What is the impact when safety is only first-*ish*?

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ABSTRACT

WBD, Inc. is a large warehouse storage and shipping company committed to a strong safety culture across the organization. Safety drives the actions of every employee, starting at the top with management down to the frontline worker. Building a safe work environment is a collective effort of the employer and the individual workers. It has been estimated that 75% of accidents are caused by unsafe behavior, 23% by unsafe environments, and 2% by natural mischances (Jain & Rao, 2008). These statistics reflect that the majority of accidents stem from individual behaviors. Safety is imperative to ensure that accidents do not affect lives, properties, and business success. WBD, Inc. has experienced an increase in accidents in the warehouse over a short period involving forklift operators and spotters.

Keywords: Performance improvement, cause analysis, leadership, safety culture, intervention, performance gap

This case is based on an actual organization and the individuals within that organization. All facts stated are actual and based on the organization. The name of the organization and the names of the individuals involved have been changed to maintain anonymity.

CASE RATIONALE

WBD, Inc., large warehouse storage and shipping company, has been in business for over sixty years. WBD, Inc. dedicates significant resources to its health and safety programs, including ethics and compliance with regulatory standards and a company goal of zero accidents. The company provides every employee with the authority to stop work if risks are perceived. This authority serves as an essential tool in empowering the workers to watch out for each other. It is also this authorization that prioritizes the safety-first culture.

Recently WBD, Inc. has observed an increase in safety-related incidents in the warehouse involving forklifts. These incidents include equipment coming in contact with personnel, equipment colliding with other equipment, and dropped object near misses during forklift operations. An assessment is needed to identify possible performance gaps (deficiencies) to understand the factors leading to the incidents and what actions are necessary to ensure the safety of the workforce and maintain the company's overall safety priority.

INTRODUCTION

This case study focuses on understanding the factors contributing to an increase in forklift safety incidents within WBD, Inc. These incidents have been relatively minor; however, over the last year, an increase in forklift accidents has been observed during typical day-to-day operations. If this trend continues, there will likely be an increased risk of a significant safety event. This could impact business operations and increase the risk of personal injury, damage to equipment, infrastructure, and inventory. An organization's "safety record" is often considered when business contracts are awarded. Continual occurrence of accidents, lost time, and near misses can increase the risk of that company losing future contracts.

This case study attempts to better understand the performance issue(s) related to safety and safety culture. This case study will explore tools and processes to increase understanding of the variables leading to such events and recommend possible interventions (solutions) that can be utilized to address the safety risks and drive the desired safety behaviors.

WBD, INC. ORGANIZATION

WBD, Inc. was established in 1953 and has been serving its customers' warehouse storage and shipping needs throughout the United States. Their dedicated team of highly qualified and world-class professionals offers the best customer service in the industry. WBD, Inc. exercises strict compliance with relevant governing bodies and federal regulations for all shipping, storage, and disposal needs.

Vision, Mission, and Values

Vision Statement

WBD, Inc's vision is to be the nationwide business leader in warehousing, shipping, and disposal, by providing imaginative and practical solutions to complex storage, shipping, and disposal problems while delivering safely on time and on budget, every time.

Mission Statement

Provide the most comprehensive, compliant, customer-friendly, and cost-effective shipping and storage.

Values

We are dedicated to the safety of our people, our clients, and the environment. WBD, Inc.'s core values drive everything we do. The company's success is built on safety, integrity, teamwork, and excellence. We provide exceptional services that consistently meet or exceed our customer's expectations. At a minimum, WBD, Inc. will use the highest ethics and professionalism to deliver high-quality services to our customers.

Performance Issue

Accountable operation of a forklift is more than just moving materials. Forklift operation includes proper training, the appropriate equipment maintenance, and the correct machine configuration for the job. The forklift operators involved in the incidents had a minimum of five years of experience and were qualified on the equipment they were operating. The operators' training meets all the regulatory requirements, such as the Occupational Safety and Health Administration (OSHA) standards and the American Society of Mechanical Engineers (ASME) regulations.

