Total Quality Management

a heartfelt approach to doing things right

1997 Edition

A Textbook
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Preface

My purpose in writing this text is to give a concise, targeted document describing Total Quality Management (TQM) and its foundations. Many students during the past several years have said they wished they had a single source which gave them enough material to understand TQM but did not require reading several thousand pages. This book is my effort to provide such a text.

The reader must understand that this text is but a brief overview of the subject matter. Should the reader find a need to read more than what is offered here, I encourage him or her to refer to the reading list and to a local major library for additional books on each subject area.

Included with this edition is the manuscript for a short book entitled: "The Master Management Builder and His Structure - A Story of Walls, Arches and Learning." I hope you enjoy the allegory.

This is the fourth edition of the text and I owe many thanks to the students who helped to proof-read the first three editions. Since I am not known as "zero-defects" in my typing, I am sure there are still a few typographical errors and grammatical mistakes. Please let me know if you find them so I can continually improve this text.

Lesson One - Introduction to TQM, Management Thinkers, Deming and his Management Principles

Objectives

After reading this lesson, the reader should be able to:

- Explain the fundamental concepts of Total Quality Management (TQM)

- Teach managers the history of the quality movement

- Explain to managers what Deming's "fourteen points" and his "diseases" are

- Explain the Plan-Do-Study-Act cycle

- Explain to others what is profound knowledge

- Explain the difference between TQM and traditional western management thinking

- Explain what fear is, its negatives effects in the workplace and how to remove fear.

Key Words

Paradigm

Total Quality Management

Deming

Plan-Do-Study-Act Cycle (PDSA)

Deming System

85-15 Rule

Profound Knowledge

Continual Improvement

Introduction

The purpose of this text is to give you a compact presentation of Total Quality Management philosophy and operations management tools. Philosophy alone will not make a good operations manager, neither will a host of tools alone. You must have a good grounding in both.

A live lecture or audio-taped lecture is used in conjunction with this text for the Total Quality Management course at Regent University's School of Business. This text, though, stands on its own for the independent student who desires to improve his or her knowledge of Total Quality Management.

This text is divided into two parts. The first section deals with philosophy and the second with tools. Remember the philosophy learned in the first part as you study the tools. Continually ask yourself how you might apply each section to your own work or personal life. Many students find they can immediately implement what they learn in their workplace.

Total Quality Management

Total Quality Management is a name like any other name and the purpose of a name is to identify the contents. The names: "Total Quality Management," "Continuous Improvement," "The Learning Organization," and "Process Management" all have a flaw in them. The flaw is that when such programs are implemented, management typically has an expectation of instant success.

Scriptural management principles have existed since the formation of scripture itself. This statement is so true, it seems ridiculous to even state it here. It is this folly that provokes me to mention it at the beginning of this text. Occasionally, man stumbles across a scriptural principle and is amazed at the success brought by living and working right. This text presents a multitude of management principles based on scriptural foundation which men have proven to be useful in the running of organizations.

The primary management thinker quoted in this text is Dr. W. E. Deming. Dr. Deming focused his life on trying to get management to understand their responsibility and live up to their requirements. I will restrain from commenting more on Dr. Deming here and save my comments for the section devoted to him.

This text centers management themes around the theories of systems, agency, Human Behavior School of Thought, statistical variation, statistical process control and the ever present belief that God created each of us -- employees and managers, to think and know what is right. God created in us a sense of joy in working for Him in all we do, of recognizing authority and fearing no one except Him.

Some managers think of TQM as a fad rather than a revolution. Revolutions are always seen as passing fancies or whims by those who have yet to see and understand the change in the world around them. Assumptions of the past do not work today. They did not work all that well in the past either, it is just that everyone accepted them. As an example, read this quote from the opening paragraph of an article examining TQM as a revolution or fad that shows management's actions masking the problem rather than removing it:

> *"A department head we know decided to purchase a $26.45 bulletin board for her office. Petty cash could not be used for anything over $25.00, so she had to submit a formal purchase order. The purchase order required five signatures. To save time, she decided to hand-carry the purchase order around campus and get the signatures herself. When she came to the last office to get the fifth signature, she was frustrated to find eight people standing in line before her. She finally went into the office and complained rather forcefully about having to stand in line so long. The next day, five chairs were placed in the hall outside that office."*[1]

Paradigms

A paradigm (pronounced "pair-a-dime") is a set of beliefs about phenomenon around us that constrains and guides our thinking. For example, consider your self to be in Spain or Portugal in 1492. You believe the sun rises in the East and sets in the West. When you look westward out over the ocean, you see a straight line where water meets the sky. You are familiar with straight edges where the plane meets the sky. If you walk off the plane of a roof, you fall. Therefore, ships must fall off the earth if they travel too far. *N'est-ce pas?*

Paradigms are shared by people creating schools of thought. The ancient mariners of the late 1400's all believed the same perceived facts and, thus, never ventured too far from land.

Paradigms change when first an anomaly appears. The late 1400's brought additional facts to bear, such as: at first you see the top of a mast, then the whole mast, then the top of the ship hull, and then the full hull as a ship approaches from far out to sea. This is similar to what you see when a person climbs over a small hill. Perhaps the ocean is like a hill and there is no edge.

Experimentation occurs to verify the anomaly and seek out new relationships and causes. People who explore anomalies may be considered outcasts by those who staunchly support the existing paradigm. Columbus was considered a "strange and touched" sailor by many who were sure they would never see him or his ships again.

Paradigm shifts occur when the anomaly is perceived to be a violation of the natural laws. Scientists and, I might add, good managers do not revolt at an anomaly or discard the old paradigm, but rather investigate the tear in the fabric of their belief and look for a different set of values which take into account the anomaly and its impact on the laws of operation. This tearing and altering of beliefs changes the framework by which we make decisions.

> *Therefore if any man be in Christ, he is a new creature: old things are passed away; behold, all things are become new.*
> *II Corinthians 5:17*

This scripture is similar to what a person senses when a new paradigm replaces an old one. The next section discusses the contributions of several significant management thinkers of our time.

Management thought, like scientific thought, progresses through revolutions brought about by changes in paradigms. Progress follows: old paradigm -- anomaly -- new perception -- new measures -- new puzzles -- new problems -- new anomalies -- and so on.

Many managers argue that employees resist change. Clay Carr argues that people do not resist change, but rather they welcome it when they can see the benefits of change to them. People resist *being* changed, not change itself. When someone understands and believes the benefits of change to them, they become change agents. The article posits five steps (or questions) to successful change in an organization:

1) Is this change a burden or a challenge?

2) Is the change clear, worthwhile and real?

3) Will the benefits of the change begin to appear   quickly?

    4) Is the change limited to one function or a few   closely related functions?

    5) What will be the impact on existing power and   status relationships?[2]

Five Men Who Shaped Western Management Thought[3]

Frederick Taylor

Frederick Taylor was called the father of scientific management. He pioneered the attitude of seeking the single source of frustration and seeking a solution. He isolated experiments to study the impact of one variable on the total output of a worker.

Taylor came from a wealthy family and was schooled in business and engineering. A gentle man, he abhorred conflict. When he first entered Midvale Steel he used the typical "carrot-stick" philosophy and drove the people under him as his peers taught him to do. The gentleness of the man and the harshness of the management techniques he was taught created a constant internal conflict for him.

He knew the hostility which developed in the workers and he reached the point of stating: "It's a horrid life for any man to live." He soon was unable to look a laborer in the eyes because of the hostility he knew they felt for him and other supervisors.

He soon knew that coercion did not work. It produced short-term benefits but treated employees like cattle and mules. He had great compassion for the workers around him, even though he was bigoted. Put mildly, he referred to Swedes and other immigrants as not being very bright. He felt that they, more than others, needed help in making their lives easier.

Taylor knew they received little pay for their labor, so he sought to develop methods where their pay could increase and the company could earn more as well. He examined the working patterns of men loading pig iron into railroad cars. He saw that as the day wore on, the men carried less and less iron, and eventually stopped from exhaustion.

He recalled that earlier 19th century engineers designed machines which did many jobs better than manual laborers. Taylor examined their studies and sought how to best adapt the engineers studies to the human machine.

At Bethlehem Steel, in 1901, he experimented with patterns of work and rest **and** methods of lifting and carrying pig iron. He received permission from the company to pay men more per day if they carried and loaded more. This became the impetus to get laborers to try his methods. His design was to have a man carry a load and rest 5 minutes. This cycle was repeated throughout the day. The rest - work cycle resulted in the men not succumbing to exhaustion.

His end result was a doubling of wages for carrying 6 times the iron. Both worker and company benefited. The benefit to the company was to reduce the number of workers from 500 to 140 during his stay at Bethlehem.

He believed that management's job was to support the worker with the tools and training needed. He believed that a foreman had to know too much about too many things to be truly effective. From this he created functional foremanship. Functional

foremanship means that one foreman is provided for each portion of the operation. Each foreman had to learn much about a small area. Taylor believed that this type of specialization would benefit the worker the most.

This functionality also required specialists to assist with training, clerical tracking of product for payroll compensation, offices for these people, etc. Even with all these increases in cost, Taylor lowered Bethlehem's cost to handle steel from .08 to .04 per ton in 1901 dollars.

Taylor summarized his thoughts in 1915 as:

- Management is science -- not rule of thumb
- Management is harmony -- not discord
- Management is cooperation -- not individualism
- Management is maximum output -- not restricted output
- Management is development of each man to his greatest efficiency and prosperity.

These summary remarks by Taylor fit well into a Biblical World View. Taylor's view of the worker is in line with part of scripture. The desire to assist and protect fits with scripture, his view of helplessness and inability to adapt and learn is not.

Kurt Lewin

Kurt Lewin provided a process for any form of content that is unusually well-suited to the changing needs of democratic societies. His insights underlie all successful large-scale efforts, no matter what you call them, or which experts are involved. They are absent or badly applied in all failed efforts -- regardless of what trendy label is used. Lewin also provided us with an understanding of how to make large scale organizational change.

Douglas McGregor

I will spend more time on Douglas McGregor than the others because of his tremendous impact on what later became Total Quality Management. I am always interested to learn that a major thinker in management philosophy was a strong Christian with foundational beliefs. I am convinced that Douglas McGregor operated on those beliefs. The editors of the essays in McGregor's book, <u>Leadership and Motivation</u>, include the following:

> Doug's great grandfather set a standard for the McGregors as a Scotch Presbyterian minister, and his son, Thomas, made a living selling pianos and organs around Ohio, taking livestock for payment, and selling the livestock too. Not content with this, Thomas raised money from businessmen in Toledo to start a mission for transient laborers, with concern for their salvation as well as providing shelter and food. His dream was to build homes for homeless men in each of the industrial cities around the Great Lakes. He died of pneumonia after digging a foundation for what later became the McGregor Institute in Detroit. Tracy McGregor, Thomas's oldest son (and Doug's uncle) continued his father's work and started many other philanthropies in the Detroit area and, in fact, helped Doug finance his graduate education.

I have no empirical data or stated confession from McGregor regarding his relationship with Jesus, but I offer the following passage written by McGregor's wife, Caroline, about McGregor and included in his book <u>Leadership and Motivation</u>:

> Doug's father became Director of the McGregor Institute in 1915. Family life revolved around this work -- a chapel service every evening as well as the feeding and housing of as many as 700 men who were low on the totem pole of human dignity. Dad conducted service, played the organ, and Doug sometimes accompanied him on the piano, and Mother, who had a lovely contralto voice, occasionally sang. Both Doug and his brother worked in the office and at the desk out of school hours. Many of the staff were rehabilitated homeless men. Mother often had groups of the men for social evenings at the house.

> Dad held strong religious beliefs, was a zealous Bible scholar and a lay preacher in his own right. As I look back on my first contacts with Doug's family, I am impressed with the deep concern for mankind, which Doug shared, and an equally deep pessimism in respect to man's potential goodness and strength, which Doug continued to challenge in his work and writings. It is significant that he chose to work with leaders in our society rather than the failures.

> Although religion had a stern quality, there was a rich enjoyment of music by the entire family. Doug studied piano and "picked up" a number of other instruments. He was a skilled accompanist and traveled during summer breaks with an evangelist. This is perhaps where he learned to sing *Onward Christian Soldiers.* Later, at Oberlin, he directed a church choir for extra income.

The evidence, above, is more than circumstantial. Douglas McGregor's upbringing and values contributed markedly to his management philosophy. He wrote <u>The Human Side of Enterprise</u> in 1960, and changed the way managers view their own assumptions and behavior. McGregor detailed and identified Theory X and Theory Y.

Theory X states that employees will not work if left to their own devices; employees are inherently bad and must be forced and coerced into work. Theory Y states that employees find work as natural as play and will work diligently to the firm's aims if the goals, beliefs, and values of the firm match their own. (Greater depth in the assumptions follow later in quoted passages from <u>The Human Side of Enterprise</u>.) McGregor's famous theories are, I believe, the most quoted and the least read by management professors.

Management professors continually teach that there are Theory X and Theory Y employees. Not so. McGregor wrote that management erroneously believed that people act as if they are Theory X, however, all people are Theory Y in belief.

Here is a series of quotations from McGregor:[4]

> Theory X provides an explanation of some human behavior in industry. These assumptions [Theory X and Theory Y] would not have persisted if there were not a considerable body of evidence to support them. Nevertheless, there are many readily observable

phenomena in industry and elsewhere which are not consistent with this view of human nature.

Such a state of affairs is not uncommon. The history of science provides many examples of theoretical explanations which persist over long periods despite the fact that they are only partially adequate. Newton's laws of motion are a case in point. It was not until the development of the theory of relativity during the present century that important inconsistencies and inadequacies in Newtonian theory could be understood and corrected.

The growth of knowledge in the social sciences during the past quarter century has made it possible to reformulate some assumptions about human nature and human behavior in the organizational setting which resolve certain . . . inconsistencies inherent in Theory X. While this reformulation is, of course, tentative, it provides an improved basis for prediction and control of human behavior in industry. (page 35)

Regarding motivation: at the core of any theory of the management of human resources are assumptions about human motivation.

Man is a wanting animal -- as soon as one need is satisfied, another appears in its place.
Human needs are organized in a series of levels -- a hierarchy of importance.

A satisfied need is not a motivator of behavior.
When man's physiological needs are satisfied and he is no longer fearful about his physical welfare, his social needs become important motivators of his behavior. These include the needs for belonging, for association, for acceptance by one's fellows, for giving and receiving friendship and love.

Management knows today *(1960)* **of the existence of these needs, but it is often assumed quite wrongly that they represent a threat to the organization.** (emphasis mine) (page 37)

Theory X explains the <u>consequences</u> of a particular managerial strategy; it neither explains nor describes human nature although it purports to. (page 42)

Assumptions of Theory Y:

1. The expenditure of physical and mental effort in work is as natural as play or rest.

2. External control and the threat of punishment are not the only means for bringing about effort toward organizational objectives. Man will exercise self-direction and self-control in the service of objectives <u>to which he is committed</u>.

3. Commitment to objectives is a function of the rewards associated with their achievement.

4. The average human being learns, <u>under proper conditions</u>, not only to accept but to seek responsibility.

5. The capacity to exercise a relatively high degree of imagination, ingenuity, and creativity in the solution of organizational problems is widely, not narrowly, distributed in the population.

6. Under the conditions of modern industrial life, the intellectual potentialities of the average human being are only partially utilized. (pages 47-48)

Theory X offers management an easy rationalization for ineffective organizational performance: It is due to the nature of the human resources with which we must work. Theory Y, on the other hand, places the problems squarely in the lap of management. If employees are lazy, indifferent, unwilling to take responsibility, intransigent, uncreative, uncooperative, Theory Y implies that the causes lie in management's methods of organization and control.(page 48)

The central principle of organization which derives from Theory X is that of direction and control through the exercise of authority -- what has been called "the scalar principle." The central principle which derives from Theory Y is that of integration: the creation of conditions such that the members of the organization can achieve their own goals best by directing their efforts toward the success of the enterprise. These two principles have profoundly different implications with respect to the task of managing human resources, but the scalar principle is so firmly built into managerial attitudes that the implications of the principle of integration are not easy to perceive. (page 49)

Acceptance of Theory Y does not imply abdication, or "soft" management or "permissiveness." As was indicated above, such notions stem from the acceptance of authority as the single means of managerial control, and from attempts to minimize its negative consequences. Theory Y assumes that people will exercise self-direction and self-control in the achievement of organizational objectives *to the degree that they are committed to those objectives."* If that commitment is small, only a slight degree of self-direction and self-control will be likely, and a substantial amount of external influence will be necessary. If it is large, many conventional external controls will be relatively superfluous, and to some extent self-defeating. Managerial policies and practices materially affect this degree of commitment. (page 54)

McGregor's other famous book *Leadership and Motivation* (1966) is a collection of thoughts and concepts developed after *The Human Side of Enterprise*. McGregor writes that he was impressed with Joseph Scanlon's work. Scanlon is well known for his efforts in human resource management and benefit plan development. He is not well known for his beliefs on people management. His work mirrors that of McGregor.

McGregor on Scientific Management:

Despite protests to the contrary, the approach of scientific management has been to treat the worker as a "hand" rather than a human being. The consequences of so doing have been attributed to the "natural" cussedness of workers and explained as the price of technological efficiency. Pleasant working surroundings and fringe benefits have been used to alleviate the negative aspects of assembly-line jobs. Fancy communications programs and Madison Avenue sales gimmicks have been used to persuade the worker of the vital importance of his tiny contribution to the enterprise. These are understandable but largely ineffective palliatives. However, work simplification and all the other paraphernalia of the industrial engineer -- consistent with a view of the worker as a glorified machine tool -- remain the commonly accepted way to utilize human effort in industry.[5]

Fred Emery

Fred Emery, an Australian disciple of Lewin and Eric Trist, friend of Lewin and McGregor and progenitor of the notion of Quality of Working Life (QWL), achieved the conceptual breakthrough needed to bring systems thinking to the work place and to undo Taylorism.

Emery, perhaps the first to apply open systems thinking to social change, pointed out that optimal results could be achieved only when social systems, which obey the laws of biology, psychology, and sociology are designed integratively with technical systems following the laws of physics, chemistry and engineering. The social technical approach required that those who do the work get a great deal more authority, control, skills and information than is customary under scientific management.

Trist

Trist invented a way of thinking about management more grounded in the way businesses really run. He called it "finding the best match between social and technical systems." It was Trist who, in the 1970s, realized that the Japanese leapfrogged the western industries in part because the JUSE (Japanese Society of Scientists and Engineers) gave away its expertise to workers and supervisors rather than collecting the knowledge and going off to solve the problems on their own.

Human Behavior School of Thought

The 1930's saw the development of a management belief system called the Human Behavior School of Thought. Elton Mayo researched employee motivation questions at the Hawthorne, Illinois' Western Electric plant. This famous study resulted in the conclusion that employees perform better if someone is concerned about them. It even proved that you did not have to improve their life, just care about them. This conclusion was diabolically opposed to the view of Taylorism held by so many industrial managers of the time that it was rejected by many.

Of interest here was that two key men were also working at the Hawthorne plant. Walter Shewart, the father of business statistics and his then-student W. E. Deming were studying statistical process control of the manufacturing process. W. E. Deming's later management teaching was soundly affected by the work of Mayo and others at the Hawthorne plant.

Of further interest is the interconnectedness of many of the men discussed above. Mayo, Shewart, Deming -- all at Hawthorne. All involved in one way or another with the work of McGregor and Scanlon and Lewin. This unplanned interconnectedness, I believe, is the basis for what is referred to as Total Quality Management.

Japan at the end of the war

Japan was devastated economically, its land occupied by foreign soldiers, its social structure severely distorted and its religious roots displaced. The occupation forces looked for ways to quickly get the Japanese economic machine functioning so the American military could return home.

Japanese leaders, seeing their own micro economy shattered, knew they would have to seek income from other countries in the form of exports. They saw a global market in the late 1940's and early 1950's out of necessity. The rest of the world did not begin to see a global market until decades later. The Japanese leaders turned to the economic giant of the times, America, to learn what to do. Management gurus such as Peter Drucker were sought. Their advice was to look for markets where they could take small amounts of material and add value through labor, then sell these goods abroad.

Japan is an isolated island with little natural resources. Every manufacturing idea required all raw material to be imported, value to be added and the goods shipped long distances to market for subsequent sale. To make a profit and still sell at the same competitive price, it was necessary to make the item as cheaply as possible. The current American thought was to lower purchasing standards and cut costs, isolate workers, create functional foremanship and seek specialists to design systems. Japan did exactly as the American manufacturers believed. The result was that "Made in Japan" meant shoddy merchandise which was always less expensive to buy but never lasted. Quality was miserable. Japan's early rise to economic well being was crumbling around them.

It was the end of the 1940s when America's industrial machine began to skyrocket. The American dream of the 1950's was beginning. There were many consumers and buyers. Quality could be higher than Japan because the shipping costs were lower. The difference went into materials. The "American Way" worked if you had enough buyers and enough money to re-purchase the item when it wore out. Quality was defined by the manufacturer and accepted by the American consumer.

Japan looked again to the U.S. for management help. Deming was first called to Japan by Douglas MacArthur. Deming was well-known in the United States for his work in census sampling. The 1940 United States census was the first successful attempt at partial sampling so that not every person had to be interviewed and counted. MacArthur wanted an accurate accounting of the Japanese population. Deming worked diligently with MacArthur's staff and the senior Japanese governmental officials. It was this contact that brought Deming face to face with the management problems of Japanese manufacturing. The census complete, the Japanese governmental officials brought Deming back to lecture on quality and management techniques.

The result of Deming's lectures resulted in an entirely new philosophy to Japan. Thus began the process of a Shinto nation teaching us in a Christian society about scriptural principles of management.

The devastation of the war provided a great power within the Japanese government. Prior to the War, Japan was run by a tightly controlled central government with great power and control exercised by each person in authority. There was a desire to try other techniques which would work. Ironically, the government of Japan used power and coercion to bring the heads of Japanese industry into training rooms to learn the new philosophy.

We know that to change the philosophy and culture in a company it is necessary to change the opinions and vision of the top leaders. This first step, imposed by the Japanese government, accomplished this well. There were economic benefits for the Japanese industrial leaders to conform to the wishes of the government. The foreign aid which Japan received for economic recovery was parceled-out to the companies who cooperated with the government's reform.

Deming (1900 - 1993)

The principles which aided Japan in becoming a world economic power within 40 years are based on scripture. I surmise from readings and W. E. Deming's comments that he was a committed Christian who, himself, lived by these same principles and understood their origin and significance. I believe Deming deliberately couched his principles in the language of the marketplace to improve the chances of their being openly adopted.

The Japanese success in world markets cannot be ignored or even discounted. Countless business writers during the 1970's and 1980's have tried to discredit their success, yet have only succeeded in perpetuating the concept of sour grapes. The Japanese were successful because of the principles they employed and the values they adopted after the World War II reconstruction.

Deming's education and young life assisted him in learning how to look for ways to do more with less. He was diligent in his studies. He had an insatiable desire to learn about the people and culture of the places he visited. Deming's mother was a strong Christian who insisted the young Deming receive a thorough education in scripture and Godly principles. Deming's life-long secretary, Cecelia Kilian, recorded in her biography of Deming that he was devoted to his wife and continually took flowers to her grave for years after her death. Cecelia also records Deming's interest in liturgical music. He wrote many arrangements for old liturgical pieces. Deming's never-ending energy drove him to use every moment of time for what he saw as the greater good. When called to dinner, if he found the meal to still be ten minutes away, he would sit at the piano and write a few more bars of a new liturgical arrangement.[6] Music was not his only means of expression, he also wrote poetry and sonnets.

His work at the Hawthorne plant gave him insight as to the "plight" of American workers. He commented that piece-rate was the lowest state one could fall into.[7] God placed this man in the specific situations that would allow him to be mentored by specific people. Deming was taught by another statistical genius, William Shewart, whose work was and still is known as a leading force in the field of statistics and sampling.

Deming, while in Japan for the census, learned as much about the Japanese culture and way of life as he could. The Japanese leaders he worked with on the census were impressed with his desire for improvement, quality and simplicity. The Union of Japanese Scientists and Engineers (JUSE) had organized to aid the reconstruction of

their country. This group, unknown to Deming, met several times a week seeking ways to return Japan to being an economically viable nation. At this point in time, Japan was not able to produce enough food to feed its citizens, much less grow financially. Deming completed his census work and returned to the United States.

The JUSE members received Walter Shewart's book, *The Economic Control of Quality of Manufactured Product*. The JUSE members read of Deming and recognized his census work in Japan. They asked him to come and help their industry leaders with quality control solutions. On June 19, 1950, Deming began to lecture to Japanese managers and engineers. Deming realized that he was talking to the wrong people. Enthusiasm for quality would burn out unless he talked with senior management. Deming requested that the JUSE president make the necessary arrangements. On July 13 Deming presented his first seminar to the 21 presidents of Japan's leading industries.[8] Dr. Deming was preceded by Homer Sarasohn and Charles Protzman and followed by Dr. Joseph Juran. Each assisted Japan with their manufacturing, but continual improvement belongs to Dr. Deming.[9]

Dr. Deming made several more trips to Japan over the next twelve months. Over 20,000 engineers were trained in statistical principles. In 1951, the Japanese showed their appreciation by establishing the Deming Prize to be awarded to an individual for accomplishments in statistical theory and to companies for accomplishment in statistical application. In 1960 Deming was awarded the Second Order of the Sacred Treasure -- the first American to receive this Japanese honor. The citation stated that the Japanese people attribute the rebirth of Japanese industry and their success in marketing their radios, parts, transistors, cameras, binoculars and sewing machines all over the world to Deming's work.

Deming's Fourteen Points.

I offer an analysis of Deming's fourteen points and scriptural support. I understand that you can "prooftext anything with a little effort," but my intent is to show that these points are sound and have support in scripture.

Deming developed these fourteen points during his time in Japan, modifying and adding to them while he worked with American firms in the 70s and 80s.

1. Create constancy of purpose for improvement of product and service.
2. Adopt the new philosophy.
3. Cease dependence on mass inspection.
4. End the practice of awarding business on the price tag alone.
5. Improve constantly and forever the system of production and service.
6. Institute training.
7. Institute leadership.
8. Drive out fear.
9. Break down barriers between staff areas.
10. Eliminate slogans, exhortations and targets for the work force.
11. Eliminate numerical quotas.
12. Remove barriers to pride of workmanship.
13. Institute a vigorous program of education and retraining.

14.   Take action to accomplish the transformation.

Read about each principle and critically examine the scriptures given in support of each. Remember to always test what others teach you and accept nothing unless it lines up with scripture, or at least is not countermanded by God's word.

1.   Create constancy of purpose for improvement of product and service.

Dr. Deming suggested a radical new definition of a company's role: Rather than to make money, a company's role is to stay in business and provide jobs through innovation, research, constant improvement and maintenance.

> *The secret of success is constancy of purpose.*
> *--Benjamin Disraeli*

The Christian executive must examine Dr. Deming's first principle with the first commandment Jesus gave when confronted by a teacher of the law:

> *Mark 12:28 - 34: One of the teachers of the law came and heard them debating. Noticing that Jesus had given them a good answer, he asked him, "Of all the commandments, which is the most important?" "The most important one," answered Jesus, "is this: 'Hear, O Israel, the Lord our God, the Lord is one.(Or the Lord our God is one Lord) Love the Lord your God with all your heart and with all your soul and with all your mind and with all your strength.' The second is this: 'Love your neighbor as yourself.' There is no commandment greater than these." "Well said, teacher," the man replied. "You are right in saying that God is one and there is no other but him. To love him with all your heart, with all your understanding and with all your strength, and to love your neighbor as yourself is more important than all burnt offerings and sacrifices." When Jesus saw that he had answered wisely, he said to him, "You are not far from the kingdom of God." And from then on no one dared ask him any more questions.*

Jesus' comments tell us to know what is important, what is the highest priority and where to focus our attention. So, also, does Deming's first point.

We cannot take scripture out of context nor even combine scriptures together to create a new meaning. The Bible speaks harshly about anyone who adds to or takes away from scripture. See what John recorded from Revelation:

> *Revelation 22:18-19: I warn everyone who hears the words of the prophecy of this book: If anyone adds anything to them, God will add to him the plagues described in this book. And if anyone takes words away from this book of prophecy, God will take away from him his share in the tree of life and in the holy city, which are described in this book.*

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The reader is encouraged — perhaps commanded is a better word — to examine this scripture and all others used in this treatise in the context of the Biblical passage it was taken from.

Christians are admonished by this passage to keep the first thing **the first thing** each and every time. Mission and vision are critical for a company if it is be successful. There must be one main goal in life. Short term profits are made when the company strays from the long term mission. Long term success will only be gained by those who constantly look to the vision and mission of the company and insure that all their actions lead the company to the complete and thorough accomplishment of the company's purpose. Scripture's admonition is, *"what does it profit a man to gain the whole world and lose his own soul?"*

Deming points out that our purpose is not to make profit. This goes against the teachings of most Western business philosophers and against the teachings of many premier business schools. Deming does not talk against profit. His other writings continuously stress that profit is important. He emphasizes that profit is the result of the operations of the business and not a primary goal.

> *Matthew 6:33: But seek first his kingdom and his righteousness, and all these things will be given to you as well.*

Deming points out in his many writings, as do his disciples in their works, that it is important for all people in the business to move towards the same goal. Christians will recognize this admonition as seeking unity in all we do. Look to see how Paul wrote of unity in his letters to the Romans, the Ephesians and the Colossians.

> *Romans 15:5-6: May the God who gives endurance and encouragement give you a spirit of unity among yourselves as you follow Christ Jesus, so that with one heart and mouth you may glorify the God and Father of our Lord Jesus Christ.*

> *Colossians 3:14: And over all these virtues put on love, which binds them all together in perfect unity.*

> *Ephesians 4:3: Make every effort to keep the unity of the Spirit through the bond of peace.*

> *Ephesians 4:13: Until we all reach unity in the faith and in the knowledge of the Son of God and become mature, attaining to the whole measure of the fullness of Christ.*

These scriptures emphasize a oneness, but not at the expense of separation of duties. Consider a man walking. The person as an organization has an agreed upon purpose in walking to a specific location across the room. To get there, he must walk around the chair and turn behind a room divider to reach his goal. Many parts of his body must perform separate activities in order for the organization to be successful. The legs must move in a preset pattern, the eyes must look at obstacles and focus on the long range goal. The mind must interpret the visual clues and advise the muscles in how to change such that adjustments around furniture are made. The hands must reach out for the back of the chair to steady the body around the turn. The internal organs must perform well before the act of walking and continue to work over the long run to insure that all parts of the body have nourishment and needed supplies,

and that waste is removed to protect the body parts. Each part is operating with the specific gifts and skills given by God, yet working with a common goal in unity with all other parts of the organization.

Examine these scriptures to see how Biblical writers saw unity as an example of strength:

> *Genesis 11:6: The Lord said, "If as one people speaking the same language they have begun to do this, then nothing they plan to do will be impossible for them.*

> *Amos 3:3: Do two walk together unless they have agreed to do so? (Amos is citing a proverb.)*

> *Matthew 12:25: Jesus knew their thoughts and said to them, "Every kingdom divided against itself will be ruined, and every city or household divided against itself will not stand."*

Unity, by itself, does not contribute "rightness." Thieves who practice unity become better and stronger thieves. Think for a minute, what makes a gang of thieves so strong? Is it their ability to write a strong Articles of Incorporation and Bylaws? No, for the most part there is a formal structure understood by all members. There is also a common base of unity from which the entire gang operates, with one mind and one purpose.

Unity brings a cohesiveness to the direction of the whole, for there is a commonality of purpose. Without unity, it is very easy for individuals and small groups of people who mean well to invest resources and time into activities which will actually move the organization away from the stated goals.

Look at how John recorded the words of Christ. See how the focus of unity and the desire for a common direction yield the greater intent of seeking God and the kingdom of heaven through all actions.

> *John 17:23: I in them and you in me. May they be brought to complete unity to let the world know that you sent me and have loved them even as you have loved me.*

The writer of 2 Chronicles illustrates that God was at work in the lives of the Jewish organization. Unity provided strength and purpose to carry out the directions of "senior management."

> *2 Chronicles 30:12: Also in Judah the hand of God was on the people to give them unity of mind to carry out what the king and his officials had ordered, following the word of the Lord.*

The Psalms speak of times of good and times of bad. Unity is described in this single verse as both pleasant and good.

> *Psalms 133:1: How good and pleasant it is when brothers live together in unity!*

There is protection in unity as well. Divided we fall, but united we can endure all things. Matthew's scripture is repeated here because it applies to this thought as well.

Matthew 12:25: Jesus knew their thoughts and said to them, "Every kingdom divided against itself will be ruined, and every city or household divided against itself will not stand."

Ecclesiastes 4:12: Though one may be overpowered, two can defend themselves. A cord of three strands is not quickly broken.

This was best described during a Cub Scout Blue and Gold Banquet. The Cub Scouts are organized into dens, then into packs, then into districts and then into zones. The pack usually contains some 25-100 boys. The Blue and Gold Banquet is an annual dinner where members of the pack and dens are honored for the work they completed during the past year. The Cub Master, leading the banquet, desired to demonstrate to the boys and to the parents how unity impacts our lives. He used two examples. The first was to bring up one scout from each of the six dens. He took six long pieces of thick yarn, three gold and three blue, and gave each piece to each scout. He asked for the largest, strongest father in the crowd to come and break a seventh piece of the yarn. The father's strength severed the yarn easily. He asked each cub scout if his one piece of yarn could bind the man. Each scout in turn answered no.

The Cub Master then instructed each boy to stand in front of the other scout with the same color yarn. He instructed the scouts to take the other's yarn in their free hand and then step back, removing the slack in the yarn. The Cub Master through demonstration, verbal signals and encouragement had the boys braid the six strands of yarn into one unified rope. The rope was thick and strong.

The Cub Master then looked at the group of six scouts and asked if they, together with their "rope" of yarn, could bind the strong man. They yelled a resounding "YES" and proceeded to tie the yarn around the upper body and arms of the giant father. The father twisted and squirmed and stretched with all his might to no avail. The rope held. What each could not do alone was accomplished with unity. The scouts worked well together and left that demonstration happy in their new found strength.

There are economic and spiritual strongmen around us each day. Daily we must set our defenses to ward off the strongmen and learn how we might go through their defenses. Unified we can stand firm. The center of the unified Christian group is God. We are to do all things for the glory of the Lord and seek Him in all we do. Note that this becomes a circular reference. We are to start with God and end with God. Note this in the following two passages.

1 Corinthians 10:31: So whether you eat or drink or whatever you do, do it all for the glory of God.

Psalm 27:1-3: The Lord is my light and my salvation--whom shall I fear? The Lord is the stronghold of my life--of whom shall I be afraid? When evil men advance against me to devour my flesh(or to slander me), when my enemies and my foes attack me, they will stumble and fall. Though an army besiege me, my heart will not fear; though war break out against me, even then will I be confident. (Parenthetical note mine)

Deming's first point provides the same intensity and solidity that Jesus' statement in Mark 12 presents. We must be focused in our walk with our Lord and in our businesses. It is equally important for each person to know and internalize the focus.

Note the close relationship between the first and second of Deming's points as you read through the second point.

2.   Adopt the new philosophy.

Americans are too tolerant of poor workmanship and sullen service. We need a new religion in which mistakes and negativism are unacceptable.

Deming refers to the adoption of the philosophy not just by the employees of the firm but by all of the country. Customers must not accept shoddy workmanship as well. This principle seems to move from the executive suite to the middle managers and then to the line workers themselves. Marketing would have to communicate the message of the new philosophy to all the customer base as well to accomplish this step.

Proverbs speak to wisdom and acceptable behavior. They also warn of the fool and the un-trustable. As an example, Proverbs 23:7 speaks about a man interested in the cost of the product. He appears to be interested in you as a customer but is, in fact, only interested in his own well being.

> *Proverbs 23:7: For he is the kind of man who is always thinking about the cost. (Or for as he thinks within himself, so he is; or for as he puts on a feast, so he is) "Eat and drink," he says to you, but his heart is not with you.*

Deming instructs senior executives to set an example for other managers and for all employees to follow. Joshua was one such example. Joshua found it necessary to convince many others with him to act in a unified manner. He commanded those around him to choose whom they would serve and to make a visible and complete commitment. Note his teaching:

> *Joshua 24:14-15: Now fear the Lord and serve him with all faithfulness. Throw away the gods your forefathers worshipped beyond the River and in Egypt, and serve the Lord. But if serving the Lord seems undesirable to you, then choose for yourselves this day whom you will serve, whether the gods your forefathers served beyond the River, or the gods of the Amorites, in whose land you are living. But as for me and my household, we will serve the Lord.*

Joshua understands that not all people will be brought along on this "band wagon." There must be an acceptable way out for customers who seek vendors whom they can intimidate and employees whom they can mistreat because they are unable to see beyond the high walls of mis-management that engulf most western companies. We encourage them to leave and seek a pit they can be satisfied with. Note here that the missing ingredient is teaching and training. I will stress the importance of teaching and training in later points. This is akin to the parable of the wheat sower who, upon awakening, finds tares in his wheat. Jesus taught that the tares would be sorted out in the end. The end for business occurs rapidly and frequently in the marketplace with customers deciding whether or not to continue a relationship. The parable of the talents makes it clear that when a business leaves the marketplace, the talents are taken away and given to a firm who already possesses talents.

Deming's second principle has a built-in presumption that senior management explained and taught the principles to the best of their ability. This second principle deals with the company-wide adoption of the focus, vision and mission detailed in Principle One.

It is also presumed that senior management adopts the management lifestyle of servant leadership. More about servant leadership later in this writing.

