



2019

## NEAR MISS REPORTING: PERSPECTIVES ON WORKER CONVERSANCE OF INCIDENT EVENTS ACROSS TWO INDUSTRIES

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NEAR MISS REPORTING: PERSPECTIVES ON WORKER CONVERSANCE OF  
INCIDENT EVENTS ACROSS TWO INDUSTRIES

By

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A Dissertation Submitted to the

Graduate School

In Partial Fulfillment of the

Requirements for the Degree of

DOCTOR OF EDUCATION

Benerd College

Educational and Organizational Leadership

University of the Pacific  
Sacramento, California

2019

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Julia R. McGee

## DEDICATION

This work is dedicated to Gregory. I thank God for his encouragement, patience, and support throughout my years of study. I extend my gratitude for his insight about simplicity.

## ACKNOWLEDGMENTS

I am thankful for continuous mentorship from Dr. Rod Githens. I will continue to recognize the value of his perspectives about the importance of details. I am appreciative of the seven participants who shared their experiences. Work experiences were vital elements of the study. I extend my gratitude to Drs. Ron Hallett and Brett Taylor. I thank Dr. Hallett for his perspective on the value of participants and insight about prioritizing beneficence. I appreciate Dr. Taylor for the reminder to always think creatively and expansively. Finally, I thank God for the gift of sustainment through the broad sources of encouragement, care, and humor from my family.

# NEAR MISS REPORTING: PERSPECTIVES ON WORKER CONVERSANCE OF INCIDENT EVENTS ACROSS TWO INDUSTRIES

## Abstract

By Julia R. McGee

University of the Pacific  
2019

The practice of reporting workplace incident events is adopted as best practice by organizations and complies with Occupational Safety and Health Administration (OSHA) mandates. Reporting the near miss incident type in which no injury or damage to equipment or the environment occurs is buttressed by the assumption that both the worker and the organization ascribe to the same goal to identify workplace hazards and prevent incident recurrence. The goal of incident reporting is not apparent, and the path to achieving the goal is obstructed by internal and external hazards that act to oppose the reporting process, such that the goals are obscured by competing priorities. The general qualitative method was applied to a nonrandom snowball sampling technique to recruit eight participants. Over 176 years of combined experience across aircraft maintenance and petrochemical operations are represented. Participants were removed from either industry within the last five years. Each participant experienced multiple near miss incident events in the past. At the time an incident occurs, the compelling individual need that exists is explained in terms of Abraham Maslow's (1943) theory of motivation. The Process-Practice-Purpose principle is developed and used to demonstrate the association between activities (the "what") that occur within workspaces and customary practices (the "how") that develop in the course of realizing the incident reporting goal. Three recurring themes support the findings: (a) The motivation to report, (b) Beliefs about reporting, and (c) The purpose of

reporting over time. Together, the themes form the three-legged stool of the incident reporting perception. Any leg missing renders the stool out of balance. Hazards are identified in terms of personal safety. The near miss definition is expressed in terms of individual perspective and is guided by experience, personality, knowledge, and personal agency to take action. The goal of reporting is explained in terms of benefit to people, the process, and practice. Alignment with the OSHA goal is evaluated by examining the motivation to report, beliefs about reporting, and the purpose of reporting over time. The Principle of Understanding partnership model is developed to engage the worker and the organization in active learning from near miss incidents through awareness and knowledge about the cumulative utility of near miss data, perceptions of incident severity, and optimizing communication.

*Keywords: latent hazards, near miss, HaSE, priority of motives, cumulative utility*



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## CHAPTER 1: INTRODUCTION

Across industry sectors, from agricultural operations to petroleum refining, the utility of reporting incidents is recognized and applied in efforts to detect and eliminate workplace hazards that reduce the risk potential for injury, illness, and equipment damage (National Institute for Occupational Safety and Health [NIOSH], 2015b; U.S. Department of Labor, 2015b). Despite the perceived value in reporting, near miss events continue to remain underreported (Jones, Kirchsteiger, & Bjerke, 1999; Miller, 2008; Reason, 1998).

An incident is defined as “a work related event in which an injury or ill-health (regardless of severity) or fatality occurred, or could have occurred” (U.S. Department of Labor, 2015a, p. 2). A near miss is “an incident that could have caused serious injury or illness but did not; also called ‘near miss’” (U.S. Department of Labor, 2015a, p. 2). Incident statistics that are mandatorily required are promoted by corporations and publicly emphasized. The statistics represent how safety programs are managed. Near miss statistics data are more abundant and accessible than other incident data (Barach & Small, 2000). The Bureau of Labor Statistics (BLS) is required by the Occupational Safety and Health Administration of 1970 (OSHA) to collect accurate statistics about reported injuries, illnesses, and fatalities that occur in the workplace. BLS data determine that the occurrence of underreporting is problematic and chronic (Miller, 2008). If lessons are to be applied from incident reporting opportunities, workers must be able to connect to the goal of reporting. And more clarity in the definition and purpose of near miss reporting is needed.

Since the enactment of OSHA law in 1970, workplace injuries and fatalities have been reduced by more than 65% through the cooperative efforts of OSHA administrators, workers, and employers (U.S. Department of Labor, 2018). Despite the benefits to reporting near miss



events, some employers fail to report severe workplace injuries and face the probability of monetary fines and more frequent inspections from OSHA (Michaels, 2016).

Aircraft maintenance and repair and petrochemical operations are classified as different industry sector types: Transportation and Warehousing and Manufacturing (U.S. Census Bureau, 2017). However, sufficient commonalities exist between petrochemical operations and aircraft maintenance to study the two industries together. Aircraft ground and petrochemical operations share common workplace hazards. For example, hazardous noise is common in environments where rotating equipment and motor drives are in service, and 24-hour operations are common within shared workspaces. As well, shared workspaces have inherent potential for fall hazards. Cargo compartments, wheel wells, and permitted confined workspaces include fuel cells, process vessels, and towers. Personal protective equipment (PPE) and lockout tagout procedures are required protection against known hazards. Within the industrial Transportation and Manufacturing sectors, the volume of incident events is estimated to be thousands per year, and resources are required to analyze the collected data (Cooke & Rohleder, 2006).

In 2017, 2.8 million nonfatal workplace injuries and illnesses were reported in the United States (Bureau of Labor Statistics [BLS], 2018). The incentive for organizations to influence the reporting of injuries and illnesses is described in the U.S. House of Representatives Staff Report, and is attributed to four factors: (a) Workplaces with low incident rates of recordable injuries and illnesses are subject to less frequent inspections by OSHA, (b) Higher or lower incidences of recordable injury rates influence the public image of an organization, (c) An organization that demonstrates a desirable safety record is distinguished amongst other organizations, and (d) Organizations are better positioned to offer and receive incentives when desirable safety records are demonstrated (Miller, 2008).

In 2015, the OSHA Severe Injury Reporting Program was implemented, and employers reported 10,388 severe injury incidents; 26% of 7,636 hospitalization reports and 57% of 2,644 amputations were reported in the private-industry manufacturing sector (Michaels, 2016). OSHA advises that employers in highly hazardous chemical operations exercise caution in relying on metrics as the sole source of safety management measurements of past performance to predict future safety efficacy (U.S. Department of Labor, 2018).

OSHA strongly encourages employers to report all incidents to include near miss events (U.S. Department of Labor, 2015a, 2018). The parameters of a near miss are unclear to workers. A study of 106 participants across 20 worksites in the chemical and pharmaceutical industry determined that 68% of a segment of study participants (40 out of 59 pipefitters, operators, and mechanics) are unclear about the near miss definition (Phimister, Oktem, Kleindorfer, & Kunreuther, 2003).

Mandatory requirements to report incident events are focused on injuries and illnesses. Reporting near miss events is obscured by mandatorily required events. Most near miss events are not identified (Wald & Shojania, 2001), and 10 out of 12 aviation incident reporting systems are confidential (Barach & Small, 2000). It is also assumed that complacency in attitudes develops as the occurrence of accidents declines (van der Schaaf, 1992). Near miss events in patient safety are compared to the aircraft industry. When it comes to patient safety, it is difficult to quantify the benefits of near miss based on the outcome of the event partly because of intervention on behalf of patient beneficence (Wald & Shojania, 2001).

The combination of organizational practices of reporting protocols and worker misunderstanding of the near miss definition poses a challenge to realizing the goal of incident reporting. In understanding the elements of near miss reporting, there is a need to understand

how workers are challenged along with a greater need to understand how the goal of reporting is interpreted. Amongst organizations, the methods of assessing levels of workplace safety vary and are even disputed. Hence, near miss incident reporting in industry requires immediate attention.

A result of the 2005 BP-Texas City Refinery Disaster and Worker Safety Hearing before the 110th Congress was that OSHA and BP utilized process operations injury statistics as the source of determining safety vulnerability. However, “how well the company follows up on near misses, how well the company maintains its equipment, and how willing the company is to shut down a process when there are problems” (p. 31) are more useful indicators of process safety than injury statistics (The BP-Texas City Disaster as cited in Cohen, Smith, & Cohen, 2008). Incident and accident reporting statistics are well-documented in the literature, but the worker perspective of near miss events is limited.

### **Statement of the Problem**

Amongst workers in aircraft ground and petrochemical operations, the relationship between near miss reporting and the connection to the OSHA investigation goals to identify hazards and prevent the recurrence of an incident are not well defined or understood. Organizations publicly report safety incident metrics that measure mandatorily reported injuries, but those reports are interpreted as measures of safety efficacy and under-emphasize the importance of near miss incident data. Reporting a near miss is useful in preventing future incidents (Hopkins, 2008; Morrison, 2004; National Safety Council [NSC], 2013; U.S. Department of Labor, 2015a, 2018). In the chemical process industry, specific tools applied in incident investigation are constantly refined to promote learning from incidents (Morrison, 2004).

The volume of data collected poses an obstacle to learning, such that the ratio of data collected is disproportional to the learning that results (Macrae, 2015). A lack of clarity in understanding the requirements to report contributes to underreporting (Miller, 2008). A gap in the knowledge exists amongst workers in understanding how hazard identification is related to the goals of near miss incident reporting.

### **Purpose of the Study**

The purpose of this study was to understand how aviation ground and petrochemical operations workers interpret the goals of near miss reporting through analysis of worker descriptions of hazards and incidents in hazardous environments. OSHA and the National Safety Council [NSC] advocate that near miss reporting is a vital component in reducing the potential for more serious near miss incidents in the future (NSC, 2013; U.S. Department of Labor, 2015a, 2018). OSHA advocates that “All incidents – regardless of size or impact – need to be reported” (U.S. Department of Labor, 2015a, p. 1) and implores employers to adopt a systems approach in the investigation of accidents and incidents (U.S. Department of Labor, 2015a).

### **A Brief Description of the Study**

The near miss reporting study was developed to learn about workplace incidents and hazards and to understand how workers perceive reporting. The ideal approach to studying incidents is to interface with the workers closest to the process. I approached the design considering that most near miss incidents are not identified (Wald & Shojania, 2001), 10 out of 12 aviation incident reporting systems are confidential (Barach & Small, 2000), and the decline in accidents over time presents a challenge to the volume of accident data available for analysis (van der Schaaf, 1992).

Most importantly, concern for the beneficence of subjects shaped the protocol that defined the study population. The criteria to participate were that subjects must have prior experience working in either aircraft maintenance or petrochemical operations, must not be presently working in either industry, and must be recently removed from working in either industry within the last five years. No minimum length of experience was required.

The general qualitative method was applied to a nonrandom snowball sampling technique to recruit eight subjects to participate in one-on-one interviews. Eight consent forms were mailed to recruits, and one recruit expressed interest but did not return the mailed consent form to participate in the interview. Further attempts to contact the prospective subject were unsuccessful; thus, seven subjects were interviewed. The study represents over 170 years of combined experience in aircraft maintenance and petrochemical operations.

### **Significance of the Study**

The near miss study is significant because it provides a descriptive account of hazards and incident interpretation from the workers who are closest to the process and will inform practice about how near miss reporting is perceived. The ideal goal in safety operations to reduce injuries must be centered on diminishing the existing hazards within the work environment rather than adopting systems that respond to emergencies and diverting the focus from the operating work process (Walline, 2014). When hazards are identified during the process of work, efforts to mitigate, eliminate, or report the associated conditions depend on the degree of motivation.

Regulatory and administrative governing agencies such as OSHA set standards and rules of safe operation within industries, but safety policies and rules are elements of the bigger matrix of safety management (Hodson, 2014). Organizations must support a clearer understanding of

hazards in the workplace (Hodson, 2014), and organizations are poised to support understanding when worker motivation to report incident events is understood. The challenge posed to employers is to understand motivation. The elements of motivation are not stagnant, and employee initiatives are subject to change (Bowen & Radhakrishna, 1991). Organizations focus on training employees to meet the objectives of regulatory compliance but fail to consider the motivation factors associated with training (Kincaid, 2015).

This study will inform organizations about the elements of concern in near miss reporting within the context of attaining the OSHA goal of identifying hazards and preventing the recurrence of the incident. To do so, four research investigation questions laid the foundation for the focus of the study.

Key question one. *In what ways do workers in aircraft ground operations and petrochemical operations describe hazards of the work environment?*

Key question two. *How is a near miss incident defined amongst workers in aircraft ground operations and petrochemical operations?*

Key question three. *How is the goal of near miss reporting interpreted amongst workers?*

Key question four. *In what ways are reporting the occurrence of an incident related to the OSHA goals of identifying hazards and preventing the recurrence of an incident?*

### **Operational Definitions Used in Industrial Environments**

An important perspective on how the existence of latent hazards contributes to incident events is described by Reason (1997):

Like pathogens, latent conditions – such as poor design, gaps in supervision, undetected manufacturing defects or maintenance failures, unworkable procedures, clumsy automation, shortfalls in training, less than adequate tools and equipment – may be present from many years before they combine with local circumstances and active failures to penetrate the system's many layers of defenses. They arise from strategic and other top-level decisions made by governments, regulators, manufacturers, designers and organizational managers. The impact of these decisions spreads throughout the organization, shaping a distinctive corporate culture (see Chapter 9) and creating error-

producing factors within the individual workplaces. Latent conditions are present in all systems. (pp. 10-11)

Hazards may exist in a latent state or may be visible. It is common practice in work environments for organizations and workers to gain knowledge about latent and visible hazards and the controls used to mitigate those hazards. The potential repercussions of near miss reporting cannot be understated for all involved: the workers involved in the incident, the organization, and the public (Wood, Murray, & Beckett, 2006).

Organizations employ near miss incident reporting in safety practice management programs because the action represents an alert to conditions that signal anomalies and require correction to prevent a recurrence of the incident. Safety incidents are often identified and described in terms of the potential and severity for injury and damage. A near miss incident is a type of precursor (National Aeronautics and Space Administration [NASA], 2015; van der Schaaf, 1992), and tools such as accident precursor analysis (APA) are used to evaluate process anomalies that have the potential to recur (Corcoran, 2004).

The intent of near miss incident reporting and analysis across industries is to stem the tide of workplace safety incidents that have significant capacity and potential to cause injury, illness, or to result in the loss or damage of equipment (U.S. Department of Labor, 2015b). As defined by the NSC (2013):

*A near miss* is an unplanned event that did not result in injury, illness, or damage – but had the potential to do so. Only a fortunate break in the chain of events prevented an injury, fatality or damage; in other words, a miss that was imminent. (para. 1)

A near miss is the type of incident in which a worker could have sustained an injury or become ill, or equipment could have been damaged if the conditions were changed or different (U.S. Department of Labor, 2015b). To impact the occurrence of future near miss events, the definition of a near miss must be revised to capture a broader occurrence of incidents (Phimister

et al., 2003). Phimister et al. (2003) defined a *near miss incident* as “An opportunity to improve environmental, health and safety practice based on a condition, or an incident with potential for more serious consequence” (p. 449).

### **Incident Classification and Incident Investigation**

A *worksite incident* is distinguished from an *accident* by considering the context and perception of the event. The occurrence of many incidents during worksite job operations is preventable, whereas accidents are considered to occur at random or “by chance” and result in injury or damage to equipment and property (U.S. Department of Labor, 2015b). The practice of incident investigation has been adopted by various workplaces, and the classification and management of reported unsafe circumstances vary across industries. OSHA recommends that worksites develop an incident investigation program (U.S. Department of Labor, 2015b).

Although the reporting, analysis, and sharing of near miss data (collectively known as “documentation”) are recognized as established practice in hazardous industries, challenges to reporting incidents exist. Organizations adopt forms of incident investigation and analyze incidents reactively, with a goal to mitigate recognized hazards and stem the reoccurrence of incidents. *Incident Investigation* is the procedure applied to the analysis of an incident, which utilizes root cause analysis tools to determine the contributing reasons for the occurrence of an incident (U.S. Department of Labor, 2015b).

The challenge exists in motivating workers to proactively report near miss incidents. Herzberg, Mausner, and Snyderman’s (1959) theory divides Maslow’s (1943) needs hierarchy into two categories of factors: hygiene and motivation. Organizations are more inclined to neglect motivation factor needs over more readily recognized hygiene needs in workers (Ozguner & Ozguner, 2014), as discussed in Chapter 2. The near miss reporting study applies



the operational definition of an incident used by Phimister et al. (2003), and the near miss reporting study describes a near miss incident as an opportunity to learn. In incident reporting, opportunities to learn exist for both the worker and the organization. The near miss incident reporting study presents a chance to learn from worker experiences.

### **Conclusion**

Industries classified under NAICS Air Transportation and Petroleum and Coal Products Manufacturing sectors are required to keep OSHA injury and illness records (U.S. Census Bureau, 2017; U.S. Department of Labor, 2015b). Statistics of safety management are important to organizations. All employers are mandated to report to OSHA any incident that results in a fatality, amputation, in-patient hospitalization, or loss of eye (U.S. Department of Labor, 2015c).

Near miss reports are regarded as vital components of learning, yet the utility of reporting to accomplish the OSHA goal is untapped. Incidents are classified in different ways. In Chapter 2, the conceptual framework of the perception of a near miss incident is presented through the lens of Maslow's (1943) hierarchy of needs and Herzberg et al.'s (1959) motivation-hygiene theory. Together, the theories guide understanding about how worker perception of near miss reporting may not align with the organization, even though it is assumed that both the worker and the organization share the same goals of identifying the hazard and preventing the recurrence of an incident. In Chapter 2, a review of the literature describes what is known about incident reporting and the opportunities that exist to learn from incidents.

## CHAPTER 2: REVIEW OF THE LITERATURE

The goal of reporting near miss incidents remains unmet in industry. In the United States, employers in private industry reported nearly 2.9 million nonfatal workplace injuries and illnesses in 2015 (BLS, 2017), and the incidence of near miss events is even higher (OSHA, 2015). A near miss is classified as an incident, and all incidents should be investigated (OSHA, 2015). Despite the decrease in rates of reported injury and illness incidents within the Manufacturing and Oil and Gas Extraction sectors during 2015, significant injuries continue to occur in the workplace (BLS, 2016). Near miss incident reporting is a reactive response to learning and to track and document events. Therefore, organizations must understand the role of worker motivation in learning.

Organizations use safety management programs to strive to prevent the occurrence of incidents by establishing and engaging in safety management programs (Drupsteen, 2014), and the milestones of attained accident rates are prominent components of organizational safety programs (Zohar, 1980). The way in which workers perceive the need to mitigate hazards must be understood through the lens of motivation.

As discussed in Chapter 1, a *near miss* or *close call* is classified as an incident, and all incidents should be investigated (U.S. Department of Labor, 2015a). Three key perspectives on workplace incidents arise from the literature review. First, organizations use incident data collection as components of safety programs. Secondly, conceptual frameworks and analytical tools, such as learning from health and safety incidents and root cause analysis, apply past incident events as opportunities to share lessons learned and improve best practices through hazard identification. Thirdly, it is necessary to collect data from both near miss and accident

events since both events are assumed to share identical root causes, and the frequency of accident occurrences is low relative to incidents.

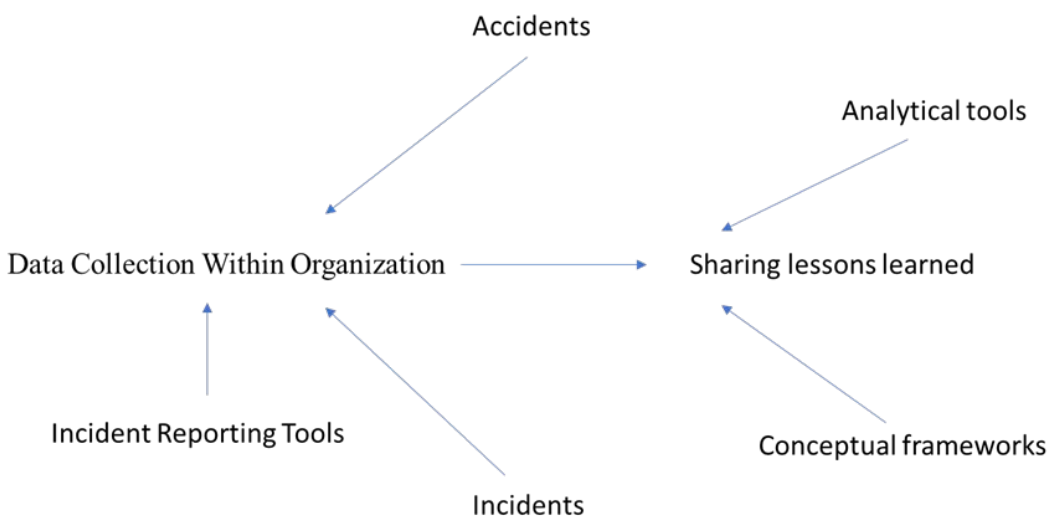
Chapter 2 begins with a perspective on accidents in organizations and the beliefs and theories about accident causation, followed by a discussion about the distinction between accident and incident definitions and the implications for worker health and safety. The discussion continues by exploring organizational safety programs to determine how data are utilized, specifically, data about near miss reporting. Next, Maslow's (1943) theory of motivation and subsequent theories frame worker needs in the context of incident data collection and near miss reporting. Finally, a critique of the relationship between near miss reporting and the goal of OSHA incident investigation is presented.

Throughout the chapter, Maslow's (1943) theory of motivation and subsequent theories frame worker needs in the context of hazard identification, incident data collection, and near miss reporting. Maslow's (1943) theory is used to understand the inspiration for humans to satisfy unmet needs (Ozguner & Ozguner, 2014; Pardee, 1990). The chapter concludes by summarizing the major topics of discussion and declaring an urgent need to inquire about how workers perceive the relationship between near miss reporting and the dual goal to identify hazards and prevent recurrence of an incident.

### **Organizational Perspectives on Accidents**

The three key literature review take-aways that introduce this chapter are summed up in Figure 1. Organizations utilize tools to collect and record data on incidents and accidents. Incident data are necessary components of incident investigation. Employers use tools to collect data on workplace incidents and accidents. The collected data are analyzed using tools such as

root cause analysis. The lessons that result are extracted and shared. The conceptual framework of the incident reporting process demonstrates the process of how lessons are shared.



*Figure 1.* Context of the literature review.

Some incidents in the chemical process industry share common root causes (van der Schaaf, 1992). Challenges to collecting data are inherent to the process; and analytical tools such as root cause analysis are used to inform organizations about recovery (van der Schaaf, 1992). Models and theories of accident causation and organizational learning frame the way organizations perceive and manage safety systems in operations that drive change, such as implementing corrective actions and sharing lessons learned with workers. The review of literature examines the organization, the workers, and the relationship of both to near miss reporting.

Historically, accidents have gathered attention in industrial workplaces. Corrective actions to mitigate accidents have been undertaken since early industrial history, and some

lessons learned have been adopted in industries. As early as 1811, DuPont gunpowder factory responded to accidents by adopting rules at the Delaware Mill (Feinberg & Kolar, 2009). After identifying the factors that contributed to the accidents, DuPont instituted corrective actions to mitigate hazards (Feinberg & Kolar, 2009). Workers were supplied with specially designed shoes, and alcohol was banned from the workplace (Feinberg & Kolar, 2009). Two hundred eighty-eight explosions occurred during the period the mill operated between 1802 and 1921. Two hundred twenty-eight people died (Feinberg & Kolar, 2009; New York Times, 1863; The News Journal, 2015). The single action of eliminating a hazardous substance is insufficient in preserving the health and safety of workers and the work environment since some hazards may not be as easily recognized as others. When an incident event occurs and is investigated, the analytical tools utilized must be applied with the goal to preserve the health and safety of workers (U.S. Department of Labor, 2015b).

### **Organizational Challenges**

To the organization, the volume of incident events is estimated to be thousands per year and requires resources to analyze the data collected (Cooke & Rohleder, 2006). Organizations within some industry classifications are exempt from maintaining records of injury and illness because of the size of the organization or because of NAICS classification, but all organizations are mandated to report to OSHA any incident resulting in a fatality, amputation, in-patient hospitalization, or loss of eye (U.S. Department of Labor, 2015b, 2015c).

Since the OSHA law of 1970 was enacted, workplace injuries and fatalities have been reduced by more than 65% through the cooperative efforts of OSHA administrators, workers, and employers (U.S. Department of Labor, 2018). Prevention of workplace injuries, illnesses, and fatalities in industrial environments is attributed to the implementation of regulatory

standards such as machine guarding, lead, benzene, harmful chemicals, fall protection, confined spaces, and other such standards developed by OSHA (U.S. Department of Labor, 2018).

Organizations are obligated by the OSHA General Duty Clause to provide safe workplace conditions that are free of serious, identified hazards, and workplace hazards must be eliminated or reduced (U.S. Department of Labor, 2018). Hazard identification is a key component of a comprehensive safety program, and two principal approaches to hazard control are recommended to organizations to reduce the incident risks: (a) Implement engineering principles of hazard control and (b) Apply root cause analysis tools to the incident investigation process (U.S. Department of Labor, 2018).

Industry worksites are required to keep and maintain records of worker injuries and illnesses unless the worksite is exempt according to the NAICS workplace sector list (U.S. Department of Labor, 2015c). Support activities for air transportation and petrochemical and coal products manufacturing are two of the industry groups required to keep injury and illness records (U.S. Department of Labor, 2015b). Some industry classifications are exempt from maintaining records of injuries and illnesses because of the size of the organization or the classification of the industry, but all organization classification types and sizes are mandated to report an incident that results in a fatality, amputation, in-patient hospitalization, or loss of eye. The diligence required to protect workers also poses challenges.

### **Challenges to Workers**

Workers are challenged to understand the complexities of near miss reporting, and the distinct connection to the goal of reporting is not apparent (Williamsen, 2013). The challenge to workers yields two key assumptions.

