HOW INDUSTRIAL-ORGANIZATIONAL PSYCHOLOGISTS CAN CONTRIBUTE TO WORKPLACE SAFETY IN HIGH-RELIABILITY ORGANIZATIONS

A Thesis

by

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Submitted to the Office of Graduate and Professional Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

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December 2019

Major Subject: Industrial/Organizational Psychology

ABSTRACT

This literature review describes how Industrial-Organizational (I-O) psychologists can contribute to workplace safety in high-reliability organizations (HROs) through various human resource practices. HROs are organizations that have the obligation to avoid incidents as much as possible due to the significant consequences those events would cause to various stakeholders. Fifty-seven peer-reviewed journal articles, popular press articles, and book chapters were reviewed and are referenced within. Several suggestions are offered on how I-O psychology professionals can contribute to HRO safety through job analysis, recruitment, selection, training, performance management, climate and culture, teamwork and leadership. This thesis also reviews other common psychological concepts and theories used extensively within HROs.

CONTRIBUTORS AND FUNDING SOURCES

Contributors

This work was supervised by the student's thesis committee chair, Professor Stephanie C. Payne, with Professor Winfred Arthur, Jr., of the Department of Psychological and Brain Sciences, and Professor Wendy Boswell of the May's Business School as committee members. It also reflects feedback from Professor Olabisi Atoba. All work for the thesis was independently done by the student.

Funding

There are no outside funding contributions to acknowledge related to the research and compilation of this document.

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I. INTRODUCTION

Technological advances (e.g., automation) has reduced the need for manual labor and physical demands and reduced the number of hazards and risks that entry-levels workers are exposed to. However, the rapid change of technology also transforms the types of machines, tools, and equipment workers must use to accomplish their tasks and jobs. Many changes require a higher cognitive load, because there are more buttons to press, more detailed procedures to follow, and more safety policies to comply with (Sætren & Laumann, 2014). Ironically, advances in technology can sometimes make work even more complex and hazardous.

High-Reliability Organizations (HROs) cannot afford even the smallest of incidents due to the significant consequence those incidents could impose on the stakeholders. LaPorte and Consolini (1991) used the phrases "trials without errors" and "failure-free organizational performance" to describe how work must be performed in these organizations. Nevertheless, there are instances of deviance and unsafe behaviors recorded in these domains. For example, there were 30 loss of well control incidents reported between 2010 and 2017 in the oil and gas industry (Tamim, 2018). The purpose of this paper is to describe how industrial-organizational psychology can contribute to workplace safety in HROs.

I.1 High-Reliability Organizations (HROs)

Although there is some variability in how HROs are defined in the literature and researchers have not come to consensus on what requirements are necessary for organizations to be considered HROs (Sutcliffe, 2011), HROs are generally understood to be organizations that must maintain good safety records due the inherently high-risk environments that they operate in, which is often coupled with severe consequences of error (Flin, 2001; Roberts, 1990; Weick & Sutcliffe, 2007). Some examples of HROs include space exploration, the nuclear industry, and

air-traffic control. These organizations need to constantly perform above and beyond expectations in order to maintain incidents and injuries at a minimum level.

I.1.1 Brief History of Accident Theories

The term "accident" is used throughout this paper interchangeably with the term "incident" due to the frequent use of the word accident in the broader safety literature. An accident is defined in the dictionary as "an unforeseen and unplanned event or circumstance" (Merriam-Webster, 2019). These events are not the focus of this manuscript, because I-O psychologists focus on failures that are describable, explainable, and predictable and therefore preventable.

In the 20th century, scholars had varying thoughts about the causes of accidents. The two major schools of thoughts were the high-reliability theory, conceptualized by La Porte and Consolini (1991) and the normal accident theory, which was developed by Perrow (1984).

I.1.1.1 High-Reliability Organization Project

The 'high-reliability organization' theory was first formulated by researchers at the University of California, Berkeley. The project was designed to explain the unusual phenomenon of complex, high-risk industries having relatively high standards and remarkable performance in safety (La Porte & Consolini, 1991). The characteristics that these organizations have in common is that they are "large, internally very dynamic, and intermittently intensely interactive" (La Porte & Consolini, 1991, p. 58). Other characteristics that La Porte and Consolini (1991) specified for HRO include:

1. not being tolerant of failure due to the tightly interrelated systems that will prevent other parts to resume if one part is experiencing error;
2. if failure occurs, the results will be visible and become public concern; and

3. a large number of resources to invest in "reliability-enhancing" processes.