The new philosophy which Deming speaks about in his first principle is akin to the young man keeping the Word of God close to him as told in this passage from Psalms 119:

> *Psalm 119:9-11: How can a young man keep his way pure? By living according to your word. I seek you with all my heart; do not let me stray from your commands. I have hidden your word in my heart that I might not sin against you.*

With the adoption of a new or modified philosophy, there is a need for a clean break and a commitment to the new thought. Marriage and binding contracts between two business parties require loyalty. Jesus' words from the gospel according to Matthew emphasize the importance of loyalty and a complete turning toward the new philosophy:

> *Matthew 6:24: "No one can serve two masters. Either he will hate the one and love the other, or he will be devoted to the one and despise the other. You cannot serve both God and Money.*

> *Matthew 6:32-33: For the pagans run after all these things, and your heavenly Father knows that you need them. But seek first his kingdom and his righteousness, and all these things will be given to you as well.*

3. Cease dependence on mass inspection.

American firms typically inspect a product as it comes off the assembly line or at major stages along the way; defective products are either thrown out or reworked. Both practices are unnecessarily expensive. In effect, a company is paying workers to make defects and then to correct them. Quality comes not from inspection but from improvement of the process. With instruction, workers can be enlisted in this improvement.

Deming supports the concepts of engineering and building quality into the process. To accomplish this, it is important for the production line worker to consider the next process or employee as the customer. Each employee must see his or her actions contributing to the quality of the product as Paul saw himself being only one of several who tended the crops:

> *1 Corinthians 3:6-13: I planted the seed, Apollos watered it, but God made it grow. So neither he who plants nor he who waters is anything, but only God, who makes things grow. The man who plants and the man who waters have one purpose, and each will be rewarded according to his own labor. For we are God's*

fellow workers; you are God's field, God's building. By the grace God has given me, I laid a foundation as an expert builder, and someone else is building on it. But each one should be careful how he builds. For no one can lay any foundation other than the one already laid, which is Jesus Christ. If any man builds on this foundation using gold, silver, costly stones, wood, hay or straw, his work will be shown for what it is, because the Day will bring it to light. It will be revealed with fire, and the fire will test the quality of each man's work.

This passage from 1 Corinthians portrays an excellent example of separation of duties with a common goal. Note that neither Paul nor Apollos desired to take credit for the final accomplishment. Rather, they were willing to give the credit of the whole to God.

Consider these two passages as examples of what must happen to cause mass inspection at the end.

Jesus told them another parable: "The kingdom of heaven is like a man who sowed good seed in his field. But while everyone was sleeping, his enemy came and sowed weeds among the wheat, and went away. When the wheat sprouted and formed heads, then the weeds also appeared.

The owner's servants came to him and said, 'Sir, didn't you sow good seed in your field? Where then did the weeds come from?'

'An enemy did this,' he replied.

The servants asked him, 'Do you want us to go and pull them up?'

'No,' he answered, 'because while you are pulling the weeds, you may root up the wheat with them. Let both grow together until the harvest. At that time I will tell the harvesters: First collect the weeds and tie them in bundles to be burned; then gather the wheat and bring it into my barn.'"
Matthew 13:24-30

And I saw the dead, great and small, standing before the throne, and books were opened. Another book was opened, which is the book of life. The dead were judged according to what they had done as recorded in the books. The sea gave up the dead that were in it, and death and Hades gave up the dead that were in them, and each person was judged according to what he had done. Then death and Hades were thrown into the lake of fire. The lake of fire is the second death. If anyone's name was not found written in the book of life, he was thrown into the lake of fire.
Revelation 20:12-15

Each of these two passages show the results of corrupting the process. The first example shows the results of sowing seeds of destruction in a company by building junk from the start. How much better would it have been if the enemy were blocked from sowing weeds in our wheat. The second is like the first. God did not make man to sin against Him. He made man in order that man might work and God might fellowship with him. When this process was corrupted by man's decision to sin, then the need arose to examine man in the end times and cull out the bad products.

Sin was brought into the world by man and Satan, not by God. God desired a perfect world in which all things are produced without defects. Sin can be compared to faults in the processes of business which allow the manufacture of goods and services with defects in the first place. Once the defect is made, the damage is done. We can prevent the next customer, or final consumer, from seeing our defect by inspecting defects out of the finished goods. We can never inspect quality into a product or service. The payment for allowing sin into the processes of our companies is the need to inspect for defects. The cost for this sin must be added to the cost of the product. Those firms which are able to remove sin from their lives can offer the same package of goods and services to the consumers for a lower price and thus are more competitive in the marketplace.

4.   End the practice of awarding business based on the price tag alone.

Purchasing departments customarily operate on orders to seek the lowest-priced vendor. Frequently, this leads to purchases of low quality. Instead, buyers should seek the best quality in a long-term relationship with a single supplier for any one item. The key word here is *relationship*. Price alone implies only a superficial involvement between parties. Rather, a covenantal relationship should be developed, sole sourcing each component or raw material. This concept is also called creating value-added partnerships. Each party brings certain needs and desires to the table in addition to the materials and labor. Vendors want long term commitment to goods and prices. Buyers want long term commitment to supply and price. Each party has the best interest of the other in mind. This attitude is significantly different from the typical Western manufacturing mentality. See what the writer of this Proverb said:

> *Like a bad tooth or a lame foot is reliance on the unfaithful in times*
> *of trouble.*
> *Proverbs 25:19*

Rather, we should follow the advice of Paul:

> *Nobody should seek his own good, but the good of others.*
> *1 Corinthians 10:24*

The typical broad stroke comparison of buyer-supplier relationship is that of the buyer arguing over price, soliciting bids from several suppliers and always looking for a lower price. The supplier is always suspicious of the buyer's intentions and ability to pay. The supplier never believes the stories of grand orders to come if only the supplier does this or that for the buyer on the first order. The writer of these Proverbs gives us advice and warning together:

> *"It's no good, it's no good!" says the buyer; then off he goes and*
> *boasts about his purchase.*
> *Proverbs 20:14*

> *Food gained by fraud tastes sweet to a man, but he ends up with a mouth full of gravel.*
> *Proverbs 20:17*

Imagine a friendship where each party seeks to take from the other and give back only minimally. Imagine a friendship where lying and the hiding of information are common activities. Imagine a friendship where long term relationships are accepted only if each party sees what is in it for themselves.

> *Simply let your 'Yes' be 'Yes,' and your 'No,' 'No'; anything beyond this comes from the evil one.*
> *Matthew 5:37*

Imagine the reaction when one friend finds out that the other has been seeing several other people and telling them that each of them is his or her best friend.

This analogy stretches the attitude a little to over-emphasize the point. The typical relationship between buyer and vendor is not quite so openly antagonistic. Most buyer-seller relationships, however, are based on a "what is in it for me" attitude.

Deming's fourth point goes beyond the need to seek quality and service as main components of the contract award. It goes to the basis of relationship. Companies adopting this philosophy have sought to implement this principle. Those companies, such as Xerox, have reduced vendor lists to 10% of their former size. Xerox reduced its vendor base from 3,000 to approximately 300. Each of the 300 vendors are satisfied even if the sales dollars are the same. The vendor does not have to wonder about the buyer's behavior toward future business.

This relationship implies a different way of operating as well. Each party should have access to the staff and facilities of each other. Since the parties are dependent on each other, it is advisable for each party to know the financial and structural soundness of the other. Consider the words of advice about relationships from this Proverb:

> *A man of many companions may come to ruin, but there is a friend who sticks closer than a brother.*
> *Proverbs 18:24*

Deming's fourth point about stopping the award of purchase orders on price alone can be supported by the scripture of looking at the heart of man rather than at the surface. There are many hidden costs in purchasing. The costs of quality, or rather the lack of it; the method and timeliness of delivery; the packing and containerization; the amount of waste; the list goes on and on. See how the writer of 1 Samuel records the words of God to Samuel about appearance:

> *But the Lord said to Samuel, "Do not consider his appearance or his height, for I have rejected him. The Lord does not look at the things man looks at. Man looks at the outward appearance, but the Lord looks at the heart."*
> *1 Samuel 16:7*

This scripture does, in fact, support an interesting trend beginning to develop in world class manufacturing companies and suppliers. There is a trend to look for suppliers who will grow with the buyer. The buyer knows where they are heading and what type of supplies and suppliers they will need in the future. The buyer looks

for suppliers who have the internal qualities to become world class suppliers in the future. This can only be done by knowing the heart of the man.

A company trying to embrace these concepts found themselves faced with a cash shortfall. The CEO thought: "Should I inform my main suppliers of my current financial weakness? Will they lose faith in me as their customer?" The CEO opted to tell his main suppliers about the condition. The major suppliers took immediate action granting a significant amount of unexpected, much needed credit and some discounts as well. This only could occur when trust and openness in information exists.

> *Most men will proclaim each own goodness but who can find a*
> *faithful man?*
> *Proverbs 20:6*

Paul advises wives not to rely on ornaments or braided hair to make them attractive, but rather to have an inward beauty which is solid and longer lasting than the fleeting cosmetic appearance. So it should be in the relationship of the vendor and buyer. The relationship should be based on the solid inward trust and beauty of a value-added partnership.

An issue to consider is the scripture admonition of not being unequally yoked. If we know the heart of the man and we have sought a value-added partnership and allowed the relationship to grow, there is little chance of unequal yoking. Should the supplier or the buyer change their philosophy in the future, then new decisions are made as to whether or not the relationship should continue. All good friendships, and even marriages, grow and improve when both parties keep their eyes open and look out for the best interests of the other.

5. Improve constantly and forever the system of production and service.

Improvement is not a one-time effort. Management is continually obligated to look for ways to reduce waste and improve quality.

This direction by Deming follows the same logical thought process as the Christian walk: constantly seeking to become Christ-like but knowing that we will never attain the final state. We continue to strive toward the end goal: ever working, ever improving in the way we live our life. There is no support in the Bible for living a life of sin and being satisfied. We rejoice in the scriptures which assure us that we are forgiven when we sin. It is important to remember that forgiveness is given when we show repentance and turn away from the sinful activity. This repentance leads to a correct lifestyle, and it is this lifestyle that we should endeavor to continue.

In business we need to manage our affairs so that we can win the race. We must follow Paul's teaching to the Corinthian church:

> *Do you not know that in a race all the runners run, but only one gets*
> *the prize? Run in such a way as to get the prize. Everyone who*
> *competes in the games goes into strict training. They do it to get*
> *a crown that will not last; but we do it to get a crown that will*
> *last forever. Therefore I do not run like a man running aimlessly;*
> *I do not fight like a man beating the air. No, I beat my body and*
> *make it my slave so that after I have preached to others, I myself*

> *will not be disqualified for the prize.*
> *1 Corinthians 9:24-27*

We must continually train and exercise our management gifts and abilities so that we continually improve our capabilities.

These next three scriptures help to support this concept of doing our best and continually improving our abilities. Paul's comment to Timothy refers to the thought of keeping your mind and energy focused on what your firm has called you to do. The emphasis is not on ignoring the civilian affairs but remembering to accomplish the firm's tasks first.

> *Whatever your hand finds to do, do it with all your might, for in the grave, where you are going, there is neither working nor planning nor knowledge nor wisdom.*
> *Ecclesiastes 9:10*

> *Whatever you do, work at it with all your heart, as working for the Lord, not for men.*
> *Colossians 3:23*

> *No one serving as a soldier gets involved in civilian affairs--he wants to please his commanding officer.*
> *2 Timothy 2:4*

This ties also to the Law of Use as expressed by Pat Robertson in his book *The Secret Kingdom*. The Law of Use states that as we use a gift, the gift increases in measure, thus improving our skills and abilities. This is best illustrated by someone physically exercising his muscles. In the beginning there is pain and discomfort while the body adjusts to the new lifestyle. Over time, the body adjusts and begins to respond to the use. As weights are increased, the muscles continue to gain strength and definition. The organization and managers grow in this same manner as efforts are made to continually improve.

6. Institute training.

Too often, workers have learned their job from another worker who was never trained properly. They are forced to follow unintelligible instructions. They can't do their jobs well because no one has told them how to do it properly.

Scripture guides us in this study. Jesus spent 40 days in intensive spiritual training before beginning His ministry. Paul spent three years in the desert being taught. The disciples were paired and sent out by Jesus. Each pair returned and gave an account of their activities. Throughout the Bible we see the pairing up of men to learn from each other.

The old guild process of master and apprentice should still be considered today. Apprentices were indentured to a master craftsman for a period of time, usually for two or more years, during which they learned the craft from the master. When the apprentice could produce work indistinguishable from the master's, then the apprentice was released to work on his own.

Today we allow workers who may or may not know their job well to train new workers. One of the saddest things in modern industry is the instructing of the

unteachable by the untrained using untested methods. This, combined with the lack of follow-up by managers, provides a costly combination to the firm.

Deming promotes the concept of training the trainers and making sure that each and every employee knows how to do their job well. In addition, each employee is taught the methods of statistical control and how to apply the knowledge gained from tracking the process. See the following advice from Paul to Timothy:

> *And the things you have heard me say in the presence of many witnesses entrust to reliable men who will also be qualified to teach others.*
> *2 Timothy 2:2*

Americans remember with pride how we trained Air Force pilots during World War II. The best aviators were taught how to teach and were kept here in the States to train new pilots. Only the best were sent overseas as a result. Yet, in industry, we are willing to allow the three month employee to train the new recruit. Then we wonder why workmanship deteriorates.

Teaching is not to be taken lightly. The scriptures warn the teacher that he or she has taken a fiduciary position and the outcome of the student is entrusted to him.

> *Not many of you should presume to be teachers, my brothers, because you know that we who teach will be judged more strictly.*
> *James 3:1*

With teaching comes the necessity for students to have a teachable spirit. A closed mind is the hardest thing to open and usually if opened, is full of so much clutter that there is no room for anything else. Note the following scriptures and their wisdom towards teaching.

> *He who scorns instruction will pay for it, but he who respects a command is rewarded.*
> *Proverbs 13:13*

> *Whoever gives heed to instruction prospers, and blessed is he who trusts in the Lord.*
> *Proverbs 16:20*

> *A wise man has great power, and a man of knowledge increases strength; for waging war you need guidance, and for victory many advisers.*
> *Proverbs 24:5-6*

> *A student is not above his teacher, but everyone who is fully trained will be like his teacher.*
> *Luke 6:40*

Training is an ongoing process. The scriptures tell us that we are to train up a child in the way he should behave and as he grows, he will not depart from the way. The child is not trained in acceptable behavior one time or even two or three times. The parents and elders of the child will continuously instruct him in correct ways and beliefs. The

parents and elders will also watch to see that bad behaviors and habits do not creep into the child.

7. Institute leadership.

The job of a supervisor is not to tell people what to do nor to punish them, their job is to lead. Leading consists of helping people do a better job and, learning by objective methods, discovering who is in need of individual help. The Old Testament is full of examples of leaders leading people and not just telling people. David led in war, Solomon led in war, and Joshua led in both peace and war.

We need true leaders in business today more than ever before. The need is imperative because of the lack of leadership in today's business offices. Look at the Old Testament advice to a leader:

> *When a country is rebellious, it has many rulers, but a man of understanding and knowledge maintains order. A ruler who oppresses the poor is like a driving rain that leaves no crops.*
> *Proverbs 28:2-3*

Our businesses are guided by "un-captains" who know not the sea, the ship, nor the men who are placed on board to handle the rigging and cargo. Our companies are steered by many "un-leaders", who vie for their own agenda and seek not the greater mission of their companies. Perhaps much of this is our own fault. Each step that we took away from the path of leadership and strong business foundations seemed appropriate at the time. It is the combination of all the small angles of deflection which now show us the chasm which we have allowed to develop in our businesses.

Hard goods manufacturing companies' CEOs stand before the press and cry for protection from foreign competition. Why not look at themselves and ask what could they do for their countries? CEOs across America are giving themselves raises while their companies lose money and competitive advantage. We have allowed the leaders to no longer be accountable to us for the condition of the ship. Rather, we have allowed them to blame the government, the foreign governments, the unions, and even the workers -- the very people they were chosen to lead.

Leadership must be by example, word and belief. The phrase "do as I say and not as I do" must be banished from the board room and executive suites of America. As business people, Americans scoffed at the behavior of the Japanese when senior executives wore short sleeve shirts with their first name above the pocket and participated with workers in problem-solving sessions. American business people scoffed when the Japanese executives listened in earnest as workers described improved safety procedures. The reason given was clear. The American CEO was too prideful of positional authority to allow someone he supposedly led to advise him on what to do.

How sad it is when we are no longer able to learn because "we are the boss." How sad it is that our minds are so full of pride and prejudice that we no longer can see the people we are called to lead as intelligent, interested, thoughtful people capable of guiding us, and yes, even the entire organization.

These following Proverbs give us insight into understanding the value of advice we get from those who know more than we do. The employees who work with the

product or service everyday know much more than the senior leaders about what is going on in the company.

> *When a mocker is punished, the simple gain wisdom; when a wise man is instructed, he gets knowledge.*
> *Proverbs 21:11*

> *Through knowledge its rooms are filled with rare and beautiful treasures. A wise man has great power, and a man of knowledge increases strength; for waging war you need guidance, and for victory many advisers.*
> *Proverbs 24:4-6*

Scripture teaches about the priesthood of the believers. The priesthood implies the need to learn, to develop, to teach, to guide, to lead. How then can we have a priesthood of everyone? Is not one supposed to lead? We know that Jesus is the leader of all of us and we are to submit to His guidance. We lift up the mission of reaching all people with the message of salvation and redemption. How does this concept of priesthood relate to a corporation?

Each employee has an opportunity to lead in the function they perform. Each employee has the opportunity to exercise the skills and gifts of a leader. Yet, each must submit to one in a higher authority. This hierarchy exists in all companies. Different companies have different levels ranging from as flat as three to as gross as 15 levels.

The concept of shared leadership applies here as well. Shared leadership is viewed by some as serving two masters. This occurs with immature leaders in a position of shared responsibility. Shared leadership is effective only if each submits to the other when appropriate. Consider a formation of geese as they fly south for the winter months. The V-shape pattern of geese moves across the sky. Suddenly, without committee meetings or mandates from the board of directors, the formation changes. The leader moves to the end or the middle of the formation, a new leader assumes the head position and the flock glides into a new formation. It is all done without fanfare or press releases.

Why does the change occur? The leader and the one to the left and the one to the right take on the added stress of breaking the airflow. Each goose in sequence takes on a reduced air resistance. The leader can become tired sooner than those who follow. Failure to replace the leader periodically would mean the formation would continually slow down and eventually stall. The leadership changes to better the organization and to better the condition of all who follow. The leader who is now on R & R will not grumble or complain about the job the new leader is doing because the actions of the new leader and new pattern are well known to all in the formation. It has been tried and proven successful. The R & R leader is resting and must be mature enough to submit once again. Leadership is seen as a rightful duty to perform to the best of one's ability. Followership is as important and requires as many skills.

Read the words of Ted Engstrom in *The Making of A Christian Leader:*

THE WORLD NEEDS MEN . . . .

> *who cannot be bought;*
> *whose word is their bond;*

> *who put character above wealth;*
> *who possess opinions and a will;*
> *who are larger than their vocations;*
> *who do not hesitate to take chances;*
> *who will not lose their individuality in a crowd;*
> *who will be as honest in small things as in great things;*
> *who will make no compromise with wrong;*
> *whose ambitions are not confined to their own selfish desires;*
> *who will not say they do it "because everybody else does it;"*
> *who are true to their friends through good report and evil report, in*
> *adversity as well as in prosperity;*
> *who do not believe that shrewdness, cunning and hardheadedness are*
> *the best qualities for winning success;*
> *who are not ashamed or afraid to stand for the truth when it is*
> *unpopular;*
> *who can say "no" with emphasis, although all the rest of the world*
> *says "yes."[10]*

Paul described the character of leadership to Timothy saying:

> *Here is a trustworthy saying: If anyone sets his heart on being an*
> *overseer, he desires a noble task. Now the overseer must be*
> *above reproach, the husband of but one wife, temperate, self-*
> *controlled, respectable, hospitable, able to teach, not given to*
> *drunkenness, not violent but gentle, not quarrelsome, not a lover*
> *of money. He must manage his own family well and see that his*
> *children obey him with proper respect. (If anyone does not know*
> *how to manage his own family, how can he take care of God's*
> *church?) He must not be a recent convert, or he may become*
> *conceited and fall under the same judgment as the devil. He must*
> *also have a good reputation with outsiders, so that he will not fall*
> *into disgrace and into the devil's trap.*
> *1 Timothy 3:1-12*

Deacons, likewise, are to be men worthy of respect, sincere, not indulging in much wine, and not pursuing dishonest gain. They must keep hold of the deep truths of the faith with a clear conscience. They must first be tested; and then if there is nothing against them, let them serve as deacons.

In the same way, their wives are to be women worthy of respect, not malicious talkers but temperate and trustworthy in everything. A deacon must be the husband of but one wife and must manage his children and his household well.

Peter aptly describes a crowning motto for all leaders:

> *Be shepherds of God's flock that is under your care, serving as*
> *overseers--not because you must, but because you are willing, as*
> *God wants you to be; not greedy for money, but eager to serve;*
> *not lording it over those entrusted to you, but being examples to*
> *the flock. And when the Chief Shepherd appears, you will receive*

> *the crown of glory that will never fade away.*
> *1 Peter 5:2-4*

Note that Peter says to lead because you are willing, not because you must. Those who lord it over a flock do so because of greed, pride and a haughty spirit. Those leaders who are truly in submission to Christ are unable to lord it over anyone because their role model is Jesus. Jesus led by example. That example was Servanthood.

> *Who, being in very nature God, did not consider equality with God something to be grasped, but made himself nothing, taking the very nature of a servant, being made in human likeness. And being found in appearance as a man, he humbled himself and became obedient to death--even death on a cross!*
> *Philippians 2:6-8*

The Christ-like leader will have people following him wherever he goes. The Christ-like leader knows that people follow him not because of what he is or who he is, but because of who Christ is. The Christ-like leader understands that all the skills and abilities he possesses are given to him by God and must be used in a stewardly manner. The abuse and misuse of people we are called to lead cannot occur if we operate under Biblical Stewardship guidelines.

Stewardship of people is best summarized by this scripture:

> *The good man brings good things out of the good stored up in him, and the evil man brings evil things out of the evil stored up in him. But I tell you that men will have to give account on the day of judgment for every careless word they have spoken.*
> *Matthew 12:35-36*

Good begets good and evil begets evil. Bring the good up out of a leader and good will be brought up out of the people who follow. The leader can choose to bring up good or evil. The Christ-like leader should always be clear on which to choose.

Isaiah aptly describes the type of leader we look for:

> *He who walks righteously and speaks what is right, who rejects gain from extortion and keeps his hand from accepting bribes, who stops his ears against plots of murder and shuts his eyes against contemplating evil, this is the man who will dwell on the heights, whose refuge will be the mountain fortress. His bread will be supplied, and water will not fail him.*
> *Isaiah 33:15-16*

This is the type of leader Deming speaks of.

8. Drive out fear.

Many employees are afraid to ask questions or to take a position, even when they do not understand what their job is or what is right or wrong. They will continue to do things the wrong way or to not do them at all. The economic losses from fear are appalling. To assure better quality and productivity, employees need to feel secure.

The scriptures speak of two types of fear. The fear described above is handled in several scriptures. The following is a collection of scriptures on "negative fear." See for yourself what God tells us.

Moses answered the people, "Do not be afraid. Stand firm and you will see the deliverance the Lord will bring you today. The Egyptians you see today you will never see again. The Lord will fight for you; you need only to be still."
Exodus 14:13-14

So do not fear, for I am with you; do not be dismayed, for I am your God. I will strengthen you and help you; I will uphold you with my righteous right hand.
Isaiah 41:10

Then Jesus said to his disciples: "Therefore I tell you, do not worry about your life, what you will eat; or about your body, what you will wear. Life is more than food, and the body more than clothes. Consider the ravens: They do not sow or reap, they have no storeroom or barn; yet God feeds them. And how much more valuable you are than birds! Who of you by worrying can add a single hour to his life? Since you cannot do this very little thing, why do you worry about the rest? Consider how the lilies grow. They do not labor or spin. Yet I tell you, not even Solomon in all his splendor was dressed like one of these. If that is how God clothes the grass of the field, which is here today, and tomorrow is thrown into the fire, how much more will he clothe you, O you of little faith! And do not set your heart on what you will eat or drink; do not worry about it. For the pagan world runs after all such things, and your Father knows that you need them. But seek his kingdom, and these things will be given to you as well.

Do not be afraid, little flock, for your Father has been pleased to give you the kingdom. Sell your possessions and give to the poor. Provide purses for yourselves that will not wear out, a treasure in heaven that will not be exhausted, where no thief comes near and no moth destroys. For where your treasure is, there your heart will be also."
Luke 12:22-34

I have told you these things, so that in me you may have peace. In this world you will have trouble. But take heart! I have overcome the world.
John 16:33

Do not be anxious about anything, but in everything, by prayer and petition, with thanksgiving, present your requests to God. And the

peace of God, which transcends all understanding, will guard your hearts and your minds in Christ Jesus. Finally, brothers, whatever is true, whatever is noble, whatever is right, whatever is pure, whatever is lovely, whatever is admirable--if anything is excellent or praiseworthy--think about such things.
Philippians 4:6-8

But thanks be to God! He gives us the victory through our Lord Jesus Christ. Therefore, my dear brothers, stand firm. Let nothing move you. Always give yourselves fully to the work of the Lord, because you know that your labor in the Lord is not in vain.
1 Corinthians 15:57-58

But thanks be to God, who always leads us in triumphal procession in Christ and through us spreads everywhere the fragrance of the knowledge of him.
2 Corinthians 2:14

For everyone born of God overcomes the world. This is the victory that has overcome the world, even our faith.
1 John 5:4

I can do everything through him who gives me strength.
Philippians 4:13

The underlying theme to these scriptures is the understanding that we need not be afraid of man, for God is with us. Man can do nothing to us in the long run.

The previous section on leadership made it clear that the mature Christ-like leader would not do anything to hurt followers. How can he if the care of the followers is entrusted to him? The steward entrusted with the Master's goods must protect, nurture and cultivate those goods. The Master expects an increase. The servant leader will work to that end.

Why then do we see so much fear in the workplace? Many immature leaders are only able to control people through threats and pain. This is akin to managerial extortion. This behavior should be as illegal in management as it is in the courts.

The second form of fear used in the scripture is of the form of respect and great understanding, usually used in the context of the fear of the Lord. Follow these scriptures to gain a better understanding of the fear of the Lord. It is important to remember that these scriptures are stepping stones into the Bible.

Abraham replied, "I said to myself, 'There is surely no fear of God in this place, and they will kill me because of my wife.'"
Genesis 20:11

Moses said to the people, "Do not be afraid. God has come to test you, so that the fear of God will be with you to keep you from sinning."
Exodus 20:20

When you were weary and worn out, they met you on your journey and cut off all who were lagging behind; they had no fear of God.
Deuteronomy 25:18

The God of Israel spoke, the Rock of Israel said to me: "When one rules over men in righteousness, when he rules in the fear of God,. . ."
2 Samuel 23:3

The fear of God came upon all the kingdoms of the countries when they heard how the Lord had fought against the enemies of Israel.
1 Chronicles 20:29

He sought God during the days of Zechariah, who instructed him in the fear of God. As long as he sought the Lord, God gave him success.
1 Chronicles 26:5

An oracle is within my heart concerning the sinfulness of the wicked: There is no fear of God before his eyes.
Psalms 36:1

God, who is enthroned forever, will hear them and afflict them--Selah men who never change their ways and have no fear of God.
Psalms 55:19

There is no fear of God before their eyes.
Romans 3:18

The fear of the Lord is described in several parts of scripture. Each passage emphasizes the understanding of the commandments, wisdom and discernment as elements in the fear of the Lord. The following group of scripture is valuable for the comprehension of the fear of the Lord.

The fear of the Lord fell on all the kingdoms of the lands surrounding Judah, so that they did not make war with Jehoshaphat.
2 Chronicles 17:10

Now let the fear of the Lord be upon you. Judge carefully, for with the Lord our God there is no injustice or partiality or bribery.
2 Chronicles 19:7

He gave them these orders: "You must serve faithfully and wholeheartedly in the fear of the Lord."
2 Chronicles 19:9

And he said to man, "The fear of the Lord--that is wisdom, and to shun evil is understanding."
Job 28:28

The fear of the Lord is pure, enduring forever. The ordinances of the Lord are sure and altogether righteous.
Psalms 19:9

Come, my children, listen to me; I will teach you the fear of the Lord.
Psalms 34:11

The fear of the Lord is the beginning of wisdom; all who follow his precepts have good understanding. To him belongs eternal praise.
Psalms 111:10

The fear of the Lord is the beginning of knowledge, but fools* despise wisdom and discipline.
Proverbs 1:7

(* The Hebrew words rendered "fool" in Proverbs, and often elsewhere in the Old Testament, denote one who is morally deficient.)

Then you will understand the fear of the Lord and find the knowledge of God.
Proverbs 2:5

The fear of the Lord is the beginning of wisdom, and knowledge of the Holy One is understanding.
Proverbs 9:10

The fear of the Lord adds length to life, but the years of the wicked are cut short.
Proverbs 10:27

The fear of the Lord is a fountain of life, turning a man from the snares of death.
Proverbs 14:27

Better a little with the fear of the Lord than great wealth with turmoil.
Proverbs 15:16

The fear of the Lord teaches a man wisdom, and humility comes before honor.
Proverbs 15:33

Through love and faithfulness sin is atoned for; through the fear of the Lord a man avoids evil.
Proverbs 16:6

The fear of the Lord leads to life: Then one rests content, untouched by trouble.
Proverbs 19:23

Humility and the fear of the Lord bring wealth and honor and life.
Proverbs 22:4

Do not let your heart envy sinners, but always be zealous for the fear
of the Lord.
Proverbs 23:17

The Spirit of the Lord will rest on him--the Spirit of wisdom and of
understanding, the Spirit of counsel and of power, the Spirit of
knowledge and of the fear of the Lord--
and he will delight in the fear of the Lord. He will not judge by
what he sees with his eyes, or decide by what he hears with his
ears.
Isaiah 11:2-3

He will be the sure foundation for your times, a rich store of
salvation and wisdom and knowledge; the fear of the Lord is the
key to this treasure.
Isaiah 33:6

Then the church throughout Judea, Galilee and Samaria enjoyed a
time of peace. It was strengthened; and encouraged by the Holy
Spirit, it grew in numbers, living in the fear of the Lord.
Acts 9:31

The fear of the Lord brings with it an understanding of knowledge and wisdom. The scriptures intertwine the fear of the Lord, knowledge of right and wrong, discernment of the environment and the wisdom to know what to do with the information.

9. Break down barriers between staff areas.

Often a company's departments or units are competing with each other or have goals that conflict. They do not work as a team so they can solve or foresee problems. Or worse, one department's goals may cause trouble for another.

Managers are guilty of building miniature kingdoms within the companies they work for. Each manager seeking to build greater walls around his little kingdom insulates himself from the other departments. The building up of the little kingdoms is akin to the rich man who sought even greater barns. See the story in the gospel according to Luke:

Luke 12:16-21: And he told them this parable: "The ground of a
certain rich man produced a good crop. He thought to himself,
'What shall I do? I have no place to store my crops.' Then he
said, 'This is what I'll do. I will tear down my barns and build
bigger ones, and there I will store all my grain and my goods.
And I'll say to myself, "You have plenty of good things laid up for
many years. Take life easy; eat, drink and be merry."' But God
said to him, 'You fool! This very night your life will be demanded

> *from you. Then who will get what you have prepared for*
> *yourself?' This is how it will be with anyone who stores up things*
> *for himself but is not rich toward God."*

Greed is a powerful negative force impacting the very soul of the collective management team. Charles Swindoll, in his book *Living Above the Level of Mediocrity,* describes the four faces of greed. The third and fourth faces are applicable to what is discussed here.

> *Third, greed can wear the face of fame. Greed is also an excessive desire to become more famous, to make a name for oneself. Some are so determined to be stars, to be in lights, they'd stop at nothing to have people quote them or to be seen in celebrity circles. Thankfully, not all who are famous fall into the greedy category. It's wonderful to meet people who are stars and don't know it. . . .*

> *Fourth, greed can wear the face of control. Such greed is an excessive need to gain more control -- to gain mastery over something or someone, to always be in charge, to call all the shots, to become the top dog, the king of the hill. The great goal in many people's lives is to manipulate their way to the top of whichever success ladder they choose to climb.*[11]

Walls and barriers to communication are forms of shunning the other managers. A haughty spirit will usually accompany this barrier building.

> *Be kind and compassionate to one another, forgiving each other, just*
> *as in Christ God forgave you.*
> *Ephesians 4:32*

> *Command those who are rich in this present world not to be*
> *arrogant nor to put their hope in wealth, which is so uncertain,*
> *but to put their hope in God, who richly provides us with*
> *everything for our enjoyment. Command them to do good, to be*
> *rich in good deeds, and to be generous and willing to share. In*
> *this way they will lay up treasure for themselves as a firm foun-*
> *dation for the coming age, so that they may take hold of the life*
> *that is truly life.*
> *1 Timothy 6:17-19*

The fourth chapter of Ephesians is an outstanding source of guidance as to how we as managers should conduct ourselves toward other managers. This chapter is the great chapter on unity. It provides an understanding that each of us has certain gifts and abilities which, when taken together, make a magnificent body of people.

Paul wrote in verses 2 - 6:

> *Be completely humble and gentle; be patient, bearing with one*
> *another in love. Make every effort to keep the unity of the Spirit*
> *through the bond of peace. There is one body and one spirit --*
> *just as you were called to one hope when you were called -- one*

Lord, one faith one baptism; one God and Father of all, who is over all and through all and in all.

Verse 16 summarizes this thought:

From him the whole body, joined and held together by every supporting ligament, grows and builds itself up in love, as each part does its work.

Verses 25 through 32 concludes this critical chapter:

Therefore each of you must put off falsehood and speak truthfully to his neighbor, for we are all members of one body. In your anger do not sin. Do not let the sun go down while you are still angry, and do not give the devil a foothold. He who has been stealing must steal no longer, but must work, doing something useful with his own hands, that he may have something to share with those in need.

Do not let any unwholesome talk come out of your mouths, but only what is helpful for building others up according to their needs, that it may benefit those who listen. And do not grieve the Holy Spirit of God, with whom you were sealed for the day of redemption. Get rid of all bitterness, rage and anger, brawling and slander, along with every form of malice. Be kind and compassionate to one another, forgiving each other, just as in Christ God forgave you.

Paul's words to the church at Ephesus are still sage advice to the corporate middle managers today. The need to bond together and give of ourselves for the betterment of the greater corporation, serving one another, is paramount to creating a service-oriented organization.

I watched middle managers take pains to set up another manager so that the second manager fails in order that the first manager might look better by comparison. How sad that we are so immature we are unable to stand on our own, but must create a pile of damaged and destroyed lives around us to feel superior. See the admonition in the following Proverbs:

A righteous man is cautious in friendship, (Or man is a guide to his neighbor) but the way of the wicked leads them astray.
Proverbs 12:26

A perverse man stirs up dissension, and a gossip separates close friends.
Proverbs 16:28

Paul understood the need to deny self and support those around us. He taught the Roman church what love was. See his description from the book of Romans:

Love must be sincere. Hate what is evil; cling to what is good. Be devoted to one another in brotherly love. Honor one another above yourselves. Never be lacking in zeal, but keep your spiritual fervor, serving the Lord. Be joyful in hope, patient in affliction, faithful in prayer. Share with God's people who are in need. Practice hospitality. Bless those who persecute you; bless and do not curse. Rejoice with those who rejoice; mourn with those who mourn. Live in harmony with one another. Do not be proud, but be willing to associate with people of low position (Or willing to do menial work). Do not be conceited.
Romans 12:9-16

We should not think too highly of ourselves lest we be taken down several notches. Note the admonition in this lesson by Christ:

When someone invites you to a wedding feast, do not take the place of honor, for a person more distinguished than you may have been invited. If so, the host who invited both of you will come and say to you, "Give this man your seat." Then, humiliated, you will have to take the least important place. But when you are invited, take the lowest place, so that when your host comes, he will say to you, "Friend, move up to a better place." Then you will be honored in the presence of all your fellow guests.
Luke 14:8-10

Paul also discussed the issue of love with the Corinthian church. A customer service manager of the Ford Motor company read the thirteenth chapter of first Corinthians as a guide for customer service for several hundred Ford Motor Dealership owners.

If I speak in the tongues (or languages) of men and of angels, but have not love, I am only a resounding gong or a clanging cymbal. If I have the gift of prophecy and can fathom all mysteries and all knowledge, and if I have a faith that can move mountains, but have not love, I am nothing. If I give all I possess to the poor and surrender my body to the flames, but have not love, I gain nothing.

Love is patient, love is kind. It does not envy, it does not boast, it is not proud. It is not rude, it is not self-seeking, it is not easily angered, it keeps no record of wrongs. Love does not delight in evil but rejoices with the truth. It always protects, always trusts, always hopes, always perseveres.

Love never fails. But where there are prophecies, they will cease; where there are tongues, they will be stilled; where there is knowledge, it will pass away. For we know in part and we prophesy in part, but when perfection comes, the imperfect

> *disappears. When I was a child, I talked like a child, I thought like a child, I reasoned like a child. When I became a man, I put childish ways behind me. Now we see but a poor reflection as in a mirror; then we shall see face to face. Now I know in part; then I shall know fully, even as I am fully known. And now these three remain: faith, hope and love. But the greatest of these is love.*
> *1 Corinthians 13:1-9*

Paul also told us in 1 Corinthians 10:24: "Nobody should seek his own good, but the good of others."

