Michigan Lean Consortium Learning Program

A History of Deming, the Red Bead Experiment and Lean

The Scientific Method Applied to Management and Leadership

Facilitated by Dennis Sergent
517-285-5500
A Learning Agenda For Today

• **Learning About Deming & Quality – First Hour**
  - the connection of Deming’s work to the scientific method
  - his long history and why some call him the “father of quality”
  - his philosophies of systems, productivity, and economics
  - a number of tools of quality that help your Lean journey

• **Learn and Practice The Red Bead – Second Hour**
  - the source of low performance by workers
  - the influence that workers have on quality
  - the source of variation between shifts and workers
  - how to predict the future based on the past
  - how mechanical sampling results differ from random numbers
  - how to understand common cause and special cause variation
  - how well intended managers, leaders and workers tamper with the system through performance appraisals, rating and ranking of workers

• **Linkage of Deming to Lean – Third Hour**
  • the many connections of his work to Lean
  • embedded in the System of Profound Knowledge
An Introduction to this Learning Program

• **Learning, not training**
  – This is about you, not the facilitator

• **Dialogue, not a lecture**
  – We will facilitate the dialogue about the subject

• **We will not read the slides to you**
  – We will use the handouts as a point of reference today and in the future

• **You do not need to read the slides**
  – But it might help you learn more if the subject matters to you

• **Part of an Emerging Transformation**
  – Management & Leadership Development Programs
  – Good Management Practices
  – Professional, Quality Management Fundamentals
  – Effective Operations
  – Productive Quality By Design
An Aim for Today

• **Learn**
  – There is no substitute for knowledge
  – “What is in it for me?” applies to all of us

• **Make a difference**
  – We have been misled and stuck in old knowledge
  – The prevailing management and educational “science” is a myth
  – So are our most of our educational notions and institutions, as well as our other organizations
  – We ought to be leading the world, but we are not

• **Have fun in the process**
  – The prevailing system of education has crushed joy out of the schools and learning.
  – The prevailing system of management has crushed joy out of the workplace.

• **Eradicate superstitious learning**
  – We will use our theories, facts, and PDSA Cycle
Sticky Note Exercise

• Pick up a 2x2” Sticky Note
• Put the “sticky” part at the back and top
• Draw a line down the middle
• On the left side print a percentage %
  – How much of your time here is NOT SPENT on high priorities?
• On the right side, print another percentage %
  – How much of your organization’s time is NOT SPENT on high priorities?

OPERATING DEFINITIONS:

– Your time means you personally
– ORGANIZATION time means everyone else in your organization – top to bottom
So What Is In It For Me?

• Think about your numbers on the sticky notes

• You spend ____ % of your time on non-priority work

• Could you think of priority things to do with that time?

• YOUR TIME on PRIORITIES IS WIIIF YOU!
  – For You Personally and Professionally
  – For Team Members and Colleagues
  – For Customers
  – For Suppliers
  – For EVERYONE who benefits by your work
W. Edwards Deming – A Brief History
Who is W. Edwards Deming?

• A humble, apprentice statistician (his words @ 90 Years old!)
• Educator
  – B.S. - Electrical Engineering at Univ. of Wyoming (1921)
  – M.S. - Mathematics & Physics at Univ. of Colorado
  – Ph.D. - Mathematical Physics at Yale (1928)
  – Intern at Hawthorne Works – Bell Telephone Laboratories (1925-1928)
    • Met Dr. Walter Shewhart (the creator of the Plan-Do-Create-Act cycle or Shewhart cycle).
  – Professor of Statistics at Graduate Business School - New York University (1946-1993)
• Mathematical Physicist
  – Department of Agriculture (1927-1939)
• Statistician
  – US Census Bureau (1939-1946)
    • Improved bureau productivity six times
  – Consultant and teacher of Methods for US War Production (1942)
  – Japanese Reconstruction (1946)
  – Consultant to MacArthur & Government of Japan (1948)
  – Recognized by Japanese Scientists and Engineers with “Deming Prize” (1950)
More About W. Edwards Deming

• Consultant, Teacher and Advisor
  – Presented system of improvements to 32 top leaders at Tokyo Economic Club (1950)
  – Presented with Ichiro Ishikawa (Fishbone Diagram - 1950)
  – Recognized by Japanese Scientists and Engineers with “Deming Prize” (1951)
  – Received Second Order Medal of the Sacred Treasure from the Emperor of Japan for improvement of quality and the economy (1960)
  – Consultant and Teacher to American executives and a worldwide demand.
  – Deming held four-day seminars for improvement and productivity, supported by George Washington University to about 20,000 people each year (1981-1993)
  – Received National Medal of Technology by President Ronald Reagan (1987)

• Author and Creator (Books & concepts published in more than twenty languages)
  – Elementary Principles of Statistical Control of Quality Control (1950)
  – Presented Deming Wheel - specification-production-inspection (1950)
  – Subject of “If Japan Can, Why Can’t We?” NBC-TV special (1980)
  – Out of The Crisis (1986)
  – Presented Shewhart Cycle for Learning and Improvement (1986)
  – Presented 14 Points for Managers (1986)
  – Presented System of Profound Knowledge (1987)
  – Presented P-D-S-A (1993)
“If Japan Can, Why Can’t We”

• At a time when American manufacturing was in noticeable decline, this 1980 broadcast brought immediate attention to Dr. Deming’s work in Japan.
  – The day after the show, Dr. Deming’s phone rang off the hook.

• In 1983, Ford retained Dr. Deming to deal with quality challenge from Japanese autos.
  – Within 3 years, Ford made great strides in quality and sales and expressly attributed its success to the quality improvements inspired by Dr. Deming.

• He went on to work with General Motors, Xerox, Proctor and Gamble, Hewlett-Packard, and many others.

