

The Red Beads:

They have more to do with safety than you might think

By Thomas A. Smith

For over 45 years Dr. W. Edwards Deming would teach some major points of his management theory doing what he called “a stupid experiment” but he promise it would be one “you would never forget.” He carried his Red Bead experiment out over four days. It was a simple yet powerful demonstration of just how perverse the American management system is and how it prevents continual improvement by overemphasizing maintenance of the status quo.

He sets up the audience for a role playing experience by asking for volunteers to participate. He calls for six willing workers and two inspectors. He explains how in his imaginary company they do everything the wrong way by keeping over staffed and adds a chief inspector. He then adds a recorder whose job is to make independent counts. Deming played the role of the foremen since they have nobody available who knows they job and then explains to the willing workers their job is to make only white beads. The customer will accept only white beads.

Deming then explains “the rules.” The first rule is, everyone must put forth their best effort. The workers agree to this. Then he tells them they have procedures they must follow and shows them how to handle a paddle they will use to dip into a container filled with both red and white beads. He provides every worker with the exact same instructions of how to dip their paddle into a container that is filled with 3,200 white beads and 800 red beads. He selects one willing worker to be “average.” He constantly reminds the workers their job is to “make white beads only.” If they can’t make only white beads management will close the plant down. He tells the workers he made a red bead just to show them what they look like.

The willing workers are then asked to do their work adhering to the strict procedures. They dip their paddles and then have the results recorded which is passed up to management. When a worker produces a higher number of red beads than the other workers Deming chastises him. If a worker produces a lower number Deming heaps praise on them and tells the workers who made a higher



number of red beads to do better or the plant will be closed. After each willing worker’s results are read aloud Deming praises or chastises them based on

whether they have made more or fewer red beads. At the end of each day’s work he talks to the workers and reminds them they must improve. At the end of the fourth day he explains he can’t see any improvement and the plant will have to be closed. He thanks the willing workers and tells them to pick up their checks on their way out.

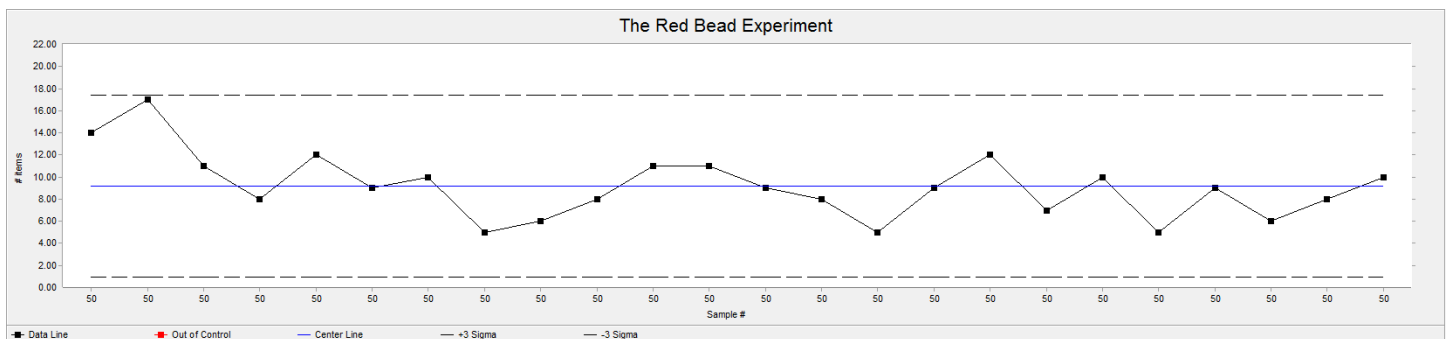
Deming then reviews and reflects on the results. Below are figures from an actual Red Bead Experiment¹:

Name	Day 1	Day 2	Day 3	Day 4	All 4
Dick	14	10	9	10	43
Pat	17	5	8	5	35
Bob	8	8	9	6	31
Steve	12	11	12	8	43
Horst	12	11	12	8	43
Dave	9	11	7	10	37
All 6	71	51	50	48	220
Avg (x-bar)	11.8	10.2	9.6	9.2	9.2

Deming starts to analyze the results. He points out that some worker’s results are above average and some are below. On the first day Steve was The Man of the Day. Much better than the rest of the workers. On the first day Pat had 17 red beads but improved to be number one with only 5 on day two. Deming says she went from the worst to the best in just one day. He wonders what happened to the other workers. He feigns dismay with their effort. He just can’t understand what went wrong.

