THE DEMING LIBRARY

The Red Bead and Funnel Experiments
DISCUSSION GUIDE

VOLUME 7:
THE RED BEAD EXPERIMENT AND LIFE

VOLUME 8:
LESSONS OF THE RED BEAD EXPERIMENT

VOLUME 9:
THE FUNNEL EXPERIMENT

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VOLUMES 7, 8, AND 9

OVERVIEW

The Red Bead and Funnel Experiments illustrate central lessons in the Deming Method, and taken together, the two demonstrate some elements of profound knowledge. Yet the Red Bead and Funnel Experiments are so deceptively simple that their critical importance is easy to miss. This Discussion Guide is designed to prevent that.

The more participants talk about what they see on these videocassettes, and what they think about the points being made, the more likely they are to realize and appreciate the value of the Red Bead and Funnel Experiments. At the same time, it is important to remember that the two experiments are, in fact, fun. The discussion should be approached in the same spirit; learning should not be a somber experience.

VOLUME 7: THE RED BEAD EXPERIMENT AND LIFE

INTRODUCTION

The discussion leader should have read Out of the Crisis and the Overview to this Discussion Guide. Participants must be reminded that this is a discussion, not a quiz, and the more they take part, the more they and their colleagues will gain.

Volume 7 shows the Red Bead Experiment as it is done at Dr. Deming’s four-day seminars, edited for videocassette. The more participants realize that the rules of the experiment are the same as the rules found in business and industry today, the more readily the lessons can be transferred from the classroom to the office.

QUESTIONS 1-5

1. What are the standard operating procedures in the Red Bead Experiment? Were they made clear to the Willing Workers?
2. Are there reasons for the Willing Workers to manufacture white beads? Is there a reward for good work? Is there a punishment for poor or substandard work?

3. Did the six Willing Workers, the two Inspectors, the Chief Inspector, and the Recorder do what they were told to do? Did they follow the company's rules?

4. Foreman Deming told the workers that their jobs depended on their performance. Is that usually true in business and industry? Do your jobs depend on your performance?

5. Did Foreman Deming deal fairly with the workers? Was he honest with them? When he said, "All you have to do is follow procedures rigidly," was that the truth as he knew it?

QUESTIONS 6-8

6. Is the Foreman justified in telling one of his Willing Workers, "One thing is sure, you couldn't do worse"?

7. Why did Karen's coworkers react badly when she did well and was praised by Foreman Deming?

8. Did the Willing Workers do their best? If they had tried harder, what would have changed?

VOLUME 8: LESSONS OF THE RED BEAD EXPERIMENT

INTRODUCTION

The discussion leader should have read Out of the Crisis and the Overview of this Discussion Guide. He or she should also have seen Volume 7 of THE DEMING LIBRARY, and at least been present for the discussion that followed it.

QUESTIONS 1-5

1. Why does Dr. Deming say that the number of beads in the container has no meaning except in terms of how you count them?

2. If a colleague in your business uses the word mistake, do you know with certainty what he or she means?
3. How can a process "talk" to you and tell you what it is doing?

4. How can you differentiate between a common cause and a special cause? Why should you want to?

5. Once you identify a stable system, can you predict with certainty what it will do in the immediate future?

QUESTIONS 6-10

6. What is the advantage of having a stable system?

7. In any process, what is the environment? What part does it play?

8. Willing Worker Ann wrote, "I was frustrated. Logic said there was no way that I could succeed. Emotions said I must try." Was her frustration justified? Should she have tried? If she had not tried, what difference would it have made?

9. What information would it have been good for management to have in hand before they set a price on white beads?

10. After management had quoted the price for white beads to its customers, they discovered, when operations commenced, that with three red beads per work load, on the average, they would just about break even – costs would be about equal to revenue. Fewer than three red beads per work load would bring some profit. Why was it futile, under the circumstances (rules, procedures, system), to set three red beads as a numerical goal?

QUESTIONS 11-15

11. Would it have been beneficial if management had collaborated with the supplier of beads to try to improve the supplier's process and thus reduce the proportion of red beads in the incoming material?

12. How might the Willing Workers have improved their output of white beads had they been granted the privilege to try out suggestions on improvement of procedures?

13. What did the control limits tell us?

14. What are some of the advantages of a system that is stable enough to use for prediction? (The control limits for a stable system, if extended into the future, provide
prediction of variation in the number of red beads in work loads, and of the average, the
costs, and the output.)

15. What barriers (red beads) may there be to pride of workmanship in your own job?

QUESTIONS 16-20

16. How would you describe the interaction between the workers on the Red Bead
Experiment and the system that they worked in?

17. What was wrong with the merit system that rewarded the worker with the fewest red
beads on any day? What was wrong with putting on probation the worker with the
greatest number of red beads on any day?

18. Why was it faulty practice to rank the Willing Workers?

19. When a Willing Worker makes an unusually high number of red beads, would it be
useful to stop the line and try to find out what happened? Should the same be done when
a worker makes an unusually low number of red beads?

