Human Error: There Is No Root Cause

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Introduction

The title of this paper and presentation, “There Is No Root Cause” is lifted directly from Sydney Dekker and his book, The Field Guide To Understanding Human Error. As was Dekker’s intent when he wrote this as a section heading in his book, our discussion here is not intended to make the point that investigating incidents to find the root cause should be abandoned. Our purpose here is to explore what Dekker and others are telling us about causation and the process by which we construct a narrative about what is believed to have occurred. It is this process of constructing or developing the basis for the narrative where care must be taken. Author Erik Hollnagel, in his recent book Safety I and Safety II writes, “A problem with root cause analysis as well as most other methods used … is that providing a definitive answer rules out any alternative explanation or even motivation to search for ‘second stories’.”

Background

Investigating workplace incidents is a fundamental skill for safety professionals. It is our job to gather the facts, identify what happened and why, and to find ways to keep it from happening again. However, most of us have received limited training in the investigative process, and even less in how to uncover the multitude of contributing factors that could be material in determining causation. We have learned what we know by reading articles, listening to speakers at conferences, by attending seminars, and by applying what we have learned on-the-job. Functionally, we know the fundamental process for investigating well enough. At least well enough to gather information for filing workers compensation claims and OSHA record keeping, and to prescribe corrective measures.
Depending on our experience and the complexity of the situations faced, we may have also been exposed to advanced analytical tools and methods to find the root cause, including the “5 whys”, Pareto charts, fishbone diagrams, fault-tree analysis, MORT, HFACS and others. Depending on who you read or hear, and your level of experience, each has its strengths and weaknesses. In the end, they all start at the beginning and attempt to find a defining cause for what happened.

Herein lies one of the issues we will discuss during this presentation; Can we in fact find “the” root cause? Are we biased in the process? Are we able to uncover and evaluate contributing factors? Do we stop investigating when we reach a plausible conclusion, what we believe is the root cause, short of understanding the context in which the incident occurred and more?

Among experienced safety professionals who conduct investigations and teach the process to others, “root cause analysis” and “incident investigation” are almost one in the same. In an article published October, 2014 in the ASSE Professional Safety Journal, Fred Manuele wrote about incident investigations and how our methods are flawed. He helps us to see that much of our thinking about what and how to investigate, and who should conduct investigations is linked to the writings of H. W. Heinrich. In Heinrich’s book *Industrial Accident Prevention,* written in 1931, the author believed that front line supervisors, by proximity to the work and workers, were the ones who should be conducting incident investigations. He argued that it was their job to “identify the first proximate and easily prevented cause in the selection of remedies for the prevention of incidents.” Of course this led supervisors and anyone else conducting an investigation to look at what the person did or did not do, and, as Heinrich suggested, “to consider psychology when results are not produced by simpler analysis.” After all, in Heinrich’s assessment 88% of all incidents were due to the unsafe acts of people. Thus, the remedies or corrective actions that followed were focused at what the person did and their lack of knowledge or situational awareness, lack of personal motivation, disregard for the rules, or need for protective equipment.

Even though we now know a great deal more about the importance of safe job design, effective systems of control, and organizational influencers, this “old thinking” still pervades and underpins many safety programs. Unfortunately, we are now faced with unlearning much of what Heinrich taught us about causation. Then, in our role as safety professionals and teachers, helping others learn about human error and what Manuele describes as the “multifactorial aspects of incident causation.”

Our purpose for this discussion is to move to a new level, exploring human error and incident causation, to gain a better understanding of multifactorial causation in complex systems. We will also examine our ability, or inability, to identify the fundamental root cause of a situation and why it is so difficult. Difficult due to a number of reasons, such as the influence of our linear thinking about “cause and effect” and how we construct a narrative about causation. We are also influenced by our cognitive biases, and inability within the employment or consulting structure to get at the root causes of the underlying design, system and organizational issues. In the end we
will see that “There is No (single) root cause”, but many. What we do about this will be the subject for another discussion.