The premise behind HRO is that accidents can be avoided by putting in place systematic measures to manage their frequency. Weick, Sutcliff, and Obstfeld (1999) argued that this level of reliability is a result of sufficient management of change.

I.1.1.2 Normal Accident Theory

Another school of thought that attempts to explain accidents in organizational contexts is the Normal Accident Theory (NAT). The NAT was proposed by Perrow (1984) in order to analyze the nuclear accident at Three Mile Island. In his book, Perrow proposed that some accidents are inevitable due to the complexity of some systems. He also introduced the idea of "coupling," in which one component of a system is interdependent with another. Perrow divided systems into four levels: (1) individual parts, the first level of a system, (2) a unit, where individual parts that are related interact with each other, (3) a subsystem, a collection of units, and (4) a system, the combination of subsystems.

Contrary to the definitions cited earlier, Perrow (1984) proposed that errors that happen at the individual and unit levels are referred to as *incidents*, and failures that happen at the subsystem and system levels are referred to as *accidents*. He also argued that some accidents are caused by inevitable tangles of events at different levels of systems. He suggested that most engineered safety features are created to prevent incidents from becoming accidents and that failures that escalate incidents into accidents are events that are able to get through those engineered safety features and that there is no way to apprehend them. Perrow mentioned two other interactions that would make events impossible to predict – *complex interactions* and *tight coupling*.

Complex interactions refer to the interactions that happen that are unfamiliar or unexpected (Perrow, 1994). This makes it possible that events go undetected for a long period of time. Tight coupling refers to a system that is extremely organized; there is no room for deviations. The premise of NAT assumes that errors happen in the same manner that *normal* accidents happen, which is due to chance.

A comparison of the two theories highlights where they differ. NAT argues that some occurrences are inevitable despite efforts to avoid them, whereas HRO theory proposes that controls can be designed to keep accident rates low. NAT focuses on elements in an organization that may contribute to accidents, whereas HRO theory centers its attention on reliability. NAT suggests that de-complexing a system may lower accidents, whereas HRO theory proposes commitment alone to ensure reliability matters. Shrivasta, Sonpar, and Pazzaglia, (2009) pointed out that although the motivations of NAT and HRO theory differ, the implications for practice are similar. Both NAT and HRO theories strive to lower accident statistics by putting specific initiatives that address organizational factors into place.

I.2 Human Factors and Safety Culture

Technological advances also change the way workers interact with the tools given to them for their jobs. The concept of human factors was first proposed as early as 1940, during World War II when aircraft crashes were attributed to design issues of the cockpit. “Human factors” is a label assigned to human causes and contributions to accidents. The concept also considers the effectiveness of controls that can be used against hazards and how they depend on humans who must perform within the controlled environments.

I.2.1 Significance of Human Factors in HROs

In the early 1990s, many HROs like nuclear power operations, offshore oil and gas drilling, and air traffic control relied on human abilities to maintain productivity, which is problematic due to the fact that 80-90 percent of workplace incidents could in part be attributed to human factors (Clarke & Robertson, 2005).

Reason (1995) pointed out that since the conceptualization of human factors, organizations have been trying to minimize humans' unsafe impact on high-risk environments. He theorized that the reason for the high percentage of accidents to humans lies in the tendency of humans to "design, build, operate, maintain, organize, and manage" said systems (p. 80). Reason further described three different ways that humans contribute to accidents.

First, Reason (1995) noted multiple kinds of human error. He differentiated errors based on consequence and presumed cause. Already widely known in HRO, the consequence classification differentiates between (1) mishaps and (2) slips and lapses. Mishaps refers to cognitive errors that lead to decision-making mistakes. Slips and lapses are physical errors that happen to an individual that may lead to bigger events. According to Reason, these usually occur during a routine, which could be caused by a disruption in thoughts or distractions from the immediate environment. The second error classification, cause of the error or type of mistake, is divided into two groups by Reason: (1) rule-based and (2) knowledge-based. Rule-based mistakes happen either because of bad policy or a bad application of a good policy. Knowledge-based mistakes happen when an unplanned issue exists, where no resolutions were pre-programmed. This results in relying on the worker to decide best practices to resolve a conflict.