This passage is supported by Jesus' words recorded by Luke:

> *Do to others as you would have them do to you.*
> *Luke 6:31*

> *Forgive us our sins, for we also forgive everyone who sins against us (Greet everyone who is indebted to us). And lead us not into temptation (Some manuscripts state "temptation but deliver us from the evil one")*
> *Luke 11:4*

Managers are scripturally called to lift up one another; to serve the needs of the others and not to seek harm to another in order that they may look good by comparison.

As a prologue to the ninth principle, look at how God used barriers between areas to confound an organization. God knew that the opposite of what is good will create waste and stop an otherwise successful organization.

> *But the Lord came down to see the city and the tower that the men were building. The Lord said, "If as one people speaking the same language they have begun to do this, then nothing they plan to do will be impossible for them. Come, let us go down and confuse their language so they will not understand each other." So the Lord scattered them from there over all the earth, and they stopped building the city. That is why it was called Babel-- because there the Lord confused the language of the whole world. From there the Lord scattered them over the face of the whole earth.*
> *Genesis 11:5-9*

10. Eliminate slogans, exhortations and targets for the work force.

These never helped anybody do a good job. Let workers formulate their own slogans. Deming is not banning the use of slogans and banners, but rather encouraging the production employees to create their own control charts which tell facts and not empty calls for action by management. Proverbs is a collection of exhortations and principles by which life in the organization can be lived.

I am indebted to Nancy Hughes, a 1993 student, for the following example:

> *"In the Old Testament, Isaiah includes the 'trust in empty words' as a deplorable sin of Israel:*

> *No one calls for justice, nor does any plead for truth. They trust in empty words and speak lies. They conceive evil and bring forth iniquity.*
> *Isaiah 59:4*

This sheds some light on the use of 'empty slogans,' which are in essence the unrealistic belief that the slogan will solve the problem. Managers deceive themselves by believing that the problem can be fixed by adherence to a slogan. There is room for slogans. However, the slogan must be an inspiration of the person who it is intended to motivate."

Another student wrote of his time in the United States Army:

> *"One thing about my last few years in the Army -- I heard so many slogans and exhortations that none of them meant very much to me. There were even times that I slipped into the pattern of coming up with a saying that the troops could rally around. But most of the time we just made fun of the sayings, so they had no actual value. One saying does stick in my mind though. While assigned to the __ Armored Cavalry, the soldiers said the unit's motto every time they saluted the officers. The motto was "Always Ready." You could almost sense a source of pride in the statement as though the one using it was proud to be associated with the organization. But other than this one experience, I would say that very few of my troops were ever motivated by a slogan or saying.*

The motto was not a slogan, but rather part of the mission statement. I wish all employees could repeat the mission of their firm every time they addressed one another.

11. Eliminate numerical quotas.

Quotas take into account only numbers, not quality or methods. They are usually a guarantee of inefficiency and high cost. A person, to hold a job, meets a quota at any cost, without regard to damage to his company. Deming is not referring to goals and targets. He has repeatedly emphasized the need for identifiable, measurable and dated targets and goals. He is referring to production quotas based on finished units, regardless of quality or other parameters.

Quotas force employees to do what is necessary in order to have the numbers correct. There is little concern for quality or the mission of the firm. Recall the earlier scriptural passage of "Seek ye first the Kingdom of God and all else will be given unto you."

A student involved in law enforcement (name withheld) gave an interesting example of the misuse of quotas. He wrote:

> *"An example of misuse of numerical quotas by management is the managers of the department I work for. They wanted a certain number of people arrested each month. There is a strong rumor that some detectives drove to the grave yard and arrested the dead people to see how stupid the manager's system was. The names of the dead*

> *people and dates of birth along with a made up address were written down. A charge was then given to the dead person. In the reports that were written the detectives would let the people go for supplying information. The mangers were happy that so many people were being arrested. The did not care about the outcome. It became a very sad place to work."*

12. Remove barriers to pride of workmanship.

People are eager to do a good job and distressed when they cannot. Too often, misguided supervisors, faulty equipment and defective materials stand in the way of good performance. These barriers must be removed.

13. Institute a vigorous program of education and retraining.

Both management and the work force will have to be educated in the new methods, including teamwork and statistical techniques.

This principle is a follow-up principle to principle six. It was added by Deming after American firms sought him in earnest. American firms in their search for a quick fix put all people through training one time and considered themselves to have done their managerial duty. Deming points out that it is not enough to train. Rather the verb tense here is future present -- to train and keep on training, to listen and keep on listening, to improve and keep on improving.

14. Take action to accomplish the transformation.

It will require a special top management team with a plan of action to carry out the quality mission. Workers cannot do it on their own, nor can managers. A critical mass of people in the company must understand the Fourteen Points.

Deming is speaking of a covenantal relationship which the senior managers make with their stockholders and employees. The scriptures speak to covenant in many ways.

Deming is speaking of an action plan to servant leadership as well. Ruth Calkin gives us insight into the true leader's heart in her poem:

> **"I Wonder"**
> You know, Lord, how I serve you
> with great emotional fervor in the limelight,
>
> You know how eagerly I speak for You at a Women's Club.
>
> You know my genuine enthusiasm at a Bible study.
>
> But how would I react, I wonder,
> if You pointed to a basin of water
> and asked me to wash the calloused feet of a bent and wrinkled
> old woman day after day, month after month, in a room where
> nobody saw and nobody knew?[12]

The actions of the leader in the midst of work and in contact with people on a daily basis is the mark of character and leadership quality.

Take action today to improve and keep on improving your leadership skills. Establish the vision for your organization, adopt the vision and pass it on to your employees

and co-workers. Recognize the training needs and wants of the people in the firm. Be a steward of your employee's talents and abilities. Listen to the advice of the many wise and skilled workers God placed in the firm with you. Remove fear and banish it as well as barriers to communication. The body cannot operate with hindrances to communication. Eliminate slogans and exhortations from the workplace. Place factual presentations of operations so that all can see how the company and their own department is doing. Allow the people at the site of the operation to record the data. Eliminate quotas. Above all -- improve, improve, improve.

Deming's Seven Deadly Diseases

1. Lack of constancy of purpose

A company that is without constancy of purpose has no long-range plans for staying in business. Management is insecure, and so are employees.

2. Emphasis on short-term profits

Looking to increase the quarterly dividend undermines quality and productivity.

3. Evaluation by performance, merit rating or annual review of performance

The effects of these are devastating -- teamwork is destroyed, rivalry is nurtured. Performance ratings build fear and leave people bitter, despondent, and beaten. They also encourage defection in the ranks of management.

One manager I recently interviewed (name withheld to cover the guilty) told me his department always had several different goals to meet. In the event that the goals were not met, they would simply amend the goals. This occurred because senior management's annual bonuses were dependent on departments reaching their goals. Some system!

4. Mobility of management

Job-hopping managers never understand the companies they work for and are never there long enough to follow through on long-term changes that are necessary for quality and productivity.

5. Running a company on visible figures alone

The most important figures are unknown and unknowable -- the "multiplier" effect of a happy customer, for example.

6. Excessive medical costs for employee health care, which increase the final costs of goods and services

Deming would simply apply his concepts to this field and strive for higher quality at ever decreasing real costs. In fact, the medical community is turning to Deming's points to reduce costs. Unfortunately, a litigious society which seeks to sue everyone at every turn is forcing the medical community to run excessive tests and treatments to protect themselves. See the next item.

7. Excessive costs of warranty, fueled by lawyers who work on the basis of contingency fees

Lawyers were a particular sore spot with Deming. Dr. Deming was not opposed to fair representation, he was opposed to the "ambulance chasing behavior" of many attorneys.

Deming's Obstacles

"Hope for instant pudding,"

the idea that "improvement of quality and productivity is accomplished suddenly by affirmation of faith;"

"Search for examples,"

which companies undertake to find a ready-made recipe they can follow when they must instead map their own route to quality;

"Our problems are different,"

the pretext managers raise to avoid dealing with quality issues;

"Our quality control department takes care of all our problems of quality,"

another excuse managers use to avoid taking responsibility;

"We installed quality control,"

yet another excuse that lets top management off the hook;

"The supposition that it is only necessary to meet specifications,"

not only may products meet specifications yet vary widely in quality, but in addition, "the supposition that everything is all right inside the specifications and all wrong outside does not correspond to this world."

Deming's miscellaneous principles

The 85-15 Rule:

The 85-15 rule holds that 85 percent of what goes wrong is with the system, and only 15 percent with the individual person or thing. In this connection, we do well to remember that in any group of people, not all, nor even the majority, can be above average. In fact, exactly half will be below average.

Know Thy Customer:

In quality-minded organizations, the word "customer" describes more than a relationship in which money merely changes hands. It describes the exchange of services as well. For any given enterprise, there are two sets of customers; external and internal. The external customer is the end user of a product or service. The

internal customer is the person or work unit that receives the product or the service of another within the same company.

Too often one department does not understand how its work is used by the next, and thus cannot learn what things are important in carrying out its tasks. The notion of internal customers lends relevance to each employee's job and is absolutely critical to a quality transformation.

The PDSA Cycle:

The Plan-Do-Study-Act cycle is referred to as the Deming cycle by the Japanese. The cycle represents work on processes rather than specific tasks.

The Deming System

Suppliers of
Materials and
Equipment

Design
and
Redesign

Consumer
Research

Receipt
and test of
materials

Consumers

A
B
C
D

Production, assembly, inspection

Distribution

Tests of processes,
machines, methods,
costs
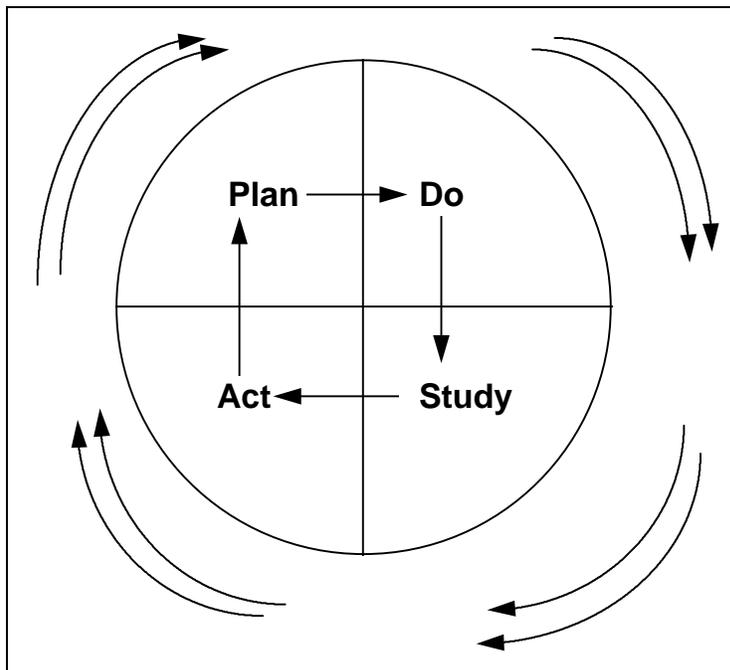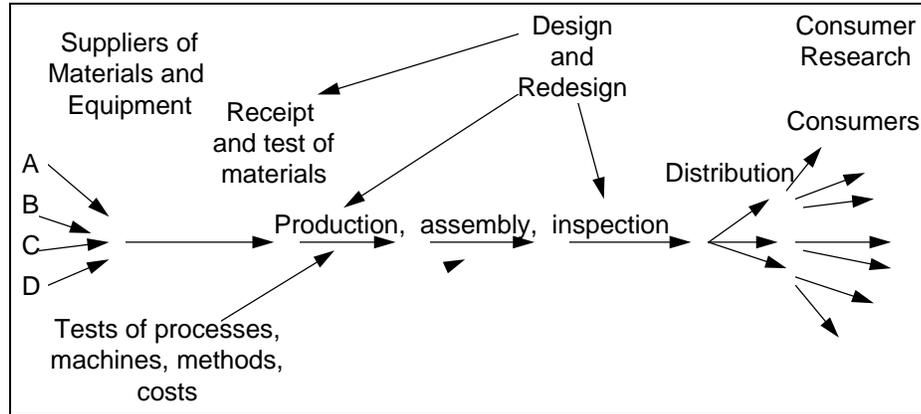
The Deming system looks at all phases of production from suppliers to consumers. Deming was quick to point out how management created functional walls around many of the subparts of the system. These walls became barriers to communication and resulted in frustration among employees and competitive spirits between managers.

Profound Knowledge

Deming constantly referred to his concept of profound knowledge in every seminar he gave. Profound knowledge requires you to think about and observe behavioral phenomenon in a global manner. You must simultaneously consider both common and special variation, how people learn, and the psychology of humans.

Since all behavior and interaction of people in a business is part of a system, you must be able to observe the system from one level higher. This advantage point gives you the ability to see the interactions between people and departments. Management is the control of interactions using several theories.

The Funnel Experiment

Deming used a demonstration called "The Funnel Experiment" in which a participant from the audience dropped a small steel ball through a funnel onto a paper target. The ball left a mark on the paper each time the ball hit. Dr. Deming would ask the participant what to do each time the ball missed the target. There were one of three errors, described below, committed by most participants. Rarely did the participant choose the correct fourth alternative. These errors demonstrate the problems we create when we do not use profound knowledge.

Rule 1 is the correct rule and we will discuss it last. Rule 2 is the first error reaction by participants. Rule 2 says to move the funnel the inverse of the vectors drawn when the ball hit the paper. Consider the target on the paper to be 0,0 on an XY coordinate grid. If the ball hits 1,2, then move the funnel to -1,-2 thus correcting for the error. This new position -1,-2 becomes the last resting point and any additional movements are made

from this new center. This error implies acting on common variation as if it is special. The stock market's overreaction to good or bad news is an example of rule 2.

Rule 3 is similar to rule 2 in that the funnel is moved the inverse of the vector drawn by the ball on the paper. The difference here is that the funnel is always relocated to 0,0 before the movement is made. This error implies that people with inadequate knowledge about the process try to return to the starting point. Setting current sales goals based on last period's overage/underage is an example of rule 3.

Rule 4 is a terrible condition which occurs in industry. The funnel is moved to the coordinates of the steel ball. If the ball hits at 1,2 you move the funnel to 1,2. This creates a wild non-recognizable pattern. On the job training is an example of rule 4. Each person trains based on how they were trained with an adjustment for where they believe they are in the company. The nth person trained in this manner usually has no recognition to the first person trained. "Just make it like the last one" is also an example of rule 4.

The only correct decision in the funnel experiment is to follow Rule 1, leaving the funnel alone and dropping 50 balls. The pattern will be the tightest and the most acceptable. Common variation must be accepted as common. You must then seek ways to minimize common variation. Individual movements of the funnel alone will not clean up a process.

Knowledge of Loss

Dr. Deming included the knowledge of loss in the concept of profound knowledge. Taguchi's loss calculation brought up later in this text will assist in your understanding. A piece of trivia here: Dr. Deming attended the presentation of Taguchi's loss calculation paper. The loss function goes beyond product made out of specifications. Dr. Deming tried, in vain, to get the United States government to see the futility of trade barriers. Greater good is always gained by learning how to expand the market, not restrict competition.

Taguchi's loss function teaches us that there is an optimum for everything. While a small shift in either direction from the optimum might not cause a serious loss, continual movement results in exponential losses. Therefore, there is wisdom in maintaining the optimum.

Learning

We must understand how people learn and at what rate each person learns. Everyone is different. Management must train and re-train with the understanding of how learning occurs. Some of us learn by reading, some by watching, some by hearing and others by doing. Most learn best by some combination of these.

People learn when they need the information. I experimented with this in class one year. I gave all the study areas for the mid-term and a sample question to all the students on the first day of the course. At mid-term time I gave the students the take-home test and announced that there would be special sessions held on Saturday and during the last half of the next class to go over any concepts the students wished. True to theory, two-thirds of the students developed an overwhelming desire to clarify concepts when they were faced with an exam.

Employees are no different. They will learn some of what you want them to know during training times and will learn ten times as much when faced with a real life

problem to solve. The same is true for benefits information. You may tell everyone in the company how the medical plan works, but until an employee has an emergency and needs to know, there will not be serious learning. Profound knowledge would have you set up training-on-demand systems which your employees can access as they need.

Psychology

So much of management is motivation and communication. We must understand how people are intrinsically motivated. It is through intrinsic motivation that people find joy in work and excitement in application of new knowledge. True innovation in a company only comes at the discretion of the employees. Think about this saying: "you can lead a horse to water but you cannot make him drink." A professor of leadership/motivation/management once told a class, "you don't get paid to get a horse to drink, you get paid to motivate him to float on his back in the pond!" I thought about that saying for three days before I understood the tie with intrinsic motivation and innovation in a company.

Dr. Deming is quoted as saying:

> Everything we have came from somebody responsible only to himself. Newton had established his laws of motion . . . by age 22. Who was he responsible to? Do you think he did it for a higher rating? He had economic security behind him. This enabled him to have intrinsic motivation, dignity, self-respect, and to be responsible to nobody but himself. That is how real progress is made. But such opportunity is smothered by the rating system, by grading and ranking people in the system. We must not try to rank them -- that is impossible to do for reasons which are easy to understand, and which people in business must understand. Modern management has reduced people to extrinsic motivation. Extrinsic motivation is a day's pay for a day's work. It is degrading, humiliating; it robs people of joy in work -- their birthright. So, as over-justification, they make low quality and low productivity.

> Should we regard people for acts which they do for sheer happiness and delight? For example, this morning a lady in British Airways gave me special help. I think she enjoyed her work, and she helped me for the happiness of doing it. If I had tried to pay her, I would have insulted her and degraded her. People should derive sheer happiness for doing their work, and management should enable this to happen. We cannot ignore these things; we have been doing so for far too long. North America has been falling behind for three decades -- from bad management, not bad people.[13]

Within the concept of knowledge of psychology, we must understand how people react to change. You have heard it said that people resist change. This is absolutely untrue. People have welcomed change through out history AS LONG AS they understood the benefit of change to them. Management's responsibility in using profound knowledge is to market change so as to be exciting and desirous by employees.

Lastly, profound knowledge requires an understanding of transformation from competition to collaboration. Negotiators have long understood that cooperation and mutually satisfying results start by someone taking a risk and offering another something that is desired.

Comparison of Deming's Points to Traditional Western Management

Deming's Fourteen Points	Western Thought
1. Create constancy of purpose for improvement of product and service.	1. Produce as many products as possible at the quality level which will sell. Caveat Emptor
2. Adopt the new philosophy.	2. People will accept what is put before them. The British say "throw it out and see if the dogs will eat it."
3. Cease dependence on mass inspection.	3. Inspect quality in ('in' what?)- cull out the rejects and rework them. Install significant field warranty work stations.
4. End the practice of awarding business on the price tag alone.	4. Always bid and award on low price. Keep the vendors guessing and scared.
5. Improve constantly and forever the system of production and service.	5. Find an acceptable level and maintain it. If it is not broken -- don't fix it.
6. Institute training.	6. Use typical OJT. Allow the last hired to train the new employee. Do not stop production for training.
7. Institute leadership.	7. Use positional authority. Lead by "doing what I say and not what I do."
8. Drive out fear.	8. Use fear to create an attitude of anxiety. People will work harder if they know they might be punished for failure to perform.
9. Break down barriers between staff areas.	9. Institute bureaucracy and instill an organizational wall between departments. Build as much of an empire as possible. It will improve your chances of being promoted. Make sure no other department can do your job.

10.	Eliminate slogans, exhortations and targets for the work force.	10.	Place slogans about quality, safety and increased productivity around the workplace. The employees will get the message that we mean business.
11.	Eliminate numerical quotas.	11.	Drive all employees with quotas. Impose regional and area quotas on salespeople. MBO means to take last years results and add a fixed percentage.
12.	Remove barriers to pride of workmanship.	12.	Isolate the job functions so no one person or group of people can impact the product. Take functional specialization to the point of needing a group of specialists to each task.
13.	Institute a vigorous program of education and retraining.	13.	Train an employee once and then forget it. Literacy is not necessary. They can follow verbal instructions.
14.	Take action to accomplish the transformation.	14.	Leave well enough alone.

Concerns about TQM

Ishikawa lists 14 reasons why Japan accepts the new philosophy and the Western world does not.[14] His reasons are mostly invalid. This section of his book provides a useful tool for explaining the very opposite -- why all countries could adopt this philosophy. My comments are in italics following Ishikawa's reasons.

Professionalism

Western countries place a high degree of emphasis on professionalism and specialization. Therefore QC is handled by the QC specialist and not the employees who make the goods or services. Japan places little emphasis on professionalism and specialization. Engineers are rotated between design, manufacturing, etc. to improve their general knowledge. In Japan, organizations such as JUSE are created to promote academic study and industry standards, not to protect the rights of the member. *This is true in Japan today, but was not true before W.W.II. Rank and separation have been a way of life in Japan for centuries. Changes in approach and thinking have shaped a new culture in Japan. This can also happen in other countries.*

Japan is a vertical society

This implies to the corporation that there is a close bond among workers from upper management to all areas of production and even from one line group to another, such as marketing to production to design. However there is a weak relationship between staff and line. Manufacturing may not heed the requests of a small QC staff or a finance staff. *I believe this is from the same source as professionalism. Japan has*

developed a better relationship model than the US. It occurred because of the change in the thought process and not because of long term beliefs. Japan's dynasties relied heavily on the advice of its staff cabinet. The impact here is that staff (servant) departments should be small and provide service at requests, not control. Data processing should not be the determining force in what equipment and what information will be made available to whom. Rather, DP should respond to the needs of line positions.

Labor Unions

Western countries have developed labor unions to protect the rights of the member. *Now, it appears, the union is as much interested in its own preservation as the preservation of the member.* Japanese unions exist for the betterment of the industry and to promote education and industry standards. Most Japanese unions are enterprise wide and not company/local/regional as in the U.S. Western unions may represent people in many different industries -- not so in Japan. *This Western trait is the result of ideology and belief as well. Taylor, although his heart was in the benefit of the worker, created a belief structure which led to a me-first mentality in the American worker. It is still changeable.*

The Taylor Method and Absenteeism

Here, Ishikawa illustrates that Taylor, irrespective of his motives, set in place the future ideology that work is not rewarding to the average American and that people work to live. *(See also Ishikawa's comments on merit pay.)* Ishikawa points out the high absenteeism on Mondays and Fridays. The rate of absenteeism and rate of turnover are measures of strengths and weaknesses of management style.

Elitism and Class consciousness

This is similar to items 1 and 2. Many companies openly admit that they only promote people to positions of high responsibility if they have been educated in certain schools. *(This is similar to the classic story of three CEOs who are discussing where they received their MBA's from.)* Japan does not show this elitism. Again, this is a learned behavior.

Pay system

Western thought emphasizes the merit pay system: Hold the carrot of money out before the worker and he/she will work harder. If this is true, then why do we have the high amounts of absenteeism in many companies? It is interesting to note here that in those companies which have low absenteeism, you will always find a sense of self-worth in the job and a feeling of belonging, of being listened to and being respected *(sounds a little like Paul's discourse on love to the Corinthian church).* Ishikawa offers this look at external and internal compensation:

Monetary rewards fill the needs of: (1) the minimum conditions of survival; (2) man's perennial quest for wealth (which is rarely satisfying); and (3) material satisfaction (which is motivational until you get the item. Satisfaction of doing a job well promotes greater personal achievement. Cooperating with others and being recognized by others is a by-product of personal achievement. Man cannot live alone -- he is a social animal with the need to interact with others in friendship and love -- to establish a sense of community (look at what the cults offer -- and then, sadly, look at what the major churches in America offer). The joy of personal growth is another by-product of personal achievement (this ties to Maslow's hierarchy). There is joy in knowing the satisfaction

which comes from growing as a person. Unfortunately, self-confidence lacks in many American workers.

Turnover Rate, Layoff and Lifetime Employment System

This has been discussed earlier in the section regarding Pay and Taylorism.

Difference in Writing Systems

Ishikawa believes that because the Japanese writing style and those of certain other oriental societies are so difficult to learn, it shows that the Japanese are, by nature, prone to try harder and continue a program longer. *This has to be the greatest bunch of hooey that I have ever read. Granted, the Japanese writing style (called Kanji) is difficult, but it by no means shows a superior ability. The same is true for English with regard for speaking and not writing. Many foreigners who speak several languages will tell you that English is difficult to learn because of its many grammatical rules and exceptions. There are so many similar words or same words with different meanings. If anything, the Kanji writing style is antagonistic to the development of a simple working philosophy. Ishikawa should check his own history -- Kanji was taken from the Chinese hundreds of centuries ago.*

Homogeneous Nations, Multi-Racial Nations and Foreign Workers

Ishikawa points out that Japan is a nation of one race and one language. This homogeneity is essential for economic development and the acceptance of the quality movement. Japan is the only country exceeding 100 million in population. *A single language is important in educating workers and in examining a domestic market for product ideas. However, I am unclear why Ishikawa believes this is important for the adoption of this philosophy.*

Education

The Japanese people are very interested in education. After W.W.II, parents became intensely interested in the education of their children. *It was during this time that the rise of secular humanistic education began to take strong hold in America. Although the American dream from the 1950s to the early 1960s could only be achieved with education, the American family began to buy into the concept that professional educators knew more about educating their children than did the parents. Interest in education waned and the emphasis on education declined.*

It is interesting to note here that the system of education in Japan is different than in western countries. Japan teaches technical knowledge and general knowledge in what we call high school, and then teaches philosophy, beliefs and social structure in college. Western countries do the opposite. Emphasis on social and personal development occur in high school, and then in college we get serious about studying. Studies have shown that American college students read much more than their Japanese counterparts.

Religion

Ishikawa brings up the concept of religion as a basis for the adoption of the new philosophy. His conclusion is wrong, but brings an interesting view for discussion.

Ishikawa notes that Christianity is prominent in Western cultures, Islam in developing countries and Confucianism and Buddhism in Japan. He continues that

Confucianism is divided into two strains. One strain is represented by Mencius who said that man is by nature good. The other strain is represented by Hsuntzu who said that man is by nature evil. Ishikawa believes that with education, anyone can become good in the best tradition of Mencius.

The basic teachings of Christianity say that man is evil by nature. Ishikawa believes this may be the basis for Taylorism and the distrust between management and worker, theory X, etc.

Although Ishikawa is correct as far as he has gone, he fails to consider that the primary source of his paradigm came from W. E. Deming, whom I believe is a strong Christian who intertwined Christian beliefs and principles into his teaching. Despite the fact that man is evil by nature, the Bible teaches us that through Christ, all things are made new. This raises several questions for discussion:

If man is basically evil, can we ever hope to change?

If the mind of Christ allows us to overcome evil, what do we do with the non-Christian workers?

If man is basically evil and would only work to sustain himself (Theory X), why has the U.S. led most countries in the development of entrepreneuring? Where does the Jewish faith come into play? They have shown an ability to work hard and do well.

Relationship with Subcontractors

Ishikawa illustrates the working relationship of manufacturers to their suppliers. The western view is one of stealth and negative negotiation based on fear. The Japanese view is one of cooperation and sharing of all information. The supplier becomes one of a team member and not an adversary. *Again this is a result of the paradigm and not a developmental variable. Those Japanese companies who do not participate in this philosophy are no different than those found in the U.S.*

The Role of the Government -- No Control, Just Stimulation

This is an important condition and it is a recent development in the Japanese culture. The government follows the same logic as the line-staff relationship in business. The government sees its role as servant and assistant rather than controller. This is an excellent example of greater benefit from less control. *I believe that the greed of one group of people will cause another group to ask the government for control. Greed can also prompt a group to seek control in order to have an advantage. This condition can also be changed with time as it was in Japan.*

Understanding Levels of Knowledge

A key concept in understanding the implementation of TQM in organizations is to understand the level of knowledge that the firm operates within. There are nine stages that a firm progresses through as it develops and matures in its quality journey. These nine stages are:

- Stage 0: Total ignorance

- Stage 1: Can tell the good from the bad

- Stage 2: Can list the variables which comprise a good result

- Stage 3: Can prioritize the variables from most important to least important

- Stage 4: Can measure the variables

- Stage 5: Repeatable performance

- Stage 6: Understand environmental variables and their impact on the process

- Stage 7: Can develop a quantifiable model

- Stage 8: Completely procedural

Stage 0: Total ignorance

Fortunately, few firms operate at this level for long. Occasionally new product development starts at this stage. The first vulcanized rubber came about as an accident. After the accident, the researcher and others in the firm probably operated at this level for a while. Another way of describing this stage is to use an example of giving a small child a cookie and asking if the child likes the cookie. Assuming we get an affirmative answer we then ask the child what makes the cookie "good." We might get the answer: "I don't know." This would be operating at a stage 0 level. Not many of us have to work in stage 0 companies.

Stage 1: Can tell the good from the bad

Many customers operate at this level with regard to your product or service. They "know quality when they see it," but cannot tell you why they feel as they do or what contributed to the feeling.Ask people to taste several cookies. Each person can tell you if the cookie is high or low quality compared to some past standard or personal taste. They may not be able to tell you why.

Stage 2: Can list the variables which comprise a good result

Think of a child in stage 0. As the child grows up, his or her knowledge of cookies might improve. If the child is in stage 2, then he or she could tell you that some cookies are good and some are bad. The child could also tell you that there are several variables that contribute to a cookie being "good." These variables might include ingredients like sugar, butter, flour, salt, etc. as well as variables like crispness or "cheweyness" and whether or not the cookie is cooked "just right" or burned. However, this is the extent of the child's knowledge. Knowledge exists, but little understanding about relationships occurs.

Stage 3: Can prioritize the variables from most important to least important

This stage shows some understanding of how the variables interact to cause quality perceptions and ratings. While not all the relationships are clear, there is an understanding of which variables contribute the most. Carrying our cookie example a little farther, the child begins to realize that regardless of the combination of ingredients, if the cookie is burnt then it is never any good. Thus, the child realizes that above all else, the baking temperature and time must be watched.

Stage 4: Can measure the variables

This next stage seems simple, but it is not. For example, in education we know that student commitment and feedback are two key variables to the improvement in learning and the satisfaction of the student. However, few people in education really know how to measure the variables. Deming mentioned this dilemma many times when he admonished managers not to rely on visible numbers alone. He did not advocate not measuring, but rather, that although you cannot measure a variable at the time you must still consider it. I would add that managers should continue to identify the variables and strive to understand how to measure them. The next stages cannot occur until you can measure the variables.

Stage 5: Repeatable performance

Stage five is marked with repeatable performance as the name implies. Let us re-visit the cookie example. Imagine the child growing up and deciding that their cookies are quite good and could possibly be a success in the market. Perhaps this is another Famous Amos® case. Our cookie entrepreneur knows that for these cookies to be successful every batch that comes out of the oven and into a bag or display case must be consistent with earlier batches or customers will not be satisfied. You might find an example of this when you visit your local sandwich shop. Many food service firms added a franchise cookie process to their menu. The franchise provides a small table top cookie baking oven and premixed dough with instruction on how to cut and shape the dough to produce the same cookie every time. Customers come to trust the cookie vendor because the customer always knows what to expect.

This stage is important because until you can repeat performance, control charts make no sense at all. Later in this text we will address special and common variation. Special variation implies that the system is not predictable so any change in the process or the system would not produce improvements, except by random chance. When all common variation is removed, the system is said to be stable, or it produces repeatable performance within a range of normal distribution.

Stage 6: Understand environmental variables and their impact on the process

If you have ever lived in high altitudes you understand why so many cookbooks and boxed cake mixes tell you to adjust your cooking time and temperature for such a condition. This stage is characterized by the understanding of how variables outside of the process might affect quality.

In my experience in commercial printing we learned that temperature in the press room at different heights affected the performance of different inks. After considerable studying of poor ink performance on one of our presses we discovered that the air temperature near the ceiling was 15 degrees higher than the temperature at the six foot level. (The press room had a 12 foot ceiling.) The press that we had problems with had an ink fountain at 9 feet above the floor. Over the course of several weeks of study and gathering data we saw a pattern of problems occurring in the latter part of the afternoon and early evening with the problem disappearing as the second shift continued. It became evident that as the day progressed, the temperature rose at higher heights because of all the equipment operating, but since only some of the equipment ran during the second shift, the heat dissipated over time. As we understood the environmental variables we could modify the environment to

improve quality. We did not need to change our process, just the variables in the environment.

Stage 7: Can develop a quantifiable model

Few firms reach this stage. Managers can, and do, develop computer models and simulations to predict what will happen if changes are made to the ingredients, the process or the environment.

Stage 8: Completely procedural

This is the domain of highly successful franchises and companies known for outstanding quality. At this stage everything that can affect quality is understood and controllable. Documents exist to train new employees on all aspects of production and quality measurement. Companies like Motorola fit into this stage.

Root Principles

Schmidt and Finnigan in their book, *The Race Without a Finish Line,* state that the Total Quality Movement springs from these root principles:

1. **Scientific Management:** Finding the best one way to do a job.

2. **Group Dynamics:** Enlisting and organizing the power of group experience.

3. **Training and Development:** Investing in human capital.

4. **Achievement Motivation:** People get satisfaction from accomplishment.

5. **Employee Involvement:** Workers should have some influence in the organization.

6. **Socio-technical Systems:** Organizations operate as open systems.

7. **Organization Development (OD):** Helping organizations to learn and change.

8. **Corporate Culture:** Beliefs, myths and values that guide the behavior of people throughout the organization.

9. **The New Leadership Theory:** Inspiring and empowering others to act.

10. **The Linking-Pin Concept of Organizations:** Creating cross-functional teams.

11. **Strategic Planning:** Determining where to take the organization, and how and when to get there.

In addition, Schmidt and Finnigan list these American theories and practices as antagonistic to the Total Quality Management mind set:

1. **Bureaucratic Management:** Direction from the boss, compliance from the subordinate.

2. **Caveat Emptor:** Let the buyer beware.

3. **MBO and MBR:** Management by objectives and management by results.

4. **Internal Competition:** Encouraging each department to be number one.

5. **The Strategy of Organizational Stability:** "If it ain't broke, don't fix it."

6.   **Antagonism Toward Unions:** Workers' interests are basically different from managers' interests.

7.   **Bottom-Line Driven:** Profit is the first test for every decision and action.[15]

Is Christianity And Its Doctrine of Total Depravity Consistent With Total Quality And Its Theory Y Assumptions?

by

Donald J. Plowman ©1994
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(I include this article written by a student because it adds to the understanding of a Christian Worldview and Total Quality Management concepts. Citations for this article follow the article)

Christianity has historically viewed man as totally depraved, or basically evil, in light of Adam's fall. Kaoru Ishikawa, a leading Japanese Total Quality expert, indicates that this doctrine has resulted in western management's distrust of the worker, and is the reason that it operates according to management theories such as McGregor's Theory X. According to him, the success of Japanese Total Quality efforts is due in part to the view that "people by nature are good," and that the worker can be trusted,[1] a position in accord with McGregor's Theory Y. While total depravity is Biblically sound, it is the purpose of this paper to show that it is also compatible with Total Quality and its Theory Y assumptions because of God's common grace.

This idea will first be explored by examining McGregor's Theory X and Y which touch upon the nature of man. Discussions of the view of man found first in TQ and then in Scripture will follow. The last section examines the common grace of God and its effect upon man.

McGregor's Theories X and Y

Douglas McGregor, in his book *The Human Side of Enterprise*, states, "Behind every managerial decision or action are assumptions about human nature and behavior."[2]

He groups these assumptions into two categories which he labels Theory X and Theory Y.

Theory X represents the traditional Western view of direction and control in the work place. Managers who operate according to this theory make three assumptions about workers:

1) "The average human being has an inherent dislike of work and will avoid it if he can.

2) Because of this human characteristic of dislike of work, most people must be coerced, controlled, directed, threatened with punishment to get them to put forth adequate effort toward the achievement of organizational objectives.

3) The average human being prefers to be directed, wishes to avoid responsibility, has relatively little ambition, wants security above all."[3]

McGregor claims that this view has its roots in Scripture, and in particular the fall of man. He points to the punishment that God meted out to Adam and Eve for disobeying His command, forbidding them from eating the fruit of the tree of knowledge of good and evil. According to McGregor, this punishment consisted of banishment from the Garden, and most importantly, the requirement that Adam and

Eve work for a living.[4] Management, in emphasizing productivity and performance rewards, reflects a basic belief that man's tendency to avoid work must be overcome.[5] In general, rewards are not sufficient to motivate people; only fear of punishment will accomplish that.

In contrast to the assumptions of Theory X, McGregor lists the following Theory Y assumptions:

1)   "The expenditure of physical and mental effort in work is as natural as play or rest.

2)   External control and the threat of punishment are not the only means for bringing about effort toward organizational objectives. Man will exercise self-direction and self-control in the service of objectives to which he is committed.

3)   Commitment to objectives is a function of the rewards associated with their achievement.

4)   The average human being learns, under proper conditions, not only to accept but to seek responsibility.

5)   The capacity to exercise a relatively high degree of imagination, ingenuity, and creativity in the solution of organizational problems is widely, not narrowly, distributed.