**Linear Thinking**

Today, as it was long before Heinrich, supervisors and other untrained management personnel are the ones who conduct most initial incident investigations. To them it is a linear, straight-forward process to gather the facts, identify what happened and to prescribe remedies. Looking at the events and the mistakes that were made, untrained investigators point to the behavior as the proximate cause and prescribe simple fixes, like retraining or disciplinary action. The problem with this is that it disregards the numerous contributing or influencing factors beyond the control of the worker. Incident investigations conducted by first-line supervisors seldom identify incriminating supervisory or management factors due to fear of reprisal, nor could they provide much input concerning suspect work design, inadequate systems of control, or organizational failures. And worse, this focus on workers’ behavior fosters a culture of blame and mistrust that shuts off meaningful communication and learning throughout the organization.

As author and lecturer Professor Sidney Dekker points out in his book *The Field Guide to Understanding Human Error*, “cause is something you construct” after-the fact and with the benefit of hindsight. Other students of human error understand and have written that incidents are not from conscious choice or disregard, but are from innocent errors or mistakes, and not rule or procedural violations. They recognize that the design or context of the work and the management systems of control are critical to the outcome, and may set the stage for an error or violation to have potential negative consequences. The design of the work may even provoke the error.

Dekker’s hypothesis about how we construct the cause of an incident is important to our understanding of prevention strategies. He writes that “You can find causes of failure everywhere. The causal web quickly multiplies and fans out, like cracks in a window. What you call ‘root cause’ is simply the place where you stop looking any further. The cause you define is the last necessary element for the mishap to have occurred and (in the thinking of the investigator) is sufficient. Nothing else would have needed to go wrong, otherwise you would have labeled them causes as well.”

Linear thinking about causation dates back to the times of Sir Isaac Newton (1642-1727), and revolves around what we learned from him about “action and reaction”, “cause and effect” and the “scientific method”; the later establishing the importance and relevance of and systems thinking (“if this then that”, “if/and/or”, “with or without then”, and “leading to as a result”, as examples). Later in the 1930s through the 1950s, Heinrich wrote about his studies into accident causation based on his review of thousands of insurance claim investigations, their findings and his analysis about causation and prevention. He wrote that 88% of all accidents were due to the
“fault of the person” and their unsafe behavior, and if we could find the act or proximate cause of the incident (the behavior involved) we would be able to target corrective actions.

Working to motivate workers to be safe through better training, behavioral observations (though not called that in 1931), incentives and discipline were important solutions for Heinrich. He put forward several hypotheses like the original domino theory and the accident pyramid that have since been debunked by Manuele and others. Using flimsy data from untrained supervisors in the 1920s and ‘30s, the writings of Heinrich established Newtonian cause and effect relationships, and promoted several notions that have led us to our current beliefs about accident causation. These include the role of the employee’s antecedent behavior (what motivated the choice to act in a certain manner), the imagined choices they make, and why the focus on correcting employee unsafe behavior will lead to identifying methods for safety improvement. Unfortunately, these beliefs are like bedrock and provide a misguided underpinning for today’s fundamental thinking about prevention and what constitutes safety, including the components of a modern safety and effective preventative approaches.

According to Edward de Bono, PhD., “Mistakes arise directly from the way the mind handles information, not through stupidity or carelessness.” The worker makes choices about how to complete the work, not how to complete it in a manner that decreases their own safety.

**Hindsight Is 20/20**

With the benefit of hindsight the errant act, the choice made on incomplete or incorrect information, the step in the process that was omitted, and the failure to recognize obvious signs of warning are easy to pinpoint. This is usually where we start investigating, and can set the stage for incorrect or incomplete conclusions. Even when we follow the “5 whys” process or other methods of investigation to get at the root cause, Dekker and Hollnagel reason that due to biases and other influencing factors we tend to focus on the person and what they did, or did not do as the problem. Prescribed corrective actions still includes retraining, incentives, PPE or disciplinary action.

