USING AUGMENTED REALITY
to Develop a Safety Culture of Engagement

By Saso Krstovski, Jake Ruchala and Kristi McGough

"You are scheduled for safety training." This statement evokes a classroom setting outlining standards and procedures—not very exciting or engaging for non-safety professionals.

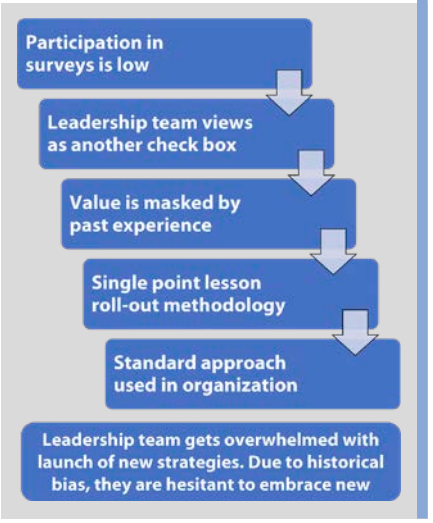
Realizing this, Ford Motor Co.'s Van Dyke Electric Powertrain Center leveraged technology to create excitement and engagement around traditional safety training deployment solutions.

Solution Strategy for Focused Engagement

Logic and research indicates that more observations help drive a culture of safety engagement. In a brainstorming session, the organization uses an existing safety and health application that helps guide hazard categorized review. Replicating the current safety and health survey application across cross-functional users allows for an increase in facility-wide observations. Using the application, the assessor selects a categorized topic to review within the work zone. The assessment form guides the auditor through a series of questions specifically tailored to inputs that drive hazard levels. Assessing work zones helps mitigate hazards, moving from a reactive to a proactive approach.

Conducting safety work zone audits supports the engagement of safety processes and policies. Additional layered audits of the environment specifically categorized based on facility safety standards and associated risk levels to increase the auditors' sensitivity to critical inputs for hazard conditions. This strategy supports increasing "eyes for safety" to uncover potential concerns.

FIGURE 1
FIVE-WHY & ROOT-CAUSE ANALYSIS



Solution Deployment Strategy

The proposed solution to increase safety assessments meets the requirements necessary to migrate safety culture from reactive to proactive. Before rolling out an additional task for the management team to embrace, the safety team conducted a five-why analysis to assess past program launch failures (Figure 1).

In the past, employee engagement in embracing additional tasks has been low. Several attempted initiatives resulted in minimal gains and eventually dissipated. The assessor is required to complete a safety assessment survey form. Previous attempts at step-by-step instructions were not appealing to employees. Seeking an innovative approach to increase engagement, the team decided to pivot the approach and utilize augmented reality (AR).

AR has been embraced as a viable solution to complement training programs across various organizations. Initially, AR was used within the entertainment sector to immerse users in a virtual world (Thomas et al., 2000). As the technology matured facilitating the ability to generate or modify context internally without specialized equipment and software, various industries started to complement training solutions with AR. Cost and flexibility encouraged organizations to pivot training solutions to use this technology. AR support systems increase visualization of concepts and a significant increase in excitement level over pictures or video (Yang et al., 2013).

Creating a Comprehensive Virtual World

To ensure a comprehensive solution, the organization assembled a cross-functional team that included safety, engineering and production. Adult learners embrace learning that associates materials with practical application. Scenarios were generated utilizing familiar work zones to enhance association with potential hazard conditions. AR technology brings a scene directly in front of an audience. The team constructed a mock version of safety violations.

By comparing and contrasting, training helps enhance learning and observation for learners. With this in mind, the team staged a scene from within the facility and captured it in 3D.

Two employees were staged to enact potential safety violations. Learning and observation are enhanced with the ability to compare and contrast; therefore, one person played the violator and the other person played a model safe employee. Comparing good to bad drives comprehension of the topic. Figure 2 shows a snapshot

FIGURE 2
AR WORLD FOR SAFETY OBSERVATION

of a staged scene captured in 3D where one employee is not using gloves and safety glasses required in the work zone.