6)   Under the conditions of modern industrial life, the intellectual potentialities of the average human being are only partially utilized."[6]

According to Theory Y, work is natural, and people are capable of self-directed, responsible, and creative behavior in the work place. The implication, according to McGregor, is that problems of cooperation in an organization are not due to human nature. Rather, these problems are because of management's failure to unlock the potential of its human resources.[7]

TQ Anthropology

In Japan, Total Quality, and the assumptions it shares with Theory Y, is the standard system of management. Kaoru Ishikawa finds a religion's anthropology plays a significant role in implementing Total Quality principles. He observes that Japanese society has been influenced by Confucianism, one strain of which teaches that man is good by nature. He agrees with that teaching, and that through education, anyone can become good. Managers that are convinced of the basic goodness of their workers will trust them to exhibit self-direction, responsibility, imagination, ingenuity, and creativity. This being the case, the worker is given a great degree of control over the production process.

In the West, Total Quality principles began to be implemented in the late Seventies. As stated earlier, Ishikawa teaches that these principles will have a more difficult time taking hold in the West because our management principles have traditionally been based on assumptions that man is basically evil (Theory X). However, Western Total Quality advocates seem to have embraced Theory Y assumptions based on non-Biblical presuppositions, just as in Japan.

In his book, *Safer Than a Known Way; The Deming approach to Management*, the Australian John McConnell states that people want to learn, to be innovative, and to

enjoy their work. These ideas are consistent with Theory Y. He also implies that man is basically good, and that factors extrinsic to himself (which he calls the "Forces of Destruction") are responsible for any inability to work well.[8]

American Alfie Kohn is another example of an influential Western author associated with the Total Quality movement who embraces Theory Y ideas. Set in the context of his critique of competition, he says that while man may not necessarily be good, he is at least neutral.[9] Attitudes that make us a good worker (e.g. the desire to cooperate with others, creativity, ingenuity[10]) either come to us at birth or are learned shortly thereafter.

The reason that western Total Quality practitioners have embraced non-Biblical views of man may be due to the influence that eastern philosophy has had on our culture during the latter half of this century. However, the West has its own philosophical traditions which reject the Biblical view of fallen man. For instance, the 18th century philosopher Jean-Jacques Rousseau taught that man is naturally good and his problems come from the influences of society.[11] Existential philosophers such as Jean-Paul Sartre believe that man does not have a nature, as such. Rather, he comes upon the scene undefined, neither good nor bad, and determines himself, what he will be.[12]

Biblical Anthropology

In contrast with these philosophies, the Biblical doctrine of the total depravity of man teaches that man is basically evil; that is, because of sin, "every part of man's nature is corrupted--his intellect, his will, his emotions, his judgments, his imagination... Man is by nature dead in sin."[13] This doctrine is derived from verses such as the following:

> *Genesis 6:5 Then the Lord saw that the wickedness of man was great in the earth, and that every intent of the thoughts of his heart was only evil continually.*

> *Titus 1:5 To the pure all things are pure, but to those who are defiled and unbelieving nothing is pure; but even their mind and conscience are defiled.*

> *Colossians 2:13 And you, being dead in your trespasses and the uncircumcision of your flesh, He has made alive together with Him, having forgiven you all trespasses.*

Common Grace

On the surface, this seems to indicate that Theory X is the natural result of the doctrine of total depravity and would lead to distrust of the worker, as Ishikawa claims. However, a closer look at the doctrine of total depravity shows us that it is compatible with Total Quality and its Theory Y assumptions because of the working of God's common grace.

Common grace is defined as general operations of the Holy Spirit whereby He, without renewing the heart, exercises such a moral influence on man that sin is restrained, order is maintained in social life, and civil righteousness is promoted.[14] So, while the doctrine of total depravity insists that man is by nature evil, God's common grace prevents man from being as evil in his thoughts and actions as it is possible for him to be.

The primary means of common grace is God's general revelation. This revelation of the Holy Spirit is to all men and is revealed externally and internally. Concerning external revelation we read in Psalm 19, "The heavens declare the glory of God; And the firmament shows His handiwork." Also, in Romans 1:19-20 Paul states: "Because what may be known of God is manifest in them, for God has shown it to them. For since the creation of the world His invisible attributes are clearly seen, being understood by the things that are made, even His eternal power and glory." Concerning the internal revelation of the Spirit we are told in Romans 2:15 that the Gentiles *"show the work of the law written in their hearts."*

Common grace is manifested in a number of ways. First, even though natural man is totally depraved, sin is restrained in the life of the individual. This view is expressed by the 18th century theologian Jonathan Edwards:

> There are in the souls of wicked men those hellish principles reigning, that would presently kindle and flame out into hell-fire, if it were not for God's restraints. ...The souls of the wicked in Scripture are compared to the troubled sea, Isaiah LVII, 20. For the present God restrains their wickedness by His mighty power, as He does the raging waves of the troubled sea, saying, "Hitherto shalt thou come, and no further."[15]

An example of God restraining sin in the life of the unregenerate is given in Genesis 20:6. In speaking to Abimelech in a dream, God says, "Yes I know that you did this in the integrity of your heart. For I also withheld you from sinning against Me." Another example is found in Genesis 31:7; concerning Jacob, it states, "Yet your father has deceived me and changed my wages ten times, but God did not allow him to hurt me."

Second, common grace is shown in that unregenerate man still has a sense of truth, and reveals a desire for morality.[16] This is discussed in Romans 2:14-15, "For when the Gentiles, who do not have the law, by nature do the things contained in the law, these, although not having the law, are a law to themselves, who show the work of the law written in their hearts, their conscience also bearing witness, and between themselves their thoughts accusing or else excusing them." This can be observed in non-Christian cultures such as Japan's, which display morality and respect for family and the worker. In this country, people of faiths other than Christianity show a high degree of morality and a strong work ethic.

Third, God's common grace to unregenerate man is shown in that he is capable of performing natural good, or civil righteousness.[17] For example, Jehu, one of Israel's kings, did not love God. However, in II Kings 10:30, God commended him for his good deeds: "And the Lord said to Jehu, 'Because you have done well in doing what is right in My sight, and have done to the house of Ahab all that was in My heart, your sons shall sit on the throne of Israel to the fourth generation.'" In Luke 6:33, Jesus tells us that sinners can perform good acts: "And if you do good to those who do good to you, what credit is that to you? For even sinners do the same."

It is God's grace that allows men to even desire to do good. As a result they develop skills and abilities, harness the forces of nature, and make positive contributions to the cultural, scientific and social welfare of the world.[18]

Common grace, then, restrains sin in the lives of totally depraved men, gives unregenerate men a sense of morality, and enables them to perform outwardly good acts. As the Christian reformer John Calvin states:

Whenever we come upon these matters in secular writers, let that admiral light of truth shining in them teach us that the mind of man, though fallen and perverted from its wholeness, is nevertheless clothed and ornamented with God's excellent gifts. ...Shall we deny that the truth shone upon the ancient jurists who established civic order and discipline with such great equity? Shall we say that the philosophers were blind in their fine observation and artful description of nature? ...Shall we say that they are insane who developed medicine, devoting their labor to our benefit? ...No, we cannot read the writings of the ancients on these subjects without great admiration. ...But shall we count anything praiseworthy or noble without recognizing at the same time that it comes from God? ...Those men whom Scripture calls 'natural men' were, indeed, sharp and penetrating in their investigation of inferior things. Let us, accordingly, learn by their example how many gifts the Lord left to human nature even after it was despoiled of its true good.[19]

Since unregenerate man receives the benefits of God's common grace discussed above, Christianity and its doctrine of Total Depravity is consistent with Total Quality and its Theory Y assumptions. Because of common grace, those in the work force are capable of self-control and self-direction. Because of common grace, workers can be trusted to do a good job and to be responsible. Because of common grace they can be looked to for imaginative, ingenious, and creative solutions to business problems.

ENDNOTES

Scripture quotations in this paper are from The New King James Version of the Bible.

1.   Ishikawa, Kaoru. What Is Total Quality Control?, trans. David J. Lu. Englewood Cliffs: Prentice-Hall, Inc. 1985. p. 31.

2.   McGregor, Douglas. The Human Side of Enterprise. New York: McGraw-Hill Book Co., Inc. 1960. p. 33.

3.   Ibid.

4.   Ibid. p. 33. McGregor is incorrect in interpreting the Scripture as saying that work is a punishment brought on by the fall. Genesis 2:15 indicates that before the fall, God put man in the Garden "to tend and keep it." Thus we see that work was built into creation. What resulted from the fall was the addition of toil and sweat to man's work, not work itself (Genesis 3:17-19).

5.   Ibid.

6.   Ibid. p. 47.

7.   Ibid.

8.   McConnell, John. Safer Than A Known Way; The Deming approach to management. Washington: Delaware Books. 1988. p. 156.

9.   Kohn, Alfie. No Contest. Revised ed. Boston: Houghton Mifflin Co. 1992. p. 19.

10.   Ibid. p. 206.

11.   Rousseau, Jean-Jacques. A Discourse on Inequality, trans. Maurice Cranston. New York: Penquin Books. 1984. p. 147.

12.   Sartre, Jean-Paul. Existentialism and Human Emotions. Secaucus: Castle division of Book Sales, Inc. p. 15.

13.   Masselink, William. General Revelation and Common Grace. Grand Rapids: Eerdmans Publishing Co. 1953. p. 218.

14.   Berkhoff, Loius. Summary of Christian Doctrine. Grand Rapids: Eerdmans Publishing Co. 1938. p. 121.

15   Masselink, William. General Revelation and Common Grace. Grand Rapids: Eerdmans Publishing Co. 1953. p. 211.

16   Berkhoff, Loius. Summary of Christian Doctrine.   Grand Rapids: Eerdmans Publishing Co. 1938. p. 122.

17   Ibid.

18   Benton, W. W., Jr. "Civil Righteousness." Evangelical Dictionary of Theology, ed. Walter A. Elwell. Grand Rapids: Baker Book House, 1984. p. 250.

19.   Calvin, John. Institutes of the Christian Religion, trans. Ford Lewis Battles. Philadelphia: The Westminster Press. 1960. p. 273.

Fear in the Work Place

Deming saw the cost of fear in employees. The cost of fear is difficult to quantify and measure. Think of your own work background or your time in college. How often have you done less than you could, covered up an error, or refused to offer a suggestion for fear of what might happen?

Employees are concerned that peers and superiors will view them in a poor light if the suggestion is discarded. Employees refuse to think in many companies because of past abuses. It is my belief that fully two-thirds of American employees have mentally retired on the job. This loss of mental capability is staggering. We see firms who implement TQM principles re-energize their employees to think. These excited, motivated employees accomplish an amazing amount for their companies.

Fear of reprisal or loss of job prevents many employees from speaking up and saying what is on their mind. I watch students come into my classes each year with fear and trepidation. Students do not believe me when I work to reduce fear in the classroom and provide an open path for learning. Some students have commented that it took a full year and two classes to overcome the fear of the classroom. Imagine what the fear must be like in a work setting where livelihood for the employee and family exists.

Consider this anonymous story about the walrus.

The Walrus --
(by an anonymous source)

"How's it going down there?" barked the big walrus from his perch on the highest rock near the shore. He waited for the good word.

Down below, the smaller walruses conferred hastily among themselves. Things weren't going well at all, but none of them wanted to break the news to the Old Man. He was the biggest and wisest walrus in the herd, and he knew his business — but he did hate to hear bad news. And he had such a terrible temper that every walrus in the herd was terrified at his ferocious bark.

"What will we tell him?" whispered Basil, the second-ranking walrus. He well remembered how the Old Man had raved and ranted at him the last time the herd caught less than its quota of herring, and he had no desire to go through that experience again. Nevertheless, the walruses had noticed for several weeks that the water level in the nearby Arctic bay had been falling constantly, and it had become necessary to travel much farther to catch the dwindling supply of herring. Someone should tell the Old Man; he would probably know what to do. But who? And how?

Finally, Basil spoke up: "Things are going pretty well, Chief," he said. The thought of the receding waterline made his heart feel heavy, but he went on: "As a matter of fact, the beach seems to be getting larger."

The Old Man grunted. "Fine, fine," he said. "That will give us a bit more elbow room." He closed his eyes and continued basking in the sun.

The next day brought more trouble. A new herd of walruses moved in down the beach, and with the supply of herring dwindling, this invasion could be dangerous. No one wanted to tell the Old Man, though only he could take the steps necessary to meet this new competition.

Reluctantly, Basil approached the big walrus, who was still sunning himself on the large rock. After some small talk, he said, "Oh, by the way, Chief, a new herd of walruses seems to have moved into our territory." The Old Man's eyes snapped open, and he filled his great lungs in preparation for a mighty bellow. But Basil added quickly, "Of course, we don't anticipate any trouble. They don't look like herring-eaters to me — more likely interested in minnows. And as you know, we don't bother with the minnows ourselves."

The Old Man let out the air with a long sigh. "Good, good," he said. "No point in our getting upset over nothing, then, is there?"

Things didn't get any better in the weeks that followed. One day, peering down from the large rock, the Old Man noticed that part of his herd seemed to be missing. Summoning Basil, he grunted peevishly, "What's going on, Basil? Where is everybody?"

Poor Basil didn't have the courage to tell the Old Man that many of the younger walruses were leaving every day to join the new herd. Clearing his throat nervously, he said, "Well, Chief, we've been tightening things up a bit. You know, getting rid of some of the deadwood. After all, a herd is only as good as the walruses in it."

"Run a tight ship, I always say," the Old Man grunted. "Glad to hear that everything's going so well."

Before long, everybody but Basil had left to join the new herd, and Basil realized that the time had come to tell the Old Man the facts. Terrified but determined, he flopped up to the large rock. "Chief," he said, "I have bad news. The rest of the herd has left you."

The old walrus was so astonished that he couldn't even work up a good bellow. "Left me?" he cried. "All of them? But why? How could this happen?"

Basil didn't have the heart to tell him, so he merely shrugged helplessly.

"I can't understand it," the old walrus said. "And just when *everything* was going so well!"

Discussion of Red Bead Experiment

Deming's famous four-day seminar always included the Red Bead Experiment. Deming showed the problem with common variation and why employees are so frustrated trying to improve a process that is flawed.

The exercise consists of a bowl of 1,000 beads. There are 800 white and 200 red beads. Dr. Deming solicits five "willing" workers, two inspectors and a recorder from the audience. He trains the "willing" workers in the exact method of inserting a paddle with 50 depressions (each to hold one bead) and explains that the employee's purpose is to produce white beads only. The red beads are defects. The inspectors count the white beads and the recorder keeps record of production.

At the end of each round, Dr. Deming examined the results and berated the employees for not producing better. If the white bead count went up he told the employees that they were on the right track. He would even give the highest performer a bonus. He was known for firing an employee who showed continually low white bead count.

The employees were frustrated with the process. They had no control over the white bead count, the red beads were so spread through the beads that it was impossible to control the count. Of interest was that if an employee brought up a paddle with only two or three red beads the audience would cheer and applaud as if the employee had created a masterpiece. Pity the poor employee who brought up a paddle with 15 red beads. The audience booed and jeered. Dr. Deming would immediately castigate the poor employee with the 15 red beads and demand a full accounting of the behavior.

I have used this same demonstration in my classes with great success. "Willing" employees are sought and trained. I use a larger bowl and paddle since I do not have advantage of overhead video cameras and large monitors to ensure all can see. It is fascinating to watch employee behavior. The first year I ran the demonstration, all the employees clustered around the bowl to block my view and as the employee brought up the paddle, other employees were picking the red beads off and substituting white beads. Their classmates shouted encouragement to them. I allowed the action to continue for three rounds and then fired them all for violating company policy.

Another "willing" worker during a different demonstration openly took the red beads off and substituted white beads. I fired her instantly. She was shocked that while she saw herself doing right, management fired her for not following instructions.

I have observed employees picking red beads out of the bowl and putting the beads in their pocket to improve the overall performance. One employee showed the extent people will go to beat an obviously flawed system by bribing the inspectors with a dollar to change the count. They did change the count!

After the exercise, we create a control chart to show how the entire system is in control and that the amount of defects are common to the system. No amount of tweaking would improve production. We discuss the futility of inspecting after the paddle is brought up from the bowl. Students quickly see that the inspection should be done before the beads are accepted. If the bowl only contains white beads, there is no concern about quality. It is assured!

Statistical reasoning is used as well. The average of the red beads contained in the paddle and in each round is discussed. Students are sure the average should be close to ten per paddle since there are 50 depressions and 20 percent of the beads are red. It is important to understand that the average need not be ten here. There are many variables which affect the number. The beads are different. In my case, the white beads are smooth round wooden beads. The red beads are smooth round wooden beads stained with mahogany stain. Some red beads are stained well and some are stained poorly to make it difficult to easily recognize the red beads. The red beads are not as smooth as the un-stained beads. The red beads are slightly bigger and slightly heavier because of the stain. The inspectors see the beads differently because of the level of stain and the recognizability. The employees consciously try to angle the paddle as they lift it out of the bowl in attempt to cause the red beads to roll off the paddle rather than into a depression. Finally, there are two paddles used. Each is custom made and no two depressions are alike.

Statistically guessing at an average of ten would be logical if only common variation of the beads was at play. Common variation of the red beads and special variation of the paddle and the employees must be taken into account as well. The demonstration is a magnificent way to learn about production process and quality control.

The Lessons Learned From the In-class Exercise

I include a document I wrote for the students in the 1993 TQM class. This exercise was designed to allow students to experience what continual improvement is like in an environment where management means well but implements the principles poorly. I started the class out on day one by informing everyone that since it was a class involving production concepts, I expected all students to use them. I instructed students that they were to be in the classroom precisely at 6:00 P.M. and no later. I expected the least amount of time used for entering the room. I then informed the students that prior classes could enter the room and be ready for class in less than 20 seconds.

Improving a process is as easy as entering a door

The purpose of this in-class exercise is to give you a real life experience changing a process. It allows you to understand what needs to be done, how to do it, and the limitations to change. The most important lesson is to understand what management's responsibility is and how much of an impact management makes on the improvement process. There are several assumptions in this particular exercise. The first assumption is that you are here to learn and are willing to participate because you will gain knowledge as the result. The second assumption is that changing one process is identical to changing all processes. Only the places and people are varied.

There are several lessons to be learned from this exercise.

The first lesson is that incredible improvement can occur simply by management asking for improvement. The improvement in student performance from the first night to the second night was near ten-fold. I, as management, did nothing more than simply say what it was that I wanted and how I was going to measure it. Dan Chamberlin told you that you always get more of what you measure. Measuring arrival times aided in producing a huge improvement.

The next lesson is that communication is essential to long-term comfortable change. Feedback must be employed to ensure that each and every employee knows what management wants. My request on the first night was for every student to be in the classroom by six o'clock. Nobody should enter the room until 5:59 p.m. and everyone should be ready to go by 6 o'clock. What most students, or employees, heard was: "I want you to come into the room at 6 o'clock." Management's expectation, therefore, didn't occur.

The next lesson is that when employees don't understand what is requested of them they will simply go along with the other employees. This was referred to by students on the second night as "herd mentality," peer pressure, or fear. Note that the fear came from employees around them, not management.

The next lesson involves MacGregor's Theory Y. MacGregor stated that work occurs naturally. He goes on to say that employees will only work to benefit the organization if the behavior is in line with what the individual wants to accomplish. In this particular case students heard questions the second night of class asking why we were doing this exercise. I remember hearing: "Of what use is it to me?" Remember that one of the presumptions is that you are here to learn. Logically, it follows that you came back to class the second night because you wanted to learn. The lesson here is that management must be able to articulate the values of the behavioral change to the organization and how the behavioral change will benefit the employee.

Individual incentives are worthless when it comes to operational improvement. Think back to what happened in the classroom when two students said: " . . . well, what's in it for me?" and I asked them what they wanted. One student said, " . . I don't know. Let me think about it." The other one said: "Well, I want a change in the weight of the class participation score." "No problem, you got it," I replied. Do you really think he's going to be more committed now to this particular project? The answer is no. The reason he will not be more committed is that what he asked for is irrelevant to what his behavior needs to be. There is no causal relationship between his behavior and the change in his participation score. They're not directly connected.

The next lesson is the necessity for unity in order to bring about lasting change. Change occurs because we alter the organizational culture. Change occurs because people are willing to accept different procedures. Change occurs because we are willing to modify what we believe. Change occurs because we are willing to use a different paradigm. Each of these reasons presupposes that everyone is working together. If all 45 of you are rowing a boat and you are not in unity, there is a lot of water motion, but limited forward movement. If management is unwilling to ensure unity among a group of employees before change is requested, success will not likely occur. Employees, however, recognizing the value of the change to the organization, and thus to the customer, and ultimately back to themselves, may take it upon themselves to seek unity. They will build camaraderie within the group. If you achieve unity in this exercise you will see sustained improvement in a short time. If not, then the benefits from improvement may never be reached.

The next lesson is that we are unwilling to look at the obvious because we presume nothing else exists. I am not surprised that the majority of the students ignored the second door leading into the classroom. Besides the door, you might have rearranged the desks and chairs or moved the clock . Ninety percent of American managers and employees, in my estimate, jump immediately to a change in behavior without analyzing their environment. Long-term operational change must begin with an incredible amount of planning, thinking and preparation. The visible behavioral change period is quite short. You can see this in how long it takes world class manufacturing companies to bring a new product on-line. Tool up time is considerably longer than non-world class manufacturers, yet the total time from concept to market is shorter. The amount of planning, preparation and practice that goes on allows the actual implementation to be close to perfection when the system starts.

The next lesson is the impact of expectations on organizational change. I said to you on the first night of class: "The students before you were able to come into the classroom in 20 seconds." The implication is that I expect you to do as well. It is interesting to note that nobody stopped to ask what the 20 seconds was based on. There is a wealth of information available. It would have been provided if anyone had asked. Let me give you the information now, with the presumption that in the future you will be able to think about this and ask more questions. The 20 seconds occurred in a room about one-third the size of our current room. The other room accommodated about 25 students in a U-shaped design of desks. There was one door. Seven or eight practice sessions were conducted looking for different methods of entering the room and preparing for class. This 20 second time, in reality, has no validity to what you're doing in the current room. I set a level of expectation for you by stating "20 seconds."

The next lesson is understanding the barriers to improvement management places on employees. I doubt that anybody took time to sit down and work out a diagram which

showed how we enter the room or what the environmental constraints are. This is an audio classroom. We have wires mounted on the outside edges of the tables. There is a reason they are mounted on the outside edges of the table. Considerable thinking, preparation and questioning went into the placement of the tables and wires. Those wires are not going to be changed because of the probable impact to the rest of the business school. Therefore, we have a limit upon how we can move these tables and chairs. This limit is management's responsibility. It is part of the 85% that management is responsible for. Management, through its reluctance to allow a change in the tables, has limited your ability to improve. My setting of a 20 second expectation while preventing you from moving tables and building new doors may be the cause of a sense of failure on your part. Still, there is much that you can do to improve the entrance process into the room. I hope you will learn the lessons still waiting to be discovered.

The next lesson in this exercise is that the methodology and instruments used to collect data must be appropriate for the data being collected. The first night I used a chart that had plus or minus 6 minutes on it. It was reasonably appropriate. The second night, everybody came in within a one minute time frame. Thus, a plus or minus 6 minute chart gave me no real understanding of movement. I had another chart ready to go, because I've been through this process before. So many times management will not allow the change in record keeping, they say: ". . this is the way we've always done it and we can't make any changes." If you want to see long term change occur, you're going to have to adapt your record keeping technology and methodology to fit the data.

The next lesson learned in this exercise is the benefit of improving a process without increasing cost. We can either increase gross margins or we can decrease price, thus increasing the size of the market by making our product or service more attractive to more people. Look at the numbers below. The allocations are contrived and are only to show an example. Take this information and apply it to any industry you want and see what happens when you increase capacity by 8% without increasing overhead.

Make a presumption that we have an average of 40 students at $760.00 per class. Twenty-five percent goes for faculty costs, 25% goes for indirect support cost, such as secretarial time, copy cost, materials, telephone expense, janitorial service, etc. Forty-five percent goes for overhead.

Look at what happens when capacity is increased to 13 classes. Revenue increases, direct and indirect costs increase, but overhead has not changed. Note that profit increases significantly. There are many firms operating with a profit margin similar to this example, so there is validity to business. Consider the option of decreasing the price to expand the market. Can you imagine more people buying your product or service at the lower price? One of Deming's cornerstones is that a function of business is to expand the market. As you improve services and abilities, improve quality, and reduce waste, you can produce an ever-decreasing cost.

	Before Change	After Change	% Chg	If we lower the price to $183	% chg -4%	10% Increase in volume	% chg
Number of Courses	12	13		13		13	
Avg. student load	40	40		40		44	
4 hrs @ $190.00	364,800	395,200	+8%	380,640		418,704	+10%
Direct Variable	91,200	98,800		98,800		98,800	
Indirect Variable	91,200	98,800		98,800		108,680	
Overhead	145,920	145,920		145,920		145.920	
Profit	36,480	51,680	+42%	37,120		65,304	+ 76%

The next lesson learned is that without direct management involvement, motivation, or excitement, employees will not be committed to change. Was I excited, motivated, or involved? Was I out in the hall talking with you and lending a hand where asked? Did I offer to carry in your books or coats?

Yet another lesson learned is that silence from employees does not constitute agreement. Silence is simply that -- silence. Saying nothing does not mean you agree to change your behavior so that we can have a more efficient operation. Too often management presumes that since nobody complained or said anything at all, everybody is in agreement and that change just has to happen.

The next lesson is that if employees do not fully understand what they will be measured by, they become upset. A female student came into the room before the beginning of the class saying: "I'm really not here, I'm just passing through." What I stated in the beginning of the course was my desire to have people come into the room and be ready for class and that I would track arrival time. Thus, coming into the room was what I was measuring. This female student interpreted the purpose as coming into the room to start class and she believed that is what should be measured. Later in class discussion, the female student made comments towards the other students who waited outside of class, referring to them as "Those people . . . ." Suddenly, there was dissension and frustration when it was never meant to be. I, as management, could have avoided the problem by making sure there was feedback from everybody.

Professor Chamberlin has told you that the greatest defect in communication is the belief that it actually occurred. If you want to see improvement in your organizations and increase efficiency to reduce costs, increase quality, improve customer service and to make your employees happier, then it is going to be your responsibility to make sure that the employee knows exactly what is expected of them. The employee must know exactly what parameters they can work with and how their performance will be measured.

There are more lessons to be learned in this exercise. Seek them and use the wisdom in your management life.

All operations problems can be examined from a position of least common denominator. This problem is best examined by seeing that there is a natural division in the room. There are two doors and two sections of desks.

Working harder has not improved the score significantly now. The greatest improvement occurred in the first session and only a small amount of improvement has occurred since. Training in problem solving coupled with a true commitment to improve is the only way that permanent improvement occurs.

Improvement is lost as quickly as it is gained. Several students commented that they wanted to "prove" that they could enter the room and be seated in less than 20 seconds so that they could put this silly game behind them. Employees in real life situations see your requests for improvement as nothing more than a silly game as well. The difference comes in gaining a true level of commitment from the people you work with. This requires a true commitment from you first. Your employees will not "care that you know, until they know that you care."

Select from the group a responsible list of people with the cross skills that the problem will take. Insure that the remaining employees will submit to the resolutions the team will implement. A team with no followers from the among the body will be useless. Mature employees know that submission to a team is essential because they, also, are on a team, or will be soon.

When using two teams on similar problems, such as this in-class exercise with two natural divisions in the room, never place one in competition with the other. In such instances, information will not be shared and the company will suffer in the end. But, with mutual cooperation between the units, information will be shared and both can become stronger because of the union.

Management and workers should accept structure and rigidity while performing tasks; yet, this should occur always with the condition that between task executions, improvement can be discussed and practiced. There is comfort in knowing what will happen. No one likes surprises or uncertainty in business. Rigidity does not mean dictatorial slavery. Rigidity can provide comfort. Imagine what it would be like if we did not have a set class time and location each week. Rather, how would you feel, and how would you perform, if you did not know from week to week when or where we were meeting. Between terms, or even during a term, we can discuss and plan new meeting times and locations which best serve the body and provide improvement. Consider what it would be like if there was uncertainty. See Psalm 133:1; Amos 3:3; Matthew 12:26; Mark 3:23-25; Luke 11:17; Acts 4:32; 1 Corinthians 1:10; Philippians 2:2; Ephesians 4:3; 1 Peter 3:8.

Management must be directly involved when employees are untrained at team development or when employees are immature. This is in line with the Hershey-Blanchard Leadership model tying leadership style to employee immaturity.

Employees will not believe that you are interested in improvement unless you improve with them. Using terms like "associates" in place of "employees" will only make matters worse unless there is true commitment behind the words. Merely talking the talk and not walking the walk will instill a deep sense of hypocrisy in employees' minds. Management by walking around can only be useful when you roll up your sleeves and participate.

Long term improvement must be tied to long term goals. Employees must be able to see the future and benefit. This is what Chamberlin refers to as the vision-keeper. You, as managers, must hold up the future for all to see. Everyone must be looking forward -- at least five years forward, not just quarterly.

End of Lesson Questions

1. Can you use only some of Deming's fourteen points and not others? How does this compare to the Ten Commandments?

2. State examples from your own experience for Deming's principles and diseases.

3. What are the costs to the workplace caused by fear?

4. What does fear do to students in the classroom? Think of which (which what?)are caused by fear?

5. How does Christianity's beliefs fit Total Quality Management?

6. What does the story of the "Walrus" tell you?

7. Which parts of Deming's philosophy do you have the most difficulty understanding and accepting? Why do you think you have this dissonance?

Lesson Two - EOQ, Process, Systems and Agency Theories

Objectives

After studying this chapter and working through the problems and questions at the end of the chapter, you should be able to:

- Calculate the economic order quantity for any item

- Identify the typical items included in order costs and carrying costs

- Identify and convince managers of what additional items should be included in carrying costs

- Explain to managers how to reduce order costs using TQM techniques

- Explain to managers how operations operate as a process

- Identify processes in an organization

- Identify processes that operate in a system

- Identify inputs, processes, and outputs of a system

- Explain to managers how improvement plans follow Deming's Plan-Do-Study-Act cycle

- Explain to managers how managers act as agents on behalf of owners and employees

- Explain to managers what their fiduciary responsibility is.

Key Words

Economic Order Quantity

Economic Manufacturing Order Quantity

Safety stock

Process Theory

Input

Process

Output

Systems Theory

Deming System Model

Plan-Do-Study-Act Cycle

Agency Theory

Fiduciary Responsibilities

Economic Order Quantity

Most manufacturing operations courses use the Economic Order Quantity Model (EOQ) to establish ideal quantities to purchase or to manufacture. Although this text does not support the idea that companies must make all operations decisions based on the lowest cost and the highest yield, stewardship demands that managers consider this. There are two annual controllable costs that EOQ works with: order costs and inventory carrying costs. If we make one order of an item a year, we have the lowest possible order costs, but we will have to carry a year's inventory. If we order only one unit of an item at a time, we will have no inventory carrying cost since the item would be consumed immediately, but we would have tremendous order costs. The EOQ formula seeks to find the quantity that results in the lowest possible order and carrying cost.

The EOQ formula is:

$$EOQ = \sqrt{\frac{2DS}{IC}}$$

where D = annual demand; S = order cost or setup cost and IC = carrying cost per unit

Let's look at a simple example of widgets:
Annual demand is 10,000; order cost is $25 and IC is 15% of cost; cost is $2:

$$EOQ = \sqrt{\frac{2*10,000*25}{.15*2}}$$

$$EOQ = 1290$$

At 1290 we will have 10,000/1290 purchases or 7.75 purchases of 1,290 widgets per year. The average inventory would be 645 (1,290/2). A presumption of the EOQ model is that inventory is used at a constant rate over time. Since we begin with 1,290 units and end with 0, the average is (1,290 +)/2 points in time. The annual cost will be (7.75 * 25) + (645 * .30) = 193.75 + 193.5.

Notice that the two sides are equal. (See the following graphic)

EOQ
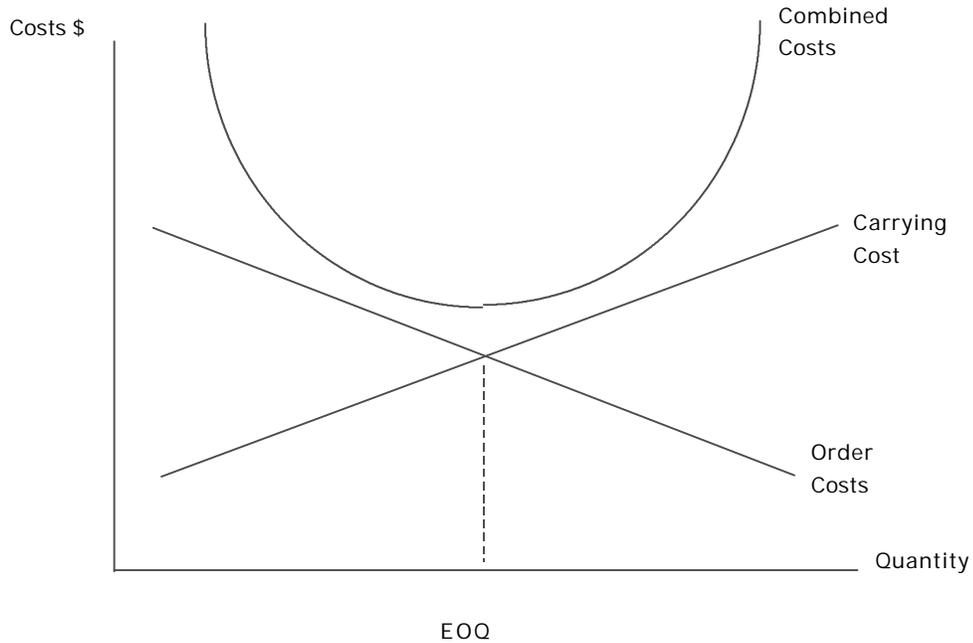
This graph shows that at the EOQ the two cost lines (annual carrying cost and order cost) cross, showing they are equal. Take a look at the same problem but with a different set of costs associated with each component:

Annual demand is 10,000; order cost is $5 and IC is 35% of cost; cost is $2:

$$EOQ = \sqrt{\frac{2*10,000*5}{.35*2}} = 378$$

At 378 we will have 10,000/378 purchases or 26.45 purchases of 378 widgets per year. The average inventory is 189. The annual cost will be (26.45 * 5) + (189 * .70) = 132.25 + 132.30.

Companies are beginning to realize that their carrying costs for inventory are greater than they previously thought. Carrying costs were once considered to include rent, capital cost (interest on holding money), and spoilage. Carrying costs are now seen to be rent plus an allowance for what that space could yield if it was converted to production space (known as opportunity cost), capital, spoilage, utilities for light and heat, and some miscellaneous. Of interest is the fact that we include the cost for people who move items within the warehouse, but we do not include a portion of the accounting and staff people who work because of the inventory, or a portion of supervisors and managers that work because of the warehouse people.

Large lots allow greater waste allowance on the production floor. Scrap piles are larger in companies with large lot production and purchases. Contrast this to smaller lots that allow the capture of defects before internal and external failure. Smaller lots

allow more flexibility to customer demand. There should be a cost consideration added to the carrying cost in the EOQ formula for this as well. I referred to this in the "miscellaneous" reference above.

Many production managers and purchasing agents rely on the EOQ model to determine quantities. TQM can use the EOQ formula to explain the advantage of small orders. I suggest that if you include all the real costs of carrying inventory and producing in large lots, the EOQ formula does support smaller lots and a Just-In-Time (JIT) production philosophy. More on JIT later.

Safety Stock

The old philosophy stated that all vendors take time to deliver an order once it is placed. Thus, it was important to order more (or order earlier) to avoid running out. Another impact on the quantity ordered and carried is safety stock. The old philosophy said that if we run out of an item, the cost to production was greater than the cost of carrying extra inventory.

The premise of the "new" philosophy is that lead time can in fact be reduced to zero. Imagine a condition where the correct amount of any item is delivered at precisely the same time as the storage bin is empty. Imagine too that there is a guarantee of delivery, and therefore no safety stock is necessary. Although we may not achieve utopia, we can move closer to it.

Quantity discounts can play havoc with EOQ as well. You can run several EOQ calculations based on quantity pricing and compare the difference. You can also use more complex mathematical expressions. The Wagner-Whiting algorithm provides a lower inventory allotment if all mathematical inputs are correct. The drawback is that it requires the company to accurately predict future demand. The farther into the future you project, the less accurate your calculations. The intent is still to forecast the next unit demand and provide for it. This text uses the EOQ formulas presented and, for the sake of simplicity, does not use the more complex algorithims that you might find in advanced production or inventory management texts.

Economic Manufacturing Quantity

EOQ, with a modification, can also handle manufacturing your own components. We must allow for the rate of manufacture and the rate of use to establish an inventory level. There is a presumption that you can manufacture the component at a rate greater than you can use it. If the production rate is less than the use rate, then the company would still have to buy components from an outside supplier and we would use the EOQ equation for the purchased amount.

The model changes to the Economic Manufacturing Quantity (EMQ), such as:

$$EMQ = \sqrt{\frac{2DS}{\text{interest}\left(\dfrac{\text{demand rate}}{\text{production rate}}\right)}}$$

for a given time period. Let's look at the last example of widgets.
Monthly demand is 1,000, monthly production rate is 1,500, order cost is $25 and IC is 15% of cost, cost is $2:

$$EOQ = \sqrt{\frac{2*12,000*25}{.15*2*\dfrac{1000}{1500}}} = 1738$$

This means that we will produce 1738 at a time. Since we produce 1500 a month, we will run for approximately five weeks at a time. The excess production over the 1000 used in a month will go into inventory. When we are near finishing off the inventory, we start manufacturing again.

We can use similar figures as we did for the comparison EOQ model and show that if true carrying costs and improved set up costs were used, the lot size would change. Manufacturing and the EOQ formula rests in large part on the setup cost. The old philosophy says to produce more to spread out the impact of the set up costs. This is the concept of "economies of scale."