Due to the multifactorial aspects of causation and the increasing complexity of work, we are increasingly unable to see the full picture and identify most of the true, underlying factors that influenced the situation. The “5 whys” is the approach many of us use ourselves and teach others, but as good a technique as it is, we still have difficulty finding the root cause, or causes. As we begin the investigative process, human nature and how we are hard-wired clouds our view. Our experience, beliefs and biases create mental images of what we think occurred. Partially because we have a need to find a cause to correct, we move down an investigative path to confirm the cause that we may have already defined. Cognitive bias handicaps us. We begin the investigation with “thinking errors” that all humans make in processing Information.
Two important biases to understand are “Fundamental Attribution Error” and “Hindsight Bias.” The first relates to the fact that most of us explain behavior by assigning attributes, or labels. We see error or mistakes as failures resulting from poor choice. The result is that we project ourselves as better than the person who made the mistake. The second, Hindsight Bias, distorts our understanding of reality so that when looking back on an event, we see all the causal consequences coming. In hindsight, it is clear to see what happened and we have difficulty understanding why the person involved was unable to see it as well. But those involved and in the moment, armed only with limited foresight, see no such convergence. Their mind is on the work and does not see what is about to happen. Biases often exclude related factors, or distort them, which often leads to feelings of superiority, ending with blaming or shaming the individuals who are involved.

**Finding THE Root Cause**

At this point it should be pointed out that this writer believes that there are root causes and that we can find them in the investigative process. However, we are handicapped by our methods, biases, and a myriad of other factors. Of course we can find the root cause, but if we stop when we find it we will likely miss all the others!

Erik Hollnagel, in his book *Safety 1 – Safety 2*, discusses the problem of root cause analysis shutting off the discovery of the “second (or any other) story.” Because we start down an investigative path that tends to be linear, answering several ”whys” along the way, a narrative of what occurred is constructed. And as Dekker also points out, when we reach what we believe to be a plausible conclusion the story is finished. At this point we have no motivation to look for “second stories”, so we move on to the next step of looking for corrective measures that deal with the root cause we have defined (constructed).

As we conduct an investigation, what may be most important, yet difficult to determine is what may have influenced the person to make the mistake at that moment, and why this time it resulted in a negative outcome. Based on the research and writings of James Reason in *Human Error*, and out of the need to develop an investigative taxonomy to help explain what may influence or trigger pilot (human) error in U.S. Naval aviation, Doug Wiegmann, PhD. and Scott Shappell, PhD. developed the Human Factors Analysis and Classification System (HFACS). With this system they were able to gather significant data not only about the types of errors that were occurring, but about preconditions that influenced the error, and the influences of leadership direction and organizational resources, culture and policies. For the first time there was a system that could go beyond the error of the pilot, addressing the context of the error as well. The HFACS process for data collection and analysis has proven to be effective for other industries as well, including oil and gas, waste management, power generation, nuclear, mining, and manufacturing.
To get at the multifactorial aspects of causation we need to understand the nature of work, and the concept of “drift”. Both Dekker and Hollnagel write about injuries and fatalities occurring during normal work. Errors and accidents occur as employees perform the tasks of their normal work, and in the same manner they do them every day. To understand the importance of normal work, we need to become familiar with the concept of “work as imagined” versus “work as done”.

Processes and procedures are often designed or created by those who do not have first-hand knowledge about the work or have ever done it, yet they create processes and procedures as they imagine the work will be done. During routine work, situations develop that may require workarounds or alternate methods. Workers frequently are required to compensate for some process difficulty, previously unrecognized situation that develops, lack of proper tooling, or a step in the procedure that may be out of sequence or impractical. The people doing the work make these changes for efficiency and flow to get the job done. In some cases workers compensate for improved safety, not to take shortcuts so they can get done faster. As workers compensate for the reality of work and deviate from established procedures, they may be unaware that they are creating problems down the line and increasing their own risk of injury.

“Work as done” is not necessarily unsafe work behavior, and it may in some cases may be even safer. However, without others routinely checking to see how work procedures have evolved, assessing any new hazards and making sure it is safe, we may be adding significant unrecognized risk. According to Hollnagel, this checking activity provides perfect rationale for work observations and conversations to learn how the work is actually done. It provides opportunity to discuss any deviations from the original planned process or procedure and the reasons for the deviation, to review the attendant hazards and assess the risk, revise hazard control methods as prescribed, document it, and then communicate the changes to others.