He goes on and the message becomes clear. Even with the same identical tasks, tools, instruction and talent production outcomes will vary. He has done this experiment hundreds of times and the results are always the same. That is, the outcomes of each worker varies even though the imaginary factory is always set up the same way. Some of the workers are above and some are below average. This happens every single time. There is nothing you can do about it. The system they work in is not something they control. Put different people in the system and the results are always the same.

He then displays a control chart that establishes the limits of variation. The chart is shown below:



Deming then explains there are no patterns in the data. It is a nearly perfect constant cause system displayed on the chart. This system allows you to compute the limits of variation into the future. A pattern may be 7 or 8 points in a row. No such thing. Nobody exceeded the upper control limit. Came close but it didn't happen. With this system you can be confident no one will exceed the upper or lower control limits. You have statistical stability in the sense what happens in the future will be pretty close to what has happened in these twenty-four points. There is no absolute guarantee since empirical evidence is never complete.

Then Deming lays a different scenario on the audience. Given the fact there are 80% or 3,200 white beads and 20% of 800 red beds what would have been their prediction for the average

number of red beads \bar{x} been? Some people hazards a guess of 10 since the daily production is 50 and 20% of 50 equals 10. Deming tells them they are wrong. He prods them for an answer and to explain their reason for their answer. He tells them \bar{x} has to settle down to something but none of their answers are correct. He pushes the audience to think harder and finally someone comes up with the idea the red beads may be different than the white. Deming points out they are different, they are painted red so they are somewhat larger because of the coating. They feel different to the paddle. He has used different paddles over the years and each paddle has produced different \bar{x} .

Paddle Number 1 gave 11.2. Paddle number 2 gave 9.6 and Paddle number 3 is at 9.2. Every paddle has variation in it. It may be too small to be detected by just a quick look at it but it is still there.

If you have moderately good statistical control then \bar{x} will settle down to something eventually that you can use to make a valid prediction. To change \bar{x} you will have to fix things that are in the system.

The moral of the red bead experiment is the following:

- Variation exists in every process. You can never eliminate all of it.
- When you plan something you must include making a prediction about how

things will happen. Past performance guarantees nothing in the future.

- The work system has things in it that are beyond the workers control. It is the system, not the skill of the workers that determines how they will perform.
- Management are the only ones that can change the system. It is best for management to enlist the help of the workers to do this.
- Some workers are above and some are below average. There's nothing you can do about it and the difference may not mean anything.

The relationship of the Red Bead experiment to safety management

The Red Bead experiment is a good example of how bad management leads to bad results. Most people who watch the experiment understand the foreman (Dr. Deming) is committing some really stupid mistakes. Ironically they are exactly what American managers do in various degrees every day. He starts with employing extra layers of managers whose only job is to watch what the workers do and report the results. Then he holds the workers accountable for their mistakes, making red beads, for which they have no control. The audience can see the red beads are built into the system and beyond the control of the workers. But the foreman cannot. His solution is to force the workers to follow rigid procedures with no way of letting them make any kinds of suggestions for improvement. In short, he is the perfect command and control manager.

Deming conducted this experiment for over forty-five years and many of his associates continue using it today. The feedback from current audiences shows this style of management still reigns. It's as though deep down inside, somewhere in the DNA of American managers is a genetic code that instructs them, no compels them to follow the theory of command and control. The truly believe they have no other option when it comes to managing people or subordinates

as they call them. It started with Frederick Taylor in the 1890's and has been with us ever since. So what does all of this and the red beads have to do with safety?