*Assumption 1: The worker and the organization share the common goal to identify workplace hazards and prevent the recurrence of an incident.*

According to Maslow's (1943) theory of motivation, individuals are motivated to act towards a goal based on existing individual needs, there are variations in paths toward reaching a goal, and each need influences another. As each individual need is fulfilled, the need ceases to be a factor of consideration in the path, and needs can be partially satisfied (Maslow, 1943). Maslow's (1943) five basic needs are: (a) Physiological, (b) Safety, (c) Love and belonging, (d) Esteem, and (e) Self-actualization. To the extent that individual needs can be classified, Maslow's theory is applied in understanding how the common goals of near miss reporting are shared between the organization and the worker yet yield a variety of interpretations and outputs. The impetus to make a near miss report is examined through Maslow's (1943) motivational lens and extended theories by introducing a second assumption.

*Assumption 2: A near miss event stimulates the prominence of a compelling individual need.*

Maslow's (1943) theory of motivation conceptualizes individual basic needs on a continuum, and one need category can preside over another, depending upon the individual demand of the prevailing need (Maslow, 1943). The lack of clarity in understanding the criteria for reporting an incident as a near miss contributes to under-reporting (Miller, 2008).

### **The Reporting Challenge**

An interview conducted by the U.S. Committee on Education and Labor with ORC Worldwide, a public consulting agency, revealed two key findings: (a) Amongst employers, there is a lack of clarity and confusion about reporting procedures for worker injuries and illnesses and (b) There is a deficiency in the advice that OSHA staff administers to employers

because OSHA staff is not adequately trained (Miller, 2008). The incentive for organizations to influence the reporting of injuries and illnesses is attributed to four factors: (a) Workplaces with low incident rates of recordable injuries and illnesses are subject to less frequent inspections by OSHA, (b) Higher or lower incidences of recordable injury rates influence the public image of an organization, (c) An organization that demonstrates a desirable safety record is distinguished amongst other organizations, and (d) Organizations are better positioned to offer and receive incentives when desirable safety records are demonstrated (Miller, 2008). In addition to equipping organizations with a source of stakeholder value, some incident data collection is mandatory.

Mandatory reporting system protocols are guided by agencies that have authority to regulate operations and administer fines (Donaldson, Corrigan, & Kohn, 2000). Agencies with regulatory authority define incidents and accidents and issue guidance about what must be reported and how to make a report. For example, in an Air Traffic Organization (ATO) guidance policy issued in 2011, the Federal Aviation Administration (FAA; 2012) identifies mandatory and voluntary reporting requirements for specific types of in-flight hazards that develop and impact safe operations. The intent of the FAA order is to emphasize focus on the “why” of the incident instead of “who” contributed (FAA, 2012).

Worksites assigned to Petroleum Refineries and Coal Products Manufacturing (petrochemical operations) and Aircraft Maintenance and Repair Services NAICS classifications are required to keep and maintain OSHA injury and illness records unless the industry sector is classified as exempt, according to the NAICS list (U.S. Department of Labor, 2015c; U.S. Office of Management and Budget, 2017). Some NAICS industry sectors are exempt from keeping such records. For example, NAICS 4861, Pipeline Transportation of Crude Oil; NAICS 4862,



Pipeline Transportation of Natural Gas; and NAICS 6111, Elementary and Secondary schools are not mandated to report incidents to OSHA unless the result is a fatality, in-patient hospitalization, amputation, or loss of an eye injury and illness (U.S. Department of Labor, 2015c).

Mandatory reporting system requirements represent opportunities for organizations to evaluate the internal and external environments of safety management programs (Donaldson et al., 2000). Examination and review of BLS, OSHA, and NAICS publications across 16 industry sectors indicate that employer-reported OSHA injuries, illnesses, and fatalities data are collected and maintained, but no reporting data on near miss statistics are published by such agencies. Industries regulated by the U.S. Environmental Protection Agency [EPA] must report incidents in accordance with EPA guidelines (EPA, 2015a).

Voluntary incident reporting aims to prevent future near miss incidents (Donaldson et al., 2000). The motivation to report a near miss must be examined as a pathway to reaching the goal of proactively preventing a future injury, illness, or damage to property. Within organizations, a report of a near miss event is often submitted in confidence, outside of public parameters, and absent of penalties (Donaldson et al., 2000); however, the development of computerized Safety Information Systems (SIS) in oil and gas process operations lessens the choice between mandatory and voluntary reporting (van der Schaaf, 1992). In other words, there are progressively fewer options to report an incident within systems that are electronically monitored. The culture of the workplace environment influences the motivation to work (Tampoe, 1993).

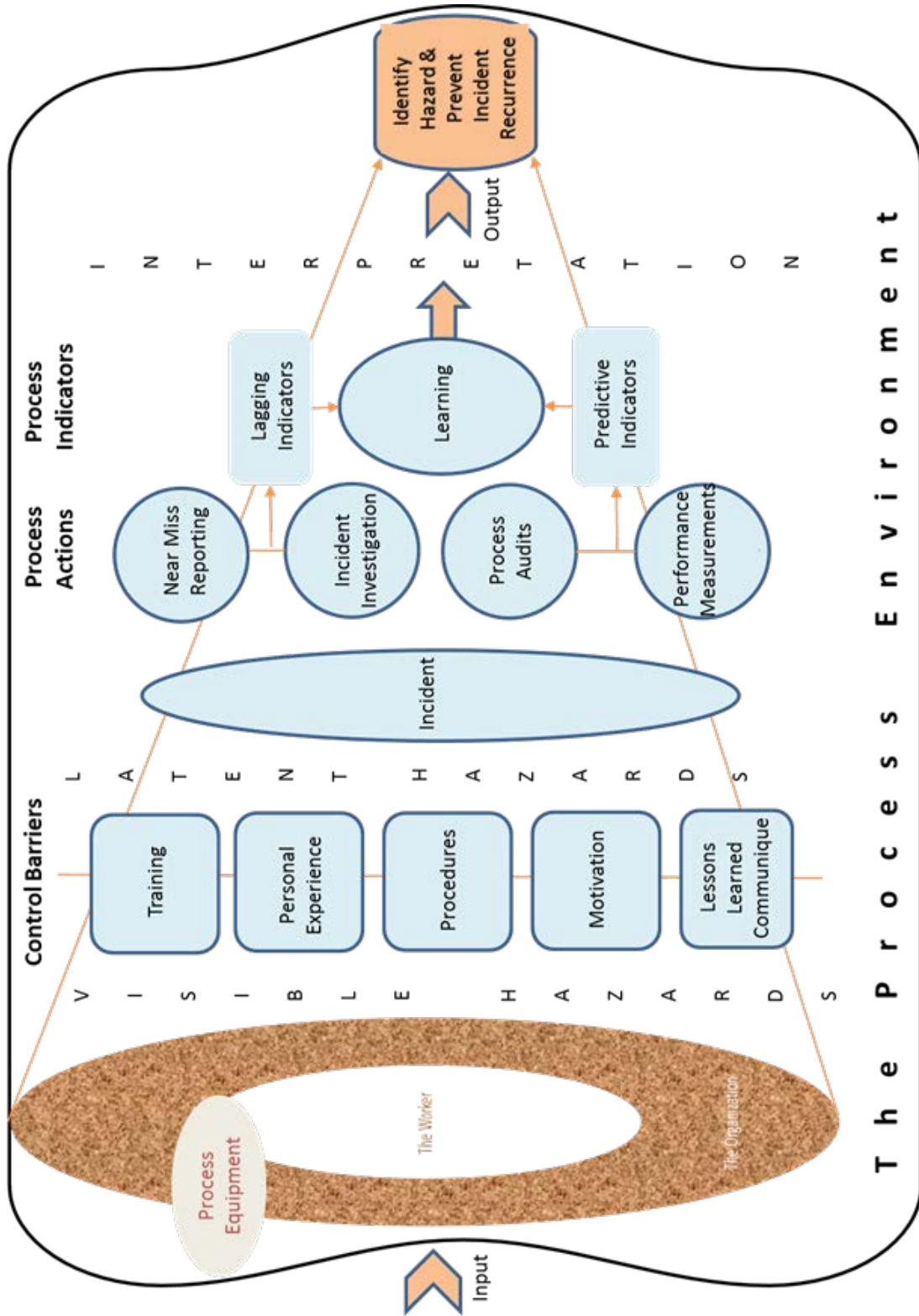


Figure 2. The work process environment concept.

In Figure 2, near miss reporting is conceptualized within the context of the work environment. Reading from left to right, the worker resides within the organization and interacts with the working equipment in the process of the operation. The worker, the organization, and the equipment represent the input to the process. The organization exists as the foundation from which the worker operates and the equipment resides. A safe process incorporates the OSHA goal to identify hazards and prevent the recurrence of an incident; therefore, the OSHA goal is incorporated into the industrial process and resides within the process itself, from input through output. The two vertical lines represent potential hazards to the process. The first line represents visible hazards, and the second line represents latent hazards.

In the course of the work process, some hazards are visible and recognized, but others are not. The worker interacts with the equipment and the organization in a dynamic capacity, and the organization provides guidance and feedback about tasks that support operations and guide work processes. The worker operates according to standards set by the organization and the industry. The organization utilizes barriers to prevent exposure to potential hazards, and barriers are represented by five blocks. During normal operations, tools equip the worker to perform assigned tasks. The five vertically aligned barrier blocks identified from left to right are training, personal experience, procedures, motivation, and lessons learned. The lines connecting the boxes indicate that the control barriers work together. The foregoing elements are defensive against incidents and are protective or control barriers against impediments to the work process.

When visible or latent hazards impede the production process, the result is an incident or accident. A visible or latent hazard may reside internally or externally to the process and may have sufficient potential to trigger an incident by penetrating one or multiple control barriers.

The oblong shape represents the incident. When the incident is interrupted, and an accident is averted, a near miss results. After a near miss event, communication is generated and functions as training to learn from past lessons. The top two of four vertical circles represent the actions taken after a near miss event. The top arrow points to the lagging indicator that connects the near miss reporting circle to incident reporting, indicating that both are lagging indicators. The bottom two vertical circles represent the actions taken after a near miss event. The top arrow points to the lagging indicator that connects the near miss reporting circle to incident reporting, indicating that both are lagging indicators. First, a near miss report is made. Next, the second circle represents the incident investigation. According to OSHA, all incidents must be investigated. A near miss event is an incident, and therefore must be reported.

The remaining two circles represent process audits and performance measurements and are part of uninterrupted process operations. The arrows connect process audits to performance measurements, and both are identified as predictive indicators. Performance measurements proactively evaluate and measure process progress against an established standard. A process audit is a more proactive action than a near miss report, and is, therefore, considered a leading indicator. A near miss report is considered a more lagging indicator than a process audit because the near miss event is an unplanned occurrence.

Next, the oblong represents the learning that results from the combined production process, including the learning from near miss incidents, either from lagging indicators at the top or predictive indicators at the bottom. The circle at the top of the oblong indicates the training is a lagging indicator, generated after the near miss event. The learning opportunities that result from near miss events are contextual, according to the near miss event itself. The sum of the

production process is interpreted as a determined value. The arrow indicates the termination of the process at the goal, and the goal is identified in the output box as “Identify the hazard and prevent the recurrence.”

### **Beliefs and Theories of Accidents and Hazards**

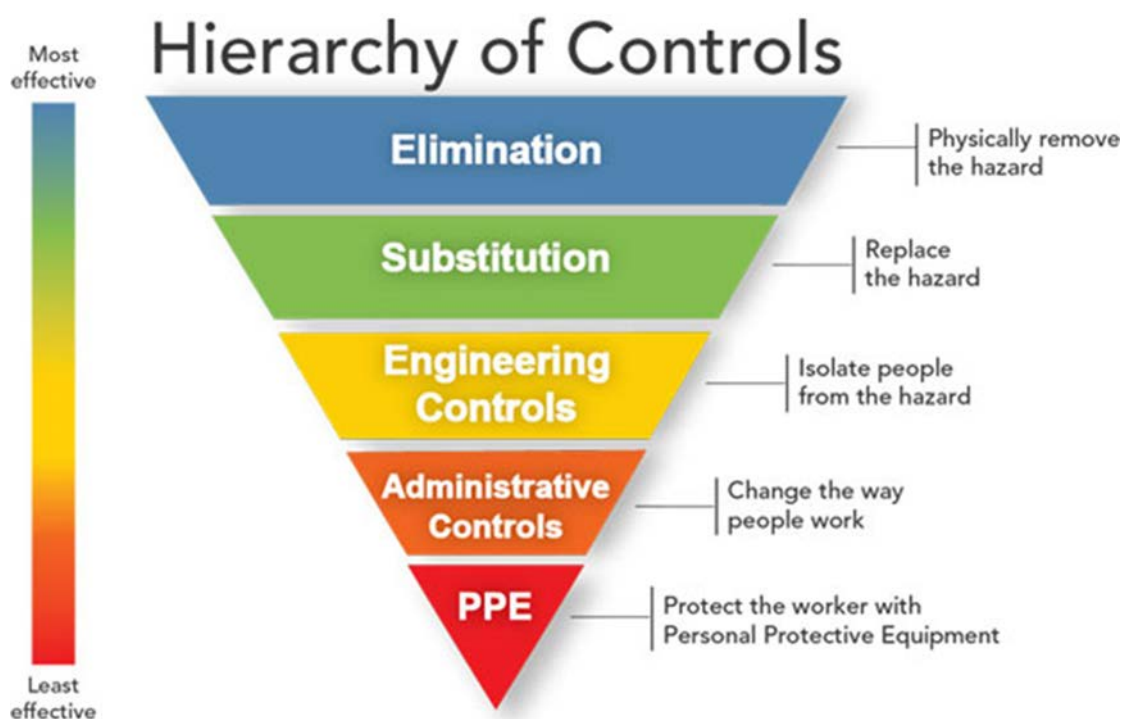
Near miss reporting and data analysis are utilized in petrochemical, aviation, and nuclear industries as safety management tools, and associated analytical designs are recommended as models significant enough to be adopted by the medical industry (Barach & Small, 2000). Organizations are concerned with stemming the tide of the same incidents and avoiding the heightened global public interest that results when incidents recur (Wood et al., 2006); they utilize the analytical models as tools to manage hazards. The control of workplace hazards is a proactive measure used to eliminate risk and control incident events.

The beliefs and assumptions of organizations are reflected in policies and work rules, which workers are expected to follow (McGregor, 1960). The policies are applied to strengthen safety programs, but workers must be motivated to act upon set policies. The conditions for optimal workplace efficiency can be established through an understanding of how individual needs are connected to the motivation to work (McGregor, 1960). Maslow’s (1943) theory of motivation is the lens used to frame individual needs and the motivation to report a near miss.

### **Hierarchy of Controls**

One method of applying hazard control in the workplace is to undertake a pro-active review of a task with the aim of identifying potential hazards (Tixier, Albert, & Hallowell, 2017). Hazard control is the first choice in applying engineering principles to eliminate hazards and is regarded as the most effective method (Centers for Disease Control and Prevention

[CDC], 2015b). The Hierarchy of controls is a model used to emphasize hazard control priorities. Figure 3 illustrates the effectiveness of hazard controls from the most to least effective.



Source: CDC (2015b, para. 2)

*Figure 3.* The hierarchy of hazard controls.

The hierarchy of controls is conceptualized as a two-tiered structure. At the top of the pyramid, priority is applied to protective measures, which eliminate the hazard by physical removal. A hazard is eliminated from a process by removing the need for the action or step, or by changing the design, which eliminates worker exposure (CDC, 2015a; Weinberg, Bunin, & Das, 2009). Secondary to elimination is the action to replace the hazardous element of concern

by substitution. An example of how hazard controls is applied to hierarchical methods is illustrated in an agricultural case study in California.

In an investigative case study designed to evaluate alternatives to pesticide use in agricultural citrus fields where 27 agricultural workers became ill, Weinberg et al. (2009) analyzed proposed methods to control pests of orange crops. The findings indicated that eliminating the use of pesticides was a viable proposed method to isolate worker exposure, but the sustained physical damage to the exterior of the fruit from pests would potentially result in adverse consumer sentiment about the perceived quality of the fruit and increased economic risk to the grower (Weinberg et al., 2009).

The findings also indicated that a reduction in the amount of active ingredients in the pesticide was a viable proposed method of substitution to reduce worker exposure, but the high population of pests would potentially render substitution methods prohibitive (Weinberg et al., 2009). The value of applying elimination and substitution methods within the hierarchy of controls was in the protection that both methods extended to workers by removing the hazard or eliminating worker exposure in the process. The levels of engineering controls are primary elements of defense in guarding against both the hazards that are visible and the visualized, perceived hazards. Both hazard types are key elements of incidents. Engineering controls are discussed next.

### **Engineering Controls**

In Figure 3, the next priority hazard control method is identified as the engineering control. Engineering controls are applied to existing workplace hazards that have not been eliminated or substituted (CDC, 2015a). Engineering controls are effective in controlling worker

exposure when hazards that are anticipated or recognized are mitigated at the onset (CDC, 2015b; Weinberg et al., 2009).

Protections from noise and heat and equipment barriers are examples of engineering controls. Safety management programs use incident data as measures of organizational effectiveness and apply the use of engineering controls to isolate hazards.

In a three-phase investigative study designed to examine the safety programs of five NSC award-winning organizations, Cleveland, Cohen, and Smith (1979) described the characteristics of five industries: (a) A textile manufacturer, (b) Three chemical plant manufacturers, and (c) A photoflash consumer products manufacturer. Three key findings of the Cleveland et al. (1979) study hold implications for applying engineering methods to hazard control in industrial environments: (a) Plants with lower OSHA reported rates of accidents incorporated a balanced use of engineering and non-engineering approaches to hazard control, (b) There was a stronger organization commitment to safety programs in plants with lower OSHA-reported rates of accidents, (c) Workers are motivated by feedback received from management, and (d) Workers approach work more safely in secure working environments (Cleveland et al., 1979).

Many characteristics of industrial organizations are reflected in safety programs. OSHA incident reporting data are tracked and valued, but the focus and emphasis on mandatory reporting requirements is assumed to guide safety programs. OSHA strongly encourages employers to report all incidents, including near miss events (U.S. Department of Labor, 2015a). The gathered data are utilized in ways that serve the needs of an organization.



### **A Balanced Approach to Hazard Control Methods**

The distinguishing quality performance components used to characterize industries in the Cleveland et al. (1979) study indicate that positive safety records are interpreted as effective execution of safety programs. Within the chemical process industry, trends in incident safety statistics are used to drive safety efficacy (van der Schaaf, 1992). In other words, low incident numbers have been associated with the perception of safe work practices, and that belief is still prevalent amongst organizations today. In the Cleveland et al. (1979) study, the top five organizations reported between 7,501,176 and 49,291,249 hours worked without a lost time injury. Safety data are utilized in making changes in operations, and the changes are grounded in beliefs. An understanding of such beliefs is gained by an examination of the administrative tools utilized in hazard control.

As illustrated in Figure 3, administrative tools are applied to hazard control to manage and change the working process (CDC, 2015a). Administrative controls commonly recognized in industrial environments are training, procedures, alarm systems, and noise control. In a study designed to evaluate noise exposure and hearing loss prevention in workers across 76 companies, Daniell et al. (2006) found that organizations chose to use personal protection equipment (PPE) as the primary means of noise hazards over administrative controls.

Audit tools are useful in measuring the effectiveness of practices that organizations adopt (Reason, 1997). An audit tool was applied to measure safety climate in a Mearns, Whitaker, and Flin (2003) study of offshore oil and gas workers across 13 installations in the United Kingdom Continental Shelf. The Mearns et al. (2003) study analyzed self-reported questionnaire responses from employee groups and found there were statistically significant differences in the

way worker groups perceive installation managers and how workers are involved in health and safety communication. Workers with one to five years of experience perceived installation managers more positively and communicated more about health and safety matters than workers with 6-10 years of experience (Mearns et al., 2003). The Mearns et al. (2003) study also found there is no statistically significant difference in the willingness to report incidents amongst different worker groups. The effectiveness of safety programs is associated with the level of involvement and the degree of commitment from safety leaders. A key finding in Daniell et al. (2006) determined that the use of hearing protection by workers was not maximized in hazardous working environments, partly attributed to insufficient efforts on the part of the organization, although 62% of workers reported regular use of hearing protection (Daniell et al., 2006).

The individual needs of the worker are central to the concept of near miss reporting. The impact of an event extends beyond the worker to families, the environment, the organization in which the event occurs, and the industry (Miller, 2008). Workers may or may not have a choice in the decision to report an incident. Some industry sectors such as aviation and oil and gas are mandated by regulatory agencies to report incidents.

The goal of incident reporting is to identify the hazard and prevent recurrence of the incident (OSHA, 2015). It is suggested that the motivation path to the assumed mutual goal of reporting a near miss incident is different for the worker and the organization; each path may be motivated by separate needs. Data captured in incident reports are dependent upon documentation and analysis of the occurrence itself, but are insignificant if workers are not motivated to initiate reporting and population of the databank.

### **Incidents, Accidents, and Culture of Near Miss Reporting**

Perceptions of culture may not accurately reflect the underlying values of an organization (Schein, 2010). In a study that examined the role of safety culture in predicting accidents, Neal and Griffin (2006) found that a change in worker behavior was associated with a reduction in accidents and that higher levels of safety participation over time corresponded with higher levels of safety motivation. Commitment to safety practices in organizations is a measure of organizational culture and identified by a dynamic involvement in safety practices, low turnover rates, the status of safety officers, consistent training, the status of safety officials, and identifiable safety promotion efforts. Safety practices are designed to prevent incidents.

In a study designed to examine error reporting amongst aircraft flight crew, Helmreich and Merritt (2000) analyzed line operations safety audit data that were collected and reported by expert observers. The findings indicated that line data were useful in facilitating error analysis beyond the capacity of the flight data recorder by providing supplementary human factor data in narrative form (Helmreich & Merritt, 2000). The attributes of effective safety cultures include the utility of data collection systems that reflect intent to resolve errors, which are known to organizations (Reason, 1998).

### **Cultural Components and Organizational Beliefs**

There are primary and secondary organizational components that impact culture (Schein, 2010), and a greater focus on the secondary elements can render the culture unstable. Primary mechanisms exist closer to the core of organizational beliefs (Schein, 2010). In other words, if an organization aims to institute change about specific elements related to accident causation such as near miss reporting, then the value of near miss reporting must first be deemed important

to leadership (the primary component) before changes in procedure (the secondary component), for example, will result in meaningful impact to culture. Motivation and culture are applied in industrial contexts where the outcomes of accidents can be potentially detrimental.

In framing two distinct perspectives on the motivation of organizations, McGregor (1960) theorized that organizational beliefs span a bandwidth of two extreme limits identified as Theory X and Theory Y (McGregor, 1960). Within an organization, motivation is fostered by the types of elements within the working environment, and a complex relationship exists between the safety culture and the climate (Neal & Griffin, 2006). Elements in industrial environments include hazardous environments in which production, training, worker safety, and incident events are managed within organizations.

### **Organization Perception of Accident Theories**

Theory X represents an organizational belief in the absence of motivation in individuals; therefore, guidance and structured management by the organization is required to manage people (McGregor, 1960). Theory Y represents autonomy and less dominance of management such that the organizational posture assumes individuals are innately motivated to work and are contributors to the work process. The value of learning from incidents and sharing information amongst refineries is globally acknowledged as a necessary industry key practice in preventing incident recurrence and controlling public sentiment, but there are obstacles to sharing data (Wood et al., 2006). Therefore, the approach to near miss reporting in organizations depends on how organizations perceive worker motivation.

To analyze a near miss event, it is assumed that the occurrence of an incident is acknowledged. Near miss modeling is simulated by retrieving data from workers and equipment

associated with the event from three sources: (a) Workers involved in the incident who voluntarily report an event or are mandated to do so, (b) Equipment that records occurrences of out-of-limit operating perimeters, and (c) Other observers of the event who are not directly involved in the incident (van der Schaaf, 1992). Prior to the year 2000 publication of *To Err is Human: Building a Safer Health System*, a prevailing public perception existed that attributed medical accidents to human error (Donaldson et al., 2000). The Donaldson et al. (2000) report focused on the delivery of healthcare and found that most incidents in healthcare were attributed to failures in the system.

Incidents are related to the systems and environments in which the incidents occur (Donaldson et al., 2000). Similar perceptions about safety relationships exist in industrial environments. Health, safety, and environmental (HSE) indicators are used to measure and track safety performance (Broadrib, Boyle, & Tanzi, 2009). In 2005, 15 souls were lost in the BP Texas City incident. A recommendation of the independent review panel and BP was to acknowledge and identify process safety incident events as proactive opportunities to learn (Broadribb et al., 2009). A key finding of the independent panel was that the potential severity of events that occurred less frequently was not identified in existing metrics (Broadribb et al., 2009). The Heinrich (1941) Iceberg theory of incident causation is prevalent in the literature, OSHA publications, and in practice and is used as a model that guides safety management programs.

### **The Heinrich Model**

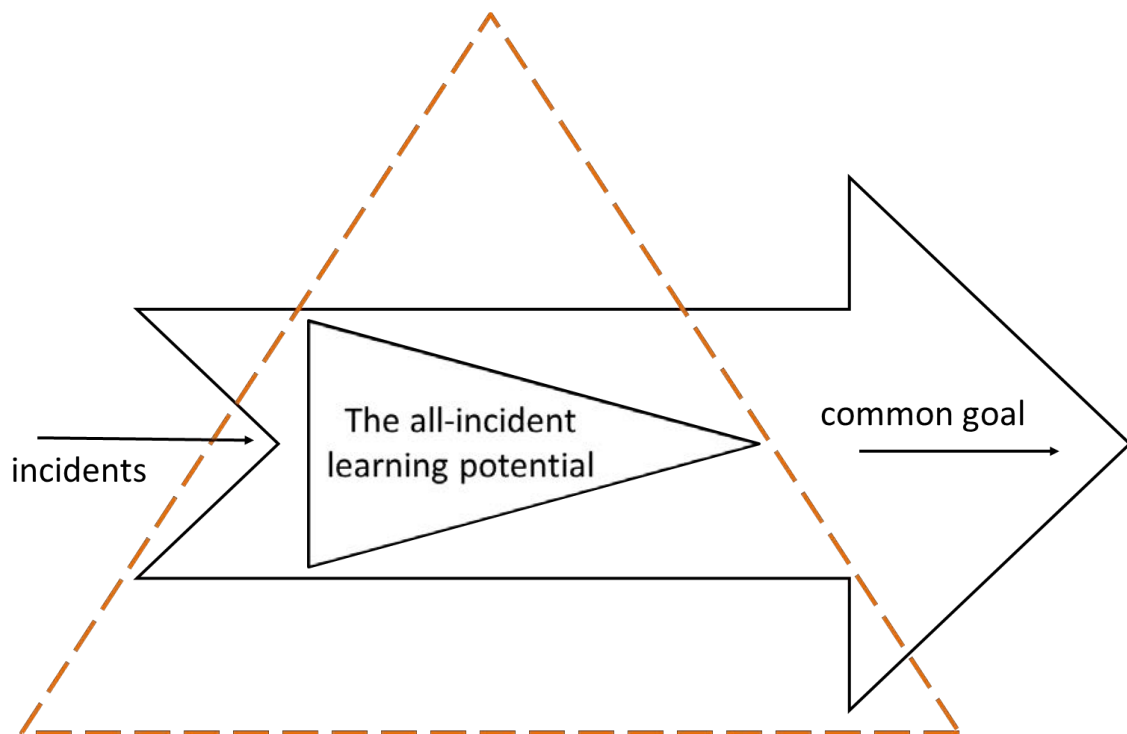
The Heinrich (1941) model is used to support the organizational practice of translating statistical data into measures of safety.