• More than 100,000 managers and engineers from hundreds of companies attended Dr. Deming’s four-day seminars over the next decade

• Sometimes as many as 4,000 people at one sitting!
A Timeline

1921  BSc Electrical Engineering - University of Wyoming
1925  MS Mathematics & Physics - University of Colorado
       - Summer Jobs at Western Electric Hawthorne Works in 1925 & 26
1928  Ph.D. Physics - Yale University
       - Internship @ Bell Telephone Laboratory with Walter Shewhart
       - U.S. Department of Agriculture, U.S. Census
1942  Consultant/Teacher of Methods to War Production
       This group became the American Society for Quality (ASQ)
1948  Consultant to MacArthur & Japanese Government
1950  First lectures to 600 Japanese Industrialists
       *Elementary Principles of the Statistical Control of Quality* – Published
1960  Awarded Medal of the Sacred Treasure by Emperor of Japan for improvement
       of quality & economy through Statistical Control of quality
1980  *“If Japan Can, Why Can’t We?”*
1986  *Out of The Crisis* – Published
       *Fourteen Points For Managers* - Published
1987  Awarded National Medal of Technology by President Reagan
       *System of Profound Knowledge* – Published
1993  *The New Economics* – Published
Why Is He Called the “Father of Quality”? 

- Statistical Work With Walter Shewhart 
- World War II Economic Advisory Board 
- Japanese Census & Deming Medal 
- PDSA – Shewhart Cycle for Learning & Improvement 
- The Deming Wheel (Design-produce-sell-research) 
- Japanese Economic Recovery & Sacred Treasure 
- Deming Lifecycle 
- If Japan Can, Why Can’t We” 
- 14 Points 
- 7 Deadly Diseases 
- System Model 
- System of Profound Knowledge
Deming’s Philosophy

“The basic problem anywhere is quality. **What is quality?**
A product or service possesses quality if it helps somebody and enjoys a good and sustainable market. Trade depends upon quality.”


- Dr. Deming trained and taught his 4-day workshops until his death in 1993.
- At the time of his death, he was expanding his philosophy of *profound knowledge*.
- He stressed that real improvement could only come from deeper knowledge—knowledge of systems and variation, having a theory (ideas for improvement) based on systems and data, and a basic understanding of human psychology—how people learn, what motivates them, and how change occurs in human environments.
- In practice, he continually tested and revised his theories right up to his death.
- He repeatedly emphasized that his chief goal was to prove himself wrong.
Deming’s Lifecycle Diagram

Effects on the individual from the present system of norms and expectations.

Life begins
- Grading in school
- School atmosphere

Merit system: judge people, put them into slots
- Incentive for performance

M. B. O.: met by the number

Suboptimization: people, groups, divisions
- Competition between
- I win, you lose
- Numerical quotas

Life ends

Fear, self-defense. Compete for a high rating.
- Play to win. Extrinsic motivation.

Destruction a day’s pay for a day’s work — humiliated, beaten. Drop out of school, drugs, jail.

Intrinsic motivation, nourishment of the individual
- Self-esteem, dignity, security.


Thoughts as of 20 July 1989

From *The Deming Dimension* by Henry R. Neave
Life begins

Forced distribution of grades in school and Gold stars put them
Merit system. Judge people: Competition between people, groups,
Incentive pay, pay for performance methods
Numerical goals, without
Explanation of variances

Life ends

Suboptimization. Every group, every division, a profit center

These forces bring humiliation, fear, self-defense, competition for gold stars, high grades, high ratings on the job. They lead anyone to play to win, not for fun. They crush out joy in learning, joy on the job, innovation. Extrinsic motivation (complete resignation to external pressures) gradually replaces intrinsic motivation, self-esteem, dignity

One is born with intrinsic motivation, self-esteem, dignity, cooperation, curiosity, joy in learning. These attributes are high at the beginning of life, but are gradually crushed by the forces of destruction.
Deming’s Plan-Do-Study-Act-

The Scientific Method and Evolution of PDSA
Evolution of Scientific Method & PDSA Cycle

• PDCA = plan-do-check-act
• PDSA = plan-do-study-act
• QC = quality control
• TQC = total quality control

Ron Moen’s article* in the *Quality Progress” magazine in November 2010 with Cliff Norman on the Deming Cycle has expanded our understanding of the PDSA learning and improvement cycle as well as the relationships to fundamentals of the tool and variants. It is also clear to see the connection into Deming’s description of the System of Profound Knowledge.

*Circling Back – Clearing up myths about the Deming Cycle and seeing how it keeps evolving by Ronald D. Moen and Clifford L, Norman
PDSA / PDCA

• **PDSA = Plan - Do - Study - Act**
  - The Engine of Continuous Improvement
  - A continuous learning and improvement cycle
  - Fundamental to Quality Practitioners
  - We prefer PDSA
  - You will see references to PDSA
  - Created by Walter Shewhart –
    - “Statistical Method From The Viewpoint of Quality Control”
    - Deming labeled as the “Shewhart Cycle for Learning & Development”

• **PDCA = Plan – Do – Check – Act**
  - When Japanese developed PDCA – he called it a corruption
  - Dr. Deming’s concern with the word “check”
    - “Check”, in some interpretations means “stop”
  - PDSA was for management and leadership, PDCA for shop floor
  - You will see a slide with PDCA With Control
  - If we use PDCA – we mean without stop, without end,
Deming in 1951

The Old Way

1. Design it
2. Make it
3. Try to sell

The New Way

1. Design the product (with appropriate tests)
2. Make it, test it in the production line and in the laboratory
3. Put it on the market.
4. Test it in service, through market research, find out what the user thinks of it, and why the non-user has not bought it
5. Re-design the product, in the light of customer reactions to quality and price

Continue around and around the cycle.
PDSA Cycle

- We **PLAN** what we want to accomplish over a period of time and what we will do to get there.
- We **DO** something that furthers the strategies and goals developed in our plan.
- We **STUDY** (Check) the results of our actions to make sure we achieve what we plan.
- We **ACT** by developing procedures to ensure our plans continue to be successful and by changing what is needed to achieve the initial goals.