Second, Reason (1995) pointed out that human errors imply either (1) an inadequate plan or (2) the failure to achieve a set plan. However, accidents will always implicate some degree of

deviations. Errors are distinct from violations, which differ in intent or volition. Violations are deliberate, whereas errors are unintended deviations.

The third way that Reason (1995) identified humans contribute to accidents is through active and latent human failures. Active failures are hazardous actions conducted by the workers like opening the wrong valve. These actions usually have immediate consequences. Latent failures are the result of a decision made often by individuals higher up in the organization like requiring workers to work over time. These decisions are usually made by managers and the consequences may be hidden for a long time until a trigger reveals the damage.

In summary, human factors' scholars like James Reason have enlightened HROs about the role that workers play in keeping the organization safe. In particular, they have pointed out important distinctions concerning human error that need to be considered when designing work, investigating accidents, and identifying ways to improve worker safety.

I.2.2 Models Used to Explain Safety in the Workplace

I.2.2.1 Swiss Cheese Model

Reason (1990) developed the Swiss Cheese Model to explain accident causation in the workplace. He speculated that an accident could be traced to one or more sources of missteps: organizational influences, supervision, preconditions, and specific acts. Using the metaphor of Swiss cheese, the slices of cheese portray the barriers that organizations may put in place to lower chances of accidents, while the limitations and flaws of the barrier are represented by the holes. When these holes align, accidents happen.

The Swiss cheese model is useful for heightening awareness about barriers that prevent accidents. Organizations frequently put three different kinds of barriers or controls in place, specifically administrative, physical, and personal. Administrative barriers include organizational policies and procedures or rules, like "pedestrian traffic should stay in designated walkways".

Physical barriers shield employees from hazards. These include gates, guards, and fences. For example, fences are often used to enclose the space around a hazard. Finally, organizations provide employees with personal protective equipment like fire retardant clothing. Personal controls are usually thought of as the last line of defense for protecting the employee from various hazards. I-O psychologists often measure employees' perceptions of the enforcement of organizational policies and procedures (organizational climate) and develop and evaluate safety training to educate employees about the importance of complying with administrative and physical controls and ensure employees know how to properly don and use personal protective equipment.

I.2.2.2 Bow-Tie Model

Another well-known model used in HROs is the bow-tie model. The origin of this model seems untraced. The Piper Alpha incident of 1998 spiked the use of the model as a risk evaluation model. The application of the model has two purposes: (1) a visual summary of various threats that are associated with adverse events as well as the barriers that prevent those threats from turning into an incident as well as recovery controls that can be used to mitigate the severity of the consequences that follow the event and (2) to aid in the identification of barriers that an organization can put in place to avoid an accident (GCE, 2017).

Both models were created to explain accidents that may be attributed to human factors including human error. They also highlight systems, procedures, and technical errors as contributing factors as well.

I-O psychologists have also put forth a number of models to explain safety in the workplace. Unlike human factors models which attempt to explain individual adverse events or incidents, I-O psychology models attempt to explain worker behavior which proceeds adverse

events or incidents in the workplace. For example, Neal and Griffin (2002) proposed that safety climate (employees' perceptions of the enforcement of safety-related policies, procedures, and practices) relates to worker safety knowledge, skill and motivation which in turn is related to safety performance or behavior which is comprised of compliance and participation. Christian, Bradley, Wallace, and Burke (2009) expanded Neal and Griffin's (2002) model elaborating on the antecedents of safety knowledge and motivation.

I.3 Safety Performance Indicators

Measurement of safety performance is complex and difficult to achieve the accuracy for. The reason for this is that most methods used to quantify safety often comes from reactive and infrequent statistics, such as accident rates, the number of injuries, near-misses, etc. (Cooper & Phillips, 2004). An example of when reactive data, such as injury statistics, is used to determine safety performance in mining Coleman & Kerkering (2007). Various researchers have developed disparate analyses to measure the construct. For example, Barbaranelli et al (2015) used safety knowledge, safety motivation, safety compliance, and safety participation as indicators of safety performance in various geographical locations. Cooper and Phillips (2004) measure perceptions of safety training as a prediction for safety behaviors. Meanwhile, Christian et al.'s (2009) Model of Workplace Safety used safety knowledge, safety motivation, safety compliance, and safety participation as indicators of safety performance.