The scene was staged with different types and complexity of safety hazards. Based on historical facility data of safety hazards and typical survey form questions, the scene portrayed several concerns: PPE, slips and trips, technology, and hazard control tools. The team took deliberate steps to generate violations to help enhance the surveyor's knowledge.

Simple infractions of typical PPE are very easily detected and need to be continuously monitored. Facility data showed a consistent violation of glove type usage. This information was applied within the scene to help teams learn different glove requirements based on the task at hand.

Slips and trips are consistently a problem, and the chance of these incidents increases when parts are not placed in their designated area. To address this, the mock scene displays parts and components in nondesignated floor space. They were placed in discrete locations, requiring the learner to have a keen sense to notice them.

As technology continues to grow, it creates new workplace hazards that are often misunderstood. Seeing someone use a cell phone is a typical scenario that is observed daily. People normalize these activities mentally and they are not flagged as potential hazards. To address this, the scene depicts one employee conversing on the phone.

Access to safety mitigation devices is crucial to reduce impact. Fire extinguishers are vital tools within manufacturing facilities to control safety hazard conditions. In the event of a safety concern, access time directly affects resolution effectiveness. To address this need in the AR solution, the scene was constructed showing obstruction of access. A ladder was placed in the direct path of the fire extinguisher, which is a frequent violation.

These examples highlight several of the different safety hazards incorporated into the mock 3D scene. They were carefully constructed, requiring "eyes for safety" to be able to detect them. Challenging individuals to take notice of abnormalities strengthens their observation techniques and ability to consistently detect problems.

Delivering a Strategy for Success

The success of launching new strategies is directly affected by how they are showcased. The organization launched the new concept via AR in a layered deployment. Application and training were vetted by operating committee members, comprised of senior leaders within the facility.

FIGURE 3
INDIVIDUAL & TEAM TRAINING MOMENTS

During the meeting, the team revealed the 3D viewer. To increase the excitement level, the presenter purposely did not start with the topic of AR. The audience became excited and began asking questions (e.g., "What does it do?" "Can I try it?"). Immediately the energy level in the room became noticeably higher than in previous sessions. The team deferred questions to later in the meeting and discussed the normal agenda items. The anticipation drove the excitement and engagement level considerably higher even from the start of the meeting. Setting the stage, the team migrated to discussing the 3D viewer and its purpose within the meeting.

The team explained what the 3D viewer had captured and its purpose in helping facilitate understanding of requirements for the survey form. A few abnormalities were highlighted within the 3D scene and associated how to capture these within the assessment form. Team members were encouraged to try on the headset and walk into the virtual world. Participants were presented with a visual of a staged scenario analysis where essential survey focus items were abnormal. Immersing users into an activity helps support a safety environment in which the user's engagement drives others around them. Each member was challenged to highlight the number of abnormalities they observed. A gamification methodology was incorporated to drive conversation among participants.

As the headset device worked its way around the room, presenters strategically began explaining the form and how 3D was incorporated. Attendees' comprehension grew as they discussed why specific abnormalities existed and how these were captured on the form. Increasing people's knowledge about the process of constructing the survey helped to demystify the form. Fostering confidence and complete understanding for employees eased the time and the stress around filling out the form. Subsequent sublaunches followed a method similar to that used to introduce the AR device and training for the safety and health assessment survey. During each launch, the level of excitement and engagement remain consistently high. Figure 3 displays individual and team training sessions utilizing the AR technology. The expressions of excitement among the participants and the audience around them are clearly visible. This is a critical aspect to ensure engagement.

Control & Sustainment

These actions and work are lost unless engagement continues. The golden rule of process improvement is that a project is not completed unless actions are in place to prevent drift back to the state before modification. Realizing that after several sessions the novelty will wear off and engagement will diminish, the team investigated how to institutionalize the program. Leveraging the production operating system, the team added to the assessment review as an agenda item to the standard safety monthly cadence meeting. This meeting charter requires participation from all levels of the organization

and is ideal for reporting out. The presence of stakeholders from every level is required to support a culture of safety engagement.

