An Integrated Approach for Understanding, Correcting & Preventing UNSAFE ACTS

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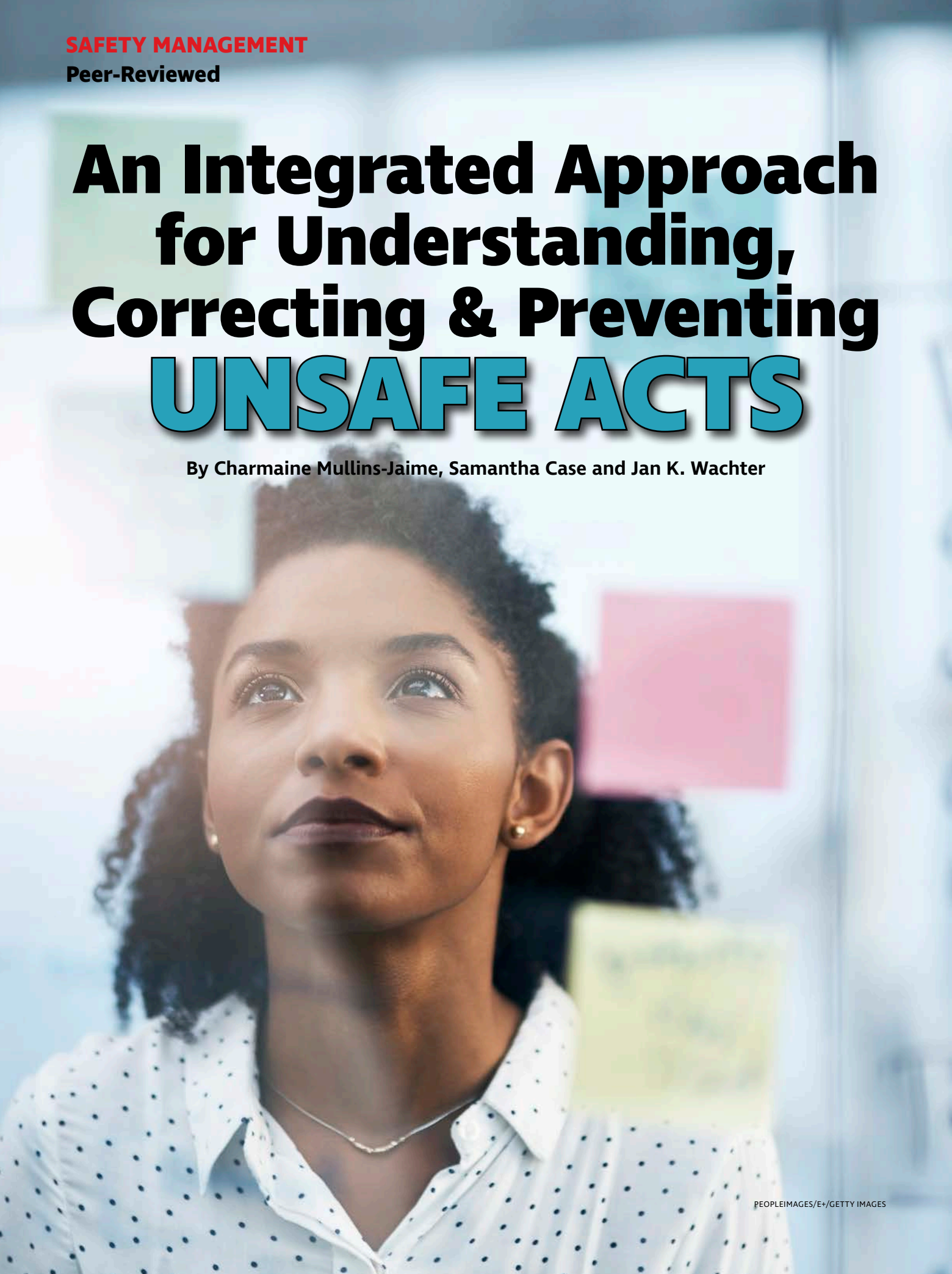

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A REVIEW OF THE HISTORY OF THE SAFETY FIELD reveals an apparent tendency to change how safety is managed according to whatever approach is in vogue (e.g., regulatory-based safety, behavior-based safety, safety management systems, human performance). Each approach promises to be the cure-all for understanding the causes and elimination of unsafe acts leading to incidents. This also has led to many organizations adopting only a singular approach to managing their safety function and addressing unsafe acts and their impacts within a limited scope (Wachter & Yorio, 2014; 2018).

This strategy has not likely been successful over the years. Although incident rates have decreased over the past century, the rates of severe and fatal incidents have remained fairly constant in recent years (BLS, 2019). The majority of incidents are still being attributed to human error as was true at the start of industrialization (Reason, 1990). For example, in industries such as rail transport and airlines, human error is the top cause of incidents (Koen, 2015). Approximately 80% of airplane incidents are due to human error (e.g., pilots, air traffic controllers, mechanics), while 20% are due to equipment failures (Ranking, 2007). Human error has been implicated in 94% of motor vehicle crashes, due to violations and the presence of error precursors such as speeding, fatigue, and drunk or distracted driving (Brown, 2017).

OSH professionals continue to look for some catchall solution to resolve unsafe acts and incidents in the workplace. Both the mooring of a safety program's direction to a single bright star, then its eventual replacement with another seemingly brighter star on the horizon seem to be the historic norm. It seems that the plateauing of serious injuries and fatalities and the continued attribution of incidents to unsafe acts indicate that no single approach has been or can be successful at understanding and addressing the complex and varied origins of unsafe acts and resulting incidents.