I.4 Occupational Health and Safety

In most HROs, the department that is typically in charge of safety is the Occupational Health and Safety (OHS) department. This department can also have other names like Health, Safety, and Environment (HSE), Workplace Health and Safety (WHS), Quality, Health, Safety, and Environment (QHSE), or other similar titles. According to the World Health Organization

(WHO), occupational health refers to the well-being and overall health of individuals relating to their work. Safety being set as a priority is especially important in HROs because of the hazards in the workplace and the chances that employees could be injured is potentially higher than in other industries. One of the primary responsibilities of the OHS department is to put into place and manage various barriers that protect employees from hazards in the workplace. As noted earlier, there are a range of barriers including physical barriers (e.g., a shield or gate), administrative barriers (e.g., policies, permits-to-work), and personal barriers (e.g., personal protective equipment). Safety personnel are often trained as experts in their field (e.g., engineers, nurses) and then take on safety as a focal responsibility. As a result, they are not always knowledgeable about theories of human behavior (psychology) and the application of those theories to behavior in the workplace (I-O psychology). Nevertheless, I/O psychologists have a lot to contribute to occupational health and safety.

II. HOW I-O PSYCHOLOGISTS CAN CONTRIBUTE TO HRO SAFETY

II.1 Personnel

II.1.1 Job Analysis

One way that I-O psychologists can contribute to safety in HROs is by ensuring the organization uses scientifically-sound personnel-related practices. These begin with a job analysis. According to Gatewood, Field, and Barrick (2016), a job analysis is defined as "a purposeful, systematic process for collecting information on the important work-related aspects of a job" (p. 47).

Some information that can be gathered from the analysis is critical worker-related characteristics necessary to perform the job. For example, HROs may seek employees who are low on neuroticism, because this construct has been shown to be negatively associated with workplace safety (Flin, 2001). The information gathered in a job analysis can be used to guide decision making in selection. Some of the information that may be obtained from a job analysis include:

1. Details of activities done on the job, such as frequencies of said activity, step by step procedures, work environment, tools, and equipment needed
2. Certain requirements needed for individuals doing the job, such as knowledge, skills, abilities, other characteristics (KSAOs)
3. Minimum qualifications to filter applicants who will likely succeed as well as standards that represent success in job performance, based on the criteria discovered on the analysis

Using a job analysis will not only help companies select the right people, but it will also help them legally defend their selection processes and decisions if an applicant raises any doubts

about their selection decisions. According to the Title VII of the 1964 Civil Rights Act, it is unlawful for companies to differentiate applicants based on race, sex, color, national origin, or religion in the context of employee practices, such as selection, pay, and terms of employment. The Equal Employment Opportunity Commission (EEOC) investigates accusations of discrimination. However, this does not mean that companies should hire just anybody. Job analysis information can help organizations filter through multiple applicants lawfully.

One resource that is particularly helpful for identifying relevant KSAOs for future workers is the Occupational Information Network or O*Net (onetonline.org). O*Net is a comprehensive database that was developed by the U.S. Department of Labor to provide public access to occupational information. O*Net was designed to "facilitate career exploration, vocational counseling, and a variety of human resources functions, such as developing job orders and position descriptions and aligning training with current workplace needs" (O*Net, 2019). O*Net is frequently updated, with over 900 occupations available to be searched. Although O*Net can be very helpful, a thorough job analysis cannot be replaced by a simple search of O*Net. Human resources professionals still need to carefully decide on the KSAOs they that one needed for their specific organization due to the unique nature of each company. Gatewood et al. (2016) also noted that further research is still needed regarding the efficiency of using O*Net as a reference to future employee specifications. For example, companies can use O*Net to look for summary report for the job title "Roustabouts", which are common entry level employees for the oil and gas industry. Employees in this job are responsible for "unscrewing or tightening pipes, casing, tubing, and pump rods using hand and power wrenches and tongs" (O*Net 2019). O'Net users can also see other characteristics or demands for this job, such as technological skills, KSAs, work activities, and work context.

