A Personal Development Strategy for Safety Management

By Thomas A. Smith

"*For every complex problem, there is a solution that is simple, neat, and wrong*."
H.L. Mencken

Introduction

One of the first axioms I was taught in safety management was *unsafe acts + unsafe conditions + time = an accident*. It sounds right. The logic is simple, neat and as I spent time in safety management it became readily apparent - it was wrong. The theory unsafe acts causes the majority of industrial accidents came out of research conducted from 1931-50 by Herbert H. Heinrich, considered the father of modern industrial safety. Heinrich worked in the safety department of the Travelers insurance company where he investigated thousands of industrial accidents. He concluded when it came to accidental injuries *man failure* was the heart of the problem and methods of control must be directed toward man failure.[1] Heinrich said that 85% of industrial accidents were the direct result of the unsafe actions of workers. Safety management has focused its effort to prevent accidents on fixing the behaviors of workers ever since.

This fixation on changing worker's behaviors as the way to improve the quality of any safety program opened the door for psychology to enter the field of safety management. In the 1960's the dominant psychological theory in American academics was *behaviorism.* It wasn't difficult to link behaviorism with Heinrich's theory. The marriage of the two ideas provided a simple solution for the complex problem of how to prevent accidents. But by the 1970's behaviorism proved to have serious flaws and lost its level of dominance with the move in psychology toward cognitivism.[2]

Regardless of behaviorism falling from grace in its own field by the 1980's companies were embracing it as *the way* to solve the problem of how to prevent employee accidents. Safety journals remain inundated with articles pushing the idea that improving safety is just a matter of motivating workers by applying behaviorism in one form or another. It provided management a seductive and easy option to fix the safety problem. Managers were more than willing to go along with this since it meant the workers had to change, not them.

Only a few people in safety management seemed to question the validity of the theory behind this process. When they did they found behaviorism could explain only "*the elementary forms of behavior that make up only part of the psychology of rats, and a very small part of the psychology of human beings.*"[3] Nonetheless the uncritical application of behaviorism continues to this day with the advent of observing workers and giving them positive reinforcement if they are observed working safely. In this paper we will take a more in depth look at what the word *quality* means when applied to safety management and how it impacts the skills required of safety managers to do their job effectively.

Quality of safety management

There comes a time in any endeavor when you must stand back and evaluate if what you are doing really makes good sense. That time has come for safety management. It's important for safety professionals to ask what our ultimate goals are. What does the word "quality" mean when applied to a safety program? Do we only want to control short term behaviors of workers? or do we want employees to become responsible thinkers, decision-makers and problem solvers? How do you know when your safety program is functioning at its highest level or the Ideal State? Should compliance be the used as a measure of an ideal safety program? I believe ultimately safety should be concerned with the development of people's skills. I'm talking here about the quality of safety associated with people being engaged, enthused and empowered to take action on safety problems they face every day. Problems caused by the universal force of entropy, the measure of disorder, that exists in all systems. Not about compliance with its goal of meeting standards and maintaining the status quo or government regulations but of continual improvement where improving safety is a constant and consistent process. The latter requires the mental as well as the manual labor of all your people at every level of your organization.

For top management today, safety management equates to "meeting specifications." [4] That means once you've done this the level of safety in operations is "good enough." And you don't even have to do it all the time. It's most important during a safety inspection or safety audit. No safety program has a way of guaranteeing a guard will be in place or a safety rule will be enforced or adhered to 100% of the time. But if the meeting of safety standards is verified during safety inspections or audits the safety manager's job is secure. Yet most of us agree just meeting safety specifications has very little to do with the quality of safety delivered to the people on the job. They are the ones who must deal with the daily reality of work and the affect of entropy on the safety of operations every minute of every day.

Because top management accepts the idea quality of a safety program equates to meeting specifications safety performance has not come close to matching results achieved in quality. For example in 1987 Motorola set a goal of 10 times improvement of quality by 1989 and 100 times improvement by 1991 and to get to a level of 3.4 defective parts per million by 1992. The goal was to achieve zero defects delivered to their customers. They did achieve this goal in some parts of their operations with the overall operations achieving 40 defects per million (dpm) which a vast improvement over the accepted level of 2,700 dpm just a few years before.[5] Almost all electronic companies now work at these levels of quality. Ironically, because Motorola didn't listen to its customers and anticipate their needs other phone makers have taken their market away. Whether it will survive as a company is under question.[6]

The origins of quality management theory practiced today can be traced to what was taught to the leaders of Japan to rebuild their economy after WW II by Mr. Homer M. Sarasohn and Dr. W. Edwards Deming.[7] They stressed two important ideas about quality management that were all but abandoned by American managers after the war. Both of these ideas apply directly to the quality of safety management.

Idea Number 1: It's the system

First they emphasized to understand and improve quality you must view work as a system. They realized producing anything from mining coal, to assembling cars, to building radios, to processing paperwork is done in a system. To improve quality you must first learn how to learn about systems. The system is where problems originate. Deming defined a system as "A network of interdependent components that work together to accomplish the aim of the system." [8] Both men knew a system can't be improved until you look at the whole thing simultaneously to find out what is actually going on in it and what it is capable of producing.

Deming linked systems with management by showing us why production must be viewed as a system. He explained when people obtain and apply profound knowledge to systems they look at work differently. The overriding theory of managing a system for high quality and continual improvement is to manage your processes so the output is as consistent as possible. That means you will have to work very hard to reduce the variation that is inherent in every operation in the system. The quality of safety management can be improved using the same methods Sarasohn and Deming advocated to improve quality of any process. We should always be looking for better ways to deliver safety to our customers who are working in the system.

