator training system (OTS), as a major attractive component of the OmegaLand integrated dynamic simulation environment. It helps provide company-wide or plant-wide occasional training and regular skill upgrading for plant operators and other employees, and can efficiently monitor their training status and understanding. Instructors and trainees can remotely access the training system. Instructors demonstrate operations and provide instructions as in conventional group training, and can also check the operations of respective trainees. Trainees can share information among themselves by learning best practices, drawing lessons from inappropriate operations and so on. Trainees can access the system from their PC at anytime in preparation for group training or for self-learning for follow-up. The OmegaLand OTS Enterprise provides participants and evaluators with various benefits such as an objective evaluation of the training. This system can be set up with only a single web server on the intranet of the company's or training center's domain. The OmegaLand OTS Enterprise has the advantage of lowering management and operation costs.

INTRODUCTION

In recent years in the chemical and petrochemical industries, the contexts of fewer start-up and shut-down operations and the changes of cohorts of plant operators have made it difficult to satisfy requirements for safe plant operations, including responding to problems in equipment caused by the aging of plants, and coping with malfunctions. Thus, education, general training and operations training are becoming more and more important.

The education and general training above involve training to learn and acquire fundamental knowledge and skills: for example, understanding the principles and operations of equipment in plants, and the principles of control with PID control units. Training facilities usually have equipment for practice based on actual equipment. Many facilities are equipped with an operator training system (OTS)⁽¹⁾. The OTS provides an environment where the dynamic behavior of a plant is simulated by its dynamic simulator, and trainees can understand different phenomena of the plant and learn

its operation using instrumentation equipment or arithmetic simulators.

When a usual OTS is used, multiple operators learn operations equivalent to those for an actual system, and practice working together as a team and responding to troubles in equipment and emergencies in a plant. This training, however, requires dedicated facilities, and instructors and trainees need to have spare time to meet together for the training. Thus, due to insufficient time, the number of training sessions may decrease or the content of the training may become only partial. In addition, time-limited group training is insufficient for all of the participants to acquire the skills. The OmegaLand OTS Enterprise (OTS-E) compensates for such shortcomings of existing OTSs, helping trainees to easily enhance the effectiveness of training, and can provide attentive training corresponding to each trainee's abilities, with low load for system operation and management.

SYSTEM CONFIGURATION

Figure 1 shows a typical OTS connecting with an actual distributed control system (DCS). In contrast, the OTS-E is often used in such configurations so as to emulate DCS control logic and its screen. Figures 2 and 3 show typical examples.

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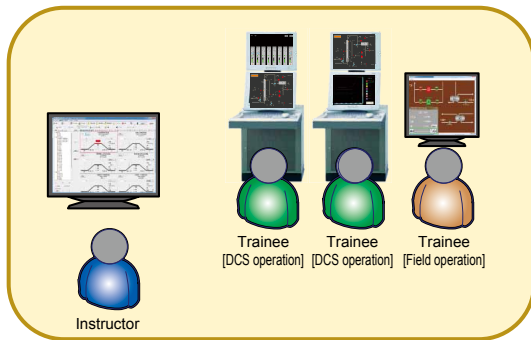


Figure 1 Typical operator training system (OTS)

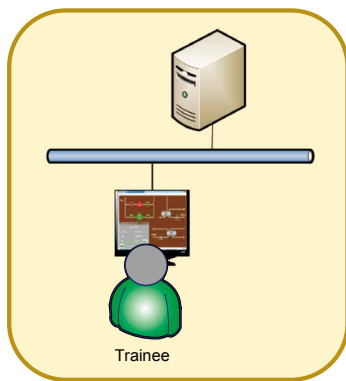


Figure 2 Self-training and automatic evaluation mode (OTS-E)

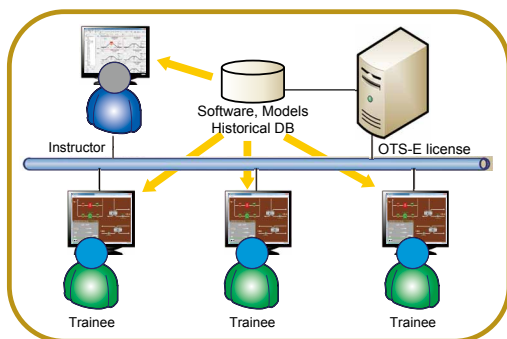


Figure 3 Instructor's leading mode (OTS-E)

The features common to examples shown in Figure 2 and 3 are that an added server function allows for the centralized management of training contents, user assignment, and operation results, and that trainees can receive training any time on any personal computers (PC) as long as they are connected to the server via intranet. This intranet is a network where PCs and users are mutually authenticated in a domain environment. Even if the network is physically wide, training can be carried out in a multiple user environment. That is, the OTS-E can be used on the usual network environment of companies or education facilities.

Major configuration examples of self-training and automatic evaluation shown in Figure 2 and instructor's leading shown in Figure 3 are described below.