In *Industrial Accident Prevention: A Scientific Approach*, Heinrich (1941) presented his philosophy about the sequence of an accident by using dominos to demonstrate how “an accident is merely one link in the chain [of events]” (p. 14). Heinrich (1941) also likened the progression of an accident that could have been prevented to a link of related elements. According to Heinrich (1941), individual character and the presence of workplace hazards are contributing factors in the accident chain link (Heinrich, 1941).

Heinrich (1941) also estimated the frequency of accidents of the same type. Heinrich (1941) analyzed 12,000 closed-claim-file insurance records classified as Industrial cases and 63,000 records from plant owners classified as Other cases. Heinrich (1941) theorized the results of the analysis to conclude that most accidents are caused by human error (Heinrich, 1941). Furthermore, Heinrich (1941) further estimated severity of the volume of accidents that occur amongst same category types. Based on the review of 330 accident cases of comparable characteristics, 300 cases resulted in no major injuries, 29 cases resulted in minor injuries, and one case resulted in a lost time injury (Heinrich, 1941). “The 300-29-1 ratio” (Heinrich, 1941, p. 27) is widely represented and used in industrial environmental health and safety programs (Wright & van der Schaaf, 2004).

Heinrich (1941) recognized early that gathering accident data with the goal to determine cause was important to the insurance industry. But the validity of the model in stemming the trend of incidents questioned specifically how the model is applied in the strategy to prevent incidents today. Industry has come to interpret the Heinrich ratio estimates as accident principles and aligns safety management programs aligned with Heinrich’s accident ratio estimate. The commonly represented triangle representative of the Heinrich ratio is utilized throughout

industry (Wright & van der Schaaf, 2004) and is useful in illustrating and demonstrating that workplace safety deserves keen attention and that incidents within a system share a degree of relatedness and potential commonalities of root cause. Heinrich (1941) was an advocate for investigating the underlying causes of accidents as a major part of the philosophy on accident causation, and Heinrich believed the cause of the majority of workplace accidents (98%) are preventable (Heinrich, 1941). When near miss events are framed without regard to the potential effects, then each tier of the iceberg is equally subject to a near miss event. In other words, the concept of incident occurrence includes a compounding quality in which less significant incidents precede more severe occurrences. The iceberg theory is widely utilized by institutions in the measurement of worksite safety and health (Wright & van der Schaaf, 2004).



*Figure 4.* The Heinrich (1941) ratio (triangle) is adapted and superimposed in the all-incident learning potential model.

Figure 4 illustrates how the Heinrich (1941) accident ratio (triangle) is superimposed and adapted in a representation of all incidents. All incidents are represented on a continuum and are not distinguished by incident category or accident type. The adapted incident model and the Heinrich model share the common goal to prevent accidents, but the adapted model is not statistically based. Instead, the focus of the adapted incident model is to recognize that all incidents have potential for learning. The goal must go beyond inquiring about the cause of the incident.

### **The Near Miss Reporting Goal and the Heinrich Model**

To drive understanding about the consequences of unsafe operations, organizations must gain more insight into how individuals are motivated to operate safely within work environments. The assumption must then be made that both the organization and the individual share the two common goals of incident reporting as prescribed by OSHA: (a) Identify the hazard and (b) Prevent the recurrence of the incident (U.S. Department of Labor, 2015a). It has become a focus of industry to emphasize statistics in the process of mandatory reporting. Near miss management systems require that lessons are shared broadly across a system in which events are recognized and analyzed (van der Schaaf, Lucas, & Hale, 1991), but the relevance of near miss reporting can be overlooked by organizations because the event itself sometimes leaves negligible visible evidence of the occurrence.

Sometimes, the Heinrich ratio is misinterpreted when the concept is applied to near miss events. Acquiring knowledge and learning about the causes of accidents through the analysis of past incident data establishes a base from which potential prioritization of safety growth effort



can be examined (Wright & van der Schaaf, 2004). Heinrich's ratio of accidents represents commonality of causal relationships amongst events, such that, assuming similar circumstances of occurrences, the model can be utilized by organizations to convince workers in conceptualizing the model as motivation to report near miss events (Wright & van der Schaaf, 2004). It is important to distinguish Heinrich's intent of establishing a common cause of occurrences ratio from the commonly misinterpreted concept of a common cause of consequences.

### **Common Cause Hypothesis and the Heinrich Model**

In a study designed to conduct an empirical test to evaluate the Heinrich model for validation and interpretation of the common cause hypothesis, Wright and van der Schaaf, (2004) conducted an empirical test of the common cause hypothesis. The common cause hypothesis is Heinrich's theory that near miss events (identified as Substandard Practices at the bottom of the triangle in Figure 4) and accidents (represented at a higher level in Figure 4) share common causes. The Wright and van der Schaaf (2004) study examined railroad incidents in one organization in the United Kingdom. The study utilized formal inquiries, signals passed at danger (SPAD) investigations, and report analysis. The Wright and van der Schaaf (2004) study included incidents with a high potential for injury such as crossing a red signal without the authority to do so. SPAD investigations consisted of an interview by a manager (with the rail driver and the signal detector who received the report) and artifacts, as applicable.

The Wright and van der Schaaf (2004) study concluded that the common cause hypothesis is conditionally supported by the results. Specifically, of the 21 types of causes, three were proportionally significant across three consequence levels: (a) Injury and Fatality, (b)

Damage, and (c) Near Miss. Analysis of eight studies identified from the literature examined concluded, “the hypothesis has not been properly understood or tested” (Wright & van der Schaaf, 2004, p. 102). Incident investigation utilizes the root cause analysis approach to analyze incidents (U.S. Department of Labor, 2015a), and both accident and incident events are assumed to share common root causes (Heinrich, 1941; van der Schaaf, 1992).

### **The Swiss Cheese Model**

The degree of near miss potential in personal safety cannot be reliably predicted without data. Therefore, a distinction between personal safety and process safety need is warranted when considering how near miss reporting is conceptualized. The Swiss cheese model (Reason, 1997) is descriptive of process safety hazards inherent to workplace operations. Specifically, the model describes how latent hazards exist within the barriers to the process outcome, and a compromised barrier represents a potential incident (Reason, 1997).

There is no implied distinction of incident severity in the Swiss cheese model, and the implied degree of risk is determined by the strength of each process barrier. The Reason (1997) model is useful in illustrating the potential for a near miss. There is no implied classification of incident severity potential as in the Heinrich model. According to Reason (1997), some hazards are latent, and are not as easily identified. A near miss is theorized to occur when the holes in the Swiss cheese are lined up sufficiently for a hazard to penetrate, and a near miss results (Reason, 1997). The goal of reporting a near miss is to identify the hazard and prevent the recurrence of the incident. As such, a near miss must result in an opportunity for organizational learning.

## **Applying the Process of Root Cause Analysis in Hazard Identification**

When an incident occurs, it is important to develop a comprehensive understanding of the elements that contribute to the occurrence. Root cause analysis (RCA) is an approach used to understand the underlying causal factors of an incident and to prevent recurrence (U.S. Department of Energy [DOE], 1992). The RCA is a retrospective action often applied in the process of examining a near miss event. Incident analysis must be applied with the knowledge that the process progresses from the top down and that there is commonality in relationships amongst incident types (van der Schaaf, 1991). Causal analysis, as described by Phimister et al. (2003) is designed “to determine what are the direct and underlying factors that enable an incident or unsafe condition” (p. 453).

Incident reporting has been used amongst organizations but the results can be described as less than stable, resulting in more immediate changes to procedures, re-training, and disciplinary actions (van der Schaaf et al., 1991). The utility in collecting incident and accident data is the shared compatibility in root causes; and the data from near miss incidents is used to build chemical process models (van der Schaaf, 1992). In other words, collecting near miss data is important to safety management practices; therefore, collecting near miss data is practical and necessary.

When applying causal analysis, determinations of root cause must go beyond the immediate and direct solutions to target a goal of correction (Phimister, 2003). OSHA strongly encourages employers to investigate all workplace incidents—both those that cause harm and the “close calls” that could have caused harm under slightly different circumstances—and root cause analysis method is applied to investigate incidents (U.S. Department of Labor, 2015a). The

design of an incident investigation must include guidance and training, and collaboration between leadership and workers is required (U.S. Department of Labor, 2015a). In considering the practical application of the process of collecting near miss data, it is important the incident causation approach “will always try to get as far to the bottom of the iceberg as possible and not stop at superficial descriptions of only the immediate events leading to an accident and its short-term consequences” (van der Schaaf, 1992, pp. 21-22).

### **Implications for Workers**

Although OSHA (U.S. Department of Labor, 2015a) advocates that employers should investigate all incidents, some organizations classify incidents based on severity and conduct investigations as such. But how do workers know what incidents should be reported? The Energy Department underscores the importance of root cause analysis by describing five essential phases in the development process in the investigation and reporting of an incident (DOE, 1992). Table 1 identifies the essential elements of the root cause analysis tool. The five phases of root cause analysis are: (a) Data collection, (b) Assessment and method of analysis, (c) Apply corrective actions, (d) Inform, and (e) Follow-up. In medical environments, methods of analyses are applied to understand the types of errors that develop out of an unclear understanding of the problem and insufficient knowledge (Donaldson, 2008).

Table 1  
*Phases and Essential Components of Root Cause Analysis*

Phase	Description
Phase I: Data Collection	<p>Prevent data loss by collecting data as soon as possible</p> <p>Capture conditions during all phases: before, during, and after</p> <p>Include personnel actions and environmental conditions</p>
Phase II: Assessment and Methods of Analysis	<p>Apply methods of analysis to determine the root cause. The method applied must include four elements</p> <ul style="list-style-type: none"> <li>(a) The problem</li> <li>(b) The significance</li> <li>(c) Existing conditions and actions before the problem</li> <li>(d) The cause of each preceding step in the sequence of events</li> </ul> <p>The root cause is the fundamental cause in the sequence to which corrective action can be applied</p>
Phase III: Corrections Actions	Protect health and safety of workers, the public, and the environment
Phase IV: Inform	The results of the analysis and mitigating actions results are reported in the Occurrence Reporting and Processing System (OPRS)
Phase V: Follow-Up	Assess the implementation of corrective actions

Source: U.S. Department of Energy (1992)

### **The Near Miss Reporting Challenge**

Despite the benefits to reporting near miss events, some employers fail to report severe workplace injuries and face the probability of monetary fines and more frequent inspections from

OSHA (Michaels, 2016). An update to the schedule of employer penalties for violations of workplace rules became effective April 2, 2019 and is published in the OSHA memo titled “2019 Annual Adjustments to OSHA Civil Penalties” (U.S. Department of Labor, 2019). A list of the minimum and maximum civil penalties assessed across categories of violation is displayed in Table 2. A review of the table indicates a low tolerance for willful or repeated employer violations (U.S. Department of Labor, 2019).

Table 2

*Adapted from OSHA Employer Maximum and Minimum Amounts for Civil Penalties, 2019*

Type of Violation	Penalty Minimum	Penalty Maximum
Serious	\$947 per violation	\$13,260 per violation
Failure to Abate Other-Than-Serious	\$0 per violation	\$13,260 per violation
Willful or Repeated	\$9,472 per violation	\$132,598 per violation
Posting Requirements	\$0 per violation	\$13,260 per violation
Failure to Abate	N/A	\$13,260 per day unabated beyond the abatement date (generally limited to 30 days maximum)

Source: U.S. Department of Labor (2019)

In a study of 106 participants across 20 worksites in the chemical and pharmaceutical industry, 68% of a segment of study participants (40 out of 59 pipefitters, operators, and mechanics) had an unclear understanding about the elements that constitute and define a near miss (Phimister et al., 2003). In petroleum refining and chemical plant process operations, the

use of hazard identification methods such as near miss reporting, job safety audits, process deviation reports, and the preventative maintenance of equipment are more effective as indicators of workplace safety vulnerability than utilizing statistical reports of injury and illness incidents (Miller, 2008).

When considering how needs are classified, Maslow's (1943) theory is applied in understanding how the common goal of near miss reporting is shared by the organization and the worker, yet has the potential to yield variety in interpretations and outputs. As such, the impetus to make a near miss report is examined through the motivational lens. The value of learning from incidents and sharing information is globally acknowledged as a necessary industry key practice in preventing incident recurrence and in controlling public sentiment, but there are obstacles to sharing data (Wood et al., 2006). The differences in motivation needs amongst workers are acknowledged and vary depending on the work environment (Tampoe, 1990).

### **Motivation and Limitations**

The motivation to report a near miss must therefore be understood as a pathway to reaching the goal of proactively preventing a future injury, illness, or property damage. As such, the process of incident investigation should be outlined, and the motivation to report a near miss incident must be understood by the organization and worker. The mandate of OSHA law of 1970 requires the BLS to collect accurate statistics about reported injuries, illnesses, and fatalities that occur in the workplace (Miller, 2008). BLS data and workplace record-keeping indicate that under-reporting of incidents is problematic and chronic (Miller, 2008).

U.S. Department of Labor (2015a) contends that "All incidents – regardless of size or impact – need to be reported" (p. 1) and advocates for employers to adopt a systems approach in

the investigation of accidents and incidents. The philosophy that “most harmful workplace incidents are wholly preventable” is the foundation of a systems approach in which the root cause of an incident can be identified to discover deficiencies within safety management systems (U.S. Department of Labor, 2015a, p. 2).

### **Contributing Elements**

Knowledge of factors that contribute to the development of incidents is helpful to understand the context of near miss documentation. OSHA refers to the practice of analyzing worksite incidents and developing plans to mitigate process hazards as Incident Investigation (U.S. Department of Labor, 2015a). Since the analysis of a near miss occurs after the incident, the delay in the process distorts the report (Reason, 1997), and a comprehensive near miss management system requires more than near miss analysis (Reason, 1997; U.S. Department of Labor, 2015a).

The findings of near miss analyses are communicated to workers to avoid duplication of the same actions, to learn from past incidents, and to adopt corrective actions (U.S. Department of Labor, 2015a). The challenges to reporting near miss events include the limiting factor of the root cause analysis tool that restricts advancement of reporting the root cause to the preceding immediate cause (van der Schaaf, 1992). The projected learning intended from near miss incident reporting is hindered by “overdissemination” and “underdissemination” of the shared lessons (Phimister et al., 2003, p. 457), such that the sheer volume of lessons distributed in sufficiently high volume can overwhelm recipient workers, and when shared lessons are distributed to the originating reporter only, the utility of the lesson is limited to the worker (Phimister et al., 2003).



### **Motivation and Near Miss Reporting**

Abraham Maslow's (1943, 1968) basic needs in individuals have been established through empirical studies. A quantitative study was designed to measure the validity of relationships amongst Maslow's (1943) five basic needs: (a) Physiological, (b) Safety, (c) Love and belonging, (d) Esteem, and (e) Self-actualization (Lester, Hvezda, Sullivan, & Plourde, 1983). In the correlational study, Lester et al. (1983) found that a relationship exists amongst the physiological, safety, love and belonging, esteem, and self-actualization needs in individuals, and that higher levels of need satisfaction are associated with higher levels of psychological health (Lester et al., 1983). The implications for the near miss reporting study is that individual worker needs must be considered in the action of near miss reporting. The needs hierarchy structure is sometimes misinterpreted.

No single need exists independently (Maslow, 1943). In describing how a more compelling need displaces another need during an urgent situation, Maslow (1943, 1968) described the physiological needs as the more independent of the other need categories and less dependent on motivations (Maslow, 1943), indicating that individual need categories exist on a continuum; as a need is satisfied, the need no longer exists.

Maslow (1943, 1968) further distinguished being needs, or B-needs (Love and belonging, Esteem, and Self-actualization), from deficiency needs, or D-needs (physiological and safety). The distinction lies in the characterization of the need. When a deficiency need occupies the position of a prevailing need, the need can command a compelling position in terms of priority to be satisfied (Maslow, 1943). Maslow (1968) suggests that, as self-actualization develops, individuals perceive a clearer interpretation of the meaning of the actions of others. The

implications for near miss reporting is that, in a near miss event, the prevailing need will originate from any need category and is not dependent upon the fulfillment of a need of any lower category.

Organizations can apply worker motivation to learning from near miss incident experiences when an understanding of Herzberg et al.'s (1959) two categories of individual needs is established. Herzberg et al.'s (1959) theory states that levels of job satisfaction are influenced by motivation factors of esteem and self-actualization needs, and levels of job dissatisfaction are driven by levels of need that are lower on Maslow's (1943, 1968) needs hierarchy. Maslow (1968) aligns individual basic needs with essential body nutrients. Within the framework of Maslow's hierarchy of individual needs, hygiene and motivation needs regulate motivation (Ozguner & Ozguner, 2014). Motivation results from the application of hygiene and motivation needs applied. The implication for near miss incident reporting is that job satisfaction is a desirable tenet, and opportunities to motivate workers to increased levels of job satisfaction will result in a response toward near miss incident reporting.

### **Applying Maslow's Hierarchy**

A mixed methods study designed to assess levels of need satisfaction found that the fulfillment of the self-actualization need is dependent upon factors inside and outside the work environment, and the anticipated levels of self-actualization amongst the sample were less than expected (Shoura & Singh, 1999). The Shoura and Singh (1999) study utilized self-reporting questionnaires from a target sample of 19 construction engineers to determine levels of fulfillment in important and less important areas of life.

The analysis of the Shoura and Singh (1999) study resulted in the development of a recommended set of three self-actualization boundaries from which the targeted organization could use to develop workers: (a) Meaningfulness of tasks, (b) Self-sufficiency through continuous training, and (c) A clearly defined role in the mission of the organization (Shoura & Singh, 1999). The Shoura and Singh (1999) finding implies that near miss reporting protocol should be purposeful, incorporate training, and aligned to a goal.

Wahba and Bridwell (1976) analyzed the results of worker responses from historical data in 10 studies for evidence of human motivation to do work according to Maslow's (1943) theory of motivation. The field of study participants in the 10 studies included a variety of work disciplines such as factory and clerical workers, operators, nurses, librarians, bank workers, supervisors, and managers. Participants provided self-reported responses to job attributes that translated into categories of human need as identified by Maslow (1943). Participants ranked responses on a structured scale designed according to the measure of importance of the need and the level of satisfaction gained from the fulfillment of the need. The range of participants in 12 samples from smallest to largest was 72-380; 2 of the 10 studies each had two samples. The historical data were tested for the presence of three existing elements: (a) Maslow's (1943) five categories of need, (b) Overlap and independence amongst adjacent and nonadjacent need categories, and (c) Independence of the five needs from unrelated factors.

The analysis of Wahba and Bridwell (1976) found that no one study examined indicated that each of Maslow's (1943, 1968) categories of needs is independent of another need category. The implication for the near miss reporting study is that each category of need must be considered when motivating workers to make a near miss report. A comparison study of

Maslow's (1943) Need Theory and Herzberg et al.'s (1959) Motivation-Hygiene Theory determined that differences and similarities exist between the two theories, and there is utility in applying both concepts together (Ozguner & Ozguner, 2014).

Maslow's (1943, 1968) theory identifies needs such as protection, food, friendship, self-worth, and reaching full potential within the needs categories of Safety, Physiological, Belonging, Esteem, and Self-actualization that individuals seek to satisfy, and when a need is satisfied, the need no longer exists and does not motivate individual behavior (Maslow, 1943, 1968; Pardee, 1990). Herzberg et al.'s (1959) Hygiene (Two-Factor) theory identifies physical satisfiers and dissatisfiers in the work environment as the origins of individual motivation.

In the Ozguner and Ozguner (2014) comparison study, the researchers considered the context of motivation across both theories. The findings indicate contention in applying the Two-factor theory such that Herzberg et al.'s (1959) satisfiers (motivators) correspond with two of Maslow's (1968) five needs (esteem and self-actualization), and Herzberg et al.'s (1959) nonsatisfiers (hygiene factors that correspond with Maslow's remaining physiological, safety, and belonging needs) pose a challenge to managers (Ozguner & Ozguner, 2014). The challenge here lies in the capacity of managers to distinguish amongst worker needs and to recognize agents of motivation (Ozguner & Ozguner, 2014).

Hygiene factors are conceptualized in terms of hazards that exist in the environment (Duttweiler, 1986; Pardee, 1990), and as such, hazards must be recognized and controlled. In other words, if Herzberg et al.'s (1959) hygiene factors align with Maslow's (1943, 1968) physiological, safety, and belonging needs, then organizations must be sure to include considerations of the need to mitigate hazards when seeking to understand elements of worker

motivation. The findings in the Brenner, Carmack, and Weinstein (1971) study (as cited in Ozguner & Ozguner, 2014) indicate that respondents report job satisfaction and job dissatisfaction from motivating factors and hygiene factors, resulting in the conclusion that dissatisfaction needs can be satiated by hygiene factors, but hygiene factors will not motivate workers (Ozguner & Ozguner, 2014). Taken together, the satisfaction of hygiene elements (nonsatisfiers) can result in the achievement of motivation factors, but by itself, a hygiene factor is not a motivator of workers (Ozguner & Ozguner, 2014). The implication for near miss reporting is that satisfying D-needs/hygiene factors can result in the achievement of B-needs/motivation factors, and D-need/hygiene needs do not motivate workers.

### **Conclusion**

A review of the literature determined that organizations highly regard safety statistics. A few studies offer insight into the perceptions of the industrial worker such as Lukic, Margaryan, and Littlejohn (2013) and van der Schaaf (1992). The participants in most studies include safety professionals, managers, and combinations that include some process operators. Few studies distinguish process safety from personal safety needs in reporting a near miss. Further, process safety is emphasized over personal safety in most studies, and the ways in which a near miss is defined varies and is unclear to workers. When workers are motivated to fulfill motivation factor needs, action toward near miss reporting will result. A gap in the literature exists in understanding how near miss reporting is interpreted by industrial workers and how the action of reporting relates to the OSHA goal of identifying the hazard and preventing recurrence of the incident. Worker motivation must be understood in the context of worker needs and job satisfaction. Organizations must determine ways of identifying worker needs in near miss

incident reporting and apply efforts to satisfy identified needs. It is important to understand the actions involved in reporting near miss events to determine and measure the extent to which OSHA goals of incident investigations are met.

### **Summary**

Accidents and incidents occur in industrial environments, and organizations maintain statistics of events. Organizations align beliefs and theories of accident causation with management practices. The hazard control triangle is used and applied as a guide to different ways or methods to prioritize and control worker exposure to hazards in the work environment. examine studies that apply methods of prioritization to control worker exposures. The goals of near miss reporting are unclear to workers. The conceptual framework is used to illustrate how a near miss is positioned within the production path. Maslow's (1943) theory of motivation is used to demonstrate how actions are connected to individual needs. The methodology applied in conducting the study is described in the next chapter.

## CHAPTER 3: METHODOLOGY

The goal of the near miss study was to understand how workers in aviation ground and petrochemical operations interpret the goal of near miss reporting by examining how workers define hazards, how a near miss incident is defined, and how the action of reporting is related to the incident reporting goal. This chapter describes how the plan to collect data was executed. The anticipated challenges to data acquisition are discussed.

A review of the literature established the significance and essence of near miss reporting as an extension of incident data collection practices common to safety management programs in industries. Specifically, reporting systems of substantive value are dependent upon the input of workers closest to the process who are connected to the reporting goal. The strategies employed in data collection must be aligned with the purpose of the study (Roberts, 2010). A purposeful approach to the methodology requires specific knowledge of the problem (Roberts, 2010).

If workers are to connect to the goal and subsequently apply lessons learned from incident reporting opportunities, more clarity in the definition and purpose of reporting incident events is needed. It is established that corporations promote and publicly emphasize mandatorily reportable incident statistics as a reflection of how safety programs are managed, but the value of near miss event data is not sufficiently recognized by workers within systems that present obstacles to reporting. The approach to an inquiry about near miss reporting was rooted in the assumption that the worker and the organization share the common goal to identify hazards and prevent the recurrence of an incident

In the next sections that follow, I describe the approach to the inquiry, followed by a description of how the design was developed. A description of appropriate participants

developed out of the design. In other words, the participant parameters posed a potential challenge to recruiting. Following the description of participants is the sampling procedure. Next, the interview protocol is outlined. A description of the data analysis precedes the discussion about the extent of validity of the data. The perspectives of the researcher and the participants are considered. Finally the study limitations are outlined, and the contents of the chapter are summarized at the end.

### **Inquiry Approach**

The inquiry utilized a general qualitative, nonexperimental approach through purposeful snowball sampling and aimed to understand how workers interpret the goals of near miss reporting. A generalized qualitative approach utilizes tools such as surveys, questionnaires, and interviews to capture the bounds of the situation in a broader context (Merriam & Tisdell, 2016). Applying a qualitative approach to describe how workers interpret near miss reporting is essential in understanding the objective aspects of the near miss content. For example, there may be differences in the way that workers practically perceive the common theoretical purpose of reporting a near miss incident.

The general qualitative method of inquiry was utilized to document the “lived experiences” of seven participants (Creswell, 2007, p. 57). A basic qualitative approach utilizes the perspectives of people to construct detail in meaning by capturing experiences using descriptive methods such as interviews, observations, and data analysis (Merriam, 2009). It is assumed the reader of the study is inclined to seek out a logical construction of the near miss reporting perspective argument. The structure of the qualitative approach utilizes the rich descriptions from participants (Denzin, 1989).



In a qualitative approach, the needs of the study drive the approach to data collection (Caelli, Ray, & Mill, 2003; Roberts, 2010). The approach to the study was framed in the belief that there is variation in the way workers understand the elements of near miss reporting. Each near miss incident is unique in circumstance, and as such, the qualitative methodology applied is suited to capture and understand individual experiences.

The approach was based on a logical, “best fit” for the near miss inquiry based on learning about the perspectives in workplace environments by capturing the voice of workers. Participants described the components of near miss reporting, and the descriptions were the platform for understanding relationships between near miss reporting and the goals of hazard identification. Each near miss incident is unique in circumstance.

A general qualitative approach was applied to capture data and gain a clearer understanding about how near miss events are perceived. The unit of analysis guides the focus of the data collection (Starks & Trinidad, 2007). Furthermore, the goal of sampling to acquire rich, descriptive data is to understand the common elements and the reality amongst the sample (Starks & Trinidad, 2007). Factual content is expected to result from basic qualitative research (Sandelowski, 2000). In addition to descriptive content, the relationship between objective descriptions and subjective reflections reflect intentionality in meaning (Ehrich, 1996). Basic qualitative research utilizes participant experiences to understand and interpret meaning (Merriam & Tisdell, 2016). In this study, participants shared common experiences of working in industrial environments and common knowledge of incident reporting. The rationale for understanding how workers interpret the relationship between the elements of near miss

reporting and the OSHA goal is to listen to what workers have to say within environments where incidents have high potential consequences.