Understanding systems

To learn about and improve systems you must apply *systems thinking*. It was the 1990's before American managers would rediscover the importance of thinking about systems. In his book *The Fifth Discipline* Peter Senge describes *systems thinking* as "the discipline of seeing wholes." [9] By definition a system always exists to serve something other than itself. Safety management is a system. It exists to serve other work system such as Research & Development, Sales, Marketing, Service, Maintenance, Production, Assembly and Delivery so each one can operate without causing injuries or harm to people who work in or around them.

Traditional safety management relies heavily on *analysis* of single events to study the outcomes of the system and then take corrective action. Analysis involves taking something apart, studying the behavior of each part separately and then trying to aggregate the understanding of the parts into the understanding of the whole. This is opposite of the approach used in systems thinking. You cannot understand the behavior of a system through *analysis*. To explain a system requires *synthesis*. That means instead of breaking something down and examining each part separately you must keep the parts together and study the outcomes of the system while it is running. An impossible task for analysis. [10]

An analogy might be seen in how a football team prepares for a game. Each position of the team practices with a purpose. Lineman run drills for blocking and tackling. Ends work on catching passes. Running backs practice carrying and running with the ball. The quarterback works on handing off and throwing the ball. Defensive players spend their time practicing skills to prevent the offense from achieving its goal. This allows you to analyze the skills of each individual player.

But you can’t tell how well a team is going to do by gauging how each individual player on the team does separately in practice. The team’s performance is dependent on how well everyone works together in the game. Ironically a football team spends many hours practicing during the week in preparation for a single game in which the playing time of an individual player is only a few minutes. This is exactly opposite of the world of work where people get only a few minutes to practice job skills and are expected to use them forever on the job.

The absence of systems thinking often results in people misinterpreting single events (symptoms) as causes to explain why things happen. Consequently they end up trying to solve problems by removing symptoms rather than causes. Heinrich worked from a single event perspective. It would be easy to interpret unsafe actions as causes from that viewpoint. However from a systems view unsafe acts are interpreted differently.

Symptoms are what we call the facts of the case. When a patient goes to his doctor he starts by telling him the symptoms he is experiencing; a headache or nausea. These are the facts of the case or the symptoms of poor health. The doctor makes some initial observation of his own to determine any other symptoms to add to the facts of the case. Once he completes his diagnosis he develops a hypothesis about the illness then prescribes what he thinks will eliminate the cause. If the Doctors prescription is correct it will remove the cause and the symptom will disappear. Symptoms are caused by something else.

By applying systems thinking we have the ability to look at work from a different vantage point. From this view we’ve come to realize unsafe acts are actually symptoms of safety problems not causes. Once you have hired people, trained them and released them to do their jobs unsafe actions exist mostly because of deficiencies in the safety management system not the individual. They can be reduced, eliminated or their impact minimized through continual improvement of safety in production. But even if you eliminate all unsafe actions accidents will still happen until the system is correct.

The only management theory Heinrich had was command and control so from that perspective it made sense for him to classify the unsafe actions of workers as the cause of accidents. It was a simple easy way to solve the problem. But we now know how you manage work is totally optional. You can use command and control with the managers doing all the thinking and all the mental labor and the workers wielding the tools and doing all the manual labor. The ultimate objective for this kind of organization is for the outputs to meet specifications.

That means you will not be able to improve your outputs because of all the variation allowed within specification limits. As long as you meet specifications your output with all of the variation in it will be considered “good enough.” In this world outcomes vary as much as possible. The attitude of people is that when things are within specifications is “that is good enough.” This thinking permeates every aspect of the organization. It becomes the culture of the company. It means quality, productivity and safety can only be mediocre at best. There is no law that says you can’t manage your business this way. But there is no law that says you have to manage it this way either.

Idea Number 2: Workers are not *the* problem

The second important thing Sarasohn and Deming professed was the interactions of the components of the system are responsible for most of the outcomes of the system. That means individual workers are not responsible for most of the things that go wrong in the system. This includes the quality, productivity and safety. That distinction goes to management. In other words the majority of the problems of work including employee accidents are a result of the decisions and directions of management. Only management has the power to make decisions about the system. Deming often pointed out management cannot abdicate its responsibility for outcomes of the system. It must be held accountable for deficiencies in the system, not the workers. He didn’t do this to point fingers or place blame but to ensure management provided the leadership necessary to improve the system.

This thinking is exactly opposite of one of the most enduring beliefs held by American managers. That is if something goes wrong at work someone – a single solitary person - must be identified and held accountable for it. For managers Heinrich’s theory makes sense. It is a logical, simple, easy way to hold workers accountable for accidents.

Ironically workers are in no position to refute this proposition. If you are involved in an accident and you agree you can’t control your actions you sound incompetent. No one in their right mind is going to admit that. The easiest thing to do is to accept your portion of the blame (85%), commit to try to do better the next time and hope you aren’t reprimanded by management.

Managers are comfortable with Heinrich’s theory. It reinforces what they have been taught. It’s OK for them to assume everything they’ve done up to the moment just before an accident happens is working properly. It is easy to accept the premise that if workers would only do what they are told and obey safety rules and regulations no accidents would occur.

