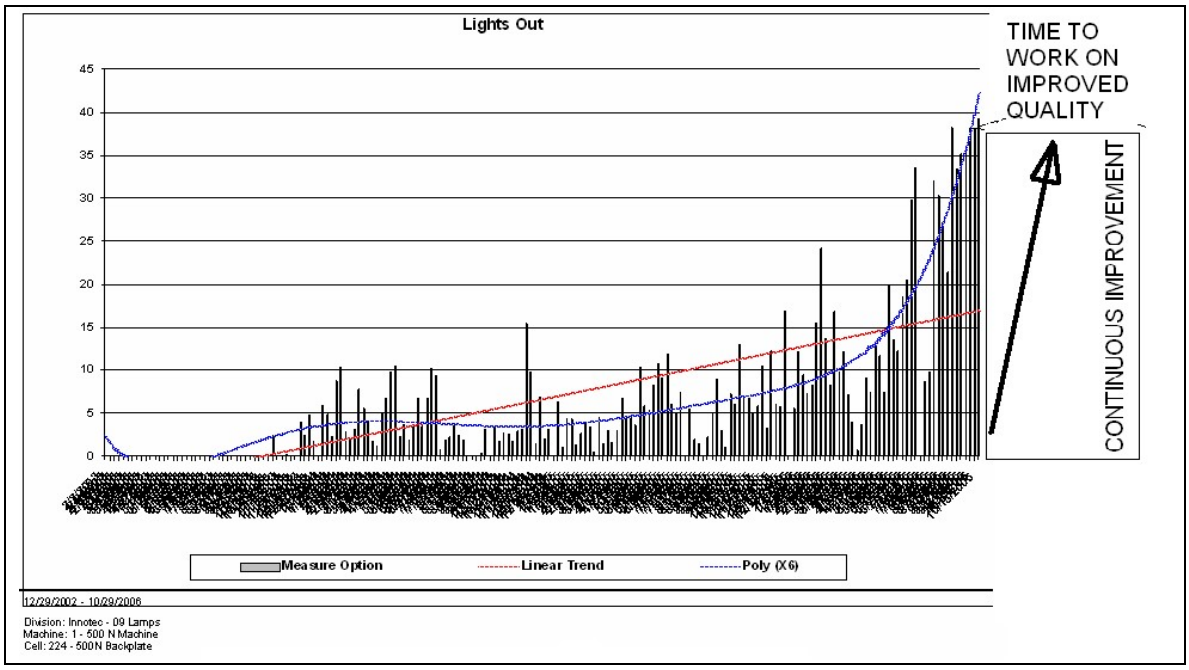
IMPROVING QUALITY & PROFITABILITY AT COMPANY X

Through Continuous Improvement



The graphic shown above should give the idea of climbing a mountain.

The climb to quality is like a journey of climbing a tall mountain. It cannot be done in one day and it is not easy, but it can be done.

This class presents one way to accomplish it.

Instructor: Kraig D. Schultz
Draft Revision: 2-16-07

IMPROVING QUALITY & PROFITABILITY AT COMPANY X

Course Content/Outline

1) **Introduction:**
   a) How are we doing? Quality and Profitability
   b) Introduction of "Profound Knowledge"

2) **Profound Knowledge: Appreciation for a System**
   a) Red Bead Experiment Video
   b) Big Picture Thinking

3) **Profound Knowledge: Knowledge about Variation**
   a) Red Bead Experiment Explained Video
   b) Common and Special Causes
   c) Drive Time Example

4) **Profound Knowledge: Theory of Knowledge**
   a) Funnel Experiment Video
   b) PDCA
   c) How vs. Why
   d) Knowledge Transfer Mechanisms

5) **Profound Knowledge: Psychology**
   a) Deming Video: The Optimization of a System
   b) Importance of People Skills
   c) 6 Practical Tools

6) **A Disciplined Approach to Process Improvement at Company X**
   a) Steven Covey Video on being Proactive: Potato Farmer Video
   b) 14 Disciplines

7) **Achieving 0 PPM & Profitability**
   a) SPC leads to lower costs and more Innovation
   b) Poka-Yokes are required for 0 PPM

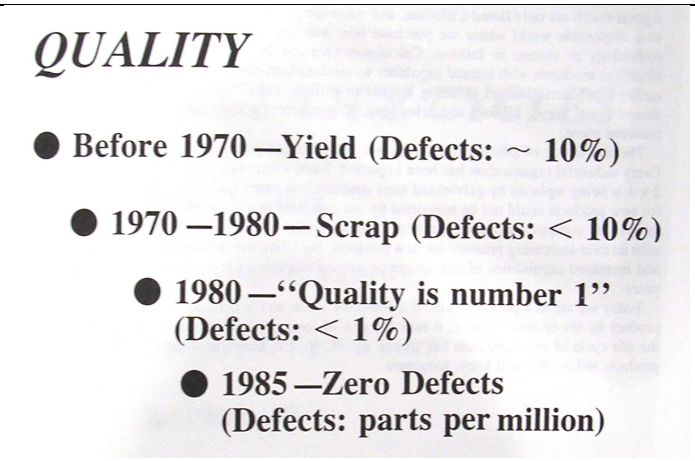
8) **Recommended Reading**

1.0 INTRODUCTION: How are we doing?

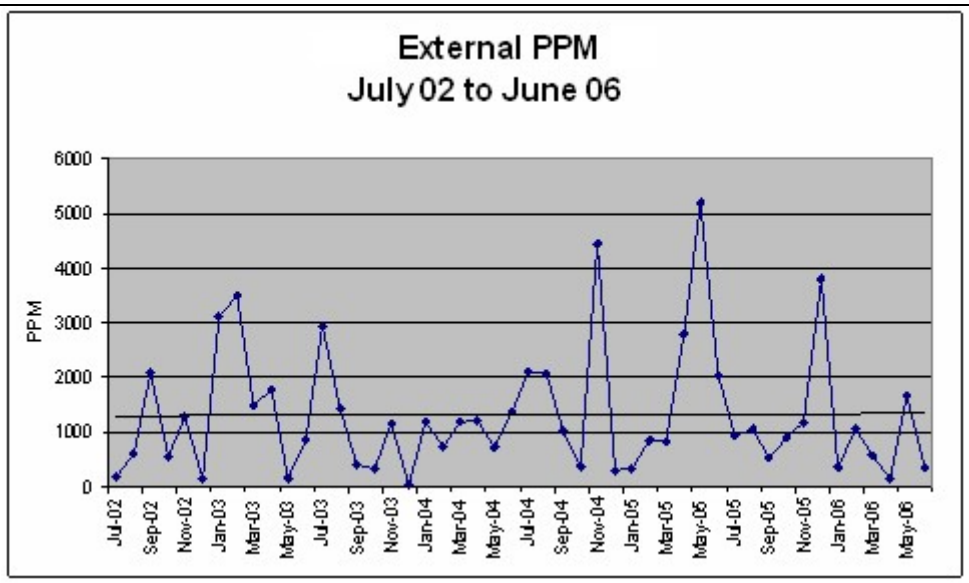
QUALITY (EXTERNAL PPM)

EPPM: External Defective Parts Delivered to Customer Per Million Parts Delivered

- Our customers expect 0 EPPM
- World Class EPPM is 0-9 EPPM (single digit PPM)
- Company X Averages over 1,000 EPPM
- Our EPPM is not improving over time



p.5, The Race, Eliyahu M. Goldratt and Robert E. Fox

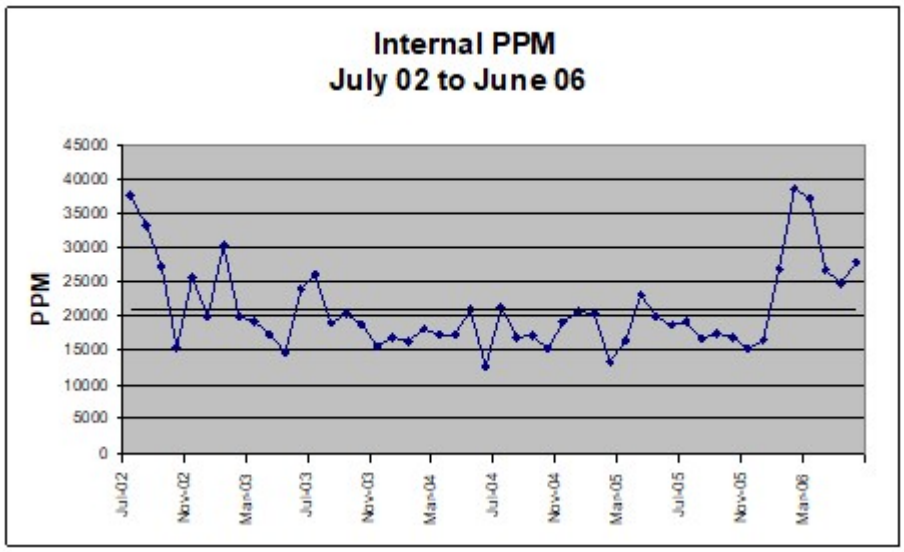


This Chart shows data for Global Company X EPPM from July 2002-May 2006

QUALITY (INTERNAL PPM)

IPPM: Internal Defective Parts Produced Per Million Parts Produced

- Company X Averages over 20,000 IPPM
- 20,000 IPPM = 2% Scrap
- Our sales revenue in 2006 was $58,000,000
- 2% of $58 Million is $1,160,000
- Our IPPM is not improving over time

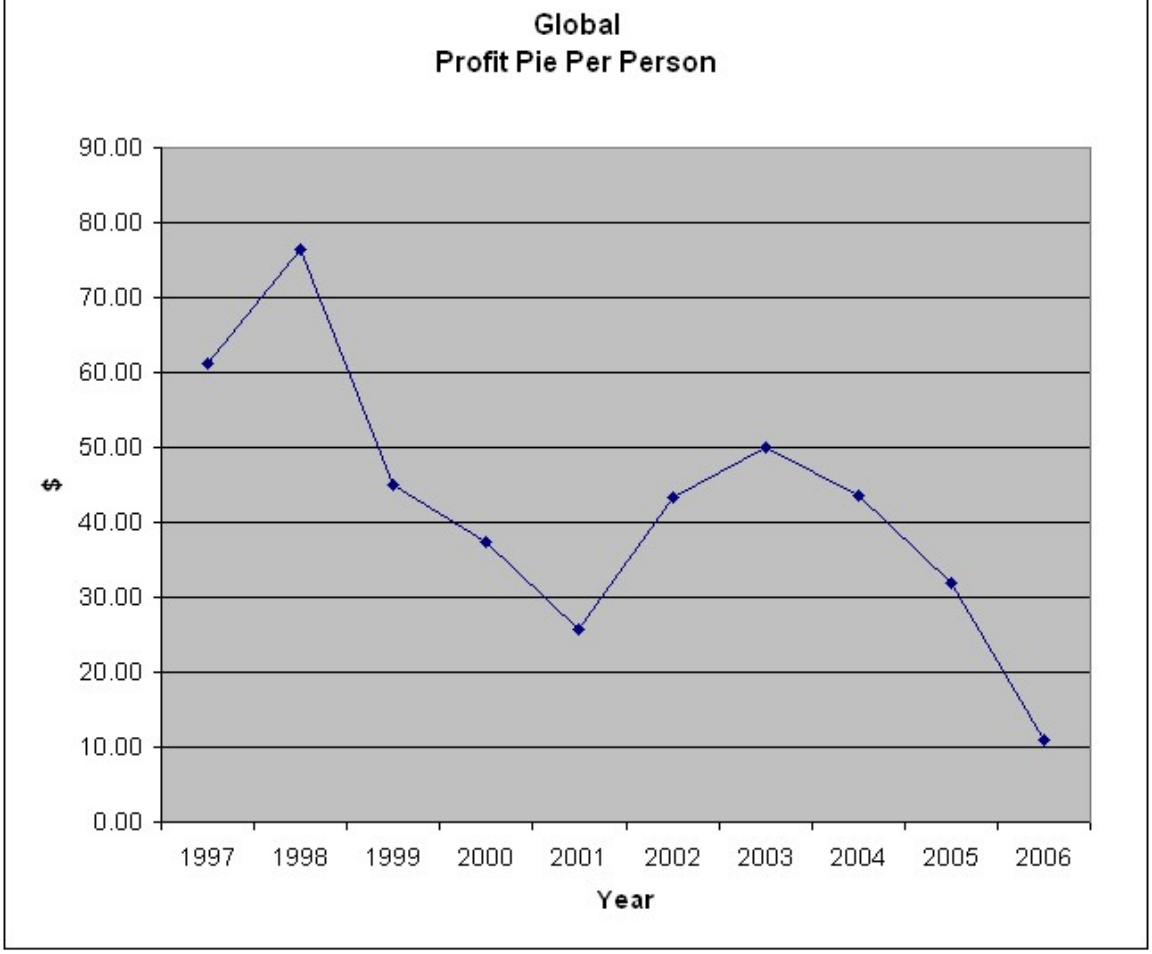


This charts shows global Company X performance for IPPM July 2002-June 2006

PROFITIABILITY (PPpP)