### **Development of the Design**

The development of the study design was also based on my own perspectives and views. I have multiple years of experience in the petrochemical and aircraft industries that enable insight into the benefits and challenges of incident reporting. I exercised care in interpreting and validating the study results. Validation in reporting the results must be based on the interpretation that is derived, and not on the data itself (Hammersley & Atkinson, 1983). In other words, I would be wrong to invalidate worker descriptions that did not align with my beliefs. It was important for me to listen objectively to what the participants had to say and to capture the multiple realities of worker experiences,

In the near miss study, it was assumed that both the worker and the organization shared the common goals of hazard identification and preventing the recurrence of an incident. My assumption was grounded in the logic that workers are vested in preserving personal safety and organizations are motivated to manage resources in an efficient way. It was also assumed that accidents and incidents share common root causes (van der Schaaf, 1992). Most near miss events are not identified (Wald & Shojania, 2001), 10 out of 12 aviation incident reporting systems are confidential (Barach & Small, 2000), and anonymous reporting poses challenges (Barach & Small, 2000).

The credibility of the near miss reporting study is identified by criteria that represent standards of quality. The analytic lens of the researcher, the researcher position, the fit of methodology to methods, and rigor (Caelli et al., 2003) are standards of quality that were used to

support the selected methods of inquiry. My position is an important component of the near miss reporting study because two perspectives of personal safety, at a minimum, exist in reporting an incident. First, the occurrence of a specific event is reported. Secondly, a generalized plan is constructed to mitigate and prevent future recurrence of like incidents. In other words, in one perspective, an incident occurs at the detriment of another element, creating a potential for future benefits in learning.

My position is that a difference in motivation to report a near miss incident exists. Understanding the elements of motivation and how worker needs are prioritized must be considered. Near miss reporting is an established protocol applied in the identification of hazards and preventing incident recurrence. My position assumed that near miss reporting systems are underutilized by workers and organizations. The researcher position identifies how the credibility of a study is supported (Caelli et al., 2003). I employed my stance to guide and ground the debate. I further believe that individual needs in workers are dynamic; and that priority of individual needs change.

It was therefore important to launch this study with the recognition that reporting is a sensitive topic, both to corporations and workers. Multiple efforts to acquire permissions and access to near miss historical data from three organizations were unsuccessful. The idea was that studying near miss data will inform practice, not only regarding the types of incidents that occur, but it will also present opportunities for deeper understanding about circumstances surrounding incident occurrence. Studying near miss incidents required a sampling method that was least intrusive yet capable of extracting valuable incident data. The study incorporated a nonexperimental general qualitative design. The data were collected from a sample size of seven

participants. The criteria to participate was that participants must have had prior experience working in either aircraft maintenance or petrochemical operations, must not have been presently working in either industry, and must have been recently removed from working in either industry within the last five years. No minimum length of experience was required.

The sample did not include present workers. The sample was bound by a limited population. Care was taken in limiting the parameters of participants to workers removed from either industry within five years. The snowball sampling technique was used to recruit participants because it is applied to populations in which access to participants is challenging, but where networking is employed in the recruitment of participants for the study (Sadler, Lee, Lim, & Fullerton, 2010).

Snowball sampling was used to recruit eight participants, and seven participants were interviewed. One recommended recruit, who initially agreed to participate, did not return the mailed consent form to agree to the interview. Further efforts to contact the recruit were unsuccessful. No pseudonym was assigned, and the potential interview would have represented a craft with experience in the petrochemical industry.

The sampling instrument was individual telephone interviews. Three key experts were used to recruit potential participants. The population eligibility will potentially decrease as the number of participants increases (Biernacki & Waldorf, 1981). The snowball sampling technique is developed by gaining recommended participants through knowledgeable sources (Creswell, 2007). The snowball strategy was adopted in a deliberate effort to use insiders who knew of workers recently removed from the industry. The next section describes the research design.

The particulars of the research design are explained and the sampling technique to recruit participants is discussed. A table of the sample demographics is displayed and a description of the participants follows. The method of data collection is explained. Next, the sampling procedure is described. The concept of the Type-X event within the interview protocol is explained to frame and establish the limitations of the near miss definition. The method of coding the data is explained. Lastly, the particulars of the interview protocol are stated, followed by descriptions of Data Analysis, Trustworthiness and Generalizability, the Researcher Perspective, Participant Critiques of Validity, and the Limitations of the Study. Demographics and the method of coding the data are explained following the presentation of the study particulars.

### **Design of the Research**

This near miss reporting study used a nonexperimental general qualitative design. The data were collected from a sample size of seven participants. The criteria to participate were that participants must have had prior experience working in either aircraft maintenance or petrochemical operations, must not have been presently working in either industry, and must have been recently removed from working in either industry within the last five years. No minimum length of experience was required. The sample did not include present workers, and the requirements of the sample were bound by a limited population.

The snowball sampling method was used to recruit participants who fit specific criteria, and each participant fit the criteria to participate in the study. Communication and contact with participants was via telephone, e-mail, and the U.S. Postal Service. Seven participants represented a field of three refinery and four aircraft maintenance crafts with 176 total years of

industry experience. Time away from the industry ranged from between one month to five years. A description of the sample is represented in Table 3. A pseudonym was assigned to each participant upon recruitment, and the participants are listed according to the order in which the interviews were conducted.

Table 3  
*Demographics of the Near Miss Reporting Sample*

	Aircraft/Petrochemical Industry Type	Craft	Years Worked	Years/Months Away from Industry
S1	Petrochemical	Refinery Operator	08	4 Years
S3	Petrochemical	Refinery Process Supervision	25	< 1 Month
S2	Aircraft	Maintenance Supervision	30	2 Years, 10 Months
S4	Petrochemical	Refinery Operator	25	3 Years
S5	Aircraft	Maintenance Supervision	35	5 Years
S6	Aircraft	Maintenance	31	7 Months
S7	Petrochemical	Refinery Operations/Maintenance	22	9 Months

S1 through S7 represent the participants in the order interviews were conducted. The demographics represent three participants with experience in aircraft maintenance and four participants with experience in refinery operations crafts. More than 176 years of combined working experience are represented amongst participants. Participants most recently worked in either industry from between less than one month to five years.

### **Description of Participants**

One participant group of adults (19 years or older) was interviewed. The participants previously worked in, but no longer, either aircraft ground operations or petrochemical operations within the last five years, due to retirement or change of career—aircraft mechanics, pipefitters, and operators are some examples of trade types represented by both industries. Working environments for workers included refineries, chemical plants, and aircraft installations. The recruitment method was snowball sampling. My experience in industry includes years of experience in aircraft maintenance and refinery operations; I knew of two candidates who retired from each industry. I contacted three known recruiters to ask them to recommend participants who fit the criteria. Once contact was made, I asked known participants to recommend other participants to take part in the study. It was anticipated that the known candidates were sources of knowledge about the population of workers who previously worked in industry and were now removed from either industry within five years.

The interview protocol incorporated validity by referencing the Type-X definition. The Type-X definition was the term assigned to the participants' description of a near miss event in which no injury or damage to equipment or the environment occurred. The Type-X event established a form of validity that was built into the interview protocol, and also established near miss definition parameters for participants. Accuracy in evaluating and learning what participants mean reflects traits of qualitative studies (Creswell & Miller, 2000).

One-on-one individual telephone interviews were used as the sampling instrument. Telephone interviews were convenient because of the extended distances amongst participants' locations. The locations of participants ranged across three states and one U.S. territory. The

telephone interview supports communication with participants when accessibility is a challenge (Creswell, 2007). By design, the interview questions were open-ended. Open-ended questions promote expression and hearing what participants have to say (Creswell, 2007). The parameter of the sample was six to eight participants. Saturation of the sample was approached when a representative number of participants was interviewed from each industry. Data collection was terminated after the seventh interview was completed.

### **Sampling Procedure**

Once a recruit was referred, I contacted the recruit via email or telephone to establish contact and to screen for eligibility. After verifying eligibility parameters, I requested a street address to mail out the consent form (see Appendix A). I assigned the pseudonyms S1 through S8 to each contact in the order of recruitment. When the signed consent form was received via U.S. Post Office delivery, I again contacted the prospective participants to set an interview date and time. Communication between individual participants and me was via telephone and e-mail. The telephone mode of communication was selected based on convenience, privacy, and distance. Participants resided across three U.S. states and one U.S. territory.

Given the variation in physical distances between participants and the researcher, a plan to use video conference or telephone to conduct the individual interviews was both practical and convenient, and required a single, reliable mobile device for connectivity. Video conferencing is a more technologically advanced mode of communication, but telephone was more convenient because of the ease of connectivity across distances. Eight recruits were contacted, and eight consent forms were mailed out. Seven forms were received, and seven individual telephone interviews were conducted.



## **The Type-X Incident Event**

By design, the description of a Type-X event was incorporated into the study to establish consistency in meaning of the near miss definition. Participants were asked to describe an event in which no injury or damage to equipment or the environment occurred. In the effort to describe Type-X events, participants demonstrated that reflection was required to separate experiences that were not Type-X. Participants were asked to describe personal experiences with Type-X events.

The design of the interview incorporated constant review of participant descriptions to manage clarification in meaning throughout. The Type-X events participants described established a consistent reference used to represent the near miss event. Participants were asked to reference the Type-X event throughout the remainder of the interview. The Type-X event represented an individual participant's example of a near miss.

## **Coding the Data**

A general inductive approach was used to code the data. Meaning is derived from the data through inductive data analysis and originates from within the participants themselves (Creswell, 2007). The themes developed from within three major categories: (a) Hazards that existed within the work environment, (b) Processes of work (the "what"), and (c) Practices or actions (the "how"). The major themes developed throughout the process of reviewing multiple audio recordings and readings of the interview transcripts and written notes.

The data were coded by transcribing audio recordings into a written document by hand. The transcriptions developed from multiple re-plays of the audio recordings. The first audio re-play was for understanding. In subsequent re-plays, clarity of meaning developed along with

common themes. Multiple re-plays of audio enhanced inflections of tone, speed, and candor that conveyed clarity in context and meaning and inspired themes during transcription. The descriptive coding process was used to begin the initial process of coding data. The descriptive coding process represents a pass used early in the coding cycle in which words or phrasing are used to summarize meaning from a section of text data (Miles, Huberman, & Saldaña, 2014). Subsequent passes of coding produced broader, dynamic themes acquired through the process of induction. When compared to hand transcriptions of audio recordings, electronic transcriptions generated from software require more time to gain familiarity with the software, but generate an abundance of themes (Basit, 2003). More than six hours of interview audio recordings were transcribed in the near miss study.

In the near miss reporting study, themes emerged in an integrated fashion, such that sometimes one theme overlapped another based on the experiences and ideas that participants presented. Collectively, the data were examined within the context of the three categories within which the major themes emerged. The data emerged from participant descriptions within the context of customary work. The data and findings of the study are presented throughout the remainder of the chapter. The findings are organized by examining the data in context to answer each of four key research questions.

### **Interview Protocol**

The interview protocol was designed to collect data about the experiences of workers within two industrial work environments. The source of data collection was seven participants from the target population. Each interview was audio-recorded. A semi-structured design was utilized to engage participants in a conversation that required reflection and elaboration on

personal experiences and observations in work environments. Individual open-ended interviews were used to capture the unique contexts of experiences. Participants were former adult workers in aircraft ground and the petrochemical operations who are 19 years and older.

The near miss study was designed to be anonymous because the topic could be sensitive to participants, and anonymity may have minimized undue harm. After a recruited participant responded by returning a signed consent form via U.S. postal service, I emailed or telephoned the potential participants to set a date and time for the telephone interview. During the interview, I continuously checked for consistency in meaning. For example, although participants agreed that all incidents should be reported, participants classified near miss events in terms of severity to determine what events should be reported.

I continually reminded participants to not describe incidents in which injury or damage to equipment or the environment occurred. I asked interview questions according to the interview protocol listed in Appendix B. I asked probing questions to follow up on responses when clarity was needed, and when elaboration created potential to lead to deeper understanding. I transcribed each interview by hand. I used codes to develop themes and draw inferences about worker responses from the descriptions to answer the four key questions.

Key question one. *In what ways do workers in aircraft ground operations and petrochemical operations describe hazards of the work environment?*

Key question two. *How is a near miss incident defined amongst workers in aircraft ground operations and petrochemical operations?*

Key question three. *How is the goal of near miss reporting interpreted amongst workers?*

Key question four. *In what ways are reporting the occurrence of an incident related to the OSHA goals of identifying hazards and preventing the recurrence of an incident?*

The interview began with opening statements that described the purpose of the study. The questions were arranged in four sections. The conversation began with a discussion about hazard identification and progressed into knowledge about incidents. The questions were designed for participants to describe an incident that framed the definition of a near miss or close call. The parameters were that the incident did not result in injury or damage to equipment or the environment.

I exercised care to ensure that the participants' definition of an incident was then used throughout the remainder of the conversation. For example, following a discussion about incident identification, I stated, "Okay, in order to distinguish between your definition of an incident and an accident, let's refer to your definition as a Type-X event." The purpose of this approach was to empower the participants by validating input and encouraging participation. Additionally, reference to a specific type of event established the parameter of an incident in which no injury or damage to equipment or the environment occurred. Collected data were stored on a secure database, and the data are retained for three years after the study is completed and securely destroyed after the three-year period.

### **Data Analysis**

Interview data were transcribed manually from audio recordings and analyzed for emerging themes that developed directly from the data. A digital recording device was utilized to record the telephone interviews. The device had variable playback speeds used to pace the audio playback. I printed each transcript and listened and re-read the transcript multiple times. On the first read, I made phrasing notations in the margins. After completing the initial read process for each transcript, I listed key phrases in the margins. The themes were further refined

and classified into a manageable number of themes. Some themes overlapped. An indication of saturation is that themes become repetitive (Baralt, 2012). At the point of saturation, I checked the categories and determined whether adjustments to the sizes of categories were warranted.

During the coding of the descriptive data, an inductive approach was used to gather meaning from the descriptions. A general inductive approach to analysis results in the construction of themes that represent a connection amongst categories that emerge from the data (Thomas, 2006). The interview data were gathered from a representative sample of the target population. Categories of hazards that emerged from the data were developed, and similarities and differences amongst the hazards and across industries were identified. The quoted descriptions from participants were stated to support each category theme, and the statements that the participants described were presented and analyzed for directly stated descriptions and implicit meanings.

Collectively, the data measured worker perceptions of hazards identification and perceptions of incident reporting. A coding scheme was established to build themes from the experiences that workers described. The themes inform practice about how workers interpret the goal of near miss reporting. I accomplish clarity in meaning by including context statements for each direct quote. The results of the data analysis are presented with clarity and objectivity and used to draw conclusions about the four research questions.

### **Trustworthiness and Generalizability**

The credibility of the study was established by justifying the data gathered. Two industry populations were used to establish commonalities and differences in workplace hazards and knowledge of incidents. I was mindful that the descriptions participants provided during the

interview occurred in different contexts. The data from workers in two workplace environments are not sufficiently generalizable to other aviation ground and petrochemical environments, given the sample size of seven participants.

To ensure that implicit meaning be retained in the observations and experiences the participants described, two elements of trustworthiness were applied to the findings. I utilized the Lincoln and Guba (1985) model of trustworthiness to establish validity through credibility, which applies the four principles of credibility, dependability, confirmability, and transferability to gauge consistency and truthfulness in the analysis of qualitative results. A measure of establishing assurance is to apply the researcher lens to determine when a saturation of themes is approached (Creswell & Miller, 2000).

Using data from two industries fulfilled two purposes. First, the data from one industry was compared to that of another industry to triangulate findings across industries. Secondly, the results of the study were compared with findings of studies with similar purpose. Two methods of establishing trustworthiness are to compare similar studies and to check for consistency in coding (Thomas, 2006). The individual interview method was used to provide opportunities for participants to be more descriptive of hazards and incident knowledge.

### **The Researcher Perspective**

My frame of reference for the near miss study assumes that both the worker and the organization share the common goal to identify workplace hazards and prevent the recurrence of an incident event. I believe the reality of near miss reporting is understood by learning from those for whom the process was developed. My academic background is rooted in Industrial Technology. In my experience in aircraft maintenance and refinery process operations, the

perceived message from the organization is “Don’t get hurt.” Depending on the worker experience, the message is interpreted in different ways, considering diversity in backgrounds and working experience. The level of formality the organization communicates is enough to establish a reputation in practicing safe work and in reporting incidents. The fact that incidents recur indicates that new hazards are identified or that old hazards are pervasive.

I adopted the interpretivist frame of reference to establish validity through three lenses described by Creswell and Miller (2000). The interpretivist paradigm relies on the context in which the inquiry occurs, and the constructs of interpretations are based upon the input data from the stakeholders and the viewpoint of the researcher (Creswell & Miller, 2000). I believe both the worker and the organization want to avoid injuries. As such, it makes sense to assume that safe work is in the best interest of each, but the prevalence of injuries over time indicates an adopted level of tolerance. The problem with acceptance through time is that industrial processes are not independent. The benefits of safe work practices are intangible. More directly, perspectives are shaped by experiences in the field and through communication with the organization. In other words, workers corroborate the reality of established processes in context.

My position aligns with a philosophy that seeks to understand and translate the experiences of the participants as described. The selection of the validation strategy was based on the interpretivist paradigm. The knowledge built from the study was constructed from the truths that emerged during the process. The views of the researcher, the participants, and the readers were used to build and establish research lenses, and the lenses direct the type of validity procedure to be applied to build credibility in the study (Creswell & Miller, 2000). The study methodology was examined to defend the integrity of the study process and findings. I ensured

that the pool of participants was qualified to discuss the topic of near miss incident reporting; each participant had experiences with near miss events.

To establish credibility, I was mindful of how the conclusions of the study are supported. For example, I demonstrated that the findings on near miss incident reporting are based on truths and are represented by supporting evidence that exhibit logic. I used a consistent method of categorizing data to organize the analysis and present the results. I also applied consistency in a logical emergence of the analysis to develop the findings and conclusions.

Incident reporting data were triangulated by applying the researcher lens, which utilized multiple sources and methods of data convergence to validate results (Creswell & Miller, 2000). The source of the data was the study participants. I compared data from workers in aircraft ground operations against data from workers in the petrochemical process industry. The interview tool was used in identifying the types of hazards across the two selected industries and produced a baseline of incident knowledge.

### **Participant Critiques of Validity**

I applied a second lens as a procedure to maintain accuracy in reporting the data participants described. Participants were used as the frame of reference by which I inform practice. I applied assessment of accuracy in interpreting the findings. Participants were asked to describe characteristics of incidents that were previously self-defined and interpreted as near miss events by said participants. For example, I asked participants: “How would you define an incident that almost resulted in an accident? Let’s refer to your definition as a Type-X event. I will reference your definition in subsequent questions.”



As the inquiry continued, I applied the self-declared definition of the incident event the participants referenced to identify characteristics that defined and clarified the definition. Throughout the interview, I asked participants to confirm, compare, and contrast elements related to a targeted event described as a near miss event. I applied probing questions that engaged the participants to clarify references to described experiences. Member checking procedures promote accuracy in interpretation by confirming the perspectives of the participant (Jackson, Drummond, & Camara, 2007).

### **Limitations of the Study**

A key limitation of the study was that recruiters could have excluded some participants by limiting the selection of workers asked to participate. The limitation may have excluded the voices of some potential participants. The nonrandom sample applied to the snowball technique may not have been representative of the population, and gatekeepers can impede progress (Starks & Trinidad, 2007).

To the extent that workers were asked to recall and describe hazards and incidents, the study did not include opportunities for participants to identify alternative channels of hazard acknowledgement. For example, workers may have encountered and identified workplace hazards and may or may not have utilized alternative actions to eliminate workplace hazards encountered. The study did not provide opportunities for workers to describe alternative methods employed in mitigating hazards when hazards are identified.

The near miss reporting study utilized a nonrandom sample technique to recruit participants to participate. The snowball sampling method was used to refer other potential participants because of the specific definition of the population. The snowball sampling method

is applicable to hard-to-reach populations, and a network is applied in recruiting participants (Sadler et al., 2010).

The key challenge to applying the snowball sample method in the near miss study was recruiting, as the population of participants who fit the criteria to participate was a limitation. Sometimes, multiple contacts to follow up were required. Sometimes, potential participants decided not to participate after all. Sometimes, potential participants did not fit the criteria. The limitation of verifying eligibility was averted by the small sample size, the diversity of the two-industry participation, and the network of available recruits. The number of participants can pose a challenge to verification as the sample size grows further from the recruits (Biernacki & Waldorf, 1981). A key limitation of the near miss study is that the data captured experiences over a period in time. Hazards or work processes introduced to the workplace today are not represented in the study. Finally, workers may not be inclined to tell the full story when recalling incidents. This study focused on incident events related to personal safety.

Participants may have experienced feelings of vulnerability and may have perceived interview conversations as negative. The descriptions and definitions of incidents determined to be worthy of reporting were determined by the population of participants. Further, participants may have considered the implications of how interview conversations may affect future job opportunities. To overcome the limitation, the sample of participants could have been more representative of the population.

### **Summary**

In summary, this chapter presented the methodology of the near miss study. The approach to inquiry, the description of participants, and the interview procedure were described.

The challenges to acquire data were described in terms of developing the study design. The inquiry approach was described in terms of the snowball sampling method to recruit and reach the specific population of former workers. The approach to data analysis was discussed along with the critiques of participants and external readers. Considerations of validity were discussed. Finally, the limitations of the study were identified. The findings of the study are examined in the next chapter.

## CHAPTER 4: RESULTS

The findings of the study are presented in this chapter. Individual worker experiences with incident events in aircraft maintenance operations and petrochemical operations are analyzed. The purpose of the inquiry was to understand how four characteristics of near miss incident events were interpreted amongst workers: (a) How hazards were described, (b) How a near miss incident event was defined, (c) The goal of reporting near miss incidents, and (d) The relationship between reporting incidents and the OSHA goal of identifying hazards and preventing incident recurrence. The four characteristics established four key research questions.

Key question one. *In what ways do workers in aircraft ground operations and petrochemical operations describe hazards of the work environment?*

Key question two. *How is a near miss incident defined amongst workers in aircraft ground operations and petrochemical operations?*

Key question three. *How is the goal of near miss reporting interpreted amongst workers?*

Key question four. *In what ways are reporting the occurrence of an incident related to the OSHA goals of identifying hazards and preventing the recurrence of an incident?*

Chapter 4 is organized into sections in which each key research question is examined. The data and the findings for each question are presented within the same section. The hazards that participants described are analyzed to answer Key Question One. The definition of a near miss incident event is interpreted through descriptions of Type-X events to answer Key Question Two. The goal of reporting an incident is explained to answer Key Question Three. The goal of reporting is then transposed to evaluate the stated goal for alignment with the OSHA goal and to answer Key Question Four. The goal of reporting is examined through the lens of motivation to

take action when an incident occurs and through the Process Practice Purpose principle. Finally, a summary of the content is presented at the end of the chapter.

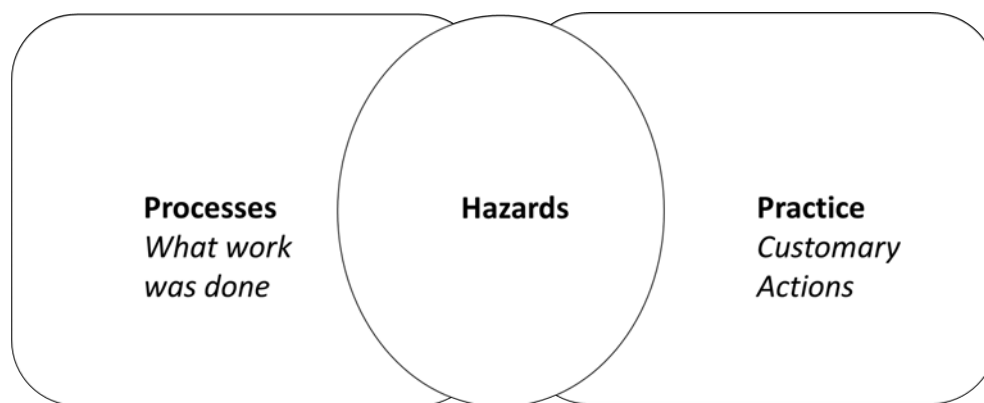
### **How a Hazard is Described: Key Question One**

*In what ways do workers in aircraft ground operations and petrochemical operations describe hazards of the work environment?*

The hazards that workers encountered are examined in this section to answer Key Question One. Data about the hazards, the process to do work (the “what”), and work practices (the “how”) are used to answer Key Question One. The practice of performing work and the processes used to do the job were central constructs necessary to frame and present the findings within the work environment context because near miss incident events occurred in the process of doing work and in the presence of hazards.

The central focus of organizing the findings was to present the descriptive stories of near miss events within the natural work settings amidst the work activities and existing hazards.

Figure 5 illustrates the context in which the major themes originated in terms of what was done and how work was done amidst existing hazards.



*Figure 5.* A representation of the context in which major themes emerged.

The hazards that participants described were categorized into three types: (a) Physical, (b) Chemical, and (c) Hazards that exist in the surrounding work environment. Other hazards were associated with the capacity to perform work but were not directly acquired from within workplace settings. Some hazards were common to both workplace types, while other hazards were specified. For example, stress was explicitly stated by petrochemical participants and implied by participants in aircraft maintenance. Participants were able to identify and describe hazards with minimal effort, indicating a measure of familiarity with and knowledge about visible and invisible worksite hazards.

Over time, knowledge about hazards developed alongside experience and training. The advancement of knowledge progressed through time, training, and experience. Hazards were mitigated through both formal established practices and informal methods. Each of the three hazard categories identified—Physical, Chemical, and Hazards that exist in the surrounding work environment—are examined in the sections that follow.

Workers are vulnerable to hazards when unforeseen and unrecognized potential exists within workspaces where multiple jobs are in progress. Multiple job activities in progress mean that workers are susceptible to unforeseen hazards by virtue of being in the surrounding work environment. Hazards in the surrounding work environment (HaSE) are recognized through training, mentorship, and experience.

Beyond the recognizable physical and chemical hazards, HaSE mean that workers new to the environment may be susceptible to the potential of unforeseen job activities that may shift over time when multiple jobs are in progress within the same workspace. Examples of such potential include poor communication and coordination amongst work crews, or under-

development of the skill to recognize how sudden changes in environmental conditions such as wind shifts impact the work task. Other examples include insufficient knowledge and training about hazards that develop in the absence of developing routines to follow procedures such as isolation and lockout tagout of hazardous energy sources.

### **Physical Hazards**

Physical hazards that were recognized signaled an alert to personal safety. The alert was acknowledged in either of two ways: with an action to mitigate the hazard or a response to take no action. When physical hazards were acknowledged, the interpretation and call to action that resulted were as varied as the workers. Participants described hazards associated with both work environments. Some hazards were more visible than others. Participants' descriptions of housekeeping, fatigue, stress, the commute to work, and the density of jobs within the workspace are examined as physical hazards in the next section.