20. Why was it faulty practice to keep the place open with the "best" workers?

QUESTIONS 21-22

21. What is wrong with the so-called merit system?

22. Can you put forth arguments for the elimination of grading in schools, including
universities?

VOLUMES 7 AND 8

CHARTS AND GRAPHS

The charts and graphs used in the Red Bead Experiment of Volumes 7 and 8 are shown
below. There is also a step-by-step explanation of the mathematics used to compute the
upper and lower limits of a process. Wherever it is possible, a qualified statistician should
explain the formula to participants.
In the charts and graphs that follow:

- \( \bar{x} \) (read “x bar”) means the average number of red beads over all work loads of 50 beads
- \( \bar{p} \) (read “p bar”) means the average proportion of beads, over all work loads, that were red
- UCL stands for “upper control limit”
- LCL stands for “lower control limit”

**RECORD OF NUMBER OF DEFECTIVE ITEMS BY OPERATOR, BY DAY**

(Lot size 50, each operator per day)

<table>
<thead>
<tr>
<th>Name</th>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
<th>Day 5</th>
<th>All 4</th>
<th>All 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mike</td>
<td>8</td>
<td>11</td>
<td>6</td>
<td>7</td>
<td>32</td>
<td>14</td>
<td>5</td>
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<tr>
<td>Leon</td>
<td>14</td>
<td>10</td>
<td>8</td>
<td>11</td>
<td>43</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Karen</td>
<td>7</td>
<td>10</td>
<td>11</td>
<td>5</td>
<td>33</td>
<td>12</td>
<td>11</td>
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<tr>
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<td>11</td>
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<td>6</td>
<td>10</td>
<td>37</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Melvin</td>
<td>7</td>
<td>12</td>
<td>6</td>
<td>13</td>
<td>38</td>
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<td></td>
</tr>
<tr>
<td>Paul</td>
<td>14</td>
<td>7</td>
<td>7</td>
<td>14</td>
<td>42</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>61</td>
<td>60</td>
<td>44</td>
<td>60</td>
<td>225</td>
<td>58</td>
<td></td>
</tr>
<tr>
<td>Cum.</td>
<td>( \bar{x} )</td>
<td>10.2</td>
<td>10.1</td>
<td>9.2</td>
<td>9.4</td>
<td>9.4</td>
<td>***</td>
</tr>
</tbody>
</table>

Inspectors: Laura    Hank    Recorder: Nellie    Chief Inspector: Ruth

**CALCULATION OF CONTROL LIMITS**

\[
\bar{x} = \frac{225}{6 \times 4} = 9.4
\]

\[
\bar{p} = \frac{225}{6 \times 4 \times 50} = .188
\]

\[
\begin{align*}
UCL &= \bar{x} + 3\sqrt{\bar{x}(1-\bar{p})} \\
LCL &= \bar{x} - 3\sqrt{\bar{x}(1-\bar{p})}
\end{align*}
\]

\[
= 9.4 + 3\sqrt{9.4 \times .812} = 17.66 \\
= 9.4 - 3\sqrt{9.4 \times .812} = 1.10
\]
WOODEN BEADS CENSUS COUNT (one by one)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>4000</td>
</tr>
<tr>
<td>Red</td>
<td>800</td>
</tr>
<tr>
<td>White</td>
<td>3200</td>
</tr>
</tbody>
</table>

Paddle No. 4

CONTROL CHART OF NUMBER OF DEFECTIVE ITEMS (RED BEADS)

Points added for Washington, 1 April 1987, to compare with prediction: same beads, same paddle, different Willing Workers, same Foreman. For Washington:

\[ \bar{x} = 9.2 \quad UCL = 17 \quad LCL = 1 \]
INTERPRETATION OF THE CHART

The process exhibits fairly good statistical control. This conclusion is based on intimate knowledge of the procedures prescribed for the job and followed by the six Willing Workers, as well as on study of the chart. This is an example of a constant cause-system. There is no evidence that one Willing Worker will in the future be better than any other. Differences between Willing Workers and between days' work are attributable to variation inherent in the system.

The operators have put into the job all that they have to offer.

The only way to decrease the proportion of red beads in the product is to reduce the proportion of red beads in the incoming material (management's responsibility).

The control limits are extended into the future as prediction of the limits of variation to expect in the near future from continuation of the same process.

VOLUME 9: THE FUNNEL EXPERIMENT

INTRODUCTION

The discussion leader should have read Out of the Crisis and the Overview to this Discussion Guide. He or she also should have seen Volumes 7 and 8 of THE DEMING LIBRARY, and at least attended the discussions following those two volumes.

The discussion of Volume 9 should be as wide-ranging as possible, covering the Funnel Experiment from this volume, the Red Bead Experiment from the two previous volumes, and the concept of profound knowledge, which is implicit in the two experiments and specifically outlined in this volume.

QUESTIONS 1-5

1. What does Dr. Deming mean when he refers to "management of failure"?

2. What is the difference between tampering with the system and improving the system? How do you know which you are doing?

3. Why does Dr. Deming say, "Tampering with a stable system . . . only makes things worse"?
4. What are the four rules of the Funnel Experiment? What are everyday examples of rules 2, 3, and 4? Can you find examples in business and industry today?

5. Dr. Deming says, "Some simple adjustments would improve the system." He lists three: Move the funnel closer to the table, change the tablecloth, change the marble. What are some others?

QUESTIONS 6-9

6. What does Dr. Deming mean when he says, "A defective item is not a signal of special cause"?

7. In what basic ways are the Funnel and Red Bead Experiments alike?

8. Why won't best efforts, hard work, and investment in machinery, gadgets, and computers ensure quality?

9. What are the elements of profound knowledge? How do they relate to the Funnel Experiment and the Red Bead Experiment?