The Use of Hazards Analysis in the Development of Training

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Abstract

When training for a job, in which human error has the potential of producing catastrophic results, an understanding of the hazards that may be encountered is of paramount importance. In high consequence activities it is important that the training program be conducted in a safe environment and yet emphasize the potential hazards.

Because of the high consequence of a human error the use of a high-fidelity simulation is of great importance to provide the safe environment the worker needs to learn and hone required skills. A hazards analysis identifies the operation hazards, potential human error, and associated positive measures that aid in the mitigation or prevention of the hazard. The information gained from the hazards analysis should be used the development of training. This paper will discuss the integration of information from the hazards analysis into the development of simulation component of a training program.
THE USE OF HAZARDS ANALYSIS IN THE DEVELOPMENT OF TRAINING
F. Kay Houghton*

When training for a job in which human error has the potential of producing catastrophic results, the inclusion of the information concerning the hazard in the training program is of paramount importance. This paper discusses the integration of the information from the hazards analysis into the training program for the dismantlement of high explosives.

A hazard is defined by Sanders and McCormick (1993) as a condition or set of circumstances that has the potential of causing or contributing to injury or death. In the case of high-explosive dismantlement, the extreme consequence is the death of the workers in the immediate area and possibly the death of other on-site workers as well as the destruction of the facility. This is considered a high consequence activity that requires very safe work practices. Dismantlement of explosives is a psychomotor intensive job that requires human handling at every step of the process. Thus, because of the high level of human interactions with the system, the safety of the work is greatly influenced by human performance. Because training is the vehicle used to aid people in acquiring safe behavior practices as well as job skills, the training program must be effective. To be an effective training program, it must incorporate the hazards found in the job. The hazards analysis is the methodology used to identify and document the hazards.

A hazards analysis is the systematic identification of the hazards encountered during the performance of a job. An early phase of the hazards analysis is the task analysis in which the required actions of the workers are documented. The task analysis is then used to identify potential accident scenarios. Because the dismantlement process is human activity intensive and the probability of an accident scenario is closely connected to the likelihood of a human error, possible associated human errors are identified during the accident scenario development. Human errors that constitute an erroneous input into the dismantlement process are emphasized. A commonly used taxonomy for the classification of human error is the Discrete-Action Classification defined by Swain and Guttman (1983). Discrete-Action Classification subdivides human errors into two primary types: errors of omission and errors of commission. Errors of omission consist of not performing the task. Errors of commission are the incorrect performance of a task and are subdivided into selection errors, sequence errors, time error, and qualitative errors. All of these error types are components of the training program.

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Training is a primary strategy used to aid in the reduction of human error. For training to be effective in the reduction of errors, it mimics the actual work conditions as closely as possible and gives the workers the opportunity to practice potentially hazardous activities in a safe environment. To be effective, the training program must be well designed and implemented. One way to help ensure that the training program is effective is to use a systematic training system with the objective that specific skills, jobs, and procedures are learned. When determining the methodology for instruction the tasks to be learned should be considered.

An effective instructional methodology facilitates a high transfer of learning from the classroom to the job performance. One of the most common methods of training is lecture. Because dismantlement requires continual involvement and physical response of the worker, lectures have limitations as the primary training methodology. While the instructor can describe the process and the trainee respond verbally, correct verbal responses do not always correlate to correct bodily responses (Holding, 1987). Thus, while a lecture may constitute part of the training, the training must not be limited to a lecture but also include observation of a demonstration and practice. Lecture is an important component of the training by including a discussion of the hazards identified in the hazards analysis.

Another common method of training is demonstration. During the demonstration the instructor draws attention to the perceptual cues that aid in the correct performance of the task and provides the worker with a standard of performance to be mastered. As with the lecture, observation of a demonstration does not always translate into correct perceptual-motor activities, and the demonstration and lecture should be followed by practice. The demonstration is an opportunity for the instructor to discuss and demonstrate error mitigating techniques. For example, when working with high explosives it is important not to drop tooling on the explosives; the workers should minimize the possible drop height of tooling applied over the explosive materials. The instructor can demonstrate techniques for applying tooling and protecting the explosives.

Practice is the basic training activity. The value of training depends on the degree that the practice transfers to the real task. The transfer between training and the job depends on both the perceptual and response similarity. The following table by Holding (1987) shows the transfer results depending on the similarities between the practice and the real task.
Table 1
Quality of Transfer from Training to the Job

As can be seen, the highest transfer rate occurs when the task stimuli and the required response are the same in the practice arena and in the job. This suggests a simulator as the training tool. However, because it is important to prevent the occurrence of negative transfer to the real job, the simulator should be a high-fidelity simulator that requires the same response to the same stimulus as the process.

Training simulators have characteristics that make them well-suited for the training of high-consequence activities.

1. Simulators reflect the dynamic response of the real system.
2. The controls and displays are as real as possible to support learning at both the intellectual and psychomotor levels. Detail characteristics are crucial. This is particularly important with manual tasks. One high-explosive hazard is dropping the material. It is important that the simulated high explosive has the same tactile characteristics (weight, shape, surface, etc.) as the actual material. Another concern is the application of too great of a pressure to the material, therefore it is important that the simulation allows the learner to feel the correct application of pressure.
3. Simulators support whole task training. This allows students to practice in the workload, stresses, and time pressures of the tasks being trained.
4. Simulators provide instructional control. This allows the students to practice response to credible deviations in the process or abnormal events in a safe environment.

A high-fidelity simulator is a valuable tool for training for high consequence jobs. The training should incorporate hazards identified in the hazards analysis and allow the trainee to practice preventive and mitigative techniques in a safe environment.
References