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The Plan-Do-Study-Act Cycle

**Plan**
- Plan a change or a test, aimed at improvement.

**Do**
- Carry out the change or the test (preferably on a small scale)

**Study**
- Study the results. What did we learn? What went wrong?

**Act**
- Adopt the change, or abandon it, or run through the cycle again.

A flow diagram for learning and for improvement of a product or of a process.

**P-D-S-A or Plan-Do-Study-Act**

- We **PLAN** what we want to accomplish over a period of time and what we will do to get there.
- We **DO** something that furthers the strategies and goals developed in our plan.

Ron Moen’s article with Cliff Norman on the Deming Cycle has expanded our views of the PDSA learning and improvement cycle.

**Plan**
- Plan the objective.
- Ask questions, make predictions.
- Plan what, where, when and who to implement the cycle.

**Action**
- Adopt the change.
- Adapt the change.
- Begin the next cycle.

**Study**
- Analyze the data completely.
- Compare data to predictions.
- Summarize learning.

**Do**
- Carry out the plan.
- Document problems and unexpected observations.
- Begin data analysis.

We **CHECK** (Study) the results of our actions to make sure we achieve what we plan. We **ACT** by developing procedures to ensure our plans continue to be successful and by changing what is needed to achieve the initial goals.
P-D-S-A - Proceed With Control

- We **PLAN** what we want to accomplish over a period of time and what we will do to get there.
- We **DO** something that furthers the strategies and goals developed in our plan.

We **CHECK (Study)** the results of our actions to make sure we achieve what we plan.
We **ACT** by developing procedures to ensure our plans continue to be successful and by changing what is needed to achieve the initial goals.

Ian Bradbury’s paper on “Design and Control of Quality” has expanded our views of the PDCA / PDSA learning cycle, especially as some companies use it.
This “wave” or “cycle” view of the scientific method in PDSA is an alternate way to view the learning and improvement cycle.

Repeating PDSA steps in a process of continuing to learn and increase knowledge with every cycle is the way PDSA works.

You may find other visual methods will work better for you and your system or organization!
Questions From API – Associates for Performance Improvement

- Did predictions improve with repeated cycles?
- Was the theory confirmed when it predicted correctly?
- What happened when the predictions were incorrect?
- Is the theory that we ended up with true?
Your Number One Concern

Your PDSA Cycle should start with your knowledge and your prediction or theory, then ask

- **What are we trying to accomplish?**
- **How will we know that a change is an improvement?**
- **What changes can we make that will result in an improvement?**

These three questions are the “Model for Improvement” added in 1991 by Ron Moen, Cliff Nolan and Lloyd Provost

- Act
- Plan
- Study
- Do
Implementing the PDSA

- In YOUR System
  - What are your theories?
  - What is your plan to accomplish a test of your theory?
    - Over what period of time?
    - What will you do to get there?
  - What will you do to find out whether your theory works?
    - What furthers the strategies and goals developed in our plan?
  - How will you study the results of the cycle?
    - How will you be certain the results come from your actions?
    - How will you make sure you achieved what you planned?
  - How will you act on your system?
    - How will you ensure your plans continue to be successful?
    - How will you change or adapt what you do to capitalize on what you learned?
Deming’s Plan-Do-Study-Act

A Scientific Approach for Learning & Improvement

- Managing Teams
- Managing Quality
- Managing Productivity
Adopt the new Philosophy #2

“We can not live with the levels of productivity that we once tolerated”

• Economic view of productivity =  
  – Output/Input  
  – If quality is poor, then output will be less than it can be  
    • Bad quality work items are in the system and must be scrapped or reworked

• When output is low and input is high =  
  – Productivity is very low

• Improve quality to reverse the system =  
  – Output goes up, input goes down, productivity shoots up

• Automation costs more than improving quality to improve productivity  
  – Output goes up, so does input to pay for automation  
  – Productivity goes up slowly, if at all
The Chain Reaction

- Deming described this as a result of the “new economics” philosophy

- Focus on the quality first, the productivity will follow, then jobs
  - Focusing on jobs or productivity first will be downstream in the system
    - And have less impact than going upstream to start with quality in processes, products & services, people and technologies

- Chain reaction below relates to non-profit and government economic

---

Improve Quality

- Costs decrease because of less rework, less waste, fewer mistakes, fewer delays, fewer snags

Productivity Improves

- Make better quality, lower price, more profit, more benefit, more value

Stay in operation

- Provide more jobs and more jobs

---

Improve Quality

- Decrease required inputs, cycle time, funds and labor.

Productivity Improves

- Make a greater benefit, for less inputs and budget

Do more important work

- Provide more effective jobs, organizations and economic security
Deming’s 14 Points for Management

Plus:

Seven Deadly Diseases
Deming’s System Model
System of Profound Knowledge
Transformation Process
Red Bead Experiment
Deming’s 14 Points

Key to understanding the 14 Points is variation.
The more special cause variation - the more waste, Deming’s 14 points are paraphrased here:

1. Create constancy of purpose towards improvement.
   • Replace short-term reaction with long-term planning.

2. Adopt the new philosophy. Win-Win. Everybody wins.
   • Management should walk the talk.

3. Cease dependence on inspection.
   • Reduced variation eliminates need to inspect for defects.

4. Move towards a single supplier for any one item.
   • Multiple suppliers mean variation between feedstocks.

5. Improve constantly and forever.
   • Constantly strive to reduce variation.

6. Institute training on the job.
   • Adequately trained staff will all work the same way, and reduce variation.

7. Institute leadership.
   • Mere supervision is quota- and target-based

8. Drive out fear.
   • Long term, it prevents workers from acting in the organization's best interests.

   • Use the ‘internal customer’, that each department serves other departments that use its output.

