

SAFETY'S EFFECT ON PRODUCTION

By Mark A. Lundell and Cheryl L. (Cheri) Marcham

IN PRODUCTION, two competing questions usually require leadership attention at the onset of many jobs: should we do this safely or should we do this quickly? Therein lies the misunderstood conflict between production and safety. The reality is that if managed properly, all jobs can be performed quickly and safely. However, production leaders are often faced with meeting time demands placed upon them. Lack of understanding about the value of environmental, health and safety (EHS) professionals and the skill sets they provide can be a blind spot for production leadership. Safety professionals across industries have made great progress in highlighting this blind spot and taking their place on the playing field with the production team, although in many organizations, the EHS team remains on the sidelines. From there, they continue the toll of tracking injuries and briefing leadership on lagging metrics with the hope of someday leading the safety efforts from the field. Many continue the safety struggle to implement corrective actions from the sidelines while knowing that the only real corrective actions must take

place in the field within the process and not as a recommendation from beyond.

The safety professional's critical process observations and analytical review of the human interface with production processes merely scratch the surface of the benefits the safety professional can contribute. Through history, artifacts of the safety professional's influence on industry are everywhere, and many improvements in industry are a result of that interaction. However, in most cases, the safety professional was called in as a response to failures that could have been corrected proactively by leading from the front, not reactively as a lagging response to injuries that had already occurred.

This is why the progressive vision for all organizations' future success rests on the creative utilization of the invaluable skills that may be overlooked in a company's safety department; the integration of EHS with production teams can greatly improve the performance of both.

To explain how the lead author initially realized that safety integration with

production was the key to improved production performance as well as to leadership requires sharing a brief history, starting in 1994 at the beginning of a career in the U.S. Navy and culminating in a greater understanding of the benefits of a safety discipline mindset to production needs. Spending 24 years in one of the most hazardous occupations in the Navy—aircraft launch and recovery—one tends to appreciate the inherent value that a safety mindset has on production, operational proficiency and the maintenance of the well-being of employees one serves. This career unfolded to present two specific and contrasting experiences, the first being a command in the early 1990s that, due to culture, was focused on a discipline that had safety ingrained within, and the second, in the 2000s, which appeared to the author to have lost that safety discipline.

At the first command in the early 1990s, safety was critical, although that was not the way it was framed by leadership. Safety aspects were ingrained within discipline; in fact, safety was the truest form of discipline. Leadership of that time did not refer to being safe, per se; instead, leadership demanded discipline in all they led and, as a result, that would keep you and your team safe. Either during operations or while conducting maintenance on the equipment, there was no tolerance for taking shortcuts; every step, regardless of how small or redundant, was demanded and expected. In operations or while performing maintenance, technical directions were strictly referenced, sometimes out loud. We spoke clearly, with focus and intent, and were on the alert to check each other at the same time. If anyone let down their guard, they were called out by team members. Even with demanding leadership standing over you, yelling to get the equipment up, it was a badge of honor, an expression of strength, integrity and discipline, to stick to your guns and do it safely regardless of the pressure.

Fast forward 9 years where the terms, "roll with it" and "get 'er done" kept coming up among the crew. It became apparent that the previous safety-disciplined mindset had been replaced with a freewheeling "get 'er done" mentality. Maintenance in the work centers took unnecessarily long; a simple job that would have taken roughly an hour in the previous command's culture would now take 2 hours or more. Often, the work areas would be in disarray, and tools and parts would be lost while critical steps were being missed, and operations were no better. It was not a lack of discipline. The crew consisted of disciplined and talented operators. They were all highly knowledgeable technicians, but they lacked the core safety integration with

KEY TAKEAWAYS

● **Production and safety need not compete, but can instead complement each other, improving both production efficiency and safety culture.**

● **Integrating environmental, safety and health efforts with production should start from the vision through completion of every process or project.**

● **Safety disciplines provide needed structure to any production plan.**

the production mindset that was coupled with discipline at that previous command—the small details within technical specifications of operations and maintenance, housekeeping and the critically important role of what now appeared to be considered redundant in the step of check, point and call, both in operations and maintenance.