Company policies and procedures require the forklift to be inspected and ensure all preventive maintenance has been signed off before using the equipment for any job. Employees are expected to perform at safe and optimal levels while performing accurately under time constraints. They must adhere to policies and procedures to maintain a safe and compliant environment. However, time constraints increase the level of stress, which may result in accidents, which stops production.

At the beginning of each shift, the manager holds a pre-job briefing. The briefing covers the tasks for the day and outlines any potential safety hazards associated with the job. The jobs are assigned to the individual worker and their qualifications are checked to ensure they are qualified for the task they have been given. In addition, before each job, there is a walk down of the work area to ensure the path is clear of obstacles to help prevent any potential hazards.

With all the policies, procedures, and safety measures in place, accidents are still happening. Several critical issues have occurred, such as moving unsecured loads with forklifts, striking spotters with the forklift tires, and dropping cargo when unloading from a flatbed truck.

DESIRED PERFORMANCE

Employees of WBD, Inc. are required to follow and adhere to the policies and procedures of the company. Each position has its own set of performance objectives in addition to the overall guiding policies. Each of these performance objectives is put into a procedure. The expectation is for each employee to work safely and compliantly by following procedures and watching out for their own safety and the safety of their co-workers. Employee involvement in prioritizing their own and others' safety serves as the cornerstone of the safety culture.

Employees have step-back/stop-work authority if they perceive a safety issue. Safety issues include changing conditions, unidentified hazards that are encountered, and other work practices that compromise safety or quality. A step-back will pause work for a readily fixable problem, such as the path for the forklift to load and unload has obstacles that need to be moved. A stop-work halts work because of a problem that is not readily fixable such as the preventative maintenance and inspection has not been completed on the equipment. Using the equipment would be against company procedures.

Employees are encouraged to voice concerns, provide suggestions, and raise questions. The goal is zero accidents.

ACTUAL PERFORMANCE

In the past seven months, there have been an escalation of accidents involving forklift operators and spotters. No serious injuries, equipment, infrastructure, or load damage have occurred. However, common more-severe forklift accidents in the industry (not this location) include bodily harm and death. Many of these accidents happen because of crushing, equipment rollover, inadvertently driven off loading docks, and lifts falling between docks and an unsecured trailer. The potential for harm is high.

In the case of WBD, Inc., each accident occurred while moving unsecured loads, moving shipping containers within the warehouse, and loading/unloading flatbed trailers. There have been incidents where the potential for serious injury to the spotter or operator has been present.

IMPACT OF PERFORMANCE ISSUE

The need to maintain vigilance during forklift operations is exceedingly crucial to the success of WBD, Inc. Injured employees create severe liabilities, and damaged cargo could cost thousands, even millions of dollars. Various factors increase the risk of damage depending on the cargo being hauled. For example, if spilled, acids and other hazardous chemicals increase the risk of industrial contamination and environmental damage. If the payload is exceedingly heavy, the risk of operators and employees getting hurt significantly increases.

The work environment at WBD, Inc is fast-paced and stressful. Because of the need to ensure the safety of all operators and limit the possibility of environmental damage, employees' attention levels are heightened to ensure precision. However, with the demand for increased awareness comes elevated stress levels which can often create complacency amongst the operators. This can result in damages and injuries.

In the case of a significant incident, the financial implications are very high. Even with these minor incidents at WBD, Inc., there is a financial loss due to production interruptions. There may be significant direct and indirect economic losses due to accidents. According to OSHA "it has been estimated that employers pay almost $1 billion per week for direct workers' compensation costs alone" (n.d.). The costs of workplace injuries and illnesses include direct and indirect costs. Direct costs consist of first aid expenses, workers' compensation payments, medical expenses, and costs for legal services. Examples of indirect expenses include work time loss, lost productivity, repairs to damaged equipment and property, training replacement employees, accident investigation and implementation of corrective measures, and lower employee morale and absenteeism costs.

ANSWERS/TEACHER'S NOTES

Questions

1. What is a performance gap? What is the impact(s) or potential impact(s) of the gap on the safety culture?
2. What techniques can be used to investigate the factors leading to the performance issue?
3. What are the stakeholders that are affected by the performance gap?
4. What are some possible interventions that could close the performance gaps?