Let's start with the fact safety management takes its lead from command and control. To this day foremen are told employee injuries are mostly the result of the unsafe actions or at-risk behaviors of the individual workers. In this world the most basic assumption management makes about safety is workers can control their performance and their performance is why most accidents happen. They either ignore or deny variation exists in workers and treat them as though they are bionic machines.

They are also ignorant about variation in all the common causes in the system that result in accidents.¹ These managers believe holding workers accountable for their own accidents is good management. In other words if employees would only make an honest effort to "do things right the first time" their safety would be guaranteed. The sign of a good manager is one that isn't afraid to hold people accountable for their action. Thus management must keep motivating workers to stay on guard and be alert because for some unknown reason workers are lax when it comes to their own safety. The Red Bead Experiment shows the folly of this line of thinking.

The foreman's role could be easily adapted from lecturing workers on the perils of making red beads to warning them about having an accident. Dr. Deming exhorts the workers to do better work. Do not make any red beads or the company will go out of business. We employ the same technique to

1. William Shewhart who introduced Dr. Deming to the thinking of statistical process control defined common causes as those causes that are inherently part of the process (or system) hour after hour, day after day and affect everyone working in the process.

prevent accidents. Management tells workers they are responsible for their own safety and will be held accountable for any accident or safety violation. This allows management to ignore any deficiencies that may exist in the system. Management uses “positive re-enforcement” to help workers to stop committing unsafe actions or at-risk behaviors as though they are consciously and willingly doing so.

They can't see how this approach parallels what Dr. Deming is doing wrong when he admonishes the workers for making red beads. Managers ask “Can't workers control their own actions?” as though it is a rhetorical question. They don't understand employee injuries are the same as the red beads in the experiment. The workers did not put the red beads in the container. Most accidents like defects are built into the system just like the red beads. That is to say ultimately businesses are set up to produce things for customers. But all processes have by-products that include waste, scrap and defects. The worst kinds of defects in any work system are employee accidents.

Dr. Deming was the first management expert to understand the majority of accidents occur due to variation of common causes in the system. This thinking is contrary to traditional command and control theory where managers believe most employee accidents are caused by the unsafe actions and at-risk behaviors of workers. They believe employees do things on purpose and involuntarily in spite of all the effort management puts forth to control them and that is what causes safety problems. The assumption being everything else in the system is OK. Although the red beads have been introduced arbitrarily in Dr. Deming's experiment they really represent variation that could come from anywhere in the system. They just happen to be discovered in the final inspection process.

Peter Senge said “*When placed in the same system, people however different, tend to produce similar results.*”² It's important to

understand management structures actually create behaviors. Becoming a systems thinker as opposed to a command and control manager, you come to realize why it is necessary to look beyond individual mistakes or misfortunes to truly understand safety problems. We need to look beyond single events. We have to examine the structures or common causes in the system that shape individual actions and generate the conditions where events (accidents) are more likely to happen. Stated another way, if employees are guilty of committing unsafe actions it is more than likely they do so because of the system. Why? Because people do not knowingly try to inflict pain upon themselves.

This isn't to say people aren't responsible for their own actions or some accidents are indeed the result of special causes the employees can control. But the fact is employees don't design the work system - management does. Therefore management must own up to its responsibility and accountability for the outcomes of the system which includes accidents. People who stay focused on event explanations, such as unsafe actions, are always going to work from a reactive mode and never get to this higher level of understanding. They will also mistake symptoms, in this case unsafe actions, for causes.

Four Levels of Safety

Basically there are four levels of safety management each one having structures that drive the thinking and actions of managers and workers. The first is called the superstitious level where managers pay very little attention to safety. As far as they are concerned accidents are a result of fate, chance, luck, or magic. At this level managers believe all it takes for workers to be safe is a little common sense. The second level is the referred to as the Neo or New Taylorism level. This is a little more sophisticated than the first level but not too much so. At this level managers focus on events and end up taking action after an