Even though it has been estimated that 80% of incidents or more result from workers' actions or behaviors, at least 70% of these actions are likely caused by deficiencies not in humans but rather in management systems and work conditions (U.S. DOE, 2009; Wachter & Yorio, 2013a; 2014). Incomplete incident investigations support the often quoted and misapplied information that incidents are overwhelmingly caused by unsafe acts, but do not further examine the contribution of the work environment or broader safety management context of the incident (Seo, 2005). Incident investigations often stop only at the proximal cause of an incident (i.e., an unsafe behavior; Reason, 1990). From experience, the authors believe the reasons for doing this include the chronological closeness of the unsafe act to the incident itself, the ease that an answer can be quickly offered to management for the cause of an incident, that blame can be assigned to nonmanagement personnel, and the effortlessness required for generating solutions, sometimes misguidedly, to the unsafe act (e.g., training or punishment). Incomplete incident investigations often lead to adopting only corrective actions to address the unsafe act or condition, rather than preventive actions to address the basic or distant causes of the incident. Investigations must provide both corrective and preventive solutions to managing unsafe acts from both short-term and long-term perspectives.

KEY TAKEAWAYS

- **Most organizations adopt a primary approach to designing and implementing their safety programs, typically either system or behavioral approaches.**
- **No single safety management approach seems to be entirely successful for understanding the causes of unsafe acts in the workplace in order to develop effective corrective and preventive actions. There are both advantages and disadvantages to using either safety management system or behavioral approaches.**
- **To better understand the causes of unsafe acts and perform appropriate corrective and preventive actions, a more comprehensive and integrated model based on system, behavioral and human performance approaches should be adopted. A recommended model is presented in this article.**
- **The human performance approach can act as a bridge for using both system and behavioral approaches for understanding the cause of unsafe acts in an organization.**

Current Perceived Situation

Based on the authors' review of expertise being sought by hiring organizations in their online job advertisements for OSH professionals during the past year, the authors believe that organizations currently lean toward using one of two major approaches to managing their safety function: a strategic safety management system (SMS) approach, seeking to correct and prevent failures in the management system including process design, or a tactical behavior-based safety (BBS) approach, influencing how workers choose to perform their work. Pragmatically, aspects of both approaches are necessary to address unsafe acts in the workplace. Neither alone is a silver bullet that would exclusively solve the problem of correcting or preventing unsafe acts in the workplace, since individual strategies have not lessened the strong association of unsafe acts with incident occurrence.

What is often missing in these corrective or preventive approaches is overt consideration for worker interfaces with tasks at hand and workers' ability to assess and control the hazards and risks within their local work environment. This is particularly important for skilled laborers that are expected to work safely, effectively and autonomously with little or no supervision, such as tradespersons, and in environments with constantly changing risk factors, such as in healthcare. This has led to an emerging third approach to safety management: a human performance (HP) approach that embraces aspects of both SMS and BBS approaches. An HP approach recognizes that worker empowerment and specific worker interfaces with tasks, systems and the environment are central to safety management.

Safety Management Systems

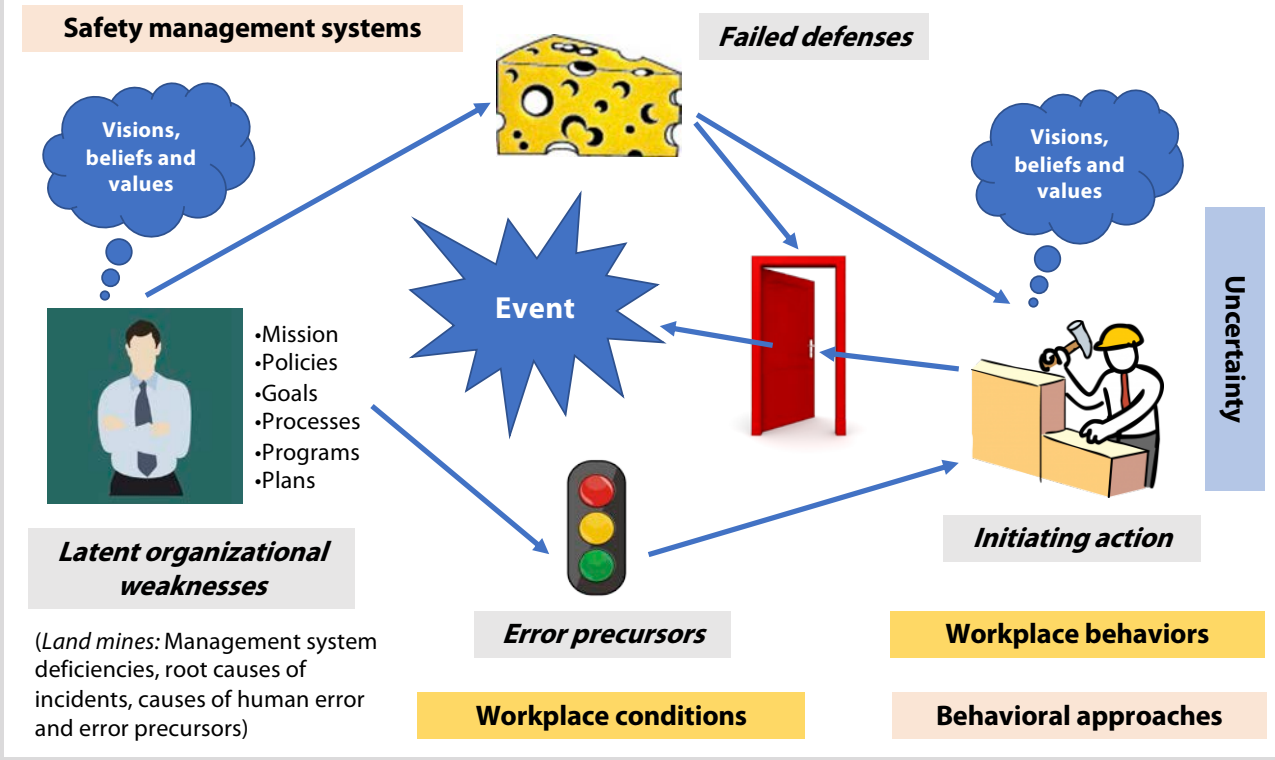
An SMS aims to improve workplace safety performance by regularly identifying safety and health risks and implementing policies, processes and procedures to mitigate and control those risks. Consensus standards such as ISO 45001 and ANSI Z10 are built upon a foundation of continuous improvement; that is, repeatedly planning for, controlling, monitoring and reducing OSH risks. By adopting an SMS approach, multiple layers of defense often result in the organization, thereby protecting workers.

