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How To Develop a Training Simulation

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TRAINING SIMULATIONS CAN MAKE ON-THE-JOB LEARNING FASTER AND SAFER BY PROVIDING HANDS-ON EXPERIENCE AND CONTROLLED ENVIRONMENTS. HERE ARE SOME TIPS FOR ASSESSING THE COSTS AND DESIGNING AN EFFECTIVE SIMULATION.

There are some things people just can't learn from words or pictures. For example, when a job task requires an operator to manipulate the work environment, he or she must actually see the consequences of each action in order to learn how to complete the task successfully. In some situations, it can be costly and even dangerous to let inexperienced operators practice with real systems. In such cases, simulations can provide safe, controlled environments in which to learn.

First, it is important to define terms. A simulation is a model of a process or activity. A simulator mimics the controls, methods, and consequences of actions performed by operators. Simulations can be supported by tutorials, but they are definitely hands-on training experiences.

Here are some examples of training simulations:

- An operator of a computerized imaging system views recorded images on a computer screen, using simulator controls to examine the images. The training objective is to classify the imaged objects. The simulator controls mimic all of the functions of the actual system used in the operator's work environment.
- In a continuous-process-control environment, a worker operates a simulator to learn how to make timely decisions using a conceptual model or game. The simulator functions according to the same rules as the actual work system.
- A medical student interviews a hospital staff member who has been trained to simulate the symptoms of a specific disease. The simulation provides the student with experience in diagnosing, collecting, and understanding patient information.

Four kinds of simulations

There are four kinds of simulations. One kind helps participants learn the psychomotor and perceptual aspects of a task as it is performed in real-world situations. For example, in a flight simulation, trainee pilots practice visual and motor coordination as well as task sequences, in response to cues from the simulator.

In another kind of simulation—called cognitive-task simulation—trainees learn the concepts and abstractions that underlie the rules and principles governing their work environments. Because these simulations focus on thinking processes, they don't represent real-world situations as accurately as simulations of psychomotor and perceptual tasks. An example of a cognitive-task simulation is a stock-market game.

A third kind of simulation—for tasks involving communication and

coordination—represents one of the newest and most exciting applications. Several trainees can perform at one time in different roles as part of a simulation of a work system; the actions of each participant are shown at the other trainee stations. This application can be used in tasks ranging from planning marketing strategies to managing nuclear power plants. In the near future, system simulations may train workers in understanding the implications of their actions on co-workers and may show them how to work effectively in organizations with far-flung operations.

A fourth kind of simulation—using virtual-reality technology—is still in its infancy as a training tool. Virtual-reality systems try to achieve total-sensory simulation through the use of special headgear and electronic gloves. Trainees wear goggles fitted with small computer screens on which they view the target environment, which they experience in three-dimensional images. As the trainees look or move in different directions, the virtual-reality simulator mirrors their moves on the goggle screens. Trainees can actually reach into, interact with, and manipulate the environment electronically.

No matter which kind of simulation is best for your training task, the steps for deciding whether to use a simulation and how to design one are the same.

Should you?

The first step in deciding whether to use a simulation is to analyze the training situation. Simulations tend to be expensive in the short term. Will the simulation be worth the high cost?

One way to determine the potential value of a simulation is to figure its return on investment, which is the product of the size of its training audience and its training effectiveness, divided by the cost. The cost is determined by the simulation's requirements for fidelity or accuracy.

Audience size. The audience size is the number of people likely to be trained using the simulation. In general, the more potential trainees you can identify, the more money you can spend on a simulation and still get a quick, measurable return on investment.

In determining the size of the audience, it's important to take into account the rate of employee turnover in the positions for which employees are being trained using the simulation. When the employee population for those positions is transitory and large, using a simulation may be appropriate. But when the population is stable and small, another form of training may be more cost-effective.

You also should consider the composition of the audience. Could employees—such as supervisors, support staff, and maintenance workers—in addition to the targeted group of trainees benefit from training on the simulator? When the audience is distributed in several locations, could you duplicate the simulator in each location and train more people?

Effectiveness. Compare the effectiveness of a particular simulation to that of other training approaches.

Typically, simulations are more cost-effective in training for skills and attitude changes than in training for knowledge. In skills training, five minutes in a real work environment can teach more than trainees would get in hours of lecture. For some tasks, simulations can reduce training time by as much as 85 percent. Simulations also work well for job tasks in which a performer's ability to obtain feedback from environmental cues is critical to success.

Contrary to some people's opinion, simulations aren't just for technical training. They also can be effective for marketing, project planning, and other so-called soft skills. In fact, you may have already built a simulation, just by designing such training activities as a model office for work-related role play.

Simulations can be very effective in industries in which competency-based performance is required for operator certification. People trained in simulated environments that closely resemble their actual work environments tend to experience a high rate of transfer of training to their jobs.

Another area in which simulations are highly effective is workplace safety. They expose trainees to critical situations without endangering people or equipment. Simulations provide risk-free environments in which operators can demonstrate their understanding of a system before using the system in the actual operating environment.

In some instances, simulation is the only way to evaluate an employee's readiness for on-the-job training. Also, simulations can give trainees practice in more varied critical situations than they might experience during years on the job.