Time can also be a factor that affects investigations. Whether it is workers compensation first reports, OSHA recordkeeping, or organizational requirements we are pressured to immediately conduct accident investigations, determine the root cause, and evaluate appropriate corrective actions. This time pressure motivates investigators to find the causes quickly, define corrective actions, fill out the paperwork and move on. The combination of time pressure, cognitive biases about the role of the employee, and fundamental satisfaction with the “first story” in determining what occurred and why, it is no wonder why the real causes are never uncovered and incidents repeat themselves.

The problem is that accidents are often quite complex. As Ron Gantt wrote recently in a blog post, many aspects of the normal environment come together in an unexpected way. We can point to many things and say, “if only this didn’t happen, then the accident wouldn’t have either”, but where do we draw the line. Often we end up with arbitrary stop rules on our investigations when we just decide to stop the investigation. Unfortunately this often leads investigators to solve the problems they wanted to solve before the accident. So the investigation is led by the need to solve problems, not by the need to learn.
Work Design and Control Systems

In the employment setting humans work in an environment constructed by management. W. Edwards Deming is right in saying “A large majority of the problems in any operation are systemic, derived from the workplace and work methods created by management, and responsibility for only the relatively small remainder lies with the workers.” Thus, error is made in the context of work and in a setting controlled by others. Not only controlled by others, but a setting that is dynamic and complex. Decisions, actions, reactions, pace, stress, procedural interaction are always taking place. It is an increasingly complex environment that is becoming more and more difficult to control. Though it is a popular notion that we can change unsafe at-risk behavior, these behaviors often have nothing to do with safety.

As previously discussed, human error or mistakes happen all the time as a result of workers trying to be more efficient. They are not actively choosing to work unsafely, but think they are working in a more productive manner. An example of this would be the use of a “cheater bar” to increase leverage on the end of a wrench used to loosen a frozen fitting. Safety professionals know that using a cheater bar increases the risk that either the wrench will slip or the bar itself will suddenly come loose resulting in head or hand injury, or both. First, let’s assume that this is not the first time the mechanic has used a cheater bar. Second, the cheater bar is necessary because there are no long handle wrenches available. Third, the area supervisor knows the correct wrench is not available, so the use of the cheater bar is condoned. Fourth, the fitting is most often frozen during turn-around, and the supervisor this beforehand. Lastly, because the cheater bar is needed for the job it is left at the base of this particular pipe rack. On the surface, an injury that might occur could be blamed on the worker for using a cheater bar on a wrench. Even if no injury occurs we could point to the worker and illustrate their at-risk behavior.

As we have discussed, errors are not usually made in a conscious manner. They are active mistakes, misperceptions or misapplied skill and occur in real time. If an error is not a conscious choice, then what was it? Within the context of the work design and its procedures or management systems, what was it that allowed this particular error to fail unsafely? When we go beyond what the person did or did not do and begin to understand the context in which it occurred and how the work is normally done, we may understand enough about the reality of work that we can begin to design more accurate and sustainable corrective interventions.

This requires us to redirect our thinking and accept that the workplace belongs to management. Management facilitates and provides for creation of work. Management owns the engineering design of work, creates work processes and systems of control, and provides the tooling, equipment, training, supervision, etc. When we accept that management owns, designs and controls the work, we are better able to understand the fundamental problem; workers are often the recipients of poor design, handicapped in the process and forced to compensate to be productive in a safe manner.
Risk Assessment

Assessment of the risk inherent to the work can and should be performed. Logic dictates that based on the results of the assessment and predetermined tolerance decisions can be made on how best to control the hazard. Fred Manuele, when discussing Prevention Through Design and the importance of the hierarchy of controls at the ASSE “Rethink Safety” Symposium, taught the audience that the best time to design out a hazard and eliminate risk is on the drawing board. Unfortunately, in the real world most employees and their managers inherit their work environment and have to deal with it accordingly.