II.1.2 Recruitment

Gatewood et al. (2016) noted three stages in recruiting; (1) attracting applicants, (2) maintaining the interest of applicants, and (3) making a decision to extend an offer and post-offer closure. I-O psychologists can facilitate each of these stages of recruitment for HROs. Attracting applicants to HROs may seem challenging due to the hazard to which workers are likely to be exposed to, most entry-level positions in HROs may also demand high levels of physical and mental abilities from their workers due to the complexity of the work required. Companies try to convince new applicants that this career path is worth the try by using two of organizational characteristics of HROs; their safety records and their pay scale.

Realistic Job Previews (RJP) are defined by Rynes, Bretz, and Gerhart (1991) as the transparent preview of an organization, which shows both the positive and less positive job-related information. RJPs can be used to let applicants know more about the job and assess their fit before applying for a position. This could prevent new hires from being disappointed and even quitting after onboarding. Research has revealed that negative or realistic glances at the job are perceived to be more credible and would not lessen the interest of applicants who are authentically interested in the position (Gatewood et al., 2016). It might be helpful to hire applicants who have previous experience in the same or similar industry. An RJP would also permit the applicant to compare their old job to the one to which they are applying for. It would be up to the company to make itself look more favorable while also being reasonably transparent to its recruits.

Another way to make HROs appealing and draw a bigger applicant pool is to use popular culture references through posters, videos, or employees' testimonies. For instance, National Aerospace and Space Administration and the aviation industry have made several posters that

used a futuristic and modern look to appeal to the popular masses. Several other HROs have also made appearances in popular media, such as movies and tv series, that may also help to increase the size of the applicant pool by appealing to the public or simply making their existence known.

The decision-making process in selection can be extensive and takes a long time. Being an effective recruiter means to not prolong the process more than necessary (Becker, Connolly, & Slaughter, 2010). Further, to keep applicants interested while the organizations go through the process, active lines of communications should be maintained. This could be done by being available to applicants should they have further questions. Companies can build rapport this way while also thinking that some applicants may want to assess their fit in the company during this time. This may push companies to think about what kind of information the organization should share at this time.

Extending job offers is a critical step in the selection process because this will determine who joins the company which can, in turn, affect the company's effectiveness. I-O psychologists and human resource professionals who are employed in HROs should always be educated on the latest research and best practices. An example of this would be RJPs and virtual job tryouts (i.e., giving applicants simulations of the job before they get hired). For example, CVS Health screens their retail pharmacists and management position applicants by giving them scenarios that might happen and assessing their answers (CVS Health, 2019). A study by Burt, Williams, and Wallis (2012) revealed that safety levels of new recruits could be enhanced by socializing safety expectations during the on-boarding process. Phillips (1998) found that the use of RJPs enhanced performance and lowered attrition from the recruitment process, as well as overall turnover, which is especially helpful for HROs that often have difficulties retaining entry-level employees. Further, RJPs and virtual job tryouts may speed up the process of setting expectations so that

safety-specific topics are addressed, and trust is established before the hiring process. Although both RJPs and virtual job tryouts could also be used to filter out unqualified or unfit applicants early on in the recruitment process (Wanous, 1980), additional selection methods are needed to successfully hire the perfect candidate.

II.1.3 Selection

For HROs, the selection process is a crucial step to ensure that only the best candidates are selected and placed in the high-risk locations. Also, a good place to start aligning a company's values with its mission is to recruit and select people who fit well with the organization and the industry. Technological changes in the industry create higher standards to use when filtering future employees that have the desire to work in HROs. Having qualified personnel in place should minimize incident rates due to inadequate knowledge and skills. Not only will these workers do better in training and further education, they may also inspire and teach new hires. Although many scholars supported the idea that systematic use of selection tools brings many benefits to companies (Flin, 2001; Gatewood et al., 2016), many hiring managers still rely on traditional methods of employee selection using intuition and subjectivity (Highhouse, 2008). This becomes an issue knowing that individual differences affect safety performance. Failing to take advantage of scientifically-based solutions is likely to hinder the growth of any HRO.

Whereas training can be conducted to add skills, it will only be successful if the recipient is able to retain information and has the desire to learn and grow. In order to prevent companies from wasting resources, recruiting should be done where qualified applicants are available in abundance. Depending on the specific characteristics, preferable applicant pools with the desired KSAOs may already exist in a different industry. For example, recruiters for an offshore drilling company could recruit candidates with military experience due to the similarity in lifestyles

between these two industries (i.e., living away from home for several weeks, sharing limited space with others, working long shifts, a lot of traveling).