This taught one great lesson: when safety is not foremost, productivity declines. In other words, safety is key to increased operational performance. It instills accuracy, tenacity and attention to detail. Safety is the icing on discipline; it is an accent or ingredient within discipline that gives it authority and structure. By the time of this realization when the author was a senior production leader, it became apparent that safety also defines the proficiency of leaders. One can be a leader that gets the job done and one can be a leader that gets the job done safely—two entirely different levels of leadership acumen, the latter being the one that is needed for a successful production team. As the authors have stated:

Leaders or managers who place profit and production over the safety of their employees, who are willing to overlook their faltering safety culture or bypass safeguards to get the job done, or who fail to support and follow regulatory requirements merely because they “don’t have the time” can create an unsafe work environment. (Lundell & Marcham, 2018, p. 36)

This discipline of safety is not only a military standard but can also be a benefit throughout industry. Therefore, greater integration of EHS into the production process is key to future production success.

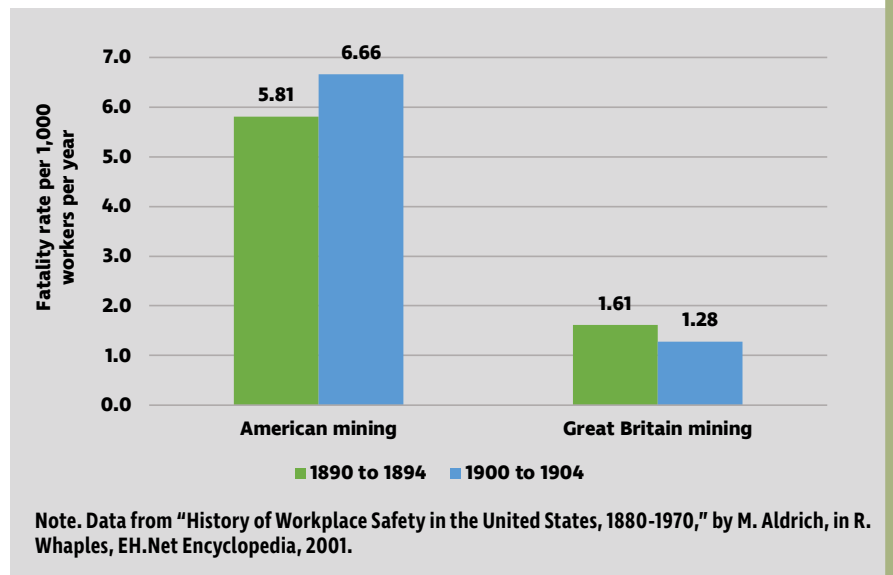
The History of Production & Safety

To fully appreciate the effect that the professional safety discipline has on the production process, we must first look at its evolution. The first phase of the Industrial Revolution began more than 260 years ago in Great Britain (Stearns, 1993). This introduced many new hazards to industry, including heavy machinery and new energy sources such as coal and steam engines, coal-fired furnaces for metalworking, petroleum for engines, and electricity (Encyclopedia Britannica, 2023). During these early years, safety and health regulations were few, which allowed for child labor, unsanitary conditions and long work hours (Hendrickson, 2015; MacLaury, n.d.).

Without a comprehensive injury reporting system, the earliest injury, illness and fatality statistics come from the mining and railroad industries of Great Britain and the U.S. The American fatality rate for all coal production from 1890 to 1894 was 5.81 fatalities per 1,000 workers per year, compared to the rate of 1.61 in Great Britain (Figure 1; Aldrich, 2001).

In Great Britain, the coal was deep, and mining methods used less blasting. The work was concentrated to isolated areas, making worker supervision easier (Aldrich, 2001). In the U.S., the coal was near the surface and spread out over a vast area, making supervision and oversight difficult. Blasting was needed to bring down the coal, and the miners were not paid hourly, but

FIGURE 1
MINING FATALITIES



instead based on tonnage of coal produced, leading to motivation to produce as much coal as possible in the shortest time without concern for the safety of the process (Aldrich, 2001).