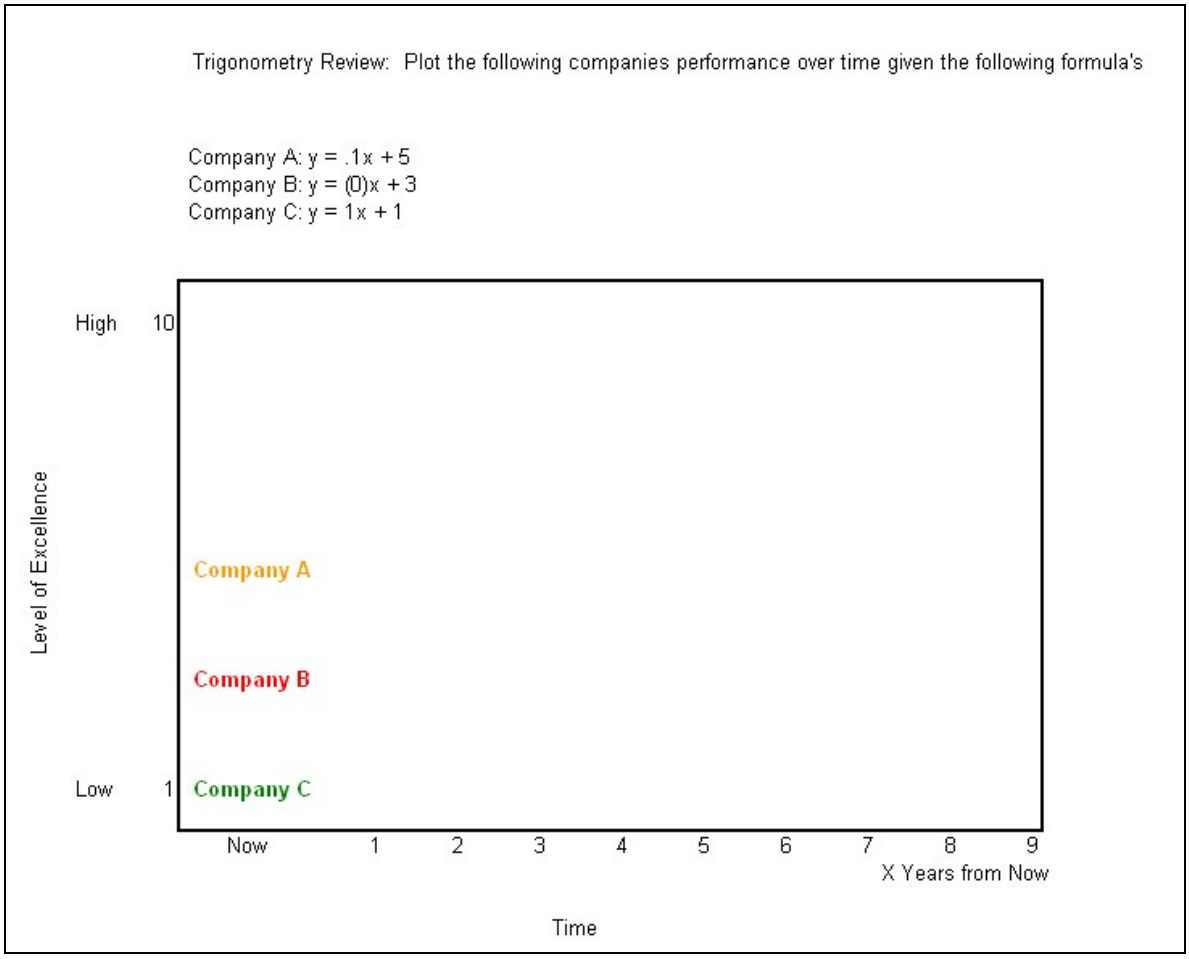
PPpP: There is a certain, fixed percentage of our total financial profit that is allocated to be used for employee bonuses. We divide this portion of the profit pie by the total number of full-time employees to determine the "Profit Pie per Person".

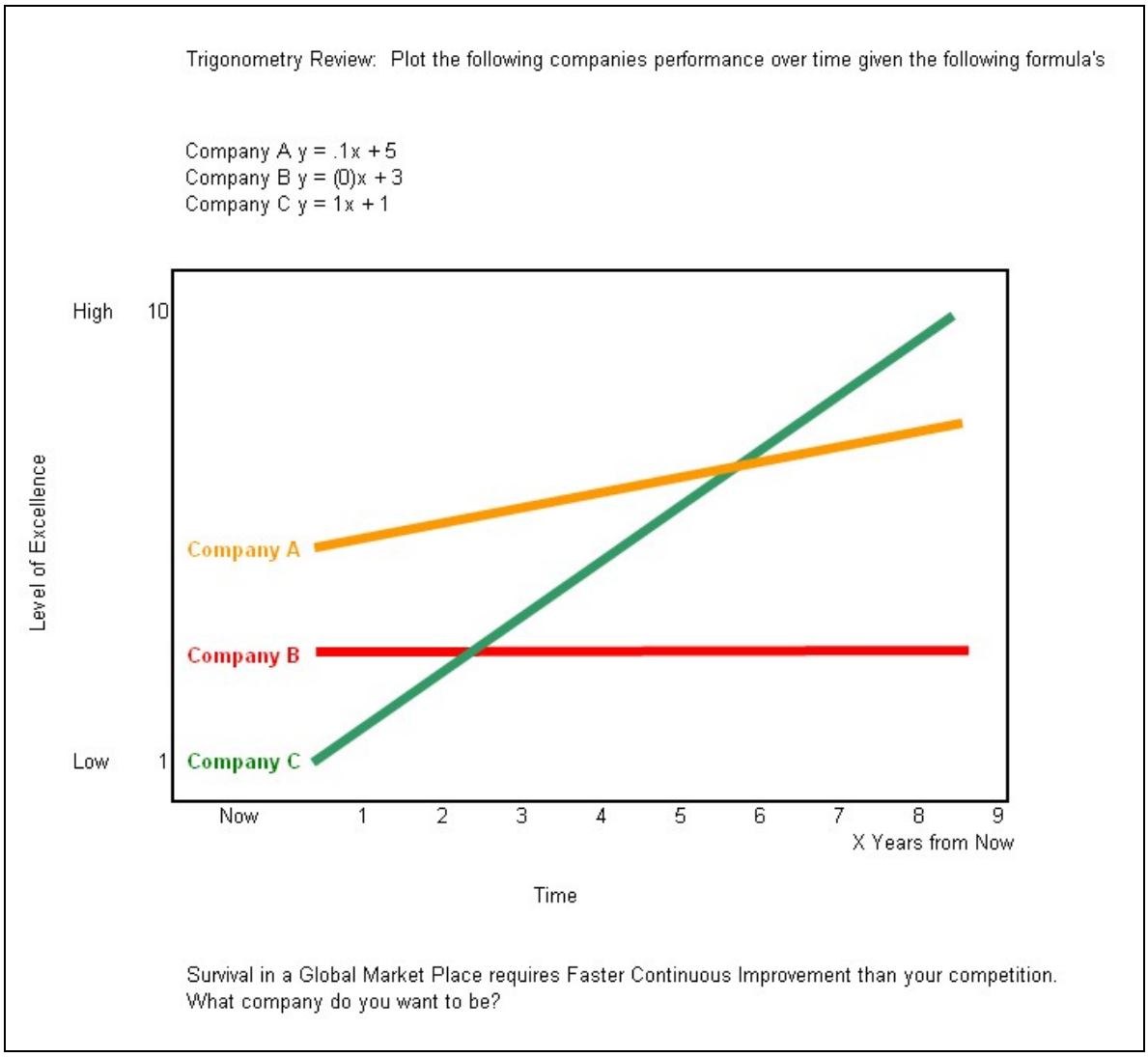
- Our PPpP is not improving over time



The chart above shows Profit Pie per Person over the last 10 years.

Concept of Continuous Improvement: If you are not improving, you are falling behind.





The slope of the line (rate of improvement) is the most important factor for predicting success in the future. This helps us understand why copying "best practices" without understanding how to improve is not a good long term strategy for success. Best practice today, will not be best practice in the future. We must learn how to improve rapidly if we want to stay ahead of our competition.

"If we are not improving, we are falling behind."
Author Unknown

Why isn't our Quality and Profitability improving over time? Are poor quality and low profitability related?

We know that poor quality wastes money. But, more importantly, solving quality problems also leads to substantial improvement in efficiency, productivity and customer satisfaction. This is true because, to improve a process we must understand the process *better* than the person who originally designed it! Once we understand it better, we are primed for more innovation.

Albert Einstein said, "The significant problems we face cannot be solved at the same level of thinking we were at when we created them."

"The significant problems we face cannot be solved at the same level of thinking we were at when we created them."
Albert Einstein

How can we improve our level of thinking?

W. Edwards Deming suggested that the ability to improve requires knowledge of four topics which he said constitute "A System of Profound Knowledge".

Dr. W. Edwards Deming's System of Profound Knowledge

1. **Appreciation for a System**
2. **Knowledge About Variation**
3. **Theory of Knowledge**
4. **Psychology**

Each of the elements of profound knowledge interact like a legs of a four-legged table. You can't separate any one of the elements without understanding its relationship to the other three. But, "one need not be eminent in any part nor in all four parts in order to understand it and to apply it." Deming, New Economics 2nd Ed., p. 93

In this class, we attempt to combine Deming's System of Profound Knowledge (class 2-5) with practical advice for day to day activities (class 6-8) in the belief that this learning will help us improve our quality and profitability.

This class is a primer for getting your head around the BIG PICTURE (philosophical) issues related to improving quality and profitability at Company X. Greater depth into problem solving can be gained by continuing your studies in various problem solving classes offered by the Problem Solving CR team.

CLASS DISCUSSION: How do we track quality and profitability at the cell level? Do we trust our numbers? Are we happy with our performance? Would we like to get better?