The need for a higher level of thinking and better way of managing

Most critical to a company’s success is how it manages operations and treats its people. By now it should be readily apparent the traditional American model with the ultimate goal of meeting specifications to maintain the status quo cannot get the best from any system. Witness the bankruptcy of GM, once the largest and most admired corporations in the world, and hundreds of its suppliers. They believed for a company to be at its best each department needed to be operating at peak efficiency. This theory served GM well its’ first fifty years. But for the last thirty years they were given numerous warnings it wasn’t working. The thinking just isn’t true. Imagine how an orchestra would sound if every member played as loud as they could to show off their ability.

We have to move beyond our current management model and learn how to manage so work can be completed most efficiently with the highest quality outcomes. This includes people not getting hurt while working. It requires a whole new way of thinking about work with the utmost respect for human capabilities. Not as bionic machines or “human capital” but the brains required to solve the daily quality and safety problems inevitable in every work system.

For most management the goal for measuring quality is to supply 100% conforming product. Basically this is done by conducting a final inspection to identify any defective parts, remove them and ship only good parts. Meeting specifications is the only thing you worry about. All costs are just passed on to the customer so there is little or no incentive to reduce waste. That includes the worst form of waste - employee injuries.

In continual improvement your measure quality in two ways: Shipping 100% good parts and the state of statistical control of your processes. The statistical control of your process helps you identify the types of problems in your system and predict how they will behave in the future. When you combine the two ways of measuring your processes you can identify four possible states. Basically any production process at any given time is in one of four states: [11]

1.) The Ideal State
2.) The Threshold State
3.) The Brink of Chaos
4.) The State of Chaos

All of these are acted on by the force of entropy which works to push everything towards the State of Chaos. There is a constant push and pull between entropy and managing to achieve the Ideal State. The goal for production is to have the work system operate at the highest possible level - the Ideal State. The Ideal state is achieved when production is running smoothly, quality levels are on target and accidents are consistently zero. When it comes to work how should you manage your systems to keep them operating at the Ideal State?

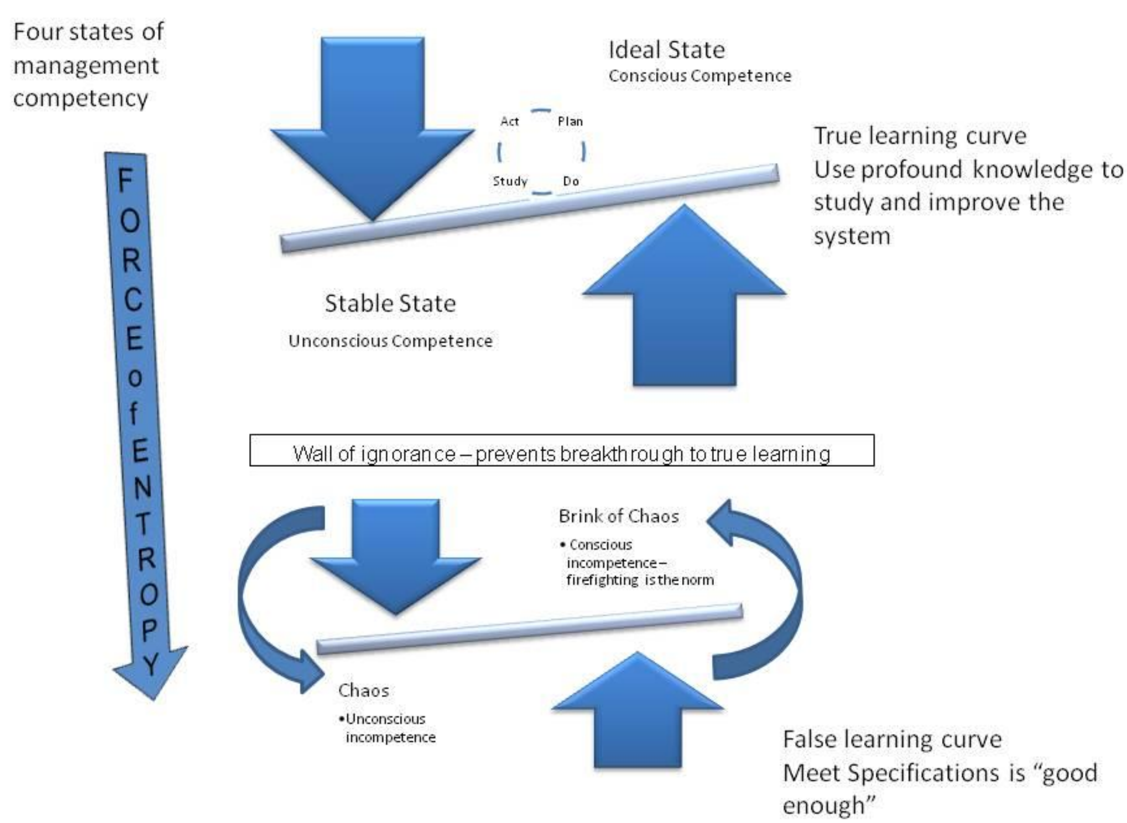

Figure 1: States of management competency and learning curves

Management and the four states

The bottom two states Chaos and the Brink of Chaos revolve around the Circle of Incompetence. Traditional management keeps shifting between what is called unconscious incompetence and conscious incompetence. This system is managed through firefighting routines by managers whose jobs are to bring the process out of Chaos up to the Brink of Chaos where outcomes meet specifications and things are considered to be “out of trouble”. After fires are extinguished managers move on to the next problem.

But after they leave the process begins the entropy slide and the fires return. You are back in trouble. The manager’s tools are what hourly employees call the “flavors of the month.” Basically the goal of meeting specifications and maintaining the status quo through firefighting routines keeps an operation trapped in the circle of incompetence. The ability of managers shifts back and forth from unconscious incompetence to conscious incompetence. They believe they are doing something that is working but it is not. These are managers certain of things that aren’t so.