Self-training and automatic evaluation

Figure 2 shows a configuration where trainees who want training can start a training program, practice operations corresponding to their training purposes, and be evaluated only by selecting a training scenario through a web browser on their own PC.

This configuration offers that trainees can receive training at any time on any PC, including their own, at their own convenience. Trainees can practice a variety of operations through trial and error and experience better operations. This configuration can be used to objectively evaluate the learning results of the trainees and their degree of understanding of a plant, its operations, and so on.

The automatic evaluation is achieved by the evaluation function of the OmegaLand/ITK module for training instructors, and the system can be easily configured so that it delivers training scenarios to trainees and starts objective evaluation at the same time of the system start-up. Scenarios include those of equipment failure, feed changes and applying disturbance. Evaluation criteria include the capability of maintaining the process state including a pressure and flow-rate within the range; operating with safety valves closed; and preparing required equipment and starting the system with the correct procedure within an appropriate time.

The system scores trainees' assessment criteria and judges the extent of their training. Through the standard interface of the E-learning system, evaluation information can be sent to the learning management system initiated at the companies or educational facilities.

Instructor's instruction

Figure 3 shows another configuration, where an instructor and multiple trainees share a single training session over the network, and virtual training can be remotely conducted as if they were in the same room. For example, instructor A delivers a wide scope training session shared with trainees B, C and D for responding to malfunctions in the plant, or instructs each trainee over the network to learn basic operations of individually assigned equipment.

FUNCTION OVERVIEW

Client Service

In addition to providing a virtually shared training environment, the OTS-E has the following additional functions to enhance effectiveness of training:

- Message exchange
- Requested task management
- Sharing model operation
- Trainee operation reference
- Operation reproduction and sharing

The message exchange function is used to provide information on the preparation, start, and end of training, and to exchange information among trainees as well. For example, trainees responsible for field operations use this function to report on-site information to trainees working in the instrumentation room, trainees responsible for field operations

use this function to confirm each other's training progress. Messages are saved as a training history, so that instructors and trainees can review them later.

Requested task management manages a series of tasks; the instructor requests trainees to perform operations in accordance with a scenario, and trainees acknowledge it and report the completion to the instructor after the operation.

Sharing model operation helps the instructor organize a virtual group for training and visibly explains a model or basic operations on-screen to the group members.

Trainee operation reference enables an instructor to reproduce operations of any trainee on his PC in order to verify these operations. Operations to process all of the users who are participating in the training group can be verified using a chronological list.

Operation reproduction and sharing enables the instructor to choose an operation from each trainee from among the list described above and reproduce and replay it on a screen showing it to all trainees in the group. They can share a better operation and/or an undesirable one to improve their operating skills and process understandings.

In addition, if a scenario which an instructor has assigned for training is practiced on some PCs on the network in the self-learning and automatic evaluation mode, the instructor can verify those training status by the ITK and a dedicated graphic module. Through the contact with the instructor for judging the validity of the operation or process status, trainees can obtain instructor's remote assistance and guidance using this function. All parties can thereby use their time efficiently.

Server services

The followings are major server service functions:

- Software update management
- Management of master information on training models and initial conditions
- User and privilege management
- Scenario management
- Training history management

As shown in Figure 3, the server stores the master information on training models and initial conditions required for training, in addition to software. When a trainee tries to open the service site of the OTS-E (web browser top site for training) through a logged on PC for training onto which the software has not been installed, messages prompting its program installation appear, and a trainee can easily install it. Once the program is installed, training models according to selected training scenarios are automatically downloaded and the program will run automatically. On the second or later execution requests, the program starts immediately owing to the internal cache.

User and privilege management has the function of allowing the system administrator to register users who can access the OTS-E system. At the same time, the permission is assigned according to each user, e.g. an engineer who can modify a scenario, a training instructor, a trainee and so on.

The scenario management function allows users with the

permission of an engineer to update models or change initial conditions through a web browser.

The training history management function enables users to review training results depending on their permission. The training results include training evaluation scores, acceptance results, training dates, training scenarios, operation logs and other information.

FEATURES

The features of the OTS-E are as follows:

- Accessible from anywhere at any time through a browser

This is a key feature to complement usual OTSs, which enables trainees to prepare before and review after OTS shared training, and to confirm the training results. For example, if any trainee is a beginner or a trainee who has been apart from relevant sites for a long time, an instructor can assign an OTS-E scenario to them before the specific OTS training for them to learn principles, start-up operations and switching operations of important equipment in the plant. In the OTS shared training, operation of a certain device can be requested of a trainee who has already learned about the device. If a trainee does not reach the acceptable level in operation, or has made mistakes in prediction of or response to malfunctions, additional scenarios corresponding to his weak points or understanding level can be assigned after the shared training for supplemental study or set as his subject for checking understanding.