RECOMMENDED READING: Related to Profound Knowledge; The New Economics, by Edwards W. Deming

2.0 Appreciation for a System

System Thinking is big picture thinking. System thinking is seeing the forest and the trees.

To understand how a system works we must have knowledge of the components that are part of the system, the relationship between the components (input/outputs) and the interaction between the components (interdependencies, feedback loops, etc.).

A system diagram is a pictorial diagram that helps us do this. A Road Atlas is very simple system diagram.

CLASS EXERCISE: Discuss possible ways to travel from Zeeland, MI to New Orleans for a service trip. Provide a road atlas.

QUESTIONS:
Who is going? For how long? For what purpose? What supplies will you need to take with you? What travel method is best (walk, bicycle, personal car, rental car, Amtrak, Airplane, etc.).
Is any travel method right or wrong? Are some better than others?
What route will we take?
Is it easier to start with individual state maps or an entire region map?
Is any route wrong or right?

TAKE AWAYS: The result of this conversation is a "system" for traveling from Zeeland to New Orleans. A system starts with a definition of a purpose (in this case a list of possible ways to travel from Zeeland to New Orleans).

The "success" of the travel system is not the result of moral decisions (right or wrong), but rather choices between various options. Most systems are designed with good intent. People design systems with the best data they have available and make decisions hoping to achieve the purpose in the "best" way.

PREFACE TO VIDEO:
The manager in the following video is NOT a bad guy! He is doing lots of good things. He represents the way of doing business that has given us the highest standard of living in the History of mankind! You will see him do many things we consider to be good management. He is providing jobs, training, numerical goals, performance reviews, he gives encouragement and when necessary negative feedback. The workers are not confused about what job they are supposed to be doing. The manager is open to questions.

Think of yourself as the Manager in the video. You are training a new Intern in your cell at Company X. The willing workers are like new employees at Company X. Or, if you'd like, consider the willing workers to be your robots and automation. You teach them what to do, they do exactly what you tell them to do. Think of the Red Bead Experiment as your cell.

CLASS EXERCISE: View Red Bead Experiment Video

CLASS DISCUSSION: What did you think? Is this how we manage our cells at Company X?

Does your process consistently make bad parts? Do you tell your new intern to avoid making/shipping bad parts? Do we count our bad parts and record data about the bad parts?

DOES THE RED BEAD EXPERIMENT APPLY TO COMPANY X?

I have heard it from several people, this video doesn't apply to Company X because “we don't have managers at Company X”.

That is NOT Demings point. His point is that every company has a SYSTEM of management (formal, documented, or informal and undocumented), and that the SYSTEM of Management is the strongest factor impacting the PERFORMANCE of the system.

At the division level, our system of management includes the following items:

- Our Vision and Values
- Our CR system that involves 150 people where “normal” companies use 10-15
- Our focus or lack of focus on Level 5 leadership
- The way we hire inexperienced engineers and train them.
- The way we share human resources between cells
- Our Launch Procedure (Design/Build/Debug Equipment in-house verses purchasing Turnkey equipment)
- Our tolerance (or passion) for risk when quoting and launching new business
- Our tooling/equipment standards

At the cell level, our system of management includes the following items:

- Cell Leader
- Cell Responsibilities
- The Monthly Scoring system
- The way we share resources between cells
- The way we document our processes

At Company X, the “manager” has been replaced with a CR system. The problem with the manager was not that he was evil. He did not have evil intent. No, he was trying to help; he was doing his best with the training, knowledge and skills he had. The problem was that the manager lacked appreciation for a system which led him to blame the workers for low performance when the performance belonged to the system of management.

It is a natural human tendency to want to find a person on whom to place blame. By getting rid of the “manager”, we have not eliminated the root cause of the problem. In fact, with the CR system we may have introduced an additional problem of rampant tampering or “overcompensating”. We will cover tampering in session #3.

Our performance is the result of our system. If we would like to improve our performance, we must improve our system. Therefore, the most important thing we can do as leaders is seek to understand our system: how it works, its inputs/outputs, its performance and understand that our system is not us, our system is what we have created.

I firmly believe that the only limit to our growth is our ability to learn and improve.

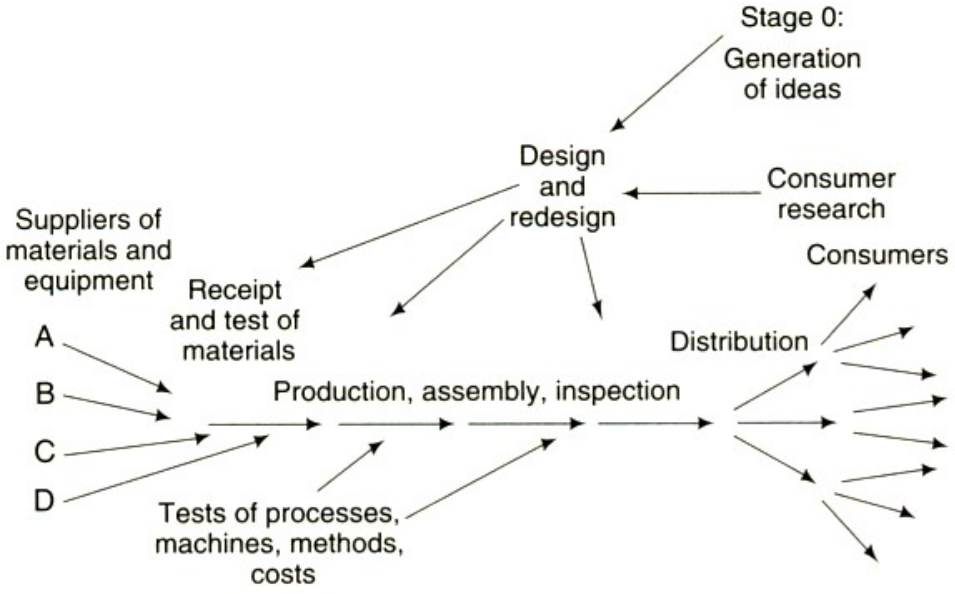
We must all understand the big picture or we will make changes that might be good for a single cell or group of people but have disastrous effects for the entire company. How does your activity support the operation of the company? A system diagram showing the entire system and our role in it is invaluable for driving system level continuous improvement.

Systems thinking helps us understand that the performance of the system is the result of the system and cannot be affected by people working within the system. Please note I did NOT say that people are powerless to improve. Improvement requires people to work on the system.

"The bottom line of systems thinking is leverage—seeing where actions and changes in structures can lead to significant, enduring, improvements. Often, leverage, follows the principle of economy of means: where the best results come not from large-scale efforts but from small well-focused actions. Our non-system ways of thinking are so damaging specifically because they consistently lead us to focus on low-leverage changes: we focus on symptoms where the stress is greatest. We repair or ameliorate the symptoms. But such efforts only make matters better in the short run, at best, and worse in the long run." The Fifth Discipline, By Peter Senge, copyright 1990, Currency and Doubleday, p. 114

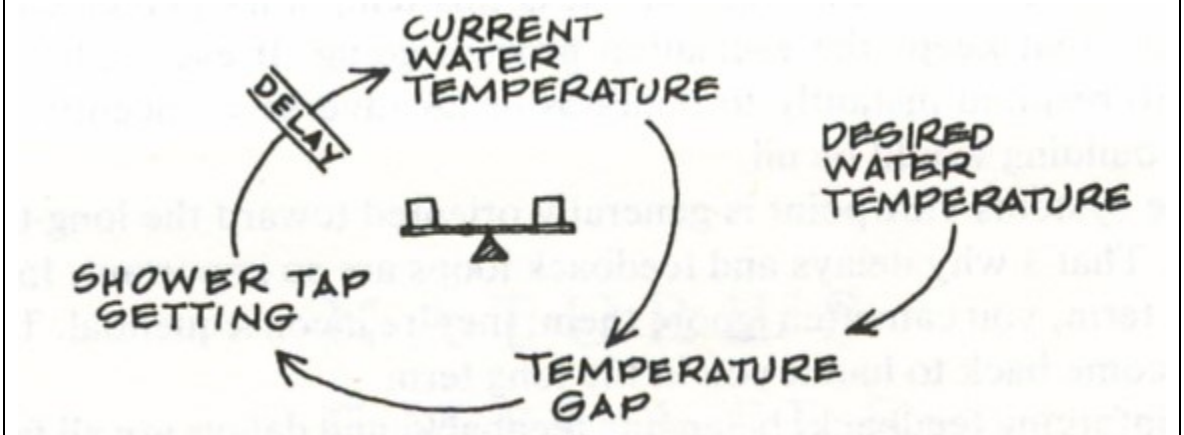
For example, to get better machine efficiency or uptime, we can focus on "fixin the fastest". Often, having good numbers today comes at the expense of better performance tomorrow and in the future. The culture of a company is a "systemic issue". If we are numbers driven without regard to the entire system, we can lose focus on the very reason we are here.

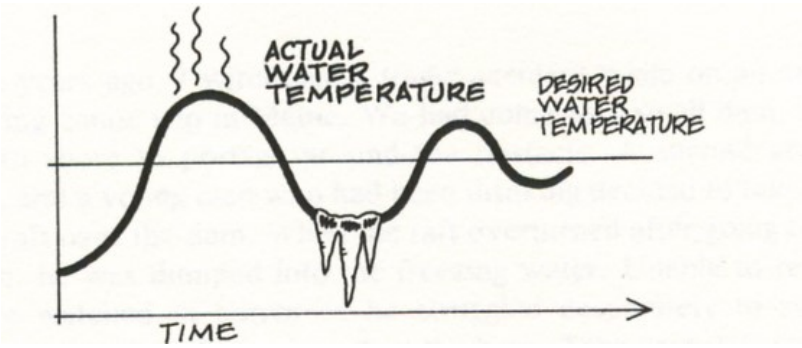
System Level Diagram



Source: Out of the Crisis, p. 4, ©1986, W. Edwards Deming, MIT Press

Simple System Diagram





Source: The Fifth Discipline, p.91, ©1990 by Peter M. Senge, Doubleday Currency

Understanding the inputs and outputs and the inner-workings (delays, balancing cycles, etc.) of a system via a diagram or a mental model provides a big picture view that is often required to make substantial or break-though improvements.

Until we understand the relationships between various activities we really cannot understand *why* things work. This limits our ability to effect change and improvement.

"The idea that most problems are due to the system or process and not to the individual worker is not new. By the early 1950's Dr. Joseph M. Juran had found in studies in a wide variety of companies than an average of only 20% of the production-level problems turned out to be worker-controllable…As long as we personalize problems—think about them only in terms of who is at fault—we're going to continue to have them, because the causes more likely reside in the system than in a person. Blaming people is a low-yield strategy for improvement; the biggest opportunities, the biggest leverage, lie in improving our work processes." P. 34, Forth Generation Management by Brian Joiner

Tim Ball a consultant said, "I've found that I can take five problems from anywhere in a company, and if I push deeper and deeper, I find that they all stem from the same core issues." P. 36 Joiner

"The good-to-great companies built a consistent system with clear constraints, but they also gave people freedom and responsibility within the framework of that system. They hired self-disciplined people who didn't need to be managed, and then managed the system, not the people."
p.125, Good To Great, Jim Collins

RECOMMENDED READING: Related to Systems Thinking; The 5th Discipline by Peter Senge

HOMEWORK: Can you draw a system diagram of Company X? Where is your role at Company X shown on the diagram?