To escape this trap companies are always trying new management techniques. In the last thirty years we have seen Total Quality Management, Right First Time, Re-engineering, Zero Defects and Six Sigma, just to name a few. All have good points to make about problem solving and managing operations but the success of these programs is dependent on a new management philosophy. Most companies made the mistake of trying to adapt or modernize Taylorism to blend in with these new techniques. Until the 1980’s manufacturing was a fairly neglected area of expertise in the U.S. Finance had taken over things and the bean counters really counted. Although the U.S. was a leader in mass manufacturing in the 1940’s it did little to advance its knowledge in this area after WW II. Continual improvement of quality and processes wasn’t on the radar screen of American companies until the 1970’s.[12] That is when American companies started to learn about quality management from Japanese competitors who were making superior products at lower costs.

American managers learned about these new techniques and implemented them with limited success. The reason was they could not abandon their existing management methods. We were slow to realize Taylorism does not work well with the philosophy of continual improvement. The only way for managers to stop fighting fires and work on truly preventing them in the first place is to advance to a higher level of thinking. Deming was one of the first to realize this. He labeled this new way of thinking profound knowledge.[13] Without profound knowledge and effective use of control charts Deming knew managers could not scale the wall of ignorance and advance to a higher level of thinking. Until managers obtain profound knowledge they can never escape this circle of incompetence.

Most people believe Deming’s only contribution to quality was in the use of statistics and control charts. They also thought control charts were only meant to be used in a manufacturing setting. Deming was the first to understand how they could be applied to general management. Through Deming we learned control charts can help you study and improve any work process so you can predict future results of processes. These include the intellectual side of your operations such as designing, planning and training all of which apply to safety.

American managers tend to use control charts as report cards, process adjustment, process trials and for extended monitoring to track quality characteristics. They never really recognized and appreciated their power to help management reduce variation and control and improve processes over time. The state of statistical process control is not the natural state of any production process. Over time if a process is left alone it will deteriorate and go out of control. Using control charts allows you to receive signals from the process so you can remove any special or assignable causes and make the process better than it was before. When managers are using control charts in this fashion they are exercising conscious competence.

Control charts also help to create knowledge about your process. To be effective they cannot exist in a vacuum. Only when the culture of a company from top to bottom is attuned to how to use them effectively can their maximum benefit of continual improvement be achieved. Your company cannot have internal barriers to cooperation and communication or the advantage of control charts will never be gained. When you have this constructive culture you will have unconscious competence for continual improvement where operating at high levels of quality, safety and productivity is “the way we work around here.”

Safety management has made little or no use of theory of control charts. Most attention has been in the form of safety articles with rudimentary understanding and explanations of how they should be constructed. Like production the safety profession has missed the point of control charts and not recognized their power and usefulness. Mostly because they felt they were after-the-fact measurements not realizing their successful application required a new way of managing and new competencies.

Some important reasons for using control charts to manage safety are:

1.) They are the only reliable method to determine common vs. special causes of variation that is responsible for accidents in a process. They will help prevent management from making the mistake of blaming individuals for causing accidents when they are built into the system. Without the aid of statistical thinking managers default to the idea that something happened here and now or something special or unusual happened such as the person being careless. When you look to find something special and take action on a particular person when the accident is the result of a common cause you are doomed to fail in your effort to improve safety.
2.) They provide a common language between management and hourly people so they can communicate without emotion and get down to the business of fixing the system so it can be moved to the Ideal State. When used for this purpose they create knowledge about safety in your system.
3.) They help people focus on reducing variation of a process which leads to consistency and predictability.
4.) They prevent managers from making the mistake of judging every single data point and classifying up or down movement as good or bad.

Cause and effect – the missing link

> "*The stupidity of people comes from having an answer to everything. The wisdom of the novel comes from having a question for everything*." Milan Kundera, author

American managers have been trained in the certainty of cause and effect – if you do this, that will happen. Command and control theory is contingent on the fact that cause and effect are always closely related in time and space. Heinrich applied the idea to safety and it became convenient for management not to worry about making this distinction. Henceforth traditional accident prevention theory mandates a thorough post-investigation be conducted on all employee accidents. The unspoken objective of this exercise is to use analysis is to discover who messed up and take corrective action on them. Managers involved in this type of activity justify it on the basis they are doing something proactive to prevent the accident in the future. In reality they are merely closing the barn door after the horses got out.

This process has evolved to a popular method of accident investigation called *root cause analysis*. The theory is you can isolate the one single thing that caused all the other things and ultimately the accident itself. Once you have identified the root cause the idea is to change something about it or eliminate it so the accident will not recur. As one learns more about the behavior of systems you realize looking for a root cause in a system might best be described as a fool's errand or the equivalent of finding your way through a fog covered Irish bog. Not just because it is extremely difficult but because it doesn't make any sense.

For a non-systems thinker seeking a root cause is logical and rational. Systems thinking exposes the fallacy of root cause logic.[14] A simple control chart often reveals even when every single defect is thoroughly investigated and corrective action taken on each one, the average number and variation of defects remains constant. (For example most companies have the policy that all employee injuries must be investigated and follow this requirement 100%. Yet their average number of accidents and amount of variation stays the same over time.)

The reason being root cause analysis often has little or nothing to do with correcting systemic problems. A root cause analysis is based on the premise cause and effect are connected instantaneously.[15] Systems thinking helps us understand cause and effect are not always closely related in time and space. Think of the effect of deficient safety training. It may not be exposed for weeks, months or even years after being administered.