**Housekeeping.** Participants identified poor housekeeping practices as a prominent physical hazard. For example, actions to mitigate housekeeping hazards were applied when the value of housekeeping practices was recognized, implying that in the alternative, housekeeping deficiencies were either unrecognized or the decision to act was waived. Participants recognized that good housekeeping practices support hazard mitigation by removing obstructions that are unexpectedly encountered in work areas. The value of housekeeping is practices described in Table 4.

Table 4  
*Housekeeping Principles and Hazard Identification*

Aircraft Maintenance	Petrochemical Operations
<p>It's the individual. How much care do you take to make sure that you remove all hazards. We have grease rags and stuff. "Did you put it in certain barrels?" "Nah, I'm not gonna' do that. I'll put it in the trash." That's not right to the individual that knows rags should, no matter what it is, should go in a barrel. And it's a hazard. And don't put it in the trash. [S7]</p>	<p>In the areas that you work, whenever you have steam, the water goes on the ground, or if it isn't routed to the sewer or something, that hot water, algae builds so fast, grows so fast on those puddles. So, you can just keep walking over it every day, and before you know it, someone is gonna' slip. Housekeeping is so big. [S6]</p>
<p>Participants recognized value in maintaining workspaces free of obstructions. When obstacles to good housekeeping were recognized as hazards, participants decided to act or take no action to mitigate the hazards.</p>	

**Fatigue, stress, and the commute.** Fatigue was common to both work environments. Component parts of fatigue include the demands of shiftwork: 12- and 16-hour work shifts and changing shift periods associated with shiftwork design, overtime, and shift trades. Fatigue was extended by the commuting distances to and from work. In the process of doing work, the volume of workers was bounded by shared and congested workspaces. Participants also expressed a heightened awareness about the influence of fatigue and long commutes on safe work practices.

Although not directly described by participants in aircraft maintenance, stress was implied through descriptions of near miss experiences. An example of implied stress, as described by one participant, was knowing the ramifications of leaving a tool on an airplane and catching the error before launch. Participants in petrochemical operations explicitly described experiences of stress. One participant expressed that, after a week of work, the transition to days



off was akin to post-traumatic stress. Participants' descriptions of fatigue, stress, and commuting are identified in Table 5.

Table 5

*Fatigue, Stress, and the Commute as Physical Hazards*

Aircraft Maintenance	Petrochemical Operations
<p>They used to put your picture on the wall when a guy had died. They'd put it over the time clock. You come in and then you see the picture. I came in and I saw his picture on the wall, and I knew he died, by just the picture being there. And the first thing I said to someone, "Did he fall asleep?" That commute was one of the toughest things for me, was going home at night, and I was falling asleep. I had common sense enough to stop on the side and take a nap. Yeah, that problem, it was one of the biggest hazards. I find that it was easier for me to work 16 hours on Days, on Swing Shift, than it was for me to work 8 hours on Midnights. You try to avoid being the one responsible because you're sleepy or something. In some ways, you protect yourself and the people around you. Or, if you have to do something that could cause harm, you grab someone, and you have them assist you, or you give them direction in any way. [S7]</p>	<p>Sometimes you're doing longer shifts than normal, coming in on your days off. A lot of people have long commutes. My commute was over an hour drive back and forth, so a 12-hour shift was more like a 14-hour shift for me, and even longer if I'm stuck in traffic. Some of the hazards of the job are being exposed to hydrocarbons, potentially carcinogens. There is a risk of fire, gas leaks, fuels, fatigue, stress. There is also loud noise, so that you gotta', some places require double hearing protection in certain areas. [S1]</p>

(Table 5 Continued)

Aircraft Maintenance	Petrochemical Operations
I've been exposed to quite a few near misses. From that whole spectrum that I pointed out earlier, from leaving a tool on an airplane if you hadn't run up and catch. [S2]	Normal process hazards in the refinery were, like I said, heat and you know, just that stress, the level of stress that you get working around that kind of stuff. And then as a management person, it, you get out of some of the physical hazards and you get more into the, the stress level is tremendous. And one of the things that I worry about the most was somebody getting hurt. When nobody got hurt? I think you get this almost post-traumatic stress thing every time you get your days off, where, you just, you know, you've been living on the edge of all this pressure, and then, all of a sudden, you're off, and it's a real low. You're on a high and then you go to a low and it's kind of a shocking physical thing. [S3]
Participants identified that working shiftwork, working extended shifts, and commuting long distances contributed to fatigue. Participants who were supervisors described stress in explicit and implicit terms. Participants described hazards in association with past experiences within and outside of the workspace.	

**Multiple jobs within the workspace.** Multiple jobs were active at the same time within limited areas. Participants referred to past events and experiences within crowded spaces to illustrate and explain the parameters of a near miss. Participants described hidden hazards based on prior experiences in the workspaces, and participants developed a level of hazard awareness consistent with experience. The described experiences combined to compose each individual participant Type-X event and define a near miss.

Participants acknowledged learning from experiences with hazards when multiple people were working in the same workspace. Exposure to live and active systems while working the job

created hidden hazards in shared workspaces where lockout tagout procedures were not used. Both visible and invisible physical hazards were active, such that conditions were subject to change. Participants cited awareness of the surroundings, timing and chance, and lockout tagout procedures as precursors of injury. Participants' descriptions of hazard awareness and learning within shared workspaces are described in Table 6.

Table 6

*Hazard Awareness of Visible and Invisible Hazards in Shared Workspaces*

Aircraft Maintenance	Petrochemical Operations
<p>You got some cross-utilization issues where you could be putting somebody at risk unknowingly, and your actions can actually hurt somebody else and somebody else's actions can actually hurt you because you're not 100% aware of what everybody else is doing. [S2]</p>	<p>Also, we do a lot of work with our hands, and you have to be, especially when you're working with another person? You have to be aware, you know, if you've got a 4-pound mallet, and you're going to hit, say, we call 'em wedges? And you just have to make sure that both you guys are on the same page, that if he's gonna' be swinging the mallet and you're gonna' be trying to hold the blind or hold the striking wrench, you use the right equipment? You have to just be really aware. You can't be asleep, you know, at 3:30 in the morning, trying to do this kinda' work. You have to be fully focused or else someone gets hurt. It happens way too much, you know? [S6]</p>
<p>A sheetmetal technician that was working on the [landing gear] door, and they were running hydraulic systems, and they had cleared everyone, except this individual thought it would've been fine for you to be in that situation, and he was inside. He was laying in the door itself. That day, there was a certain situation that wasn't looked at, and luckily, the individual was okay since there was enough, enough space between the aircraft fuselage and the door, if the door came up. I was actually involved in bringing the door back down by attaching a hand pump to the brake to release the brakes that the doors will still come down, and the individual came out of there. [S5]</p>	

(Table 6 Continued)

<p>And the ground person that was on the ground in that particular area gave the okay to bring the hydraulic system up, knowing that this individual was working, and they assumed that the safety precaution was taken, that the door will bring up and down. But knowing that, they bypassed one little safety procedure that wasn't done. From then on, to ensure that that particular Cannon plug was removed and tagged with the warning tag, so such an incident will not repeat. [S5]</p>	<p>When I think about the near misses I was personally involved in, the only thing that made the difference was time. If somebody had dropped something 2 seconds later? There would have been a serious injury. So, I mean, honestly, it's just timing. You have to have everything lined up just right. And if something's not lined up, if someone's not standing in the wrong place at the wrong time, then the injury doesn't occur. So, yeah, it's not an engineered event, there's a lotta' chance to it. [S3]</p>
<p>Participants demonstrated keen knowledge, awareness, and coordination associated with learning about hazards when multiple people were working in the same workspace. Participants described exposure to active systems without positive shutoff lockout tagout that created hidden hazards in shared workspaces.</p>	

A Type-X event is the term introduced during the one-on-one individual interviews and used to describe an incident that almost resulted in an accident. As recollection of hazards developed, participants were reminded to not describe incidents that resulted in injury or damage to equipment or the environment. The chemical hazards that participants described are examined next.

### **Chemical Hazards**

The second prevalent hazard type that participants described was the chemical hazard. Chemicals in use were likely to burn, cause fire, or inflict injury to eyes, hands, and respiratory systems. Knowledge about the potential for injury was acquired through experience, training, and a regard for personal safety. Participants were knowledgeable about the sources and use of chemical safety facts, as well as how to apply knowledge to the job function. Participants acted

purposefully to mitigate chemical hazards. Participants described change in exposure to chemical agents over time. Personal agency and managing chemical hazard exposure over time are examined in the sections that follow.

**Purposeful actions against chemical hazards.** In response to mitigating chemical hazards, participants demonstrated personal agency to take action to prevent personal injury. Participants utilized chemical safety data from Safety Data Sheets, donned personal protective equipment, and referenced past experiences as personal safety safeguards while working in chemical hazard environments. Participants regarded the decision to act to mitigate chemical hazards as a matter of individual regard for personal safety. Characteristics of personal agency and reflection on past experiences associated with chemical hazard potential are identified in Table 7.

Table 7

*Personal Agency to Take Action in Chemical Hazard Environments*

Aircraft Maintenance	Petrochemical Operations
<p>A lot of the times, experience counts. If you never see something happen, you can't make a decision. And plus, attitude. A big thing is your MSDS, your material database. It'll tell you, "This material will cause breathing problems" or "You don't want to walk on it." So, it is good to know what material you're dealing with. [S7]</p>	<p>A bleeder valve was left open, and in a quick ditch effort attempt to shut it and stop it, jumped into the ditch area and shut the valve off real quick. They were able to basically divert an explosion or major gas leak that could have resulted in a catastrophic failure. Fortunately, nothing happened to them and they were able to get the valve closed, but it could have been a very disastrous incident. I was standing pretty close to everything that had happened. Had that guy not have gotten that valve closed in time, that probably could have directly affected me. I think your own personality plays a role in that too. Are you the type that is going to react and jump into that ditch at the time to try and shut that off? Are you the type of person that's just going to run and maybe, call for help? [S1]</p>
<p>Worked with a lot of hazardous fluids and hazardous materials like grease and hydraulic fluid, fuel, engine oil, and of course, a lot of high intensity sound, noise. And as far as other protection goes, working with hydraulics or safety wire or anything that's gonna' fly into my face or my ear or my eyes, I would wear goggles, and sometimes goggles with face shield, which were required. Or, I'll wear it for my own protection, regardless. I thought that it was for my own personal benefit. [S5]</p>	<p>I can think of numerous times when there was a process variable going on, and if it hadn't been corrected, it would have resulted in potential injury or equipment damage, and for the fact that there's an operator there who sees something happening and then stops it? That's the difference, and that's why we're there, really. [S3]</p>
<p>Participants were knowledgeable about chemical hazards that compromise respiratory systems and have potential for catastrophic effects on personal safety and equipment. Participants demonstrated personal agency to act to reduce exposure. Participants also respected the production process and systems such as hydraulics for the potential to injure or cause damage.</p>	

**Change in exposure to chemical hazards over time.** Participants identified observations about chemical hazards over time. The practice of how work was done in the presence of chemicals and perceptions about the hazards that chemicals presented have changed. For example, based on increased personal awareness and experience, chemical process lines represented newly recognized potential for spontaneous leak and line rupture conditions. Participants evaluated change by reflecting on past experiences in comparison to more recent practices. Milestones in incorporating the use of engineering controls and in wearing personal protective equipment were recognized as safeguards that were implemented over time. Participants recognized changes in attitudes toward process safety. Table 8 describes participant perceptions of exposure to chemical hazards.

Table 8  
*Change in Perceptions of Exposure to Chemicals Over Time*

Aircraft Maintenance	Petrochemical Operations
<p>I remember back in the days, we never had hydraulic recycle, and that was not a good thing, and over the years, we've been asked to contain them. They have modified the equipment so certain incidents won't happen. If it was hazardous material, they've come up with a better way to contain them. Every time we did work, we always clean as we go so the hydraulic fluid doesn't spread elsewhere. Try to contain it with proper containment, whether it be a drip pan. Use a drip pan so it doesn't get into the dirt or concrete or bucket, plastic bags, use of absorbent materials. That's one of the huge experiences in my years that I've seen, just with that one hazardous material. [S5]</p>	<p>You use a lotta' chemicals. And there were smells. There're some chemicals you can't detect. You can't, so you have to protect yourself by using protective gear before you even enter the area. [S4]</p>
<p>Or, you're around a pneumatic system that is powering the air conditioner and you're looking for a leak, and you put yourself in a position where you can get burned by leaking air or being in the area where there's any kind of explosives, ruptures, any of the piping, you can get hurt. You also got risk with hydraulics, 'cause hydraulics have high pressure fluids that are being pushed through hydraulic lines, and most of those types of issues that you're looking for leaks, and if it's in a line, the leak can spray with a lot of force in a very small stream. It can puncture your skin and inject you. [S2]</p>	<p>When I was an operator, more immediate hazards were chemical. When you compare the hazards and the Type-X incidents when I first started in the 90s? Compared to the way it was when I left? The entire industry is so much safer, it's incredible. The kind of incidents that routinely went on, and the attitudes about how to behave during the incidents? It's drastically different now. And it's so much safer, it's incredible. I'd seen so much. We haven't had the level of hazard. In the old days, there was a couple times a week there'd be something major happened, and now? Maybe a couple times a year, something that I would consider major happened. So, it's definitely improved, and I don't think you can argue with that. It's definitely safer than it used to be. [S3]</p>
<p>And of course, a lot of dangerous chemicals, especially H<sub>2</sub>S, hydrogen sulfide. Probably the main hazard out there is when a pump seal would rupture. That's the most prevalent problems that we find in the refinery. You have to catch it when it first starts. That was pretty much my job, to walk around, look at equipment, find these little problems in their initial stages. [S6]</p>	
<p>Participants chronicled change in managing exposure to potential chemical release conditions over time. Participants recognized milestones in engineering controls, personal protective equipment safeguards, and attitudes toward process safety, and protecting the environment against chemical releases.</p>	



### **Hazards in the Surrounding Work Environment (HaSE)**

The third and final classification of hazard that participants described existed within the surrounding work environment. Job activities were changing and shifting relative to the workspace, and participants acted to mitigate potential incidents. The activities that occurred within the workspace presented potential consequences for everyone. After near miss events occurred, safety precautions and new procedures were adopted. Participants described hazards in terms of relationship to the potential for incidents to occur. They also explained how new hires must be trained to develop routines related to isolating hazardous energy and how experience, training, and mentorship are related. Participants then explained that experience is an element of hazard recognition.

**Inadequate training and mentorship to identify HaSE.** Participants identified training and mentorship amongst the hazards related to incidents. Participants recognized that new hires must be trained and mentored in developing routines to verify hazard isolation. Participants in aircraft maintenance who were mentors recognized the value of training new hires to develop the principle of following procedures to the letter and following lockout tagout of hazardous electrical energy.

Participants in petrochemical operations recognized through early experiences that experience is a necessary component of mentorship; job qualification by itself does not equate to experience, and mentorship requires experience. Participants explained that mentorship extends beyond qualification. Attributes of mentorship and training about hazards are described in Table 9.

Table 9

*Inadequate Training and Mentorship to I.D. Hazards*

Aircraft Maintenance	Petrochemical Operations
<p>We always would take the time and make sure that they [new hires] know all the safety hazards. Number one is that you print out the procedure. You go from top to bottom, and all the safety features. Did you pull that circuit breaker? Did you do this? The first time, before you start. And sometimes, it's pulled, but you want to get them in the habit of doing it. Now, maybe, I would say, "Well, since the plane's been here for the last week, and normally we have a card to do this, so you don't have to do it." I will never say that. I want you to go and find it [the circuit breaker that is pulled]. [S7]</p>	<p>This is an actual incident that happened, right? So, what happened was, after [training] class, you go back to your team. You'll either be on the Process [unit], learning the unit, or you'll be in a mechanical job, turning wrenches. So, you have a three-week mechanical. They [newly trained] went back to their mechanical team after 3 weeks. We rolled into Process for 2 weeks, I got signed off as a tech. They wanted me to train the [mechanical team] guy. That's ridiculous, you know? "I don't know, I know enough to get by on the unit, but I don't know enough to train anybody yet. I've only been doing it for 2 weeks!" So, I tried to do the best I could with it, but that really did that guy an injustice by me, making me his mentor when I only have 2 weeks' experience. When they say to you, "Wow, you just signed off as being qualified," I go, "Yeah, but I got no experience." It's ridiculous. I was really upset about that. This happened this one time to me, and I didn't think that was right at all. [S6]</p>
<p>Participants described elements of training and mentorship that new hires need based on past experiences and knowledge. Participants explained that training includes establishing routines, such as printing out the procedure for the job. Participants in aircraft maintenance identified the importance of mentoring new hires to develop the practice of verifying that hazardous electrical energy is isolated.</p>	

**Acquiring experience in hazard recognition.** Work activities are ever changing, as well are the workers whose experiences vary in performing different work tasks. Skill in recognizing the potential of HaSE develops over time, but when mentors are not experienced enough to even recognize the value of awareness to HaSE, the recipients of the training are less

equipped to prepare for hazard potential that develops and must learn from experience. Not only does a lack of attention to the value of mentorship develop hazard potential for the recipient, but a low value of training and mentorship signals a persistent practice of learning through experience over time. Participants described hazard recognition in terms of experience. Through experience, participants developed principles to recognize hazards that extended beyond the boundaries of the work environment. When it comes to assessing incident potential, participants described that subject matter experts who have vast experience lend insight when decisions are made to repair critical systems. Participants recognized that experience develops over time, that technical book knowledge is a supplement to experience, and that a loss of experience follows attrition. Participants adopted and applied principles of hazard awareness beyond the workspace environment to daily life. The role of experience in developing knowledge about hazards is described in Table 10.

Table 10

*Acquiring Experience in Recognizing Hazards*

Aircraft Maintenance	Petrochemical Operations
<p>You basically look at it [the hazard] and try to make a determination based on your experience. You don't want somebody that's only got 18 months of experience working on an airplane making a decision that they need to proceed forward on a risky repair. You wanna' seasoned mechanic who's got the authority to make that type of decision, because if you don't, that program's completely worthless. For safety aspect, then, I'm looking for a participants matter expert. Somebody who's got experience working on that system. And not just a little bit of experience, but vast experience, similar types of conditions that they've had to work through in the past. [S2]</p>	<p>In my earlier years, you don't know nothin'. I didn't know what to expect, to be honest with you, but I think experience gives you better information than anything could ever give you; a book or nothing. But you need book training, just to begin the job. Can't go out there just dumb, happy and dumb. In the later days, I had more information to contribute to my Board [operator], and that only comes from experience. [S4]</p>
<p>What I'm saying, you practice it at work, you normally take it home also when you're doing tiny matters. If I have a ladder, I would look at it and say, "Okay, I'm 10 pounds above the maximum weight of this ladder. Should I use it? If he wasn't in the habit of doing that, he would just climb up the ladder. Now you go to the store and you say, "I need a ladder that legally would be in the weight range." So, you're in the habit of using the right equipment for the right job. That's the norm. You develop a norm. [S7]</p>	<p>As you begin to progress through your career, all the experience starts leaving. People retire, you start losing a lot of experience. So, you have to be sure that you do it right. So the people coming behind me, I was always trying to show 'em the right way to do things. There's always a few shortcuts you can take, do it a certain way, but you don't wanna' do that if you can help it. But the experience factor is a big thing too. You gotta' keep an eye on your new people. They should always be out there with someone who's experienced, or you can trust to train 'em right. [S6]</p>
<p>Participants described that hazard recognition is acquired through experience and explained how experience declines through attrition. Participants adopted principles of hazard recognition that transfer beyond the work environment and are utilized in daily circumstances.</p>	

### **How Hazards Act as Intrusive Obstacles to the Work Process: Key Question One**

*In what ways do workers in aircraft ground operations and petrochemical operations describe hazards of the work environment?* Hazards were described as intrusive obstacles that disturb or hinder the work process; are not limited by a physical, visible presence; and are not always manifest as such. When a hazard was recognized, participants evaluated the degree of obstruction or potential for interruption to the process before deciding to take action or not to mitigate the hazard. Participants described hazards in a variety of ways and classified them into three broad categories according to appearance: (a) Physical, (b) Chemical, and (c) Hazards in the surrounding work environment (HaSE).

Participants went beyond classifying hazards by appearance to describe hazards in terms of attitude. For example, unmitigated housekeeping deficiencies may or may not be recognized as such, and the decision to take action or not in applying a corrective measure is implied as attitude towards hazard mitigation when a deficiency is recognized as a potential hazard. Participants also recognized that not all hazards manifest visibility.

When compared to other hazard types, physical hazards are more visible and as such, command more urgency to resolve. Hazards described as undetected by visible appearance alone, or the lack thereof, include some chemical fluids and gases. Beyond chemical hazards, participants described other hazards that influence the capacity to work. Demands of shiftwork, the commute, housekeeping practices, fatigue, and stress influence work practices. Participants acted purposefully to follow procedures to the letter and to don PPE to prevent infliction of potentially damaging injuries from chemicals.

Participants observed that processes to handle hazardous chemicals included more safeguards to process safety and the environment over time. When it comes to personal safety, participants acquired skills in hazard recognition through experience. Participants learned about the potential of existing hazards through experience. Some HaSE are less immediately recognized. Such is the case for training and mentorship.

Participants recognized when the present levels of knowledge and experience were insufficient to support the role of trainer and mentor after a minimum period of being qualified on the job. Participants demonstrated that hazard recognition is an action of observation. The skill to recognize is acquired through experience. Participants expressed how demand for experienced mentors is stated in as simple a term as recognizing that the present level of knowledge is insufficient to assume responsibility to undertake a job. The hazards that participants described are presented in Figure 6.

### **Description of Hazards in Aircraft Maintenance and Petrochemical Environments**

- Hazards are recognized as intrusive obstacles that disturb or hinder the work process, are not limited by a physical, visible presence, and are not always manifest as such. (Reference Table 10, Acquiring Experience in Recognizing Hazards; Table 15, Training and Mentorship Through History)
- Hazards are classified into three broad categories according to appearance: (a) Physical, (b) Chemical, and (c) Hazards in the Surrounding Work Environment (Reference How a Hazard is Described: Key Question One)
- Hazards are described in terms of worker attitude towards hazard mitigation when a deficiency is recognized as a potential hazard. For example, the decision to take action or not in applying a corrective measure to resolve poor housekeeping when deficiencies are recognized is implied as attitude. (Reference Table 4, Housekeeping Principles and Hazard Identification)
- Physical hazards appear more visibly and more prominently than other hazards, and as such, command more urgency to resolve. The decision to take action or not to mitigate physical hazards is variable. (Reference Table 4, Housekeeping Principles and Hazard Identification)
- Hazards that influence the capacity to work include the demands of shiftwork, the commute, housekeeping practices, fatigue, and stress. (Reference Table 5, Fatigue, Stress, and the Commute as Physical Hazards; Table 4, Housekeeping Principles and Hazard Identification)
- Purposeful actions that include following procedures to the letter and donning PPE are applied to prevent infliction of potentially damaging injuries from chemicals. (Reference Table 7, Personal Agency to take action in Chemical Hazard Environments)
- Discernment of hazards is acquired through experience. Knowledge of the potential of existing hazards is developed through experience. (Reference Table 10, Acquiring Experience in Recognizing Hazards)
- The demand for experienced mentors is stated in as simple a term as recognizing that the present level of knowledge is insufficient to assume responsibility to undertake a job. (Reference Table 9, Inadequate Training and Mentorship to I.D. Hazards)

*Figure 6.* Participant descriptions of hazards.

## How a Near Miss is Defined: Key Question Two

*How is a near miss incident defined amongst workers in aircraft ground operations and petrochemical operations?*

### Elements of the Near Miss Definition

The definition of a near miss incident event was expressed according to the perspective of the individual, and each participant had experienced near miss events. The definition was guided by experience, personality, knowledge, and personal agency to take action when an event occurred. The definition was dependent on the outcome of the event, and the event was categorized based on severity. In other words, participants qualified the degree of the expected outcome by post-assessment evaluation and then concluded how serious the event could have been.

The definition of a near miss incident event contained the following elements. Each element is listed in the order the interview was conducted.

**Knowledge of the potential for equipment failure or not.** You know that the seal's starting to go bad, and then that seal does or doesn't go bad. Well if it doesn't go bad, then that's, well something that could've happened but didn't. Or if it does go bad, it's something that you knew was going to go bad that did go bad. [S1]

**Action or no action against an adverse event resulting in no serious injury or equipment damage.** If something happens that's undesirable, that something is done about it or it just doesn't result in a serious injury or equipment damage, I think that's a near miss. The term "near miss" is tricky these days because we've really, in recent years, they have gotten away from the term "near miss" because anything undesirable that happened was considered an incident. [S3]

**Actions against events that almost resulted in or caused no major injury or accident.** For things that almost were, but didn't cause major injury, or accident that we were able to alleviate, whether it was by dumb luck or effective, preventative measures, I call it a near miss. That's basically a near miss. [S2]



**The beginning of an incident that did not materialize.** And near miss is that somebody came close to having an incident but didn't result in an incident. So, the near miss is the beginning of everything [S4].

**Preparation for a sudden external disturbance with potential to injure.** If you are not careful and don't have enough individuals handling it [aircraft aileron] while you're trying to install it on the aircraft itself, it doesn't take much of a gust of wind for the whole aileron to get out of control and hurt someone. [S5]

**Training into perpetuity.** It's mostly a thing that you need to be familiar and train well. You can't have enough training for those incidents. [S7]

**An event that includes injuries that are not major.** We used to call 'em near misses at my refinery. If maybe something would happen where you're pulling on a wrench and it slips, and you hit yourself with it or hit the guy next to you. You get a bruise, or you hurt your hand, but there's no broken bones, no lacerations, they call those near misses, when someone coulda' really, if they break a bone, you can't come to work, so you get a recordable incident. [S6]

The data elements of a near miss that participants described combine to form the near miss definition.

### **The Near Miss Definition**

A near miss is the beginning [S4] of an unexpected [S1, S6] and undesirable [S3] event that nearly [S4] or almost [S2] caused major injury or an incident [S4] and *may* have resulted in *no major or serious* [S6, S2] injury or equipment damage [S3]. A near miss includes minor injuries [S6]. A near miss is alleviated by conscious awareness [S5], prior knowledge [S1], training into perpetuity [S7], and dumb luck or effective, preventative measures [S2]. The definition of a near miss (known as "the stated definition") is used in the next section to examine how participants interpreted the goal of near miss reporting.

### **How the Goal of Near Miss Reporting is Interpreted: Key Question Three**

*How is the goal of near miss reporting interpreted amongst workers?*

#### **Elements of the Near Miss Reporting Goal**

The purpose of reporting an incident was linked to personal safety. The goal of reporting an incident event was explained in terms of benefit to the people, the process, and practice.

Participants referenced benefits to personal safety to describe the goal of reporting an incident.

Participants did not separate incident types when describing the purpose of reporting. In other words, major and minor incident classifications were not used to explain the goal of reporting a near miss. The goal of reporting an incident event contained the following elements, listed in the order in which the interview was conducted.