3.0 **Knowledge About Variation**

CLASS EXERCISE: View Red Bead Experiment Explained Video

There is variation in everything. Fortunately, God has placed us in a predictable world and we can expect that given the exact circumstances, the exact same thing will occur. When I was a young engineer I often hoped that when we found a bad part it would be the only bad one we found. I've never been that lucky.

The single most important requirement for learning and improvement is the ability to perceive our environment truthfully. Variation is predictable and understandable if we have knowledge and use the tools we have available. In 1931, Walter Shewhart published a book entitled, "*Economic Control of Quality of Manufactured Product".* In this book, he shared his research and how to use a new tool named "S.P.C." (Statistical Process Control) that allowed us to perceive unbiased truth about our systems.

Properly calculated control limits on the Shewhart control chart provide unbiased advice for good decisions by leadership. A control chart gives us reliable advice on when to act and when to NOT act (and what type of action is required). Without this tool we must rely on "common sense", "horse sense" or "gut" feelings. These are nice methods when we are "right", but very damaging when we are wrong. Wouldn't it be nice to have a method that allows for correct decisions 99% of the time?

Let us compare two approaches to variation: The first is comparison to specifications the second is the use of Shewharts control chart.

<u>Comparison to specifications</u> seeks to compare data to numerical goals and judge whether performance is good or bad based on these limits. The specifications are "The Voice of the Customer". From a practical stand-point, pleasing the customer is always a good idea and "the customer is always right "(even when they are wrong).

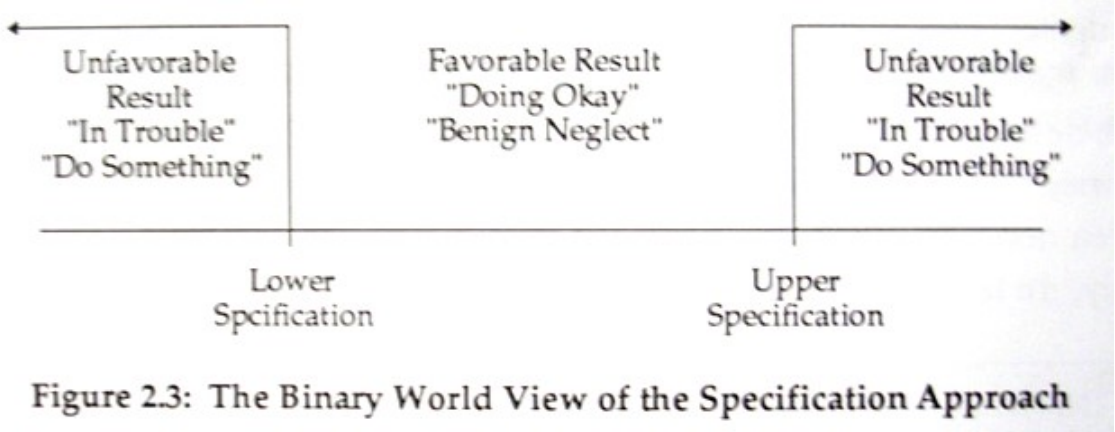


Figure 2.3: The Binary World View of the Specification Approach

p. 17 Understanding Variation

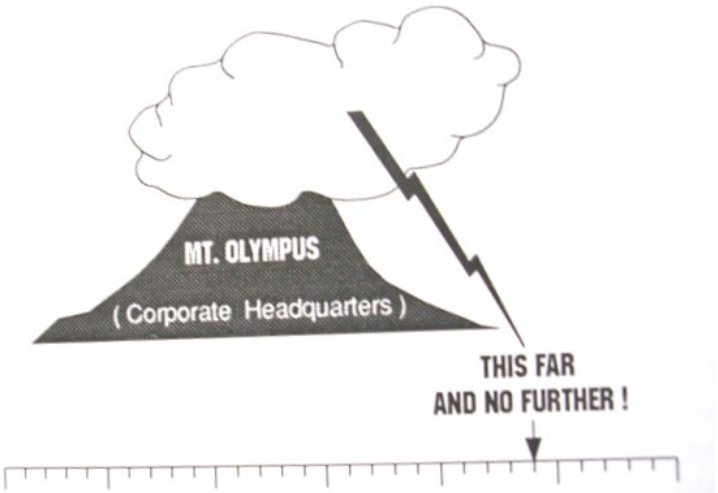


Figure 2.4: The Origin of Many Specifications

p. 19 Understanding Variation

Comparison to specifications gives feedback, we know if we are doing GOOD or BAD, but in either case it gives us no insight into what we should do to get better.

Using Control Charts allows us to hear the Voice of the Process. From the control chart below we would know that "looking for differences between the "good" and the "bad" days will simply be a waste of time". P. 25 Understanding Variation, Wheeler

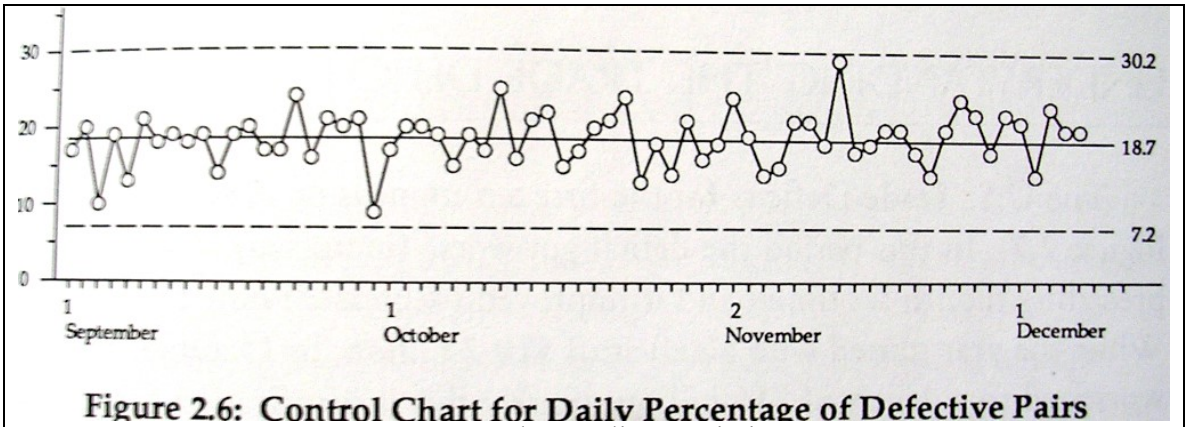


Figure 2.6: Control Chart for Daily Percentage of Defective Pairs

p. 25 Understanding Variation

QUOTES FROM UNDERSTANDING SPC BY DONALD WHEELER:

SOURCES OF VARIATION:

p. 9-10 "Common Causes (Chance Causes) of variation in a production process are causes of variation that exist because of the manufacturing system, or the way that system is managed. They arise out of the process, or out of the way the process is organized and operated. Because they are part of the system, they are the responsibility of the ones who control the system: the managers, and specifically, the top level of management. Common causes of variation can only be removed through action by management.

Special Causes (Assignable Causes) of variation are causes that are localized in nature. They are not part of the overall system, and should be considered as abnormalities. Often they will be specific to a certain operator, a certain machine, or a certain batch of material."

THE EFFECT OF ENTROPY
p. 18-20 "…there is a universal force acting on every process that will cause it to move in a certain direction. That force is entropy. It continually acts upon all processes to cause deterioration and decay, wear and tear, breakdowns and failures.

Entropy is relentless. Every process will naturally and inevitably migrate toward the State of Chaos. The only way this migration can be overcome is by continually repairing the effect of entropy. Of course this means that the effects for a given process must be known before they can be repaired. With such knowledge, the repairs are generally fairly easy to make.

On the other hand, it is very difficult to repair something when one is unaware of it. But if the effects of entropy are not repaired, it will come to dominate the process, and force it inexorably toward the State of Chaos.

Thus, a dual problem confronts every manufacturer. He must be able to identify both the effects of entropy and the presence of assignable causes…

The only way a manufacturer can ever meet the dual objectives of overcoming this barrier and counteracting the effect of entropy is by the use of the process control chart. No other tool will consistently and reliably provide the necessary information in a clear and understandable form.

Therefore, any process operated without the benefit of process control charts is ultimately doomed to operate in the State of Chaos."

"Why are costs up? What are you doing about it? Why are revenues down? What are you doing about it?...If you don't know whether it's a common or special cause, a better moto would be 'Don't just do something—stand there!' It won't create rapid improvement, but at least you won't actively be making things worse." P. 127, Forth Generation Management by Brian Joiner

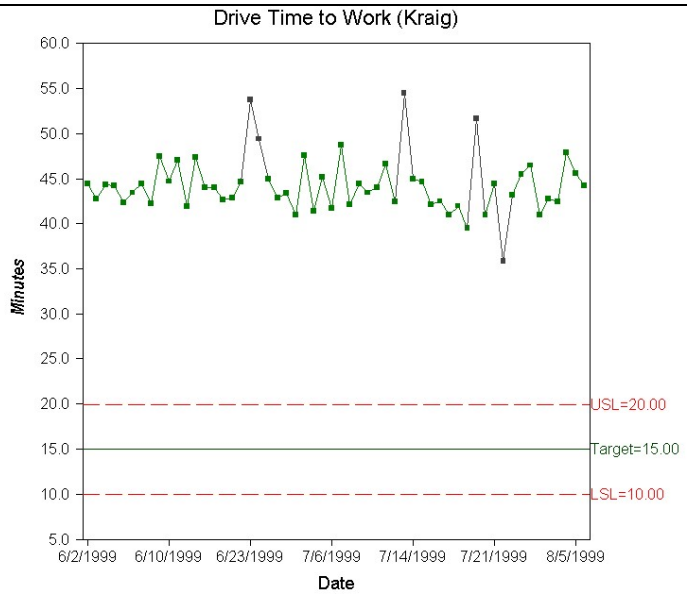
Graph from p. 173, Forth Generation Management, by Brian Joiner

SPC works! S.P.C. should stand for Statistical PROFIT Control. Control charts could be used by top management to help us maintain global competitiveness. Unfortunately, SPC is underutilized because American managers like to feel like they are in control (they like to tamper), when in fact, our system of management is the dominate factor controlling our performance. Control charts reveal that tampering is actually destructive and that lasting improvement requires leadership (knowledge, discipline, patience, teamwork, communication, shared vision, etc.).

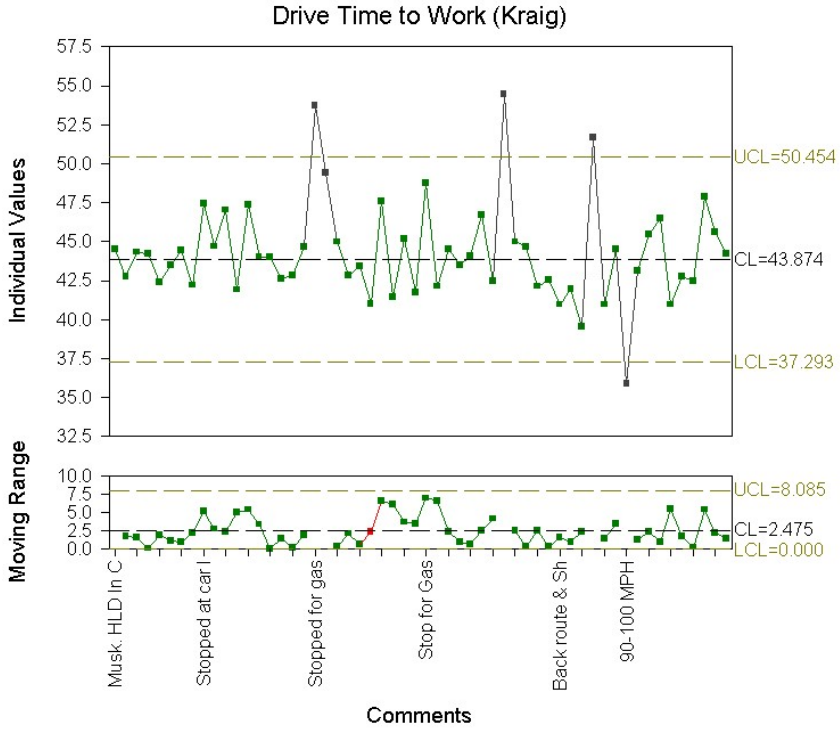
CLASS EXERCISE:
Most of us commute to work by driving ourselves there in an automobile. Trying to improve commute time is a perfect way to learn about statistical process control. It gives us an opportunity to operate within a system where we think we have complete control over our drive time.

