Hazard Recognition Training Tool Allows Mineworkers to Perform Virtual Workplace Examination
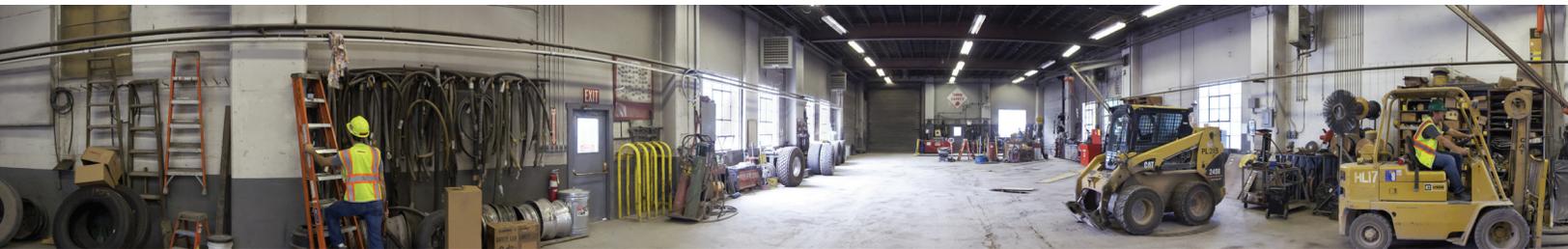
Figure 1: A portion of one of 31 panoramic images available in EXAMiner, showing six hazards in a shop.

Summary

Being able to recognize hazards in the environment where they occur is critical to mineworker safety and health. EXAMiner, developed by the National Institute for Occupational Safety and Health (NIOSH), is now available and can be downloaded from the NIOSH Mining website to run on laptops or personal computers. This Windows-based software gives mineworkers the opportunity to practice searching for hazards in virtual work environments while performing a virtual workplace examination. Workplace examinations are represented by panoramic scenes depicting locations at a mine site, where mineworkers can search and mark as many hazards as they find within a five-minute time frame. After completing the search task, mineworkers are provided feedback on their performance along with useful information on the hazards. EXAMiner also gives instructors the ability to create custom training materials, either by using NIOSH scenes or by importing their own pictures into the software.

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Software Design

NIOSH researchers designed EXAMiner so that it could easily be adopted into current training programs. Once downloaded and installed, EXAMiner does not require an internet connection and can be used with any device running a Windows 10 operating system. The software can be used during an instructor-led Part 46 and 48 annual refresher or new miner training held in a classroom setting and during other training situations as well (e.g., during monthly training meetings or toolbox talks).

EXAMiner comes with 31 NIOSH scenes (24 with and 7 without hazards) that were developed specifically to study mineworker hazard recognition ability. The NIOSH scenes are panoramic images of four locations at a surface limestone mine: the pit, plant, shop, and haul roads/other roadways (see Figure 1 for an example). To ensure realism and keep the training appropriately challenging, a range exists in the number of hazards included in scenes (between two and eight), hazard type (e.g., build-up of material, missing personal protective equipment, inappropriate use of tool), size (e.g., a large haul truck compared to a small, broken stair), and hazard placement (e.g., on an elevated walkway, on the ground). Altogether, there are 106 hazards included in the 31 scenes (see Figure 2 for an example).

Creating Training Sessions using NIOSH Scenes and Scenarios

There are two ways instructors can customize training sessions using EXAMiner—by using NIOSH scenes to create training scenarios or by using pre-built NIOSH training scenarios.

First, instructors can build training scenarios using the NIOSH scenes. This approach ensures that training sessions can be completed within a specified amount of time because instructors can select a specific number of scenes. Instructors can also customize scenarios to focus training on certain locations at the mine site and to cover specific hazards. To facilitate scenario creation, EXAMiner includes a help guide with appendices that break down NIOSH scenes both by location and by the hazards included in each scene.

Secondly, training sessions can be customized by using NIOSH scenarios. To make scenario building easier, NIOSH created five

Figure 2: Example of three hazards outlined in red from EXAMiner, taken from the left side of the panoramic image of the shop shown in Figure 1.

accident-type scenarios (slip-trip-fall, mobile haulage, etc.) and four scenarios designed specifically for new miner training. Accident-type scenarios are made up of scenes that only include a specific type of hazard. For example, the electrical scenario is made up of six scenes that include eight electrical hazards. These scenarios were designed for trainees to be able to focus on one type of hazard during a search. New miner scenarios are made up of scenes that include hazards that were accurately identified at least 20% more often in a NIOSH laboratory study by the most experienced participants (safety professionals and experienced mine workers) compared to the least experienced participants (mining engineering students) [Eiter et al. 2018]. These scenarios were designed to highlight critical hazards that novice mineworkers may not detect readily compared to an experienced mineworker.

Creating Mine-Specific Scenes and Scenarios

Because each mine has its own unique layout, policies, operating procedures, and critical hazards, EXAMiner includes a feature for creating site-specific hazard recognition training materials. Users can upload their own jpeg image files into the software. Once an image is selected, instructors are asked to input the size of the image. EXAMiner allows users to upload images that range from a 70° field of view to a 360° field of view. Once the images are uploaded, users follow the instructions within the software to mark hazards and add supplemental information to reinforce the mineworker's knowledge of the hazard. Once the scene is saved, it appears in a list of custom scenes within the software. Instructors can then create training scenarios by selecting one or more custom scenes. Instructors can also create training scenarios by selecting a blend of custom scenes and NIOSH scenes.

Training Session Debrief

Training is more likely to result in learning when paired with a debrief session [Tannenbaum and Cerasoli 2013]. Accordingly, EXAMiner gives users the opportunity to debrief performance on each workplace examination search task. Instructors can choose to debrief immediately after each scene is searched or at the end of a training session. After examining a scene, users can access the Session Debrief Screen. This screen shows a list of scenes with a performance summary for each, including overall accuracy (e.g., 1 of 4 hazards found), total search time (e.g., 3 minutes 20 seconds), and the number of clicks made (e.g., 15). Instructors can select one of the scenes to see where users clicked, which hazards they identified successfully, and which hazards they missed. This page also gives a brief explanation of each hazard along with supplemental information such as relevant accident and injury narratives, hyperlinks to "tools you can use" during training, and hyperlinks to relevant standards from the Code of Federal Regulations, Title 30.

Sharing Training Scenarios with Colleagues

Among its noteworthy features, EXAMiner makes it possible for instructors to share scenarios with others. Once a scenario is saved, users can export the file to share with others. Exported files can be emailed or added to shared folders and imported into EXAMiner by other users. Thus, different scenarios can be added to the software to further enhance its usability.

How to Download EXAMiner

EXAMiner is available for download on the NIOSH Mining website: www.cdc.gov/niosh/mining/works/coversheet2050.html. There is also a Quick Start PDF with step-by-step instructions.

References

Eiter BM, Helfrich W, Hrica, J, Bellanca, JL [2018]. From the laboratory to the field: Developing a portable workplace examination simulation tool. In Advances in Human Factors in Simulation and Modeling. pp. 361-372. Springer.

Tannenbaum SI, Cerasoli CP [2013]. Do team and individual debriefs enhance performance? A meta-analysis. Human Factors *55*(1):231-245.

For More Information

For more information on EXAMiner, contact the NIOSH Mining Program (**mining@cdc.gov**).
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