Researchers have empirically determined individual differences associated with workplace safety. Using the Big Five Personality (Costa & McCrae, 1985) dimensions (conscientiousness, agreeableness, openness to experience, neuroticism [i.e., the opposite of emotional stability], and extroversion), Clarke and Robertson (2005) found that conscientiousness and agreeableness are negatively associated with accident involvement. Flin (2001) also found that individuals with low levels of neuroticism are needed to occupy a high-reliability job. Henning, Stufft, Payne, Bergman, Mannan, and Keren (2009) found that four out of the five personality dimensions (excluding neuroticism), along with promotion and prevention focus were positively correlated with general safety attitudes. Furthermore, in a meta-analysis of personality characteristics and workplace safety variables, Beus, Dhanani, and McCord (2015) found that impulsiveness and sensation seeking have the strongest relationships with unsafe behaviors. Thus, there is empirical evidence to support using measures of these personality variables when selecting individuals to work in HROs.

Cascio and Aguinis (2019) also mentioned that personality-based measures are designed to predict counterproductive work behaviors, which in the case of HROs could be deviations from safety behaviors. Flin (2001) noted that in military aviation, personality inventories are mostly conducted for research purposes rather than selection purposes. Personality is mostly assessed by companies with interviews. Because it is the only time where direct socialization is allowed as an assessment, interviews remain one of the most common selection methods (Gatewood et al., 2016). Huffcutt and Arthur (1994) suggested that for entry-level jobs, the validity of an interview increases with more structure. This is especially important for HROs

where the entry-level employee may be exposed to more risk, so valid prediction is necessary to ensure everyone's safety.

Another predictor that may be helpful to HROs is situational judgement tests (SJTs). Although SJTs are used as a part of selection methods in HROs (Flin, 2001), not many research studies have been done within the industrial context. An SJT is defined as a selection method that simulate certain situations or behavior to assess characteristics or traits that a potential employee possesses (Gatewood et al., 2016). Regarded as a low-fidelity simulation, it is logical that companies would use SJTs to filter candidates with them instead of a high-fidelity simulation due to their cost, especially when the characteristics that are being measured may inform the organization about an individual's safety compliance.

Effective selection methods are crucial for HROs because they could predict safety behaviors of applicants. Since many managers do not have human resources or I-O psychology training, it may be hard to convince them to invest in empirically validated selection tools. For this reason, a utility analysis could be conducted to monetize the value of an efficient selection process.

II.1.4 Training

Not only do HROs need to select the right people, but they also need to train their employees the right way. A common training program that individuals who are employed in HROs must go through is basic emergency training, which informs employees the knowledge needed to survive an emergency situation. Since safety is a crucial aspect of these organizations, all employees that have the potential to be exposed to an emergency should obtain the appropriate knowledge to be able to handle such situations (Friend & Kohn, 2018). A separate organization often officiates the certifications for a specific industry. An example of training that

offshore rig workers are obligated to pass is the Tropical Helicopter Underwater Escape Training. This training educates trainees on the basics of exiting a helicopter should it land or submerge in water and is certified by the Offshore Petroleum Industry Training Organization.

These basic safety trainings are mostly conducted using high-fidelity simulations, where participants are placed in a controlled environment that replicates a situation where they would have to find an exit or exhibit survivalist behaviors (Noe, 2017). Another common training method is the on-the-job training (OJT). This is the learning experience that new hires endure when they learn the knowledge of doing certain tasks by performing them. Since OJT involves actual job tasks at work, the knowledge is easily transferred and cost-effective (Noe, 2017).

I-O psychologists are also familiar with theories that could provide insights to best practices in training. One of the learning theories that could be particularly helpful in HRO is the Adult Learning theory (Merriam, 2001). The theory differentiates the process of adult and adolescence learning and suggest best practices for adult learning. Understanding the theory could help training instructor and designers to have the trainees fully engaged and be knowledgeable by the end of the training sessions.

II.1.5 Performance Appraisal and Management

Safety behaviors at work can also be maintained by having appropriate performance management systems. A component of a good management system is a good reward system. Kerr (2009) noted 3 basic elements to an effective reward system: (1) clear operational definition of performance, which is converting tangible goals into actions, (2) development of appropriate measurements for said performance, and (3) establishing a reward system that is aligned with the needs of the employees, while also reinforcing the measurement of performance and focusing on the goals of the company – for most HROs, this includes safety.