Possible Answers

1. What is a performance gap? What are the impact(s) or potential impact(s) of the gap on the safety culture?

A performance gap is a difference between desired performance and actual performance (Van Tiem et al., 2012). Performance gaps can occur at any level of the organization. For example, there can be a performance gap with one particular individual, an entire team, or within the organization's management. Gaps may stem from various sources tied to policies, behavior, role, leadership, etc. In general, the performance gap is a result of incongruence between factors.

Safety culture is defined as a collection of human interests, shared values, attitudes, ideologies, beliefs, and customs that commonly define a group of humans (Bissah, 2019). Culture may influence safety in two ways: first, by providing frames of reference through which risk information is perceived; an organization's culture involves areas where some risks are visible, but there may be blind spots regarding others (Antonsen, 2009). Second, culture influences safety by constituting conventions for behavior and communication. This aspect of culture pertains to the informal work practices that usually exist in formal work structures (Antonsen, 2009).

Safety culture typically flows down from senior management and the system/organizational level. The commitment to safety is a statement of policy and objectives of the company. An indicator of safety culture is the organization's safety performance. To find evidence of safety culture within the organization, three aspects need to be considered: (1) the environment created by local management, (2) the attitudes of individuals at all levels, and (3) the actual safety experience in the organization. The working environment should include defined safety responsibilities and detailed practices at all levels (Sorensen, 2001).

The impact, or potential impact, of a safety culture gap could be consequences of incidents related to disturbances in production and the economic losses. An incident has the potential to stop production for hours or even months before work can return to normal (Antonsen, 2009). A significant amount of financial resources are spent on compensation and litigation due to accidents (Kukoyi & Adebowale, 2021). The increase in project costs has a significant negative impact on the client's return on investment, profits, and insurance premiums.

Other negative consequences include the company's reputation, human tragedy, long-term life-altering injuries, equipment damage, and the demotivation of the workers (Kukoyi & Adebowale, 2021).

2. What technique and which tools can be used to investigate the factors leading to the performance gap?

        While there are various assessment approaches that can be utilized, such as needs analysis and training needs assessment, one of the more substantial investigation techniques is the cause analysis. According to Dyro and Patial (2004) "the cause analysis addresses the four basic questions
1. What happened?
2. Why did it happen?
3. What are the contributing factors?
4. What can we do to prevent it from reoccurring?" (p. 227)
"Organizational, environmental, and gap analyses yield valuable information; a cause analysis determines why the performance gap exists" (Van Tiem et al., 2012, p. 163). Various data collection tools, can be used to conduct a cause analysis, as indicated in Table 1 (Appendix).

3. What stakeholders are affected by the performance gap?

        To perform a cause analysis efficiently, it is necessary to recognize who the stakeholders are and what factors were affected by the incident. "Stakeholders are any group or individual who affects or is affected by the achievement of the organizations' objectives" (Mitchell et al., 1997, p. 856). If the boundaries of the incident itself are clearly defined, then stakeholders can be easily identified (Reed et al., 2009). It is crucial to identify who holds a stake in the incident under investigation (as well as those circumstances when no incident has occurred, since we are also concerned with the impact of the potential risk) so the boundaries of the social and environmental trends can be established (Reed et al., 2009). Identifying stakeholders is usually a repetitive process.
        Classes of stakeholders can be acknowledged by their ownership or attributed ownership of one, two, or all three of the following qualities: (1) the stakeholder's power to influence the company or organization, (2) the legitimacy of the stakeholder's affiliation with the organization, and (3) the urgency of the stakeholder's claim on the organization (Mitchell et al., 1997). According to Leigh, "Stakeholders often include individuals from outside the organization such as customers, vendors, community members, and partners. Internal stakeholders may include associates, managers, union representatives, owners, and directors" (2009, p. 1095). This theory produces a comprehensive typology of stakeholders based on the assumption that these variables define the field of stakeholders: those entities to whom managers should pay attention (Mitchell et al., 1997).
        The following is a list of potential and actual stakeholders affiliated with this case:
-   Equipment operators
-   Families of employees
-   All levels of leadership/management
-   Customers
-   Vendors, providers, contractors
-   Corporate investors
-   Equipment manufacturers
-   General public

