CQI Learning Lunch
Prediction Problems and Solutions

December 9, 2013
CQI Preview - 9:00 AM to 10:00 AM - Dial-In
Capital Quality & Innovation
Audio Bridge - Conference Access 1-567-314-9082
Conference Passcode 734 254 9433

CQI Learning Lunch - 10:30 AM to 1:00 PM - In Person
University Club of Michigan State
3435 Forest Road, Lansing, MI 48909
517-353-5111
An Introduction to Learning Lunch

- **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

- **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 through Quality**
  - Management Development – Philosophy, Principles & Practices
  - Professional, Quality Management Fundamentals
  - Excellent Operations & Methods
  - Profound Knowledge
Table Dialogues

At Each Table Discuss And Document:

• What do you think?
  – Becomes “What do WE think?”

• What have I experienced?
  – Becomes “What have WE experienced?”

• What are my next action steps?
  – Becomes “What are OUR next steps forward TOGETHER?”
Today’s Topic & Thesis

- **Prediction is how we satisfy our customer needs, owner needs, team member needs and those of other stakeholders.**
  - In both “for profit” and “not for profit” organizations
    - Productivity of the system is the challenge (not profit)
  - Managers must be able to have a theory about their system, using their subject matter expertise
  - They must accurately predict the performance of their system every day
  - If the trend is in the wrong direction, they must take action to improve
  - And avoid tampering with the system

- **Join us in a dialogue about the problems and solutions which help us predict and thereby manage our organization.**
  - We’ll explore our personal impacts on the team, system and performance
  - We’ll also review the fundamentals of prediction through process behavior or "control" charts.

- **And Ask The Question:**
  - **What is it that makes prediction both a problem and a solution?**
An Aim for Today

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

• **Make a difference**
  – We have been misled by being 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 theories, facts, PDSA Cycle
Outline of Concepts & Contents

• The “Red Bead Experiment” – has many lessons
  – The system is the problem, not the people
  – The manager predicted that people needed admonishments, rewards and punishments to meet the quota
  – The system produced an artificial scarcity of “best” performers
    • Who eventually became victims of the system
  – The data can mislead us all, if we do not create control charts
    • To distinguish between special cause and common cause
  – Managers responding to limited data can only tamper with the system
    • Wasting time and money and people by treating causes incorrectly
    • Relying on hunches, gut feel, SWAG or their “crystal ball”

• Prediction by effective managers is essential to manage the system
• Using control charts of all aspects of system productivity
  – Cycle time, Quality, Service levels, Cost, Revenue, Value
• Data from yesterday & today predict tomorrow accurately
  – Within Upper and Lower Control Limits
From Data to Wisdom

- Learning begins with questions we cannot answer and ends with questions we can. . .
  - Russ Ackoff

**ANALYSIS** yields **KNOWLEDGE**
- A pound of data is worth an ounce of information
- A pound of information is worth an ounce of knowledge

**SYNTHESIS** yields **UNDERSTANDING**
- A pound of knowledge is worth an ounce of understanding
- A pound of understanding is worth an ounce of wisdom
- A pound of wisdom is priceless

SYNTHESIS focuses on **FUNCTIONS** and **WHY** things work
ANALYSIS focuses on **STRUCTURE** and **HOW** things work
System of Profound Knowledge

- 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

- “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.”
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.
Understanding Variation

• 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.
W. Edwards Deming

• “You understand what a rational prediction is? It is one that you can explain.”

• “It is not easy, after all, to be told that the executive skills in which you take pride are misguided and short-sighted – simply wrong, in short”
Process Prediction and Possibilities

Four Possibilities for Any Process

- **Process is Predictable**
  - **Product Trouble**: Predictable Process with Too Much Nonconforming Product or Service
  - **No Trouble**: Predictable Process with Little or No Nonconforming Product or Service

- **Process is Unpredictable**
  - **Double Trouble**: Unpredictable Process With Too Much Nonconforming Product or Service
  - **Process Trouble**: Unpredictable Process with Little or No Nonconforming Product or Service

- **Too Much Nonconforming Product or Service**
- **Little or No Nonconforming Product or Service**
Unpredictable Processes?