When you correct a “root cause” you believe if you remove it you have taken action to prevent an accident. The problem is, no two accidents can be exactly the same (There’s that variation again.) so the accident you are working on won’t be exactly the same in the future. The odds are also pretty good that you have missed something. Not because you don’t have good powers of observation but because you are using the wrong theory.

We have learned there are at least two fundamentally different kinds of problems. One type are called *convergent* where the problem you are working on has *an answer*. The other type are *divergent* problems where the more people with knowledge and intelligence study the problem the more their solutions contradict each other. When using root cause analysis the premise is you are dealing with a convergent problem. [16] But if you are dealing with a divergent problem you will need to use the heuristic approach to problem solving as opposed to an algorithm.

Just classifying a convergent or divergent can become a very tricky proposition when it comes to safety. If a safety director wants to stop lacerations she may believe her solution will solve it. She sees a convergent problem with an obvious answer, enforce the safety rule. But workers who may know a lot more about the operations might have answers that contradict what the safety director believes. They see a divergent problem and may offer up many different solutions. This is similar to the conundrum Deming warned us about regarding common and special causes. Who is to say whether the person or team doing a root cause analysis has come to the correct conclusion?

Deming’s quality system has proven once you have a stable system spending time looking for a scapegoat to blame for a something caused by the system is a major mistake. As explained earlier you are applying analysis and this does little or nothing to help you understand the behavior of the system. Most problematic outcomes of a work system stem from common cause variation. If the problem is systemic and you blame the worker you will lose their respect now and in the future. You also end up doing nothing to fix the system which allowed the mistake to occur. That means something similar can occur again in the future.

The obvious question is, if investigating every single accident does little to improve safety what should you do? The answer is to think about, examine and manage work systems in a new and different way.

Where do accidents at work come from?

“We have met the enemy and he is us!” from the comic strip Pogo

Like Pogo in the comic strip after much deliberation we realize the answer to our problem is in the question itself. Employee accidents are built into the work system. They are not the result of workers messing up all of the plans of management to control things. Deming’s quality theory taught us variation of *common causes* is primarily responsible for most of the accidents and things that go wrong in the system not the unsafe actions of the workers as Heinrich suggested. Making things more difficult is the fact that interactions of common causes are not easy to discern. That is why even simple systems can be quite complex and prove difficult to manage.

Common causes are required for the system to function. They are inherent in the system hour after hour, day after day and affect everyone working in the system. They include but are not limited to people, materials, methods, machinery, equipment and environment. They are not good or bad in and of themselves. But one common characteristic of them is variation. They depend on each other in some form to get the job done and their variation determines the quality of these interactions. According to Deming's theory of quality common causes are responsible for 85-99% of both the desired and undesirable outcomes of the system. That includes defects and accidents. [17] The remaining causes which are responsible for the other 1-15% of the system are those things not normally found in the system. They come and go without warning. They are called *special* or *assignable* causes.

Variation in common causes is difficult to observe and manage. Adding to the challenge is the fact that common causes may not be connected physically but can still have a strong influence over the things you do. Picture the mental processes associated with training people about how to do their jobs safely. There is always variation in what each person learns from any training program. This variation causes many things to happen in many different ways. i.e. how workers handle customers, follow safety procedures while running machinery and equipment, think on the job, etc. Most employee accidents are created by the interaction of this variation. Making their detection even more difficult is the fact once the work system is up and running the effect of common causes can be instantaneous or long-term. There is no starting point for common causes, they just are.

For example variation of safety training interacts with the variation of people, methods, environment, machinery and equipment. If safety training is not properly designed it could be disastrous. How safety training "fits" with all other common causes influences safety outcomes. If an employee doesn't understand some of the information conveyed in safety training he will not be able to apply it on the job and could be injured as a result. Management controls most of the common causes involved in safety training. These include things such as the training facilities, lighting, content and delivery, room temperature, time allotted, etc. All of these have variation and could reduce the effectiveness of safety training. One common cause management doesn't control is the fact human beings forget topic content information over time. Who is to blame for that?

When the variation of common causes lines up properly the odds are the quality of the safety training will be good. Employees will learn the important part of safety training and apply it on the job. But if common cause variation goes awry the quality of the safety training and ultimately its effect will be less than desired. What happens if some employees are not able to see data on a screen due to poor lighting or hear the instructor because of the poor acoustics or layout of the room? (All of us have experienced these or similar conditions.) What if they do not learn valuable information as a result? Whose fault is it? These are common causes controlled by management, not the employees.

Common cause deficiencies in safety training occur every day which means you have just introduced a boatload of variation into your production operations. They impact every aspect of a business every single day. Dr. Deming, a world-class statistician estimated they cause 85-99% of all accidents. When managers don't know about them or how to manage them they have a tendency to hold individual workers accountable for them. That's exactly what Heinrich did. He did not have the benefit of profound knowledge.