- Signalperson (signal persons are an operator's eyes and ears. Their signals and communications are crucial in preventing accidents).
- Spotter (an individual who guides equipment operators so people or things do not get hurt or damaged).
- Maintenance division
- Training organization
- Human resource department
- Legal
- Local authorities
- Environmental Protection Agency (EPA)
- Occupational Safety and Health Administration (OSHA)
- Industry Regulators
- Industrial Safety

4. What are some possible interventions, or solutions, that could close the performance gaps?

   Gilbert's (2007) Behavior Engineering Model is frequently used to assist in determining the cause of performance gaps from the findings identified in Question #2. According to Gilbert, there are three factors that influence performance – information, instrumentation, and motivation (2007). The three factors are divided into two categories: environmental and individual factors, and the environmental factors consist of information, instrumentation, and motivation. The individual factors consist of knowledge, capacity, and motives (2007). Table 2 (Appendix) is based upon Gilbert's ideology to include the possible interventions that could be used in this case, based on the findings in the cause analysis phase.

   During the HPT model's intervention selection phase, we attempt to correctly identify and recommend "the most appropriate activities to successfully resolve a performance improvement problem, opportunity, or challenge. The intervention selection process helps manage and simplify the selection effort so that interventions may be selected, planned, and implemented carefully" (Van Tiem et al., 2012, p. 197). As indicated above, several possible interventions were identified for this case and included in Table 2 (Appendix).

   Once the possible interventions are identified, the chosen or selected interventions will be made. Typically, in these situations, interventions implemented are based on many different factors, such as best practices, risk, feasibility, appropriateness, cultural fit, and cost/time resources needed. The concepts of accuracy (does the intervention truly address the cause(s) of the gap) and sustainability (will the intervention be appropriate over time) are central to the intervention selection process.

REFERENCES

Antonsen, S. (2009). Safety culture assessment: A mission impossible? *Journal of Contingencies and Crisis Management*, *17*(4), 242–254. https://doi.org/10.1111/j.1468-5973.2009.00585.x

Barker, K. N., Flynn, E. A., & Pepper, G. A. (2002). Observation method of detecting medication errors. *American Journal of Health-System Pharmacy*, *59*(23), 2314–2316. https://doi.org/10.1093/ajhp/59.23.2314

Bissah, Z. (2019). Safety culture and occurrence of accidents: Review of literature. *International Journal of Innovative Research and Advanced Studies*, *6*(4), 54–62.

Bowo, L. P., & Furusho, M. (2018). Human error assessment and reduction technique for reducing the number of marine accidents in Indonesia. *Applied Mechanics and Materials*, *874*, 199–206. https://doi.org/10.4028/www.scientific.net/amm.874.199

Card, A. J., Ward, J. R., & Clarkson, P. J. (2012). Beyond FMEA: The structured what-if technique (SWIFT). *Journal of Healthcare Risk Management*, *31*(4), 23–29. https://doi.org/10.1002/jhrm.20101

Department of Energy. (1992). *DOE-ne-STD-1004-92; root cause analysis guidance, NERC*. U.S. Department of Energy Office of Scientific and Technical Information. Retrieved December 3, 2021, from https://www.nerc.com/pa/rrm/ea/CA_Reference_Materials_DL/DOEGuidelinesforRootCause.pdf.

Dyro, J. F., & Patail, B. (2004). Patient safety and the clinical Engineer. In *Clinical Engineering Handbook* (pp. 227–234). essay, Elsevier Academic Press.

Fassett, W. E. (2011). Key performance outcomes of patient safety curricula: root cause analysis, failure mode and effects analysis, and structured communications skills. *American Journal of Pharmaceutical Education*, *75*(8), 1-8.

Gilbert, T. F. (2007). *Human competence: Engineering worthy performance*. John Wiley & Sons.