“When a process displays unpredictable behavior, you can most easily improve the process and process outcomes by identifying the assignable causes of unpredictable variation and remove their effects from your process.”

— Donald J. Wheeler

• To remove these effects, you must remove the causes.
• To remove the causes, you must understand the system and interdependencies.
• You must talk to the people in the process
• Listen to what the process has been telling you through the variation.
• *The X-Bar Control Chart Will Help You Hear The Process*
Variation & Process Control Charts

• Pages 16 to 26 – Come from the CQI Academy of Quality Management Fundamentals
  – Materials from “Day 4 – Variation”
• Help us learn how to distinguish “Special Cause”
  – A signal that something in the system has changed
• We’ll look at a young man’s example of his school bus times
• We will explore the simple math and method to create upper and lower control limits
• Also we’ll look at some signals of special causes
What does a Time Plot say? Not enough!

Product Deliveries Late per Week

Percent Deliveries Late

Week
"You know that whether this dot is higher than that dot is of minor interest compared to the much more sophisticated questions, 'Is the system that produced this dot different from the system that produced that dot? Has the process changed or is it still the same process that produced this variation?' These are much more sophisticated, much more important questions..."

- Brian L. Joiner
The Patrick Nolan Story

<table>
<thead>
<tr>
<th>Name</th>
<th>Patrick Nolan</th>
<th>Process</th>
<th>School Bus Transportation</th>
<th>Characteristics</th>
<th>Bus No. 164, time the bus gets at my shop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective</td>
<td>To tell when I have to get to bus stop in the morning.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Range (R)</td>
<td>2 1 2 1 5 1 1 4 2 5 6 7 4 1 1 2 1 2 1 6 1 0 5 5 2 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes

Total = 480

\[ X = 18.46 \]

\[ \bar{R} = 2 \]

\[ \text{UCL} = 18.46 + (2 \times 3.14) = 18.46 + 6.28 = 24.74 \]

\[ \text{LCL} = 18.46 - (2 \times 3.14) = 18.46 - 6.28 = 12.18 \]
How Patrick’s Chart Was Created

1. Plot data in time order.
2. Calculate the average. Call this average X ("X - bar").
3. Determine the median of the ranges. Call this median R ("R ~ til-da").
4. Multiply the median of the ranges by 3.14.*
5. Add that result to the average to get the Upper Control Limit (UCL). Subtract the result from the average to get the Lower Control Limit (LCL).
6. Draw the centerline and control limits on the chart.

* Ask Dennis for a brief explanation of where the figure 3.14 comes from!
Notes on Control Charts

• Other formulas can be used to calculate the control limits
• The ones given here have proven very reliable even when we have data with special causes.
• The centerline is often drawn as a solid red line on a control chart
• The control limits are drawn as dashed green lines.
• These techniques make it easier to read the charts.
### School Bus Data and Control Chart Calculations

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<thead>
<tr>
<th>Minutes After 8:00 a.m. (X)</th>
<th>Range (R)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15</td>
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<td>2</td>
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<td>20</td>
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</tbody>
</table>

Total X = 480

Average (\(\bar{X}\)) = \(\frac{480}{26}\) = 18.46

Median (\(\bar{R}\)) = 2

Individuals Chart Centerline (\(\bar{X}\)): 18.46  
  UCL: 24.74
  LCL: 12.18

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Sponsored by

October 15, 2013  Dennis Sergent 517-285-550 - Page 21
Definitions

**Average** - The sum of all the data points divided by the number of data points.

**X** (pronounced X-bar) - A mathematical symbol for the average.

**Centerline** - The solid line on the control chart that shows where the average is.

**Median** - The middle point in a set of numbers. There are as many numbers higher than the median as there are lower.

**Range** - The difference between two data points. When used for this exercise, the range is always calculated for consecutive data points.

**Frequency** - The number of times a value occurs in the data (in this exercise, the frequency of the ranges is plotted).

**Median Range** - The middle point in the set of ranges. There are as many ranges higher than the median as there are lower.

**R** (pronounced R til-da, and written R tilde) - A mathematical symbol for the median range.

**Upper Control Limit** (UCL) - The dashed line on the control chart that shows the upper limit for common cause variation.