From experience dealing with pushback, safety professionals have learned to accept less effective controls. For economic reasons removing or engineering out hazards to acceptable levels of risk is all too often cost prohibitive. We have learned to settle on procedural controls, training, guarding, protective equipment, signs and warnings, and other less effective and reliable methods. Herein lays the significant problem with our root cause analysis, and Dekker’s point about construction of the cause. Because we have not appropriately reduced the risk and still depend on humans to act correctly all the time, not making material mistakes, the cause that we define in the accident investigation often points the finger of blame at the employee.

Owners, engineers, and managers continuously wrestle with the complex issues that surround designing and manufacturing products that meet customer needs while creating sufficient profit. Process design, productivity, cost control, risk assessments, human error, quality through-put, safe work design, and system controls are intertwined. Work is work; profitability is required; costs must be controlled; decisions made; risks taken; mistakes made; and as long as people are at the sharp end, injuries or deaths will likely continue to occur. How we approach the interface between humans and the context of their work may determine how we improve safety.

Whether you read James Reason, Jens Rasmussen, Wiegmann and Shappell, or other scholars who have studied human factors, serious injuries and complex work design, they all have taken a more or less linear approach to causation and proposed solutions. Today, through the works of Dekker, Hollnagel, Manuele and other thought leaders, we are learning that accidents do not occur due to causes that triggered a domino effect.

Causation is multi-dimensional, multifactorial, and is far more difficult to pinpoint and predict that we have previously thought. Conducting a detailed investigation to find the root cause is important and should be attempted. However, keep the important issues raised in this presentation in mind:

- Help others understand that the design of the work, procedures, and system components can provoke error.
- Workers will deviate and compensate during normal work. This is to be expected, so we need to learn from it and continually manage the risks this reality entails.
- Investigate beyond the visible mistake or violation.
- Look at the “context” of work: engineering design, procedures, management systems of control and direction, measurement and compensation, organizational influencers, etc.
- Work to remove blame from the organization.
- Work to share information and lessons learned to help create a “learning culture” where mistakes are seen as an opportunity to learn and improve the organization.

Summary

Many other factors and influencers that have shaped our approach to safety, which Dekker discusses in his most recent book *Safety Different*, and Hollnagel has labeled “Safety-I” in his book *Safety-I and Safety-II*. Both authors have put forward ideas to move organizations forward in their thinking about safety. Key thoughts that are the underpinnings include:

- The workplace belongs to management. Management facilitates and provides for creation of work. Management owns the engineering design of work, creates work processes and systems of control, provided tooling, equipment, training, supervision, etc.
- There is a difference between “work as done” and “work as imagined”. Processes and procedures are often designed or created by those who do not actually do the work. As work begins, modifications are often made for efficiency, flow and in some cases safety.
- Employees will make mistakes and error. This is normal and to be expected.
- Procedural and process “drift” occurs naturally, is unintentional and is most often from the desire to be more efficient and effective.
- Mistakes are different than violations and should be treated differently.
- The higher the level of risk involved in a work processes or procedures, the greater the need for management to work closely with workers to identify deviation and procedural drift.
- When deviation becomes normal and routine it has become the new procedure in-fact. Often these new procedures which become normal work are undocumented or verified. If deviation results in a shift in procedure that compromises safety, significant additional risk may be injected into work processes. This can be compounded when another part of the operation is affected and unaware of the shift.
- Sustainable safety requires a positive culture of trust, with open and honest communication.
- When something goes wrong the organization must work to not place blame. A blame free workplace is perceived as “just” and “fair”, and leads to a much higher level of trust among workers and management.
- Work to create a culture of learning, so problems are not hidden and the workers are not seen as the problem, but are the solution.
- Work to achieve a better flow of information, more positive interactions, and greater focus on work, all helping to improve productivity and safety.

Accidents do not occur in a linear construct as like a chain of falling dominos. Causation is multi-dimensional, multifactorial, and far more difficult to pinpoint and predict than previously
thought. Most incidents have multiple causes, none of which is more important than the other. Next time you conduct an investigation and think you have the story, check yourself. Imagine other potentialities and see if there might be a “second story.”

Bibliography


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