10. Eliminate slogans.
    • It's not people who make most mistakes - it's the process they are working within.

11. Eliminate “management by objectives”.
    • Deming saw production targets as encouraging the delivery of poor-quality goods.

12. Remove barriers to pride of workmanship.
    • Many of the other problems outlined reduce worker satisfaction.

13. Institute education and self-improvement.
    • Harassing the workforce without improving the processes they use is counter-productive.

14. The transformation is everyone's job.
    • “You do not have to do this. Survival is not compulsory.”
Seven Deadly Diseases

1. Lack of constancy of purpose
2. Emphasis on short-term profits
3. Evaluation by performance, merit rating, or annual review of performance
4. Mobility of management
5. Running a company on visible figures alone
6. Excessive medical costs
7. Excessive costs of warranty, fueled by lawyers who work for contingency fees

A Lesser Category of Obstacles includes:

- Neglecting long-range planning
- Relying on technology to solve problems
- Seeking examples to follow rather than developing solutions
- Excuses, such as "our problems are different"
- Obsolescence in school that management skills can be taught in classes
- Reliance on quality control departments
  - Rather than management, supervisors, managers of purchasing, and production workers
- Placing blame on workforces who are only responsible for 15% of mistakes
  - When the system designed by management is responsible for 85% of the unintended consequences
- Relying on quality inspection rather than improving product quality
Deming’s System Model

A

Suppliers of information, material, equipment

B

Receipt and test of information & materials

C

Production, assembly, inspection, conformance

D

Test of process, machines, methods, costs, user acceptance

Design and redesign

Consumer Research

Distribution

Consumers of products & services

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System of Profound Knowledge

• “The aim . . . is to provide an outside view - a lens . . . provides a map of theory by which to understand the organizations that we work in”

• Components of The Whole
  – Theory of Knowledge
    • Knowledge is built on theory
  – Appreciation for a System
    • A system is a network of interdependent components that work together to accomplish the aim of the system
  – Knowledge About Variation
    • There will always be variation.....
  – Psychology
    • Individuals
    • Groups
    • Society
    • Change

• “One need not be eminent in any part of profound knowledge in order to understand and to apply it”

• “The various segments of the system . . . Cannot be separated. They interact with each other. For example knowledge about psychology is incomplete without knowledge of variation.”
Transformation Process Described by Deming

- Compared to the PDSA/PDCA Cycle

START PHASE

GAIN KNOWLEDGE

APPLY KNOWLEDGE

CONTINUE TRANSFORMATION

START TASK

Read books, papers, see videos, and other sources

Develop theories and test them in organization

THEORY + EXPERIENCE = KNOWLEDGE

In not, then either theory or experience misleads us.

Do the results match the theory?

If theory and experience match, then we have a better theory, after many tests, we have knowledge

Then, we can use knowledge to improve our enterprise

There are a number of dependencies between the Phases and Tasks which are not depicted.
A System of Order From Chaos

In YOUR System
• You have **SUBJECT KNOWLEDGE**

• You **DESIRE IMPROVEMENT**

• What is Your **AIM**?

• What is Your **THEORY**?

• What are we trying to accomplish?

• How will we know a change is improvement?

• What changes can result in an improvement?

• Use the **PDSA Cycle** to learn if your **THEORY** is correct

• Change your theory if it is not correct

**“What Is In It For Me!”**
What Can We Do?

• **Be comfortable with;**
  
  – **Learning & PDSA Cycle**
    • Productive Reasoning
    • Leadership, and management
  
  – **Managing by Fact**
    • Data drives decisions
  
  – **Customer, Team and Owner**
    • Cooperative processes
    • Middle management must lead, support
    • Alignment & adaptation of plan by whole team
    • Involvement and engagement by all employees
    • Customer perception of value must be kept in focus
  
  – **Commitment to Quality**
    • Time and Resources
    • Action Consistent With Words
Pause For Reflection

AT EACH TABLE DISCUSS:

• What did we learn here?
• What do we need to discuss next?
• Who else needs to hear about this?
• What adds value to you and your organization?
• What are the positive attributes you can use?
• What are the differences which influence your thinking?
• What will we do with our learning?
• WHAT ARE OUR NEXT ACTION STEPS?
Deming’s Red Bead **Plus:**
Seven Deadly Diseases
Deming’s System Model
System of Profound Knowledge
Transformation Process
The Red Bead Experiment
The Red Bead Experiment

• A metaphor for our workplaces and the way we manage.

• You will have the opportunity to combine Profound Knowledge with YOUR experiences

• It will become a lens to view your experiences in your organization.

• If you pay attention to the feeling of working in this system defined by someone else . . .
Red Bead Objectives

- Learn the source of low performance by workers
- Learn the influence that workers have on quality
- Learn the source of variation between shifts and workers
- Learn how to predict the future based on the past
- Learn how mechanical sampling results differ from random numbers
Lesson: The Red Bead Revolution

1 Hour
The Red Bead Experiment

• INTRODUCTION TO A “SHORT” RED BEAD EXERCISE (5 Minutes)

• The Exercise (5 Minutes Intro)
  – Training In The Procedure

• The Scenario (15 Minutes to Execute)

• The Players (Tables of 8 or 9)
  – 1 Process Supervisor
    • The person most “North” at your table
  – 1 Results Recorder
    • The person to the immediate right of the Supervisor
  – 6 Willing Workers
    • Everyone Else at the Table
    • Willing Worker #1 is immediately to the right of the Results Recorder
    • Quality Inspections will be done by neighboring workers

