

Dispelling Myths About Human Error

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Introduction

The movement for improved workplace safety and the desire for creating more effective injury prevention initiatives have evolved over the past century. The results are evident as injury and fatality rates in the US have declined significantly, and especially since World War II. As recent as the 1980's most safety initiatives focused on prevention utilizing the 3 E's of engineering, enforcement and education. Employers who embraced these fundamental elements showed marked improvement. Safety was considered in facility and equipment design, the design of work procedures and work systems, training of workers, and through adherence to proper safe work procedures. Hazard identification, job safety analyses, hazard control procedures, machine guarding, measuring and monitoring environmental contaminants, job instruction training, personal protective equipment, safety inspections, incident investigations, and more were all part of a well-rounded safety program.

A portion of the early success of the safety movement was due to the pioneering work of H. W. Heinrich, through his book "Industrial Accident Prevention: A Scientific Approach", first published in the 1930's. From the publishing of this book through today, Heinrich likely has had more influence than any other individual on the work of occupational safety practitioners. Heinrich was highly influential in perpetuating two important concepts that still today drive most safety initiatives: that unsafe acts of workers are the principle causes of occupational accidents, and that reducing accident frequency will achieve an equivalent reduction in injury severity. More on this influence later.

With the enactment of the OSH Act in 1970, the safety movement in the US gained strength through broad regulatory requirements. Providing a safe place to work was now the law of the land. Enforcement looked beyond an organization's policies, work procedures, worker training, safety rules, and focused on compliance with regulatory standards. As employers became aware of OSHA standards and the cost of citations for failure to comply, they hired SH&E professionals to conduct compliance audits, find and correct deficiencies, and ultimately avoid fines. OSHA and its enforcement powers had a positive effect on safety in the US, reportedly reducing fatalities since 1970 by 65% and disabling injuries by 67%.

During the first decade of OSHA regulatory oversight and the new focus on compliance, many organizations began to view “safety” as if it was synonymous with “compliance”. A side effect of this was all too often many employers measured the success of their safety programs against compliance with OSHA’s (often minimal) standards. This resulted in a reactive approach, while the more proactive approaches to injury prevention, such as safe work design and many of the developing injury prevention initiatives took a back seat. Also during this same period of time another influencer developed as State workers compensation insurance requirements were strengthened across the US and medical/disability costs began to rise. Beyond compliance, the cost of injuries was now becoming a focal point.

Even though employers were achieving OSHA compliance and seeing some reduction in the injury rates, workers compensation costs were increasing. As insurance costs increased, safety professionals were able to show how good safety performance could have a positive impact on profitability and made good business sense. Slogans like “prevention pays” became common. However, in many cases safety initiatives aimed at preventing injuries and resulting claims were secondary to those aimed at workers compensation case management and return to work programs. Many in the safety community argued that this was a classic case of putting the cart before the horse, since these approaches were aimed at reducing cost **after** an injury occurred.

In the late 1980’s and early 1990’s safety professionals, influenced by the teachings of Heinrich and his premise that “Psychology lies at the root of sequences of accident causes,” were exposed to the concept and process of behavior based safety. Psychologists began to speak at safety conferences and write about the science behind potential behavioral interventions. These behavior based safety (BBS) experts used the teachings of psychologist B. F. Skinner and others to create systems and interventions with the intention of controlling worker behavior and unsafe acts that often led to incidents. Common to the BBS approach was a process for defining “at risk” behaviors, observing for those behaviors, intervening and coaching, and measurement of observation findings. Based on the “antecedent – behavior – consequence” ABC approach, it was believed that behavior could be changed by focusing on the behavior itself and the consequence of that behavior.

The BBS approach often brought initial improvements, but over time many efforts were found to be unsustainable in less committed, open or mature organizations. One of the factors for the lack of sustainable improvements is the focus on the worker behavior, and not the process or context of work in which the behavior occurred. Blaming the individual workers for safety issues or for not following procedures was and still is common, so trying to change the unsafe behavior made sense. What a person did or did not do was almost always the proximate cause, which Heinrich taught is where appropriate remedies should be applied. The ABC model underlying most BBS interventions solidified the belief that a given unsafe behavior was made by choice (to achieve the antecedent), and not necessarily due to any inherent work system design issues.