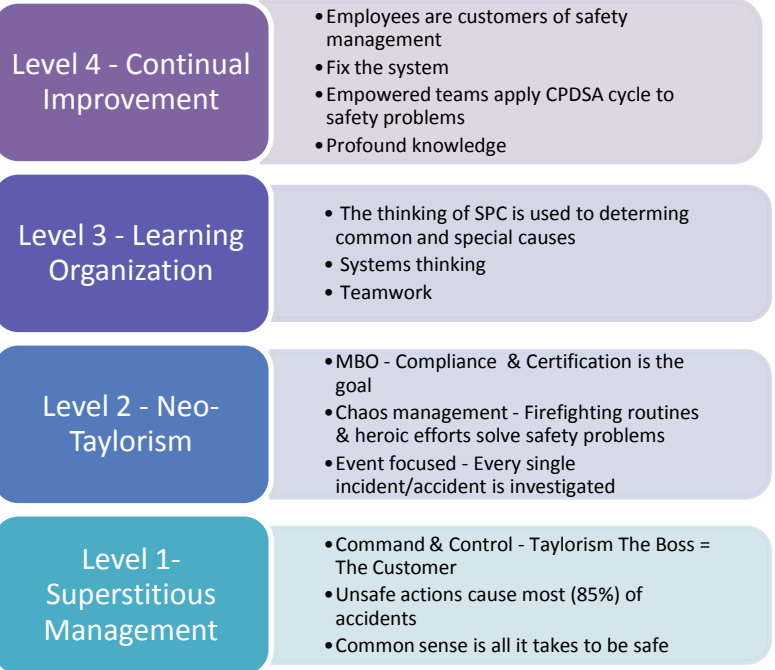
accident happens. They are content to believe this is being proactive. Their safety credo should be: *There's never enough time to do things right but always plenty of time to do things over.* Most companies operate at this level. The third level is the beginning of what is called a learning organization. At this level managers are starting to understand systems and the thinking of SPC. They try to identify common and special causes but their knowledge is limited so they alternate between Level 3 and Level 2 sending mixed messages to workers. And finally there is Level 4 where managers have attained what Dr. Deming referred to as profound knowledge and look at safety through a different lens. At this level managers and workers work together on teams to constantly fix the system so accidents are kept to an absolute minimum.

Deming estimated that as much as 99% of causes of accidents stem from common causes in the system and only 1% from carelessness. These kinds of accidents will not be eliminated until the system is corrected.³ The only place the system is being worked on is Level 4. In his experiment the red beads represent defects created by the system. But they could just as well be accidents.

Focusing on fixing a defect or changing an unsafe behavior would be similar to a doctor prescribing an aspirin for a headache caused by a brain tumor. Instead we should be looking at the common causes in the work system to determine how their variation results in employee accidents. In the Red Bead experiment participants start to realize x-bar of the red beads is dependent on variations in the paddle and the beads. Things not easily identified at first like the diameter and roundness of each of the 50 holes in the paddles and the beads themselves.

We should first ask, was the accident a result of the common causes or was it because of a special cause? The only way to

make any kind of valid determination is with the aid of statistical thinking which ultimately is what Dr. Deming is telling us to do. Look for the patterns of things that cause the red beads (employee accidents) in your operations. Then have teams use the Check, Plan, Do, Study and Act cycle to study the system and find ways to prevent them in the first place. That's what continual improvement is all about.



The Four Levels of Safety Management

To learn more about how your company can manage your safety program for continual improvement contact *Thomas A. Smith* at Mocal, Inc. Mr. Smith works with management and hourly employees to help them

learn about new theory of management to obtain team skills and work on culture change. His book; *System Accidents: Why Americans Are Injured At Work And What Can Be Done About It* has received high praise and can be obtained at Amazon.com. He can be reached at tsmith@mocalinc.com or his company website at www.mocalinc.com or (248) 391-1818.



End notes:

¹ Walton, Mary, *The Deming Management Method*,

Perigee Books, 1986, p. 46

² Senge, Peter, *The Fifth Discipline, The Art & Practice of The Learning Organization*, Doubleday, 1990, p. 42

³ Deming, W. Edwards, *Out of the Crisis*, MIT, 1995, p. 479.