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PROCESS Instructions

- Follow this process exactly, without talking, except as described below.
- Pour beads from one nested bowl into the other at about a 45 degree angle, being careful not to spill any beads.
- Take the sampling paddle and dip it into the bead bowl until it hits the bottom and scoop out the beads above it.
- Carefully rotate the scoop about 45 degrees to each side, then move the scoop over the shallow plate and carefully place all of them in the plate.
- Count the number of red beads in the plate, announce it.
- Willing Workers on either side confirm the count verbally and pour the beads back into the bowl.
- The Results Recorder records the name and the number, then announces it.
- The Process Supervisor says “next” and the Willing Worker immediately to the right takes their turn.
- When everyone has had their turn, continue on again until the facilitator says “Stop”, completing as many samples correctly as time allows.
Red Bead – Your Table Results

- Record Them On Your Worksheet

<table>
<thead>
<tr>
<th>WILLING WORKER NAMES</th>
<th>SHIFT 1</th>
<th>SHIFT 2</th>
<th>SHIFT 3</th>
<th>SHIFT 4</th>
<th>SHIFT 5</th>
<th>SHIFT 6</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>WW1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WW2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WW3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WW4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WW5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WW6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TOTAL
## Typical Data Entry Example

- **What do we see?**

<table>
<thead>
<tr>
<th>Worker</th>
<th>Name</th>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
<th>Eval</th>
<th>Day 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>JENIFER</td>
<td>12</td>
<td>10</td>
<td>4</td>
<td>11</td>
<td>37</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>JOSEF</td>
<td>12</td>
<td>5</td>
<td>8</td>
<td>9</td>
<td>34</td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td>BRIANNE</td>
<td>8</td>
<td>11</td>
<td>13</td>
<td>13</td>
<td>45</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>JESSE</td>
<td>7</td>
<td>8</td>
<td>6</td>
<td>11</td>
<td>32</td>
<td>13</td>
</tr>
<tr>
<td>5</td>
<td>STEFEN</td>
<td>13</td>
<td>7</td>
<td>10</td>
<td>6</td>
<td>36</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>LAUREN</td>
<td>3</td>
<td>11</td>
<td>15</td>
<td>12</td>
<td>41</td>
<td>8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>55</td>
<td>52</td>
<td>56</td>
<td>62</td>
<td>54</td>
<td></td>
</tr>
</tbody>
</table>
Red Bead Bar Chart

• From Same Data

Number of Red Beads per Worker

Day and Worker
Bar Chart w/ Moving Average

- Now what do we see?
Bar Chart w/Colors

• Does this help?

Number of Red Beads per Worker

Day and Worker
Run Chart

- So what does this tell us about the variation?

![Run Chart Image]
Control Chart

• Now – do we see how this is different?
Calculating Upper and Lower Control

- **Standard Deviation**
  - is the Square Root of the Average ( Rounded) = 3.0

- **Upper Control Limit**
  - average + 3 Times the Standard Deviation
  - 9.3 + 3 Times 3.0 = 18.3

- **Lower Control Limit**
  - Average - 3 Times the Standard Deviation
  - 9.3 - 3 Times 3.0 = 18.3
  - **We are measuring occurrences – Zero (0) is Lower Control Limit**
Deming’s Red Bead Experiment Results

Record of the number of defective items by Willing Workers, per day. Lot size 50, each Willing Worker per day.

<table>
<thead>
<tr>
<th>Willing Workers</th>
<th>DAY 1</th>
<th>DAY 2</th>
<th>DAY 3</th>
<th>DAY 4</th>
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<tr>
<td>RICH</td>
<td>8</td>
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<td>RANDY</td>
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<tr>
<td>BRIAN</td>
<td>8</td>
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<td>7</td>
</tr>
<tr>
<td>MIKE</td>
<td>16</td>
<td>14</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>ALL 6</td>
<td>66</td>
<td>60</td>
<td>69</td>
<td>57</td>
</tr>
<tr>
<td>Cum x</td>
<td></td>
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</tbody>
</table>

\[
\bar{X} = \frac{252}{6 \times 4} = 10.5
\]

\[
P = \frac{252}{6 \times 4 \times 50} = 0.21
\]

\[
UCL = \bar{X} + 3\sqrt{\bar{X} (1-p)}
\]

\[
= 10.5 + 3\sqrt{10.5 \times 0.79}
\]

\[
LCL = \frac{19.14 - 1.86}{2} = 19 - LCL
\]

Wooden beads Census count, one by one
Total 4000
Red 800
White 3200
Inspectors: JIM & JOE
Recorder: COLLEEN
Inspector General: LORI

NASHVILLE, 14 NOV. 1990
WARREN, MI 15 JULY 1992
Red Bead - Source

1. What was the source of low performance by the workers?

The cause was red beads in the incoming material.

Get the red beads out of the system.

The system is a root cause – maybe the only single root cause.
2. What influence are the willing workers able to exert to improve quality?

The willing workers are helpless to improve quality in this system. They’ll continue to make red beads so long as there are red beads in the incoming supply of material.

The experiment is simple, but makes the point.

Now that you have seen it – you will see red beads (sources of trouble) everywhere in your organizations.

And elsewhere!
3. What is the source of the variation between lots and between workers?

Variation between lots and between workers arose from the system itself, not from the workers.
4. What can be said about predicting future performance based upon past performance?