**Shift-to-shift communication of local events is applied in future troubleshooting.** Something that's just as simple as changing a line-up or maybe, just a small power blip, something that may not necessarily have affected the entire unit. But at least they [next shift] know about it if they have another power blip or full power outage. "Hey, there're some other issues that happened on the previous shift that maybe, was tied to that," or could help them in troubleshooting. [S1]

**Collect and communicate detailed incident data to recognize details, and apply to future learning in preventing or minimizing future prospects.** You need to gather the information so that whatever the incident was could be avoided if it happened again. So if you learned the series of events that lead to the Type-X incident, then that may allow you in the future if you could communicate that information to the people that need it, they may be able to break the chain in the chain of events and stop it from happening again, or reduce the severity of it happening again. [S3]

**Balance the protection and conservation of resources with the management of incident potential by employing engineering and administrative hazard controls.** The purpose of it [reporting] is to try and control mishap potential by any means necessary, whether it's management oversight or training, re-training, or re-designs, engineer-out any type of mishap potential. But it's all about protecting people and equipment to conserve money and resources, and making sure people are safe enough to go home at night to see their family. [S2]

**A warning that equips others to apply the lesson in the same environment.** It [reporting] warns people and lets them know what happened, and then, that way, they can be prepared when they go out in their area. [S4]

**Prevent recurrence by communicating to all affected by the system and applying remedial training.** The purpose, first of all, ensure that it never happens again, and make sure that all personnel involved know about the incident, and, if there's a re-training required, then there'll be re-training done on individuals that need to be re-trained on certain systems, so they are more aware of the safety aspects, so there's no other incident in the future; to prevent an incident or incidents. [S5]

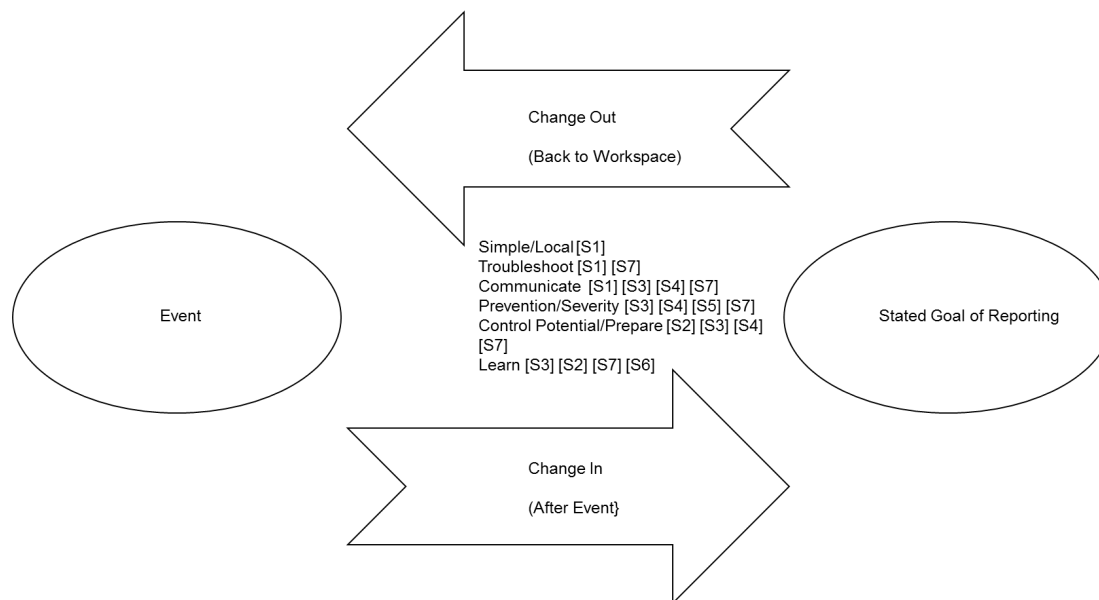
**Broadcast and signal events of serious consequence in documents such as procedures to all affected by the system.** And if it's [the Type-X event] that serious, everyone that's doing that job from that day on would know about it. Possibly making you pull out an update of the procedure as you're working, to actually look out for that, so you know the possibility, "this can happen." [S7]

**Seek out change in a process that does not work.** If you keep doing the same thing the same way, and the same problem keeps happening, you need to adjust that. Something's not right. You need to find a better way to do it. Like I said, if the guy's gonna' back his truck up and hit this cement pole, you just don't wanna' keep doing that every day, so you try to mitigate that, and you put on some reflective tape or something that helps him to avoid that. [S6]

The data elements of the incident reporting goal that participants described combine to form the stated goal of incident reporting:

### **The Stated Goal of Incident Reporting**

The stated goal of reporting an incident as simple as a localized event [S1] is to communicate [S1] [S3] [S4] [S7] that an event has occurred and to signal that change is needed [S7], to prepare to control [S3] [S4] [S7] the potential for recurrence [S2] [S3] [S4] [S5] [S7] by actively learning [S3] [S2] [S7] [S6] and balancing resources [S2]. Based on the findings from the participants, the goal of reporting an incident is illustrated in Figure 7.



*Figure 7.* The stated goal of incident reporting.

A variety of workspaces existed within the work environment. Physical and chemical hazards, and hazards that developed by virtue of the work itself were present within the workspace environment. Participants were knowledgeable about the physical and chemical hazards that existed. Participants relied on experience and training and adopted personal agency to take action to mitigate hazards.

Job activities were done where hazards existed and in the midst of active processes. Participants recognized the potential for incidents to occur. The goal of reporting incidents included active learning to preserve personal safety. The actions participants took after an incident event occurred are discussed in the next section. The findings were useful to explore the fourth and final research question.

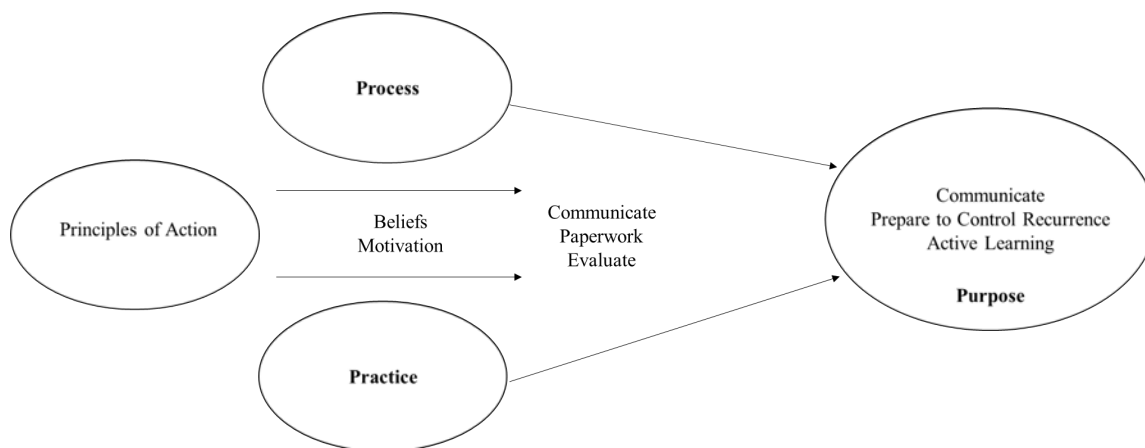
### **How Reporting is Related to the OSHA Goal: Key Question Four**

*In what ways are reporting the occurrence of an incident related to the OSHA of identifying hazards and preventing the recurrence of an incident?*

The findings from the previous sections are examined to answer the fourth and final research question of this study. In the first part of the chapter, participants described hazards, defined a near miss event, and described the purpose of reporting. A near miss event was defined according to the perspective of the individual. The purpose of reporting an incident was linked to personal safety. The purpose of reporting was established as:

The stated goal of reporting an incident as simple as a localized event [S1] is to communicate [S1] [S3] [S4] [S7] that an event has occurred and to signal that change is needed [S7], to prepare to control [S3] [S4] [S7] the potential for recurrence [S2] [S3] [S4] [S5] [S7] by actively learning [S3] [S2] [S7] [S6] and balancing resources [S2].

The approach to present the findings examined the processes and practices participants used when an incident occurred. The actions that participants applied after an incident event were examined in relation to the stated goal. The stated goal was examined to evaluate alignment with the OSHA goal. The OSHA goal is to identify hazards and prevent the recurrence of an incident. The processes and the customary actions of practice and purpose that make up the reporting system are illustrated in Figure 8.



*Figure 8.* Process practice purpose concept for reporting an incident.

The action of reporting served multiple purposes. Sometimes, the path to the goal of reporting an incident included transformative experiences from which participants adopted lasting principles. The elements of process and practice within the reporting system were connected to the stated goal by what participants believed and by what motivated participants to take action.

The motivation to act depended on what participants believed and what the stated goal was at the time. The goal of reporting was not static. The findings were presented by separating what participants do, how participants are motivated to act, and what participants believe. The next section examines the three attributes used to evaluate the goal of incident reporting: (a) Motivation, (b) Belief, and (c) History and Purpose.

### **Association Between Worker Actions and the Goal**

The actions that occurred after an incident were associated with beliefs and experiences that participants had developed over time. Three attributes appraise the goal of incident reporting: (a) Motivation, (b) Belief, and (c) History and Purpose. The attributes overlapped

multiple actions. In other words, participants shared similar perspectives of meaning and purpose. The relationship amongst the motivation to act, what participants believe, and history and purpose are examined to answer the fourth and final research question. Details of the four attributes are described in each section.

**Motivation.** Motivation coincided with a variety of actions that participants described. Participants were motivated to learn and share incident experiences amongst co-workers. Participants frequently shared Type-X experiences with co-workers and less frequently or not at all with supervision. Participants referred to technical manuals and knew the process to correct identified errors. When situations did not “look” right, participants learned to inquire further.

Participants in aircraft maintenance expressed more openness in sharing incidents, both formally and informally. Participants described cross-talk, start of shift safety meetings, and daily work crew briefings as examples of opportunities to discuss continuity of work and to share experiences in aircraft maintenance.

Participants in both industries described ways in which sharing has potential to result in negative and positive outcomes, and how attitudes toward sharing change. Participants developed perspectives about reporting, and experiences with incidents changed perspectives. With experience, participants developed resolve to adhere to principles.

Participants retained indelible memories from the Type-X incident experience and continued to share experiences over time. Participants were motivated to act by considering the value of personal safety. Participants believed in the value of personal safety. When an incident occurred, participants referenced experience and training to know what actions to take. Experience and training were highly valued to mitigate incident events.

Opportunities for training existed when an incident occurred. The descriptions in Table 11 illustrate the value of personal safety as expressed through the action of sharing. The descriptions in the table also imply association between the actions toward the goal of communicating incident occurrences and the motivation to share or not.



Table 11

*Motivation to Share Experiences and Learn*

Aircraft Maintenance	Petrochemical Operations
<p>In my earlier years, I'm learning the system, and I would always ask questions. I actually recall a real, real bad incident where I had asked questions. The individual I had asked, he blew me off. That actually taught me to ask questions, but learn about it from books. And, from then on, it actually made me a better person. It was very important to me from then on to read the technical books myself. I shared that [incident experience] with many, many, many individuals throughout my career because I was told wrong, and to forget about it; that I didn't know about it because it was not my system, and so I didn't tell anybody 'til the actual incident happened. That particular incident changed my way of thinking. [S5]</p>	<p>Not generally [shared a Type-X experience with anyone], or maybe, half the time, shared with co-workers, but the rest of the time, not at all. So, a lot of things back then, were kept from management because we just didn't need to have the scrutiny. We didn't want to be filling out paperwork. We didn't want to risk being punished for something that was not understood by management 'cause they didn't fully comprehend some of the things we had to do to get the job done. [S3]</p>
<p>It's [reporting a Type-X event] very effective. It's a very effective way of getting things done. Even if you get... Sometimes, you get backlash. They say, "Well, we don't have time." And I said, "We'll make time." So, you don't back down. If it's that important to you, you continue, and make sure it's done. If you have time constraints or anything, and somebody says, "Well, you can't do it now." And is like, "No. It doesn't matter. You'll get it done." So, you don't let them get in your way when it comes to safety. So, you just stick to your guns, and you say, "This is what we have to do." [S7]</p>	<p>The process [to report an incident] is, if something's happened where something's dropped, if someone's hurt, if something goes wrong, we're instructed to leave the area and don't touch anything. You can't go back in and try and cover for yourself, thinking that you're gonna' get in trouble. You have to leave, you call your boss, and then they start the investigation. They get ahold of Safety and then Safety comes out, looks at what happened and then they do what's it called, a Safety Investigation? A lot of times, people say, 'Uh oh, I messed up. I don't wanna' lose my job.' That was the biggest thing, is people panic, thinking that they might lose their job because they did something unsafe. [S6]</p>
<p>Participants in aircraft maintenance expressed more available opportunities to share. Participants in both industries explained how attitudes toward sharing are selective. Experiences with incidents changed perspective. Participants developed resolve to adhere to principles.</p>	

### **Beliefs and Attitudes About Post-Incident Actions and the Job Audit**

Belief is another attribute used to examine the reporting goal. Participants believed that experience is the best teacher and that experience is required to recognize hazards to the extent that hazards are obstructive elements of the work process. Participants identified no substitute for experience and copious amounts of training to prepare for incidents. Participants in aircraft maintenance expressed that incidents were used as training opportunities.

Despite the recognized value in training, participants expressed that the delivery of the training affects how the message is received. Participants understood the relationship between publicizing an incident and the opportunity for training. At a petrochemical site, performing safety audits was credited to a span of time in which no injuries were recorded. The beliefs that participants hold about how incidents are used for training and the perceived benefits of safety audits are described in Table 12.

Table 12

*Beliefs and Attitudes About Post-Incident Action and Job Audits*

Aircraft Maintenance	Petrochemical Operations
<p>If it's [a near miss] generally a work-related-type thing, where it's work practices or safety standards and things like that, where I either knowingly violated a rule, or inadvertently failed to follow a step, it was used as more of a training opportunity that identified a defect, a deficiency in our training processes, that were broadcast across the organization? But if it was something that was incorrect tech data that was being used to repair an aircraft, that puts you at risk, that would get investigated all the way out, and even getting engineering and simulations and everything else involved, looking for potential damage indicators that you could be exposed to. [S2]</p>	<p>Just your experience [how you know what actions to take after a Type-X event occurs] and your knowledge of the [process] Unit and knowing what you need to do [after a Type-X event] to stop a leak or shut a pump off. [S1]</p>
<p>You can't have enough training for those incidents. It's mostly a thing that you need to be familiar [with], and train well. [S7]</p>	<p>You have to experience it to learn from it. That's the best way to learn, is to actually go through it. [S3]</p>
<p>So, the biggest thing in my opinion, with the way management manages the distribution of that information. If they arbitrarily brief it in a tone that demoralizes their workforce or makes it so that information doesn't seem important, and they'll think everybody's, "They'll think we're stupid," that type of thing. They'll take a derogatory connotation. But if it's presented in a way, and it's more of a learning, "I'm trying to protect you"-type thing, versus "You're stupid, you need to fix this"-type manner, it's a lot better received. [S2]</p>	<p>Unfortunately, sometimes people think they're [safety audit observers] gonna' get in your business, and then, "Well, we saw this guy doing something unsafe," and you talk to his supervisor and then, the next thing you know, you gotta' answer all these questions and go on some kinda' remedial training, 'cause you just didn't do it right. But, anyway, we tend to police our own, I guess you could say. Seems to work too. We haven't had an injury in a long time. I think, I forget when the last one was. Yeah, it really helped a lot. [S6]</p>
<p>Participants in aircraft maintenance recognized that the aim of the process of publicizing incidents is to correct deficiencies in training, but the way training is delivered determines how the message is received. Participants illuminated the value of experience required to assess and respond when a Type-X event occurred. Participants in petrochemical operations credited safety audits for the prevention of injuries.</p>	

### **Beliefs About the Principle of Reporting Itself**

The concept of managing the reporting goal itself is another characteristic related to belief and is used to examine the incident reporting goal. At the time an incident occurs, participants evaluated the incident to determine if the event rose to the level of a formal report. Participants felt comfortable sharing experiences of past incident events amongst themselves. Participants used different modes of communication, from cross-talk and shift turn-over discussions to phone calls, to convey that an incident had occurred. When it comes to making a formal report, participants described a lack of transparency in the process itself, accompanied by punitive effects.

Participants did not believe the goals of incident reporting are communicated with a level of sincerity. Participants theorize that a high volume of incidents signals the process may need attention and result in adverse impressions. Participants believe the level of knowledge required to understand the circumstances surrounding an incident is lacking at the supervision level. Table 13 references descriptions of what participants believe about the role of management in reporting.

Table 13  
*Beliefs About the Principles of Reporting*

Aircraft Maintenance	Petrochemical Operations
<p>It's [reporting] a lot about how knowledgeable the people in management are about the event, and what they deem necessary to correct it and prevent it from happening again. [S2]</p>	<p>A lot of the times, they're [management] more into keeping paperwork and keeping more of a report format so that when, if something does happen, or you know something's about to happen because you've been warned of it so many times. So, it all depends on whether it's being looked at from a management side or the operations side of it. [S1]</p>
<p>Promoting it [hazard identification] is kind of a double-edged sword. You promote it so everybody knows the hazards out there. But it also brings your community closer, letting everybody know that there are issues with the equipment or issues with procedures and practices. The bad side of it is, it also can cause management to lose faith in the confidence of the workforce. So, that's the negative side of it, because if the management loses confidence in the ability of the workforce, then they take actions that the workforce deems as negative or retaliatory, and that kind of makes it where they don't want to report things. [S2]</p>	<p>I don't know if the average operator is getting all the reports. It's distributed at a certain level of management, but a lot of the ones that weren't major, I don't think the information's conveyed across all levels of people working. [S3]</p>
<p>And there's always new equipment and there's always new individuals, so there's constant incidents happening, but the ones that I've worked through, worked with, and we had minimized a lot of these incidents due to reporting because there's always a new procedure that comes out to do certain things a certain way, and that, to me, if you don't report, then nobody knows, and it doesn't get better. So, we wouldn't solve certain incidents from not happening again, no recurring events. [S5]</p>	<p>You have to show people how it [the incident] affects them personally, and how they can make a positive contribution to it. I mean, that's the bottom line. I think, a lot of times, operators feel like they are just being dictated to, and they're being talked down to, and I don't think . . . The company doesn't have a lot of sincerity when they come at you with some of their safety programs? So, it doesn't feel like a collaborative effort. I can tell you from personal experience that you could do nothing wrong and still [be disciplined] just because it was not fully understood what happened, and management, quite often, doesn't want to understand. They just sorta' wanna' close it out. [S3]</p>
<p>Participants believe the level of knowledge required to understand the circumstances that surround an incident is lacking at the supervision level. Based on experience with reporting, participants believe the deficiency impedes the transparency of the process in terms of receiving feedback, access to reports, discipline, and partnership.</p>	

### **Purpose Examined Through History**

The final characteristic used to examine the near miss reporting goal is the purpose. Participants describe competing goals between supervision and the worker. Participants recalled that feedback from the reports submitted was not timely or did not happen. Participants believe management could flag incident reports as opportunities for re-training and updates to procedures.

Participants identified paperwork as a key component of reporting and that the process of reporting had the potential to polarize the reporter from supervision. Participants believe the formal path to reporting contained obstructions to the action to report an incident. Participants indicated that resolve to maneuver the reporting system developed with age and experience.

Over time, a challenge developed to build individual resolve against competing attitudes within the reporting system. The challenge implies that either the reporting goal of the owners of the reporting system was not aligned with the reporter or the function of the reporting system was not transparent. Participants also signaled the belief that there are differences in opinion about what should or should not be reported. Participants stated that clear distinction is needed about what should be and what should not be reported. Table 14 describes the attitudes that developed over time through experiences with reporting, and the beliefs about transparency of the system.

Table 14  
*Belief in the Reporting Function Over Time*

Aircraft Maintenance	Petrochemical Operations
<p>Just because I know it was possible, doesn't mean that 350 people in the organization knew it was possible. And that information has to get out because if the information gets out and saves one person? It was valuable information, regardless of if the 349 knew it. If it gets out and it raises the awareness for one single person, that information potentially just saved their life. So, the biggest thing in my opinion, is with management, with the way management manages the distribution of that information. [S2]</p> <p>If it meant something to you, you don't care about who you're getting pressure from, and it's like, "Well, that's just minor." It means a lot to you? You'll stick with it. I think, over time, I see that increasing when you get older. You tend to take less liberty and make sure everything is done right. As a youth, you don't have the experience. You're a new mechanic, you only know so much. But, as you've been in the industry all these years, you see this happen, this happen, this happen. And knowing the equipment better, you have some kinda' clue as to what can happen. So, you take all that into effect, and you make decisions based on that. [S7]</p>	<p>One thing I noticed straight from the beginning was a lotta' stuff didn't get reported. Maybe have a class and have everybody on board as to how to use it; what should be reported and what shouldn't be reported. [S1]</p> <p>There's kind of a corruption of the system? We were logging in things [incident reports] that were pretty inconsequential? And "nothing-you-could-do-about-it-to-prevent-it-from-happening-again" kinda' stuff? That was the nature of things. People were logging incidents as a method of showing that, 'Hey, look at all these incidents we have. We need a budget to get something.' So, there was a lot of people that were having stuff logged in the incident reporting system as a political means of getting a budget item approved or stuff like that, or just to log it somewhere to track it. There was a lot of tracking going on, and some of our incident reporting things. It's an amount of information that gets overwhelming. [S3]</p>
<p>Participants believe the reporting system is not transparent. Resolve to overcome system resistance to reporting developed with age and experience. The attitudes within the system signal differences in the types of reports that are required. Participants implied that the system lacks transparency.</p>	

### **Training and Mentorship Examined Over Time**

Participants indicated that qualities of mentorship include experience and attitude.

Experience is needed to develop the skill of hazard recognition, and hazard identification is an element of the OSHA goal. The attitudes participants developed toward training and mentorship

are based on individual experiences and assessment through self-reflection. Mentoring and experiences with re-training related to near miss incidents frame individual perceptions.

Attitudes were shaped by experiences during the training phase and by re-training opportunities after an incident event. Table 15 describes attitudes of participants about training and mentorship.

Table 15  
*Training and Mentorship Through History*

Aircraft Maintenance	Petrochemical Operations
<p>I would say, as a whole, every system I've seen involved with near miss reporting, if training was required, it wasn't put out in a negative connotation. It was more of a, "We're trying to protect you"-type thing, which the workforce seemed to appreciate a lot more than resent. [S2]</p>	<p>You have to have a mentor, and a mentoring program, I thought, was the most important of part of keeping people safe because you have to have someone who cares. You just can't have a mentor who says, "Oh, I've got someone to do all my work today. I'm gonna' send him out there to do his rounds while I sit here." You don't want to do that. That was a very important job, I thought, mentoring? You have to have the right people. You have the wrong mentor, it's not gonna' be good for you. [S6]</p>
<p>The number one thing is your training, and that's the big thing. So, you know what the equipment does, you know how the equipment operates, you know the safety procedures. That's the biggest part. So, if the individual makes a mistake, then you say, "Okay, this person needs more training." So, next time you do that job, this will never happen again because you know that person is well-trained. [S7]</p>	<p>We're well-trained on the [process] Units we work. But, yeah, you have to know what's in your equipment. So, as soon as you know what's leaking, they know exactly what you have to do. But yeah, you need to know what's going on in your Unit. [S6]</p>
<p>Participants regarded training and mentorship as essential elements of hazard identification. The attitude of the mentor in the training phase and the attitude during re-training after an incident event influence learning.</p>	

Over time, participant experiences with incident events shaped perceptions of incident reporting. Each participant experienced a Type-X incident event in which no injuries or damage



to equipment occurred. Figure 9 captures the extent of participant experiences with Type-X events.

Participant Experiences with Near Miss Events
<ul style="list-style-type: none"> <li>• Yeah, I would say so [I experienced a Type-X event]. I mean, I was standing pretty close to everything that had happened, so I mean, had that guy not have gotten that valve closed in time, that probably could have directly affected me. [S1]</li> <li>• I have experienced many Type-X events. I don't know if I can describe any that did not result in injury or a severe equipment damage. I mean, those are generally so minor, I just, you just kind of, keep moving along. In the old days, in the 90s when I first started, those weren't even reported. [S3]</li> <li>• Yeah, I have. I've had quite a few near misses. And I would say I had a lot more when I was younger, when I was less experienced, and didn't particularly pay attention to the rules and the regulations as much as I did as I got older. [S2]</li> <li>• Yes, I have [experienced a Type-X event]. There've been many of 'em. [S4]</li> <li>• Over the years, the incidents that I have witnessed and experienced myself, reporting has made a difference. [S5]</li> <li>• Yeah, the good thing is, there're always people around. [S7]</li> <li>• Yeah, we used to call 'em near misses at my refinery. [S6]</li> </ul>

*Figure 9.* Participant experiences with near miss events.

### Summary

The history of reporting was described by reflecting on goals and beliefs about what could be learned from reporting. The reporting system was associated with an indicator of potential or a lack of potential. In other words, when an event occurred, participants referenced past experiences to make evaluations on the present and apply that appraisal to the decision.

Participants aligned the purpose of reporting with preserving personal safety. In other words, the reason for the action matched the reporting mode. Over time, communication about near miss events developed across internal channels.

Written feedback reports were lagging and not readily accessible. Over time, participants shared near miss experiences more openly with co-workers. Participants questioned how major incidents were classified and treated with the same rigor as incidents perceived to be of lesser effect. Participants believe the reporting system is faulty. Participants indicated that there were time lapses between the time since the event and the feedback. Participants sensed changes in the relationship with management over time. A less cohesive environment developed that obstructed the path to incident reporting. Participants utilized reflection to communicate the experiences amongst co-workers with the goal of preserving personal safety.

The near miss definition and the goal of reporting a near miss incident (known as the “stated goal”) were used to evaluate how the OSHA goal to identify hazards and prevent incident recurrence aligned with the actions that workers took when an incident event occurred. In other words, the OSHA goal was weighed against the themes drawn from the near miss definition and from the goal of reporting.

Participants agreed on the purpose of reporting. Participants verbally described past near miss events to co-workers. The elements of reporting were associated with experience, knowledge, and mentorship. Over time, participants developed resolve to overcome demands to circumvent established procedures. Participants acknowledged that reporting was effective but can lead to punitive actions when management does not understand the process. Participants developed communication more openly over time.

Each participant had multiple personal experiences with Type-X events. Some participants experienced training that was less than optimal. Participants indicated that new hires are well-qualified for the positions and that managers should acquire a level of knowledge about incident events. The reporting goal data were examined for alignment with the OSHA goal of incident reporting to identify the hazard and prevent the recurrence of an incident. A discussion of the findings follows in Chapter 5.

## CHAPTER 5: DISCUSSION

The near miss reporting study was developed to understand the worker perspective of reporting an incident. A general qualitative design was utilized for this study, and the method of data collection was individual interviews. This chapter is organized into three sections. Chapter 5 begins with a summary of the findings from Chapter 4. A discussion of the findings follows, and the third and final section presents recommendations for policy and practice. Three primary research questions laid the foundation for the study.