**Lower Control Limit** (LCL) - The dashed line on the control chart that shows the lower limit for common cause variation.
Distinguishing Special Causes from Common Causes

Special causes of variation can alter a process in different ways, some very obvious, others much more subtle. The challenge is finding patterns in the data that reliably indicate that a special cause has appeared.

As shown in the plot below, even a process with only common cause variation can have clusters of data points going up, going down, or alternating up and down.

Common Cause Data from Quincunx

For us to detect a special cause, therefore, we’d have to wait until we saw a pattern even more dramatic than these random clusters in common cause data.
Tests for Special Cause

The Tests for Special Causes listed below have been refined over the years to be very effective filters in separating the random patterns of common cause variation from patterns produced by special causes.

- 1 or more points outside the control limits
- 6 or more consecutive points all going up or all going down
- 8 or more points in a row all on the same side of the centerline
- 14 or more consecutive points alternating up and down

1 or More Beyond Limits

Run of 6

8 in a Row on Same Side of Centerline

14 or More Up and Down
Notes on Using Special Cause Tests

"When counting runs of points that are continuously increasing or continuously decreasing or runs that alternate up and down, skip over any points that exactly repeat the preceding value."

Dennis Sergent
517-285-550
"When counting for 8 or more on the same side of the centerline, skip over any points that fall exactly on the centerline."
Deming’s System Model

- 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, starting in the 1950’s
Your Role As Manager & Leader

• Create a positive workplace environment:
  – Demonstrate:
    ✓ Trust / Competence
    ✓ Professionalism / Commitment
    ✓ Positive intent
    ✓ A balanced heart and mind approach
  – Show respect to employees.
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
The Psychology of the PDSA

• The brain responds to the routine
  – To do things automatically, without thinking
  – When in control, people do not resist changes of their own design
  – When is self-directed change, alterations become acceptable
  – And when it is imposed - look out!

• Change alters familiar routines and habits
  – The brain likes habits & stores them in the basal ganglia
  – The orbital frontal cortex is a sort of “error detector”
  – With PDSA, brain changes prepare for active changes
What is Your Aim?

Use your PDSA Cycle and 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?
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.

**Plan**

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

**Do**

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

**Action**

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

**Study**

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

**Check (Study)**

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.

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

1. Individuals’ respond to either
   a) biological urges or;
   b) rewards and punishments

2. Rewarding an activity will get
   you more of it. Punishing an
   activity will get you less of it.

3. Setting goals for people will
   boost performance

4. Behavior fueled by external
   motivation delivers fast
   results

5. Performance goals are
   generated with the intent to
   cause desired results

6. Assign multiple or frequently
   changing objectives

1. Human beings seek autonomy, mastery and purpose.

2. There are seven deadly flaws resulting from carrots and sticks. They can:
   1. Can extinguish intrinsic motivation
   2. Diminish performance
   3. Crush creativity
   4. Crowd out good behavior
   5. Encourage cheating, shortcuts and unethical behavior
   6. Become addictive
   7. Foster short-term thinking

3. Goals may cause systemic problems for organizations due to narrowed
   focus, unethical behavior, increased risk taking, decreased cooperation,
   and decreased intrinsic motivation.

4. Intrinsically motivated people achieve more in the long-term, especially
   when mastery (the urge to make progress and get better at what we do)
   is important

5. Groups with learning goals (which lead to mastery) outperform
   performance-goal groups on novel challenges

6. Top performance [mastery] results from working longer without
   switching objectives

From Daniel Pink’s book “Drive”
References & Resources

• Accelerated Learning - Dave Meier
• The Brain & W. Edwards Deming - Elaine B. Johnson, Ph.D.
• Drive – Daniel Pink
• Fourth Generation Management - Brian Joiner
• The Leader’s Handbook - Peter R. Scholtes
• The New Economics, 2nd Edition - by W. Edwards Deming
• 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 Team Handbook - Peter R. Scholtes, Brian Joiner, Barbara Streibel
• Understanding Variation - Donald J. Wheeler
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?
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.
Prediction – Problem and Solution?

- Success/Highlight
- Key Learning

- Improve
- Next Steps
CQI Learning Lunch

Prediction Problems and Solutions

December 9, 2013

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