The performance of anybody on any one day is useless as a basis for prediction of his performance on any other day.
Red Bead - Sources

• Mechanical sampling is not the same as sampling by use of random numbers

• Different charts can give us a limited view of where to look for special causes

• And they can mislead us into two basic errors:
  – Treating common cause as special cause
  – Treating special cause as common cause
The Red Bead Revolution

Acting On New Knowledge

What will we do with this lesson?
Deming’s **System of Profound Knowledge**  *Plus:*  Management & Leadership Transformation Process
Deming’s System of Profound Knowledge

- Appreciation for a System
- Theory of Knowledge
- Knowledge about Variation
- Psychology of Individuals, Society and Change
System of Profound Knowledge

• “The aim . . . is to provide an outside view - a lens . . . provides a map of theory by which to understand the organizations that we work in”

• Components of The Whole
  – Theory of Knowledge
    • Knowledge is built on theory
  – Appreciation for a System
    • A system is a network of interdependent components that work together to accomplish the aim of the system
  – Knowledge About Variation
    • There will always be variation.....
  – Psychology
    • Individuals
    • Groups
    • Society
    • Change

• “One need not be eminent in any part of profound knowledge in order to understand and to apply it”

• “The various segments of the system . . . Cannot be separated. They interact with each other. For example knowledge about psychology is incomplete without knowledge of variation.”
# SoPK Map

## Deming’s reference - with updates

### TIMELINE of PROFOUND KNOWLEDGE - IMPORTANT COMPONENTS

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<th>1900s</th>
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### KNOWLEDGE

- Realism of Pragmatism, John Dewey - 1905
- Mind & The World Order, C.J. Lewis - 1929
- How We Think, John Dewey - 1933
- Experiential Learning Theory, Carl Rogers - 1969
- Double Loop Learning in Organizations, Chris Argyris - 1974
- Adult Learning Theory, Malcolm Knowles - 1975
- Descriptive & Normative Learning Models, Carlile & Christensen - 2005

### PSYCHOLOGY

- Lewin’s Equation, Kurt Lewin - 1920
- Anthropological Theories Applied to Business, Edward Tolman - 1932
- Organizational Development, D. McGregor - 1950
- Human Side of Enterprise, D. McGregor - 1960
- Relationship Awareness Theory, Elias Porter - 1971
- Participation Management, Mary Parker Follett - 1925
- Socio-Technical System, Eric Trist, Tavistock Institute - 1951
- Maslow’s Hierarchy of Needs, A. Maslow Lee Ross - 1977
- Attribution Error, Friday's Side of Enterprise, D. McGregor - 1960
- Hawthorne Experiments, Elton Mayo - 1927
- Motivation Theory, Herzberg - 1968

### SYSTEMS

- Scientific Management, F. Taylor, Frank & Lillian Gilbreth - 1920s
- General Systems Theory, Ludwig von Bertalanffy - 1949
- Holistic Management, Stafford Beer - 1959
- Principles of Systems, Jay Forrester - 1968
- Creating The Corporate Future, Russ Ackoff - 1981
- Theory of Constraints, Eli Goldratt - 1990
- The Goal, Eli Goldratt - 1984
- Fifth Discipline, Peter Senge - 1990
- Open Systems, Fred Emery

### VARIATION

- Shewhart Control Chart, W. Shewhart - 1924
- Economic Control of Quality of Manufactured Product, W. Shewhart - 1931
- Statistical Method From the Viewpoint of Quality Control, W. Shewhart - 1939
- Sampling Methods Developed, H. F. Dodge
- Use of Statistical Methods to Support The War Effort 1941 to 1945
- Enumerative vs. Analytic Studies, W. E. Deming 1960
- Statistical Method From the Viewpoint of Quality Control, W. Shewhart - 1939
- Sampling Methods Developed, H. F. Dodge
- Use of Statistical Methods to Support The War Effort 1941 to 1945
- Enumerative vs. Analytic Studies, W. E. Deming 1960
Theory of Knowledge

• “One need not be eminent in any part of profound knowledge in order to understand and to apply it”
  • Management is prediction
  • Knowledge is built on theory
  • Information is not knowledge
  • Rational prediction requires theory
  • Interpretation of data from a test or experiment is prediction
  • There is a need for operational definitions
  • Enlargement of a committee is not a reliable way to acquire knowledge

• OPERATIONAL DEFINITION:
  • Knowledge is a statement which predicts a future outcome, built on theory, which can be proven by observation and measurements, with the risk of being wrong.
Knowledge is Built on Theory

- The theory of knowledge teaches us that a statement, if it conveys knowledge predicts future outcome, with risk of being wrong, and that it fits without failure observations of the past.

- Rational prediction requires theory and builds knowledge through systematic revision and extension of theory based on comparison of prediction with observation.

- The story that Deming used to illustrate this was that of Chanticleer the Rooster
Deming’s Theory of Knowledge

• Connected directly to the scientific method
• Based in science with stated theories –
  – Proven in actual practice and operation
• Compared to management that asserts opinion as fact, gut feel, hunches, fads and flavors of the month
  – Whether out of convenience or ignorance
• Rooted in the Pragmatist school of Philosophy
• Theories must satisfy two conditions
  – Must provide a satisfactory explanation of past experience, an explanation which is not contradicted by past experience
  – Must predict future outcomes in such a way that experience in the future may contradict the explanation
Deming Defined Knowledge

- Information is not knowledge

- Experience without theory teaches nothing

- A theory of knowledge in a statement, conveys knowledge if:
  - It fits without past observations of failures
  - Predicts future outcomes
  - Has a risk or possibility of being wrong
Understanding Systems

• “One need not be eminent in any part of profound knowledge in order to understand and to apply it”
• A system must have an aim
• The aim is a value judgment
• A system includes the future and competitors
• A system must be managed, it will not manage itself
• A system can not understand itself and needs guidance from outside
• The bigger the system, the more difficult to manage
• The greater the interdependence between components
  – The greater the need for cooperation between them
• Management must manage the interdependence
  – Between components
  – Towards the aim of the system
• Left to themselves, the components become:
  – Selfish,
  – Competitive
  – Thus destroy the system

• OPERATIONAL DEFINITION:
• A system is a network of interdependent components that work together to try to accomplish the aim of the system.
Deming’s System Chart

- Stage or Phase “0” Innovations feed the Process at Design & Redesign
- Stage “0” Generates Ideas

Deming’s use of this chart in Japan demonstrated the process as a system
Sub-Optimizing the System