I have learned that my optimum commute time is 10 to 20 minutes. A shorter commute deprives me of the joy of "getting out", a longer drive time is boring and/or wasteful of my time. So, I have set a goal of achieving a 10-20 minute commute.

The following charts contain actual commute time data I collected while driving myself to work. Note: During this time I was trying to reduce my drive time.



Drive Time Compared to Specification Limits



Drive time compared to Statistical Control Limits

CLASS DISCUSSION:

Given the data, do you think I was happy with my actual commute time?

On average, was I successful at improving my drive time?

Is the process "in statistical control"?

Is the process capable of making me happy?

What is the best that I should expect from this process?

Based on this data, how much time should I allow for my commute so that I will never be late for work?

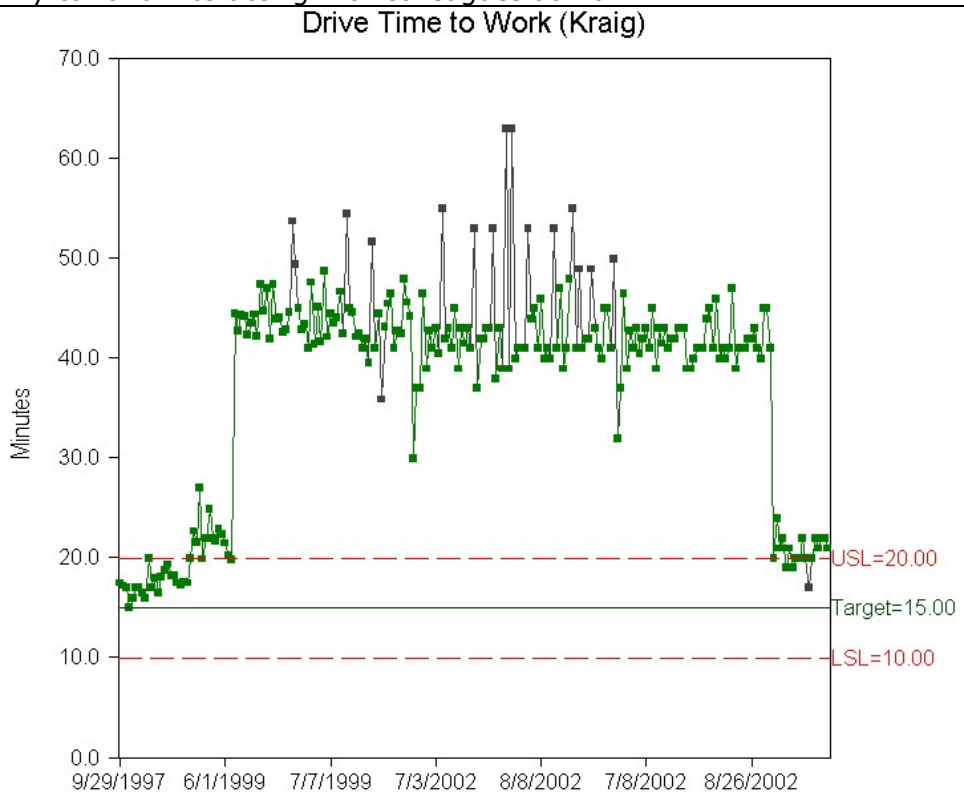
CLASS EXERCISE: Brainstorming. How can I reduce my drive time to work?

MORE DATA:

I found no way to improve my average drive time to work other than by changing the system. The two most effective system changes I've been able to implement were to change where I worked and to move closer to work. Of the two, changing jobs was the easier of the two.

Changes that did not work included driving aggressively and trying harder. Changes that I did not attempt include changing the speed limit, and/or using a helicopter or jump-jet.

The chart below doesn't include data for the time period where I completely eliminated my drive time by working at home. After a few months, I began to miss driving my car and interacting with colleagues at work.



RECOMMENDED READING on Variation for Engineers and "Slugs":
Understanding Variation: The Key to Manageing Chaos by Donald Wheeler

RECOMMENDED READING on Variation for Engineers only:
Statistical Process Control (SPC) Reference Manual, 2nd Edition, AIAG, July 2005

HOMEWORK: Plot your monthly cell score on a control chart. Is your cell score in statistical process control? If yes, what does this mean? If no, what does this mean? An Excel Workbook with a control chart for doing monthly scores can be found at the following location: N:\Corporate Responsibilities\Quality Culture\Improving Quality Class Notes\Control Chart for Monthly Scores.xls

BONUS MATERIAL:

Rules for determining if a process is in "Statistical Control" when using a control chart (from p. 107 Understand Statistical Process Control, Wheeler):

RULE 1: A lack of control is indicated whenever a single point falls outside the (three-sigma) control limits on either the average chart or the range chart.

RULE 2: A lack of control is indicated whenever at least two out of three successive values fall on the same side of, and more than two standard deviations away from, the central line.

RULE 3: A lack of control is indicated whenever at least four out of five successive values fall on the same side of, and more than one standard deviation away from, the central line.

RULE 4: A lack of control is indicated whenever at least eight successive values fall on the same side of the central line.

4.0 **Theory of Knowledge**

CLASS EXERCISE: View Funnel Experiment Video

"The alternatives to management by knowledge - such as superstition, luck, hoping and wishing, copying examples without understanding (e.g. benchmarking), following tradition for its own sake - tend to take away value." Mike Makepeace

"If you had automotive experts pick the world's best engine, best transmission, best axle, best everything from the cars of the world, and you assembled all those best parts, the car wouldn't work. The parts are not designed to fit together, so there is no worthwhile interaction of the parts, and the world's best car parts will not make the world's best car. If it ran at all, it would be pure luck." P. 41 Thinking aobut Quality.

"Don't confuse success with success. You've got to ask yourself, 'How much better could it be?'" Dr. Deming

"Part of knowledge is the ability and the willingness to question what you are certain that you "Know". As Deming said, "We 'know' so much that isn't so." …"clinging to what we "know" is what helps hold us back now." Thinking about Quality p64

At the cell level, improving a manufacturing process is relatively easy because we have the ability to "see" the entire system. We have the ability to change the rules, to agree on common goals and to test our theories (we have designed a system we can control and learn from)! The alternative is where every operator in a cell does his job his own way. In this case, we don't have a system, we have anarchy. Without a system, there can be no learning and without learning there is no opportunity for improvement.

THEORY OF KNOWLEDGE:

1. You must have a theory (Plan)
2. You must have a way to test your theory (Do)
3. Given data from your experiments you must revise your theory (Study)
4. You must apply what you've learned (Act)

Ideas for Practical application :

A. Define and Agree on a Common Vision
B. Agree that while there are many possible methods to achieve that Vision, but we are going to test one method at a time
C. Agree on the method to use (develop the Rules of the game)
D. Use that method (Discipline, Accountability, Follow the Rules)
E. Measure performance
F. What did we learn?
G. Apply learning and/or Repeat process starting at step C.

Figure 3

PDSA – The Shewhart Cycle of Improvement

You ***Plan*** a change, an improvement, something you think will work. Planning is where you spend your time. If the experiment isn't panned correctly, you many not find out what you want to know. As much as half of the time available goes into planning.

You experiment; that is, you ***Do*** what you planned, and you do it on the smallest scale possible to limit the damage in case you're wrong. If you are pushing for the greatest possible improvement in the shortest possible time, sometimes you will definitely be wrong. You'll only be harmed if you've made this a universal test.

Study the results. Did you get what you hoped you'd get? What did the test demonstrate? Be careful not to read into the results what you wanted or hoped to find.

Finally, you ***Act*** on your study. You either put the improvement into effect, or modify it and start the cycle all over a with another plan, or throw the whole thing out, march back to square one, and start again.

From Thinking About Quality – Progress, Wisdom, and the Deming Philosophy by Lloyd Dobyns and Clare Crawford-Mason, Random House, Copyright 1994

1. PLAN:
    a. Gain Knowledge of process (what is going on? Work in the cell for a while. Observe. Take notes. Start forming ideas about what is painful, wasteful, yucky... Observe inputs and outputs
    b. Create operational definitions. What is scrap? What is good, what is bad? How will we measure it? How will we record data?
    c. Is same procedure being followed by all workers?
    d. Do brainstorming. Ask why, why, why? Ask former cell members.
    e. Create Cause and Effect diagrams.
    f. Form a theory about why things work the way they do
    g. Design experiment to test theory
    h. Use SPC Charts to start learning about the process. What does the control chart tell us about or sources of variation (do we have common or special causes)? Do we have a system (Is everyone using the same method)? A system can be improved. Without a system, there is chaos & improvement is impossible. "Before one can improve any system one must listen to the voice of the system (the voice of the process). Then one must understand how the inputs affect the outputs of the system. Finally, one must be able to change the inputs (and possibly the system) in order to achieve the desired results. This will require sustained effort, constancy of purpose and an environment where continual improvement is the operation philosophy." From Understanding Variation, The Key to Managing Chaos by Donald J. Wheeler
2. DO:
    a. Conduct a short term experiment to test theory
    b. Collect data (Capability Studies, SPC Charts, Linear Regression Analysis, etc.)
3. STUDY (CHECK):
    a. Does data support theory?
4. ACT:
    a. Implement permanent changes to process or start over.

Biblical Principles:

Chaos results from lack of leadership: "In those days Israel had no king; everyone did as he saw fit." Judges 21:25 NIV

Rate of Learning is Important: "We have much to say about this, but it is hard to explain because you are slow to learn. In fact, though by this time you ought to be teachers, you need someone to teach you the elementary truths of God's word all over again. You need milk, not solid food! Anyone who lives on milk, being still an infant, is not acquainted with the teaching about righteousness. But solid food is for the mature, who by constant use have trained themselves to distinguish good from evil." Hebrews 5:11-14 NIV

We must apply our knowledge: "You foolish man, do you want evidence that faith without deeds is useless?" James 2:20 NIV

Process Improvement:

Process improvement is the result of learning about our processes, understanding inputs and outputs… We learn about our processes by doing controlled experiments. We monitor our performance while holding certain variables constant and varying others.

"We keep 'solving' these problems and reinventing the same wheels because we lack effective mechanisms for *learning*. And without effective learning, we lack sufficient knowledge to *improve rapidly*." P. 44, Brian Joiner, Forth Generation Management.

Some process measures we use at Company X:

- Efficiency – Machine, People
- Lights Out
- Monthly Cell Scores
- PPM
- Cycle Time
- Uptime

CLASS EXERCISE: _____, How is your Efficiency? Is it good enough? *Who* defines "good enough"? How do you know? What's your goal? Having a goal is not enough. What are you planning to do about it? By what method? Remember trying harder, working longer has already been tried. It doesn't work. You must know what you are doing. There is no substitute for knowledge.