Unfortunately, little was understood in the 1990's about the importance of workplace culture, climate, complexity of work, and the necessity of integrating safety into management systems. It wasn't until 2001 when during an ASSE symposium on BBS that Dan Peterson, authority on safety management systems and author of *Safety Management*, began to ask questions of fellow panelists, such as "Where is BBS going?" and "Does BBS actually build a more effective safety process or does it create another isolated *island* of safety?". He went on to list the key criteria for world class safety. This discord was eye-opening and resulted in the understanding of the importance of culture on overall safety performance. As Peterson pointed out when discussing world class safety, without senior management leadership, integrated management systems, accountability at all levels, worker and supervisor involvement, and a positive culture that sustainable "world class" performance would be unattainable.

We now are learning the power of a positive and supportive culture in a workplace and other related factors that influence behavior at all levels throughout the organization. We are also now learning that the "research" of Heinrich is not only questionable, but has misdirected the focus and work of safety practitioners on the erroneous belief that "man (person) failure causes most accidents." As pointed out by Fred Manuele in his book *On the Practice of Safety*, "Basing safety efforts on this premise has resulted in prevention efforts directed at modifying worker behavior rather than on improving the operating systems in which the work is performed." All too often this belief is supported by the organization as Manuele points out, "It is easier for supervisors and managers to be satisfied with taking superficial preventive action, such as retraining a worker, reposting the standard operating procedure, or re-instructing the work group than it is to try to correct the system problems."

The teachings of W. Edwards Deming had a profound and global impact on the quality movement, and relate directly to safety and any discussion of work culture. The fundamental belief that a worker's behavior could be changed was flawed as Deming wrote, "There would be no problems in production or service if only the production workers would do their jobs in the way that they were taught. Pleasant dreams! The workers are handicapped by the system in which they work, and the system was designed, controlled and belongs to management". Is there room for new thinking?

The Systems and Context Approach

We are now moving into and through the safety culture movement toward the next level; the Systems and Context Approach. This level is embodied in the research and writing of James Reason, Sidney Dekker (Plenary Session speaker at Safety 2014), Doug Wiegmann, Scott Shappell, Edward Deci and other scholars and authorities on behavior, motivation, human error, complexity of work, system influence and safe work design. Again, is there room for new thinking?

It is very important to understand that human error is inevitable. Systems must be designed to be less error provocative (complicated, complex, not intuitive, non-sequential) and more error tolerant (simplified, intuitive, able to fail safe). From a systems design viewpoint workers need be seen as an integral element of the design, routinely making errors as they try to be more efficient. Systems must also be designed to expect and control procedural drift; that is the normalization of deviation from the expected procedure.

As safety professionals have been looking for “the answer” or the “silver bullet”, we may have been managing safety based on myths. Not only the myths that have been perpetuated through Heinrich, but others. This presentation will explore the 4 common beliefs that drive safety initiatives and several underlying myths about human error, and provide a pathway forward in the design of work and work processes.

The four myths include:

1. **Zero incidents and injuries = world-class safety.** What we are seeing is that world-class safety requires sustainable and safe systems in a positive environment of vigilance and involvement that embraces the concepts of continuous improvement. In the absence of integrating safety with engineering and the resulting safe work design, achieving “zero” anything is purely luck. Having a goal of zero injuries is laudable and is encouraged. However, goals should be directed toward achieving all that is required to create sustainable and safe work systems.
2. **Focusing on at-risk behaviors improves safety.** We must understand that employee behavior occurs in the context of work. Workers by and large do not choose to work unsafely, nor do they go to work in the morning wanting to get hurt. They work to be efficient, get the job done and move on to the next task. As pointed out by Sidney Dekker in his book *The Field Guide to Understanding Human Error*, Human error is not a cause of failure. Human error is the effect, or symptom of deeper trouble. Human error is ... systematically connected to features of people’s tools, tasks, and operating systems. Sources of error are structural, not personal. If you want to understand human error, you have to dig into the system in which people work. You have to stop looking for people’s shortcomings.”