Example: if 10,000 items have variable costs of 1.00 and set up costs of 3000, then the run produces a true unit cost of (10,000 * 1) + 3,000) ∕ 10,000 = 1.30. If the production run can be raised to 20,000, then a true unit cost of (20,000 * 1) + 3,000)∕ 20,000 = 1.15. This yields a (1.30 - 1.15) ∕ 1.30, or 11.5% reduction in price.

TQM says to work at reducing the setup. Many companies successfully reached setup cost reduction of 1∕10th of the original. In our example, if we can reduce setup to 1∕3 of the original, then look at the results:

> unit cost at 10,000 = (10,000 * 1) + 1000) ∕ 10000 = 1.10
> unit cost at 20,000 = (20,000 * 1) +1000) ∕ 20000 = 1.05
> unit cost at 8,000 = (8,000 * 1) + 1000) ∕   8000 = 1.125
> unit cost at 5,000 = (5,000 * 1) + 1000) ∕   5000 = 1.20
> unit cost at 3,000 = (3,000 * 1) + 1000) ∕   3000 = 1.33

We can produce a lot size of one seventh the original size and maintain the same unit cost (first scenario at 10,000 quantity - unit cost of 1.30, compared to the second scenario at 3,000 quantity - unit cost of 1.33). This will result in lower inventories, less storage space, more space used for other production, etc.

Process Theory

Total Quality Management operates on the premise that the total production effort is more important than individual operations. Functional management is by-passed. For example, consider the process of purchasing a life-insurance policy. The process starts with the salesperson contacting the customer, establishing the customer's needs, and recommending a policy. The request for the policy then goes to the underwriters where they examine the policy and concur or modify the request. The request then goes to a medical review office for evaluation of the customer's health. The policy moves on to a financial office where they weigh the risks and establish a premium. The policy returns to the salesperson where the sale concludes.

Process management says that you bring together enough of each type of activity-based employees and manage the flow of work through the firm. Total Quality Management strives to reduce barriers between process steps. The customer is best served when all attention is focused on the product or service and not on the individual element.

Life insurance companies that implemented process management brought teams of personnel together to support a type of customer, a salesperson, a region, or a product line. Each team consisted of sales, underwriter, finance and medical. As the agent worked with the customer, information traveled to the team members and decisions occured simultaneously. If problems arose, all could contribute to the solution. Some insurance companies using process management reduced time to policy approval by 75% of original. This resulted in happier clients and available time for personnel to work on other projects.

Functional arrangement keeps each area separate on the belief that it is better to manage several people doing like work. An example of how functional management is at odds with the benefits of process management comes from Brian Joiner in his book, *Fourth Generation Management*. Joiner gives an example of an engineer in a manufacturing plant who discovers a way to reduce the cost of the company's product by $60. The engineer reports the wonderful discovery to his supervisor. The supervisor asks what the impact to the engineer's area would be. The engineer says that production costs in his area go up $20 but assembly costs in the next area go down $80. The supervisor knows that he must meet his budget if he is to gain his bonus this year. The switch to the new method would destroy his budget and make the next step look very good. The supervisor takes the engineer's idea and stops the discussion. The company is not well served because functional concern overrode process concern. I believe the engineer would be less likely in the future to make savings recommendations.

Systems Theory

According to Lloyd Dobbins and Clare Crawford-Mason,[16] the study of systems and systems theory began as early as the seventh century BC. The Chinese book, *I Ching*, referred to as the book of changes, describes the universe as a fluid world of continuous beginnings and endings. Much of *I Ching* fits system theory.

Deming emphasized systems thinking in his concept of profound knowledge. But what is systems thinking? Systems involve two things: the concept of a system and the use of science. So what is a system? This seems to be a circular definition. And so it is!

A system is defined as a closed operation where each component so depends on the others that you cannot examine a single part and comprehend the system. You cannot even examine all the parts and understand the whole. An automobile is a system. If you were to take the car apart and put all the pieces in a parking lot, each component by itself would not explain how the car functions. Only when you see how each part INTERACTS with the others and how sub-systems develop can you begin to comprehend the whole. So, the key to a system is the interaction between the parts.

Unfortunately, there is no word in the Christian vocabulary to describe this concept of system, yet Christ established the church as a system and Paul's many references to Spiritual gifts fit a system definition. The Buddhist concept of Zen and the New Age concept of holistic are the closest words I have found to describe this concept. I

reiterate here that system thinking is found in the Bible. In addition to Paul's reference to Spiritual gifts, the Genesis account of creation describes sub-systems.

A system receives inputs from outside the system, processes them and adds value, and moves these transformed inputs out of the system as outputs. Systems can be simple, with one or two people, or they can be complex, with hundreds. Just-In-Time thinking impacts system thinking by requiring outside vendors and customers to become part of the manufacturing system.

Consider Deming's system model (shown in the box).

A system works well when all sub-systems and system components operate together in unity and support one another. Look what happens when we allow barriers into the system:
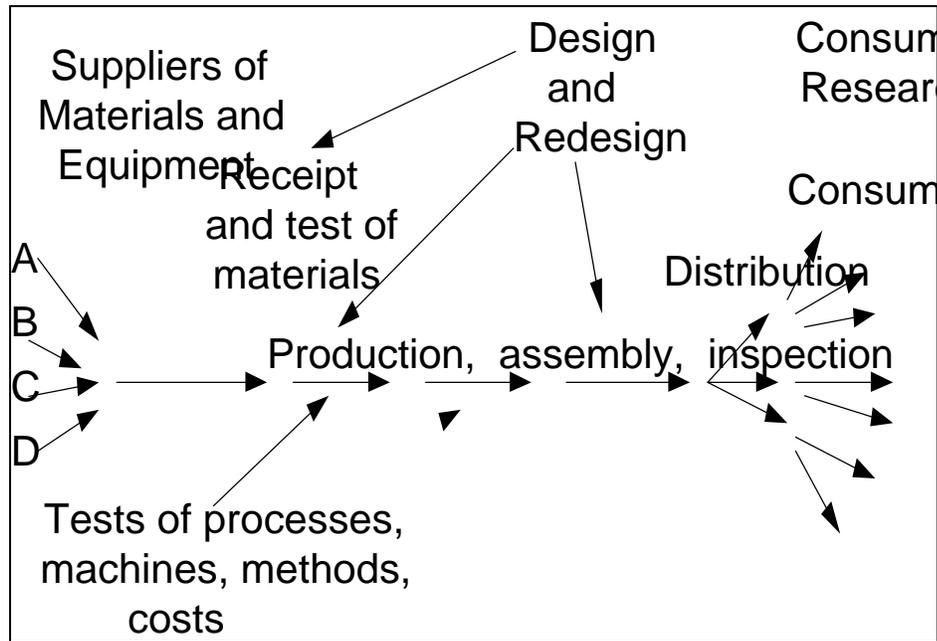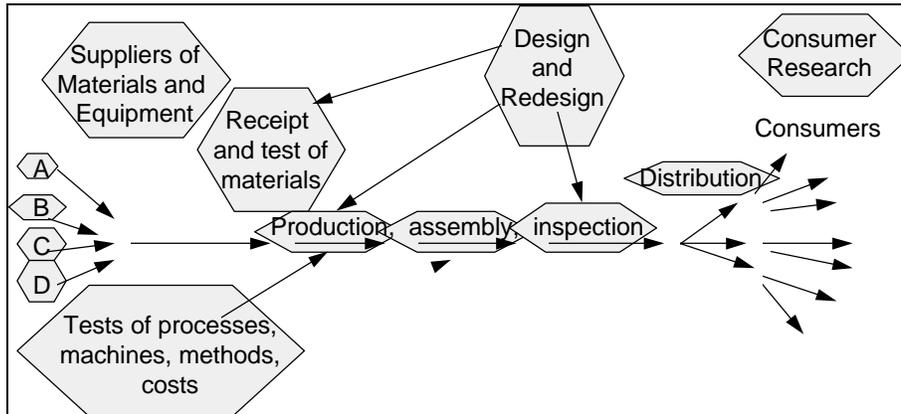
A system cannot operate when free flow of information and support does not exist. Unfortunately, managers start out unknowingly trying to establish a system and then contribute to its demise by restricting employee movement. Managers destroy systems because they are difficult to control. When something goes wrong, managers seek out the specific cause and look for someone to blame. Most managers will not tell you they are on a hunting expedition looking for an employee to become the ceremonial scapegoat. A system prevents this, thus, managers break down the system to maintain their traditional form of control. TQM looks at systems problems as such and sees employees as part of the system.

When something goes wrong in a system, it is nearly impossible to find one person responsible, unless the individual is bent on sabotage. The opposite is also true, you can't find the one person who deserves a reward when the system does extremely well.

Systems work better when all people work for the betterment of the system and not for themselves. This ties into Deming's principle of not rewarding on the basis of merit pay. The entire system must be rewarded, not the individual. So how does the system improve? You examine the system, as a whole, remove deficiencies, and enhance the operation without regard for who performs each step. Quality improves when the system improves. Looking for a scapegoat does nothing to improve the system.

Earlier, I referred to Russell Ackoff's comment about systems and the use of science. The scientific method of discovery and proof provides a framework for the improvement of systems. First, through observation we learn of an out of control situation or that some performance is less than ideal. Second, we gather data to better understand the phenomenon. Third, we form theories and opinions about the cause from studying the data. Fourth, we choose an improvement intervention and try it. Fifth, we gather data on the system after the installment of the intervention. Sixth, we compare the before and after results and determine if the system improved. And so the process continues in perpetuity.

This is conceptually in line with Deming's Plan, Do, Study, Act cycle.
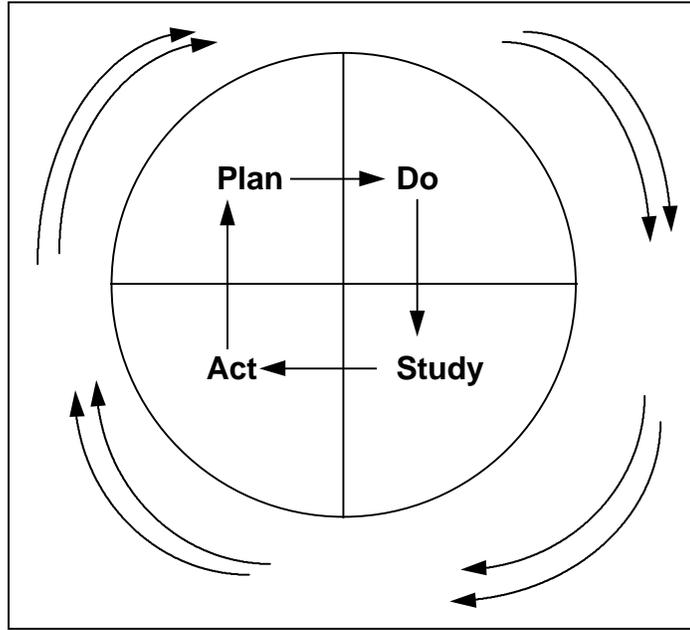
The scientific method presumes the problem lies within the system. Problems outside the system usually cannot be fixed and become part of the environment impacting the system. Managers find it difficult to accept that some problems are not fixable. Managers also find it difficult to accept that efforts to improve quality will never be finished. It is this current, future tense of the verb improve (to which the English language does not do justice) that so frustrates managers. This concept is the polar opposite of the phrase, "If it ain't broke, don't fix it." Nothing needs to be broken to seek improvement. This is parallel to the Christian concept of sanctification. Christians continually seek to become more Christ-like, knowing that we can never fully attain the goal, but yet continually striving towards it.

I referred to the problem of systems thinking causing circularity in thought -- which came first, the chicken or the egg? -- at the beginning of this section. Consider a system to be greater than the sum of its parts and able to do exceedingly more than its parts (not more in volume, but more in type). Thus, the improvement cycle is continually always producing a slightly different system as a result, and I hope you see that systems are, indeed, circular.

It is this circularity that so upsets most managers. A common belief is that if you cannot break something down and understand each component, you cannot control it. This thinking does not hold true in understanding systems and results in managers unknowingly, or in some cases knowingly, destroying perfectly good systems. Systems must be managed. A good system does not manage itself and a bad system is evidence of a lack of management. A good systems manager understands the relationships of the components and assists with communication and resource movement to ensure the fluidity and accuracy of the system.

Systems thinking is the foundation for "re-engineering," a term much in vogue these days. Re-engineering is a method of re-examining what a firm does and then trying to envision how it might be done better.

> **Discovery consists of seeing what everybody has seen and thinking what nobody has thought.**
> *--- Albert Szent-Gyorgyi*

To understand a system you must examine it from one system level higher. Here is an example: Imagine that you are a crew member in the movie "The Fantastic Voyage," where doctors were placed in a special submarine, shrunk to the size of a single blood cell, and injected into a man to perform corrective surgery. A far-fetched movie, I agree, but suitable for this analogy. While in the circulatory system, it is impossible to imagine life existing outside of the blood vessel walls. It is equally difficult to imagine the full purpose of the circulatory system since the actual exchange of nutrients and oxygen seems to be of little benefit to anyone(thing) else.

However, when you step outside the circulatory system and see the path of the veins and arteries and the capillaries connecting them and the tissues being nourished by the blood, the circulatory system seems quite logical. To understand a system we must look outward to see how it fits in the greater whole. We must climb the walls of the maze and look down upon it to see the correct path. Managers wrestle with this requirement, preferring to look inward and upward to their boss. In my opinion, this came about from rewarding for individual performance and looking for a single person to blame when something goes wrong.

Success in systems comes about by knowing what the system receives, what the system is to do with the inputs, and to whom the outputs go. This requires a thorough knowledge of the customer (internal or external), the customer's measure of success, the knowledge of the process to produce the desired results, and the vendors (internal or external) to gain the correct inputs.

Agency Theory

Agency theory is usually found in the Business Law books and in certain accounting texts. I interject the concept of agency theory to round out the theories by which managers act in the firm.

Many firms today are owned by a collection of stockholders ranging from the individual on the street, to managers of the firm, to large single investors, to investment institutions. The day is gone when the majority of companies are owned and operated by a single person or family.

> *Managers act as agents of the firm. Agency is the fiduciary relationship that results from the manifestation of consent by one person to another that the other shall act on his behalf and subject to his control, and consent by the other so to act. The principle is the one for whom action is to be taken and the one to act is the agent.*[17]

Managers act, or should act, for the greater good of the shareholders. This may mean acting for the greater good of the firm such that the shareholders are better off in the future. While ethics drive the "ethical" manager, it is important to see that the principle of this philosophy we call TQM includes a desire to better, or increase, someone other than oneself.

The old management paradigm presumed that management would look out for its own self interest. This was a basic tenet of the union movement. Unions believed that management was more interested in itself than in the worker. Servant management leaves no room for self indulgence. Servant management truly calls each of us to serve the other. So it is also in TQM -- serve others first.

A Sad Fable

(Contributed by a prior student whom I choose to keep anonymous)

There were two people working in a successful and prosperous company, both of whom were quite close to the Leader of that company. These two had dreams of their own. One of them thought that he could build the same kind of company as the one that the Leader built, just as large and prosperous. The other's ambition was to develop similar products as those produced by their company, but for another market niche not served by their Leader.

What separated these two from other ambitious people was that they quit their well-paying jobs and together acted on their respective ambitions. One of them found the required financing and built an organization which, in all internal respects, mirrored that of the Leader for whom they had both worked, but on a smaller scale. The other man developed products for another segment of users; these products were compatible with those produced by the Leader for his market and as much on the "forefront" of technology.

They began to employ people to do various things that needed doing. The company grew as customers started buying their products. Not only did customers buy their products, but they praised the products in many technical magazines. Not only did customers praise the products, they won prestigious technical awards. The two men were happy with what they had done.

At first it was easy for the new company to grow and prosper. Their customers seemed excited about buying products that, according to all technical magazines, were on the "forefront" of their technology. Soon it became more difficult to collect money from their customers.   An employee responsible for collecting money began to worry, since for the first three to four years, the company had been successful in collecting money in a timely fashion. Now though, as time went by, collection of money became more difficult. The two owners hired more people and formed a Credit and Collection department, but the problem not only remained, it became worse.

The employee wondered what to do about this problem. He decided to make a list of reasons that customers gave for not paying. He found out that most customers felt they had not received a product that could solve their problems as they anticipated. Along with some problems with which they did not receive help right away, they felt ignored after the sale, or the product arrived later than promised. In other words, a good number of customers felt that the company did not meet their expectations and therefore delayed or even avoided paying invoices.

So the employee from the Credit and Collections department went to the Sales department and told him what he had learned about why customers were not paying the invoices. Sales said that they had to sell a certain number every month and that's what they did, no matter how difficult it became with the constantly rising quotas and the rapid turnover of the sales force. Sales did not say anything about satisfying customers; in fact, no one in the Sales department even seemed to know what it took

to "satisfy a customer" in their kind of marketplace, although in every company circular and in every company meeting the main topic was "sales."

Then the employee went to the Marketing department to tell them what he had learned about why customers were not paying for the products. Marketing talked about the ad campaigns and the seminars they ran all over the country. They talked about all the leads they generated from those ad campaigns and the seminars. They did not say much about who would handle the leads, or how they would handle the leads, or when they would handle the leads, or what kind of leads they were. Marketing did not say anything about satisfying customers.

The employee went to one of the two men who started the company and told the owner what he had learned about why customers were not paying for the product. The owner talked about being a technology-driven company and, after going public, being a market-driven company. His company would be as good as the one the Leader had built.

Then the employee went to the second man who started the company, the one who developed its products, and told this owner what he had learned about why customers were not paying. The second man talked about when the next new product would go out, and about the late hours the engineers worked. His ideas were excellent, why, even his best engineers said so.

From all these talks, the employee got the impression that the company seemed more interested in the cleverness of its products than in finding out what the customer wanted and then delivering and backing it up with adequate customer service.

In touring through the company, the employee saw how others were in the same predicament, trying to understand why things were not working as they should in their respective departments. They, too, had tried to alert their managers to problems, only to find that the managers were simultaneously "fire fighting" and trying to meet moving targets of performance. So, these other employees started developing their own informal networks throughout the company to get some of their work done.

However, even with that effort, many employees problems still were not resolved the way everyone hoped and expected. Instead of getting more work done, the employees found that their informal networks carried more information about problems than about how to fix or work-around them. All of this informal network activity took more and more of the employees' time and energy.

Finally, the employee decided that he had found out why it was so difficult to collect money from their customers. Although the firm had demographic and other profiles to know how to "reach and influence the customer," no one figured out what it takes to satisfy the customer. So, when Marketing prepared marketing campaigns, they guessed at who the customer was and what the customer wanted. When Sales made sales calls, they hoped they had a customer who would buy more than one copy and help make quota for the month.

Meanwhile, the work in Credit and Collections came to resemble trench warfare with an increasingly high level of frustration and resulting turnover in the Finance department that, in turn, hampered collections. Intermediate and top managers appeared frustrated. For example, the company had four CFOs in a seven year period. While in office they were busy "fire fighting" and did not have a chance to deal with systemic aspects of their work.

The employee, as well as other employees, found that even with all the personal effort and informal networks their jobs became less and less pleasant, and they accomplished less and less. It became obvious that the entire system of this company hampered its operations. The larger the company grew, the more difficult it became to get things done, to say nothing of revisiting its underlying philosophy. The only person to fix it was the President, but he could not fix things because he saw a system in place that, for all its problems, only needed new employees to make it work better.

The employee saw how others had come to the same conclusion as he had; many started to leave the company. Many had learned by experience how the system should not work and profited by the experience in this company when building their own start-ups and when joining existing companies. However, for the employee in Credit and Collections, as well as others who decided to stay a little while longer knowing what they knew, it became a sad place to work.

Winston's postscript: At the end of December, 19XX after a grueling year-end week of work by all employees, each trying to do their best, the two owners announced a 15% reduction in force as a cost-cutting measure to benefit the company. The remaining employees had to do the work of the original 100%.

What a sad fable, but true.

End of Lesson Questions

1.   Calculate EOQ for:
        Annual demand   15,000
        Order cost   25
        Unit cost   5
        Carrying cost   15% of cost

2.   Calculate EOQ, annual order cost and annual carrying costs for:
        Annual demand   30,000
        Order cost   40
        Unit cost   15
        Carrying cost   18% of cost

3.   What additional costs does TQM and JIT indicate we should add to the
        traditional carrying costs of the EOQ model?

4.   Give several reasons why smaller lot sizes are better in the TQM/JIT
        environment.

5.   Why does process theory and systems theory make sense in the TQM
        philosophy but does not seem so important to the traditional management
        philosophies?

6.   Describe a manager in terms of Agency Theory.

Lesson Three - Quality Definition and Measurement

Objectives

After this lesson, the reader should be able to:

- Explain quality in the broad and narrow senses

- Explain typical operations measures and show how TQM measures differ

- Choose the correct quality improvement for the specific problem and/or data type

- Explain the value of the C_{pk} Constant.

Key Words

Quality

Efficiency

Utilization

Cause and Effect diagram

Flow chart

Pareto analysis

Histogram

Control chart

X-bar and -bar chart

P-chart

C-chart

C_{pk}

A Definition of Quality

Quality is best defined in the broad sense as "giving your customer slightly more than expected." This becomes a moving target because what the customer receives today affects what they will expect tomorrow. The definition of quality must also be reduced to a tighter set of descriptions based on customers' expectations. The Japanese Industrial Standards define a quality driven company as:

> "A system of production methods which economically produces
> quality goods or services meeting the requirements of consumers.
> Modern quality control utilizes statistical methods and is often
> called statistical quality control."

Ishikawa defines: "To practice quality is to develop, design, produce and service a quality product which is most economical, most useful and always satisfactory to the consumer."[18]

Juran on Quality[19]

Juran lists the following as essential in understanding quality:

1. Know your client.

2. Know the client's stated and unstated needs.

3. Use unbiased measures to track quality.

4. Develop flowcharts which include your suppliers.

5. Analyze your capabilities.

6. Establish quality goals which are specific, measurable, attainable, realistic and time-oriented.

Juran's concept of quality focuses on uses of quality. He stresses quality of design, quality of manufacturing and quality of use. Each step of the product formulation must be examined to insure that the customer will receive what is wanted. It is possible to create a product which works well in the lab, but when placed in the real world fails to perform as expected because of interactions with other environmental variables. Juran would say that this lacked quality of use.

Juran also stressed conformance to specification. I offer Juran's definitions as a means of rounding out your learning. I observed that successful companies never stopped at meeting specification. They continually went beyond the limit to insure that they stayed ahead of the pack. Meeting your competitor on specifications never gives you a lead, it only levels the field.

Quality in Education Example

The following is an example of an expanded definition of quality:

> Customers served:
> > Students
> > Alumni
> > Employers - current and future
> > Accreditation bodies
> > Board of Directors
> > Donors
> > Significant individuals (in Regent's case, Dr. Robertson)

> A Quality Education could be defined as gaining knowledge and understanding of the application, thus allowing the student to secure employment of his/her choice within six months of graduation and resulting in success in the industry.

> The materials a student must purchase should provide a substantial contribution to the learning process. Positive ratings by students should be in the upper 20% of the measurement scale. Questions of value should be asked in follow-up surveys. We could measure the percentage of students who sell, trade or barter

previous course textbooks. A low percentage would imply higher satisfaction ratings. This is a presumption that requires collaborative research to verify.

Materials should be available when promised. Measurement can be a Yes/No type question.

The educational delivery should yield a pleasurable experience to the student. This includes the classroom equipment and ambiance. Positive ratings by students should be in the upper 20% of the measurement scale.

Educational surroundings should promote a free and open exchange of ideas between students and academic personnel. Positive ratings by students should be in the upper 20% of the measurement scale.

Students should be able to score in the upper two quartiles for any national business placement examination where the exam measures areas of concentration taught at the school.

Students should be able to see academic providers acting out what is taught in the classroom. Lifestyle teaching should be measured by a qualitative seven point Likert scale, with 7 being "strongly agree." Providers should receive a score of 6 or above.

Educational support systems such as registration, computer systems, library, etc. should be available at a time and location convenient for the student. Service gaps should be limited to a differential of 2 or less when measured by the ServQual instrument.

Alumni should be comfortable with each curriculum change and see how each change is an improvement over the current curriculum. Thus, there must be continual communication in a form which is understandable and aesthetically pleasing. Measurement should be by annual surveys of attitude and belief scales. Scores should consistently be in the upper 20% of the measurement scale range.

Accreditation bodies must be able to give suggestions, but no recommendations, at each and every visit. (This is "academic-speak" implying that the school is doing well by accreditation standards.)

The board of directors should be able to approve all requests made by the Dean of the School when the requests are made through proper communication channels.

Employers of the school's alumni, six months after hiring, should give alumni positive ratings in the top 20% of the measurement scale for whatever attitude and belief measurement instrument is used.

A measurement of satisfaction should be the number of inquiries for application materials where an alumni is listed as the inquiry source.

> Measurement of satisfaction should include the attrition rate (moving toward zero), the graduation rate (moving toward 100%), and the number of terms a student stops out (does not take classes during the academic process).
>
> Measurement of satisfaction should include the number of special interest organizations formed by students to continue the discussion of management and business subjects. Also, include the measure of the life cycle of each organization.
>
> Measurement of overall quality should include the amount of donations to school specific funds. The presumption is that the higher the quality, the more willing donors are to give. This will require corroborative research.

As you can see, quality definitions become more detailed than just "slightly more than the customer expects." Each of the measurements in the above definition can be further defined and refined.

Quality attributes - quality service features

Service eluded the quality writers for some time. It was intangible and could not be measured, or so we believed. Federal Express broke the barrier to service measurement by recognizing the tangible constructs by which customers state satisfaction. Federal Express stated quality in time of pick up, accuracy in delivery location, on-time delivery and condition of the package at arrival.

Consider the doctor's office. The doctor offers a service. What are the measures of service quality? Patients might include in their lists:

> time to get an appointment
> time waiting beyond the appointed time
> promptness with which tests are completed and evaluated
> ease of understanding instructions
> appearance and temperature of the waiting/examination
> > rooms
> age of magazines
> gender of the physician
> bedside manner, attitude and personality of the physician
> etc.

These are in addition to whether or not health maintenance occurred.

Service quality is measured by what *is not* there rather than what *is* there. This is referred to as "gap analysis." Ziethamal, Parasurman, and Berry's text, *Delivering Quality Service*, offers a measurement tool for service quality. The essence of the test is that it measures the customers' ideal for the industry and then the customers' perception of the actual firm. The test also measures the service providers' perception of how customers would rate an ideal firm. Additional questions help the researcher to identify internal conditions which may lead to gaps between customers' ideal, customers' perception of the firm, and the service providers' perception of customer expectation. The instrument's reliability is verified in numerous settings.[20]

The bitterness of poor quality remains long after the sweetness of a low price is forgotten.
--Bits and Pieces (March 28, 1996)

Quality Measurements

1. How do we express quality?[21]

2. Determine the Assurance Unit. What is the assurance unit of a light bulb? A barrel of oil? A graduate?

3. Determine the measuring method. What method should be used for the bulb, oil or graduate?

4. Determine the relative importance of quality characteristics.

5. Arrive at a consensus on defects and flaws. What are defects and flaws in a bulb, oil or a graduate?

6. Expose latent defectives. A latent defective is one which was not detected in the system, or an item which was discovered and adjusted or reworked before shipping. Each of these two cases concerns a defective item. Ishikawa uses a term called go-straight-percentage to refer to the percentage of production which moved straight through the assembly process without adjustment or rework and was successfully shipped.

7. Observe quality statistically.

8. Quality of design and quality of conformance: QD is referred to as target quality, and G-conformance is a comparison of actual to target. Increasing quality of design usually increases costs unless the engineers and designs are exploring innovative ways and means. (Is this supposed to be in the form of a question or problem?)

A Lesson in Service Quality

Below is some correspondence which actually occurred between a London hotel's staff and one of its guests. The London hotel involved submitted this to the Sunday Times. No name was mentioned. (The author is anonymous and no citation is available. If you know of the source, let me know so I can cite it properly.)

WHAT TO DO WITH ALL THOSE "FREE" SOAPS WHEN TRAVELING

Dear Maid,

Please do not leave any more of those little bars of soap in my bathroom since I have brought my own bath-sized Dial. Please remove the six unopened little bars from the shelf under the medicine chest and another three in the shower soap dish. They are in my way.

Thank you,

S. Berman

Dear Room 635,

I am not your regular maid. She will be back tomorrow, Thursday, from her day off. I took the 3 hotel soaps out of the shower soap dish as you requested. The 6 bars on your shelf I took out of your way and put on top of your Kleenex dispenser in case you should change your mind. This leaves only the 3 bars I left today which my instructions from the management is to leave 3 soaps daily. I hope this is satisfactory.

Kathy,

Relief Maid

Dear Maid,

I hope you are my regular maid. Apparently Kathy did not tell you about the note to her concerning the little bars of soap. When I got back to my room this evening I found you had added 3 little Camays to the shelf under my medicine cabinet. I am going to be here in the hotel for two weeks and have brought my own bath-size Dial so I won't need those 6 little Camays which are on the shelf. They are in my way when shaving, brushing teeth, etc. Please remove them.

S. Berman

Dear Mr. Berman,

My day off was last Wed. so the relief maid left 3 hotel soaps which we are instructed by the management. I took the 6 soaps which were in your way on the shelf and put them in the soap dish where your Dial was. I put the Dial in the medicine cabinet for your convenience. I didn't remove the 3 complimentary soaps which are always placed inside the medicine cabinet for all new check-ins and which you did not object to when you checked in last Monday. Please let me know if I can be of further assistance.

Your regular maid,

Dotty

Dear Mr. Berman,

The assistant manager, Mr. Kensedder, informed me this A.M. that you called him last evening and said you were unhappy with your maid service. I have assigned a new girl to your room. I hope you will accept my apologies for any past inconvenience. If you have any future complaints please contact me so I can give it my personal attention. Call extension 1108 between 8 am and 5 pm. Thank you.

Elaine Carmen

Housekeeper

Dear Miss Carmen,

It is impossible to contact you by phone since I leave the hotel for business at 7.45 am and don't get back before 5.30 or 6 pm. That's the reason I called Mr. Kensedder last night. You were already off duty. I only asked Mr. Kensedder if he could do anything about those little bars of soap. The new maid you assigned me must have thought I was a new check-in today, since she left another 3 bars of hotel soap in my medicine cabinet along with her regular delivery of 3 bars on the bath-room shelf. In just 5 days here I have accumulated 24 little bars of soap. Why are you doing this to me?

S. Berman

Dear Mr. Berman,

Your maid, Kathy, has been instructed to stop delivering soap to your room and remove the extra soaps. If I can be of further assistance, please call extension 1108 between 8 am and 5 pm. Thank you,

Elaine Carmen,

Housekeeper

Mr. Kensedder,

My bath-size Dial is missing. Every bar of soap was taken from my room including my own bath-size Dial. I came in late last night and had to call the bellhop to bring me 4 little Cashmere Bouquets.

S. Berman

Dear Mr. Berman,

I have informed our housekeeper, Elaine Carmen, of your soap problem. I cannot understand why there was no soap in your room since our maids are instructed to leave 3 bars of soap each time they service a room. The situation will be rectified immediately. Please accept my apologies for the inconvenience.

Martin L. Kensedder

Assistant Manager

Dear Mrs. Carmen,

Who, in blazes, left 54 little bars of Camay in my room? I came in last night and found 54 little bars of soap. I don't want 54 little bars of Camay. I want my one damn bar of bath-size Dial. Do you realize I have 54 bars of soap in here. All I want is my bath-size Dial. Please give me back my bath-size Dial.

S. Berman

Dear Mr. Berman,

You complained of too much soap in your room so I had them removed. Then you complained to Mr. Kensedder that all your soap was missing so I personally returned them. The 24 Camays which had been taken and the 3 Camays you are supposed to receive daily (sic). I don't know anything about the 4 Cashmere Bouquets. Obviously your maid, Kathy, did not know I had returned your soaps so she also brought 24 Camays plus the 3 daily Camays. I don't know where you got the idea this hotel issues bath-size Dial. I was able to locate some bath-size Ivory which I left in your room.

Elaine Carmen

Housekeeper

Dear Mrs. Carmen,

Just a short note to bring you up-to-date on my latest inventory. As of today I possess: on shelf under medicine cabinet - 18 Camay in 4 stacks of 4 and 1 stack of 2. On Kleenex dispenser - 11 Camay in 2 stacks of 4 and 1 stack of 3. On bedroom dresser - 1 stack of 3 Cashmere Bouquet, 1 stack of 4 hotel-size Ivory, and 8 Camay in 2 stacks of 4; inside medicine cabinet - 14 Camay in 3 stacks of 4 and 1 stack of 2, in shower soap dish - 6 Camay, very moist on northeast corner of tub - 1 Cashmere Bouquet, slightly used, on northwest corner of tub - 6 Camays in 2 stacks of 3.

Please ask Kathy when she services my room to make sure the stacks are neatly piled and dusted. Also, please advise her that stacks of more than 4 have a tendency to tip. May I suggest that my bedroom window sill is not in use and will make an excellent spot for future soap deliveries. One more item, I have purchased another bar of bath-sized Dial which I am keeping in the hotel vault in order to avoid further misunderstandings.

S. Berman

A Service Quality Improvement Case Example

This section is condensed from a student's term paper with permission. The student's name, the corporate identification and product information have been masked to ensure anonymity.

This case presentation shows the management philosophy existing at Medical Laboratories, how it compared with Deming's philosophy and scripture, and the results of a conversion to Deming's philosophy.

Medical Laboratories experienced tremendous growth. This growth caused numerous problems in the operation, and as a result, Wall Street reacted in "true short-term" manner. The Director of Medical Laboratories faced many management challenges to counteract the sudden drop in the stock price from sixteen dollars to five dollars per share. His initial move was to cut costs in the lab. He decided that we should dilute the reagents used to detect antibodies in the malignant tissues sent by our physician-customers. I was placed in the position of knowingly putting out less of a product. I knew many tumors' responses to hormonal therapy would go undetected, i.e. false negatives. Each time I approached the director with this concern, he would go to the blackboard and show me why we needed to make this change.

Next the director thought it would be great to eliminate a step in the production process by not looking at the tumors which were sent in. This would save $60,000 by not using the additional slides these tissues were placed on. The down side is that on occasion I observed that the requesting physician did not always send representative tumor tissue. Presuming the goal of our test was to report a positive antibody result on tumor tissue and an accurate prognosis to our physician-customers, I was placed in the position of providing to our ultimate customer, the patient, erroneous unfavorable results on benign tissue and not tumor tissue. This would subsequently lead to chemotherapy, unnecessary costs to society and harm to the patient.

Deming's first point is to create constancy of purpose for improvement of product and service. This principle was violated. The director obviously did not have the ultimate customer in mind. He believed he was serving the physicians. He couldn't help it that the requesting physicians did not send the right tissue. Nevertheless, with the director's philosophy, the ultimate customer -- the patient -- was harmed.

In keeping with the violation of Deming's first principle, the director also decided to decrease operational costs by markedly cutting the funding for one research product after another. Deming believed that for a company to exist tomorrow, it must invest money into research and education of its people today. No research and development will mean no products for a changing market in the future (from Deming's Management Method by Mary Walton).

A manager who perceives his service as serving God will benefit, and he who does not shall not. We read in Mark 4:26, "The kingdom of God is like a man who casts seed upon the soil; and goes to bed at night and gets up by day, and the seed sprouts up and grows--how, he himself does not know. The soil produces crops by itself; first the blade, then the head, then the mature grain. When the crop permits he immediately puts the sickle because the harvest has come." Also noted in Matthew 6:33: "But seek first his kingdom and his righteousness, and all these things will be given you as well."

The director's disconcert for the ultimate customer, the patient, is quite obvious. These are God's people who are being violated. The cost of quality here is the patient's life.

> *1 Peter 5:2-4: "Shepherd the flock of God among you, exercising oversight not under compulsion, but voluntarily according to the will of God; and not for sordid gain, but with eagerness; not yet as lording those allotted to your charge, but proving to be examples to the flock. And when the Chief Shepherd appears, you will receive the unfading crown of glory."*

Unfortunately, the director has violated scripture as well. The director began to slowly take away my authority to make quality decisions. He overruled plans and suggestions I brought up during our weekly meetings. Fortunately, I remembered Professor Chamberlin's similar scenario as portrayed in one lecture in Servant Management, and therefore refused to give up my stance and retreat. The director's behavior was against Deming's seventh point -- to Institute Leadership. If only the director had read the scripture from Genesis 11:6. The Lord said, "If as one people speaking the same language they have begun to do this, then nothing they plan to do will be impossible for them."

Deming's third principle is to Cease Dependence on Mass Inspection. I found my job becoming limited to overseeing mass inspection. I handled all incoming customer complaints and was instructed to use the phrase: "we are working on it". It became quite apparent that the physician-customer noticed the difference in quality by the large number of problem-related phone calls I received. Soon we lost accounts which the director attributed to me since I was the head of the Medical Laboratory. Jesus told a parable in Matthew 13:24-30: "The kingdom of heaven is like a man who sowed good seed in his field. But while everyone was sleeping, his enemy came and sowed weeds among the wheat, and went away. When the wheat sprouted and formed heads, then the weeds also appeared. The owner's servants came to him and said, 'Sir, didn't you sow good seed in your field? Where then did the weeds come from?' 'An enemy did this,' he replied.

The servants asked him, 'Do you want us to go and pull them up?' 'No,' he answered, 'because while you are pulling the weeds, you may root up the wheat with them. Let both grow together until the harvest. At that time I will tell the harvesters: First collect the weeds and tie them in bundles to be burned; then gather the wheat and bring it into my barn.'"

