

Dr. Deming's Red Bead Experiment and RadCon

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management
Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

Fluor Hanford

P.O. Box 1000

Richland, Washington

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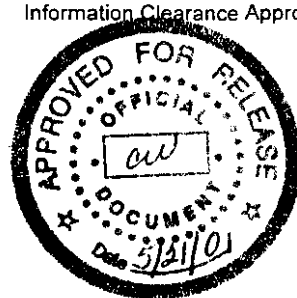
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S.S. Prevette
Fluor Hanford

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LESSONS LEARNED FROM THE RED BEAD EXPERIMENT

- 1) **It's the system, not the workers. If you want to improve performance, you must work on the system.**

Red beads were the result of a bad system; the Willing Workers were not the problem. The system is the problem. Dr. Deming stated 94 percent of the problems come from the system rather than the worker. Yet most efforts at improvement are aimed at the worker.

- 2) **Quality is made at the top. Quality is an outcome of the system. Top management owns the system.**

The systems developed by top managers of an organization have far greater impact on the success of the organization than the best efforts exerted by Willing Workers. The decision to produce white beads in the first place; the decision to purchase beads from a particular supplier; the decision to use rigid procedures; and the decision to rely on mass inspection - all these decisions made by top management resulted in a system that contributed more than the Willing Workers to the waste, the lack of quality, and to going out of business.

- 3) **Numerical goals and production standards can be meaningless. The number of red beads produced is determined by the process, not by the standard.**

The production standard of three red beads per day was impossible to achieve. The Willing Workers could not affect the number of beads produced; meeting the standard was beyond their control. The "Voice of the Customer", translated by management into a goal of 3 red beads or less, had no effect on the number of red or white beads produced. No method was given.

Even if the goal is "possible", there is little to be gained by announcing such a goal to the workforce. If the goal is based upon what you expect can happen, then 50% of the time you will come in better than the goal, and 50% of the time you will come in worse (and set yourself up for failure). If you "pad" the goal to provide a margin for expected fluctuations in results, then the goal probably is no longer "challenging".

If higher quality standards are required - a lower defect rate, for example - then the production process must be improved to achieve the standard. Management must provide the method.

- 4) **Rewarding or punishing the Willing Workers had no effect on the outcome. Extrinsic motivation is not effective.**

Rewarding or punishing the Willing Workers had no effect on red bead production. Fear was not the answer.

All the red beads produced were an outcome of the system's performance, not the individual Willing Workers. Yet the Foreman gave bonus pay and put people on probation supposedly as rewards and punishment for performance. The Foreman was actually rewarding and punishing the performance of the process, not the Willing Workers.

Quality is achieved when workers have "Joy in Their Work" - are motivated from within (intrinsic motivation), not by rewards or punishment.

- 5) **We can use statistics to create a quality control chart and look for problem areas and to predict future performance.**

Development of a Statistical Process Control (SPC) control chart with control limits will show us if our production system is stable - working in a state of control. If the system is stable, we can predict future performance with some certainty.

The red bead production system turned out to be stable - all points within the upper and lower control limits. The variation and level of output of the Willing Workers, under continuance of the same system, were predictable. Costs were predictable.

- 6) **A faulty item is not a signal of "special" causes. A process can be stable, in-control and be producing 100 percent defective items. "Defects" are defined by specification, not by process.**

The production system produced about 10 red beads or defects per run. Yet the entire process was working in a state of control. The red beads produced were not a signal of special cause. The varying number of red beads produced in each run was caused by random variation - pure chance.

It is wrong to assume that every faulty item, any failure, and any problem is due to special causes and that corrective action is required. This type of thinking results in fire-fighting with no permanent improvement achieved. We may reward fire-fighters, but most fire-fighters fall into the trap of being so caught up in the fire fighting that they allow other fires to start.

Defects may result from random variation of a stable process that is capable of achieving the required specifications - an incapable process. We must improve the process to produce a product meeting specifications.

- 7) **Rigid and precise procedures are not sufficient to produce the desired quality.**

The Willing Workers followed the procedures prescribed by the foreman. "Procedure compliance is mandatory." Despite following rigid procedures, quality was not achieved. The Willing Workers had no chance to offer suggestions for process improvement. Too many red beads were produced - the plant closed down.