During the same time, equal challenges existed in America’s railroad industry. The greatest risks on the railroad by far were to “trainmen,” arising from their role coupling cars and riding on the top to operate the hand brake (Aldrich, 1997). This practice resulted in nearly half of all fatalities to these workers and was the leading cause of death among trainmen since at least the early 1850s (Aldrich, 1997). According to Biddle (2013), as early as the 1800s, the belief arose that the most effective way to prevent and control occupational injuries, illnesses and fatalities was to design out or minimize hazards and risks early in the design process. This is evidenced by the work of George Westinghouse, who designed and engineered modifications to the existing air brake system, and of Ely Janney, who developed the automatic car coupler in the late 1880s (Aldrich, 2001). Aldrich notes that these modifications to the equipment, while meant to increase safety, also increased productivity. In 1890, the Interstate Commerce Commission (ICC) published its first detailed national estimate of employee casualties, which tallied 2,451 fatalities and 22,396 injuries severe enough to be reported; 59% of all casualties occurred to trainmen, even though they only accounted for one-fifth of total railroad employment. These numbers also included 369 fatalities and 4,750 injuries from those coupling cars (Aldrich, 2009). With this news, awareness grew about the level of danger involved in the work of coupling cars. As a result of the higher level of fatalities, more attention was finally given to safety, and the fuse was lit for integration of safety within production. This drove the establishment of railroad regulatory commissions such as the Safety Appliance Act of 1893 and others governing the safety of locomotives and freight cars (Aldrich, 2001).

In 1913, the U.S. Bureau of Labor Statistics (BLS) reported 23,000 overall worker fatalities among a workforce of 38 million, putting the rate at 61 deaths per 100,000 workers (Leon, 2016); compare this to today’s rate of roughly 3.4 deaths per 100,000 workers (BLS, 2021). The reductions in workplace injuries and fatalities over this period can be attributed to many interrelated

factors such as labor and management's improved focus on worker safety as well as advances in technology. Because of these changes taking place in industry along with new observations of occupational hazards and the new field of the safety profession, many safety advancements in industry evolved over the years. This newly recognized view of the value of occupational safety contributed to the development of many government agencies such as OSHA and NIOSH, both established in 1970, the Mining Enforcement and Safety Administration, established in 1973, and MSHA, established in 1977 (Institute of Medicine, 2000). All these factors led to physical changes in the workplace, such as improved ventilation and dust suppression, machine guarding, safety equipment for production employees, safer work practices and improved training of OSH professionals.

As the U.S. evolved its safety regulatory oversight focus and infrastructure, production across the country continued to increase through the years. From 1913 to 2020, the U.S. measure of the total value of economic output adjusted for inflation, known as real gross domestic product (GDP), increased while occupational fatalities decreased. While the American injury rate per 100,000 workers dropped from 61 in 1913 to 3.4 in 2020 (BLS, 2021; CDC, 1999), the U.S. real GDP increased from \$39.5 billion in 1913 to \$18.3 trillion in 2020 (Amadeo, 2022; Johnston & Williamson, 2023). This teamwork between the safety professional and production leadership, although in many cases not voluntary, has proven to reduce injuries while production increased across the board.

However, as Kramer (2013) highlighted, the magnitude of the age-old battle between productivity and safety will likely increase in the years to come. From 1973 to 2011, American productivity grew by 80%. From 2000 to 2013 alone, productivity was estimated to have increased by 23%, although most associated revenue had gone toward corporate profit rather than toward worker pay or increased spending on safety (Kramer, 2013), a practice that can limit an organization's profit in the long run. The adoption of human resource management systems that invest in human capital and emphasize training, empowerment and participation improve safety climate and safety performance as well as operational and financial performance (Pagell et al., 2018). Moreover, recent work in operations management has shown that increased worker safety is linked to increased operational effectiveness (Pagell et al., 2018). Returning a portion of the profits to invest in safety will in turn increase the overall organization's financial performance as well as productivity. That is where we are today: the safety professional's talents have gained greater influence and provide a significant contribution to improved performance in production across industry. The benefits of this improved interaction are enjoyed and captured by production leaders but not fully recognized as a safety contribution, internalized as a process shift or invested in for the future of industry safety.