Deming's eighth point is to drive out fear. The director continued on his reckless course of cutting costs by eliminating training and then laying off 23 people. This downsized an already stressed work force. This placed a tremendous amount of fear among the other workers which naturally led to decreased morale, worker production and satisfaction. I recalled scripture from Philippians 4:13, "I can do everything through him who gives me strength." 1 Corinthians 15:57-58 also comforts those with fear by stating: "But thanks be to God! He gives us the victory through our Lord Jesus Christ. Therefore, my dear brothers, stand firm. Let nothing move you. Always give yourselves fully to the work of the Lord, because you know that your labor in the Lord is not in vain."

Deming's fourth principle is to end the practice of awarding business on price tag alone. The Director came to me one day and told me we were to work with a new

vendor of antibodies. I worked with the previous vendor for about four years and appreciated the quality and service they delivered.

This new vendor did sell the antibody for much less than our prior preferred vendor, however, what the director failed to tell me was that the antibody was not FDA approved. Also noted were the numerous articles that were published against the use of this product. What else could go wrong? In complete faith I held to the scripture in deepest criticism: 1 Corinthians 10:24, "Nobody should seek his own good, but the good of others." In this case, the others were hurting our ultimate customer, the patient, and not the physician-customer who the director perceived as the only customer.

It became time to use what God challenged me with through Regent University and the Total Quality Management course. The first step toward this revival was to call a meeting with the director and ask him why he took my authority away. His answer was, "You chose not to be a team player." I realized he was partially correct in his statement, because I disagreed with all of his points to cut costs.

I glanced at his bookshelf and saw a copy of Mary Walton's book, "The Deming Management Method." I asked if he had read it. He said he had. Immediately, as if he had been reminded of what he had learned, he asked me if I would help him find a way to cut costs. I told him that I would but I first needed assurance that the number one priority would be to shoot for zero defects. I told him the complaint hotline was out of control and our physician-customers were worried about our quality.

My first task was to sit in on the entire operation and try to find ways to streamline production given the reduced workforce we now had. I flowcharted the process and looked for gaps and overlaps. I discovered the histotechnologists incurred down time each day. I explored the reason for this. This group consisted of four employees and a supervisor. They were less busy in the early morning because the specimens were still being unpacked, accessioned and assigned a number for identification.

I installed a small group improvement team (SGIT) with the task of finding a way to make use of this "free" morning time and maintain production. They decided to start their own program of cross-training to unpack, accession and label specimens as they came off the truck.

Later, the group was challenged to find a way that the director could have his dream of not staining the extra slide for tumor identification. One member of the SGIT worked with a similar problem in another laboratory. The solution was simple. All tested slides would be counter stained with a special dye that would not compromise the interpretation of the antibody reading. The cost of this dye would save the cutting time for one histotechnologist as well as the reagents for the other dyes, hematoxylin and eosin, as well as the cost of the additional glass slide. The savings equaled $.09 per slide X 500,000 slides per year. This was approximately $60,000, just $2,000 less than the requested savings from the director; however, quality was enhanced!

At the back end of the process, I normally interpreted the material and delivered my diagnosis on a piece of paper. The marketing department perceived one aspect of quality as how fast the product can get out the door. I saw a need to streamline the diagnostic end. Marketing pushed for a four day turnaround time. At this time it took one day for receiving, unpacking and set-up, one day for staining, one day for diagnosis and the last day for finishing and printing to be sent out via express mail.

I became the bottleneck. I handled over 200 diagnostic cases per day since I was "Doctor Medical" to the director. I immediately called a meeting with MIS to set up a computer in my office where I could enter my results as I read each case. This took some getting used to, but it became the prototype for the workstations we now have for the different lines.

I was allowed to train three other physicians and lease one hour of their time per day. Next, I asked the lab to describe the easiest and fastest way to get slides to the doctors without compromising quality. At that time, they were collating each test which consisted of a battery of antibodies including Estrogen Receptor, Progesterone Receptor, Epidermal Growth Factor, etc (up to six assays). They would take each test off of different trays and match them up with their respective counterparts matching the case number assigned at the accession step. They would, however, run each assay in a batch mode.

The simple solution was to keep the cases in batches and allow the doctors to read only one component of the test. For example, I would read the batch of Estrogen Receptors, another doctor would do Progesterone and so on. By entering the data into the computer in numerical order the data entry step was improved and the computer collated the information for free.

Now we could get all the tests earlier in the day, have the pathologists read them all in one hour as opposed to the six to seven hours per day it used to take, and the reports are finalized in the computer and ready to be printed as soon as they are diagnosed. Prior to direct entry, the worksheets would be taken from my office after the seventh hour and then entered by another person. That person now assists in other areas which need extra help.

In reference to the reagent diluting and purchasing of the cheaper antibody, I sent a team of technologists on a training course after reading about a new antigen retrieval system using microwave technology. I was able to get our current antibody vendor to finance this training after informing them that without this improvement the director may not use their antibody and may go with a cheaper vendor. Needless to say they were happy to sponsor us and our vendor believed this was an excellent investment in our partnership.

At present, 80% of the cases now go out in 36 hours, and 15% in 24 hours -- a tremendous improvement over marketing's goal of four days. I am happy to report that quality is excellent. The proof in this latter observation comes from our salesforce who now boast of excellent comments from physician-customers and from the markedly diminished customer complaints which I received during the past eight to ten weeks.

Prior to being a student at Regent University's School of Business, I didn't even know who Deming was, what quality was, or that God's Word could be used to support business decisions. I can't always explain why I end up in situations, but in this case I know now that God had a plan. Never would I have believed that after all the years in a university setting would I end up in a corporation selling to doctors and in a business school learning and watching how God's ways in business can outshine Western Style Management with ease.

In conclusion, I hope this article reflects an achievement of the objectives on my part with regards to this course and reveals the maturity I gained in managing from a Biblical standpoint.

--End --

Operations Measurements

For decades managers measured the success, or lack of it, with set measurements. It is important that you know these measurements.

Utilization

Utilization is a measure of capacity. For example, you may operate a cab service. If you have 50 cabs and 30 are in use somewhere in the city, your utilization is .60 or 60 percent.

$$\frac{\text{In Use}}{\text{Original Amount Available for Use}}$$

Efficiency

Efficiency is a measure of usage compared against a standard, or acceptable amount of input to output ratio.

$$\frac{\text{Standard Time}}{\text{Actual Time}}$$

or

$$\frac{\text{Actual Units}}{\text{Standard Units}}$$

Efficiency is a measure of how the system worked compared to presumed norm. For example, you may know or accept that a graduate business student should read at a rate of 75 pages per hour with comprehension of the concepts and principles. You read a textbook in preparation for class and read 100 pages in two hours. Your efficiency ratings would be :

$$\frac{2.0}{1.33} = 1.5$$

or

$$\frac{100}{150} = .67$$

The measure of efficiency is a ratio. The significance of higher or lower numbers depends on whether you measure time or units.

Productivity

Productivity is a measurement of yield -- what went in and what came out. We put in ten hours of labor, did we get ten hours of labor value from the end product? Productivity in time = std time of work done / time available.

Productivity is equal to: efficiency x utilization.

Now that you have read these terms and their meanings. Store them in some part of your cerebral cortex and forget them. No business exists to improve these numbers, to attain these numbers, or even to record these numbers.

American businesses, at the prodding of many accountants, have measured the wrong things for decades. We promote and fire based on these numbers, none of which measure customer satisfaction and quality. Consider this example: A past student worked as a purchasing agent for an organization. The student handled three types of purchase orders: (1) hazardous material which required several steps in the procurement process, numerous contacts with vendors regarding transportation, storage and disposal (typically 2-3 per month); (2) computer related purchases which required additional reviews by the data processing department (typically 1-3 per month); and (3) all other material orders (typically 90-95 per month).

His management used an efficiency measure of average purchase order time in his department. Every purchase order was timed, in days, when it came into his department and when it went out. Each month he submitted a purchase order average time number as part of his department's performance evaluation.

The average processing time for purchase orders was 3.5 days for several months. Then, for two consecutive months, this purchasing agent reported numbers 50% higher than the average purchase order processing time. His superior was upset. What went wrong? The purchasing agent received a poor rating because of the decrease in efficiency of his purchasing operation. A closer look at the detail showed six Hazardous Material purchases and three computer purchase orders during each of the two high months. Skewing the data resulted in the wrong measurement giving the wrong report for the wrong system.

Quality Measurement

We only need simple statistics to keep track of our systems. We need to know count, mean, standard deviation (or an estimate for a population). We need to measure the process more than the relationship of input to output.

> *Continual improvement causes an "ever increasing" stewardship of resources by "ever increasing" the way we work with people, material and resources.*

A normal distribution of data around the mean results in a symmetrical curve. One standard deviation to either side of the mean encompasses 66 percent of the data points. Two standard deviations to either side of the mean encompasses 95 percent of the data points. Three standard deviations to either side of the mean encompasses 99.7 percent, and six standard deviations to either side of the mean encompasses 99.9997 percent of the data points. We are interested in the distance from the mean to the farthest standard deviation point we wish to control in our system. Continual improvement strives to reduce the variation around the mean.
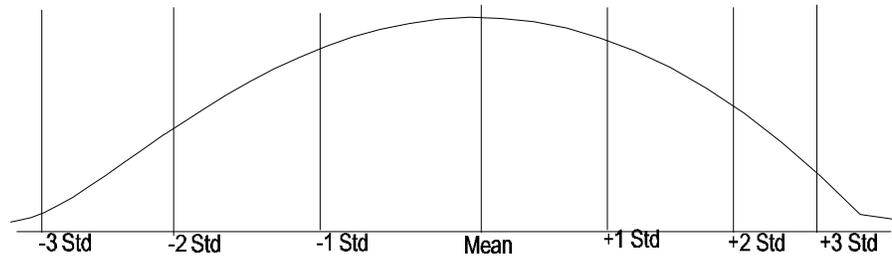
A Typical Distribution of Product Measurement
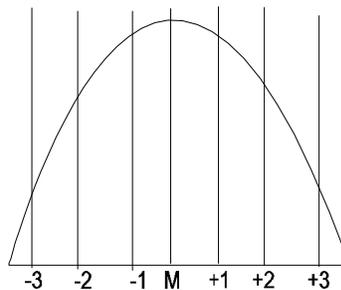
A Tighter System

The lower figure has more of its data clustered near the mean. This is a better system. Measurement of the variation gives an indication of the reliability of a system to meet expectations. More of this later in quality tools.

Measure What is Important

Harley Davidson was on the brink of going out of business. A story about the firm describes a manager of the carburetor department. He was measured on the productivity and efficiency of how he made carburetors. He was very good and produced many carburetors for each shift. The problem was that no one was buying motorcycles. His wonderful carburetors were stored in a warehouse. Each month he did better and better, according to the productivity and efficiency numbers, and each month he cost his firm hundreds of thousands of dollars in material and labor producing what did not need to be made. If your company produces motorcycles -- measure motorcycles. Harley Davidson did begin to measure motorcycles and our

carburetor manager began to produce just the amount of carburetors needed for the motorcycles in production. He found he could produce the needed carburetors with fewer people. The extra people were cross-trained to work in other areas of the plant where they were needed.

Too often we get caught up in measuring components and lose sight of why we are in business.

Malcolm Baldridge National Quality Award

The Malcolm Baldridge National Quality Award (MBNQ) emerged on the American Quality field in 1987 when President Ronald Reagan created the Malcolm Baldridge National Quality Improvement Act. President Reagan named the act after the late Secretary of Commerce, who campaigned for national quality improvement.

The award is administered by the National Institute of Standards and Technology. The award recognizes three categories of businesses: (1) manufacturing, (2) service, and (3) small businesses. Two firms may win in each of the three categories. Ernst and Young has assisted in the application and evaluation process for several years.

The quest for the award requires thousands of man-hours of self inspection and improvement, as well as site visits by teams from the National Institute of Standards and Technology. The amount of effort necessary to compete for the coveted prize is apparent in the small number of applications submitted each year (90 in 1992, 106 in 1991 and 40 in 1989). Past winners reported spending several hundred thousand dollars and over six man-years of work to complete the process and make the necessary improvements.

Deming was adamantly opposed to the Malcolm Baldridge National Quality Award. He saw the award as an ends in itself rather than the quest for continual improvement. The greed of some management may push them to improve just for the glory of the award. It is a prestigious award and carries with it considerable amounts of press coverage and industry recognition.

The inspection process looks at the following seven examination categories. Note the points, out of a possible 1000 points, for each category.

Leadership	100 points
Information and Analysis	70 points
Strategic Quality Planning	60 points
Human Resource Utilization	150 points
Quality Assurance of Products and Services	140 points
Quality Results	180 points
Customer Satisfaction	300 points
Total	1000 points

The MBNQ award examines the firm by reading the documentation produced during the self-study and determining if the firm is, in fact, acting out what it says it is doing. Each of the seven areas contains specifics that the MBNQ site visit team looks for.

Leadership

This category is interested in senior executive leadership and the level of personal involvement of the top managers. Quality starts at the top and evidence of this must exist. The firm's leaders must not only support quality but also be visible in quality related areas.

Members of the leadership must be prime catalysts in the establishing of quality values, policy, mission or guideline content. They must communicate these values to all the firm's employees. Leadership outside the firm must be evident. The firm's senior management must promote quality in the community and the public sector.

Information and Analysis

Evaluation includes the scope and management of quality data and information and the criteria for selecting data. Information system management and personnel must document the scope and type of data available to support the quality improvement process.

The site team examines the competitive comparisons and benchmarks used by the firm as criteria for their choice -- their rationales and the analysis of comparative data.

Strategic Quality Planning

The evaluation process looks at the strategic quality planning process, and specifically the goal setting process, goals and plan implementation. The MBNQ award is interested in both short term and long term plans. Long term, here, is two to five years into the future.

Human Resource Utilization

Human resource management must document and show evidence of following the documentation regarding how Human Resource plans are derived, what the key quality goals are, what level of employee involvement exists and the specific practices used to accomplish the goals.

Human Resource is responsible for quality education and employee recognition and measurement, in addition to employee well-being and morale. The MBNQ looks carefully at each of these sub-sections to determine the depth of commitment and practice to quality.

Quality Assurance of Products and Services

Quality of design demonstrates the implementation of quality concepts by building the product right from the beginning. This section includes an examination of the firm's process quality control practices and evidence of continuous improvement of processes.

Quality assurance contains the examination and evaluation of the quality assessment function and the interaction with suppliers.

Quality Results

An analysis of all current measures of product and service quality results, including, business process measures, operational, and support service quality. This analysis compares the firm's results with industry and world leaders.

Customer Satisfaction

The highest point value of the seven sections in the MBNQ award -- customer satisfaction -- looks at such things as determining customer requirements and expectations, customer relationship management, customer service standards, commitment to customers, complaint resolution for quality improvement, determining customer satisfaction, customer satisfaction results, and customer satisfaction comparison.

ISO 9000

ISO 9000 is a collection of documentation guidelines (9000 - 9004) which focus on the documentation of operational techniques and managerial activities used to fulfill customer expectations and requirements.[22] While considered to be European in scope, ISO 9000 is becoming an international standard. The structure is similar to the American National Standards Institute's (ANSI) 90, 91, 92 and 93 standards. The ISO 9000 is a contextual framework for preparing your firm. Its primary purpose is to give a consistently organized quality assurance program to all multi-national firms dealing across borders.

ISO 9000 is seen by some as a trade barrier, but others see it as an opportunity. The ISO 9000 is neither. It is a standard approach to the documentation and demonstration of quality which firms around the globe can understand. It is no different than the electrical specification standardization in the United States, which allows any electrical appliance to "plug" into a normal home electrical system.

A third party registration agent conducts the audit leading to certification of the 9001, 9002 and 9003 standards. Many people erroneously refer to "getting ISO 9000 certification," which is a misnomer since the 9000 document is a guideline only.

There are five documents in ISO. The first document, ISO 9000, is the quality management and quality assurance standards. The second document is the ISO 9001, which is a model for Quality Assurance in design/development, production, installation and servicing. The 9001 standard seeks to verify that your firm can demonstrate that your quality program is organized so as to prevent defects across the entire product/service process. The third document, the ISO 9002, focuses on the production and installation phases of a product. This standard looks at process control.

The fourth document, ISO 9003, while similar to ISO 9002, looks at the final inspection and testing phases. Again, process control is emphasized. The fifth and final document, ISO 9004, provides a guideline of how to interpret the standards. This document focuses on the interpretation of terms and clauses.

ISO 9000 is a method of documentation and organization of the quality assurance documents and processes such that outside firms can understand and interpret what you are doing.

Variation

There are two types of variation which we will measure using the quality tools in the next section. Special variation is that variation which is caused by a distinct event, person, or item. Common variation is that variation which is caused by the system itself. We cannot improve the overall operation of the company by fixing special variation. In fact, most of the time, we cannot even locate the cause. We can recognize problems in the system which allow "quasi-random" events to happen and treat the system as common variation, which prevents future problems from the identified causes.

Quality Tools

Deming was often quoted as saying: "In God I trust, all others use data!" This section looks at several data tools which you will need to use to accurately understand a process and seek improvement. Tools help the manager just like tools help a carpenter build a magnificent house. The proper tools give insight into the foundation and walls of the management. The first set of tools are known as discovery tools and the second set are know as monitoring tools.

There is a flow to the use of the tools as well. While not every tool finds its way into every problem-solving improvement project, you should find yourself using most of the first five: flow chart, scatter diagram, histogram, Pareto analysis, and cause and effect diagram.

The flow chart will help you understand the existing system and movement of materials, work and people. The Pareto analysis and scatter diagrams help to recognize, isolate, and prioritize problems. Cause and effect diagrams help to understand the factors leading up to the problem and histograms help us to see the pattern of events.

Flow Chart

A flow chart is a diagram showing the travel and interaction with people that work entails. A flow chart is different than a decision chart. While decisions may be shown on a flow chart the purpose is to show changes in direction of work. A flow chart documents the process, shows who is responsible for each step, and who the internal/external customer is. Boxes, diamonds and lines are used to show work flow. (Boxes show actions while diamonds show decisions. Lines show flow.) See the diagram below for an example of a flow chart.

Scatter Diagrams

Scatter diagrams help us see causal relationships. The diagram usually is limited to two variables, one independent and one dependent variable. An example may help demonstrate the use of a scatter diagram. Consider a production line where plastic spoons are manufactured. Orders increased recently and production added overtime hours each week to meet demand. Unfortunately, defects increased as well. Examine the data below and the diagram. What do you think?

Process Flow for Enrolling in a College Course

```
Decide to        Locate            Choose           Go to the        Fill out
enroll in   →    schedule    →     classes    →     Registrar's  →   register
a course         of classes                         Office           form

Registrar        Are                               Go to the        Pay for          Take ID
enters      ←    Courses     →(Yes)                 business    →    courses    →     photo and
course           Available?                         office                            receive card

                   │
                 (No)
                   ↓
                 Choose
                 other
                 courses –
                 fill out a new
                 course form

Go to the        Purchase          Attend
bookstore   →    books        →    first
                                   class
```

This is a small flowchart. I have worked with flowcharts extending more than 6 feet in length and 4 feet in height with type a little larger than the example above.

Day	OT Hours	Errors	Day	OT Hours	Errors
1	3	15	11	5	15
2	4	17	12	0	5
3	5	20	13	2	6
4	3	15	14	5	21
5	6	33	15	4	16
6	3	12	16	7	35
7	8	40	17	5	17
8	3	13	18	4	15
9	5	20	19	9	45
10	2	10	20	3	15

Scatter Plot of OT to Error
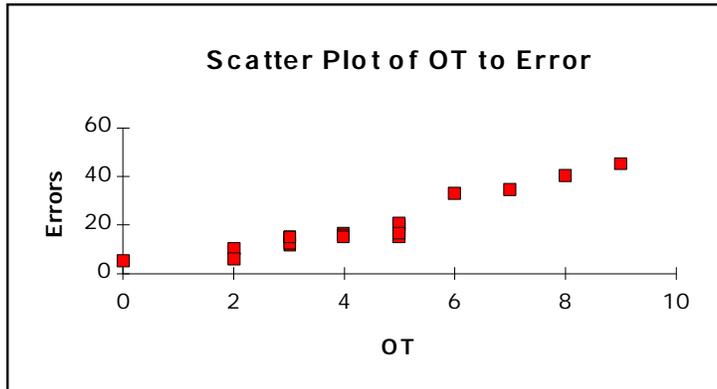
The scatter plot shows that increases in overtime cause increases in errors. Intuitively this makes sense and you might notify your production managers to reduce overtime and hire another employee. But wait, there is more information in the data. We need to gather some more information, such as errors per employee and overtime hours per employee.

Day	John OT	John Errors	Bill OT	Bill Errors	June OT	June Errors
1	3	15	0	0	0	0
2	3	15	1	2	0	0
3	2	12	2	6	1	2
4	2	12	1	3	0	0
5	3	20	0	0	3	13
6	2	10	0	0	1	2
7	3	18	3	6	2	6
8	1	9	1	2	1	2
9	3	12	1	4	1	4
10	1	8	1	2	0	0
11	1	7	3	4	2	4
12	0	0	0	0	0	0
13	0	0	1	3	1	3
14	3	15	1	3	1	3
15	1	12	2	2	1	2
16	2	20	3	8	2	7
17	3	15	1	1	1	1
18	2	12	1	2	1	1
19	4	25	3	10	2	10
20	2	12	1	3	0	0

Graphing the errors by person may show us something else in this system.
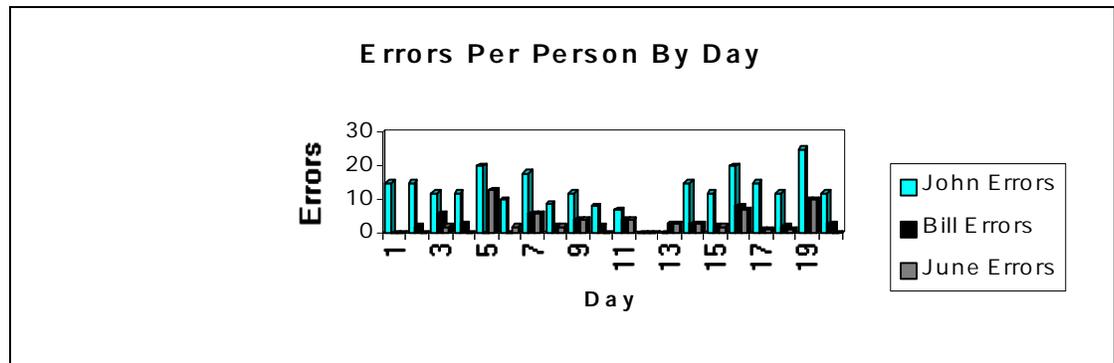
The shading does not let you see clearly who the tall lines are, but I'm sure you know it is poor John. Avoid the temptation to run in and remove John from the production line. You still do not know enough about the system. You further explore the problem and the variables to learn that John has three months experience, Bill has three years and June has 10 years experience. You also learn that production training occurs on the job without formal off-line sessions.

The tools must be used together to understand the whole system.

Histograms

A histogram is a chart showing the number of occurrences in rank order. Look at the example below which comes from the same production data above. Here we rank order the overtime hours from 0 to 9 and then count the number of days for each overtime amount. This allows us to see what frequency our data exhibits. While errors are high above 6 hours of overtime, the frequency with which those hours occur is low. We may want to see what we can do with data occurring in the lower, more frequent levels.

Histogram of Days vs Overtime Hours
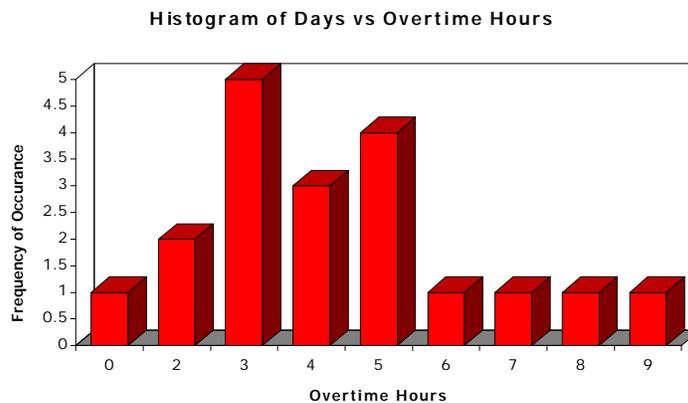
A histogram gives a picture of the data's distribution. Is it a normal bell curve? Or is it a Poisson distribution with a skew to one end or the other? Are there two modes? This latter possibility is important. Prospective students ask what is the average age of Regent University's School of Business Students. The average is 33 (as of this writing), but a histogram would show you a large number of students in their mid 20s and a large number of students in their late 30s and early 40s. So, while the answer to the question about age is accurate (the average, that is) it is not relevant. Only the histogram below tells the story.

Histogram of Ages
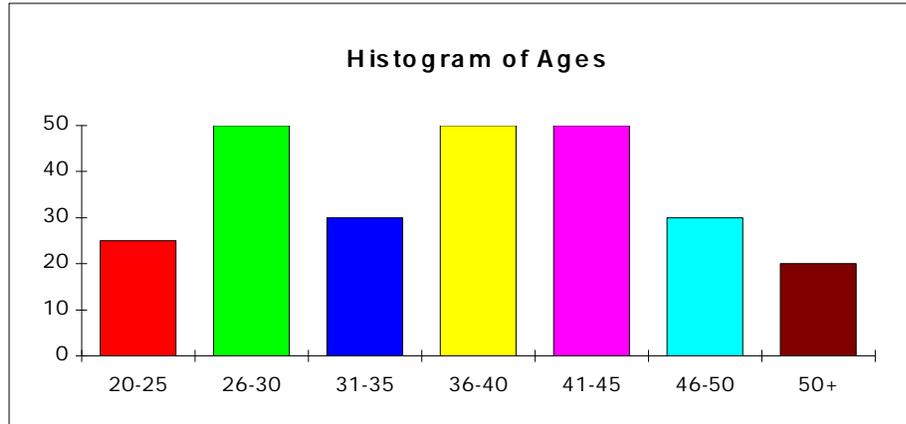
Pareto Analysis

Pareto analysis is good for prioritizing the problems. Let us continue the same example we started above. We gather additional data to determine what type of defects we experience during the 20 days. We learn from the Pareto Chart:

Pareto Chart of Defects
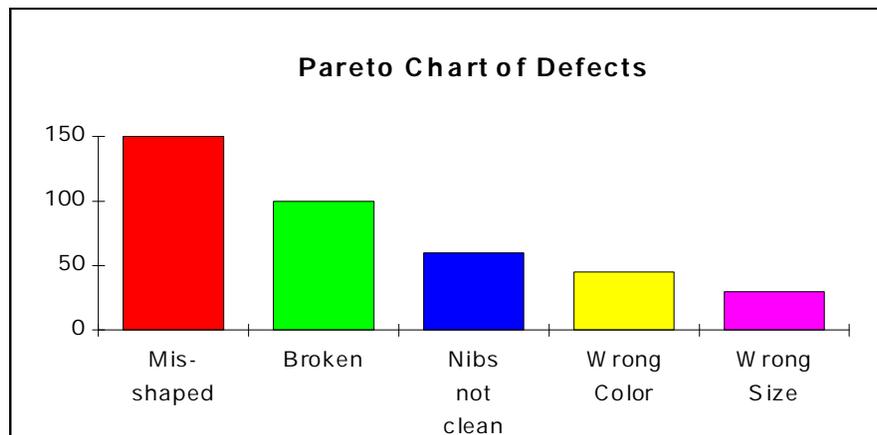
While all problems are important, continual improvement always looks for the largest problem to tackle first. Thus, in this example we should concentrate on what causes mis-shaped items.

Cause and Effect Diagrams

Cause and effect diagrams are graphic outlines of probable causes of problems. From the diagram, you then determine actual causes and seek their solutions. These diagrams are also called Ishikawa diagrams after the man who developed them. They are also called "fish-bone diagrams" because they look like a fish skeleton. The center line represents the problem and each main line off the center represents a cause category. While each cause and effect diagram is unique, many follow a set pattern to help you get started. If you are unsure of the main categories, then use Manpower,

Materials, Machinery and Method to begin. Thus, you may have a cause and effect diagram which looks like:
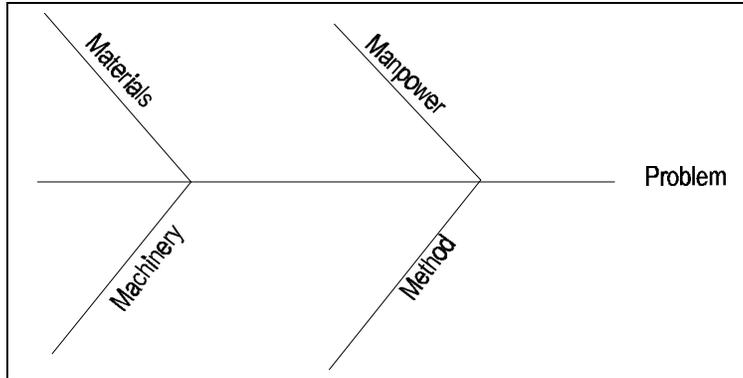
Let's build a Cause and effect diagram for the problem of mis-shaped parts on plastic spoons. This is a fictitious example so if you happen to be an expert in plastic spoon manufacturing and find flaws in my example, please write me and tell me what to change.

First, let's presume we do not have specific main causes and agree to use the four beginning criteria of Manpower, Materials, Machinery and Methods. Look at the completed chart below. It shows the four main categories and several probable causes. Look at the branching and imagine that you are looking at a graphical outline.
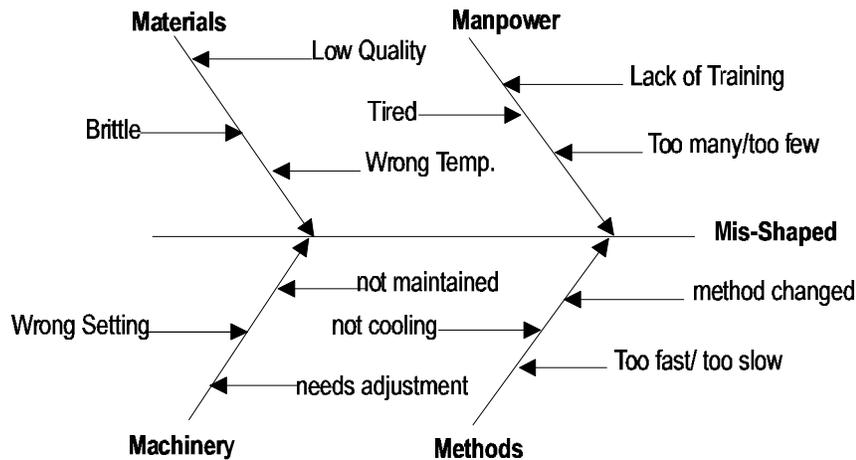
Brainstorming with people familiar with the process results in several possible causes of the mis-shaped plastic spoons. Improvement teams now evaluate the various causes and determine which are the most likely. These most likely causes are investigated to determine if a real cause exists.

Cause and effect diagrams may have many levels to them. See below for a multi-level cause and effect diagram.
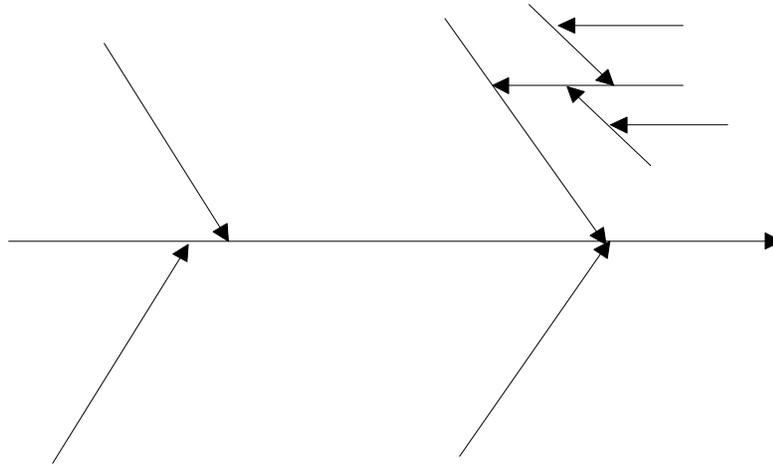
The next set of tools are monitoring tools and allow us to watch a process over time. These next tools are collectively referred to as "control charts."

Specifications

Before we work with the monitoring tools, let's spend some time with a couple of critical concepts. We speak of limits that above and below which we do not want data to fall. Statistical Process Control Limits are set by the data itself. A stable system will produce upper and lower control limits with all data contained within them. Remember that Statistical Process Control Limits reflect the condition of the system.

Customer Specification Limits are upper and lower levels which contain the acceptable product your customer will pay for. These are hard numbers and do not necessarily relate to your process.

Production Limits are the upper and lower boundaries of measurement within which your production people control. Production limits should be tighter than customer specifications.

The ideal system has Statistical Process Control limits (solid line) within Production Limits (dashed line) which are within Customer Specification Limits (alternating line) all containing the process measurement (connected dots) as shown below:

Run Chart of Variable X
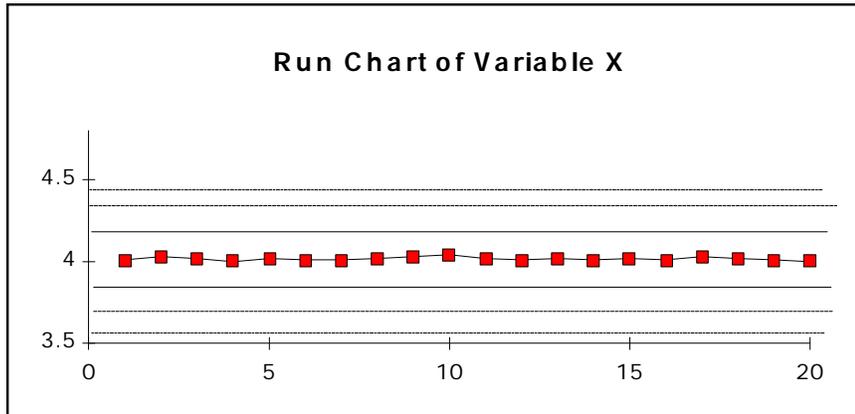
We look at statistical control limits to learn if the system is stable. We improve stable systems by reducing common variation in the system -- that variation which is caused by the system. If the system is not stable, the larger variation comes from special causes. Here we try to re-structure the system to reduce the impact of random non-system events. We must first stabilize the system and then work at reducing common variation. Remember that removing special causes of variation does nothing to improve the overall quality of the product or service. Long-term improvement comes from the reduction of common variation.

Statistically we want the control charts to represent some number of standard deviations of the population from the mean. Sigma (σ) is the population standard deviation. Sigma is only used when talking about the entire population of data points. Firms seek to know sigma from samples drawn from the process. Very stable systems allow managers to estimate sigma from sample standard deviations. Most firms use three sigma (3σ). (Some firms are now tracking their control charts at six sigma (6σ) to show how tightly they control variance.) With three sigma our upper and lower control limit formula are:

$$UCL = \overline{X} + 3\sigma$$
$$LCL = \overline{X} - 3\sigma$$

Reality prevents us from measuring every item in the population, so we must work with samples. We must estimate σ. As you progress through the following charts and formulas, know that the calculations are done to estimate the population sigma.

Which Chart to Use?

This text presents four charts: (1) individuals, (2) X-bar/R-bar, (3) p-chart, and (4) c-chart. There are many more charts that the advanced quality student might study, but these four handle most quality measures.

Follow these guidelines to deciding which of the four charts to use. If you are measuring (diameter, weight, thickness, tensile strength, etc.), use individuals charts for individual data and use X-bar/R-bar charts when working with batches. If you are counting (defects per batch, absentee employees per shift, complaints per number of

customers), use the p-chart. If you are counting defects per item (scratches on auto paint, pinholes in glass, bubbles in ceramic glaze, errors on a patient chart, etc.), use the c-chart. The next sections explain each of the four charts.

Individuals charts

We may want to monitor the value of a particular item in our process. We change examples now as a means of showing you several industries where TQM tools provide value.

Consider a photo laboratory developing and printing photographs for the general public. Photo development requires exposed film to move through a development solution at a constant temperature for a constant amount of time. Photo development solution contains chemicals which convert the exposed film emulsion to a solid state. The amount of chemical in the solution is critical, as well as the elements of temperature and time.

Test strips of exposed film (all exposed under constant conditions are processed at regular intervals to measure the density at a standard point on the film. Density measures are read and plotted on a run chart (individual chart) to show chemical levels in the solution.

Since we must estimate the population standard deviation (σ), a formula using the moving range from one measure to the next is used. Below is the data from 20 density control strip readings. The column titled "Moving R" is the difference in density readings from 1 to 2, 2 to 3 and so on.

Test	Density	Moving R	Test	Density	Moving R
1	1.98		11	1.98	0.01
2	2.00	0.02	12	2.01	0.03
3	2.05	0.05	13	2.03	0.02
4	2.01	0.04	14	2.04	0.01
5	2.00	0.01	15	2.02	0.02
6	2.03	0.03	16	2.03	0.01
7	2.02	0.01	17	2.02	0.01
8	2.01	0.01	18	2.00	0.02
9	2.00	0.01	19	1.98	0.02
10	1.99	0.01	20	2.01	<u>0.03</u>
			Total R		0.37
			Average R		0.019
			Average Density		2.01

The formula for the Upper and Lower Control limits is:

$$UCL_X = \overline{X} + 3\left(\frac{\overline{R}}{d_2}\right)$$

$$LCL_X = \overline{X} - 3\left(\frac{\overline{R}}{d_2}\right)$$

The d_2 value is a constant developed to work with the formula. It comes from Table 2 located in the appendix. We have two observations in each of our range calculations and, thus, $d_2 = 1.128$.