A good example of performance management that touches on the third component that Kerr mentioned (reinforcing measurement and focusing on safety) is the Behavior-Based Safety (BBS) approach. Commonly known as "behavioral safety," BBS is defined as "the use of applied behavior analysis methods to achieve continuous improvement in safety performance" (Krause, 1997, p. 3). Friend and Kohn (2018) argued that BBS is often misunderstood; a lot of organizations treat BBS as a program, rather than a process. Acknowledging BBS as a process should help organizations do two things: (1) remind workers of the daily importance of safety and (2) recognize safety performance as a dynamic process that can always be improved.

II.2 Organizational Psychology

II.2.1 Safety Culture and Safety Climate

Within the safety literature, the term "s*afety culture*" is used interchangeably with "*safety climate*," although I/O psychologists differentiate between them. Many researchers, including Mearns and Flin (1999), noted that safety culture refers to the bigger part of a company's identity. Specifically, they described it as a "more complex and enduring trait reflecting fundamental values, norms, assumptions, and expectations" (p. 5). Zohar (2003) described climate as a more visible snapshot of the overall safety culture, specifically as policies, procedures, and practices concerning safety. This supports the idea that safety climate reflects conscious decisions and efforts to enforce the safety culture.

Zohar (2008) described organization-level and group-level safety as unique and different from individual safety. He also noted that the effect of safety climate depends on work-ownership climate. Furthermore, Payne et al. (2009) noted the importance of safety climate as both the predictor and outcome of safety events. This was followed by a meta-analysis which

concluded that injuries predict safety climate more than vice versa (Beus, Payne, Bergman, & Arthur, 2010).

It is worth noting that the concepts of safety culture and climate are not mentioned in the aforementioned Bow-Tie model and the Swiss cheese model. I-O psychologists can help safety professionals to explain the human-related effects within accident causation, which may help better development for barriers and policy design.

II.2.1.1 Measurement

There are many relevant psychological safety-related constructs that I-O psychologists measure when predicting workplace safety behavior and outcomes. For instance, Flin, Mearns, O'Connor, and Bryden (2000) utilized 18 safety climate survey results from various industries, (petrochemical sector was the majority) to look at safety climate measurement trends. The researchers concluded that there was not a single best safety climate assessment for all HROs due to the specificity of each industry. However, they found that the most common dimensions used to measure safety climate are related to management, risk, safety system, competence, and work pressure.

Several researchers have developed safety culture and climate measures. Cox and Cheyne (2000) utilized several assessment methods, such as questionnaires, focus groups, observations, and audits. They found that the best approach to calculate the organizational safety is to combine all methods rather than using them individually. Observations included the function, behavior, and structure of the organization. Grote and KuČnzler's (2000) measurement consisted of three sets of items; operational safety, safety and design strategies, and personal job needs. This questionnaire evaluates shared perspectives of safety management of the organization. Pronovost and Sexton (2005) also recommended using the full Safety Attitudes

Questionnaire (Sexton et al., 2006) with addition with the Safety Climate Measurement Toolkit that was conducted by the Offshore Safety Division of the Health and Safety Executive of United Kingdom. Furthermore, Keiser and Payne (2018) found that it may not be necessary to include industry-specific items unless the context is less safety-salient. It is worth noting that it is critical for researchers to understand the roots of variance in culture (such as individual differences) to efficiently measure safety culture (Flannery, 2001; Pronovost & Sexton, 2005).

II.2.2 Person-Environment (P-E) Fit

Although there have not been many published studies about organizational fit specifically in regard to HROs, the perfect alignment between organizations and its personnel is important. Kristof-Brown and Guay (2011) defined P-E fit as "the compatibility that occurs when individual and work environment characteristics are well matched" (p. 3). There are many factors to be considered when determining whether a person is a match with the environment or not. First, there is a distinction between *supplementary* and *complementary* dimensions of fit.