Gracia, F. J., Silla, I., Renecle, M., Goilean, C., & Mesquita, M. (2020). Safety culture and safety Performance in high-reliability organizations: a dynthesis of IDOCAL'S contributions to the literature. *Revista Psicologia. Organizacoes e Trabalho*, *20*(4), 1210–1220. https://doi.org/10.17652/rpot/2020.4.05

Haas, E. J. (2020). The role of supervisory support on workers' health and safety performance. *Health Communication*, *35*(3), 364–374. https://doi.org/10.1080/10410236.2018.1563033

Hall, M. E., Blair, E. H., Smith, S. M., & Gorski, J. D. (2013). Development of a theory-based safety climate instrument. *Journal of Safety, Health & Environmental Research*, *9*(1), 58–69.

Jain, R. K., & Rao, S. S. (2008). *Industrial safety, health and environment management systems*. Romesh Chander Khanna.

Jayswal, A., Li, X., Zanwar, A., Lou, H. H., & Huang, Y. (2011). A sustainability root cause analysis methodology and its application. *Computers & chemical engineering*, *35*(12), 2786-2798.

Kang, S. P. (2016). What do HPT consultants do for performance analysis? *TechTrends*, *61*(1), 32–45. https://doi.org/10.1007/s11528-016-0129-1

Kannan, A. (2019, April 15). *The science of assisting medical diagnosis: From expert systems to machine-learned models*. Medium. https://medium.com/curai-tech/the-science-of-assisting-medical-diagnosis-from-expert-systems-to-machine-learned-models-cc2ef0b03098

Khouly, S. E., & Fadl, N. (2016). The impact of organizational culture on work quality. *Competition Forum*, *14*(2), 210–215.

Kukoyi, P. O., & Adebowale, O. J. (2021). Impediments to construction safety improvement. *Journal of Engineering, Project & Production Management*, *11*(3), 207–214. https://doi-org.libpublic3.library.isu.edu/10.2478/jeppm-2021-0020

Kwortnik, R. (2003). Clarifying "fuzzy" hospitality-management problems with depth interviews and qualitative analysis. *The Cornell Hotel and Restaurant Administration Quarterly*, *44*(2), 8. https://doi.org/10.1016/s0010-8804(03)90011-5

Leigh, D. (2009). SWOT analysis. *Handbook of Improving Performance in the Workplace: Volumes 1-3*, 115-140.

Litosseliti, L. (2007). Introducing Focus Groups. In *Using focus groups in research* (pp. 1–9). essay, Continuum.

Lombardi, S. (2018, September 17). *4 good examples of companies that use lean manufacturing*. Refined Impact. https://refinedimpact.com/4-good-examples-of-companies-that-use-lean-manufacturing/

Mahto, D. & Kumar, A. (2008), Application of root cause analysis in improvement of product quality and productivity, *Journal of Industrial Engineering and Management*,*1*(2),16–53, https://doi.org/10.3926/jiem.2008.v1n2.p16-53

Mallard, D. (2016). The human factor in safety and operations. *EHS Today*, *9*(6), 29–31.

Mitchell, R. K., Agle, B. R., & Wood, D. J. (1997). Toward a theory of stakeholder identification and salience: Defining the principle of who and what really counts. *Academy of Management Review*, *22*(4), 853–886. https://doi.org/10.5465/amr.1997.9711022105

Morgan, D. L. (1996). Focus groups. *Annual Review of Sociology*, *22*(1), 129–152. https://doi.org/10.1146/annurev.soc.22.1.129

Naji, G. M. A., Isha, A. S. N., Mohyaldinn, M. E., Leka, S., Saleem, M. S., Rahman, S. M. N. B. S. A., & Alzoraiki, M. (2021). Impact of safety culture on safety performance; mediating role of psychosocial hazard: an integrated modelling approach. *International Journal of Environmental Research and Public Health*, *18*(16). https://doi.org/10.3390/ijerph18168568

Occupational Safety and Health Administration. (n.d.). *Business case for safety and health*. United States Department of Labor. Retrieved October 10, 2021, from https://www.osha.gov/businesscase/costs.

Pomeroy, C. (n.d.). Safety culture utilizing behavioral based safety. Retrieved February 10, 2020, from https://www.academia.edu/18991505/Safety_Culture_Utilizing_Behavioral_Based_Safety

Reddon, T. (2016). The 6 most overlooked aspects of forklift safety. *EHS Today*, *9*(6), 43.