Gamification/Participation

To ensure participation across all team members, the team employed a gamification methodology. During the monthly cadence meeting, a leaderboard (scorecard) was presented displaying each employee's number of audits completed. This action accomplished a consistent review of the level of participation and challenged employees to increase their involvement.

Results

Compiled data from monthly completed surveys confirmed a sustained level of engagement. Month-to-month variations shown in Figure 4 can be attributed to operation pattern changes within the facility. Hours worked per month varied significantly due to pandemic-related challenges. The robust sustainment plan ensured that the focus on safety and health surveys remained consistent during uncertainty and fluctuations in operating patterns.

Review of the number of observations clearly shows a significant increase in facility participation. Figure 5 shows a comparison of metrics before and after implementation. Increase in assessments also shows some correlation to reduction in first time office visits. Having additional observations drove identification and mitigation of potential safety hazards.

The team conducted a statistical comparison to determine the sustainment of improvement efforts. Traditional statistical tests would not provide a robust comparison with low sample sets. Research publications support the use of the Tukey end count test for comparing two samples with a nonparametric data set (Gibbons & Chakraborti, 2020; Gross, 1990; Tukey, 1959). A Tukey test was performed on the ratio of safety and health surveys versus hours from each year. Following requirements of difference in the two sample populations was held to a 4:3 ratio to achieve high confidence in a comparison test. Figure 6 shows a lower than four end count between the two samples. This supports a 95% confidence level that there is no statistical difference between surveys submitted between the two years. This confirms that efforts and engagement statistically have been sustained.

Conclusion

Engagement is critical to migrate from a safety culture of contentment to one that instills involvement from the workforce. Research confirms that any OSH program must continuously educate and gain employee involvement to sustain a safe workplace. Safety standards are technical in nature and not very engaging to non-safety professionals. Embracing technology fostered the team's engagement, helping introduce a new strategic initiative to transform safety from reactive to proactive. Incorporating a gamification review tactic helped the organization sustain commitment for consistent safety audits from month to month. Future research will investigate audit data for trends or commonality of abnormality. PSJ

FIGURE 4
SAFETY & HEALTH SURVEYS COMPLETED MONTHLY

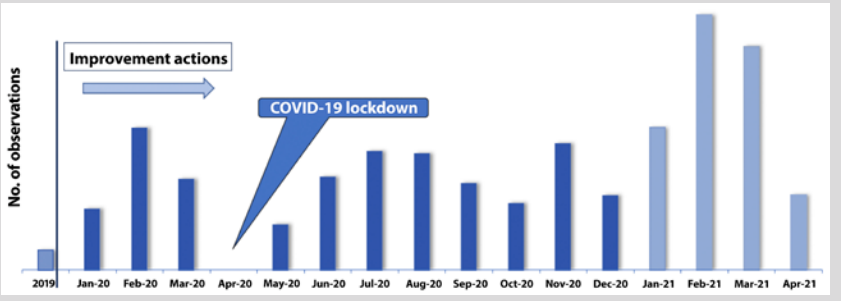
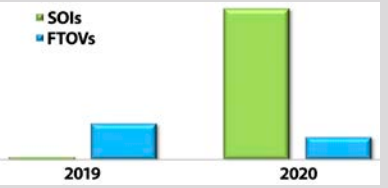
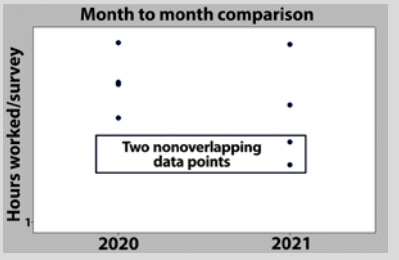


FIGURE 5
METRICS BEFORE & AFTER IMPLEMENTATION



Note. SOI = safe observation index; FTOV = first time office visit.

FIGURE 6
TUKEY END COUNT TEST, 2020 VS. 2021



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