Examples from 500N Backplate Cell

How do we gain knowledge? Where do we start? I don't know. I suspect every cell is different, but let me tell you where we started in my cell. Every few minutes it would stop running because something fell off it or broke. I found it hard to be concerned about quality; I was too busy running around my machine trying to keep it running.

We had problems keeping up with production, meetings, shared resources, vacations, service time, etc. The biggest question on a daily basis was, "Do we have enough parts for tomorrow's shipment?" This was a very important question because if we did not have enough parts it meant we could not go home. Working lots of overtime for free is not an enjoyable experience and is a strong motivator for improvement. Unfortunately, at the very time we needed to be working on proactive activities (e.g. projects, 5 year fixes), we didn't have time or resources to do the work.

PARETO PRINCIPLE
(Definition from *Wikipedia)*

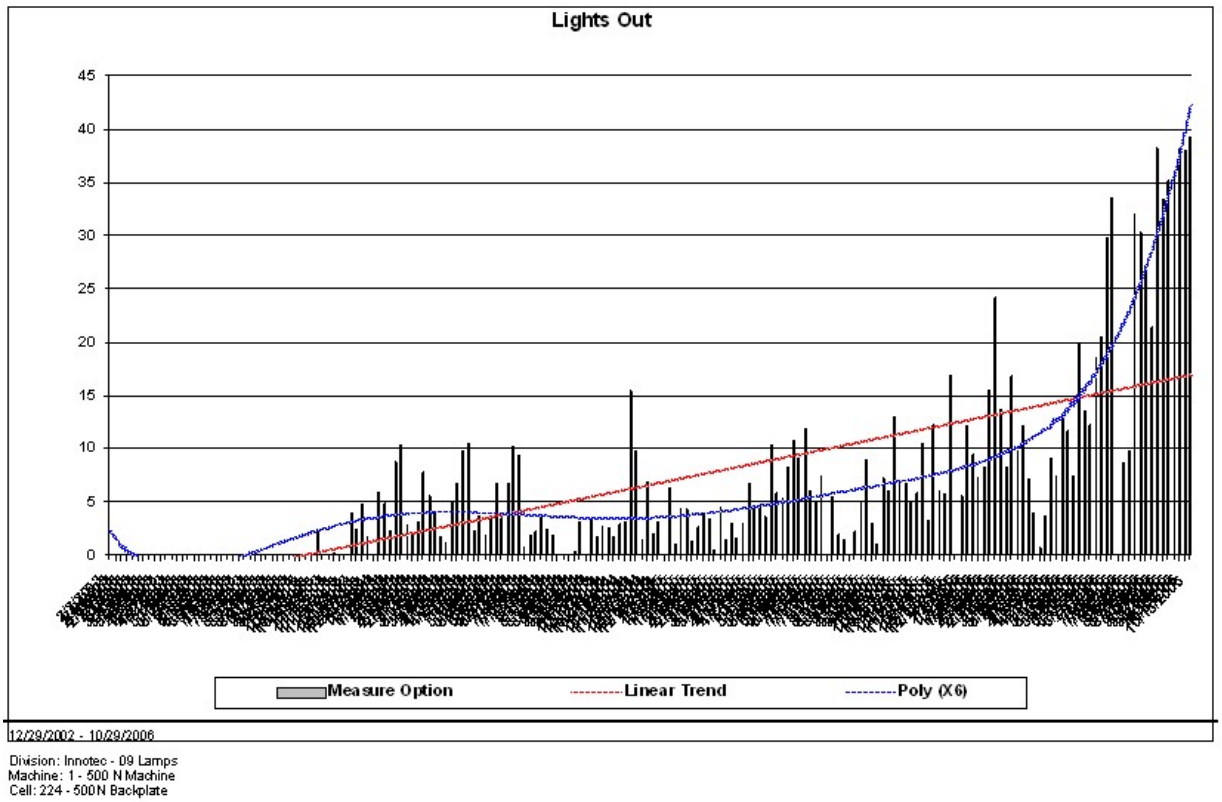
The Pareto principle (also known as the 80-20 rule, or the law of the vital few and the trivial many) states that for many phenomena, 80% of the consequences stem from 20% of the causes. This is an useful leverage tool because it provides a way to prioritize activities.

We used the Pareto Principle to significantly improve our reliability. We had 7 really big downtime issues.

Problem	Frequency / Day December 2005	Frequency/Day December 2006	X Improvement
1. Circuit Die Jamming	5	.5	10X
2. Switch Bowl Jamming	10	1	10X
3. Tote un-loader jamming	5	1	5X
4. Circuit Placement on Mold by Robot	5	.5	10X
5. Think and Do Bugs	5	1	5X
6. Reflectors Mis-Placed	10	.1	100X
7. Machine Constantly falling Apart	3	.1	30X
TOTAL	43/day	4.2/day	10X
Reliability is commonly measured as Mean Time Between Failure (MTBF) MTBF is directly related to how long your machine will run in L.O.	43/day / 12 hours = 3.8 / hour = 16.7 minutes MTBF	4.2/day / 12 hours = .35 / hour = 171 minutes MTBF	

By reducing the frequency of these 7 items we've achieved the improvement shown on the following chart:

Cell 224 (500N Backplate) Lights Out performance January 2003→ October 2006:



THOUGHTPOINT: PARETO PRINCIPLE IN LIGHT OF SYSTEMS THINKING

"In configurations of dependent variables, the Pareto Principle take the form of 0.1/99.9 rule. Just a fraction of a per cent is responsible for almost all the end result. In common practices…it is always recognized: "The strength of a chain is only as strong as the weakest link. There are no two "weakest:" the number of constraints is very limited and restricted by the number of independent "chains" in our organization." Theory of Constraints, p. 124 Eli Goldratt

Systems thinking will allow us to focus on the .1% of the problems and achieve orders of magnitude improvements in performance.

The opposite is also true. We can fix thousands of problems and see very little improvement in the performance of the total system. The difference in performance between approaches comes from lack of system thinking and lack of knowledge. Our relative lack of knowledge is a direct result of our ability to learn.

TRAINING NEW EMPLOYEES (and the importance of HOW and WHY)

How did you do it? Well, when I turn this knob, the problem goes away. Learning *how* to make a problem go away is not enough. You must understand *why*. This is why worker training worker often results in loss of knowledge unless the focus of training is on *why* something works.

True Story:

When I was 2 years out of college I tutored a co-worker who was taking night classes. He was taking an algebra class and in spite of studying 20-30 hours per week in preparation for each test, he was failing the class.

It took several tutoring sessions before I figured out what his learning problem was. He was memorizing how to solve each problem instead of memorizing the rules for solving the equations!

In the study of algebra, a person can memorize how to solve an algebra equation, but unless he learns the rules of algebra, when one thing changes in the equation he will be lost.

Figure 5
Solve for y: 5x + 10 – y = 6

It's a lot quicker to have someone memorize the steps to solving a single equation, as shown in figure 5, than it is to teach them algebra! Unfortunately, the problem in Figure 6 will also need to be memorized along with an infinite number of other combinations. Learning 20 rules is easier in the long run than trying to memorize infinite combinations! One is possible, the other is not.

Figure 6
Solve for y: 10 – y = 6 – 5x

When we train a new cell mate to run a machine, are we teaching them how and why? How are we retaining knowledge in our cell when employees leave?

RECOMMENDED READING: For Theory of Knowledge; The Fifth Discipline by Peter Senge

HOMEWORK: Is your cell "robust" to loosing all it's knowledge? What could be done to make your cell "turn-key" for a new operator off the street (That's right, zero training hours required to run an Company X machine!)?

Recommendations for Further Development of Problem Solving Skills: Company X offers Various Problem Solving Classes through the Problem Solving CR (e.g. PS 102 8D/Pareto/Cost of Quality, PS103 MSA, Fishbone, PS204 SPC/Control Charts).

5.0 Psychology

IMPROVEMENT AND HUMAN PSYCHOLOGY

CLASS EXERCISE: Deming Video: Optimization of a System via Cooperation

"So much of what we call management consists of making it difficult for people to work." Peter Drucker p. 275 The 8th Habit, Covey

We have work that needs to get done (the right work as defined by the other 3 areas of profound knowledge). Understanding human psychology helps us understand how to inspire people to get it done. The three other parts of profound knowledge are based on logic. But logic alone will not get the job done. Human action is required and human actions are motivated by feelings.

"Dealing with people is probably the biggest problem you face, especially if you are in business…" Research done by the Carnegie Institute of Technology... "revealed that even in such technical lines as engineering, about 15 percent of one's financial success is due to one's technical knowledge and about 85 percent is due to skill in human engineering—to personality and the ability to lead people." Dale Carnegie, How to Win Friends and Influence People P.18

What if we had a pill that we could take that would allow us to operate in perfect harmony with each other? No more egos, no more fear, no more misunderstanding or fighting or arguing? What if we could all grab the same rope and all pull in the same direction? We could move the planet!

MIFROG is the financial answer to how fast we can grow. But financial knowledge is not what limits our growth! What limits our growth is our ability to work together. How can we overcome this resistance? We don't need more technical knowledge, we need more people knowledge. We need to understand how we think and how our emotions affect our thinking. We need more understanding of psychology

"We have grown up in a climate of competition between people, teams, departments, divisions, pupils, schools, universities. We have been taught by economists that competition will solve our problems. Actually, competition, we see now is destructive. It would be better if everyone would work together as a system, with the aim for everybody to win. What we need is cooperation and transformation to a new style of management." W. Edwards Deming, Forward to The New Economics.

John 13:34-35 "A new command I give you: Love one another. As I have loved you, so you must love one another. By this all men will know that you are my disciples, if you love one another." Jesus

Deming, The New Economics 2nd Ed., p. 107-108.

"Psychology helps us to understand people, interaction between people and circumstances, interaction between customer and supplier, interaction between teach and pupil, interaction between a manager and his people and any system of management.

People are different from one another. A manager of people must be aware of these differences, and use them for optimization of everybody's abilities and inclinations. This is not ranking people. Management of industry, education and government operate today under the supposition that all people are alike."

The most important concept in human psychology is that we are all different. Fundamentally, God has given each of us unique interests, talents, and capacities. This God-given diversity creates the opportunity for happiness and great accomplishment.

1 Corinthians 12:14-19 "Now the body is not made up of one part but of many. If the foot should say, "Because I am not a hand, I do not belong to the body," it would not for that reason cease to be part of the body. And if the ear should say, "Because I am not an eye, I do not belong to the body," it would not for that reason cease to be part of the body. If the whole body were an eye, where would the sense of hearing be? If the whole body were an ear, where would the sense of smell be? But in fact God has arranged the parts in the body, every one of them, just as he wanted them to be. If they were all one part, where would the body be? As it is, there are many parts, but one body." NIV Bible

Servant leaders ask, "How is it going?...What are you learning?...What are your goals?...What are you trying to accomplish?...How can I help you?" p 260-261 The 8th Habit, Steven Covey

Seven Powerful Tools That Can Help Overcome Human Resistance to Change

1. SPC Charts
2. Win-Win Thinking
3. Socratic Method
4. Fly-Wheel Effect (Modeling)
5. PDCA Cycle
6. 6 Thinking Hats
7. Story Telling

1. SPC Charts (White Hat)

How do we counter human irrationality? An SPC Chart does wonders! When we plot data on a chart over time, we learn that luck, hope, numerical goals, false beliefs, etc. will not change the output of the system. A SPC chart frees us to be honest with ourselves about the true performance of our processes.