Errors that lead to injuries or worse are most often based on mistakes and not willful violations. However, violations can and do lead to injuries and must be dealt with accordingly. Mistakes, on the other hand, are based on many other factors that need to be understood and addressed through system design, procedures, training, supervisory control and the like. The HFACS system (Human Factors Analysis and Control System), created by Drs. Scott Shappell, and Doug Weigmann under grant from the US DOT and the FAA and based on the research of James Reason, is used widely by the airline industry, the US military, hospitals, the utility nuclear power industry and others to better

define contributing factors and how to deal with the human errors that will occur as workers interface with the context of work.

3. **Human Error is the result of unsafe behavior.** Unsafe behavior, according to the behaviorists is based on an antecedent or desire and is most often the result of active choice or made out of ignorance. Human error on the other hand occurs throughout the day, usually not resulting in any problems what-so-ever. As stated earlier, human error is most often made by mistake. The problem occurs when an error is made by mistake or by routine deviation and it results in the release of latent causal factors. After the fact it is easy to see the proximate error that was made and how it led to an incident. What is not so easy is to understand the context of the work at the time that preceded the incident. Nor is it easy to see all the latent conditions or predisposing factors. This is where our focus must be.
4. **Human Error can be eliminated through training, incentives, BBS and Discipline.** Human error cannot be eliminated. It has been shown that due to the complexity of work and the multiple influencing or latent factors that we cannot possibly eliminate the errors that humans make; we are hard wired. This is why no amount of training, incentives, observations or discipline will ever eliminate human error. We must design work to accept it and to allow workers to fail safe.

Challenging some of the prevailing beliefs on how to control or eliminate incidents, and even calling these beliefs “myths” won’t help if we do not have a pathway forward. Here is where the new, more comprehensive thinking by some of the top safety professionals comes to the forefront. Some SH&E professionals suggest that we should be focusing our efforts on the “Systems and Context Approach.” One well-known and respected safety professional, Tom Bresnahan, calls this approach the “Winning Triad”; Prevention through Design, Risk Assessment, and System Sustainability.

The Winning Triad

Prevention through Design is more than the engineering of a process or system as it is outlined in ANSI/ASSE 590.3-2011 Prevention through Design: Guidelines for Addressing Occupational Hazards and Risks in Design and Redesign Processes. This standard defines and illustrates “Research to Practice” and “Risk Assessment” principles. It also creates a systems view of design where safety professionals should be included as part of the design team, working with engineers conducting and reviewing research on materials and methods under consideration and seeking more data when needed. Working to create safe and efficient design, this design team considers safety along with the business or production outcomes of the process and procedural

design. This team concept is a central focus of NIOSH initiatives to identify and solve real-world safety and health related issues.

The goal of R2P is to reduce illness and injury by increasing the use of NIOSH-generated knowledge and that of others, interventions, and technologies. In order to achieve this, NIOSH continues to work with university researchers and partners, including the ASSE Foundation and Liberty Mutual to fund and focus research initiatives on ways to develop effective products, translate research findings into practice, target dissemination efforts, and evaluate and demonstrate the effectiveness of such efforts in improving worker health and safety. NIOSH, ASSE and Liberty Mutual research findings are now used by workers, employers, and others throughout the world.

The second piece of the Prevention through Design (PtD) puzzle involves the application of standards of *design and assurance of compliance*. *The design team must thoroughly review and understand* applicable ANSI and other process design standards to assure proper application. They must also review the elements of design to assure compliance once completed and in process. We not only see design errors that create common safety problems or non-compliance with OSHA standards, but process or procedural related errors that lead to losses, such as increased slip and fall exposures, improper ventilation, equipment that is insufficiently guarded or an electrical discharge that fails to go to ground.

The final area of concern as we design to prevent loss exposure focuses on work methods, procedures, training, audits and incident investigations. A key area in the complexity of work, this is where the human interacts with the system. Since we know that errors will occur, and that normal drift or deviation will as well, there should be a robust process for designing work procedures and methods, employee and supervisory training, and auditing or observing for drift. When drift is identified, the organization should consider all legitimate reasons why it occurred and make any modifications that are indicated. And then when incidents occur there should be root cause analysis of all issues that relate, including drift, individual limitations or preconditions, supervisory issues, and management controlled elements. One good investigative system in dealing with complexity of work is the Human Factors Analysis and Classification System (HFACS). By using the HFACS process all causal elements may be uncovered and dealt with accordingly.