The entire workforce must be engaged in process improvement in order to help get rid of the red beads, to stay in business and to create more jobs. Everyone has an obligation to improve the system, and thus to improve his own performance and everyone else's. The Willing Workers were victims of the process. They could not, under the rules laid down by the foreman, improve their performance.

Only management can change a system or empower employees to change the system. Dr. Deming asked, "How can a man (or woman) do it right the first time when the incoming material is off gauge, off color, or otherwise defective, or if his machine is not in good order?"

8) **Keeping the place open with only the "best" workers was acting on "superstitious" knowledge.**

Management acted on the outcome of the process itself. Acting without clear evidence, management believed the "best" workers in the past would be the "best" workers in the future. Differences in red bead production were due entirely to the process, not to differences in the Willing Workers.

"What is the purpose of management?" Dr. Deming asks. "Not to play games but to use numbers so that we can predict the future."

9) **Management was "tampering" with the system by rewarding and punishing the Willing Workers.**

To react to an outcome as if it came from a special cause when it actually came from a common cause of variation is "tampering" with the system.

Action taken on a stable system in response to variation within the control limits, in an effort to compensate for this variation, is tampering. Tampering will inevitably increase the variation and increase costs. This advice holds even if the stable system is producing faulty items.

Rewarding and punishing Willing Workers for perceived good and bad performance is tampering with the system. When errors go down, we give a bonus, or maybe we give a pizza party. We determine which workers have the highest error rate and then we take corrective action - discipline or termination. This practice is wrong - even worse, it is destructive.

10) **People are not always the dominant source of variability.**

All the variation - differences between Willing Workers in the production of red beads, and the variation day to day of any Willing Worker - came entirely from the system itself. There was no evidence that any one worker was better than another. Variation is part of any process. Even with identical or similar tools, tasks, and talents, production will vary. There is always variation.

The system consisted of the vessels, paddle, red beads, white beads, instructions and procedures. The environment, equipment, materials and procedures all contribute to variation. The Willing Worker becomes part of the system subject to variation. The Willing Workers had put into the job all that they had to offer. They could not, under the circumstances, do better. The variation in performance arises from the system itself, not from the Willing Workers.

In the Red Bead Experiment Dr. Deming has purposefully eliminated the source of variation that many think is always the dominant source: that is, the people.

The common wisdom is that if only people did not make so many mistakes, there would not be so many problems. But even with the variation contributed by the people reduced to zero, there are still too many red beads.

11) **Slogans, Exhortations and Posters Are At Best Useless To The Willing Worker.**

Motivational posters had no effect on red bead production.

Slogans like "Do it right the first time" are an insult. Exhortations and posters generate frustration and resentment. They advertise to the production worker that management is unaware of barriers to pride of workmanship.

If we have set up our business correctly, "it" will be done right the first time. In that case the slogan is useless.

If we did not set it up correctly, there is nothing that the Willing Worker can do to make it right the first time. If we didn't set up the business properly, a slogan such as this will only frustrate the worker. If the worker tries to make changes, he can only make the result worse by tampering.

Thoughts from a Willing Worker named Ann. A Willing Worker named Ann, after the experiment on the Red Beads came to a close, expressed to Dr. Deming some provocative thoughts. She wrote her thoughts down in the following letter:

When I was a Willing Worker on the Red Beads, I learned more than statistical theory. I knew that the system would not allow me to meet the goal, but I still felt that I could. I wished to. I tried so hard. I felt responsibility: others depended on me. My logic and emotions conflicted, and I was frustrated. Logic said there was no way to succeed. Emotion said that I could by trying.

After it was over, I thought about my own work situation. How often are people in a situation that they can not govern, but wish to do their best? And people do their best. And after a while, what happens to their drive, their care, and their desire?