Profound knowledge applied to safety on the job

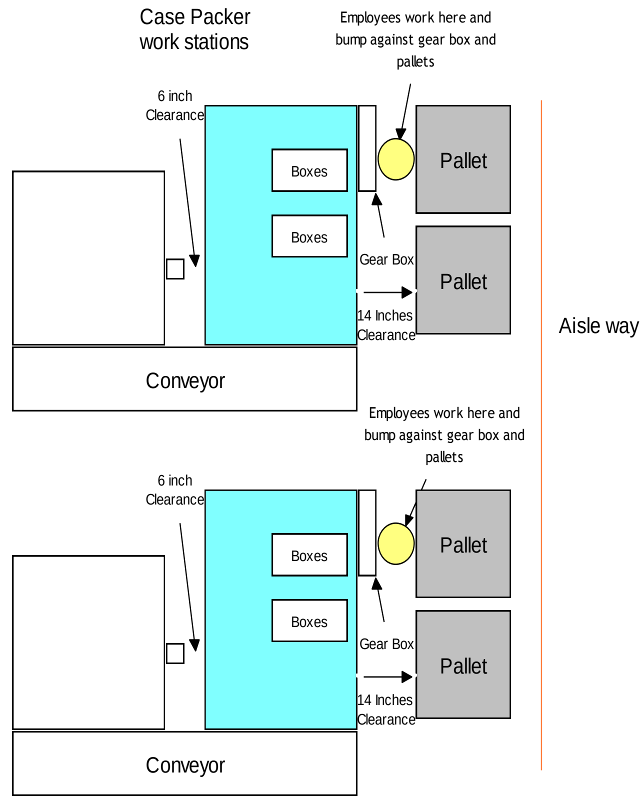

Figure 2: Team Flowchart of original parts processing operation created by author

Here is an example of what happens when people are given the opportunity to apply their profound knowledge to their daily work routines. It is based on an actual operation most operators in any plant can relate to.

The system involves operators at their work station unpacking component parts coming off a conveyor line, performing an operation and then packing them in another container for the next operation. The plant has a full time safety person. Safety inspections are conducted and all accidents are reported, logged and investigated. There had been no lost time accidents, no other recordable accidents and no minor first aid injuries in this operation for the previous 12 months. Figure 2 is a basic flow chart of the operations.

This job was in operation for over a year when it was brought to the attention of an improvement team. The operators were asked to tell management what was bothering them about safety on the job. They said they were constantly hitting their shin bones and knees against parts stacked in boxes on the pallet adjacent to their workspace. They had the bruises to prove it. There was only 14 inches of clearance between their machine and the pallets.

When the operators first told the foreman about the problem he said nothing could be done because the pallets were located inside a safety line and they were not allowed to stack anything past the line. He also said the operation was going to be changed soon when a new part was designed and this process would be eliminated. (The promise things were going to change was made months before the team revisited the problem.)

Eventually out of frustration workers stopped complaining about their bruised legs and the manager assumed things were OK. In fact the safety process remained in the state of chaos. The physical injuries sustained by the workers were minor and there was no way of identifying them in their management system. They are an example of the hidden factory that does not produce numbers. They are what Dr. Deming was talking about when he said, “The most important numbers are unknown and unknowable.” These unknown figures add to the cycle of despair people experience when the fires they put out start up again.

The team was trained how to apply the Check, Plan, Do, Study and Act cycle. First they were asked to view the operators as customers since they would benefit from the project. Second they decided they had to look at the operation as a system that had processes and could be changed. Third they had to be innovative and look at things differently to find an elegant solution. They were seeking the Ideal State where quality, productivity and safety would be at their highest level of performance and maintained that way over time.

Profound knowledge: Psychology, Systems thinking, Variation and Knowledge

To make Deming’s quality management system work he advocated the application of profound knowledge. Profound knowledge has four areas. They are: psychology; systems thinking; variation and knowledge itself. [18]

Let's start with how the team used psychology which deals with extrinsic and intrinsic motivation and how people interact with each other in different circumstances. All of us have intrinsic motivation to do a job to the best of our ability and to do it safely. In this case the operators were simply tired of hitting their legs and knees against the pallets and getting bruised. They came to believe management didn't care about them. The foreman figured the problem just went away because operators had stopped complaining about it. When employees were given the opportunity to make a difference they jumped at it without being offered any incentives.

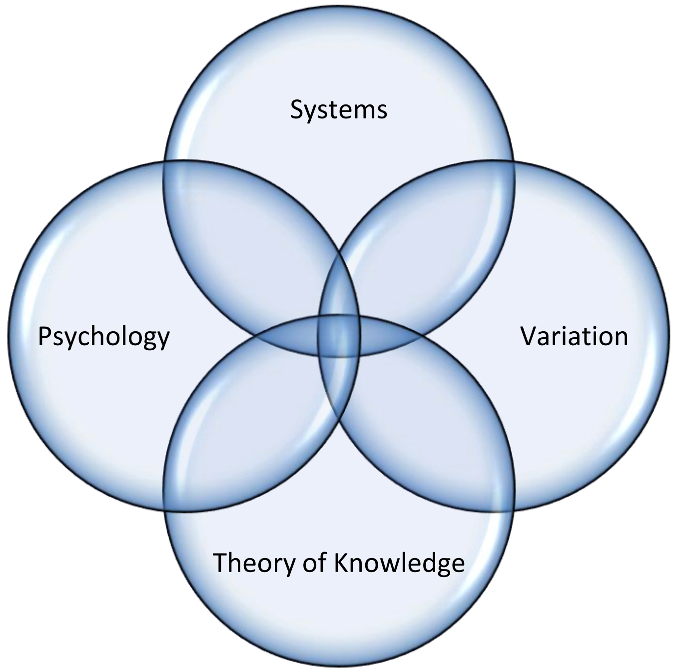

Figure 3: Profound Knowledge

Operators and supervision were able to work as a team to study the system. Everyone realized that even though they were a team their individual effort was going to make a difference. Using the tools to define, measure, analyze/synthesize and solve the problem allowed everyone involved the opportunity to cooperate instead of compete. Cognitive psychology has taught us extrinsic motivators do a lot to destroy intrinsic motivation.[19] The supervisor's response to the problem was destroying the worker's intrinsic motivation to work with and respect management. Fixing the problem restored their intrinsic motivation to do a good job and do it safely. It restored their pride and joy in work.