Reed, M. S., Graves, A., Dandy, N., Posthumus, H., Hubacek, K., Morris, J., Prell, C., Quinn, C. H., & Stringer, L. C. (2009). Who's in and why? A typology of stakeholder analysis methods for natural resource management. *Journal of Environmental Management*, *90*(5), 1933-1949. https://doi.org/10.1016/j.jenvman.2009.01.001

Rothwell, W. J., Hohne, C. K., & King, S. B. (2007). *Human performance improvement: Building practitioner competence* (2nd ed.). Burlington: Butterworth-Heinemann.

Occupational safety and health administration. (n.d.). *Business case for safety and health.* Business Case for Safety and Health - Costs | Occupational Safety and Health Administration. Retrieved December 7, 2021, from https://www.osha.gov/businesscase/costs#:~:text=It%20has%20been%20estimated%20that,and%20costs%20for%20legal%20services.

Scilly, M. (2020). *Difference between mergers and joint ventures.* Chron. https://smallb usiness.chron.com/difference-between-mergers-joint-ventures-18578.html

Serrat, O. (2017). The SCAMPER technique. In *Knowledge solutions: Tools, methods, and approaches to drive organizational performance* (pp. 311–314). essay, Springer.

SCRC SME (2004). *Philips electronics' balanced scorecard.* NC State University. https://scm.ncsu.edu/scm-articles/article/philips-electronics-balanced-scorecard

Sorensen, J. N. (2001). Safety culture: A survey of the state-of-the-art. *Reliability Engineering & System Safety*, *76*(2), 189–204. https://doi.org/10.1016/s0951-8320(02)00005-4

Haupt, T.C., Pillay, K. (2016). Investigating the true costs of construction accidents. *Journal of Engineering, Design and Technology*, *14*(2), 373–419. https://doi.org/10.1108/JEDT-07-2014-0041.

Tocino-Simth, J. (2021, October 5). *How to apply appreciative inquiry: A visual guide [+PDF].* PositivePsychology.com. Retrieved November 9, 2021, from https://positivepsychology.com/appreciative-inquiry-process/.

Van Tiem, D. M., Moseley, J. L., & Dessinger, J. C. (2012). *Fundamentals of performance improvement: Optimizing results through people, process, and organizations.* San Francisco: Pfeiffer.

Yang, Y., Schonnop, R., Feldman, F., & Robinovitch, S. N. (2013). Development and validation of a questionnaire for analyzing real-life falls in long-term care captured on video. *BMC geriatrics*, *13*(1), 1-11.

Yilmaz, F., & Celebi, U. B. (2015). The importance of safety in construction sector: costs of occupational accidents in construction sites. *Isletme ve Ekonomi Arastirmalari Dergisi/Business and Economics Research Journal*, *6*(2), 25–37.

APPENDIX

Table 1. Cause Analysis Techniques

Technique	Description
5 why's	The three elements of the Five Whys technique determine the most probable root cause of the issue and obtaining confirmation of the logic behind the analysis develops corrective actions to remove the root cause from the organization (Serrat, 2017).
Observation	Requirements necessary for the observation method include visible, predictable events, and limited duration (Barker et al., 2002).
Interview	The objective of the interview is to obtain rich, detailed data that reflect the informant's language, experience, and perspective "in depth." The most common type of depth interview is semi-structured and feature some prearranged questions to guide the dialogue toward specific topics (Kwortnik, 2003).
Focus group ➤ Mixed ➤ High achievers only ➤ Low achievers only	A method that collects data through group interaction on a topic determined by the researcher (Morgan, 1996). Small, structured groups with selected participants, generally led by a moderator (Litosseliti, 2007).
Survey/questionnaire	A valid and reliable questionnaire for assessing the experiences and attitudes of employees or/and organizations employing Root Cause Analysis (Yang et al., 2013).
Fishbone Diagram	Used to represent the significant problems in a process. Aids in visualization and convey the critical relationships between the seemingly disconnected elements (Jayswal et al., 2011).
Task Analysis (Cause and Effects [walk-trough])	A method in which personnel conducts a step-by-step reenactment of their actions for an observer without carrying out the actual function. If appropriate, it may be possible to use a simulator for performing the walk-through rather than the work location (Department of Energy, 1992)
SWOT Analysis	SWOT analysis is an approach to considering the inhibitors and enhancers to the performance that an organization encounters in both its internal and external environments (Van Tiem et al., 2012).
Failure Mode and Effects Analysis (FMEA)	FMEA is an assessment of systems and processes designed to predict in ways things can go wrong (failure modes) and the likely extent of injury or cost (effects) associated with each failure mode (Fassett, 2011).
Pareto Chart	Also known as the 80-20 rule, approximately 80% of the effects/problems come from 20% of causes. Focuses on the most critical causes instead of wasting time and energy on minor ones (Jayswal et al., 2011).
SCAMPER	Uses set of directed, idea-spurring questions to suggest some addition to, or modification of, something that already exists