- Remote participation

This feature helps to increase opportunities for training and to efficiently educate limited numbers of experts and many newcomer trainees of . Explanatory examples are seen in the case where a copy plant is constructed in other countries or similar instruments are installed in other plants. There is no need for instructors and equipment experts to travel to the site, and they can participate in the training from their regular workplace, thus training can be efficiently provided to many trainees with minimal loads. In addition, prior to the changes of equipment in facilities or transfer due to staff reassignment, trainees can gradually proceed with the preparation by observing the operation and behavior of the process or trying some operations, while remotely participating in the training.

- Easy system introduction and low loads on administrators and users

This is one of the most outstanding features of the OTS-E. Management of an existing OTS requires advanced preparation such as installing the software on a PC to be used, saving the training scenarios including models and initial conditions, and setting up the network configuration. Furthermore, users need to understand the operation of the OTS software on each PC before the training. On the other hand, the persons in charge of an education system using the OTS-E needs only to assign training scenarios to trainees for the preparation. Because the mechanism required for system

management is implemented in the server, they can use a browser on their own PC for updating OTS training contents, referring training results, and assigning scenarios to trainees. They do not need knowledge about PCs and servers and installation tasks which are required for IT administrators.

- Low load on users' execution environment

The OTS-E system rarely requires a dedicated, powerful PC because the load on an execution environment is low even in the case of large scale simulation. In particular, during preparation or review for the OTS training or learning of functions of individual equipment, heavy load software (programs) do not need to be run as they are, so trainees can use their own PC or an unused shared PC. Trainees can save the initial condition in progress of their training into the server and continue the training on another PC later.

- Low workload on the administrator

If the administrator has some IT knowledge, he can introduce the system in a half day by only adding web services on a normal server and assigning folders for training projects. Expensive hardware and multiple servers are not required. Of course, if a powerful computing center is available and its available computing power and software licenses are enough, full-scale OTSs can be run on the servers, and requests from multiple trainees can be dispatched to multiple servers and remotely executed on each simulator environment on the server. In this case, the load on client PCs will be reduced. However, response to operations may be delayed or performance of training which each trainee is participating in may deteriorate or become unstable depending on the load on the server. Prior evaluation of performance, large-scale IT system integration, and continuous server maintenances are required.

TRAINING EXAMPLE

In this example, an instructor invites two trainees for training and they carry out the training following the instructor. Through a web browser, the system administrator registers these three people and their permission, one for instructor and two for trainees, in advance, and training scenarios are assigned.

- 1) The instructor opens the training site on a browser, and selects the two trainees, who are logging on to their PC, by organizing the training group menu.
- 2) The trainees receive the invitation on their PC and then accept it.

The instructor selects a training scenario and a training mode, and then lets the trainees participate in the training. The system of the instructor's PC automatically starts, and the training screen is displayed on each trainee's PC.

- 3) The instructor uses the messenger as shown in Figure 4 to inform the trainees of the training contents and assign tasks.
- 4) The instructor uses the screen as shown in Figure 5 to proceed with the training.
- 5) When the training finishes, the program automatically terminates and the training results are sent to the server.

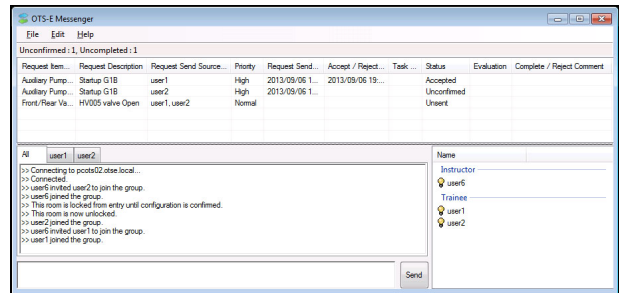


Figure 4 OTS-E messenger screen

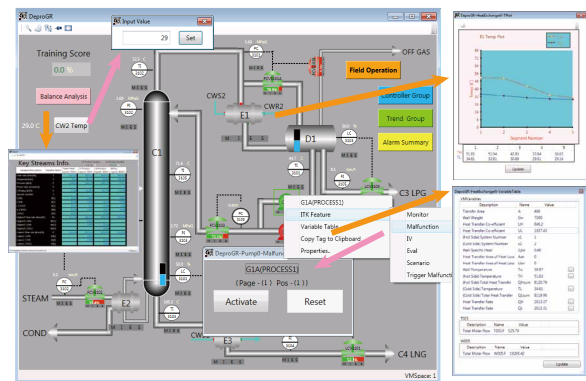


Figure 5 Instructor's screen and training operation

CONCLUSION

The OmegaLand OTS Enterprise, which compensates for the shortcomings of existing OTSs, is an easy to use system for training system staff, instructors, and trainees. The system increases the availability of education, general training and operations training, and brings effective training results to a variety of users in enterprises and education facilities. The administrator can easily understand the progress of the training. The OmegaLand OTS Enterprise is setting a new trend in operations training and education systems.

REFERENCES

(1) Katsumi Yokoyama, Takamasa Yumoto, "Simulator for Operator Training : Operation Training Simulator," The Piping Engineering, Vol. 50, No. 14, 2008, pp. 53-58 in Japanese

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