(From The New Economics by W. Edwards Deming)

RED BEAD EXPERIMENT RESOURCES

From the Master:

- 1) **Out of the Crisis**, by W. Edwards Deming
Published by the Massachusetts Institute of Technology, 1986
Center for Advanced Engineering Study, Cambridge, A 02139
- 2) **The New Economics For Industry, Government, Education**, by W. Edwards Deming.
Published by the Massachusetts Institute of Technology, 1993
Center for Advanced Engineering Study, Cambridge, A 02139

About The Red Bead Experiment From Other Sources:

CD-ROM

- 1) **Dr. W. Edwards Deming: Best Efforts Are Not Enough!**
Interactive Multimedia Symposia on CD-ROM; IMmATA Worldwide, LLC
Item BGDRD-4; at 1-800-370-7911 or 714-870-5845

Video

- 1) **The Essential Deming**, four video tapes, about three hours
Published by the Massachusetts Institute of Technology, 1991
Center for Advanced Engineering Study, Cambridge, A 02139
- 2) **Dr. Deming's Four-Day Seminar** conducted in July 1992
About 12 hours of videotapes accompanied by a guide.
Available from The W. Edwards Deming Institute,
P.O. Box 59511, Potomac, MD 20859-9511
- 3) **The Red Bead Experiment** conducted on April 7, 2000 at Richland WA.
A 54 minute video of the Red Bead Experiment performed for a
Department of Energy Integrated Safety Management System (ISMS)
workshop. Tape #5241/M1, Lockheed Martin Services, Inc. Video
Production Center, 509-376-6960.

Internet

- 1) **The W. Edwards Deming Institute:** <http://www.deming.org/>
- 2) **The Deming Cooperative:** <http://www.deming.edu/>
- 3) **The Deming Electronic Network WEB SITE:**
http://www.deming.ces.clemson.edu/pub/den/deming_assoc.htm

- 4) **Script for Dr. Deming's Red Bead Experiment:**
<http://www.quality.org/tqmbbs/tools-tech/redbeads.txt>

Books With Descriptions of The Red Bead Experiment:

- 1) **Deming's Road to Continual Improvement**, 1991, by William W. Scherkenbach
- 2) **Four Days with Dr. Deming, A Strategy for Modern Methods of Management**, 1995, by William J. Latzko and David M. Saunders
- 3) **Dr. Deming, The American Who Taught the Japanese About Quality**, 1990, by Rafael Aguayo
- 4) **The Deming Management Method**, 1986, by Mary Walton
- 5) **The Man Who Discovered Quality, How W. Edwards Deming Brought the Quality Revolution to America - The Stories of Ford, Xerox and GM**, 1990, by Andrea Gabor

Other Pertinent Works:

- 1) **The Keys to Excellence: The Story of the Deming Philosophy**, 1987, by Nancy Mann
- 2) **Understanding Variation, The Key to Managing Chaos**, 1993, by Donald J. Wheeler
- 3) **The Leader's Handbook**, 1998, by Peter Scholtes
- 4) **Deming Management at Work**, 1990, by Mary Walton

Steven S. Prevette (373-9371), FH, steven_s_prevette@rl.gov

Steven M. Byers (372-8199), CHG, smbyers@aol.com

Brief Overview of Trending

Use Statistical Process Control (SPC) control charts to detect if significant changes are occurring in the process data.

SPC uses an average line for a fixed time interval. Do not change the average with each new data point added. Do not change the average line unless a statistically significant change occurs, then construct a new baseline average if the data stabilizes at a new average.

Use three standard deviation control limits. This is the best balance between detecting real changes, and avoiding false alarms. (Would changing the sensitivity on your household smoke detector make your house more safe?)

Apply the following rules to detect statistically significant change:

- One point outside the control limits
- Two out of Three points two standard deviations above/below average
- Four out of Five points one standard deviation above/below average
- Seven points in a row all above/below average
- Ten out of Eleven points in a row all above/below average
- Seven points in a row all increasing/decreasing.

Plot at least 25 data points on your control chart before discarding "old" historic data.

If there are no statistically significant changes in the data on the control chart, then you have a stable process. You must change the process in order to change the data results. Numerical Goals will NOT cause a process change, nor a real change in the data.

If there are statistically significant changes, determine the special causes of these changes. Apply this knowledge to reinforce positive trends, and to correct negative trends.

After making a process change (management decision), perform statistical trending using SPC to see if a statistically significant change results.

Point of Contact: Steve Prevette, 509-373-9371
email: steven_s_prevette@rl.gov
Trending Home Page: <http://www.hanford.gov/safety/vpp/trend.htm>



Continual Improvement Flowchart