Deming "The most important application of the principle of statistical control of quality, by which I mean knowledge about common causes and special causes, is in the management of people."

2. Thinking Win-Win

"Win/Win is a frame of mind and heart that constantly seeks mutual benefit in all human interactions. Win/Win means that agreements or solutions are mutually beneficial, mutually satisfying. With Win/Win solutions, all parties feel good about the decision and feel committed to the action plan. Win/Win sees life as a cooperative, not a competitive arena. Most people tend to think in terms of dichotomies: strong or week, hardball or softball, win or lose. But that kind of thinking is fundamentally flawed. It's based on power and position rather than on principle. Win/Win is based on the paradigm that there is plenty for everybody, that one persons' success in not achieved at the expense or exclusion of the success of others. Win/Win is a belief in the Third Alternative. It's not your way or my way; it's a *better* way, a higher way." The Seven Habits of Highly Effective People, p. 206, copyright 1989, Stephen R. Covey, Simon & Schuster.

Think Win-Win. "Here is what I can do for you. Here is what you can do for me." When we understand how we can help each other and where we have common aims, we create more JOY at work and will be much more productive.

Deming said, "The job of a manager is to HELP his people."

To create an "atmosphere in which people are willing to take risks, make suggestions, and continually improve…requires an atmosphere of cooperation, not competition; an atmosphere of teamwork and shared goals, not individual effort for personal gain." Thinking about Quality p.112

Help each other. Stick-up for each other, Don't backbite or waste time fighting each other. Do unto others as you would have them do unto you.

3. Socratic Method

When a person invents or discovers a solution for themselves, they automatically become passionate about proving it will work. This is the "passion of the inventor" syndrome. Utilize the passion of the inventor.

Avoid telling someone the solution to the problem. Ask questions that will inspire co-workers to find their own solution. This solution will be one that they will own passionately!

Note: To avoid the wrath of the inventor, don't ever tell someone they are wrong. Instead, ask questions. I could be wrong, and I often am, but what about this?

If there are two conflicting ideas proposed, seek another option by saying, "We've discussed two alternatives, "This way and that way. Is it possible that there might be a third way that is better than either of these?"

4. Fly-Wheel Effect

If you want people to follow you, set an example. Start doing what needs to be done. When people see you are successful they will start lining up behind you asking to help.

Success breeds success because everyone likes to win and bet on a winner. But more importantly is the trust factor. People deeply want to work with people they can trust. People with proven track records are easier to trust and it is right to trust someone who is successful because they are competent, not just lucky.

"What do the right people want more than almost anything else? They want to be part of a winning team. They want to contribute to producing visible, tangible results. They want to feel the excitement of being involved in something *that just flat-out works*. When the right people see a simple plan born of confronting the brutal facts—a plan developed from understanding, not bravado—they are likely to say, "That'll work. Count me in." When they see the monolithic unity of the executive team behind the simple plan and the selfless, dedicated qualities of Level 5 leadership, they'll drop their cynicism. When people begin to feel the magic of momentum—when they begin to see tangible results, when they can feel the flywheel beginning to build speed—that's when the bulk of people line up to throw their shoulders against the wheel and push." P.177-178 Good to Great, Jim Collins

"When I look over the good-to-great transformations, the one word that keeps coming to mind is consistency….It is only through consistency over time, through multiple generations, that you get maximum results. In a sense, everything in this book is an exploration and description of the pieces of the buildup-to-breakthrough flywheel pattern." P. 182 Good To Great, Collins

Deming talked often about the fly-wheel-effect; His terms were: constancy of purpose, having a common aim, continuous improvement, and PDCA cycle…

How can someone learn to follow unless they have a leader? People learn quickly when they have an example. If you want someone to change or to treat you differently, set an example for them to follow with your life and actions.

"Be the change you want to see in the world" Ghandi

"Don't let anyone look down on you because you are young, but set an example for the believers in speech, in life, in love, in faith and in purity." I Timonthy 4:12 NIV Bible

5. PDCA Cycle

Deming said, “A goal doesn’t help anybody. ‘By what method’ are the only three words that count. By what method?” Thinking About Quality, P. 130

See the section in this paper on the Theory of Knowledge for more details on the PDCA cycle.

6. The Six Thinking Hats

Edward de Bono has created a practical tool to aide thinking and he named it the 6 thinking hats.

His book on this method is named the 'The 6 Thinking Hats'.

Some thoughts on the 6 hats from the Mind Tools Website:
(http://www.mindtools.com/pages/article/newTED_07.htm)

Six-Thinking-Hats
Looking at a Decision From All Points of View

'Six Thinking Hats' is a powerful technique that helps you look at important decisions from a number of different perspectives. It helps you make better decisions by forcing you to move outside your habitual ways of thinking. As such, it helps you understand the full complexity of the decision, and spot issues and opportunities to which you might otherwise be blind.

Many successful people think from a very rational, positive viewpoint. This is part of the reason that they are successful. Often, though, they may fail to look at a problem from an emotional, intuitive, creative or negative viewpoint. This can mean that they underestimate resistance to plans, fail to make creative leaps and do not make essential contingency plans.

How to Use the Tool:

You can use the Six Thinking Hats technique in meetings or on your own. In meetings it has the benefit of blocking the confrontations that happen when people with different thinking styles discuss the same problem.

Each 'Thinking Hat' is a different style of thinking. These are explained below:

- **White Hat:**
  With this thinking hat you focus on the data available. Look at the information you have, and see what you can learn from it. Look for gaps in your knowledge, and either try to fill them or take account of them.

  This is where you analyze past trends, and try to extrapolate from historical data.

- **Red Hat:**
  'Wearing' the red hat, you look at problems using intuition, gut reaction, and emotion. Also try to think how other people will react emotionally. Try to understand the responses of people who do not fully know your reasoning.

- **Black Hat:**
  Using black hat thinking, look at all the bad points of the decision. Look at it cautiously and defensively. Try to see why it might not work. This is important because it highlights the weak points in a plan. It allows you to eliminate them, alter them, or prepare contingency plans to counter them.

  Black Hat thinking helps to make your plans 'tougher' and more resilient. It can also help you to spot fatal flaws and risks before you embark on a course of action. Black Hat thinking is one of the real benefits of this technique, as many successful people get so used to thinking positively that often they cannot see problems in advance. This leaves them under-prepared for difficulties.

- **Yellow Hat:**
  The yellow hat helps you to think positively. It is the optimistic viewpoint that helps you to see all the benefits of the decision and the value in it. Yellow Hat thinking helps you to keep going when everything looks gloomy and difficult.

- **Green Hat:**
  The Green Hat stands for creativity. This is where you can develop creative solutions to a problem. It is a freewheeling way of thinking, in which there is little criticism of ideas. A whole range of creativity tools can help you here.

- **Blue Hat:**
  The Blue Hat stands for process control. This is the hat worn by people chairing meetings. When running into difficulties because ideas are running dry, they may direct activity into Green Hat thinking. When contingency plans are needed, they will ask for Black Hat thinking, etc.

Please Note: These hats are virtual. We don't put on physical hats, we just agree to engage in that type of thinking. The hats do not have to be used in any particular (sequential) order during a meeting. BLUE HAT thinking is used to decide when, where, and in what order to apply different hats during a meeting. Hats can be used as many times as needed to get clear communication.

6 hat thinking outside of meetings can also revolve around any hat. Communication is improved because listeners in a 6 hat conversation can be on the same "wavelength" as the speaker. All that is required is for the speaker to identify the hat he is wearing before making a statement.

The following thoughts are from the Value Based Management Website: (http://www.valuebasedmanagement.net/methods_bono_six_thinking_hats.html):

The Six Thinking Hats® Process and Tools

When teams engage in six hats thinking they are practicing parallel thinking — everyone is using the same tool at the same time on the same challenge. This speeds up

the process saving everyone time. Each person's unique thinking on the challenge is included which ensures a stronger solution is implemented, supported and is well thought out.

6 hat thinking improves the quality of thinking, the quality of communication and the effectiveness of both.

-7. STORY TELLING-

Sharing a personal story with someone does many things. It creates a bond and it provides a bridge of cultural understanding. Often, the most effective way to teach a concept is to tell a story about how it worked in your life. Stories engage people on an emotional level. Emotion is what makes us human and is the seat of wisdom. If you want to change a belief you must work on the emotional level.

HOMEWORK ASSIGNMENT: Use 1 of these 7 tools this week. See if it works.

RECOMMENDED READING: The Six Thinking Hats by Edward de Bono

6.0 A Disciplined Approach to Process Improvement at Company X

CLASS EXERCISE: Stephen Covey Video with Potato Farmer or First Things First Rock Video

Character is having the discipline to act in accordance with your beliefs.

SUCCESSFUL CELLS:

Successful cells have the following things:

1. The right people
    a. Teamwork + Leadership
    b. Knowledge
    c. Skills
2. The right Rhythms
3. The right focus + leadership

Discipline #1: Lead and support others with profound knowledge.

Discipline #2: Get the right people on the team (team players with the right knowledge and skills to get the job done).

Discipline #3: Create a Common Aim. Each member of the cell must share a common aim. Why are we here? What are we trying to achieve? What is our vision? Once this vision is shared, the details of how to get it done become much less of a problem. You can't be on a winning team, unless you know which goal post you are working towards.

Discipline #4: Adopt a philosophy of continuous improvement. "Its never good enough, but we are proud of how far we have come." Company X Vision and Values Statement

"Continuous improvement comes as a result of a long sequence of small steps. Some of these steps will result in dramatic improvements. Most improvements, however, will rest on the preceding steps as well as the most recent one." Understanding SPC, p. 150, Wheeler.

It turns out "that any improvement, no matter how big, is not sufficient. Only a process of ongoing improvement can sustain a company's excellent performance in the long run." Theory of Constraints, p. 1, copyright 1990 by Dr. Eliyahu M. Goldratt, North River Press.

Discipline # 5: Avoid numerical goals.

The danger of numerical goals, managing by the numbers, or MBO (Management by Objectives) is that people will focus on improving the numbers. In the short term, it is relatively easy to improve numbers. For instance, to improve uptime you can skip Preventative Maintenance or thrive on "Fixin' it the Fastest" instead of "Fixing it Right" (i.e. Five Year Fixes).

In order to implement Five Year Fixes, your performance numbers for the day or the week will get WORSE! If you are getting beat up on to make your numbers every day, every week, and every

month you will be reluctant to “take the hit”. The road to improvement is not the easy road. It takes extra hours, it takes knowledge, it takes patience, discipline, and a willingness to fail in the short run. We cannot improve if we are too afraid of failure. If you don’t know how to improve, you will “do your best”, hoping that somehow you’ll get lucky and the numbers will improve.

When we have a numerical goal, we will do one of three things as described by Brian Joiner:
1. Improve the process 2. Distort the process 3. Distort the data

Discipline #6: Prioritize – Collect data and Use Pareto Analysis to identify TOP ROCKS. Every person in your cell should be able to recite your top five issues for safety, quality and downtime from MEMORY!