- What’s in the system affects the system, what goes around comes around
- Focus on one part of the system only - makes the whole less optimal
- Every part is downstream in the system
- Human effects are everywhere in the system
Understanding Variation

• “One need not be eminent in any part of profound knowledge in order to understand and to apply it”
• There will always be variation in every thing
• Variation in common causes and special causes are to be understood
• Stable systems and their capabilities must be studied to be understood and appreciated
• Use of data about a system requires knowledge about the different sources of uncertainty and variation
• Use of data requires understanding of the distinctions between enumerative studies & analytic problems
  – Enumerative Studies = Information about the frame
  – Analytic Problems = Results of a test or experiment must be inferred
    • To a predicted future state
• The cost of mistakes of thinking and action
  – Fundamental Attribution Errors
  – Tampering

• OPERATIONAL DEFINITION:
• Numerical differences in measurable, observable characteristics of a process or product.
Knowledge about Variation

Result

Signal of special cause

Time

UCL

Center line

LCL

Dennis Sergent 517-285-5500 dsergent@srgnt.com - 07/09/2013 - Page 74
Knowledge about Variation

NOAA graphic – estimated from bubbles in Antarctic ice core samples
Knowledge about Variation

NOAA graphic with 2008 Mauna Loa Observatory sample added
Mistakes 1 & 2; Tampering

• There are two mistakes frequently made in attempts to improve results, both costly (Out of the Crisis, p. 318)
  – Mistake 1.
    – To react to an outcome as if it came from a special cause, when actually it came from common causes of variation
  – Mistake 2.
    – To treat an outcome as if it came from common causes of variation, when actually it came from a special cause

• Shewhart Control Chart - Minimum Net Economic Loss
• Tampering
Psychology of People

• “One need not be eminent in any part of profound knowledge in order to understand and to apply it.”
• Psychology helps understand people and the interactions between them
• Every person is different than every other person
• People are born with a natural inclination to learn
• People learn in different ways and at different speeds
• People are born with a need to be in relationships with others and need love, respect and esteem by others
• All people are motivated differently by extrinsic and intrinsic factors
  – See Daniel Pink “You Tube” Video
• Intrinsic and extrinsic sources motivate in much different ways
• Total submission to extrinsic motivation
  – Leads to destruction of the individual

• OPERATIONAL DEFINITION:
• Psychology is the science and study of the connections between mind and actions, to understand behavior and mental processes and thereby, solve problems in many different spheres of human activity
Psychology – of Individuals, society and change

- Positive Innate Attributes of People
- Intrinsic & extrinsic sources of motivation
- Over-justification
- Motivation and Motion (Hertzberg)
- One inherits a right to enjoy his work
Management’s Job

W. Edwards Deming

- Sponsor and energize the determination of the aim
- Clarify the aim for everyone in the organization
- Direct the efforts of all components toward the aim of the system
- Focus on a system of quality
- Manage the system
- Achieve the best results for everybody—everybody win
- Manage changes brought by time
- Predict, as far as possible, changes that time will bring
- Be ready to change the boundary of the system to better serve the aim
- Be ready to redefine the components of the system
- Imagination
- Govern their own future and not be victims of circumstance
- Change the course of the company and the industry by anticipation of needs of customers
- Learn that in order to compete, they must learn to cooperate
- Be guided by theory, not figures
- Recognize and manage the interdependence between components
- Resolve conflicts and remove barriers to cooperation
- Improve quality without running equipment and employees to exhaustion
Leadership & Motivation

“Management controls people by pushing them in the right direction; leadership motivates them by satisfying basic human needs.”

John Kotter, Harvard Business School, in What Leaders Really Do

The secret to motivating your team; stop demotivating them.

– What Motivates Us – By RSA and Daniel Pink
  • http://m.youtube.com/watch?v=u6XAPnuFjJc&desktop_uri=%2Fwatch%3Fv%3Du6XAPnuFjJc
Appreciation for a System

• Characteristics of the ball?
• Take your piece
• Make it the best you can
• Characteristics of the combined best pieces?
Expansion of Systems Thinking

Starting with this familiar map, let’s expand the foundations of systems thinking and see the connection into Deming’s description of the System of Profound Knowledge.

1610
Modern Science
Galileo

1872
Pragmatism
Charles Pierce & William James

1929
Integration of Pragmatism & Empiricism
C. I. Lewis

1959
Holistic Management
Stafford Beer

1933
How We Think
John Dewey

1957
Introduction to Operations Research
Churchman, Ackoff & Arnoff

1967
Concept of the Corporation
Peter Drucker

1990
Creating the Corporate Future
Russ Ackoff

1910
Inductive Learning
Francis Bacon

1912 - 1924
Scientific Management - Time & Motion Studies
Frank & Lillian Gilbreth

1946
General Systems Theory
Ludwig Bertalanffy

1971
Drucker on Management
Peter Drucker

1990
The M-Form Society
William Ouchi

1911 - 1915
Scientific Management - Time Reduction
Frederick W. Taylor

1937 - 1946

1929

1967

1990

What is a system?

- A series of functions or activities (processes, sub-processes, stages or components) within an organization that work together for the aim of the organization.
- “The components are necessary but not sufficient (alone) to accomplish the aim of the system”.

- There is interdependence between components of any system.
- The greater the interdependence between components, the greater the need for communication and cooperation between them.

Degree of Interdependence

Need for Communication and Cooperation
### Russ Ackoff on Systems

<table>
<thead>
<tr>
<th>Whole</th>
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<table>
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<td></td>
</tr>
<tr>
<td>Ecological</td>
<td>Social</td>
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</table>
• Consider the relationships and transactions with the organization
• Each stakeholder needs the organization to work well
• The organization needs the stakeholders to succeed also.
• **The key is development of value**
• It is movement from efficiency to effectiveness by developing value in the relationships
The Sea Otter Story - By Mike Beck

Fishermen

Sea Otter

Salmon

A Linear View

A Systems View

A Systems View Was Missing
The Sea Otter Story - By Mike Beck

Fishermen

Sea Otter

Salmon

A Linear View

A Dynamic Systems View

Fry

Salmon

Kelp

Sea Urchins

Sea Otter

Fishermen

Dennis Sergent
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07/09/2013
Why are we here?