SMSs and their components (e.g., management commitment, communication) have been shown to have positive effects on safety performance outcomes and safety behaviors (Bottani et al., 2009; Fernandez-Muniz et al., 2012; Ismail et al., 2012; Kim et al., 2019). Worker engagement has been shown to moderate the relationship between an SMS's effectiveness and safety performance outcomes (Wachter & Yorio, 2014).

Worker participation or involvement has become a recent trademark component of SMSs, particularly the ISO 45001 standard. But worker engagement is not necessarily guaranteed when worker participation is required by a consensus standard. This distinction is critical: Workers may participate in safety programs but may not be cognitively and emotionally invested in the system (e.g., showing pride, enthusiasm and interest in safety programs). This seems to suggest that an SMS approach alone may not be enough to effectively improve safety if workers are not adequately engaged and integrated into the SMS.

FIGURE 1

THE HUMAN PERFORMANCE PERSPECTIVE OF INCIDENTS



Note. Adapted from *Human Performance Improvement Handbook, Volume 1: Concepts and Principles* (DOE-HDBK-1028-2009), by U.S. Department of Energy, 2009; "Current Practices Related to the Use of Human Performance Improvement and Worker Engagement Tools," by J.K. Wachter and P.L. Yorio, 2013a, *Journal of Safety, Health and Environmental Research, 8*(3), 70-80; "Human Performance Tools: Engaging Workers as the Best Defense Against Errors and Error Precursors," by J.K. Wachter and P.L. Yorio, 2013b, *Professional Safety, 68*(2), 54-64; and "A System of Safety Management Practices and Worker Engagement for Reducing and Preventing Accidents: An Empirical and Theoretical Investigation," by J.K. Wachter and P.L. Yorio, 2014, *Accident Analysis and Prevention, 68*, 117-130 (https://doi.org/10.1016/j.aap.2013.07.029).

In addition, SMSs are imperfect because they are developed and implemented by imperfect people and their imperfect organizations. Although policies, processes and programs are developed with the goal of successfully mitigating risks, it is not possible to plan for and prevent every scenario given the constraints and resources needed that would impact financial viability. Further, creating additional policies may not resolve conflicts between how the work is imagined and how the work is being performed, especially if workers are not truly involved in designing and implementing an SMS (Dekker, 2014). The "proceduralization" of safety through the policies, processes and procedures demanded by an SMS may in the end create a "concretized" system that may not be resilient, adaptive or specific enough to control the occurrence of unsafe acts by workers influenced by changing tasks and fluctuating work environments.

These deficiencies in and limitations of SMSs create a need for supplemental or additional organizational risk management strategies to understand the cause of and avoid unsafe acts.

Behavior-Based Safety

BBS focuses on addressing worker behaviors (i.e., increasing safe behaviors and reducing at-risk behaviors) to prevent work-related injuries and incidents. BBS strategies involve developing performance goals, objectively observing and measuring critical safety behaviors of frontline employees, tracking results and providing feedback. BBS places an emphasis on accountability, responsibility and commitment that can help a worker in their own safety self-management to go above and beyond what is required to prevent injuries (DeJoy, 2005; Geller, 2005; Geller & Clarke, 1999; Hidley & Krause, 1994; Yuan & Wang, 2012). Interventions that are implemented to change behaviors typically fall into three categories: instruction, support and motivation (Geller, 2005).