Risk Assessment is an important process known to many safety professionals and is a key element of the PtD methodology. As detailed in ANSI/ASSE 590.3-2011 Prevention through Design: Guidelines for Addressing Occupational Hazards and Risks in Design and Redesign Processes, risk assessment is a formulaic methodology for identifying the most hazardous elements of an operation to assure proper and effective controls are in place. Here risk assessment techniques are applied to a hazard assessment and design issues in an effort to deal with worst case scenarios first. The process involves 4 steps: inventory of workplace hazards/risks, organize and prepare the risk assessment team, conduct the risk assessment, and

sustain and continuously improve the risk assessment process. It is advised that the reader go to ANSI/ASSE 590.3-2011 Prevention through Design Guidelines for Addressing Occupational Hazards and Risks in Design and Redesign Processes, and dig into the detail for a more in depth understanding of the process. You may also wish to investigate the new ASSE Risk Assessment Institute website for more information, as well as numerous articles on the subject in the ASSE Professional Safety Journal.

System Sustainability is an extension of the fourth step in the risk assessment process and involves rigorous follow up and attention to detail. Complexity of workplace systems and how humans interact are at issue here. As mentioned earlier, humans will make mistakes and will err in their judgment. They will also deviate or drift from written and known procedures. This drift is normal, but if not monitored and caught early can have a cumulative negative effect on the overall elimination of hazards within an operation or process. Integrating the PtD elements and the risk assessment process with a comprehensive safety management system is essential. Following the models put forth in ISO 14001, OHSAS 18001, or ANSI Z10 and factoring in unique organizational nuances helps to create ownership and a visible system of involvement with increased overall control.

Image for a moment that there are several individuals working in a department, and that this department is serviced regularly by various maintenance workers. Over time, each individual changes their established slightly new work procedures. This procedural drift goes undetected by supervisors, managers and engineers because work continues normally and without hiccups. Until one day when a maintenance worker is expecting a valve to be closed, the line purged and a blank put in place as he begins a disassembly process. However, communication procedures were not followed, nor were the line pre-check procedures by those who were supposed to secure the line, nor were the procedures for upstream shift of product flow to another line, and so on until this complexity of work and shift from procedures results in a severe burn to the maintenance worker. Complex systems require a high degree of oversight and rigor, especially when serious risk from identified or suspected hazards are present.

In Summary

Safety and health professionals must continue to learn more about human error, risk assessment and complexity theories in order to play a more significant role in the “Winning Triad”. As we become more aware and involved in the risk assessment process and how a given assessment is influenced by systems design and procedural drift, we can become more effective as participants in managing the overall safety process. Moving away from traditional behavior based safety that focuses on the person and their at risk behaviors, while still observing workers for procedural drift when doing their jobs, will move us closer to the Systems and Context Approach to safety. We all know and understand that the culture of an organization must support a high level of

safety performance. We are now learning that understanding human error in the context and complexity of work is equally as important, if not more so.

In a recent newsletter from Richard Knowles, PhD. and author of *Partnering for Safety and Business Excellence* and *The Leadership Dance*, he summarizes the context and complexity issues well and provides a clear pathway forward. “In learning about complexity theory, I have found that there are some things that they (managers) can do to reduce these tragedies and help to make more money. First, they need to be very clear with their leadership teams about what their position is regarding the importance of safety and get rid of mixed messages and conflicting approaches.

Second, they, with their managers and supervisors, need to go into their workplaces to talk with the people about what is going on, listen and look for better ways to do the work more safely and cost effectively. Together, they need to explore how they can make all the safety training, equipment and technology serve them better. In doing this, they will build trust and interdependence. As trust and interdependence build, people will make much better contributions to improving the safety and cost performance.

Third, through these conversations everyone will have a better picture of their own work and how what they do is important to their fellow workers and the success of the business. As the communications get clearer and more coherent, as trust and interdependence build, and as people see the bigger picture, (risk will be reduced) the number of injuries and fatalities will drop, the costs will go down, earnings will increase, and the number of inspections from the regulators will drop. Many more people will be working to improve the safety and business performance, so the top leaders and managers will have much more help. These are all good outcomes that have a strong impact on the performance of the total business. This is a Win/Win/ Win for all of them.”

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