Substituting numbers into the formula and we find:

$$UCL_X = \overline{X} + 3\left(\frac{0.019}{1.128}\right)$$

$$LCL_X = \overline{X} - 3\left(\frac{0.019}{1.128}\right)$$

$$UCL_X = 2.01 + .051$$

$$LCL_X = 2.01 - .051$$

$$UCL_X = 2.06$$

$$LCL_X = 1.96$$

Thus our control chart might look like this:
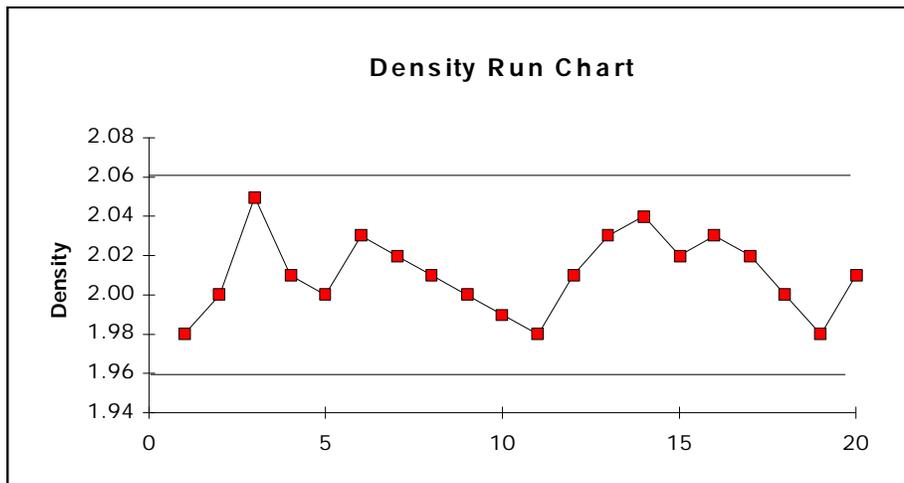
The data points are all within the upper and lower control limits which tells us we have a stable system. There are some interesting things going on with the data, but it is still statistically stable.

p-Charts

Proportion charts are used to track what proportion of the items in a batch have defects. Continuing with the photo developing laboratory example we find the firm pulling samples of 20 photos from each batch and inspecting for scratches. Here is the data gathered for 20 batches:

Batch	Batch Size	Defective	Proportion	Batch	Batch Size	Defective	Proportion
1	20	4	0.20	11	20	3	0.15
2	20	5	0.25	12	20	2	0.10
3	20	4	0.20	13	20	4	0.20
4	20	6	0.30	14	20	5	0.25
5	20	4	0.20	15	20	3	0.15
6	20	7	0.35	16	20	6	0.30
7	20	5	0.25	17	20	2	0.10
8	20	3	0.15	18	20	7	0.35
9	20	5	0.25	19	20	3	0.15
10	20	7	0.35	20	20	5	0.25
				Total Def.		90	
				Avg. Def.		0.23	

The formula for calculating upper and lower statistical control limits for proportion charts is:

$$UCL = \bar{p} + 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$$

$$LCL = \bar{p} - 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$$

where "p - bar" is the average proportion and "n" is the number in each sample. Substituting numbers in this formula we calculate:

$$UCL = .23 + 3\sqrt{\frac{.23(1-.23)}{20}}$$

$$LCL = .23 - 3\sqrt{\frac{.23(1-.23)}{20}}$$

$$UCL = .23 + 3(.094)$$

$$LCL = .03 - 3(.094)$$

$$UCL = .512$$

$$LCL = .000$$

The lower control limit is held at .000 because you cannot have negative defects. Thus our proportion control chart looks like:
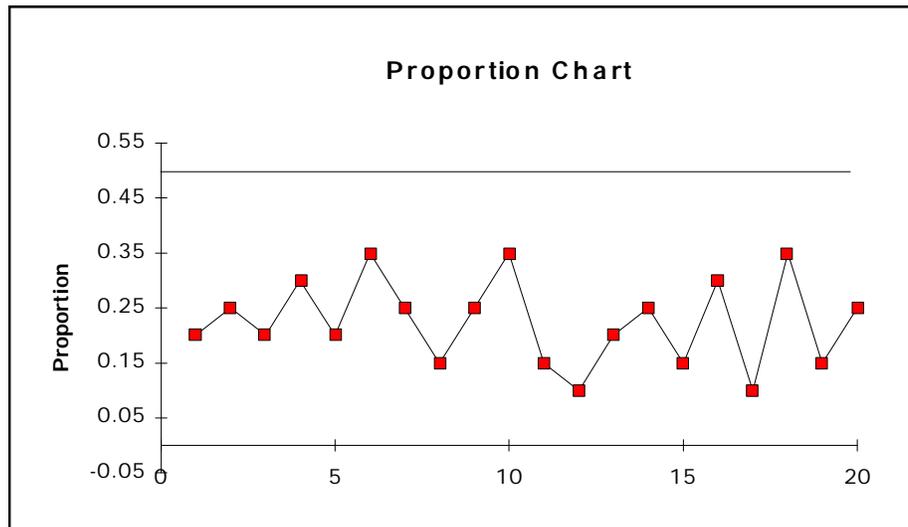
All the data points fall within the upper and lower control limits, which tells us that we have a stable system. Remember, these are *STATISTICAL CONTROL* limits and do not represent what the customer or the firm wants.

X-bar and R-Bar Charts

Another tool used in the monitoring of production systems is the combination of the X-bar and R-bar charts. Where one is used -- the other must be as well. Let us linger awhile with the photo laboratory. The laboratory wishes to insure the size of its photographs remain at a certain height. The firm buys photo paper in six-inch wide rolls and the printing and developing machine cuts the prints to four inches tall. The machine never cuts an exact amount and the photo lab determined that they are interested in the average height of the photoprints. The operator samples five prints from every order and measures the prints, calculates the average for the five prints,

and plots the value on a chart. The operator must also plot the range of each batch. Look at the data from our photo lab and from a competitor. The averages are similar but the ranges are different. Which do you think produces a more controlled size of print?

Our Photo Company

Batch	Meas. 1	Meas. 2	Meas. 3	Meas. 4	Meas. 5	Mean	Range
1	4.00	3.98	3.97	4.01	4.02	3.996	0.05
2	4.01	4.02	4.00	4.01	3.99	4.006	0.03
3	4.00	3.98	3.97	3.99	4.00	3.988	0.03
4	4.01	4.02	4.03	4.01	4.02	4.018	0.02
5	3.97	3.99	4.03	4.03	4.00	4.004	0.06
6	4.01	4.02	4.02	4.01	3.99	4.010	0.03
7	4.02	4.04	4.01	4.03	4.03	4.026	0.03
8	3.99	3.98	3.99	4.02	4.01	3.998	0.04
9	4.00	4.01	4.02	4.00	4.01	4.008	0.02
10	3.98	3.99	4.02	4.01	4.00	4.000	0.04
11	3.97	3.99	4.01	4.00	4.02	3.998	0.05
12	4.01	3.99	3.98	4.02	4.03	4.006	0.05
13	4.02	4.03	4.01	4.02	4.00	4.016	0.03
14	4.01	3.99	3.98	4.00	4.01	3.998	0.03
15	4.02	4.03	4.04	4.02	4.03	4.028	0.02
16	3.96	4.00	4.02	4.04	3.99	4.002	0.08
17	4.00	4.03	4.01	4.02	3.98	4.008	0.05
18	4.01	4.05	4.00	4.04	4.02	4.024	0.05
19	3.98	3.99	3.98	4.03	4.00	3.996	0.05
20	3.99	4.02	4.01	4.01	4.00	4.006	0.03
			Average of Averages			4.007	
			Average Range				0.04

Competitor Photo Lab

Batch	Meas. 1	Meas 2.	Meas 3.	Meas 4.	Meas 5	Mean	Range
1	4.00	3.95	4.02	3.95	4.05	3.994	0.10
2	4.01	4.04	4.00	4.02	3.96	4.006	0.08
3	4.00	3.96	3.95	3.96	4.06	3.986	0.11
4	4.01	4.08	4.02	3.98	4.00	4.018	0.10
5	3.97	3.98	4.08	3.98	4.01	4.004	0.11
6	4.01	4.05	3.99	4.01	3.99	4.010	0.06
7	4.02	4.08	3.99	3.99	4.03	4.022	0.09
8	3.95	4.00	3.98	4.05	4.06	4.008	0.11
9	4.01	3.94	4.03	3.94	4.06	3.996	0.12
10	4.02	4.03	4.01	4.01	3.97	4.008	0.06
11	4.01	3.95	3.96	3.95	4.07	3.988	0.12
12	4.02	4.07	4.03	3.97	4.01	4.020	0.10
13	3.98	3.97	4.09	3.97	4.02	4.006	0.12
14	4.02	4.04	4.00	4.00	4.00	4.012	0.04
15	4.03	4.07	4.00	3.98	4.04	4.024	0.09
16	3.96	3.99	3.99	4.04	4.07	4.010	0.11
17	4.02	3.93	4.04	3.93	4.07	3.998	0.14
18	4.03	4.02	4.02	4.00	3.98	4.010	0.05
19	4.02	3.94	3.97	3.94	4.08	3.990	0.14
20	4.03	4.06	4.04	3.96	4.02	4.022	0.10

| | | | | Average | Mean | 4.007 | |
| | | | | Average | Range | | 0.10 |

The competing firm has the same Average Mean ($\overline{\overline{X}}$), pronounced "X bar-bar" but the average range in the batch is two and one-half times the range of our firm. Our firm has a competitive advantage with regard to the accuracy in print size.

Let's calculate the upper and lower control limits for **<u>our firm's</u>** X-bar and R-bar charts.

The formulae for X-bar and R-bar upper and lower statistical limits are:

$$UCL_{\overline{X}} = \overline{\overline{X}} + (A_2)(\overline{R})$$
$$LCL_{\overline{X}} = \overline{\overline{X}} - (A_2)(\overline{R})$$

$$UCL_R = (D_4)(\overline{R})$$
$$LCL_R = (D_3)(\overline{R})$$

Values for A_2, D_4 and D_3 are constants developed to work with the formula and are found in Table 2 of the Appendix. Turn to the appendix. Follow down the left hand

column until you come to "5," which is the number in the sample. Then move to the right until you come the columns headed A_2, D_4 and D_3. Substituting numbers for the values we get:

$$UCL_{\bar{X}} = 4.007 + (.577)(0.04)$$

$$LCL_{\bar{X}} = 4.007 - (.577)(0.04)$$

$$UCL_{\bar{X}} = 4.030$$

$$LCL_{\bar{X}} = 3.984$$

$$UCL_R = (2.114)(0.04)$$

$$LCL_R = (0)(0.04)$$

$$UCL_R = 0.0846$$

$$LCL_R = 0$$

You will find **our** X-bar and R-bar charts below. You can see that everything is in control.
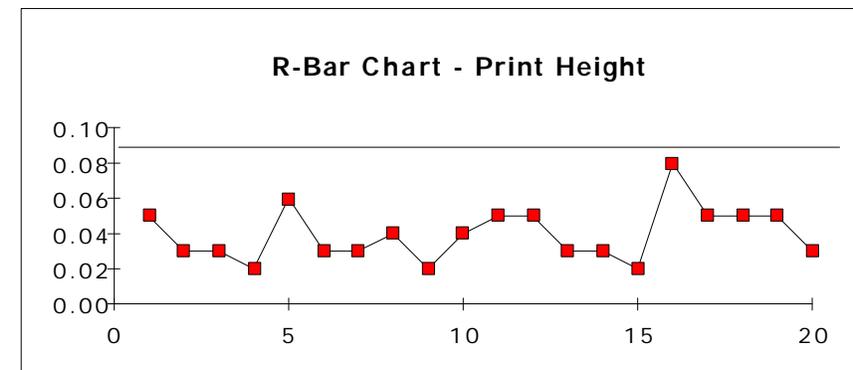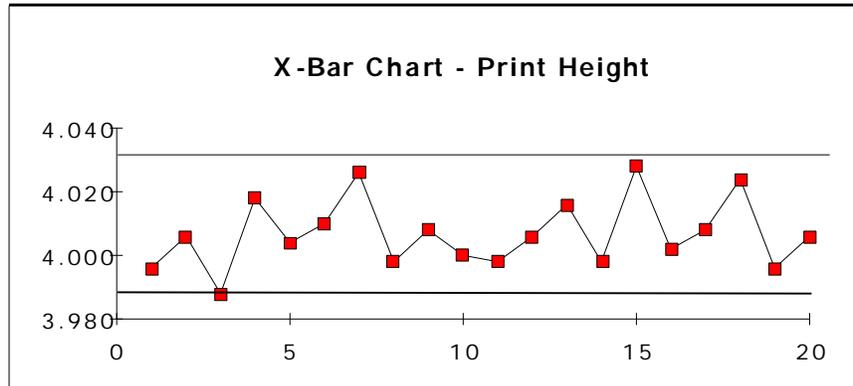
c-Charts

The c-chart provides information on the count of defects per finished item. Hanging on to the photo lab example one more time, let's examine the work of the custom enlargement department. This department is responsible for making enlargements of customer's negatives. A typical print size for this department is 16 x 20. Sizes range from 8 x 10 to 32 x 40. Each print is carefully inspected and the number of flaws, such as scratches, hair marks, dust marks, color imbalance, etc. are counted and recorded.

Here is the data sheet for one day's work in the enlargement department:

Print	Defects	Print	Defects
1	2	11	2
2	0	12	1
3	3	13	2
4	1	14	3
5	2	15	1
6	3	16	3
7	1	17	2
8	0	18	0
9	0	19	1
10	4	20	1
		Average	
		Count	1.6

The formulae for Upper and Lower control limits for c-charts are:

$$UCL = \bar{c} + 3\sqrt{\bar{c}}$$
$$LCL = \bar{c} - 3\sqrt{\bar{c}}$$

where c-bar is the average count. Substituting numbers in for values we get:

$$UCL = 1.6 + 3\sqrt{1.6}$$
$$LCL = 1.6 - 3\sqrt{1.6}$$

$$UCL = 1.6 + 3.78$$
$$LCL = 1.6 - 3.78$$

$$UCL = 5.38$$
$$LCL = -2.18 \, or \, 0$$

The Lower Control Limit is held to 0 since we cannot have negative defects. Our control chart looks like:
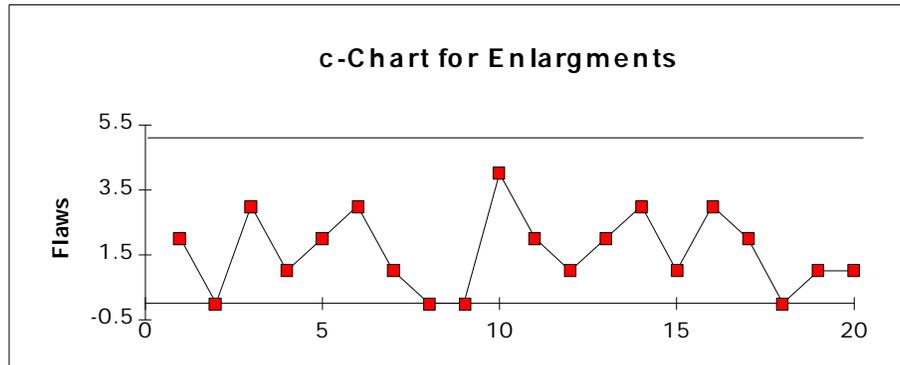
The Lower Control Limit hides at the zero line. This chart shows that everything is in control.

C_{pk} Measure

The C_{pk} Measure tells us how capable the process is. C_{pk} means "Process Capability Constant." It is a measure of how close the distribution of process data is to the nearest customer specification or production limit. This measure is a confidence measure that alerts you to the possibility of a problem. The formula to calculate the constant is:

$$C_{pk} = \frac{\overline{X} - NCL}{3s}$$

where NCL is the nearest control limit. Sigma (σ) is estimated in each of the formulae above, so no matter what chart you are working with, you can substitute in the 3σ you used. An acceptable C_{pk} value is 1.33 or greater. Less than 1.33 implies the system

may not be capable of staying within the specification boundaries and over 1.33 implies a safety margin.

Look at the graphics below to better understand what this constant shows. The graphics show the expected distribution of data across a control chart and the variation signified by the C_{pk}. The curve lines represent the distribution of process data around a mean. The solid center line represents the specification mean (the first graphic shows the target and specification as the same) and the dashed lines represent the upper and lower control limits (either specification or production). Moving from left to right, the first curve line represents a C_{pk} of 1.00. Note that some of the data fall outside of the control limits. The second curve represents a C_{pk} of 1.33. Here, all data is within the control limits with a little latitude to spare. The far-right curve represents a C_{pk} of 2.00. Note the increase in latitude between the end of the data and the control limits.

Note in the second chart that even with a shift in the process mean, a system with a C_{pk} of 2.00 will contain the data within the limit boundaries. The same shift in the middle curve would be out of control. The shift would no longer yield a C_{pk} of 2.00 or 1.33 respectively if a shift occurred because of the change in the numerator of the equation. Thus the C_{pk} is a dynamic measure constantly telling you the capability of the process to stay within the bounds of the control limits.

UCL

1.00   1.33   2.00

LCL

UCL

1.00   1.33   2.00

C_{pk} of 2.00 with a significant process mean shift

LCL
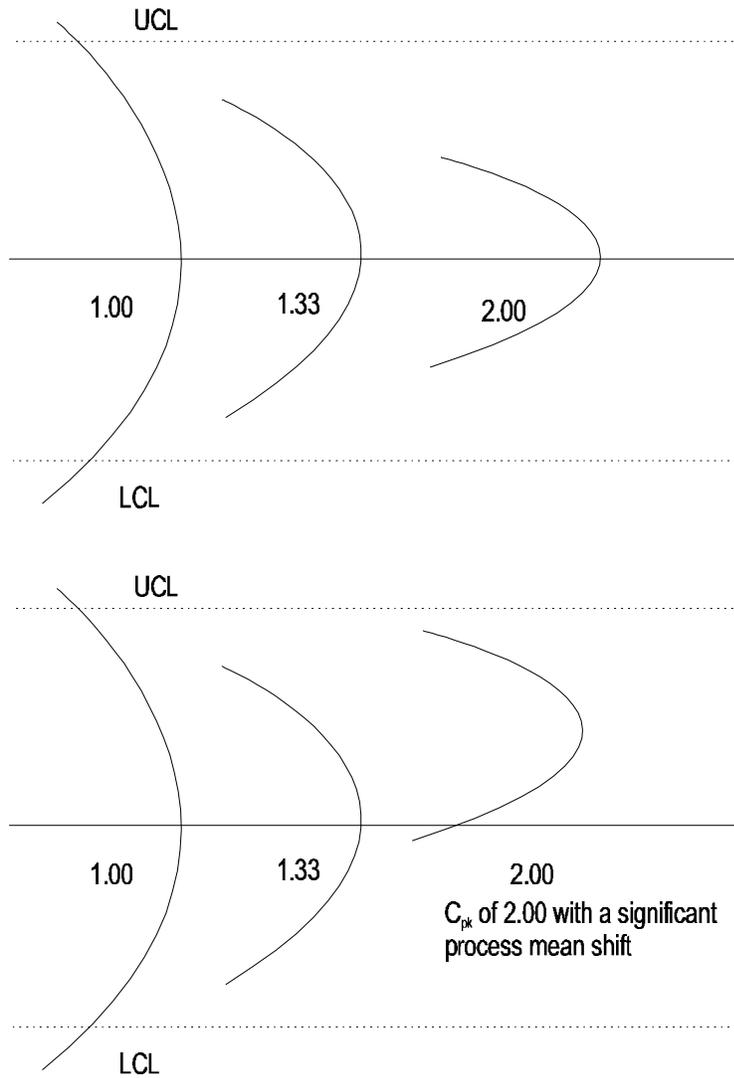
Let's use the most recent example of the c-chart. The enlargement department sets an upper production limit of 2.5 defects per print. Recall our average over 20 prints was 1.66. Substituting numbers into the equation we see:

$$C_{pk} = \frac{1.66 - 2.5}{3.78}$$

$$C_{pk} = \frac{0.84}{3.78}$$

$$C_{pk} = 0.22$$

This constant indicates that the enlargement lab will have great difficulty staying within the limits using the system as it exists today. This is a good illustration of where a stable system may not be as good as you want it to be.

So, the photo lab thought that since their process was in control, there was nothing to worry about. The C_{pk} shows that the system is not performing to the expectations of the customer. Since quality is determined by the customer, something must be done.

Improvement might occur if the photo lab reduces average defects and reduces the amount of variation.

Service Case - Banking

The Irate Customer and the Customer Service Representative[1]

It was a Saturday morning when I entered the small branch of a bank in which I do business. I had two checks for my sons that they needed to have cashed in order to buy school clothes. I endorsed the checks, presented my identification and stood in line. The bank branch was quite busy, it was the Saturday before a long holiday weekend, so people were trying to get all of their morning banking business done. The bank tellers were pleasant in completing my banking transactions in routine manner, and I was very pleased with the service.

On my way out, I noticed the NADA price book and thought about the used car I was driving and my wife's used car and the need for a new one next year. I was curious as to which of our cars had more value as a trade-in, and which one had the highest, current car payment. I walked over and stood in line at the customer service window, but realizing that it was going to be some time before the customer service representative finished with the people ahead of me, I just reached around and picked up the used car price booklet and stood back, leaned against the wall, and began to peruse it. In the meantime, the customer service rep finished with the clients and a new customer approached the counter. I sensed the customer was somewhat upset when the customer said, "I want to see a manager." It is not all that unusual to want to see a bank manager, but the fact that it was a Saturday morning, combined with the casualness of the individual's attire, led me to believe that the customer was upset. I continued to look through the book and also tried to keep an ear to the conversation. The customer repeated: "I want to see your bank manager." The tone was terse and direct.

The customer service rep reacted as any normal human being would react and tightened up. Her answer was, "Sir, I'm sorry, the branch manager is not in on Saturdays."

The customer, feeling even more defensive now and perceiving that he had been put off by the rep said, "Look, somebody must be in charge, and I want to speak to that person NOW!"

The customer service rep, being pushed farther, reacted more defensively than before. With a curt tone and looking down at the counter rather than at the customer, she said, "Sir, we have a head teller, but she's on the teller line right now. Is there something I can help you with?"

At this point, the customer, feeling that he was getting the run-around, took an envelope out of his pocket. He removed a letter from the envelope, unfolded it, and laid it on the counter between the customer service rep and himself. Tapping the letter vigorously, the customer said, "I received this threatening letter from this bank and I want a written apology, and I want it NOW!"

The customer service rep, who was becoming much more tense and stressed under the pressure of the charges of the customer, picked up the letter and began reading it. The customer began to complain that he had done business with the bank for over 12

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[1] This case note is written as a means of showing how a company committed to quality and customer service might handle an irate customer

years, and he didn't need to be threatened. He emphasized that he could take his business elsewhere, asking who these people thought they were. About this time, the customer service rep finished reading the letter and said, "Sir, this is not threatening you in any way. This says because you have a car loan with us, we need to have proof of insurance and according to this letter, we've asked for it a couple of times. If you don't want to provide insurance, we will provide a policy for you at a cost of $1200."

The customer said, "You are telling me that you are going to take $1200 of my money? My brother-in-law is an insurance rep, I've had coverage on this car from the day I purchased it, so what do you mean that this is the third time you requested the information? This is the first time I've been contacted."

The customer service rep said, "Sir, I'm sorry that you are upset, however, we need to have proof of insurance -- now, what's the problem?"

Now let's stop at this point. A company fully committed to quality and customer service might have handled the scenario differently. Think about the ramification of giving the customer a letter of apology.

> Dear Customer:
>
> In our recent letter we offended you by our language and our request, and we greatly apologize for that. Our intent was not to in any way insinuate that you were guilty of any wrong doing, rather we seek only to complete the transaction that we started. Please accept our apology and know that we will endeavor to change our systems in the future.

Now who does that hurt? In my opinion, no one. Now let's think about what happened. Was anyone wrong? The customer received a letter. The customer felt threatened. Is the customer just paranoid? Perhaps he is, perhaps he isn't. Perhaps the customer wants to be treated as if someone cares and the letter did not have a caring tone, so a strong worded negative letter brought a strong worded negative response from the customer. Well, if we understand the psychology of people, that seems normal. Think of it from the bank's perspective. They loan money on a car, they want to know if the car is fully insured in the event of an accident or damage in any way, and the insurance company knows the bank has a loan and the car is secured for collateral. In the event of an insurance company payoff, the bank wants to know that they receive payoff first. Is there anything wrong with that? Is the bank perhaps paranoid? If you have studied finance or taken an entrepreneurial course, you know that banks want to have security for their loans. They are not in the business of just giving money.

So then let's take a look at what might have happened in this situation had we been dealing with a company that was fully committed to quality and customer service. Let's imagine that the customer walks in and, having received the letter, is furious. Let's imagine that the company has trained its customer service people to recognize an irate customer and not to react negatively, but rather to remain open and positive. The customer comes up and demands to see a manager. It's clear by the tone of his voice that the customer is upset. The customer service rep should have been trained to say, "I'm sorry sir, our branch manager is out today, but our head teller is here. She's on the line right now. Is there something that I could assist you with?"

"I want to see the head teller," the customer says.

"Yes sir, may I tell her what it's about?" replies the rep.

"I want an apology," the customer says.

"Yes sir, I'm sure we'll be glad to apologize for any wrong doing we have done. What is it that we did Sir?"

"I received this letter, and this letter is threatening." So the customer begins to tell the customer service rep all of the problems.

The customer service rep should have been trained to say, "Let's write that letter of apology for you right now. Come back with me into the office and have a seat, and let's write this letter and have the head teller visit with you."

So you escort the customer back to a quieter office and notify another service rep to come and replace you while you handle this matter. You ask the customer to tell you the problem he experienced in his own words. In looking at the letter, the letter says that this was the third time the customer was notified. Then say, "I'm sorry Sir, something must have happened with the system. When did you notify us of the insurance coverage so that I can correct the records?"

At this point, the customer is going to react less negatively, because if you don't react negatively, there is no reason to escalate. The customer is still going to be irate, there is no question about that. The customer may say, "I haven't brought any insurance information with me because I wasn't asked to bring in proof of insurance." Or the customer may say, "I brought it in two days after I arranged the loan."

The customer service rep, if finding out that the customer did not bring in proof of insurance, could state: "O.K., when we complete the apology process, do you have an insurance card that I could copy so that I can attach it to the letter showing that you have the insurance?" You should do anything you can to get the customer to begin moving in your direction. At the same time the customer must understand that he is responsible for the insurance, but that an apology is still forthcoming. The customer service rep should write the letter of apology. Having gathered the facts and information, the customer service rep should take that information and the letter out to the head teller and ask the head teller to close her station down and come and visit with the customer. The head teller has the letter of apology, has the letter from the bank, has the proof of insurance or information about insurance, and offers a sincere apology -- now remember you are not apologizing for asking for the insurance, you are apologizing for offending -- and then advises the customer that his business is well appreciated and that you've enjoyed a long time relationship with him.

The head teller will then notify the people who have the ability to change the system so that these problems will not occur in the future. Had the customer not completed insurance, then the head teller, after apologizing, could also say, "Now we need to complete the transaction that we started. Part of the conditions of the loan is that we have an insurance policy on the car. Can you help me understand how you are going to accomplish that?" Here you talk through the problems. The bank should have never issued the loan in the first place without insurance or proof of insurance. So you have an opportunity to rebuild a customer, and again, writing a letter of apology does not hurt the organization.

To analyze this case, go beyond the given solution and develop additional ideas of what this bank, or any service provider, might do to improve service and avoid the problems demonstrated in this case.

The Case of Car Repair and a Patient Owner[2]

Although the location and names in this case are fictitious, what occurred was real. As you read through the case, identify the facts, the assumptions, the perceptions, and analyze the process using the concepts of quality in customer service taught in the course.

In Columbia, South Carolina, there is a car dealership called Southern Auto Inc. Southern Auto sells new and used cars, maintains fleet and lease operations, and maintains large service and auto body departments.

The client, Mr. Johnson, arrives considering the purchase of a newer car. His present car has high mileage, and he is experiencing a great deal of car repair and maintenance. Mr. Johnson does a lot of highway driving which requires him to stay overnight in towns around Columbia, and he is concerned about the car breaking down while he is away from home. In looking at various car options and in talking with the salesperson, he decides to purchase a car that is one year old with 23,000 miles on it. The salesperson describes the car as a program car. It has been either a lease or rental car, purchased back within one year of its original sale with less than 25,000 miles, which allows the warranty to be transferred to the next owner.

During the final stages of negotiation and closing, the dealer offers Mr. Johnson several options in addition to the car purchase: permanent waxing, interior fabric coating, undercoating, and a warranty extension option. Mr. Johnson decides to take the undercoating in order to reduce the highway noise, and since he has had so much automotive repair, he decides to take the warranty extension even though he knows he will be paying for more than he actually gets. After the first three months of ownership, Mr. Johnson notes some problems with the car. Upon leaving a client's building in a town outside of Columbia, he finds the car will not start. A passerby offers to jump his car, but after connecting the battery cables up, Mr. Johnson's car still will not start. It's in the evening, he's 100 miles away from home, and most of the auto repair dealerships are closed for the evening. He calls around trying to find a car repair service station that offers towing, finds one, and has his car towed to the repair station. There were no mechanics on duty at night, but the service attendant promises that a mechanic will look at the car first thing in the morning. There is a hotel two blocks down from the service station, so Mr. Johnson decides to spend the night there.

The next morning he comes to the service station at 8:30, and the mechanic, true to his word, has already looked at the car and said all he did was put a battery charger on and the car started. The mechanic noticed that when he charged the battery, the fans came on. Seeing no reason for the fans to come on, he advises Mr. Johnson that there may be an electrical problem and suggests that Mr. Johnson take the car back to the dealer where he bought it. Mr. Johnson takes the car back to Southern Auto Inc. As he drives into the repair bay for the very first time, he sees a sign hanging in the ceiling above the cars that says, "Fixed right the first time, 100%." Well that sounds good to Mr. Johnson, and he remembers that when he bought the car they offered hospitality service. They offered free oil changes and free state inspection services. They offered free transportation back to your home or office if your car was in for repair, and he

[2] This case note is written by Bruce Winston for the purpose of class discussion of Management Principles and Techniques for MGMT642 Total Quality Management. It is not meant as a means of presenting good or bad management.

remembers in the hospitality document that if the car wasn't fixed right the first time, Southern Auto would provide a loaner car free of charge for the customer's use. He meets one of the service technicians and describes the problem of the car not starting, battery being charged, fan running, having the car towed, staying overnight, and agrees to leave the car until the next day.

At 5 p.m. Mr. Johnson gets a call from the technician saying that they found the problem and there is a switch on the fan that was faulty. It has been replaced, oil has been changed, and the total bill comes to $64.00. Mr. Johnson can pick up the car anytime he likes; they were open until 8:00 p.m. that evening. Mr. Johnson arranges transportation and picks up the car.

Two months later, Mr. Johnson notices a problem with the transmission. When it shifts into overdrive, there is extensive vibration. Mr. Johnson is not a mechanic; however, he believes that the car is trying to shift into overdrive too soon. Since most of his driving was highway driving and it was probably not a big deal, he decided to keep an eye on it and see how things progressed.

Two months went by, and Mr. Johnson experienced the same problem with the car not starting, the battery running down, and upon jumping the car, finding out the fans come right back on again. Mr. Johnson takes the car into Southern Auto, talks to the service technician, describes the problem from before, the fan problem now, and the shuttering vibration problem which he believes is associated with the transmission. Mr. Johnson leaves the car early in the morning. At noon he receives a call from the service technician saying that they could not find anything wrong with the fans or the electrical system, and they couldn't find any of the vibration problems that Mr. Johnson was talking about. However, the tires may be out of round, that would cause the vibration, and since the two front tires are beginning to show wear, and the car has 35,000 miles on it, Mr. Johnson ought to consider replacing the front tires. Charge for today's visit: $65.00. Mr. Johnson picks up the car, takes it to a tire service place, has two new tires put on and asks for an alignment. The car did need a slight alignment. So now with two new tires and an alignment, this bill comes to $140.00. Mr. Johnson drives out and notices that there is no more shuttering when the car's transmission shifts. Feeling he has solved the problem, he feels good about the car.

About one week later, the shuttering returns, this time growing more noticeable. Three months go by, and Mr. Johnson again experiences the same problem with the fans. This time in the morning when he gets up, the car will not start. He uses his wife's car to jump his own car, and again the fan comes on as soon as the battery cables are connected. Mr. Johnson takes the car into the Southern Auto dealership, drives back into the service bay, and again sees the sign "Fixed right the first time, 100%." He asks for the same service technician which helped him before and he says, "This is the third time that I have brought this car in for these problems."

The service technician says, "Do you have the repair bills from the other times?"

Mr. Johnson says, "Well I'm not sure, they may be in the car, but you have them on computer record, at least that is what I was told."

The service technician says, "Well, we just put in a new computer system, and we don't have the details on your past service work anymore. I see you did bring the car in, but I don't know what for or what was done." Mr. Johnson relays all of the concerns and problems before, describes the problem, asks the service tech to go for a ride with him to feel the vibration. Twice during the short drive, the vibration occurred, very mild but it occurred. Mr. Johnson leaves the car early in the morning.

At noon Mr. Johnson gets a call from the service technician who says, "We've researched the problem with the fan and we believe that the fan relay, which measures the temperature of the water, is faulty and we are replacing it. We've inspected the transmission, and we find problems with the linkage and a problem with the throttle body housing, which also affects the rate of transmission shifting." Cost: $450.00. Understand that Mr. Johnson has extended warranty, but none of this applies under extended warranty. Also, since there are no more details about his past service work, Mr. Johnson doesn't have proof that this was being brought back for the same problem as before. Mr. Johnson picks up the car.

Three months later, while driving in Columbia, his car begins to overheat. He stops at the gas station, opens up the hood and now sees that the fans are not turning at all, hence there is no cooling action. He shuts the car off to let it cool down naturally, and turns the car back on and the fan starts. He drives home and early in the morning starts the car and the fans are not running. He takes the car back into Southern Auto, and this time he brings the receipts in with him. He talks to the same service technician, hands the technician the receipts for the previous repairs and says, "This is the fourth time this car has been brought in for the same repair. The car is now overheating." The service technician writes up the work order as the car overheating. Mr. Johnson watches the technician put the information on the computer screen. When the technician comes to the field that says "Is this a possible call back" meaning is this the second time for the same problem, the technician puts in "No." Mr. Johnson points out and says, "This is the fourth time I've brought it back for the same problem."

The technician says, "No Sir, you brought it in for overheating, that's a new problem."

Mr. Johnson said, "The problem is the fan, the overheating is the result. This is the fourth time that the car has been in for this kind of repair." Mr. Johnson realizes that the technician is beginning to get defensive and says, "There is nothing that you have done to cause the problem. You as the service technician have done everything for me you possibly could. Needless to say, this is still the fourth time this car has been brought in for this problem. Now I need something done, and I need it done now."

The technician says, "Well, we'll take a look at it, call the extended warranty people, and if they cover it, we'll let you know."

Mr. Johnson says, "I'm not making myself clear. This is not your problem. You're going to have to figure out what should have been done a long time ago. I have already paid for this problem." The technician then asks Mr. Johnson if he would like to wait while a mechanic examines the car. Mr. Johnson agrees to do this. This was at 7:30 in the morning.

At ten o'clock in the morning the service technician came and got Mr. Johnson. No one had talked to Mr. Johnson since 7:30 A.M. The technician says, "Well, the mechanic observed the problem, the fans are turning when they are not supposed to. However, we've already made the repairs that we believe should be made, and we do not see what else is to be done. We would like to keep the car here overnight. My manager says he will cover the costs of the rental car." Mr. Johnson is kind of puzzled at this because the hospitality service says that Southern Auto will provide one automatically. The service technician says, "We'll call the extended warranty people and see if they will cover the repair if we find a problem and then if they cover it, they will also cover the cost of the rental car." Mr. Johnson nods in agreement and the service technician calls for a rental car. Surprisingly to Mr. Johnson, Southern Auto

doesn't maintain any cars for rental. They called a local car rental agency who doesn't have any cars. Although, they agreed to come pick up Mr. Johnson and take him to another one of their branch offices ten miles away that has cars. Mr. Johnson agrees. It is now 10:45 a.m.

At two o'clock in the afternoon, Mr. Johnson gets a call from the service technician asking for more information about the fan problem. Mr. Johnson restates all of the problems, discusses options with the service technician since this may be an electrical problem, what kinds of things cause the fans to turn on and what kinds of things cause the fans to turn off. Having discussed this, the service technician says that they will look into it again.

At three o'clock in the afternoon, Mr. Johnson receives another call from the service technician. They believe they've found the problem. The last time they replaced one of the fan relays. This time they believe they need to replace all three; even the one they replaced previously was bad. Then the service technician asks, "Mr. Johnson, when you bought the car, did you have the warranty transferred?"

Mr. Johnson answered, "I bought the car and signed the papers and purchased an extended warranty and was told the original warranty came with the car. Why would I have bought an extended warranty if I wasn't interested in the original warranty?"

The service technician said, "I understand Sir, I'm not trying to say you did anything wrong, I'm just trying to get some facts because the extended warranty people said that this should be covered by the first warranty and yet the records indicate that the car dealership does not show the warranty in your name."