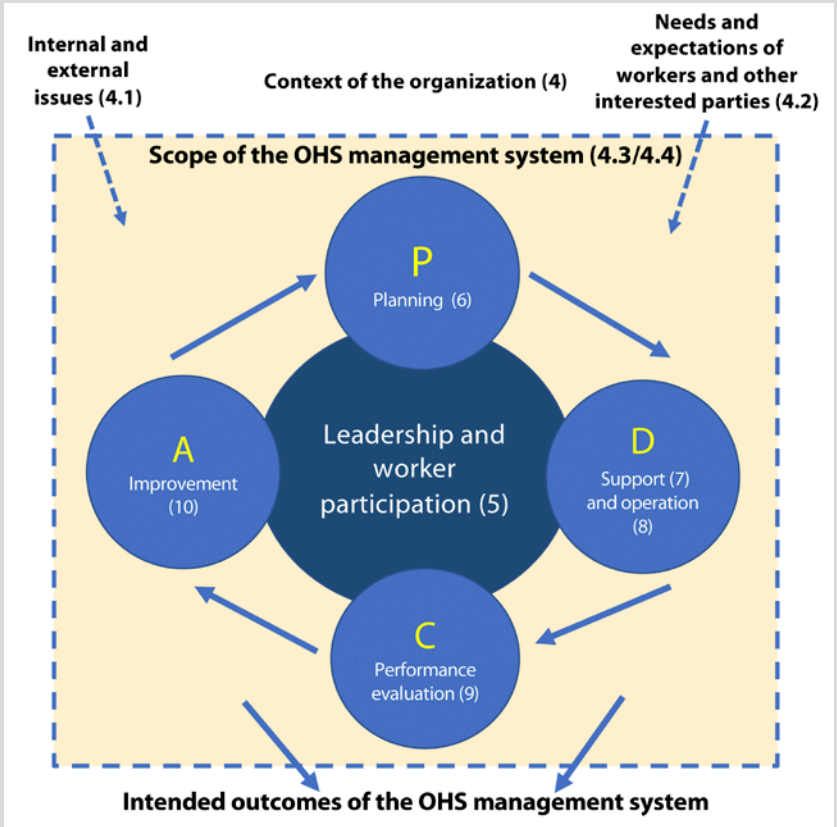
While the underlying premise of BBS has remained consistent over time (i.e., observe worker behaviors and provide feedback and support) various iterations and expansions have been put into practice. For example, the activator/antecedent-behavior-consequence (ABC) approach can help identify the triggers for the behavior that stem from the working environment or gaps in the safety management system (Geller, 2005; Yuan & Wang, 2012). However, the BBS approach has suffered in its implementation. BBS's focus has tended to remain strongly focused on the worker at the "sharp edge" of incidents and the self-management of their own behavior, rather than delving deeper into the systems, policies and practices in place that may be causing unsafe acts (Dekker, 2014). This can potentially result in underreporting of safety incidents to management due to fear of being blamed or punished as well as correcting only behavioral symptoms of system deficiencies (DeJoy, 2005; Dekker, 2014). Using only a BBS approach to address unsafe acts may hinder the ability to fix the real problems that are present in the organization and its policies and programs (DeJoy, 2005). Thus, additional strategies are needed to complement the strengths of BBS.

Human Performance

It seems that the advantages of SMS approaches tackle some of the disadvantages of BBS approaches and, likewise, the advantages of BBS approaches tackle some of the disadvantages of SMS approaches. But is there another way of understanding and addressing unsafe acts that incorporates or links the best features of both SMS and BBS programs and addresses deficiencies common in both?

FIGURE 2

ISO 45001 FRAMEWORK & PDCA MODEL



Note. Numbers refer to sections of the ISO 45001 standard. Adapted from "Occupational Health and Safety Management Systems—Requirements With Guidance for Use (ISO 45001:2018)," by International Organization for Standardization, 2018.

A recent view of human error emphasizes that unsafe acts and errors are symptoms of larger problems within the system (Dekker, 2014). As discussed, organizations that implement SMSs can still experience safety problems because of latent weaknesses in the organization. These weaknesses can lead to the presence of error precursors that increase the probability of unsafe acts occurring (Wachter & Yorio, 2013b). The HP approach views workers and their engagement as necessary components to dealing with error precursors and improving workplace safety and can work with SMS and BBS approaches in an integrated way (Figure 1). The HP approach views the worker as an asset to the organization rather than as a liability and as the focal point in which the processes, procedures, environment, conditions, facilities and equipment intersect (Wachter & Yorio, 2013b). Workers manage safety on a very personal level by 1. being perceptive of workplace and individual conditions that lead to the presence of error precursors and 2. being perceptive of defenses that may be failing. The HP approach supports the notion of autonomous workers being in control of their safety by adapting organizational SMSs and their own behaviors to that which their individual situations require.

Error precursors that can lead to unsafe acts and incidents include 1. task demands (e.g., pressure to work fast, multitask or deal with high workloads); 2. worker-specific capabilities and skills (e.g., unfamiliar or infrequent tasks, lack of knowledge or experience, poor problem-solving or communication skills); 3. worker-specific cognitive characteristics (e.g., worker overconfidence, attitudes, mental biases or assumptions); and 4. the working environment (e.g., distractions and interruptions, changes or departures from routine, unexpected work or equipment conditions). These error precursors can arise from SMS deficiencies (e.g., poor hiring practices, a production-over-safety mentality, poor task assignment, poor work design processes) that can potentially lead to unsafe acts, incidents or near-hits (Wachter & Yorio, 2013b).

HP and worker engagement tools can be used to identify and deal with error precursors so that unsafe acts and subsequent adverse events are minimized. HP tools aim to increase the mental and social skills needed to perform work safely and effectively. HP-focused safety and health management practices have been shown to improve safety performance outcomes (Yorio & Wachter, 2014).

Human Performance Tools

HP tools reduce human error by making workers more mindful of their work and environment, increasing workers' situational and self-awareness, helping workers identify error precursors, and having workers more accurately estimate and respond to risk (Wachter & Yorio, 2013b). They also provide clear guidance on when to stop and seek additional guidance or get help in the face of changing, confusing or new situations encountered. Examples of human performance tools are pretask and posttask briefings, self-checking, stop-and-think activities, field-level hazard assessments and jobsite reviews, coaching and observation, safety questioning, three-way communication, concurrent verification, and worker involvement in procedure appraisal aimed to ensure that procedures are practicable and translate situational awareness into procedural awareness (Wachter & Yorio, 2013b).

With most incidents being associated with human factor-type errors, building HP tools into the SMS can help reduce human errors and provide workers with the knowledge, skills and autonomy to actively manage the hazards in their environment and changing work conditions.