Supplementary fit happens when the individual adds value or has similar characteristics to other members of the organizations. This fit is also referred to as person–person fit because the perception of belongingness occurs due to likeness of personal attributes to others (Muchinsky & Monahan, 1987). Supplementary fit is especially important in confined sites where workers are living for extended time periods in their working areas, such as an offshore rig or a space station. Complementary fit happens when an individual fill in a gap within the organization, like employing an extroverted individual as the safety monitoring person rather than another introvert, so that an investigation may provide more information through socialization.

Another dimension of P-E fit is *needs-supplies* and *demands-abilities* (Edwards, 1996). This dimension is categorized under a complementary fit. The needs-supplies dimension is met when resources that are demanded by workers are given by the environment. Such resources could be financial, developmental, spiritual, or more. An example of this may be full coverage of training expenses by the company. The demands-abilities dimension is the opposite; it is met when individuals fulfill the demands of the environment. For example, the demands could be efforts, KSAOs, or time commitments.

The last dimension of fit is the *perceived* (or subjective) versus *actual* (objective) fit (Caplan, 1987). Perceived fit is measured by the individual's personal impression of belonging within that environment, whereas actual fit is measured by analyzing the contrast of characteristics of the environment and its people.

Two specific forms of fit that I-O psychologists are concerned about are person-organization (P-O) and person-job (P-J) fit. P-O fit refers to the degree of harmony between the person and the organization that person is a member of (Kristof, 1996). For example, a petroleum company may be hesitant to employ an individual who feel strongly against crude oil extraction. P-J fit refers to the compatibility of a person's relevant characteristics to the expectation of the job for which they are applying to (Edwards, 1991). As noted in the Selection section, there are some personality characteristics that are associated with being safer (e.g., conscientiousness) and therefore would be expected to result in higher levels of P-J fit. In an HRO, both aspects of P-E fit are important. Should alignment be difficult to find between the person and the job and organization, there may be a lack of engagement that may lead to carelessness for one's own and others' safety.

II.2.3 Leadership Roles

Lack of experience in frontline leadership positions may harm the company and potentially cost them a lot of money. Martínez-Córcoles, Gracia, Tomás, & Peiró (2014) found that empowering leaders leads to worker safety compliance. Simon (2019) noted several things that leadership needed to ensure high compliance in safety: shared vision, engagement with decision-makers, effective communications, clear and visible leadership, leadership development, and mutual trust and respect. It is worth noting that though managers hold critical positions and have a high impact on high-level decisions, they often have ambiguous data to work with (Flin & Fruhen, 2015). This leads to ambiguous result also, which is unfortunate because leaders are critical members of the organization that can drive the safety culture up or down (Friend & Kohn, 2018).

Mullen, Kelloway, and Teed (2011) found that transformational leadership was associated with higher safety compliance and participation. Furthermore, leaders who are familiar with the Goal-Setting theory (Locke & Latham, 1990) may suggest better collaboration with end-users to improve motivations in compliance of safety (Cooper, 2000). This illustrates that selection for effective leadership is also critical.

II.2.4 Teamwork and Its Effects on HROs Performance

Teamwork is an essential component for HROs due to the increase in dependencies between individuals following the dynamic and unstable nature of current organizations (Baker, Day & Salas, 2006). Furthermore, many complex systems that exist within HROs (such as emergency management, tight coupling, and occasionally confined living spaces) offers no substitute for collaboration and teamwork (Rice, 2018). Since safety is a priority, teamwork is a continued process that all personnel must abide by. If an accident happens, team members must

persist in effective collaboration in emergency situations to keep injuries and fatalities low (Orasanu & Salas, 1993). Not only is teamwork important in HROs, organizations that seek to improve their reliability also need teamwork in order to do so (Burke, Wilson, & Salas, 2005).

II.2.4.1 Adaptations in Membership Changes

When membership changes in an organizational team, the performance of that team may be compromised. In HROs, the team dynamic consistencies are even more critical (Baker et al., 2006). Myers and McPhee (2006) noted acculturation as a major predictor to assimilation outcomes at the individual level as well as involvement, which means that is important for HRO to ensure the that their members are fully assimilated to safely perform their jobs as expected.

III. CONCLUSION

This literature review demonstrated many of the ways I-O psychologists can provide input to drive positive safety behaviors in HROs. It presented insights about predictors of incidents, focusing on safety behavior and highlighted personnel and organizational psychology topics that are relevant to HROs. In conclusion, there are many ways that an I-O psychologist can contribute to safe behaviors at work.

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