|	(Serrat, 2017).
SWIFT	A systems-based risk identification technique that employs structured brainstorming, with the use of predeveloped guide words/headings (e.g., timing, amount, etc.) in combination with prompts elicited from participants (which often begin with the phrases "What if. . ." or "How could. . .") to examine risks and hazards at a systems or subsystems level (Card et al., 2012).
Human Error Assessment and Reduction Technique (HEART)	Aimed at evaluating the probability of error, the human error assessment and reduction technique utilizes both a qualitative and quantitative analysis (Bowo & Furusho, 2018).
Sustainability root cause analysis	It is built on the combination of the Pareto chart and Fishbone diagram. Helps to improve the efficiency of screening by eliminating non-viable processes systematically at the early design stage (Jayswal et al., 2011).
Kepner-Tregoe	A highly structured approach focuses on all aspects of the occurrences and problem resolution (Department of Energy, 1992)
Barrier Analysis	A systematic process identifies physical, administrative, and procedural barriers or controls that should have prevented the occurrence. Helps determine why the barriers or controls failed and what is needed to avoid recurrence (Department of Energy, 1992)
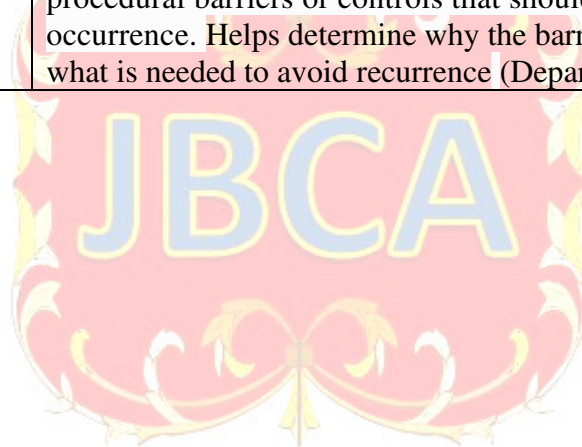
Table 2. Possible Intervention Solutions

	Addressing issues relating to information	*Addressing issues relating to instrumentation and capability*	*Addressing issues relating to motives and consequences*
Items Stemming from the Organization	**Expectations** · Preventative maintenance · Inspections **Practices** · Environmental scanning-walk downs · Management support **Policies** · Spotters · Operators · Pre-Job Briefing · Security management	**Instrumentation to assist with** · Reengineering · Realignment · Restructuring · Step back · Lessons learned · Positive growth foundations · Availability of personal protective equipment	· Monetary Incentives · Career advancement opportunities · Career development opportunities · Safe work environment · Accountability
Items Stemming from the Individual	**Education/Training of** · OSHA training · Certification[1,2] · Site-specific training[1,2] · Training refresher[1,2] · Additional OJT[1,2] · Just-in-time training[1,2] · Leadership development[3] · Preventative maintenance knowledge[1] · Inspection of equipment[1]	**Cultural Intelligence** · Communication differences · Understanding various backgrounds/diversity · Differing skill levels	**Motivation** · Autonomy support · Connection with others · Overall level of competence **Ethics** · Always following procedures · No work arounds · Honest reporting

[1] Operators
[2] Spotters
[3] Supervisors, managers