SMS Consensus Standards & HP

ISO 45001:2018 is the most recent significant safety management consensus standard that has been issued. While SMSs call for employee/worker consultation, ISO 45001 attempts to include more of an HP approach by putting leadership and worker participation in the center of the plan-do-check-act (PDCA) model (Figure 2). While there is a big difference between participation and true emotional and cognitive engagement in safety (Wachter & Yorio, 2014), ISO 45001 is at least a better attempt to draw SMSs out of the boardroom toward the "sharp edge" of incidents and injuries like BBS approaches. Organizations that choose to incorporate HP even further into their SMSs will adopt a worker-centered approach and build their policies, procedures and processes outward starting from the worker interface. They also involve the workers in the design and assessment phases of their SMSs. Since human factors errors are associated with many incidents, consideration of worker interaction with error precursors at the design stage of the SMS and building provisions into the management system for multimodal layers of protections would enhance the functioning and worth of SMSs. Through policies, procedures and HP tools that can be used more autonomously by

TABLE 1

PROPOSED SEQUENTIAL PROCESS TO CORRECT & PREVENT UNSAFE ACTS

Comprehensive and sequential process to correct and prevent unsafe acts observed in the workplace or identified during incident investigations.

		Corrective action	Preventive action
Human performance (HP) approach			
1. Did the presence of error precursors contribute to the error, unsafe act or at-risk behavior?	If yes:	Eliminate the presence or better defend against the effect or impact of the error precursors for that worker or task, if possible. Requires management support from line management to top management depending on how widespread the error precursor is.	Have management develop new or revised work policies or implement action plans to organizationally eliminate the frequency of error precursor presence. Requires top management support. May require a paradigm shift by management to eliminate error precursor.
2. If error precursors were present, did the worker identify the precursors using HP tools?	If no:	Identify whether new or revised HP tools are required for identifying the specific error precursor and provide them accordingly. Retrain worker if appropriate HP tools were present or available but were not used.	Add new HP tools to the arsenal of tools being utilized and train workers on these tools. Training could occur during new employee orientation or when determined necessary by management.
3. Ask, "What is the worst thing that could have happened due to the error, unsafe act or at-risk behavior?" Are appropriate, multiple layers of defense available and working to protect the worker from the realistic worst consequence?	If no:	Provide to the worker or impose upon the task additional layers of defense to protect the worker against the impacts of the error or unsafe act.	Develop and implement new or revised policies or procedures on requirements for adopting layers of defense based on risk levels. This could mean revising prestartup safety review processes. Audit the implementation of the policy or procedure.
Safety management systems (SMS) approach			
4. Did the design of the process prevent the worker from performing the work safely?	If yes:	Change the process design for the specific situation.	Change the method for designing and modifying processes to include OSH professional review and sign-off. For example, manage change by ensuring that new processes and process changes prompt a new risk assessment or a review of risk assessment, and new and existing controls are assessed for their effectiveness in controlling hazards. Ensure that subject matter expertise is sought, including from workers, prior to OSH professional review and sign-off. Consider adopting a formal prevention through design program.
5. Was the desired safe act or behavior written in a standard operating procedure (SOP), job hazard analysis (JHA) or job safety analysis (JSA)?	If no:	Rewrite the specific SOP, JHA or JSA to include the safe act or behavior.	Change the SOP, JHA or JSA authoring process to include more rigorous safety analyses. Have OSH professionals review them.
6. Was the worker physically and emotionally capable of performing the work?	If no:	Make reasonable accommodations for the specific situation if possible.	Review and revise hiring and worker placement practices, including how tasks are assigned.
7. Could the worker perform the task if the individual's life depended on it?	If no:	Train the specific employee on the specific task.	Add critical safe behavior to the training program. Include the behavior in new employee orientation or group training as appropriate.
Behavioral approach			
8. Did triggers (antecedents) for safe behavior exist?	If no:	Provide safe behavior triggers (antecedents) for the specific situation. Triggers could include providing caution signage, making PPE readily available that is comfortable and easy to use, and discussing the negative consequences of the unsafe act during staff meetings.	Revise processes to add the placement of triggers (antecedents) into the design and operation of processes and safety documentation (i.e., SOP, JHA, JSA).
9. Did triggers (antecedents) for unsafe behavior exist?	If yes:	Remove triggers (antecedents). Look for error precursors being triggers. Triggers can include factors such as PPE not being readily available, comfortable or in pristine condition, workers being in a hurry, peer pressure, or poor risk perception.	Revise processes to add the removal of triggers (antecedents) during the design, operation and training on processes and reflected in safety documentation (i.e., SOP, JHA, JSA).
10. Had all positive consequences to unsafe behavior been removed?	If no:	Remove positive consequences. Look for specific rewards and recognitions that are being provided for working unsafely especially by the task manager. Positive consequences of performing an unsafe act could be situations such as saves time, is more convenient, supports peer acceptance, results in more praise for meeting production goals, or increased pay by speeding up piecework.	Conduct senior management analysis and implement actions to stop rewarding unsafe behaviors. Look for organizational barriers to safety excellence (e.g., production over safety philosophy) that may reinforce unsafe behaviors. Could require a paradigm shift on the part of management.
11. Had all positive consequences to safe behavior been provided?	If no:	Provide consequences for safe behaviors in the task or work area. The best consequences are sooner, more certain and positive. Positive consequences could be immediate worker praise by task manager, on-the-spot safety awards, and recognition of safety performance in staff meetings.	Conduct senior management analysis and implement organizational actions to reward safe behaviors. Implement a site-wide reward and recognition system for managers and employees who promote or exhibit safe behaviors.

Note. Adapted from "Human Performance and Safety Culture," by J.K. Wachter and P.L. Yorio, 2018, in *Supervisors' Safety Manual* (11th ed., Chapter 3), L.F. Martin & D. Corcoran (Eds.), National Safety Council.

workers to manage their safety and situations that they encounter in the workplace, organizational outcomes can be improved.