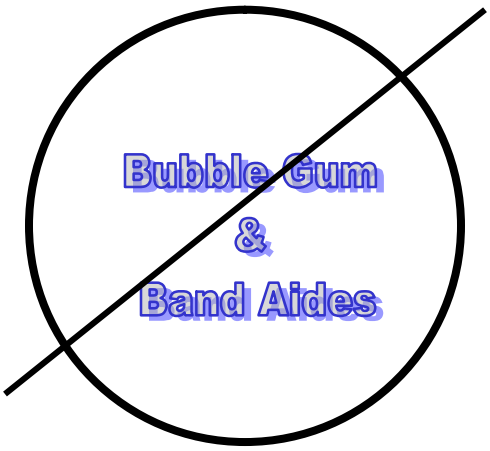
Discipline #7: Divide and Conquer-

Use a prioritized Project List to allocate resources and delegate work - no one person can do it all. Quality and process improvements don’t happen by themselves and don’t happen over night. Also, having EVERYONE in the cell work on ALL the problems at the SAME time is COUNTERPRODUCTIVE. For example, if we have a loader problem and each of the 4 people in the cell are tweaking during the course of the day, it will actually take LONGER to fix the problem. Assign a problem to one person in the cell. Make him/her the owner. Hold them accountable and responsible. This helps a person fix it and they will feel great about it. Record EVERY problem/ticky-tack issue you find no matter how little. Fixing small issues add up to BIG improvements. Small improvements should be celebrated as victory’s. Each success should feel good and add momentum. Momentum and positive thinking is extremely important to long term success!

Remember, the lug nuts (holding the wheels) on a car are inexpensive and unglamorous, until they fall off! Who can say that the lug nuts are LESS important than the car engine? Less sophisticated, but certainly not less important!

Discipline #8: Implement 5 year fixes. When something breaks always ask, "What is the RIGHT way to fix it?", and then have the team-discipline to invest the time and money to fix it right.

We must stop trying to get 5 year fixes using Bubble Gum + Band aides to hold our machines
together



Discipline #9: DON'T FOCUS ON WHAT YOU WANT TO IMPROVE!

To Improve this	Work on This
Machine Efficiency	Reduce cycle time
Lights Out	Uptime and Scheduling
Uptime	Reliability, MTBF (NOT babysitting or working longer, faster or harder)
IPPM	PDCA Cycle SPC Stable (Reliability), Predictable (Understanding of variation), Controllable (Profound Knowledge) Continuous Improvement Pareto of Defects
ME + LO	Cycle Time, Uptime, and Scheduling
Cost	Quality, ME + LO

The important concept here is that to improve something we must not focus on the measure, but rather on the factor controlling that measure! Why? Normally, it is not possible to repair a machine while it is running. Fixing a machine correctly (5 year fixes) normally takes longer than using Bubble Gum and Band-aides. Every time you take time to fix it right, your efficiency is lower for the day.

Discipline #10: Have a Game Plan

Here is an example game plan from Cell 924 (500N backplate).

Cell 924 LEVELS OF IMPROVEMENT
Note: Cell 924 is at currently at level 2 and would like the opportunity to move to level 4

Types/Levels of Improvement	Driven By	Activities
1. Paying attention to detail (adjusting the machine to the best it can be).* "Tweaking"	People + Teamwork (Project List)	Admitting there is room for improvement, Perfectionist attention to detail, Observing, collecting data, creating operational definitions, Studying data, developing plans and theories.
2. Making physical changes to the process to "fix" problems. Changing process parameters in a disciplined and documented fashion.	Knowledge, skill, $, teamwork (Project List)	Building tooling, modifying tooling, adding PM activities, changing procedures and work habits. Testing experimental tooling.
3. Implementing 5 year fixes based on level 1 & 2	People + Knowledge + Skill + Teamwork (Project List)	Creating Work Instructions and permanent tooling to institutionalize learning and "idiot proof" the process so that fixes are not undone or lost during staffing adjustments.
4. Mentoring & Innovation!	People + Knowledge + Skill + Experience + teaching skills (organized/planned training classes)	Transferring the "skill" of process improvement to young engineers throughout Company X. Classes, training, coaching, mentoring by people who have knowledge and ability to teach.

Discipline #11: Keep it Clean

There is a linkage between Preventative Maintenance and 5S. When you make it a practice to keep your machine clean by daily cleanings (wiping it with a rag, sweeping the floor UNDER the machine, etc.) you have an opportunity to check the status of your machine with all 5 of your senses (sight, hearing, feeling, smell and even taste if you want). You will detect loose or missing fasteners, oil leaks, bad bearings, metal or plastic shavings, etc. that indicate machine problems BEFORE you have downtime or produce bad quality parts.

3-16-07: Today a few things happened with 5S that were good lessons. I've been modeling good behavior by volunteering my time to clean the work area 3 times a day. I take 15 minutes

first thing in the morning, a few minutes at lunch and then again just before I go home to give the work area a quick clean up. A few days ago I found some screws on the floor. They looked suspicious but I couldn't figure out where they came from. This morning when moving the Kennedy toolbox it all made sense. One of the wheels fell off!

Also, I cleaned the Bridgeport (with a rag) It was very dirty and greasy and so People didn't want to sweep it off after using it (the broom would get stuck). But, while cleaning the milling machines I found 2 loose wiring connections, one missing bolt and after cleaning off some gunk, I realized that that both machines are plumbed with lubrication systems. This is really important because I'm in charge of the PM and lubrication for the machines and was using a squirt gun to lubricate them by hand when all I had to do was pull the lubrication lever!

Discipline #12: Be patient and have courage

Slow down with the changes! Use the scientific method or the PDCA cycle when it comes to process changes. Document EVERY fix, change, tweak, in a logbook. Make an owner for each piece of equipment and all team members must get approval before changing equipment "owned" by others. Allow time for the process change to prove itself. Test the changes. Make sure the changes are better, worse or no change.

Remember things will get worse before they can get better.

I have never owned a new car. My father was an auto mechanic and he taught me how to refurbish a "beater" into a reliable car. We would buy a junker and take it apart, replace worn-out parts, patch the rust holes, etc. The car would be in pieces all over the garage. The entire interior might be outside the car while we were doing body work to repair rust holes. We'd tear the front end of the engine off to replace the timing chain and gear. Remember, we were taking a car that was drivable and making it absolutely non-functional for a time, so that, in the end it would be as reliable as a brand new car (for a fraction of the purchase price of a new car). The universal law I learned was "It must get worse before it can get better."

Discipline #13: Learn something new every day.

Every member of your cell should be reading at least one educational book. There is a minimum level of literacy that every engineer should have achieved. What is your cells minimum level? The last page of this document has a Recommended Reading list.

Discipline #14: Daily communication
Have a daily team meeting. Have an agenda, keep it short, but cultivate open communication everyday.

Discipline #15: Conduct Good Meetings
Attend the Effective Meetings class by Keith Andrews. All meetings must have a published agenda. Start meetings on time, end on time, and publish minutes!

Discipline #16: Just do it!
Problems don't fix themselves. Take personal ownership of tasks to be done, and don't leave until you get at least one positive thing done today! If there is anyone on your team who hasn't had Franklin Day Planner training, get them enrolled in the next scheduled class today. Personal time management is the single most important skill-set in an engineers education.

7. 0 ACHIEVING "0 PPM" & Profitability

When the wheels are not falling off our car we can focus on enjoying the ride! How can we improve quality?

a) Customer Expectation is 0 PPM. 0 PPM is not achievable via SPC alone. +/- 6 Sigma quality = 4 PPM. But, 0 PPM *can* be achieved via Poka Yokes. Poka Yokes can achieve 100% conformance to specifications but only result in customer being "satisfied". Furthermore, poka-yokes can result in *higher* scrap rates.
b) S.P.C. should be renamed Statistical Profit Control. SPC provides a method for continuous process improvement (improved quality, reduced costs, and process innovation). SPC provides lowest cost with best quality and results in customer being "delighted" through innovation.
c) Poka Yokes + SPC = 0 PPM + Profitability

Poka Yokes + SPC	=	0 PPM + Profitability

Containment with 100% Human visual inspection is expensive and not 100% reliable. To achieve 0 PPM and "hands free" manufacturing, we must poka-yoke every quality feature as part of the manufacturing process. For example, if one station is supposed to form the bulb clips, a subsequent station must verify that bulb clips are formed correctly.

Rumble Strips on the road:
"Driving by braille is not recommended; however, these carved depressions in the road are an effective warning that the vehicle's wheels are headed for danger. The little bumps provide the driver with tactile and audible warning that the care is not in its lane…" (http://pokayoke.wikispaces.com/RumbleStrips)

If a high volume, automated machine with poor quality is poka yoked, a high scrap percentage can be easily produced. Improving the process via SPC, the frequency of scrap can be reduced to an economically justifiable level.

Poka-yoke (ポカヨケ - pronounced "POH-kah YOH-keh" means "fail-safing" or "mistake-proofing" — avoiding (*yokeru*) inadvertent errors (*poka*)) is a behavior-shaping constraint, or a method of preventing errors by putting limits on how an operation can be performed in order to force the correct completion of the operation. The concept was originated by Shigeo Shingo as part of the Toyota Production System. Originally described as *Baka-yoke*, but as this means "idiot-proofing" the name was changed to the milder *Poka-yoke*. One example is the inability to remove a car key from the ignition switch of an automobile if the automatic transmission is not first put in the "Park" position, so that the driver cannot leave the car in an unsafe parking condition where the wheels are not locked against movement. Another example can be found in a normal 3.5" floppy disk: the top-right corner is shaped in a certain way so that the disk cannot be inserted upside-down.

From Wikipedia on-line Encyclopedia 1-30-07

GLOSSARY:

PPM: Parts Per Million. This acronym is commonly used by automotive suppliers as a quality metric to describe "Defective Parts Per Million".

SPC – Statistical Process Control. (Another description is Stable, Predictable, Controllable). Invented by Walter Shewhart as a tool to help management know when to take action based on statistics, instead of on "gut feel".

W. Edwards Deming – American Quality Consultant who taught the Japanese about quality after WWII.

Walter Shewhart – Invented the SPC chart, the concept of special and common causes, and the PDCA Cycle of improvement (Shewhart Cycle). Author of the classic *Economic Control of Quality of Manufactured Product*, orginally published in 1931.

8.0 RECOMMENDED READING

Recommended Reading	Systems Thinking	Understanding Variation	Theory of Knowledge	Psychology
7 Habits of Highly Effective People: Restoring the Character Ethic by Stephen Covey	X		X	X*
Understanding Variation: The Key to Manageing Chaos by Donald Wheeler		X*		
The 5th Discipline: The art and practice of the learning organization by Peter Senge	X*		X*	X
Forth Generation Management by Brian Joiner	X	X	X	X
Thinking about Quality: Progress, Wisdom, and the Deming Philosophy, by Lloyd Dobbins & Claire Crawford Mason	X	X	X	X
Out of the Crisis by W. Edwards Deming	X	X	X	X
The New Economics by W. Edwards Deming	X	X	X	X
Theory of Constraints by Eli Goldratt (Read The Goal by Eli Goldratt first)	X		X	X
The 6 Thinking Hats by Edward de Bono				X
Statistical Process Control (SPC) Reference Manual, 2nd Edition, AIAG, July 2005		X		
The New Manufacturing Challenge by Kiyoshi Suzaki	Manufacturing Excellence*			

* = Read These First

This is obviously NOT an Company X Employee!

Why isn't our Quality and Profitability improving over time?

One reason is poor machine reliability. The wheels keep falling off the car! We are not able to focus on quality and profitability when most of our time is consumed just trying to get enough parts to make our shipment today.

Stock Photo of Porsche Cayenne Off Road in Scotland

From http://www.worldofstock.com/closeups/TRC1862.php