Fidelity. Simulation fidelity is defined as the degree to which a simulator accurately represents the actual work environment. In a flight simulator, fidelity requirements are high. It is critical to flight training for the simulator's instrument controls—as well as other visual and aural cues—to be highly accurate.

In a model-office simulation, real paper forms and memos, and a realistic time structure, may be all that is needed. The exact placement of desks, the color of the wallpaper, and the position of the water cooler don't have to be accurate for the training to be effective.

The total cost of a simulator's fidelity requirements involves several factors. The most significant cost factor is a simulator's level of interactivity, which is determined by the number and complexity of operation controls. For example, a computer-based training system with response buttons depicted on the screen has a

Are You Ready?

Before you begin implementing a simulation, make sure you've completed these steps:

- Establish the simulation's training goals and outcomes. Know what skills you expect trainees to gain from training and what effect the training will have on the organization and its operations.
- Determine whether the simulation is cost-effective, based on the number of people expected to use it, its complexity, and its expected benefits compared with other kinds of training.
- Define and document on paper the level of interactivity required to meet training needs. Make sure everyone involved in developing the simulation understands its complexity.

low level of interactivity. A process-controller simulator with hundreds of controls requiring complex interactions has a high level of interactivity.

A simulator's level of interactivity should be carefully defined and managed to ensure that the training meets its objectives. Designers of training simulators should omit any interactive features that don't contribute to training goals. One of the greatest threats to a training budget and schedule is creeping interactivity growth.

Another cost factor involves a simulator's controls and displays. How will the simulator re-create the controls and displays seen by trainees in the actual work environment? How accurate do these visual, tactile, and aural representations have to be? Can some displays be shown just through photographs? Can computer graphics adequately represent such dynamic displays as actual buttons and dials? But must all displays be identical to the actual system's hardware?

It's important to remember that not all information imparted by the simulator requires the same level of fidelity or accuracy. You might be able to cut costs by using different levels of fidelity for different parts of a simulation.

Developers can also save money through careful selection of the variables that determine the sequence of events in a simulation. The variables differ from interactivity levels, which involve only the number and complexity of user controls.

For example, in designing a flight simulation, it's important to take into account such variables as wind speed, air speed, altitude, geographic position, radio frequencies, and aircraft weight in determining the positions of the simulator instruments and the sequence of their use. In a model-office simulation, the sequence of events may be determined by such variables as the time of day, the last actions of a participant, and the cost associated with each action.

The more variables that can affect the outcome of a simulation, the higher the cost to design, develop, and test it. Generally, a simulation's cost and complexity increase exponentially as the number of factors increases. For example, if you double the number of factors, you probably should quadruple the estimate of resources and time needed to develop the simulation.

Going ahead

Once you've decided to use a simulation in your training, the first step in developing it is to create an interactivity model—a diagram, flowchart, or other representation of the effect of each of the simulator's operational controls. The model shows what happens when users touch any of the controls at any time during a simulation. This is the decision-making stage of development. By the time the model is completed, you should have made all decisions about how users will interact with the simulator.

You may want to divide the development of the interactivity model into two stages. The first stage is to identify the major modes or states of the simulator. For example, there may be a setup mode in which the training situation is defined, a tutorial mode in which users receive guidance from the simulator or an instructor, and a simulation mode in which the simulator operates as much as possible like the actual system.

The second stage is to identify all user "controls" and their effects for each mode of simulator operation. The ultimate success of the simulation rests on the developer's thoroughness at this stage. Now is the time to finalize all decisions regarding the design and placement of the simulator controls.

Once the interactivity model is completed, you have an abstraction of the simulator, though not a physical manifestation. The last task is selecting the simulator's medium. In other words, what exactly will the simulator look like?

The medium should carry out the simulation's design in a finished simulation system. The medium should make the simulation's implementation efficient. And the medium should provide an environment in which training goals can be translated into perceptual, psychomotor, attitudinal, or cognitive changes in trainees.

There are two basic categories of media to choose from: static and dynamic. Static simulations use such media as workbooks and paper exercises. During static simulations, the content doesn't change, though many different interactions and outcomes are possible. The biggest limitation of static simulations is that they can represent only situations that occur on paper, such as problems with customer orders.

Dynamic simulations use such media as computers and video displays to provide instruction and information. Not surprisingly, computers do a wonderful job of simulating other computers. If most of the skills being learned involve the use of computers, a relatively inexpensive computer simulation can mimic expensive complex systems at a much lower cost.

Be creative. If you can identify several elements—such as people, paper, and computer displays—that can teach a particular skill, don't hesitate to combine them.

Getting buy-in

Simulations require a large investment of time and money up front. Consequently, it can be difficult to get top management's approval for them. One way to convince senior managers to invest in a simulation is to show them a successful one, perhaps in a related but noncompetitive business. Once they see how much training simulators can reduce training time and operational errors, they are more likely to approve their development and use.

Keep in mind that it is rare for a simulation to meet all of its goals in the first implementation. It's important to plan—financially, emotionally, and chronologically—to make upgrades and modifications.

The tools and methods for developing simulations have never been better. And the prospects for applying cost-effective training simulations are more favorable than ever before. ■

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