• Learn
• Have Fun
• Make a Difference

This is how W. Edwards Deming opened his 4 day seminars! *(Even at 93 years old!)*
Quotes of W. Edwards Deming

- There is no substitute for knowledge.
- In God we trust; all others must bring data.
- The most important things cannot be measured.
- The most important things are unknown or unknowable.
- The most important figures that one needs for management are unknown or unknowable, but successful management must nevertheless take account of them.
- Experience by itself teaches nothing.
- By what method?... Only the method counts.
- You can expect what you inspect.
- The worker is not the problem. The problem is at the top! Management!
- The problem is at the top; management is the problem.
More Quotes of W. Edwards Deming

• *I think that people here expect miracles. American management thinks that they can just copy from Japan—but they don't know what to copy!*  
• *What is the variation trying to tell us about a process, about the people in the process?*  
• *A system must be managed. It will not manage itself. Left to themselves in the Western world, components become selfish, competitive. We can not afford the destructive effect of competition.*  
• *What is a system? A system is a network of interdependent components that work together to try to accomplish the aim of the system. A system must have an aim. Without an aim, there is no system. The aim of the system must be clear to everyone in the system. The aim must include plans for the future. The aim is a value judgment.*
Deeper Thoughts

• Knowledge is theory. We should be thankful if action of management is based on theory. Knowledge has temporal spread. Information is not knowledge. The world is drowning in information but is slow in acquisition of knowledge. There is no substitute for knowledge.

• To successfully respond to the myriad of changes that shake the world, transformation into a new style of management is required. The route to take is what I call profound knowledge—knowledge for leadership of transformation.

• They realized that the gains that you get by statistical methods are gains that you get without new machinery, without new people. Anybody can produce quality if he lowers his production rate. That is not what I am talking about. Statistical thinking and statistical methods are to Japanese production workers, foremen, and all the way through the company, a second language. In statistical control, you have a reproducible product hour after hour, day after day. And see how comforting that is to management, they now know what they can produce, they know what their costs are going to be.
Deep Thoughts

• (About Quality Circles) That's all window dressing. That's not fundamental. That's not getting at change and the transformation that must take place. Sure we have to solve problems. Certainly stamp out the fire. Stamp out the fire and get nowhere. Stamp out the fires puts us back to where we were in the first place.

• Taking action on the basis of results without theory of knowledge, without theory of variation, without knowledge about a system. Anything goes wrong, do something about it, overreacting; acting without knowledge, the effect is to make things worse.

• With the best of intentions and best efforts, managing by results is, in effect, exactly the same, as Myron Tribus puts it, while driving your automobile, keeping your eye on the rearview mirror, what would happen? That’s what management by results is, keeping your eye on results.
A Solemn Responsibility

- **W. Edwards Deming**
  - . . . You have taken on a solemn responsibility - and you can’t wriggle out of it.
  - We’ve got some big changes to make, and you’re going to have to make them. Who else will do it?

- **Martin Luther King, Jr.**
  - We are witnessing the birth of a new age and we must face the responsibilities that come along with it.
  - Shall we say the odds are too great? Shall we tell them the struggle is too hard? Or will there be another message, of longing, of hope, of commitment? The choice is ours.
Deming Connections to Lean: What Do You See?

1. PDSA
2. Dignity of Workers
3. Joy of Work
4. Get the Data
5. Systems & Processes
6. Collaboration
7. X
8. X
9. X
10. X
11. X
12. X

1. PDCA
2. Respect for People
3. Go To Gemba
4. Get the Data
5. Value Stream Maps
6. Collaboration
7. X
8. X
9. X
10. X
11. X
12. X
Wrap Up

• What are three new things you learned in this lesson?

• How might this learning help you in your role?

• What are three useful ideas for the future?
References & Resources

- **Accelerated Learning** - Dave Meier
- **Developmental Sequence in Small Groups** - Bruce W. Tuckman
- **Fourth Generation Management** - Brian Joiner
- **The Leader’s Handbook** – Peter R. Scholtes
- **On Purposeful Systems** – Russell Ackoff
- **On the Profession of Management** – by Peter Drucker
- **Orchestrating Learning with Quality** - by David P. Langford & Barbara A. Cleary, Ph.D.
- **Overcoming Organizational Defenses** - by Chris Argyris
- **Out of the Crisis** - by W. Edwards Deming
- **The Seven (7) Habits of Highly Effective People** – Stephen R. Covey
- **The Team Handbook** – Peter R. Scholtes, Brian Joiner, Barbara Streibel
More References

- **Business As Unusual** - Price Pritchett & Ron Pound
- **Circling Back – Clearing up myths about the Deming Cycle and seeing how it keeps evolving** - by Ronald D. Moen and Clifford L. Norman (PDF)
- **Design & Control of Quality** - by Ian Bradbury (PDF)
- **Entrepreneurial Thinking** - Dr. Melvin Gravely II
- **Here Comes Everybody - The Power of Organizing Without Organizations** - Clay Shirkey
- **How To Deliver on A Great Plan** - Neilson, Martin, Powers
- **The Last Lecture** - Randy Pausch with Jeffrey Zaslow
- **Secrets to Successful Strategy Execution** - Harvard Business Review
- **Seven (7) Stages of Small Business Success** - Carl Gould
- **The Talent Powered Organization** - Cheese, Thomas and Craig

Or

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Michigan Lean Consortium Learning Program

A History of Deming, the Red Bead Experiment and Lean

The Scientific Method Applied to Management and Leadership

Facilitated by Dennis Sergent
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