Production's Relationship With Safety

Through this history, many management schemes have been implemented over the years starting with the mass production system to lean production to today's agile model (Douglas, 2002). Mass production developed to produce products faster and more efficiently with the establishment of a production line. As industry pursued greater performance, many in industry began using the lean six sigma process improvement model (Douglas, 2002). While developed from the production view to decrease the waste of time, energy or effort in the production

process, it also improved safety. Another model is the agile project management production model, which was developed to keep pace with the ever-changing business environment. This model strives to reconfigure operations, processes and business relationships efficiently while simultaneously flourishing in an environment of continuous change (Douglas, 2002). The agile development cycle, although intended to improve project management flexibility, also introduces and lends itself to increased efforts focused on a continuous and adaptive formal change management processes (Project Management Institute Inc., 2019), thereby meeting administrative management of change safety controls as a discipline of the agile process.

From mass production through lean six sigma to the agile model, with each new scheme, elements of improved safety were ingrained into the production process. Once these new processes were rethought and evaluated properly with safety and productivity combined, great improvements were made for both, either intentionally or as a by-product of a new focus on the system or process. Highlighting the interaction of safety with production, the mass production customization effort of the 21st century resulted in experimenting with techniques such as total quality management, 5S and total productive maintenance (TPM; Douglas, 2002). Total quality management uses a climate of teamwork for continuous improvement of all related work processes including production, while incorporating public health, safety and environmental protections as well as ethical business practices (Ciampa, 1992). Originally developed in Japan to streamline the production process, 5S is based on the discipline of cleanliness, keeping organized and improving the physical working environment (Douglas, 2002). It provides greater performance, although these gains are made through the safety standard of housekeeping as well as by focusing on reducing clutter and non-value-adding steps of production that also remove unnecessary hazards in the working environment. TPM, where equipment is monitored and maintenance is controlled through computer tracking and metrics, maintains the equipment in an optimal state and decreases risk to the equipment operator by reducing unexpected hazardous failures (Douglas, 2002). From a broad overview, these customization efforts led to many improvements in production but have also increased safety because the processes implemented by each are incidentally aligned and integrated between production and safety together as team members are working toward the same objective, reducing risk and downtime for both machine and personnel.

Leaning into more integration between production and safety, prevention through design and the safety planning and control (SPC) model are EHS-minded performance techniques integrated into the production process to address potential risk and introduce safety into production planning from the onset through the life cycle of any plan. The 2007 national initiative on prevention through design was a collaborative partnership between investigators and practitioners such as NIOSH, ASSP (then ASSE), the National Safety Council, OSHA and others (NIOSH, 2014). Prevention through design addresses the safety and health of employees by eliminating hazards and controlling risks to workers to an acceptable level at the source or as early as possible in the life cycle of equipment, products or workplaces. Accomplishing this requires the inclusion of worker safety and health in the design, redesign and retrofit of new and existing work premises, structures, tools, facilities, equipment, machinery, products, substances, work processes and the organization of work into all plans.

Another approach to safety integration with production is the SPC model, a process that integrates the safety organization into hierarchical levels of production control (Saurin et al., 2004). This long-term planning starts with a preliminary hazard analysis at the root design stages of the process. That preliminary hazard analysis is updated at medium- and short-term intervals throughout the project. In the SPC process, EHS is brought in as a leading stakeholder of weekly planning-level production integration and look-ahead planning meetings (Saurin et al., 2004).

Every production plan has a beginning and end. The EHS elements of the organization matter not only when something happens; it starts from the initial vision through to removal or replacement of every process or project, with no breaks in between. EHS teams should be integrated as high-level contributors throughout the process as early as possible, beginning to end. As happened through the COVID-19 pandemic, EHS professionals have shown to be a critical asset and advisor to the highest levels of management. Safety professionals continue to have an impact on the workers they help protect and the value they exhibit to the people in the C-suite (Bottino, 2021). Employees are the backbone of any organization and EHS is there to work with leadership to help keep them happily and healthfully participating in the production process.