The second part of profound knowledge was the application of systems thinking. The improvement team looked at everything going on in the operation to make sure any changes made would be evaluated to see what else would be impacted. To do this they drew the flow chart shown in Figure 2 above to evaluate and understand the system. This helped them redesign the operation by moving the gear box to the opposite side of the work area and then move the safety line a total of 11 inches into the aisle. This gave the operators 25" of workspace vs. the 14" they had originally.

Third, they started to understand variation and how it affected safety of the process. Some days the operators would not have as much of a problem due to the amount and size of the boxes. Consequently they were not always bumping against them so the problem was not always there. Other days the problem returned. All of the operators were different size, shapes and age. Some would hit the parts boxes more often than others. They couldn't change the size and shapes of the people but they could change the size and shape of the work process itself. They also learned that variation is what we are talking about when we say absence of a negative doesn't mean you have a positive.

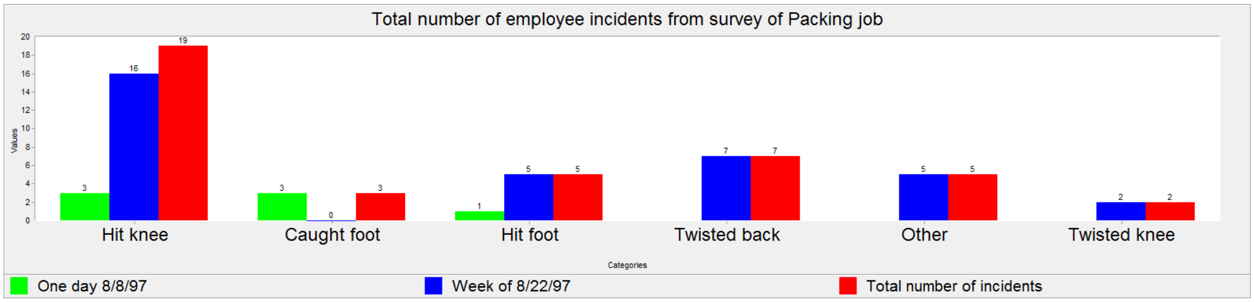

Figure 4: Data the team obtained about non-reported injuries graph by author

And last was the knowledge they gained by working on the project. Knowledge requires you make a prediction. They learned how to predict what was going to happen by gathering the data about how many times people bruised their legs when they worked in the area. (Shown on Figure 3) The team obtained this data by going directly to the workers. It was not available in the existing system. The team used the flow chart and data to convey the situation to the maintenance department who made the changes. Once the improvements were made they predicted zero instances of the problem and they were correct and verified it with data. They tracked the data for 6 months for which they experienced "0" accidents or near hits.

The team goal was to take the safety process to an Ideal State so they could perform their task at maximum efficiency with no injuries. The workers were under the impression nothing could be done to fix the system. They used the flow chart and the data to communicate with the safety and maintenance departments. After seeing the data everyone agreed something had to be done. The team then brainstormed and came up with a re-configuration shown in Figure 4.

By just moving some of the machinery around they obtained enough space to allow the workers to perform their tasks without bumping up against the pallets and machinery. The new design worked to eliminate any injuries over time. The maintenance department performed the moving of the equipment on a weekend shift at minimal costs. The team was able to achieve the ideal state (no accidents) and keep it at that level over time.

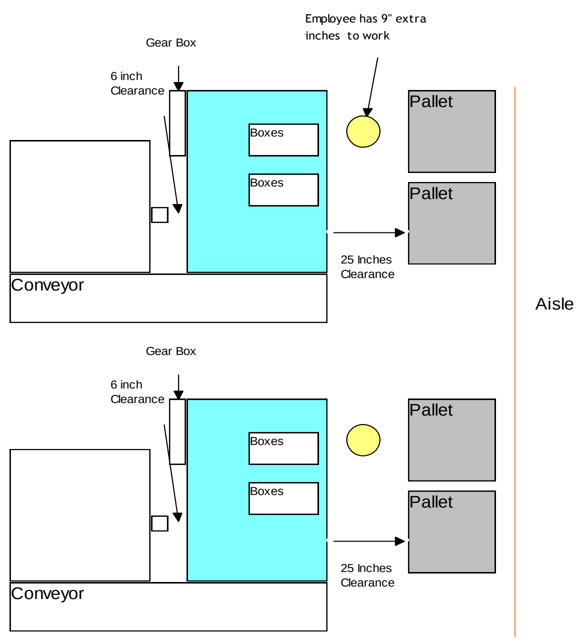

Figure 5: Flow chart of System Re-designed by the team created by author

Once the team looked at the entire system they realized quickly the injuries were not the fault of operators just not paying attention but the interactions of many different things: the layout of the process; the variation in the size and physical ability of each individual worker; and the amount of work load were the obvious common causes. They saw how things not related directly to the work process still influenced the operation. The safety department required the line on the floor so the equipment would be kept out of the aisle but they had no problem with moving the line over so extra space would be available. The interaction of processes of the system created the accidents.

Initially in a very subtle way the supervisor in our example shifted the problem back on the workers. He did this by holding them accountable for their own actions and appealed to them to use their common sense while working. This eliminated the need of any urgency on his part to change anything in the system. When they do this management is requiring employees to workaround the problem instead of solving it. It's an event focused response instead of a systems thinking approach. It shows the effect of Taylorism being engrained in both the supervisor and the hourly workers.