Current Issues in Dealing With Unsafe Acts & Investigating Incidents

When investigating unsafe acts or resulting incidents, companies will often use root-cause analysis aiming to focus their attention on fixing whatever is determined to be the singular root cause of the unsafe act or incident. Top industry choices for investigation techniques are cause-and-effect models, such as fishbone diagrams and five-why methods. Cause-and-effect models that only seek a single root cause can be problematic. While the intent is positive and admirable, this approach often fails to recognize that human decision-making is complex and diverse. Most scenarios that govern human behaviors are not linear. Many incidents involving people are complex because people and situations are complex. Thus, there could be many causes of an incident or reasons employees may be acting in unsafe ways. Stopping at superficial or single causes and not looking at all issues such as design, systems, management, supervision, training, human factors, equipment and environment are potential shortcomings with these cause-and-effect models (Oakley, 2012). Thus, while root-cause analyses can be helpful in prioritizing resources and actions, looking for a root cause as a single-minded goal can lead organizations to overlook distal causes that may be even more problematic as they continue to occur.

For example, if we were to look at an unsafe act or an incident in a fault-tree analysis, we would likely see many failures or flaws that would qualify as "or" gates leading to multicausal factors from various areas such as organizational factors, materials and equipment, rather than a single true root cause. Many of these failures would be considered error precursors in a human performance model. The presence of these failures or precursors must be addressed, not just the root cause. Additionally, following a root-cause path tends to narrow the focus and place blame on the worker (Dekker, 2012). However, investigations based on a just culture tend to take an HP systems approach and only punish violations if they are intentional without the presence of error precursors (Dekker, 2012).

A Comprehensive, Sequential Approach to Addressing Unsafe Acts & Investigating Incidents

Given the interrelatedness of and deficiencies within system, behavioral and human performance approaches that attempt to manage safety in organizations (Wachter & Yorio, 2013b) and the reality that there could be multiple causes of unsafe acts, the authors propose a comprehensive and sequential approach to understanding the causes of unsafe acts, their role in incident causation, and corrective and preventive actions that can be taken. This approach is multifaceted, integrating the major safety philosophies currently used by organizations (Figure 3) and described in this article.

When trying to identify the causes of unsafe acts and correct and prevent unsafe acts or the incidents resulting from them, consider using the structured, sequential approach for performing the investigation shown in Table 1. The process begins with the human performance approach, then applies SMS concepts, followed by more behavioral approaches.

Step 1: Apply Human Performance Approach

Human performance is considered first. Unless error precursors and failing defenses are addressed, the policies, processes, plans and procedures emanating from an SMS to address risks could be rendered ineffective. Even the slightest of hazards can be activated by an unsafe behavior to cause an incident if error precursors are present. The OSH professional should first look at task demands, task conditions and the timing of tasks that could explain the unsafe act. For example, was the worker rushed, distracted, interrupted, multitasking, performing the task for the first time, performing an unfamiliar, infrequent or nonroutine task, working at the end of a shift, a second shift, or an erratic work schedule, returning to work after being off 3 or more days, assigned a high workload, conducting a difficult physical or mental task, performing a monotonous task, experiencing changes and departures from routine, or experiencing unexpected equipment performance or environmental conditions in the field?

A more difficult analysis for the OSH professional is to assess whether error precursors associated with the worker's cognitive characteristics are present that could explain the unsafe act, such as being tired or sick, exhibiting overconfidence, taking mental shortcuts or biases, having poor risk perception or bad assumptions, lacking knowledge or proficiency, having a poor ability to handle stress, or having poor problem-solving or communication skills.

These error precursors are not tied to a particular hazard, but rather to how work is conducted and under what conditions (e.g., the worker interface with the task). The reason identifying the presence of and dealing with these error precursors is first in the proposed model is that error precursors are risk moderators. They can affect the execution of many tasks across the organization (beyond the specific one being analyzed) and can lead to activating typically inconsequential hazards to cause adverse events.

However, the ultimate question for OSH professionals and their organizations to address is why these error precursors are allowed to exist in the organization in the first place. The answer typically lies in SMS deficiencies that often lead to barriers in achieving organizational safety excellence (Gualardo, 2014). For example, these SMS deficiencies (which normally require root-cause type analysis to identify them) could range from unrealistic production schedules to poor task assignment by managers, from mindless budget reduction mandates to inadequate work/rest regimes, or from widening spans of control (resulting in stress, multitasking and loss of concentration) to complacency and overconfidence developed due to presumed superior safety performance, as measured by OSHA statistics and other lagging indicators (Gualardo, 2014).

Many more organizational deficiencies can contribute to the presence of error precursors leading to unsafe acts. Additional questions for the OSH professional to ask are whether the worker was aware of the presence of any error precursors, why the worker was not aware of the presence of these precursors if they were present, and why, if the worker was aware of these error precursors, nothing was done to deal with them. If the presence of error precursors had been known, workers could have attempted to take both offensive and defensive actions against their potential impacts, such as heightening their situational and self-awareness or reaffirming that defenses or controls are in place and operational in the workplace.

This is where the adoption of human performance tools in the workplace could be beneficial (Wachter & Yorio, 2013b). However, the use of these HP tools must be supported by management, consistently implemented by workers, and lead to actions taken by management if the presence of these error precursors reflects a pattern of mismanagement causing organizational barriers to safety and health excellence.

The presence and effectiveness of layers of defense is often a collateral analysis when attempting to address unsafe acts through a human performance approach. According to HP theory, events occur due to the presence of error precursors and/or failing defenses (Figure 1, p. 22). Thus, an analysis must occur to assess whether the impacts of an unsafe act could have been avoided or lessened if existing defenses had been working op-

timally or additional layers of defense had been implemented. Thus, this particular HP line of thinking does not attempt to eliminate the unsafe act (unlike dealing effectively with error precursors), but rather in protecting the worker and the organization from the effects of the unsafe act and error precursors.

