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# Improving Your Safety Performance with Intelligent Use of Data

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## Introduction

Injury and illness rates have long been used as indicators of safety performance. Over the years, companies have set numerical targets for injury rates, based employee pay and management bonuses upon injury rates, and taken many actions based upon the numbers. Safety professionals often find themselves on the receiving end of goals and exhortations to reduce injuries. Dr. Edwards Deming spent his life (from 1900 to 1992) disproving many of the common methods we have used to try to improve performance numbers. His Fourteen Points suggested elimination of numerical targets, elimination of management by objective, and that cooperation between workers and management is needed to improve quality, safety, and productivity. This session will utilize Dr. Deming's Red Bead Experiment to illustrate these points, and to demonstrate an intelligent way to make use of injury statistics.

## The Red Bead Experiment

Dr. Deming documented the Red Bead Experiment in his books Out of the Crisis and The New Economics for Industry, Government, Education. The experiment establishes a workforce of six "willing workers" from the audience who produce white beads for the "White Bead Production Corporation". Three quality inspectors and a data recorder are also "hired" from the audience. All of the workers are provided indoctrination into the corporation by the Foreman and the President of the company (the two session authors). There are motivational posters, on-the-job training, and formal procedures provided.

The “willing workers” are expected to produce white beads from an incoming bead supply. The exercise consists of four “days” of production, each worker making one production attempt per day. However, the incoming bead supply has a mixture of red and white beads in it. For purposes of this exercise, the red beads can represent defective product, or unsafe practices and conditions which cause injuries. The goal is to have zero red beads. As the exercise unfolds, various goals, punishments, and rewards are offered to the workers in order to avoid the red beads. As this is an exercise that the audience must experience, this paper will not go into great detail about the sequence of events, thus not to give away the plot ahead of time to the participants.

## Data Analysis

During the experiment, the number of red beads produced by each “willing worker” are counted, and documented on a reporting table. The workers are rated and ranked based upon the numbers of red beads they produce. Results from each “day” are compared to other days, and the numerical targets established.

At the end of the exercise, the data are examined. The original data table is analyzed, then the data are plotted on a bar chart, a moving average chart, and a “rainbow” chart (a chart with red, yellow, and green zones on it for evaluating each result). These charts appear to show that actions are needed as a result of specific individual workers’ results.

## Statistical Process Control

Finally, a Statistical Process Control “control chart” is made of the data. The control chart plots a baseline average through all 24 results, and control limits are established at three standard deviations from the average. The data are evaluated for trends using a set of trending rules. This exercise does not go into detail on construction of control charts. For those interested in more detail, please refer to the “Hanford Trending Primer” on the internet at http://www.hanford.gov/rl/?page=1144&parent=169.

The control chart analysis of the data shows that all of the results came from the same process. The workers were consistently doing the same operation in retrieving beads from the same incoming bead supply. There were variations in results from worker to worker and day to day, but these variations were all explainable as random noise. There were no bases in the data for the management actions taken during the exercise.

## Lessons from the Beads

Dr. Deming developed the Red Bead Experiment as a lesson in quality and statistics. The lessons are equally applicable to safety. If safety professionals and managers expend their resources reacting to the latest injury, reacting to random noise, little will be accomplished towards improving performance. If the variation in results is due to the process, and not the individual workers, or individual organizations, little will be accomplished by pitting workers and organizations against each other, with the resulting rewards and punishments. The control chart

provides a tool to discern if the observed variation in results is from the individuals, or from the process.

Subjecting workers and safety professionals to exhortations, posters, numerical targets, rewards and punishment are likely to only result in increased levels of frustration if the underlying mechanisms that produce injuries are stable. If the underlying mechanisms are indeed stable, they are also predictable through the use of the control chart. Safety professionals and workers are able to make intelligent use of their data through the control chart methodology demonstrated, and can then change the underlying mechanisms and processes that cause injuries to occur.