The example also shows how easy it is for Taylorised managers to shift the burden for safety away from the system to the workers. Deep down inside most managers believe the majority of industrial accidents are caused primarily by individuals not applying common sense or paying attention. The last thing managers want to do is to mess with the system. They know how hard it is to change it.

The people on the team used what profound knowledge they had to look at the problem. (Profound knowledge does not require a Phd. Even small amounts can make a huge difference.) Doing so helped them approach the problem with a much different attitude. Instead of competing, management and the workers cooperated as did the different departments; production, safety and maintenance. They stayed focused on fixing the system, not the blame. The final result was a synergistic solution which increased ownership of safety by everyone involved which in turn created pride and joy in work. They were able to extricate themselves from a cycle of despair by looking at the situation through the lens of profound knowledge which all of them possessed to some degree.

Things Safety Managers Need to Learn and Apply

There's a penchant for management and the general public to pay more attention to safety when severe or catastrophic events occur. But what about the attention paid to hazards people face on the job when they perform more mundane work activities of assembly and process operations? Like the one in our example above. Remember every year over four million people in private industry and government jobs are injured at work.[20] Most of these accidents are a result of the common causes and they are the problems safety management needs to address. Investigating these types of accidents to fix the blame or find a root cause hasn't worked that well. There is a better way and that is to apply the methods we have used to eliminate defects of products to improve quality.

Since most accidents are caused by the system you are more than likely dealing with convergent problems of a systemic nature. Any investigation of these should be done using a heuristic approach for learning by discovery through enquiry. That is why Deming advocated the Plan, Do, Study and Act cycle.

New challenges require new skills

In the new economy people responsible for ensuring safety is functioning in daily operations will need to learn new things about leadership and management.[21] To improve the quality of safety in operations they will need to learn new tools and techniques which will include the following:

1.) The management philosophy of continual improvement
2.) Profound knowledge and how it can be used to examine safety in work systems
    a. Systems – systems thinking
    b. Variation - how it relates to accidents
    c. Psychology – the important role of intrinsic motivation
    d. Knowledge - how confident are you about your predictions?
3.) Basic knowledge about elementary statistics and statistical process control theory
4.) How to determine common and special causes of accidents and react appropriately
5.) Heuristic problem solving tools including:
    a. Process flow charts
    b. Run charts
    c. Control charts
    d. Operational definitions
    e. Getting the Voice of The Customer into the Voice of the System
    f. The Pareto principle
    g. Brainstorming
    h. The Check, Plan, Do, Study and Act Cycle

6.) Understand how to develop and lead teams for problem solving and process improvement of safety
7.) Why and how the Customer Principle applies to safety
8.) How to make constancy of purpose for safety a reality
9.) How to restore pride and joy (intrinsic motivation) back into work
10.) Culture and its impact on safety

As a safety manager you should be able to recognize, define, describe and improve the safety of the work systems your customers (employees) work in. This will require the application of the theory of continual improvement to replace what you are doing now. You will have to understand the customer-supplier link and how it impacts safety. You should spend most of your time working with other managers and employees either training them on the items listed above or using them to improve safety of your work systems.

Conclusion

"No organization can survive with just good people. They need people that are improving."

W. Edwards Deming

When people see a completed continual process improvement project, such as the one described in this article, they express amazement at the seemingly simple and obvious solutions. They forget they are observing things after the PDSA cycle has been completed and changes have been made. They assume the solutions were obvious and easy to implement. But anyone who has tried to fix the system, especially while it is running, knows the enormity of this task. Even for routine operations. Fixing the system is anything but easy. Nonetheless a company the size of Toyota implements a million ideas a year that are similar to the kind presented in this article.[22] Command and control management doesn't come close to this kind of change and innovation. It can't because its focus is on maintaining the status quo.

In the world of profound knowledge and continual improvement the theory of accident causation is elevated to a higher level. From there one can see how the system itself creates most accidents. This places most of the responsibility for safety on management and prevents it from being conveniently shifted back to workers. It doesn't for one second change or allieviate the responsibility of workers to employ proper safety practices or to pay attention. It does provide a theory to ensure accountability and responsibility for safety is always properly assigned.

When it comes to safety the most senior management of the company should sit down and ask; What are we doing? Why are we doing it? No production system can exceed the amount of safety designed into it. We now know managing to meeting specifications and emphasizing compliance will never deliver continual improvement. Systems thinking helps you understand when a safety problem exists there is a high probability management caused it. The lack of quality in a safety program almost always stems from the absence of profound knowledge and a management thinking that when it comes to safety meeting safety standards and complying with safety regulations is "good enough." Managers aren't bad or evil people. They've just been burdened with an outmoded safety management theory.

Without profound knowledge deep down inside managers still believe holding workers accountable is the key to good safety management. For them managing safety to meet specs or find faults or a root cause is more important and makes more sense than fixing the system. When these traditional safety techniques fail these managers resort to incentivizing workers to get them to follow safety procedures, use their common sense or just try harder. Administering a safety incentive program is much easier than changing a management paradigm.

With profound knowledge management ascends to a higher level of understanding about what causes accidents. It gives management the ability to examine the system in a new way and teach others how to remove barriers around workers that prevent them from being safe on the job every minute of every day. Profound knowledge will truly improve the quality of your safety effort. It's time to upgrade our system.

Thomas A. Smith
Lake Orion, MI.
September 9, 2010

End notes

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