Step 2: Apply SMS Concepts

SMS deficiencies are addressed next. Often, causes for unsafe actions and their resulting incidents are traced back to SMS deficiencies. These deficiencies can be considered structural fixes and most times can be effectively implemented with strong management support. Many of these fixes are preventive in nature (e.g., issuing, revising or enforcing a process, plan or procedure). From an SMS perspective, OSH professionals might ask whether the process design prevented the worker from working safely. To do this, they would need to consider inputs to the process including appropriateness of tools, equipment and workspace design as well as assess the effectiveness of the risk assessment and identified controls resulting from that process.

If process design facilitated the unsafe behavior, then an SMS approach not only should prompt a process design change but also would trigger a review of the risk assessments associated with the process, including an assessment of existing controls, to determine how changes might impact these controls and what controls must be added or changed. This might also trigger a review of the process itself that allowed the poor process design to occur in the first place and prompt more robust management-of-change efforts, including having safety reviews evaluated by OSH professionals. In smaller or less complex organizations, this might mean OSH professionals facilitate or review risk assessments with the input of designers and workers. However, what can happen as organizations grow and become more complex is that the OSH professional unwittingly takes on the oversight role of policing changes with limited time available to effectively conduct thorough assessments of hazards and risks. A more effective suggestion is to ensure that management-of-change procedures require the change initiator to facilitate the safety review and risk assessment with OSH professional and worker input, and OSH professional approval is given only after worker input has been adequately considered. For this to be practical, the OSH professional would have to train those stakeholders in how to conduct risk assessments and in appropriate control selection based on the hierarchy of controls. While this may seem like more work up front, it will pay in the long run through more collaborative and sustainable risk management efforts requiring less oversight.

Another SMS approach is to look at the procedures in place to assess whether they facilitate positive behaviors. A review of the applicable work instructions or standard operating procedures might reveal that safe behaviors are not promoted. In this case, an SMS approach would include expectations for safe behavior within the work instructions. Moreover, such an approach would address the process by which procedures are developed so that when performing or referring to risk assessments as part of the procedure design, safe behaviors are specified as necessary controls and highlighted as such in the work instructions.

A wide variety of human factors type issues involve somatic and psychological predispositions to particular tasks wherein some people are better suited to certain tasks than to others. An assessment of whether the person is more apt to safely performing the particular tasks should be a consideration in the hiring process and placement practices. However, some human factor considerations are transient related to burnout, fatigue and emotional distraction. A way to assess and possibly remediate these conditions is by having a culture of positive, open dialogue and good working relationships between employees and supervisors, whereby supervisors can recognize when employees are not feeling their best and can respond appropriately and empathetically to the situation, such as by suggesting the worker take an extended break or by assigning less-taxing activities that day. From a systems perspective, this can be made possible by supportive organizational policies that take a total worker health approach, promoting policies that enable supervisors and workers to respond to these transient risk factors (e.g., allowance of personal days, process and policy design that considers fatigue and burnout avoidance).

Another question the investigator might consider under an SMS approach is whether the worker could perform the task if the individual's life depended on it. If the answer is no, then an immediate response would be to train the employee on the task and add critical safe behaviors to the training program and in new hire orientation.

Step 3: Apply Behavioral Approaches

The SMS approach is followed by behavioral approaches, which could be considered as a last resort for resolving unsafe acts, largely due to the difficulties in changing worker behavior and in permanently changing that behavior over the long term in the absence of continuing motivators and consequences. Additionally, not all unsafe acts are necessarily behavioral or intentional choices (i.e., violations). However, adding triggers and positive consequences to encourage safe acts and eliminating triggers and positive consequences to discourage unsafe acts can be powerful mechanisms for organizations to adopt.

For example, consider a situation in which a worker was found not wearing the appropriate PPE while performing a hazardous task. Through interviews with the worker, the OSH professional may discover several triggers and consequences that resulted in and from this behavior. Triggers for not wearing the PPE could include lack of training or awareness of the requirement, low perception of risk, lack of available PPE, and the worker finding the PPE cumbersome. On the other side are consequences, both positive and negative, for that unsafe behavior. Positive consequences for the worker may be increased comfort and efficiency to get the job done, whereas a negative consequence is an injury, although the worker perceives the likelihood of this occurring as low. This context demonstrates why a worker might choose to forgo PPE in this instance. Therefore, the OSH professional should work with senior management and frontline workers to reduce the triggers for the unwanted behavior including tolerance for the unwanted behavior, identify positive triggers that influence safe behaviors, and eliminate any unintended positive consequences of the unsafe act such as reward for other gains made by forgoing safety precautions.

A participatory approach that incorporates feedback and rewards may help motivate individuals to change their behaviors (Geller, 2005). In this example, that could mean the company implements new training, invests in comfortable PPE, makes PPE easily accessible, provides positive feedback to workers wearing PPE, and more. It is likely that many of these issues will be identified and addressed earlier in the process, but explicitly including the basic tenets of behavioral approaches here provides a more complete context of the work environment.

Benefits of an Integrated Approach

This integrated approach is pragmatic for a number of reasons:

1. It does not rely on one safety approach to addressing the problem with unsafe acts.

2. It offers practical solutions in terms of possible corrective and preventive actions for organizations to take based on the conditions found to be present.

3. It is a convenient, logical and structured tool for looking at resolving the issue of unsafe acts, much like using causal analysis forms in incident investigations.

This approach also forces organizations to consider both corrective and preventive actions to resolving the presence of unsafe acts and their effects. As noted, incomplete analysis of how to resolve unsafe acts and the causes of incidents often leads only to corrective actions being taken: dealing specifically with the unsafe act itself (at a specific location, time and circumstance) rather than looking at and resolving organizational factors that could be causing the action to occur. Operating in an organization where only corrective actions are performed to address unsafe acts means that these actions will be repeated at other locations, times and circumstances because the systemic causes of these actions have not been addressed.