Safety's Relationship With Production

Production is necessary for the world to continue moving forward. Production also must improve and change, reevaluate its processes and performance, and strive for the best possible solutions to generate growth for each individual company. An organization's labor force is an equally integral contributor in the system of production as any machine on the line. Production teams put significant time and effort into their TPM process but may resist or outright reject attempts at preventive measures that keep the workforce safe and effective.

As Sharma and Bhardwaj (2012) note, all assets on which production depends are always kept in optimum condition and available for maximum output. This is accomplished through TPM and maintenance management where the purpose is to reduce the adverse effect of breakdown and to maximize the production system availability at minimum cost (Sharma & Bhardwaj, 2012). EHS efforts in mitigating risk and hazards for the workforce mirror this intent daily, although, without integration with the production teams, EHS can only provide a modest contribution to production performance. If applied holistically to the workforce by every organization's EHS and production teams together, significant progress can be made.

Major concerns affecting worker productivity include improper workplace design, ill-structured jobs, mismatch



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between worker abilities and job demands, adverse environment, poor human factors, and poorly conceived and implemented management programs (Shikdar & Sawaqed, 2003). This can lead to workplace hazards, poor worker health, mechanical equipment injuries and disabilities, and in turn reduces worker productivity and product or work quality and eventually increases the cost of production (Shikdar & Sawaqed, 2003). In an example of addressing this from a TPM or EHS ergonomic evaluation process, Resnick and Zanotti (1997) reported a 7% increase in productivity merely from a small safety observation and ergonomic adjustment of a technician's elbow for a task from 10 cm above elbow height to 10 cm below. This small adjustment

created optimal posture, supporting the employee's safety and health while also providing a 7% increase in speed of motion toward improved production.

According to Hallioui and Herrou (2020), the implementation of ergonomics in manufacturing to reduce injuries and improve efficiencies required significant communication between safety, quality and production professionals, but this created an active part or process of the organization as a whole with safety being combined within production. However, the researchers further explain that "Although an integrated approach is thought to be very important to bringing safety and productivity together, companies may struggle finding compatibility between working safely and being productive" (Hallioui & Herrou, 2020, p. 60). Why does that mindset exist, and what negative impact does it have on an organization? As shown, there are many performance issues in production that can be addressed by the safety professional as well as many safety processes that could be improved by having a production technician's viewpoint. According to Karanikas et al. (2018), "In general, when workers are satisfied with the working conditions and feel safe from injuries, they become more productive" (p. 257).

As noted, productivity and safety tend to compete for priority in an organization; balancing these two priorities tends to enhance both, and both are essential for success (Mathis, 2017). According to Dekker (2013), there is a mistaken belief in this competition between the two that "you cannot have high levels of one and or the other: one is always sacrificed for the other. If production is higher, safety is lower, and vice versa" (p. 8). However, Dekker explains that as production ramps up, sometimes safety metrics improve. This could be due to higher investment in better equipment and better training for personnel, including safety equipment and training; therefore, safety does not need to be the casualty of production; it can, in fact, be lifted with such a rising tide (Dekker, 2013). As stated well by Kramer (2013), the real battle will be in moving employees, business owners, Wall Street

and the international economy toward a system that recognizes the true costs of injuries and internalizes safety into all aspects of all business models. Production and safety can increase at the same time, if only we make it so (Kramer, 2013).

For Toyota, the largest automotive production organization in the world, the production of 10 million vehicles each year does not exist without safety being an essential part of the production line (White, 2020). Toyota has as closely as possible perfected the production process and has done so by integrating the safety manager into the highest levels of its production planning organization. The system that Toyota has in place puts every manager into the EHS conversation and has them discuss this with each employee as well (White, 2020). Toyota uses a twofold process that empowers managers across the floor to take a more active role in the EHS conversation, which results in empowering the individual workers to take an active role in developing a safer, better system for their daily production responsibilities (White, 2020). This is just one example of the many progressive safety organizations in the U.S.