Key question one. *In what ways do workers in aircraft ground operations and petrochemical operations describe hazards of the work environment?*

Key question two. *How is a near miss incident defined amongst workers in aircraft ground operations and petrochemical operations?*

Key question three. *How is the goal of near miss reporting interpreted amongst workers?*

Key question four. *In what ways are reporting the occurrence of an incident related to the OSHA goals of identifying hazards and preventing the recurrence of an incident?*

### Summary

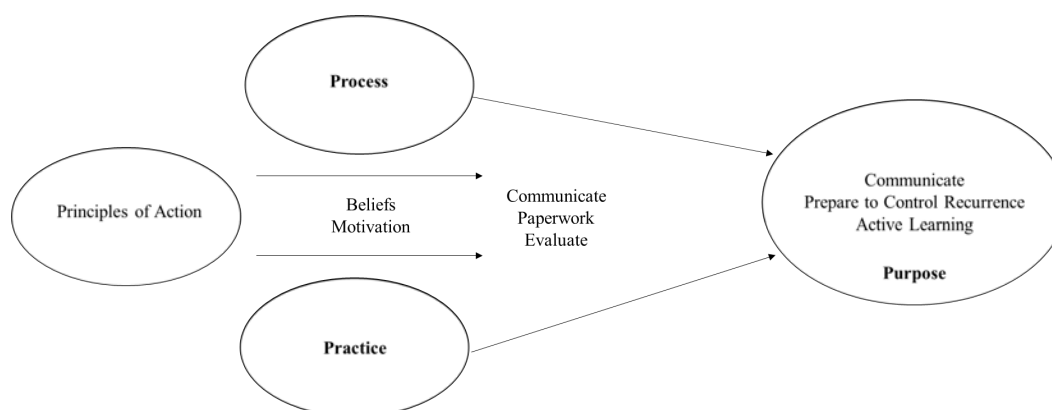
In Chapter 4, the findings of the near miss reporting study were discussed. The definition of a near miss was described in terms of personal safety and the safety of others and included minor injuries. The purpose of reporting was identified in terms of the benefit to people. The goal of reporting was illustrated by the Process Practice Purpose principle developed to illustrate how participants were motivated to act or not to meet the goal of reporting practices (the “how”).

The Type-X event was described in terms of an incident that did not result in injury or damage to equipment or the environment. Participants shared Type-X events amongst co-workers and actively learned from incident experiences. Participants believe that the path to

reporting contained obstructions to the action to report an incident. Participants aligned the purpose of reporting with personal safety and the safety of others. Finally, participants acknowledged that reporting was effective, but can lead to punitive actions when management does not understand the process.

### Discussion

The findings from Chapter 4 are discussed in this section. Three concepts support the themes of the findings: (a) Beliefs, (b) Motivation to take action, and (c) Purpose. Together, the concepts form the three-legged stool of the incident reporting perception. Any leg missing renders the stool out of balance. This section is divided into two parts: worker beliefs in the first part and motivation, and purpose in the second part. The concepts of belief and motivation to take action toward a desired purpose are illustrated in Figure 10.



*Figure 10.* The process purpose practice concept of incident reporting.

The concepts were formed out of the work environment context. The Process, Practice, Purpose concept was developed and used to demonstrate the path to the incident reporting goal.

Process refers to “*what*” was done within the work environment. Practice refers to the actions that workers took, or the “*how*.”

Beliefs, motivation, and purpose are three themes that frame the concept of near miss reporting. In the context of the processes and hazards within the work environment, beliefs, motivation to action, and purpose were the three recurring themes associated with incident reporting. Each theme is discussed in the remainder of this section.

### **What Workers Believe About Incident Reporting**

Three prominent beliefs emerged from the findings: (a) Participants believe that the purpose of reporting an incident was linked to personal safety; (b) Participants also believed experience and training were of high value when it comes to mitigating an incident, and that experience is the best teacher; and (c) Participants believe that reporting is necessary to mitigate incidents but can lead to punitive action when management does not understand the process.

Various paths to accomplishing the same goal exist (Maslow, 1943). In the case of incident reporting, participants described that the need is to preserve personal safety. Personal safety links were observed by how workers communicated when an incident occurred.

The value participants ascribed to experience and training is attributed to individual experiences with initial training and opportunities for re-training when incidents occurred. The emphasis participants placed on experience implies that the training participants received insufficiently captured the types of situations participants encountered in the field. Participants experienced multiple incidents over time. The sheer volume of incidents implies that the goal to prevent recurrence of an incident is not met.

Although participants agreed that reporting is a necessary action to mitigate incidents, experience in the delivery of re-training and initial training influenced the reception of the message, such that attitudes toward reporting change. So, even when participants believed that reporting was a functional concept in incident mitigation, personal safety prevailed in participants' actions.

### **Links to Personal Safety**

The actions of participants toward the goal of incident reporting were explained in terms of preserving the safety of the participants and others by delivering the message to a limited audience. The elements of reporting are complex. When tasked to construct a definition of the Type-X event, participants were hard-pressed to recall examples of events that did not result in injury or damage to equipment or the environment. Each participant had experienced multiple Type-X events. When an incident occurred, participants assessed the event in terms of potential and decided whether or not to take action. The resulting actions did or did not include reporting.

**Communicating an incident.** Participants communicated incident events primarily amongst co-workers, and less with management, inferring that the practice of worker-to-worker communication is functional to identify the hazard and accomplishes the intended goal. Conversely, worker-to-worker communication is limited to the receiving audience, such that others outside the loop of communication are excluded.

Participants explained the goal of reporting an incident event in terms of preserving personal safety of people. In other words, the actions participants take after an incident occurs are associated with preserving personal safety and the safety of others. The mode of verbal communication indicates that participants are motivated to act when personal safety is the goal.

**Considerations in reporting.** Although participants defined a near miss incident as an event that included minor injuries, participants disagreed on whether minor injuries should be reported. Additionally, participants agreed that all incidents should be reported. The inference is that a near miss may include a minor injury, and participants may or may not report a near miss depending on the extent of experience with incidents and incident reporting, even though participants agreed that all incidents should be reported. The disagreement indicates a disconnect between the process to report and the actions in practice.

Participants applied individual discretion to report, based on past experiences. The disagreement between what *should* be done and what *is* done is attributed to individual past experiences in which indelible lessons were learned over time. Two lessons capture the experiences and resolve of participants to uphold principles to mitigate an incident through hazard identification.

**Experience and training.** The individual lessons of hazard mitigation that participants learned extend from the workplace to home and beyond. Participants adopted lasting principles to communicate and report hazards and incidents based upon training, transformative experiences, and mentorship. The following two examples illustrate how, over time, individual perspectives about what participants believe are entrenched when it comes to identifying hazards and reporting incidents.

***What workers believe: Two lessons in experience and training.*** In the time following the transformative near miss experience in the early days of a career in aircraft maintenance, S5 would not shy away from reporting and had adopted the principle to share the experience with



workers new to the environment. New to the field of maintenance at the time, S5 had reported an observation to supervision and the observation was ignored.

A near miss of serious consequence was associated with the experience. S5 adopted advocacy to report hazards into personal life and still maintains the attitude of hazard identification within the community today. S5 adopted the principle to ask questions, but to always read the technical data for oneself. The second lesson to be considered about what participants believe relates to training and mentorship.

As recently as seven years ago, following a 4-week training rotation between process units and mechanical craft job responsibilities, and after just two weeks of on-the-job experience, S6 was delegated to train another new worker. S6 since adopted the principle that mentorship requires more than to be signed off and qualified on a Process Unit, and more than being able to identify equipment and to possess knowledge about how to perform Operator Rounds. The discussion about what workers believe about the function of reporting continues in the next section.

***What workers believe: Transparency in the motivation to report.*** Participants believe reporting is necessary to mitigate incidents but lack full confidence in the process. In Petrochemical operations, participants indicated that feedback from reporting was mostly non-existent and that feedback from incident reports not considered to be major events was not communicated and not easily accessible. Petrochemical participants also had experience in reporting that resulted in punitive actions.

In aircraft maintenance, participants identified more available channels of communication, such as crosstalk, and indicated more openness in communicating with

supervision. In each industry, participants who were supervisors helped shape insight about the disconnect between the management process of incident reporting and what participants who were not supervisors believed. In the third and final section of the discussion, the findings of incident reporting are examined in terms of motivation.

### **The Motivation to Report**

Participants agreed that reporting is a method to mitigate hazards and avert future incidents. OSHA (2018) encourages employers to study and evaluate near miss incidents. Participants indicated that workplace processes to report incidents exist. Participants linked personal safety to the purpose of reporting an incident. Reporting incidents is recognized as an effective way to mitigate incidents in the future (NSC, 2013, 2019; U.S. Department of Labor, 2015a). But how is incident reporting linked to the purpose? The motivation to report is examined in the next section.

### **Misalignment with the Reporting Goal**

Abraham Maslow's (1943) theory of motivation states that a goal can be achieved through various paths, that each need influences the other, and that individuals are motivated to act to achieve a goal. In the case of incident reporting, participants described the need is to preserve personal safety. Participants who were supervisors described a reporting system that is overloaded and out of alignment with the intended goal.

In the Process Practice Purpose concept, what participants believe was directed toward purposeful actions. When the same concept is applied to the data from participants who were supervisors, the purpose is not aligned. The purpose of reporting is misaligned with the motivation to report. Participants explained the purpose of reporting in terms of benefit to

people. Participants who were supervisors described two elements of the reporting system that challenge the reporting goal: (a) The high volume of incidents and (b) Timeliness of feedback.

**A high volume of incidents.** Owners of the incident reporting system are motivated to act to manage the volume of incidents. The applied actions appear to be aimed at sorting and categorizing incidents of high visibility to meet reporting mandates, such that, in a system where workers are directed to report everything, a worker must either (a) Believe that near miss incidents do not provoke urgency, and adopt the attitude that near miss incidents are of minor consequence and are simply part of the workplace process or (b) Believe the reporting system is non-transparent and insincere in presenting the goal. The result is a failure of the process to meet the goal.

Since participants are motivated to action by a need to preserve personal safety, then the communication of incident events amongst co-workers fulfills that need for an audience limited by the extent of the communication. On the other hand, owners of the incident reporting process are motivated to manage the volume of incidents, resulting in attending to incidents of high visibility and neglecting feedback reports interpreted by participants to be of lesser importance. The process falls short of the goal when participants recognize that feedback related to near miss incidents is almost non-existent, and major incident events capture higher visibility.

**Timeliness and accessibility of feedback.** Participants who were supervisors described two aspects of feedback. In the first instance, the owners of the reporting system are motivated to manage the reporting system out of concern for the integrity of the reporting system itself. An abundance of reporting may signal misinterpretation that a system requires attention. On the other hand, owners of the reporting process could be motivated by an abundance of reporting if

benefits to reporting exist, even if the benefits are not aligned with the purpose. The result is a delay in the feedback to the initiator of the report, and further, to a larger audience of interest.

In a review of 25 non-medical incident reporting systems, Barach and Small (2000) identified timeliness in feedback as one of eight conflicts that exist within reporting systems. Actions in the reporting system are directed towards a goal. Each need influences another (Maslow, 1943).

In the second instance, participants who were supervisors in Petrochemical operations indicated the inaccessibility of reports. Again, the result is a delay in the feedback to the intended audience. Across all participants, reporting experiences were both positive and negative. The number of incidents is a distinguishing factor amongst organizations and low rates of incidents result in less frequent inspections by OSHA (Miller, 2008).

A focus on keeping incident rates low is a factor in the decision to report. Notably, participants demonstrated difficulty in capturing the Type-X description of an event that did not result in injury or damage to equipment or the environment. Of note, participants included minor injuries in the definition of a near miss event. As a matter of process, participants demonstrated knowledge about existing policies to report all incidents. As a matter of practice, all participants had multiple experiences with incidents, such that participants decided to report or not, based on training and experience.

The Lukic et al. (2013) study examined how individual elements contribute to learning from incidents in the oil and gas industry. Lukic et al. found that experience and safety values influence participation in safety objectives. The value of reporting a near miss event is unrecognized as an opportunity to mitigate future incidents (NSC, 2013). A near miss is an

opportunity to apply active learning. The motivation to align with the goal of reporting is recognized by the actions taken by participants and the owners of the reporting process.

### **Recommendations for Future Research**

Aircraft maintenance and petrochemical operations share common traits in incident reporting, but specific issues exist in each industry. Organizations may be inclined to keep some incident reporting matters in-house if mandatory reporting requirements permit. Future research must be directed at examining how organizations communicate and respond to near miss reports within each industry system. Specifically, “On the petrochemical side, the existing process of reporting is subject to delay,” as participants described. The finding does not mean that delay in the process is exclusive to one industry.

The future research is urgent to minimize the delay in response to initial reports. Participants also reported that communication amongst co-workers exists. Near miss data collection extends the advantage of accessibility over incidents of greater consequence (NSC, 2013). A broader understanding of the elements of worker-to-worker communication and how the practice has changed over time will inform the reporting process of trends in reporting and engage a larger audience within the incident reporting system.

### **Implications for Policy and Practice**

The implication for practice is that a partnership between the worker and the organization is needed to meet the challenge of keeping workers safe. The Principle of Understanding model demonstrates how a partnership optimizes active learning from near miss incidents. The value of learning from near miss reporting is acknowledged (NSC, 2013; U.S. Department of Labor, 2013). Two implications for practice result from the near miss reporting study. Barach and

Small (2000) studied near miss reporting systems from aviation, petrochemical processing, NASA, and the nuclear industry to identify characteristics of reporting from nonmedical industries. A review of 25 reporting systems resulted in the analysis of 12 of the reviewed systems. An analysis of the 12 reporting systems found that 2 of 12 were anonymous, and 7 of 12 were confidential (Barach & Small, 2000).

Barach and Small (2000) also determined that data from near miss incidents are more abundant and accessible than other incident data. The near miss reporting study found that worker-to-worker communication about incident events exists, and workers are motivated to act to preserve personal safety and the safety of others. In the Lukic et al. (2013) study, participants distinguished the motivation to preserve personal safety from concern about the safety of others. The recommendation of the near miss reporting study is that owners of incident reporting systems should utilize available channels of worker-to-worker communication to include confidential and anonymous reporting in incident reporting systems.

Participants in the near miss reporting study also echoed the need to receive timely feedback. The desire for feedback to the reporter was identified as an obstacle to reporting (Barach & Small, 2000). The near miss reporting study found that the feedback, which participants received from reporting was not timely and sometimes non-existent. Participants who were supervisors indicated that reports were not easily accessible or available and described actions within the reporting system that were not aligned with the incident reporting goal.

Individuals are motivated to act based on an existing need (Maslow, 1943). The misalignment of purpose resulted in opportunities lost to learn from incidents. The recommendation of the near miss reporting study is that owners of incident reporting systems

must include transparency in the process because cultural transformations and change do not develop overnight.

The Principle of Understanding model was developed to understand how a developing partnership drives change between the worker and the organization through active learning from near miss incidents. The recommendations of the near miss reporting study are grounded in the research findings. The recommendations are designed to develop and sustain a culture of preserving personal safety.

Research findings form the three-legged stool principle of understanding about how active learning from near miss incident data is applied to work practice in industrial environments. Active learning evaluates the circumstances surrounding a near miss event and applies lessons from past events in a cumulative way such that hazard mitigation results. Near miss data facilitate active learning.

The principle of understanding is applied within the work environment because near miss incident events occur in the course of the work process and in the presence of hazards. The goal of the principle of understanding is to apply active learning from near miss incidents as soon as is practical. The path to active learning leads to insight about the three-legged stool principle of understanding.

### **How the Principle of Understanding Develops**

Figure 11 illustrates how active learning from near miss incident events develops from the principle of understanding.

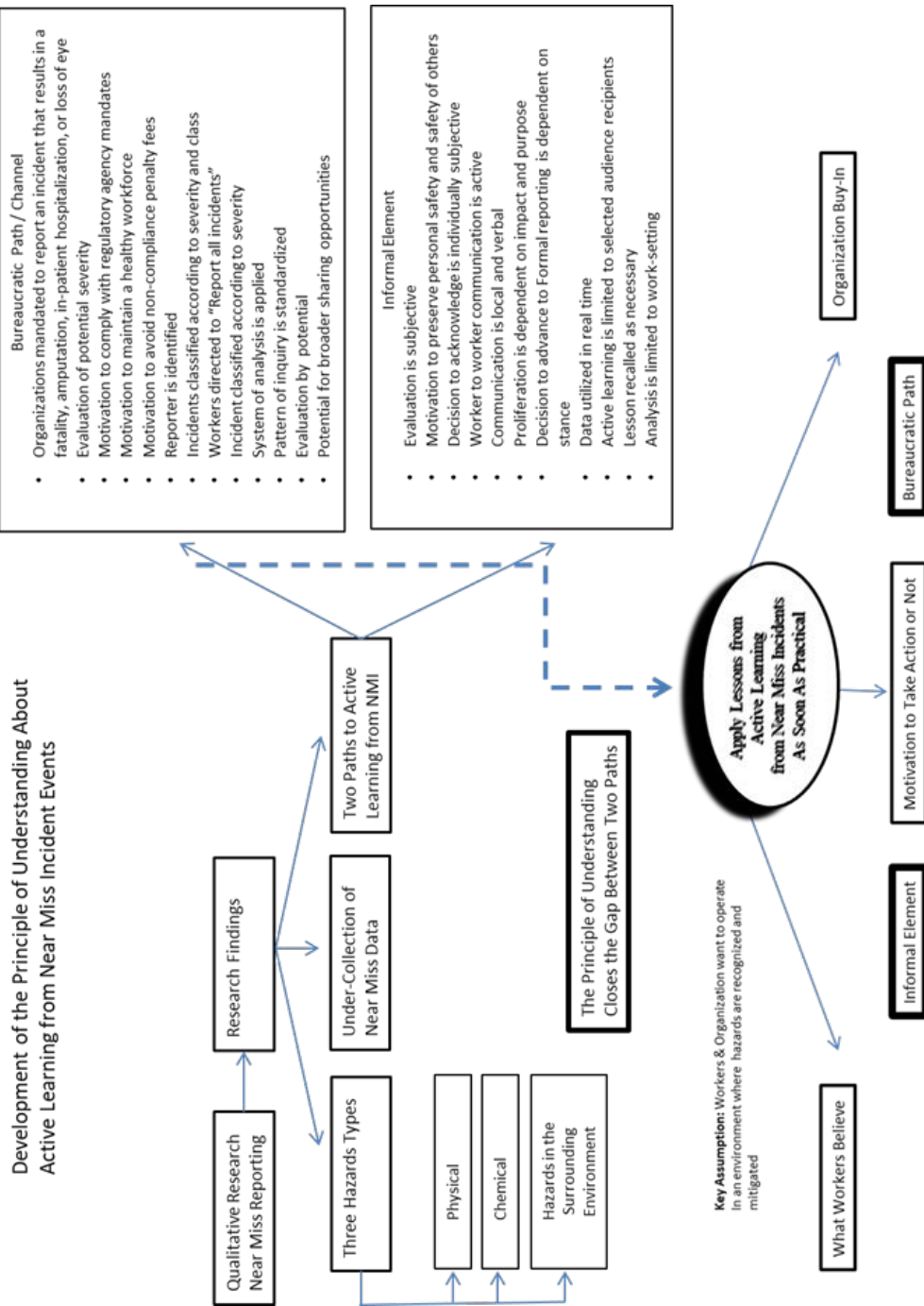


Figure 11. Development of the principle of understanding about active learning from near miss incident events.

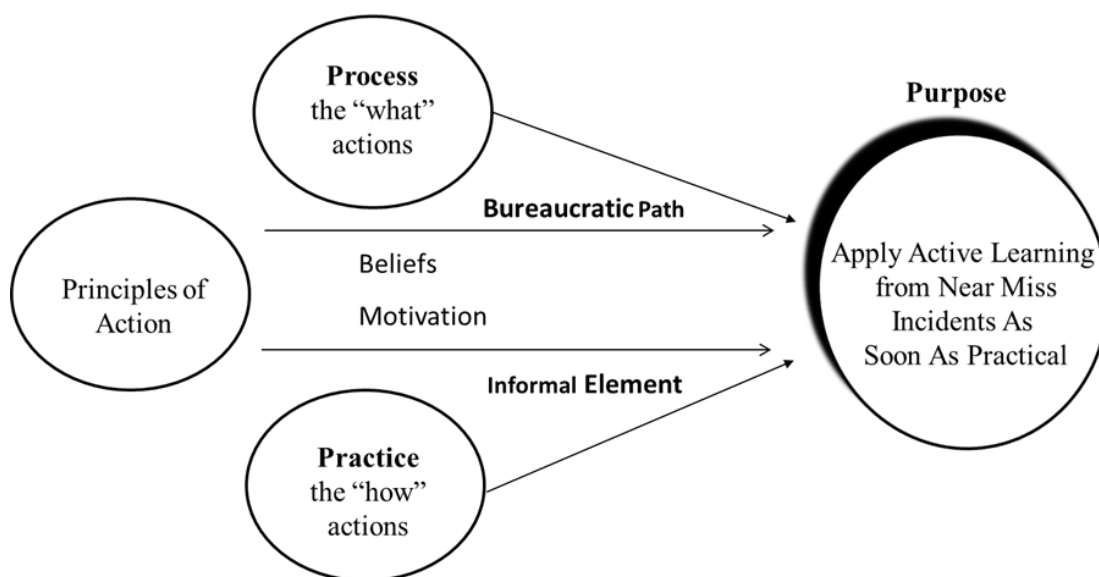


Active learning develops out of an assumption that both the worker and the organization want to operate in an environment where hazards are recognized and mitigated. Regrettably, near miss events do not provoke the urgency to action and do not rise to the level of analytical priority as accidents, such that near miss data is under-collected. Two paths to active learning arise when the circumstances surrounding an incident are analyzed and when unanticipated hazards are recognized.

The bureaucratic path must meet regulatory mandates of compliance, such that incidents are classified and tiered according to severity. The informal element is aligned with preserving personal safety and the safety of others. A challenge to active learning from near miss incidents arises when the paths to learning are out of alignment. The goal of the principle of understanding is to act as soon as practical to close the gap between the two paths by applying active learning.

### **Active Learning from Near Miss incident Events**

Active learning is the process of evaluating the conditions surrounding an event and applying the data to the work process in a cumulative way, such that in the long-term, reduction or elimination of near miss incidents results. Active learning requires continuous application of lessons from incidents to the work process as soon as practical. The key to active learning is the continuous application of adopted principles, such that learning is cumulative. Adopting principles is a way of learning and doing through observation and action. Figure 12 illustrates the context of active learning



*Figure 12.* The context of active learning from near miss incidents.

The path to active learning from near miss incidents begins with actions directed by the work process. Customary practices (the “how” actions) and procedural activities (the “what” actions) are oriented toward a work production objective. Incidents occur in the course of doing work. The bureaucratic path and the informal element are the two active channels used to reach the active learning objective.

The two paths are driven by the beliefs and motivation of the worker and the organization. The principle of understanding partnership closes the gap between the two paths to facilitate the application of active learning. Near miss incident data present a distinct value to active learning. Three incidents in industry illustrate the value of incident data.

**Air Canada taxiway overflight Flight 759.** On July 7, 2017, at 2356 Pacific Standard Time, Air Canada Airbus A320-211 Flight 759 overflew a taxiway on descent to San Francisco

International Airport (SFO) where four aircraft were positioned for takeoff (National Transportation Safety Board Incident Report [NTSB], 2017). The incident aircraft approached the taxiway instead of the runway, and overflew one aircraft at 100 feet above ground level, made a low-altitude go-around, overflew a second aircraft at 60 feet, overflew a third aircraft at 200 feet, overflew a fourth aircraft at 250 feet, and landed safely on the second approach attempt.

An incident investigation by the NTSB (2017) determined that the configuration of the runway changed in February 2017 at the start of a maintenance project to re-surface and upgrade lighting on one of two runways that run parallel to the incident taxiway. The runway under maintenance was scheduled to close at 2300 hours each night and most weekends. During the period of construction, requests from pilots for adjustments to the lighting on the active runway increased.

Visual lighting indications alone were not sufficient assurance of alignment with the correct runway during construction. Following the incident, controllers implemented a change in procedure to communicate needs for lighting adjustments with the first pilot to arrive after dark during construction periods. The recommendations from the NTSB (2017) include improvements to cockpit displays and instrument systems that detect misalignment of aircraft with runways, and ways to optimize runway configuration data.

**Boeing 737-8 (MAX).** The Boeing Company is the largest aerospace corporation in the world, manufacturing aircraft since 1916 (Boeing, 2019). A new fleet of 737 MAX aircraft is the subject of two international accident investigations. The 737 (MAX) holds the distinction of the fastest-selling aircraft in the history of the Boeing company (Boeing, n.d.).

On October 29, 2018, at 2320 UTC, Pacific Time, Lion Mentari Airlines (Lion Air) Boeing 737-8 (MAX) Flight JT610 departed from Jakarta with 189 souls on board. The aircraft

crashed 13 minutes after departure, and no one survived (Tjahjono, 2018). On the incident aircraft, from October 26, 2018 until October 28, 2018, four flight defects related to speed and altitude flight controls were logged for maintenance on the Flight and Maintenance log (Tjahjono, 2018). On March 10, 2019, at 0538 UTC, Ethiopian Airlines Boeing 737-8 (MAX) Flight 302 departed from Addis Ababa Bole International airport (HAAB) with 157 souls on board. The aircraft crashed after departure, and no one survived (Federal Democratic Republic of Ethiopia, Ministry of Transport, Aircraft Accident Investigations Bureau [AIB], 2019).

On March 11, 2019, in a Continued Airworthiness Notification to the International Community [CANIC], March 11, 2019, the FAA issued updated guidelines for the safe operation of the Boeing 737-8 and 737-9 (737 MAX) fleet. The FAA completed a review of the Boeing Maneuvering Characteristics Augmentation System (MCAS) flight controls production process and will continue to provide oversight to Boeing upgrades to MCAS design, flight crew manuals, and training (FAA, 2019a). The FAA also announced that the agency was provided with no data to act or to make conclusions regarding the Lion Air Flight JT610 accident and the Ethiopian Airlines Flight ET302 accident involving the Boeing Model 737-8 airplane (FAA, 2019a).

On March 12, 2019, the European Union Aviation Safety Agency [EASA] issued an Airworthiness Directive to suspend operation of the Boeing 737-8 and 737-9 Max aircraft in Europe (European Union Aviation Safety Agency [EASA], 2019). On March 16, 2019, the Bureau of Enquiry and Analysis for Civil Aviation Safety, France (BEA), announced that a joint investigation team of the U.S. NTSB, the Ethiopian AIB, and the BEA together verified data from the cockpit voice recorder and flight data recorder, and found “clear similarities” between Ethiopian Airlines Flight 302 and Lion Air Flight 610 and that the investigation team would continue to study the similarities between the data.