Conclusion

Due to the complexity and range of causes for unsafe acts occurring in workplaces and given that historically a single approach to addressing unsafe acts has not been entirely successful, an integrated approach to addressing their presence using HP, SMS and BBS strategies is recommended. This approach must consider both corrective and preventive actions to manage these unsafe acts from short-term and long-term perspectives.

Organizations that fail to put workers at the heart of their safety management approach fail to recognize how much workers influence and are influenced by their changing work environment. An SMS is a necessary framework and behavioral interventions should be a core element in this system to effectively manage safety. However, approaches to understand why unsafe acts occur and how to control or eliminate them also must recognize that workers should be given the tools, skills and authority to actively manage their safety from a human performance perspective. If integrated with SMS and behavioral approaches, HP can be a driving mechanism of a multifaceted safety management strategy. **PSJ**

References

Bottani, E., Monica, L. & Vignali, G. (2009). Safety management systems: Performance differences between adopters and nonadopters. *Safety Science, 47*(2), 155-162. https://doi.org/10.1016/j.ssci.2008.05.001

Brown, B. (2017, Oct. 6). Evidence stacks up in favor of self-driving cars in 2016 NHTSA fatality report. *Digital Trends*. www.digitaltrends.com/cars/2016-nhtsa-fatality-report

Bureau of Labor Statistics (BLS). (2019, Nov. 7). *Employer-reported workplace injuries and illnesses—2018* [Press release USDL-19-1909]. www.bls.gov/news.release/archives/osh_11072019.pdf

DeJoy, D.M. (2005). Behavior change versus culture change: Divergent approaches to managing workplace safety. *Safety Science, 43*(2), 105-129. https://doi.org/10.1016/j.ssci.2005.02.001

Dekker, S. (2012). *Just culture: Balancing safety and accountability.* Ashgate.

Dekker, S. (2014). *The field guide to understanding "human error"* (3rd ed.). CRC Press.

Fernandez-Muniz, B., Montes-Peon, J.M. & Vasquez-Ordas, C.J. (2012). Safety climate in OHSAS 18001-certified organizations: Antecedents and consequences of safety behavior. *Accident Analysis and Prevention, 45*, 745-758.

Geller, E.S. (2005). Behavior-based safety and occupational risk management. *Behavior Modification, 29*(3), 539-561. https://doi.org/10.1177/0145445504273287

Geller, E.S. & Clarke, S.W. (1999, July). Safety self-management: A key behavior-based process for injury prevention. *Professional Safety, 44*(7), 29-33.

Gualardo, S. (2014). *Achieving safety and health performance excellence in organizations* (2nd ed.). National Safety Consultants Inc.

Hidley, J.H. & Krause, T.R. (1994, Oct.). Behavior-based safety: Paradigm shift beyond the failures of attitude-based programs. *Professional Safety, 39*(10), 28.

International Organization for Standardization (ISO). (2018). Occupational health and safety management systems—Requirements with guidance for use (ISO 45001:2018).

Ismail, Z., Doostdar, S. & Harun, Z. (2012). Factors influencing the implementation of a safety management system for construction sites. *Safety Science, 50*(3), 418-423. https://doi.org/10.1016/j.ssci.2011.10.001

Kim, N.K., Rahim, N.F.A., Iranmanesh, M. & Foroughi, B. (2019). The role of the safety climate in the successful implementation of safety management systems. *Safety Science, 118*, 48-56. https://doi.org/10.1016/j.ssci.2019.05.008

Koen, S.L. (2015, Oct. 25). Safety leadership: Neuroscience and human error reduction. *Safety + Health*. www.safetyandhealthmagazine.com/articles/13159-safety-leadership-neuroscience-and-human-error-reduction

Oakley, J.S. (2012). *Accident investigation techniques.* ASSP.

Ranking, W. (2007). MEDA investigation process. *Aero Quarterly, 2*(7). www.boeing.com/commercial/aeromagazine/articles/qtr_2_07/article_03_1.html

Reason, J. (1990). *Human error.* Cambridge University Press.

Seo, D.C. (2005). An explicative model of unsafe work behavior. *Proceedings of the ASSE Professional Development Conference and Exposition, New Orleans, LA*. ASSP.

U.S. Department of Energy (DOE). (2009). *Human performance improvement handbook, volume 1: Concepts and principles* (DOE-HDBK-1028-2009).

Wachter, J.K. & Yorio, P.L. (2013a). Current practices related to the use of human performance improvement and worker engagement tools. *Journal of Safety, Health and Environmental Research, 8*(3), 70-80.

Wachter, J.K. & Yorio, P.L. (2013b, Feb.). Human performance tools: Engaging workers as the best defense against errors and error precursors. *Professional Safety, 68*(2), 54-64.

Wachter, J.K. & Yorio, P.L. (2014). A system of safety management practices and worker engagement for reducing and preventing accidents: An empirical and theoretical investigation. *Accident Analysis and Prevention, 68*, 117-130. https://doi.org/10.1016/j.aap.2013.07.029

Wachter, J.K. & Yorio, P.L. (2018). Human performance and safety culture. In L.F. Martin & D. Corcoran (Eds.), *Supervisors' Safety Manual* (11th ed., Chapter 3). National Safety Council.

Yorio, P.L. & Wachter, J.K. (2014). The impact of human performance focused safety and health management practices on injury and illness rates: Do size and industry matter? *Safety Science, 62*, 157-167.

Yuan, X. & Wang, K. (2012). Study on safety management of small and medium-sized enterprises based on BBS. *Procedia Engineering, 45*, 208-213.

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