Similarly, in another highly hazardous environment, U.S. Navy aviation squadrons have safety officers educated and trained in safety program management, operational risk management and a vast array of safety industrial hygiene requirements. These safety officers report and consult directly to their base or shipboard commander. From the first author's experience, naval safety infrastructure operates by having leadership consisting of certified supervisors highly trained in EHS standards with a rotating staff that comes from the production and operations environments that they oversee. This very conscious decision to rotate personnel through the EHS department accomplishes two rather critical challenges: it ensures that the technicians from the shop floor build a more comprehensive and robust understanding of how safety integrates across the organization, and it infuses the current EHS team with a renewed sense of those operational challenges faced on the shop floor, thus removing competing priorities between safety and operations (Grenier, 2019). As Grenier (2019) notes, "Every day should be used to look for ways to improve and combine EHS and operational principles together into a harmonious relationship." Rather than pitting safety against cost or safety against production, we should be interested in the creation of safety in production and in the creation of safety under cost pressures (Dekker, 2013).

Safety Professional Integration

EHS is no small job, and the demands felt by the safety professional are tantamount to those faced by any production team. It takes years of education and experience, and a dedication to reading and thoroughly understanding the standards and requirements that are as demanding as most professions throughout industry. Today's EHS environment and regulations require organizations to have a group of highly skilled professionals to ensure compliance (Grenier, 2019). Many safety professionals throughout industry start out their career in college and proceed directly to the EHS department at the worksite or company where they now work. In that process, one critical step is missing—the shop floor, worksite or ground-level experience and empathy for those who are getting the work done. This missing step contributes to the breakdown and separation between the two.

The path of many EHS leaders may be that they develop an exceptional knowledge of regulations but over time, they lose a sense of the challenges faced by operations and production leaders (Grenier, 2019). That is where the safety professional's

understanding of the work is essential and can be complemented by collaboration with the production team. The essential elements of a good safety environment are the integration of safety leadership with the commitment of leadership and the engagement of all employees in all safety plans as well as safety education, engagement and commitment of all to safety (Nkrumah et al., 2020). The future of production and safety requires transitioning safety professionals from outside of the production process to being senior contributing team members of the overall production plan to serve as the conduit of communication with leadership, production teams and employees throughout the production environment.

Conclusion

It is clear to the authors and to many in industry that the integration of EHS with the production infrastructure teams will not only benefit production performance within an organization but is critical to achieving further progress in industry. The steps industry can take to integrate these two significant assets within any organization into the high-performing teams they can be will revolutionize industry, as has been demonstrated through the evolution of safety through the years and the current level of integrating safety aspects into many of the steps taken to improve production performance across industry. This integration, although proven to fit in the operational setting, also supports the workforce's confidence in their organization as well as their psychological safety. Sulasami et al. (2020) explains that psychological safety enhances employee performance by providing everyone the ability to easily and without fear raise the issues they face in their jobs. Hence, integrating safety within production provides confidence that employees have the support they need to feel comfortable in raising safety concerns and will provide the production teams a representative who will listen, evaluate and defend those concerns. As the authors have noted, psychosocial and psychological safety are critical to maintaining an organization's safety culture as well as for promoting greater production performance (Lundell & Marcham, 2018).

There are many blind spots throughout industry where EHS has either been forgotten due to ignorance of their contribution, ignored due to avoidance of increased oversight, or intentionally left out to save time or money. However, this is where a gap in production performance and worker protections exists, and this should not be accepted. A simple solution to the identification of these gaps and blind spots is to establish strong EHS interaction and oversight into the organization's operational structure. Integration can be as little as establishing a stakeholder or consulting position within the project team structure, or as great as integrating EHS completely within the production process and placing an EHS professional in executive consultation with the organization's leadership.

Safety and production integration demonstrates a clear indication of management commitment to safety, leadership's focus on employee safety, and fulfills the basic human need for safety and security of the workforce. It enforces management's interest in taking a holistic approach to production that supports their workforce just as much or more as their customers, while establishing EHS at the organization's highest levels keeps it consistently in the conversation and in the minds of those on the production floor. Management commitment to EHS is an aspect of almost all international safety standards and a well-known foundation for an organization's safety culture. Integration is one easy way to make management commitment

apparent and nurture the growth of safety culture across industry. It will keep EHS always at the forefront, not on the sidelines or the background, keeping awareness of safety in the conscience of every employee, on the tip of everyone's tongue to the tips of their fingers and toes. **PSJ**

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