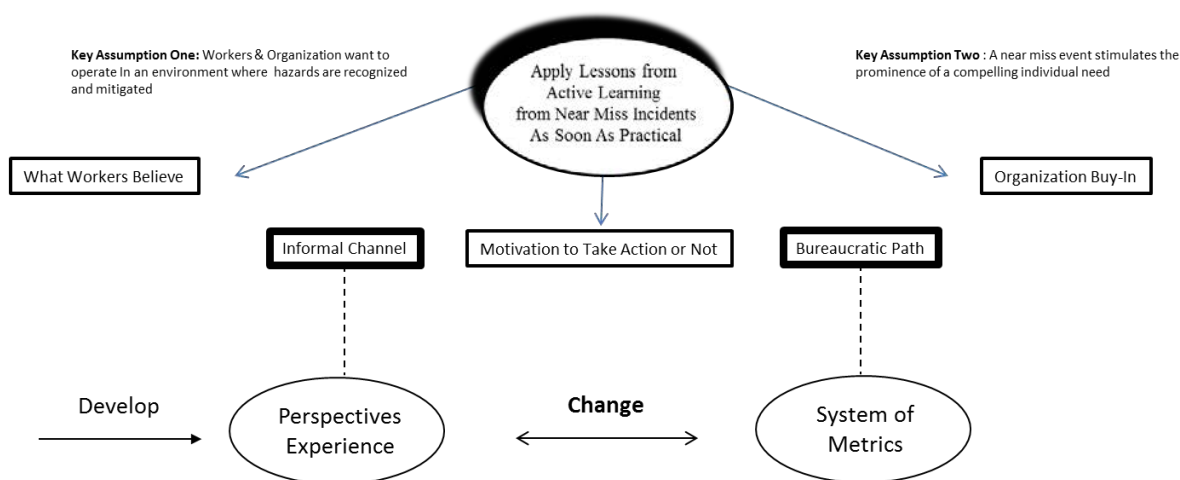
On March 20, 2019, the FAA announced an Emergency Order of Prohibition to cease operation of the Boeing 737-8 and 737-9 by U.S.-certificated operators based on developing information from the investigation that similarities between the two accidents exist (FAA, 2019b). The order affects 387 aircraft worldwide and has not been revoked or revised as of publication. On April 19, 2019, the FAA confirmed that a Joint Authorities Technical Review (JATR) team of nine international civil aviation experts will join the FAA and the National Aviation and Space Administration (NASA) to evaluate the design of the 737 MAX automated flight control system for compliance with certification (FAA 2019c).

**Exxon Mobil refinery explosion, Torrance, California.** On February 18, 2015, an explosion occurred at the Exxon refinery in Torrance, California. Two workers were injured. The event had potential for a catastrophic outcome (CSB, 2016). Airborne debris scattered from the explosion to a distance far enough to strike scaffolding near a tank containing a highly combustible volume of hydrofluoric acid. The debris struck the scaffolding instead. In a preliminary report, the CSB compared actions surrounding the event to similar refinery incident reports in which a review and analysis of hazards for non-routine maintenance did not occur (CSB, 2016).

**Philadelphia Energy Solutions fire.** On June 21, 2019, a fire occurred at the Philadelphia Energy Solutions [PES] refinery. Initial reports indicate that hydrocarbon vapors were released to atmosphere and ignited (WPVI-TV Action News, 2019). The CSB is investigating the accident (CSB, 2019). The distinct value of learning from near miss incident data is applied to the principle of understanding.

## The Principle of Understanding About Active Learning from Near Miss Incidents

The impact of the near miss experience changes what workers believe and changes the course of progress for the organization, and sometimes, the industry. Figure 13 illustrates the three-legged stool principle of understanding.



*Figure 13.* Three-legged stool principle of understanding about active learning from near miss incident events.

The cornerstone action of the stool is to apply active learning from near miss incidents as soon as practical. Each leg of the stool supports active learning within the work process. There are two paths to take action or not when a near miss event occurs. The informal channel is recognized by actions directed toward preserving personal safety.

The worker evaluates the situation and makes the decision to take action or not. Over time, workers develop perspectives about reporting, but experience with near miss events changes perspectives. A system of metrics is structured to meet mandates for compliance with

regulatory requirements within the Bureaucratic path. The Bureaucratic path is a formalized, standardized approach applied in the analysis of incidents.

The motivation to take action or not after a near miss incident event occurs is supported by what workers believe and by the extent of buy-in from the organization. The circumstances that surround each incident are original. In other words, for each future condition or situation, the worker, the environmental conditions, and the HaSE are all subject to change. Buy-in from the organization is necessary to strengthen the partnership towards the goal of hazard mitigation.

If meaningful action is the goal, then hazards must be equally recognized as such by both the organization and the worker. A recurring pattern of near miss incidents signals that learning beyond the circumstance of a single event alone is needed. Change demonstrates an understanding of active learning. Active learning from near miss incident events facilitates change.

Three components function to support a guided approach to understanding the active learning principle: (a) the level of regard for near miss events and a pervasive attitude based on incident outcome present a challenge to recognize the value of a near miss, (b) the cumulative utility of near miss data applied to minimize the learning gap and to understand the motivation to take action or not to change perceptions about the severity of incident outcomes, and (c) the impact of a near miss incident and communication of hazard mitigation.

### **Low Regard for Near Miss Incidents and a Pervasive Attitude Towards Outcome**

When the work process is working as it should, it is easy to discount the value of near miss data and ignore the intangible value of safe work. It is a challenge to recognize value in near miss event outcomes that are of low appeal. However, low-appealing outcomes do not signal low hazard potential. There is a tendency to focus on outcomes and to categorize low-

appealing results such that value in learning from near miss data is reduced to a system of cataloging and tracking. The prevalent categorization is sufficient to permeate the organization and influence reporting perceptions that direct a focus on outcomes and overlook new hazards in such a way that cumulative learning is limited to old data.

Each incident originates out of unexpected circumstance. The level of regard for incident outcomes of low-appeal suggests that over time, new hazard identification is de-emphasized or that existing hazards have re-surfaced. Each near miss event has potential value to identify new hazards. Work environments are not static, and the reality is that learning from near miss incidents is a cumulative process in which new circumstances are presented within changing work environments.

Cumulative learning occurs through the on-going process of refining guiding principles using near miss data to achieve the intangible goal of keeping workers safe. Refinement develops through the analysis of new data. Data from each near miss event is valuable when applied to cumulative learning because each circumstance is unique. The worst-case potential outcome is appropriate to apply because each near miss is original and HaSE are not static. The intangible benefit of a low visibility outcome does not sound the alarm to generate immediate action and to regard near miss data as if the outcome were worst case.

The pervasive attitude aligns near miss analysis based on outcome, but the analysis is unlike the approach to the calculating, predictive, and foreseeable measures of job hazard assessments that precede job tasks. The idea of classification before analysis is important because job hazard analyses precede the job task, and the usefulness of post-incident analysis is limited by the application of old data when classification occurs before analysis, which suggests that chronic hazards persist or that new hazards are presented. The problem is that a focus on



classifying the incident type based on outcome limits the cumulative potential for active learning by using the outcome as the basis for analysis.

In the case where the outcome is considered minor and the worst-case potential is not considered, learning from the incident is limited to the severity of the result at hand. The utility of near miss data to cumulative learning is intangible. When a near miss occurs, measurements of the full extent of hazard severity in the surrounding environment are uncalculated since the conditions of one near miss are subject to change.

HaSE that are not under the direct control of the worker can be anticipated, yet are not predicted, and present obstacles to safe work. As such, HaSE maintain an elusive presence, low visibility, and are subject to limited communication when near miss analysis is limited by classifying the outcome. Organizations apply less urgency in attention to incidents in which the resulting outcomes are perceived to be of lesser consequence by assigning a severity of consequence based on outcome and not worst-case.

In the process of categorizing incident events, a tiered system of prioritization is applied to incidents of lesser consequence. For incidents in which the outcome of a near miss is less immediate, the resulting action provokes a level of urgency often associated with the category of incident. As such, within the bureaucratic path, the focus on categorizing incident events renders incidents of lesser consequence in a dismal position in terms of potential for meaningful evaluation and analysis.

Incidents are categorized and tiered according to the result or outcome of the event. The practice subjects near miss incidents to a lower level of urgency when the result of the incident does not present an “immediate” problem in the work process. The problem with such a casual approach to analyzing near miss incidents of low consequence is that evaluation based on

outcome tends to precede analysis, and new HaSE data are excluded from building cumulative learning opportunities.

### **Cumulative Utility of Near Miss Data**

It is essential to acknowledge the gap that exists between the bureaucratic element and the informal path to be able to recognize compounding utility. Cumulative or compounding utility means the data surrounding each event are useful and are applied to change in the work process, such that the way in which work is done (the “how”) actively incorporates learned principles. In other words, the extent of recovery from a trip or potential fall is not an indicator of the degree of severity of what could have been, nor does recovery gauge or influence the full extent of a future event.

Unmitigated HaSE present risks to personal safety when hazards are not directly controlled by the worker. In other words, a worst-case potential must be assumed to advance active learning from near miss incidents because the dynamics of the surrounding environment are constantly changing. Inasmuch as HaSE present obstacles to safe work, the approach to recognizing hazards that result from near miss incident events and the action that follows must focus on the cumulative utility of near miss data.

Given the original conditions and circumstances that surround a near miss incident, future conditions are subject to change. As such, active learning must capture the cumulative component of hazards in changing environments. Active learning applies lessons from near miss incident events to the work process as soon as practical, such that, in the long term, reduction in frequency or elimination of events and refinement of developing principles result.

The action applied to active learning demonstrates individual need. Basic individual needs are conceptualized on a continuum, and, depending on demand, one need category

presides over another (Maslow, 1943). Near miss data are more abundant and accessible than other incident data types (Barach & Small, 2000).

Although accidents are more visible, a larger amount of data from near miss incidents is available for analysis since accidents occur at lower rates (van der Schaaf, 1992). It makes sense to understand how near miss incident data are useful when applied cumulatively to change the work process through active learning. The remaining two sections combine to complement the additional utility of near miss data: (a) The motivation to act toward the active learning goal and (b) Closing the gap to active learning by changing perceptions of incident severity and impact, and optimizing communication after an event.

**The motivation to take action or not.** According to Maslow's theory of motivation, goals are connected to individual needs and motivation (Maslow, 1943). Each need influences another need, there are variations in the paths to reaching a goal, and the motivation to act towards a goal is based on existing individual need (Maslow, 1943). Two elements of Maslow's theory are applied in utilizing near miss data to change the work process and apply learned principles: (a) Variations in the paths to reach the goal of active learning from near miss incident events and (b) The motivation to take action or not after an event to advance active learning.

To the extent that individual needs can be classified, Maslow's theory of motivation is applied in understanding how the common goal of learning from near miss incidents is shared by the organization and the worker, yet varies in interpretation. As previously illustrated in Figure 13, the context of active learning shows how purposeful actions or non-actions are directed toward the goal of active learning. Active learning is driven by need. Needs are observed through the actions or non-actions directed toward the active learning goal or purpose.

The purpose of reporting a near miss incident is explained by workers in terms of benefit to people. Actions or non-actions are recognized as bureaucratic and informal practices that align with the beliefs of the worker and the organization. The goal to achieve active learning is encumbered when the two sets of practices obstruct the goal.

**Closing the active learning gap.** An acknowledgement of the gap that impedes the path to the goal of active learning from near miss incidents is essential because near miss data are under-collected. Under-collection impacts the way data are utilized to apply change to the work process and to incorporate learned principles in a cumulative way. Active learning is facilitated by diminishing the obstructive elements. Active learning optimizes near miss data and minimizes obstruction between paths in three ways: (a) by changing perceptions about the severity of an event, (b) by extending the range of impact of the event itself, and (c) by optimizing the communication that follows the event as soon as practical.

### **Perceptions of Incident Severity**

HaSE do not always maintain a visible presence in the work environment. It is possible that the tendency to evaluate severity potential at the time an incident occurs develops through experience with incidents. The practice of evaluating severity with a goal to categorize based on effect or outcome of the event suggests that pervasive beliefs exist about incident types. The outcome of the event helps to shape beliefs in each path.

Beliefs drive the motivation to take action or not to advance learning from near miss data. If incident data are categorized strictly as a function of the incident tracking process, then the path to active learning remains limited by old data and by updates to new HaSE. The future of active learning depends on how the value of near miss data are perceived and utilized.

### **The Impact of the Near Miss and a Perceived Priority of Motives**

The motivation to take action or not to advance active learning is observed through actions or non-actions by the worker and the organization. Over a career, workers log multiple near miss incident events. The organization is motivated by three needs at the time an incident occurs: (a) the need to maintain a healthy workforce, (b) the need to comply with regulatory agency mandates, and (c) the need to avoid non-compliance penalty fees. Although some industry classifications are exempt from maintaining records of OSHA injury and illness because of the size of the organization, all industries are mandated to report an incident that results in a fatality, amputation, in-patient hospitalization, or loss of eye (U.S. Department of Labor, 2015c).

The incident worker is motivated to preserve personal safety and the safety of others at the same time the organization is motivated by the desire to maintain a healthy workforce, to comply with regulatory agency mandates, and to avoid penalties for non-compliance. The prioritization of individual needs is subject to change (Maslow, 1943). Assuming a near miss event stimulates the prominence of a compelling need, the four motivation components (maintaining a healthy workforce, compliance with regulatory agency mandates, non-compliance penalties, and preserving personal safety and the safety of others) compete for priority.

A prevailing need does not depend on the fulfillment of another need (Maslow, 1943). In other words, depending on demand of the prevailing need, one need presides over another. As such, the action or inaction of the organizational translates to the individual worker as a perceived near miss incident priority of motives. The way the near miss incident priority of motives is perceived suggests workers pay attention to what management pays attention to. Workers apply past experiences to form perceptions about near miss incidents. The perceptions frame decisions to take action or not.

The near miss incident priority of motives and individual worker experiences with incidents and with reporting incidents combine to frame the motivation to take action or not toward reaching the active learning goal. Workers expressed that the goal of reporting an incident (known as “the stated goal”) is to communicate that an incident has occurred and to signal that change is needed to control the potential for recurrence through active learning and balancing resources. It appears that the near miss incident priority of motives is the worker reality of the value of near miss data and what the data mean to the organization. As such, the actions the organizations take after an event is the reality of the prevailing need priority. It is the experience with incidents and with incident reporting that changes worker perceptions and motivates workers to take action or not.

The worker experience and the incident priority of motives prevail to guide the principle of action. In other words, worker action or inaction after a near miss event is guided by (or the worker is motivated to act or not) a prevailing need arising from experience with past near miss incidents or beliefs about the incident priority of motives, or a combination of both. Individual principles of action or inaction develop out of beliefs and perceptions and are adopted over time. When management pays attention to prioritizing the results of the incident over the value of the data itself, workers come to expect that the resulting severity of an event aligns with value of the data and, as such, the level of attention that the incident commands.

It is possible that increased attention by management will result in a change in worker perception. Both the worker and the organization are driven to act or not to seek change that facilitates hazards mitigation. Active learning facilitates change when the unique circumstances that surround a near miss are understood. Although communicated formally by the organization, the reality is that the near miss priority of motives is validated by experience with incidents and

through the actions associated with reporting an incident. The actions or inactions of the organization after a near miss occurs communicate the priorities for the work process.

### **Optimizing Hazard Mitigation Through Communication**

The value of near miss data to hazard mitigation is overlooked and leads to the under-collection of data. The lessons from incidents that result in the form of formal and informal practices, training, procedures, and guidance documents are applied through formal, informal, and local verbal communication. Organizations must understand that analyzing near miss data facilitates active learning, and active learning drives hazard mitigation. Unfortunately, when the result of a near miss is classified by severity, the action level does not provoke priority, and the low priority is reflected in the communication that follows.

The formal procedures and guidance documents that organizations use to communicate hazards originate from the evaluation of hazards by potential for severity. Near miss events are often overlooked based on the degree of severity of the outcome. A potential of severity is applied to classify the results of a low priority near miss event. The problem with classifying the result of the event before analysis is that classification limits active learning by utilizing old HaSE data that do not include consideration of emerging new hazards. A focus on the outcome of the event itself means that new HaSE are not communicated. The broadest opportunities for learning reside within the immediate work environments that are closest to the process.

Organizations communicate the value of near miss incident data through actions or inaction. Even though organizations direct workers to report all incidents, workers gauge the resulting organizational actions against a desire to preserve personal safety and the safety of others. It is the measurement of concern about near miss incident events and the perceived value of the data to the organization that workers interpret and transfer into action or inaction.

Therefore, the goal of active learning is optimized when the worker perceives that the near miss incident priority of motives resembles the desire to preserve personal safety and the safety of others. The channels of worker communication are open when personal safety and the safety of others are perceived to be important to management.

Not only do workers evaluate near miss communication based on perceived organizational action or inaction, but workers use experience with events, past experiences with reporting, and personal resolve to guide action or inaction to communicate the near miss data. Ideally, the near miss incident priority of motives and the need to preserve personal safety and the safety of others combine to frame worker action or inaction to communicate. The action demonstrates the goal to learn from near miss data in a cumulative way.

When near miss data are communicated and shared in real time, updates to HaSE support the cumulative component of active learning. It appears that the approach to communicating is tied to a perceived value, since the perspectives that workers develop about near miss incidents change with experience and with experiences in reporting. Workers evaluate a perceived benefit from reporting and communicate the value through action or inaction when the outcome of the near miss appears to be tangible or when past experiences with incidents frame personal resolve to share.

The future of understanding recovery from near miss events in terms of perceptions of severity, impact, and cumulative utility of near miss data lies in continued research. I propose four key questions that direct the focus of future inquiry: (a) What are key indicators that workers are engaged in active learning within workspaces? (b) In what ways do worker beliefs impact communication of near miss data? (c) What are the types of near miss incidents that



occur within confined spaces? (d) How are housekeeping practices regarded and managed within workspaces?

### **Conclusion**

When the work process is working as it should, it is easy to discount the value of near miss data and ignore the intangibles. The utility of near miss data to cumulative learning is not easily quantified. When the perceived benefit is tangible enough or is subjectively valuable to motivate, action results. The action does not necessarily result in communication because some hazards are mitigated on the spot. To overcome the subjective evaluation associated with the prioritization of near miss data based on the outcome, organizations must recognize the intangible value of near miss data. Therefore, organizations must communicate in a way that encourages the prioritization of near miss data and demonstrates commitment to preserving personal safety and the safety of others.

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## APPENDIX A: CONSENT FORM

## INTERVIEW CONSENT FORM

*Near Miss Reporting: Perspectives on Worker Conversance of Incident Events  
Across Two Industries*

You are invited to participate in a research study about how workers interpret near miss incident reporting. My name is Julia McGee, and I am a student at the University of the Pacific, Benerd School of Education. I am studying worker experiences in and observations of near miss incident reporting in aircraft ground and petrochemical process industries to understand how the goals of hazard identification and preventing incident recurrence are interpreted. You were selected as a participant in this study because you have worked in either or both industries within the past five years.

The purpose of this research is to understand how workers in aircraft ground operations and petrochemical processes interpret the goals of incident reporting. If you decide to participate, you will be asked to participate in a one-on-one audio-recorded interview. The expected duration of the interview is 60-90 minutes.

There are some possible risks involved for participants. The risks associated with participating in this research project are as follows: Psychological: When recalling, recollecting, and describing past incidents, you may experience a negative emotion (e.g. feeling guilty) in the context that you would think on how a change in event circumstances could have resulted in different outcomes. Please note that you will be allowed time to gather your thoughts and respond as you see fit. You will also have the right to discontinue the interview at any time. Sociological: Subjects could potentially face negative social consequences from peers if the data were breached. However, you will be reminded at the beginning of the interview that you should not describe incidents in which you or others were injured or incidents in which there was property damage. Loss of confidentiality: There is a chance that data could be breached. To protect against loss of confidentiality the recorded interview data, transcripts, and hand-written notes will be stored on a password-protected database. The data recorder, transcripts, and hand-written notes will be secured in a locked cabinet in a private room at the researcher's home. The cabinet will be secured with a combination lock. The researcher will not share the lock combination with anyone. When reporting the findings, the researcher will use pseudonyms to mask the names of people and organizations. Criminal or Civil Liability: There is a chance that you could make self-incriminating statements that can potentially incur civil or criminal liability. Once again, you will be reminded at the beginning of the interview that you should not describe incident events in which workers were injured or property damage was incurred.

For all the foregoing reasons, I ask that you do not talk about incidents in which injuries occurred or property damage was sustained. The researcher will always use pseudonyms to mask the names of any organizations of people that you identify. You may experience negative emotions when recollecting and describing incident events, and the database that stores the interview response data is subject to compromise. There are some benefits to this research, particularly that the experiences that participants share will contribute to building the body of knowledge about near miss incident reporting. The data that are gathered as a result of sharing individual experiences will be used to understand how near miss reporting is interpreted.

If you have any questions about the research at any time, please call me at (707)624 -0780. You may also contact my faculty advisor, Dr. Rod Githens at (916) 739 7332. If you have any questions about your rights as a participant in a research project please call the Office of Research and Sponsored Programs, University of the Pacific (209) 946-7716. In the event of a research-related injury, please contact your regular medical provider and bill through your normal insurance carrier, then contact the Office of Research and Sponsored Programs.

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission. Measures to ensure your confidentiality include masking your identity and the name of any persons or organizations that you disclose. Documents will be secured by a password--- protected database. When the results of the study are reported, your identity will be masked. The data obtained will be maintained in a safe locked location and will be destroyed after a period of three years after the study is completed.

Your participation is entirely voluntary and your decision to participate will involve no penalty or loss of benefits to which you are otherwise entitled. If you decide to participate, you are free to discontinue participation at any time without penalty or loss of benefits to which you are otherwise entitled. The interview will be a one-on-one conversation with me, and should last 60-90 minutes. In order to capture the pertinent details of your responses and to ensure accuracy, I plan to audio-record the interview. Subjects may bear a burden of shame if they assume responsibility for the welfare of others in certain event circumstances as they recall and describe their experiences. I plan to manage adverse reactions by allowing the subject time to respond and time to gather thoughts. The data gathered may be sensitive, and I will always advise you of the right to discontinue the interview at any time.

Your signature below indicates that you have read and understand the information provided above, that you willingly agree to participate, that you may withdraw your consent at any time and discontinue participation at any time without penalty or loss of benefits to which you are otherwise entitled, that you will receive a copy of this form, and that you are not waiving any legal claims, rights or remedies.

You may print a copy of this form to keep.

Signature

Date

\_\_\_\_\_





## APPENDIX B: INTERVIEW PROTOCOL

Good Day,

Thank you for taking the time to meet with me for this interview. I am Julia McGee, a student at the Benerd School of Education at the University of the Pacific, Sacramento campus, California. I am conducting a study about worker perceptions of incident reporting in aircraft ground operations and petrochemical industries. This interview is designed to discuss workplace hazards and incident reporting. The duration is 60-90 minutes. I will request your permission to audio-record the interview in order to capture the pertinent details of our conversation. I ask that you **not** describe incidents in which injuries or damage to equipment or the environment have occurred. The topic of incidents can be sensitive, and the interview questions will require reflection on past experiences in your former workplace. You may withdraw from this interview at any time. At all times, I will make every effort to protect your anonymity when the results of the interview are shared. No personally identifiable information will be asked of you. Your responses in the interview will be kept anonymous. The interview questions are designed to understand your interpretations about hazards and incidents in your previous work environment. The interview should last about 60-90 minutes. Again, thank you for taking the time to participate in this video conference or telephone interview.

Do you have any questions about what I have explained so far?

Your responses will be assigned to pseudonym Number (Assign Numbers S1 -S8) \_\_\_\_

To capture the pertinent details of our conversation, I would like your permission to audio-record this interview.

Do I have your permission to audio-record this interview? I will start the recording.

Pseudonym	Interview Date / Time
Industry	Recording Start / Stop
Key Question One: <i>In what ways do workers in aircraft ground operations and petrochemical operations describe hazards of the work environment?</i>	
Key Question Two: <i>How is a near miss incident defined amongst workers in aircraft ground operations and petrochemical operations?</i>	
Key Question Three: <i>How is the goal of near miss reporting interpreted amongst workers?</i>	
Key Question Four: <i>In what ways are reporting the occurrence of an incident related to the OSHA goals of identifying hazards and preventing the recurrence of an incident?</i>	

The first set of questions is about hazards that existed where you used to work.

1. So, tell me a little bit about the type of work that you have done.
2. When did you last work in that industry?

3. How long have you worked in that industry?
4. Thinking about your time in the \_\_\_ industry, describe some of the hazards of that job.
5. In your observation, what were some of the more frequently occurring hazards?
6. What are some of the benefits to identifying a hazard?
7. How can you determine if a hazard had the potential to cause an injury?

*Throughout the conversation, I remind you to **not** describe incidents that resulted in injury or damage to equipment or the environment.*

*Sometimes, injuries, damage to equipment, or damage to the environment occur when hazards are recognized or when hazards go undetected.*

*Sometimes, injuries and damage are averted when incidents do not advance or do not materialize to become accidents.*

8. What has been your experience with incident events?

*If none, then thank you for sharing your experiences and participating in the interview. I will now stop the recording. Otherwise, continue to the next question.*

9. How would you define an incident that almost resulted in an accident?

*Let's refer to your definition as a Type-X event. I will reference your definition in subsequent questions.*

*Throughout this conversation, I remind you to **not** describe incidents that resulted in injury or damage to equipment or the environment.*

10. Have you experienced a Type-X event? If so, describe your experience.

11. In reflecting on your Type-X event, did you share your experience with anyone? Describe the experience.

12. How did you know what actions to take when a Type-X event occurred?

13. Were you required to report a Type-X event? If so, what was the process to report?

14. What has been your experience in reporting a Type-X event?

15. What do you consider to be the purpose of reporting a Type-X event?

16. Thinking about your progression in the industry, from the earlier years to the more recent, what has been your experience in reporting Type-X events?

*I remind you to **not** describe incidents that resulted in injury or damage to equipment or the environment.*

17. Describe the types of incidents that you were required to report.

18. Based on incidents that you know of, describe incidents that you would classify as Type-X events.

19. When thinking about preventing recurring hazards, what makes one method of hazard removal more effective than another?

20. In what ways are reporting Type-X events useful?

21. How does reporting a Type-X event prevent the recurrence of a future incident?

22. How does reporting a Type-X event promote hazard identification?

23. Thinking about your span of experience on the job, from the earlier days to the more recent, how has your interpretation of reporting Type-X events changed, if at all?

24. Earlier, you defined the purpose of reporting incident events. What other approaches or methods are useful in achieving the same goal?

25. Now that you have been away from the industry, how has your perception of reporting Type-X events changed, if at all?

*Is there anything else about Type-X events that you haven't had a chance to discuss?*

*Thank you for taking the time to share your experiences. I will now stop the recording. If you have any further questions, you may contact me at 707 624 0780. Thank you for participating in the study.*