Mr. Johnson says, "That appears to be a problem on your end between you and the extended warranty people. It's your responsibility to solve that. I did my part when I purchased the car and bought the extended warranty." The service technician realizing Mr. Johnson is getting a bit upset says, "I understand Sir, and you are absolutely correct. Let me go to my manager and see what can be done."

The next morning Mr. Johnson gets a call at nine o'clock, and the service technician says, "We have made contact with the appropriate people and are still trying to find out why the warranty wasn't transferred and how we can get it transferred. I am ready to do all of the repair work, but I cannot do anything until we have an understanding as to who has warranty, whether it's the original warranty or the extended warranty. Until then, I'll keep you posted."

Mr. Johnson says, "As long as you are willing to continue paying for the rental car, you can keep the car as long as you wish."

The next morning Mr. Johnson gets a call from the service technician saying that the extended warranty folk agreed to pay, and they will pay for the rental car. Mr. Johnson was somewhat surprised by the comment about the car, because again, the hospitality service automatically provided one. The service technician advises Mr. Johnson that there is no charge on the car. They have now replaced not only all the fan relays, but the automotive manufacturer suggested that they replace both the fan and the condenser fan in order to insure that there is not a short caused in the system. So virtually, the entire electrical system that causes the fans to operate has now been replaced. Mr. Johnson returns the car to the rental company, the rental company returns Mr. Johnson to Southern Auto dealership, and Southern Auto provides the car back to Mr. Johnson.

Now, one month later, the car does not appear to have any problems. Analyze this case from the following perspectives:

1. Is it clear to you that Southern Auto had a true commitment to quality and customer service?

2. In your opinion, what power did the service technician have?

3. What could the service technician do to solve the customer's concern?

4. In your opinion, should the repairs have been made to Mr. Johnson's car by Southern Auto regardless of whether or not they knew the original warranty or the extended warranty would pay for the repair, or whether no warranty would pay for the repair?

5. Ask yourself what changes in the system you would provide in order to make Southern Auto more committed to quality.

6. Ask yourself what was the purpose of the banner hanging in the service bay that said "Fixed right the first time, 100%."

7. Ask yourself what benefit existed in the hospitality service document that talked about the oil changes and the free inspections and the loaner car if the car is not fixed right.

8. Ask yourself the benefit of capturing data on the computer screen about whether or not the car repair is a possible call back.

9. Think about how repair managers are measured. If it seems logical to you that they are measured on the reduced number of call backs, what would be their interests in ascertaining a new problem when a car comes back in for repair?

Karla's Cookies[3]

Karla, while working on her MBA at Regent University's School of Business, looked for ways to generate income to provide spending money. She was fortunate that she had enough dollars to cover tuition and books, and her parents provided enough income to cover her share of the rent, food and utilities. She lived with one roommate in student housing. Karla was an excellent cook and had a real flair for making cookies. It became clear in the beginning of her time at graduate school that Karla's cookies could bring a handsome price. Karla found that she could spend her free evenings baking cookies and delivering them around student housing.

She could make a batch every 20 minutes, allowing time to mix the dough, put the dough onto the cookie sheets, bake the cookies, take the cookie sheets out of the oven, put the cookies on the rack, and then begin the process all over again. She could speed the process up to where she was producing a batch every 12 minutes if she made cookie dough ahead of time, or while the cookies were baking. So she could possibly produce a batch every fifteen minutes, allowing for 2 minutes to remove the cookies and cool, 1 minute to put cookie dough on the sheet, and 12 minutes to bake.

Karla charged $3.00 per dozen cookies. She found that she could produce some 20-24 dozen cookies per night and generate about $150-$200 in spending money after expenses each week. This provided a nice income for her and met all of her needs. Several people suggested that Karla open up a cookie business, either before or after graduation, and become an entrepreneur.

Upon graduation, Karla looked at available employment opportunities in her field of interest and decided to give the cookie business a try. Virginia Beach is a tourist city with high tourist traffic at the beach area. Regent University is located some 15 miles away from the ocean, so Karla decided to look for a possible storefront down on the beach. She needed a small storefront where she could bake cookies and sell them to tourists. She thought she might have some pre-made cookies that people could just buy, thus capturing the spur-of-the-moment customer, as well as creating a novel concept of baking a dozen cookies to custom order. She had experience with custom orders at student housing, and she kept a variety of ingredients to go into two basic doughs. She used a basic shortbread dough and a basic sugar dough. She kept ingredients such as raisins, chocolate chips, walnuts, other nuts, sprinkles and other ingredients in order to create custom batch cookies.

Karla located a storefront down on the beach that the owner would rent at a reasonable rate. She secured a loan from her parents to start the business. She found two used baking ovens. She located and purchased mixers, bowls, utensils, a supply of ingredients, a refrigerator to hold the pre-made dough and ingredients that needed refrigeration. She built cabinets to display pre-made cookies. She build a counter for taking orders, and added a production area in the back with areas for mixing, holding ingredients, filling cookie sheets, baking, and racks for cooling. In order to speed up the process, she also purchased some fans to shorten the cooling processing time. She

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[3] This case written by Bruce Winston for classroom discussion and demonstration of the use of quality measurement tools. The facts of the case are fictitious. Any representation to real companies and individuals is purely coincidental.

decided to open on Memorial Day, the beginning of the big summer push for the beach.

Only two weeks away, Karla was just about complete with the remodeling and began to look for employees to help her. She remembered two first year MBA students who worked with her in a couple of classes. She thought they might be excellent employees. She contacted them, and both agreed to work for her at 30 hours per week while they continued working on their MBA degrees. They both met Karla on Saturday, one week before the grand opening. Karla explained to them how cookies are made, showed them the ingredients and instructed them in the process. They made a few batches of cookies, and Karla was surprised when some of the batches appeared to be burnt on the outside, where other batches appeared to be undercooked on the outside. She wasn't sure what the problem was. She did not have much time to think about it since she had a meeting with the bank in a few hours. She asked the two new employees to clean up the store, put everything away and lock up. Since they had not officially opened, paper still covered the windows to prevent customers from presuming they were open for business. Thus, the new employees could work without customers asking them for service they were not prepared to give. Karla went to the bank, completed the processing for the loans, checking accounts, and returned late that afternoon.

Part of Karla's marketing plan revealed that people on the beach looked for things that were different and unusual. Tourists on vacation wanted new experiences. Her concept testing indicated that people would like tropical flavors in the cookies. She brought in things like bananas, pineapples, mangos, and papayas. These were all fresh ingredients. She also brought in oranges and apples. She also wanted to create some healthy cookies, although she couldn't find anything that would go conveniently with sugar dough or shortbread dough.

Karla made a batch of dough, put a tray of cookies in the first oven, and set the timer for 12 minutes. When the timer buzzed, she removed the cookies and noticed that those on the outer edge were burnt. She made another batch, put them on a different tray, put that tray in the bottom oven, baked them for 12 minutes and discovered the cookies in the back of the tray were overdone. Concerned about possible hot spots in the oven, she began to wonder if the oven temperature settings were correct. The oven temperature settings were both controlled by slides located on the upper top corner of the stove. Karla was only a few days away from the grand opening, and she was not able to produce two consecutive batches of cookies that appeared or tasted the same.

Based on this information alone, try to answer the following:

1. What is Karla's measure(s) of quality?

1. What is Karla's level of knowledge?

1. What quality tools would you use to begin the investigation of this quality problem?

1. How would you determine where the problems are actually occurring?

1. Create a cause-and-effect diagram for this situation.

1. Explain the training process that Karla would need to create in order to insure that the employees do exactly what she instructed.

1. Think through how many people would need to be working in a cookie store at any one time in order to insure quality. Justify your answer.

Lesson Three Questions

1.   Why is quality defined from the view of the customer?

2.   Calculate the following:
        Regent Airways calculates that a flight attendant needs two minutes to fully
        serve a meal to a passenger on one of its aircraft; that is, the standard time is
        two attendant-minutes per meal.

        a   If 2 flight attendants are assigned to an aircraft with 80 passengers
                on board and serve all of them in a flight having 1 hour of serving
                time, what is their efficiency?

        b   If the flight attendants are utilized (busy) 90 percent of the time (not
                counting when they are strapped in for takeoff and landing), what
                is their productivity?

        c   If a new jumbo aircraft seats 600 passengers, how many flight
                attendants are needed for a flight with 100 minutes of serving time?

3.   The following data occurred from ten days worth of widget manufacturing.
        The dimensions are given for the diameter of the center opening. Your small
        group improvement team has the assignment of improving the variation.
        Your first task is to see if the process is in control. Calculate upper and lower
        statistical control limits and compare them to the upper and lower
        specification limits of +/- 2 with a target of 9.00. Determine if the process is
        statistically in control and whether or not you have a problem.

                                Data

                11.0   8.5
                10.0   10.0
                 9.5   11.0
                 9.2   11.5
                 8.0   10.0

4.   Why must quality be built into a product? What is wrong with inspecting for
        quality? Describe to a manager who is still "inspecting quality in" why
        he/she should change and how to begin.

5.   Smith Electrical Supply manufactures power supplies for personal
        computers. The power supplies convert standard AC current into controlled
        DC voltage. Random samples of 5 power supply units produced the
        following data. Calculate the Upper and Lower Statistical control limits for
        the appropriate chart. Plot the data on a chart and determine if the process is
        in control.

Sample #	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5
1	5.002	5.003	5.000	5.001	5.004
2	5.003	5.001	5.000	5.004	5.002
3	5.001	5.002	5.003	5.002	5.001
4	5.000	5.001	5.000	5.001	5.002
5	5.003	5.002	5.001	5.002	5.002

6	5.001	5.002	5.001	5.003	5.004
7	5.002	5.004	5.001	5.002	5.004
8	4.998	4.999	5.000	5.001	5.002
9	5.000	4.998	5.002	5.001	4.999
10	5.002	5.001	5.004	5.002	5.000

6. Create a cause and effect diagram (Ishikawa diagram) showing causes for why a student may not do well on an exam.

7. Flowchart the process of preparing, writing and submitting a class paper.

8. Create a histogram of the following heights (in inches) from an eighth grade class.

Student	Height	Student	Height
1	60	10	58
2	58	11	62
3	64	12	64
4	48	13	62
5	44	14	66
6	70	15	68
7	72	16	60
8	65	17	62
9	61	18	64

9.   Provide the characteristics of quality for the following organizations: (what measurable characteristics would you be interested in when discussing the details of quality improvement?)

a laundry soap manufacturer
a cookie baker
an insurance company
a church
a publisher
a university

Lesson Four - Teams, Taguchi and JIT

Objectives

After this lesson, the reader should be able to:

- Describe what teams are and what they are not

- Define the correct type of team for a given work situation

- Define Taguchi's loss function

- State Taguchi's contribution to the definition of quality

- Choose the appropriate orthogonal array for a simple experiment

- Explain the advantages of Just-in-Time (JIT)

- Explain the new purchasing paradigm and contrast it to the old paradigm

Key Terms

Team

Taguchi

The Loss Function

Just in time (JIT)

Orthogonal array

Teams

TQM builds on the team concept. It is important to understand what teams are and what they are not.

Definition

A team is an ad-hoc collection of people with a common goal and purpose. The members of the team possess skills that, in unison with each other, create a synergistic relationship. Management, or the greater whole of employees who will be affected by their decisions, choose team members. The team is mutually accountable and collectively responsible for the attainment of the assigned goals or objectives. The team has the authority to request information and resources up to a prescribed limit set by management, and the authority to make changes in the organization pertinent to the assigned goals and objectives. A team is small - usually 3 - 10 people.

A team is not:

- a group of people each doing their individual best and   coming together to share information and insight

- a group where individuals receive recognition for their   part of the performance
- internally competitive
- permanently formed as a "standing committee"

Team Article

by Kenneth Teller and Bruce Winston

Many organizations are moving from a hierarchical system to one with decentralized authority. The reason is simple. The way we have done business is no longer good enough and many organizations are fighting for survival. There is a growing realization that radical and fundamental changes must occur in the way we go about business.

Traditional management theorists sought a motivational model that explained levels of worker performance on the job. Douglas MacGregor hypothesized a two-pronged behavioral pattern, labeled X and Y. His theory X holds that one can only manage the number of employees that one can see. This span of control is necessary as people have an inherent dislike for work and will seek to avoid it. This concept is flawed. The underlying premise is that if a worker isn't watched; they will not work. If this is the case, any greater span of control over one-to-one would be impossible. Theory Y holds that work is a natural phenomenon. If people are committed to organizational goals, they will exercise self-direction and self-control. Commitment depends on rewards associated with goal attainment. MacGregor postulated that problem solving capacity is widely distributed in the population, and the average worker's intellectual abilities are only partially utilized.

MacGregor's model placed its own expectations and demands between management and labor. This provided a framework on which the work relationship ethic grew.

In any organization, there are employees who fit the theory X or Y models. Indeed, any employee may vary between an X and Y reaction to any task at hand. The weakness of this theory is that it places management in a reactive position to the worker. In reality, this theory places the manager in *loco parentis*. The worker must either perform to avoid punishment or to gain approval. We must change our philosophy. We cannot continue to compete this way in today's global market. It is time for us all to grow up. Modern management theorists like W. E. Deming are asking if we can still learn. We can, and it is time to begin. Self-managed teams are one area we must learn about.

Self-managed teams require exceptional maturity of the organizations that attempt to use them. Top management will place enormous amounts of trust in workers as workers become empowered to act and react on behalf of the corporation. Single managers will make decisions that previously required any number of approval signatures. The impact will be a leaner, faster organization that goes beyond survival to winning. Self-managed teams will see their work as a process rather than a set of unrelated tasks. The process has a beginning and an end.

David prevailed over the much larger Goliath through the ability to move quickly and decisively. He would not have stood a chance if he had been weighed down with King Saul's armor. Bloated staffs, mid managers and supervision represent a modern business corollary to Saul's armor. They give great comfort to the aging king, but

represent victories of the past rather than hope for the future. The king may give the purpose, but he must trust his warriors to plan and execute the battle. True leaders inspire their people. True leaders release their people to act according to the mission and vision. True leaders do not live in the past, but in the future. There is no room for bloated staffs and excess overhead.

Implicit within the design of self-management is the concept of self-discipline. This discipline will only come about when each individual has a foundational part in creating the goals for the team. Leadership provides the mission and vision for the organization and should, at all times, be holding up that vision for all to see. The book of Proverbs is rich with advice on discipline and the benefits of diligence.

Discipline becomes the path to perfecting mind, body and spirit. Discipline and disciple both spring from the same Latin root, *discipulus,* or pupil. This is no coincidence.

To be a disciple one must totally submit to a higher order. This requires a renewal of thought. Christ called this renewal being "born again." The metamorphosis from managed to self-managed is no less revolutionary. Paul's letter to the Galatians stated (paraphrased): "If you are led by the Spirit (the overall goals of the organization), you are not under the law (management). You become one with the law."

Policies and procedures become means of guidance rather than concrete rules. People who use the policies and procedures revise them as warranted. Anarchy does not exist in this state of disciplined self-management. Rules and procedures are changed when all in a team agree that changes will improve the process.

This is where traditional management has always failed. When one is managed, life consists of obeying or disobeying rules, nothing more. Where there are laws, there will be lawyers. Lawyers bring rationalizations and excuses. Lawyers are taught to find problems, not solutions. The nation of Israel represented a people of the law. In their attempts to keep the law, for its own sake, they had lost sight of the purpose of the law. Traditional management has taken on much of this aspect. Lawyers, more than managers, run today's major American corporations. It is no wonder we are mired down in problems rather than surfing on solutions.

Self-managed teams strive toward common goals. Constant monitoring of these goals assures that they are meeting the overall goals of the organization. This will prevent teams from becoming work groups with private agendas. Paul's letters are full of admonishments to the early churches to keep their focus on Christ.

When a member strays, co-workers bring it to his attention. This is not done in anger or spite, but in a true sense of gentle concern. If the member continues to stray, the members should take him before the team leader and then the general manager. The member must be expelled, should he not mend his ways. He is no longer violating the arbitrary rules that some distant manager has deemed. He is slandering the very basis of the groups' existence. Read Bruce Winston's treatise on "<u>M</u>anaging <u>By</u> <u>A</u>bsolutes" for a discussion of repentance and forgiveness in the workplace.

Knowledge is a critical pivot point for self-managed teams. Knowledge of the whole task assigned to the team is essential for each member. Work assignments are rotated throughout the team. In this way each may learn the others' work. This will deepen the appreciation of the value of a co-worker's labor. This absence of specialization will reduce the false pride of narrow expertise. Finally, rewards should be based on group success and individual merit, rather than individual merit alone. Team success must

always be of paramount importance. The best player on a losing team is still a loser. The worst player on a Super Bowl winning team still gets to wear the ring.

Within any winning team, there are still those who stand out. It is far more difficult to make a self-managed team succeed than it is to create one. Many teams die as buds on a vine. Many more will blossom, only to wither out. This is because few organizations will have the will to carry out so bold a change. Like those who accept Christ, few have the discipline and patience to grow in Christ and become Christ-like through the process we call sanctification. American firms are always looking for the fast fix -- the quick "quarter-ending financial pick me up." Wall Street announced in December 1992 that the most popular stocks were defense contractor stocks. These companies were winding down their contracts without expending any funds on R&D. Because they were not building for the future, their bank accounts were flush and short term profits were assured. Why do we continue to support the short term gain at the expense of the long term? Jesus died for the short term so that all might have eternal life.

This self-managed team concept, briefly described here, is like a race without a finish line. The phrase: "When will we be done?" cannot be heard in firms who have adopted the truth. American firms are accustomed to short term races. Seasonal sales, annual evaluations, and product introductions all have short term beginnings and ends. The self-managed company sees business as a process rather than a project. Continual effort exists on behalf of all self-managed teams and managers. Many have, and many more will, make the change to self-managed teams because of the great gains they have heard of. Once this change has occurred, most will not have the sense of continual self-examination and renewal. This is the only way that they will survive and flourish.

The Japanese practiced self-managed team concepts for two decades before anyone in America noted it, except their American teachers. Americans rejected the concept of self-managed teams, even though the idea was taught by an American. Only a few visionaries, such as Walt Disney, saw the value.

Building Teams

Teams should be built, or perhaps grown. American companies, in their excitement to gain the benefit of teams, start them too soon with too little training and expect too much.

Teams, like all organizational units, go through the four stages identified by B. W. Tuckman: (1) forming, (2) storming, (3) norming and (4) performing.

Stage 1 sees members trying to determine what behaviors the group finds acceptable, what goals and motivations each member has and who psychologically commits to the group.

Stage 2, recognized by emerging conflicts, shows the doubts and frustrations of individual members. During this stage, norms of expected behavior develop and as the group resolves conflicts, some uncommitted members may leave the team.

A sense of cohesion develops in stage 3. Conflict in stage 3 is over ideas, not egos. This conflict is easy to resolve. Team performance begins in this stage.

Stage 4 is difficult to achieve but worth the effort. Team members work well with everyone, easily make decisions with full agreement, and understand the roles they need to perform for the group to be continually effective.

Teams must mature to full effectiveness. Maturity occurs in four steps and generally takes 12 - 24 months to complete. In step 1 teams look for ways to improve general administrative housekeeping chores such as safety checks, vacation, holiday planning, etc. The second step allows teams to participate in the improvement of set-up/changeover operations, quality improvement, process monitoring and reporting. More complex tasks emerge in the third step, such as customer contact, budgeting and purchasing for the team's production responsibility. The fourth step involves team leader rotation, job re-design, product design input and hiring or terminating team members.

Taguchi and Operations Research

Taguchi's Philosophy:

Quality should be designed into the product and not inspected into it.

Poor quality cannot be improved by the process of inspection -- it only removes the defects. The cost of poor quality still exists. Taguchi believed rather that quality should be designed in the beginning.

Quality is best achieved by minimizing the deviation from a target. The product should be so designed that it is immune to uncontrollable environmental factors.

Taguchi believed that quality is determined by the amount of deviation from a target value and not within a given range. The results of a system may provide a product skewed to one side of the range, thus not providing the ideal quality.

The cost of quality should be measured as a function of deviation from the standard and the losses should be measured system-wide.

Taguchi believes that the cost of quality should include the entire life cycle of the product and should include the total cost to society. *This is a concept that leaves much open to interpretation. Taguchi provides some assistance as to what constitutes cost. Although debatable from Western viewpoints, Westerners cannot argue against the success Japanese manufacturers have had when using these and other concepts.*

Quality improvement is an ongoing effort to reduce the variation around the target point.

The desired effect would be to reduce the standard deviation to zero. Taguchi does incorporate the problems of what he refers to as noise factors. Noise factors such as weather condition, machinery wear, etc. influence the response of a process, but cannot be economically controlled.

Taguchi recommends designing a process in three stages:

1. Systems design
2. Parameter design
3. Tolerance design

Each level allows further refinement. Each level may require modifications to the level above it if the results are not attainable.

The concept of the Loss Function

Costs of poor quality fall into two categories. The first relates to losses incurred as a result of harmful effects to society (pollution). The second relates to losses arising because of excessive variation in functional performance.

The conventional approach to quality loss is based on the number of parts rejected and reworked.

Taguchi examined the traditional loss function that said any product produced within the customer's tolerance band is acceptable. Traditional thought believed that attempts to improve beyond this band is wasteful (the area between points A and B in the graphic below). Taguchi's loss function took a deeper look at the costs of quality and determined that any deviation from the target was a cost to the system, the company, the customer and society.
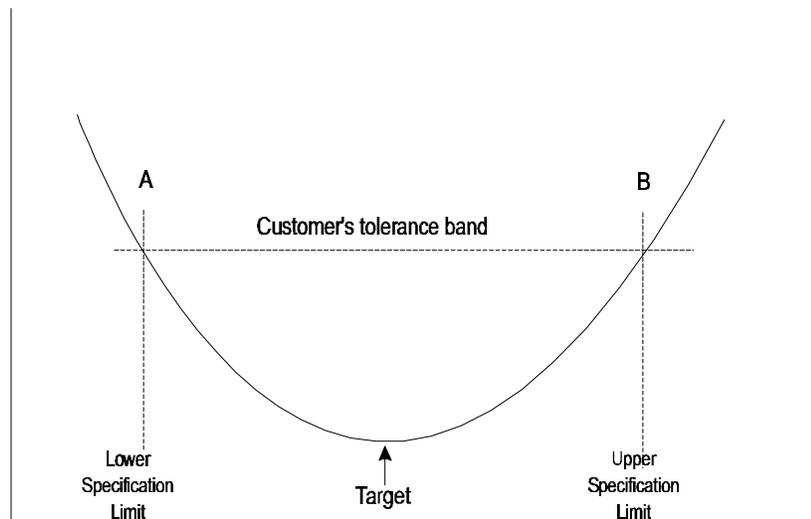
Taguchi maintains there are no hard edges to the loss calculations. A case study depicting this comes to us from SONY. Both Japanese and American manufacturing plants of SONY were operating with the same control limits of color density. The Japanese plant was using Taguchi's Philosophy of limiting deviation from the target. The American plant was using Upper and Lower control limits as the bounds of acceptable product. American consumers consistently preferred the Japanese sets. Data was gathered on color density and the results were plotted. Consumers could not tell SONY specifically why they preferred the Japanese sets, they only knew the image looked better. When the American plant converted to the same philosophy as the Japanese plant, there was not preference difference among American consumers.

Note:

- The quality loss function is a continuous function and is a measure of deviation from the target value. The conformance to specification limits LCL and UCL is an inadequate measure to define the quality loss function.

- Quality loss is related to product performance characteristics and can best be minimized by designing quality into the product. Prevention of poor quality is less costly than rework and yields a far better return.

- Quality loss results from customer dissatisfaction and should be measured system-wide rather that at a discrete point in the manufacturing process.

- Quality loss is a financial and social loss.

- Minimization of quality loss is the only way to be competitive and survive in today's international business environment.

Experimentation Design

Imagine a product with 7 components, for example, a cake: flour, eggs, sugar, shortening, milk, flavoring and butter. We want to know the best combination of each to achieve the best quality. For simplicity, let us use two quantity levels of each ingredient. In reality, it could be much more. We use two levels -- high and low.

The total combination would be 2^7 or 128 runs to test all combinations. Taguchi developed an experimental design using "orthogonal arrays". This comes from the mathematical concept of Latin squares dating back to World War II.

Taguchi created a series of "templates" one of which is shown below. The purpose of the array is to provide a statistically accurate cross-sampling of possible combination. Mathematical analysis of the effect of each variable yields the "proposed ideal" combination. Final testing and verification of the "ideal" will prove or disprove the answer.

Here is an example of how you can use Taguchi's Orthogonal Arrays to determine a "correct" mixture of ingredients. (To best understand this example, continually look down to the charts with the numbers entered as you read the example.) Imagine that you are a rubber stamp manufacturer interested in attaining a specific hardness in the final rubber stamp.

We will use a durometer to measure hardness. A durometer is a tool which through spring or pneumatic pressure measures the resistance of the material against the strength of the pressure -- thus measuring its hardness.

For the sake of simplicity, we will presume that there is no target amount that we must not exceed and we presume that a higher number is preferable.

We will restrict the experiment to three variables with two orders each -- high and low.

We have determined that the amount of vulcanized material placed in a pound of rubber stamp mix; the temperature of the oven and the pressure applied to the form impacts the hardness of the stamp.

We have devised the following possibilities:

Variables	Amount of Vulcanized	Temperature	Pressure
Low	8 oz	400°	300 p.s.i.
High	10 oz	450°	400 p.s.i.

There are 2^3 possible combinations or 8 total experiments. The orthogonal array can accomplish the task with 4 experiments. The difference in this example is small simply because this is a simple explanation. In real situations there would be more variables and/or more orders of magnitude to test.

Using the orthogonal array designs from the appendix, we choose to test the following combinations:

Experiment\Column	Vulcanized.	Temperature	Pressure	Durometer
1	Low	Low	Low	
2	Low	High	High	
3	High	Low	High	
4	High	High	Low	

We run the experiments and record the results in the column for Durometer values. Remember, in this experiment the higher the number the better.

Experiment\Column	Vulcanized.	Temperature	Pressure	Durometer
1	Low	Low	Low	42
2	Low	High	High	37
3	High	Low	High	46
4	High	High	Low	39

We calculate an average for each high and low condition to see what effect the variable has on hardness.

Vulcanized Low (V_l)   = (42 + 37) / 2 = 39.5
Vulcanized High (V_h)   = (46 + 39) / 2 = 42.5
Temperature Low (T_l)   = (42 + 46) / 2 = 44.0
Temperature High (T_h) = (37 + 39) / 2 = 38.0
Pressure Low (P_l)   = (42 + 39) / 2 = 40.5
Pressure High (P_h)   = (37 + 46) / 2 = 41.5

The highest score for each variable (remember, high is good in this experiment) is V_h; T_l and P_h.

We already tested this combination and thus already confirmed it as the highest score of all test runs. This occurs frequently when only a few possible combinations exist. Most experimental designs only test 10% of the possibilities and therefore it is rare that the "optimum" conditions were included in the test design.

Should the "optimum" not be included in the test design, it is important that you run one more test of the proposed "optimum" conditions and see the results. Taguchi's experimental design facilitates the discovery of "optimum" conditions for quality improvement.

You can find several different arrays in the appendix of this text for two and three levels of ingredients. If you do not find the exact combination for what you desire, use the next larger array and simply ignore the missing ingredients.

JIT

Just in Time is best described as an operational philosophy whereby the plant is operated using the following principles and beliefs:

1. A sense of constant and never-ending improvement permeates the entire organization.

2. Customers are considered to be most important; above company, product or process.

3. Only the amount of material, components, or finished goods are moved, produced, or stored which can be instantly used by the next process step.

4. Kanban (visual record) of need or requirement is used to automatically signal the flow of material or service.

5. Quality is built into the process and not inspected into the product after manufacturing.

6. Incoming product is purchased from a sole source so that quality is assured to be at, or above, the expected level. No inspection of incoming goods or materials is required (referred to as ship-to-stock).

7. Zero inventory levels are sought. Buffer stocks are allowed in the beginning of the JIT conversion process. Inventory is seen as the water covering the rocks. The rocks (problems) are still there, you just can't see them. The ideal batch size is always "one." All improvement is designed to reach a batch size of one.

8. Manufacturing flow is designed to allow teams to build the product or provide the service, typically, in U-shaped cells. The cells can be added to or taken away from as demand varies. These small teams have access to each other in order to discuss work flows and improvements. Each team is empowered with the capability and authority to stop the production line.

9. Manufacturing facilities are located near customers, thus allowing delivery of small batches of product or service to clients.

10. Small group improvement teams consist of personnel from all walks of the company and usually include customers and vendors.

Purchasing

Components, materials and services are incorporated into the manufacturing-service process. Separate staff personnel called purchasing agents, traditionally, obtain these items. Remember from agency law that the agent is to operate on behalf of the principal and maintain a fiduciary responsibility.

A recent trend is to place more of the manufacturing and service provision with other firms rather than to make or provide them inside the firm. This "outsourcing" allows firms who are best at the function to play a "value-added" role in the operation system.

The Old Management Paradigm

The old management paradigm called for purchasing agents to work on behalf of the financial side of the firm and secure the most goods for the lowest cost. Purchasing agents received purchase requisitions from the firm's employees and then became the sole contact to outside suppliers. The measure of savings was the invoice price from the supplier.

The old style purchasing was best characterized as an "arms-length" process. Purchasing agents believed suppliers would not perform unless monitored closely and would cheat the company if given an opportunity. In addition, purchasing agents presumed that suppliers' prices were inflated and required high-pressure negotiation tactics to get the "best price." The best price was the lowest price the purchasing agent could secure. Purchasing agents held little regard for the well-being of the supplier's firm.

The old style purchasing relied on many suppliers for each item. Purchasing agents pitted one supplier against another. It was common to get a price from one supplier, take the price to another supplier and ask for a lower price and then go back to the first and try to get a lower price again. Purchasing agents threatened to take their business to another supplier if demands were not met. Purchasing agents might take one supplier's specifications and drawings to other suppliers to see if they could outperform the prior supplier. Purchasing agents would say that they did not like to have all their eggs in one basket.

The old style purchasing used many purchase orders. Each request was treated like a new order. It was not unlikely that a supplier would get one order and a week later, another supplier would get an identical order. Purchasing departments were measured on how much in invoice dollars they saved the firm. The cost of purchasing was secondary.

The old style purchasing held tightly to information. Suppliers rarely saw the early specifications of a new product or service. Company research which might benefit a supplier was withheld for fear the supplier might give it to a competitor.

The New Paradigm

The new paradigm calls for trust on both sides of the partnership. Each must know that the welfare of both parities is critical for long-term success.

The new management paradigm calls for purchasing personnel to assist in the long term relationship between internal users and external providers. Relationships are

long-term and the measure of savings is total manufactured cost, quality, and customer satisfaction.

The new paradigm calls for only a few suppliers. Firms employing the new paradigm have successfully reduced the number of suppliers by over sixty percent. A 3M factory in Minnesota reduced vendors from 2800 to 600.[23] The Wallace Company reduced the number of valve suppliers from 2500 to 325.[24]. Purchasing agents in the new paradigm learn that all the eggs in one basket was better because you had two sets of hands holding the top and the bottom of the basket. The concern held by many managers that they do not want a significant percentage of their business to come from one source is reduced when information about the client is readily available to the supplier. Thus the element of unwanted surprises is removed. It is common for meetings of senior managers from a firm and its supplier to meet and discuss the financial condition of both firms. The long term well-being of both is essential for the success of each. The two firms jointly create contingency plans for potential high-risk situations.

A printing company in Seattle maintained a new paradigm with a major software manufacturer. The software firm discerned a communication problem in the printing company, approached the owner of the printing company and offered the larger firm's expertise in communication. The software firm conducted a seminar for the printing company and even paid for the down time so that all the printing company's employees could attend.

New paradigm purchasers learn that there is increased production cost when multiple suppliers provide components and materials. Each firm produces to a different set of tolerances and ships product in a different manner. This variation slowed down production and increased costs.

New paradigm purchasers learn that information is not a commodity by which to manage but rather a resource through which you attain success. A manufacturer of copiers was shocked to learn that a new copier had no less than 135 custom manufactured screws and bolts. These items were custom manufactured at a cost many times more than using standard sizes. Value-added suppliers are more concerned about the success of the new product than they are in getting the order, since they already have the contract. Supplier's personnel become no-cost consultants to the manufacturing firm's designers and producers.

New paradigm purchasers understand that under JIT, deliveries must be small and frequent. Packing and delivery practices must be coordinated by vendors' shipping personnel and the buyers' receiving personnel. The added costs of frequent small deliveries are offset by the increase in business because of the long-term contract.

New paradigm purchasers learn that less paperwork is required. You no longer need a requisition, purchase order and receiving report for every shipment of material. Long term contracts establish the legal relationship of specifications, prices and payment terms. Even receiving reports disappear as JIT becomes the predominant materials philosophy. JIT calls for goods to "ship to stock" or "ship to line" (more on this in Inventory).

Imagine that you are producing televisions and you agree to purchase remote controls from a vendor. Each television has one remote with it. The vendor has access to your production forecast data and knows that you need 800 remotes delivered tomorrow morning. You know that if you boxed and shipped 800 televisions you must have received 800 remotes. You simply, pay the vendor for 800 remotes based on your own

data, not the vendor's. There is no purchase order, no receiving report, not even a voucher check if you use electronic funds transfer.

Who Resists the Purchasing Paradigm Shift?

Old paradigm purchasing agents see the new paradigm as removing their job. It is true that the job goes away, but the need for people in the firm does not change. The intent of TQM and the other related philosophies is to improve quality and reduce cost, which results in more people wanting to purchase the firm's goods and services, thus requiring more people. People from purchasing receive training in different areas of the firm and the company transfers them to areas where the firm can use the employee's skills.

Finance managers resist change because they deal with hard visual numbers. Reduction in variation and subsequent improvement in quality and overall production costs do not seem real to them.

Friends support friends

Earlier the idea of the eggs in one basket with two sets of hands on the basket generated a visual image of the support both vendor and purchaser generate. Friends don't hurt friends. Small children grow up believing in their friends and try to maintain long-term relationships.

Monogamous marriage requires a commitment between two people to make a better life for both than either one could create alone. New paradigm purchasing is similar to a marriage in that there is a strong commitment between the two players.

What About the New Vendor ?

New suppliers look for new purchasing firms to establish long-term relationships. The growth and change of established firms offers opportunity for new suppliers to build relationships as new products appear.

Sole Sourcing

The result of reducing vendors, long term contracts and electronic data interchange (EDI) is that one vendor is the sole source for a particular item or service. This concept is difficult for many firms to adopt. A method which eases firms into this relationship is to start with two vendors providing similar items but sole source each item to a vendor. In the event of a problem which you have not established contingency plans you may use the alternate vendor to substitute. For example, consider you have two office supply vendors. You purchase all your computer supplies from supplier A and all paper products from supplier B. Both suppliers are capable of supplying you with both. Should there be a problem with A, then B can be called on for help. Many firms sole source in this manner which assists the skeptics to adopt the practice.

Purchasing people visit suppliers regularly to inspect manufacturing process and planning steps. Good relationships are based on trust and the willingness to allow a "friend" to visit and ask personal questions and give answers.

Pareto Analysis

Pareto's "80/20" rule, as it is commonly called, provides purchasing agents with a tool to examine the current purchasing practice and determine which products and services to move to sole source practice.

Eighty percent of the purchasing effort can be attributed to twenty percent of the products purchased. These are the first to be handled in the new paradigm method.

Levels of Vendor Relations

Relationships do not blossom from emptiness. Relationships build along a set continuum. Vendors start the relationship journey as a "Candidate." A candidate is a firm who expresses interest in building a stronger bond with you. Small orders and short-term contracts test out the ability of each party to work with the other.

Following this, the relationship moves to "Commodity." Here, the vendor's product/service is deemed most acceptable to the firm and there is a recognition that both sides want the relationship to progress. During this stage, long term compatibilities are examined by both parties.

The next stage is called "Ship to Stock." During this stage, the vendor's products are not inspected upon arrival and electronic data interchange allows free access to information by the vendor. A consulting relationship emerges at this stage.

At the final stage the vendor becomes a "Full Value-Added Partner." A free flow of information and personnel between the buyer and the purchaser characterizes this stage. A full consultative relationship exists and the purchaser consults the vendor at the thinking stage and then at the design stage to create an optimum product/service.

Here is a note I received from a student in the 1995 class.

From: Dear Prof. Winston:

Part of my responsibilities as director of development and finance of my church involves building relationships with businesspersons here in the Shenandoah Valley of Virginia. The story I am about to relate stems from a breakfast meeting I had recently with the owner of a large concrete company in the area. I feel it is a good example of how sole sourcing can prove to be effective for all parties concerned.

During the course of our conversation, I was relating to him my reasons for wanting to develop a relationship with him, and the mutual benefits which could result from this effort. He agreed with the importance of relationships, and shared an example from his company.

He pointed out that for a number of years, he has been purchasing his crushed aggregate (stone) from one supplier. This relationship has developed to the point that the supplier knows the needs of this company, and can and will deliver the needed product in the required quantities right when needed. The concrete company has limited space for storage in one of its urban facilities, and needs to depend on the supplier to provide what is needed "just in time."

This has been working for a number of years, with some interesting effects. For instance, the supplier knows that the company will buy all its product from him, and prices it at a rate which recognizes this fact. Additionally, the supplier goes out of its way to make certain that this concrete company always has what it needs, even in times of high demand and general industry shortages. Other concrete companies do not always understand the seemingly preferential treatment given this company. An atmosphere of trust has been developed between both parties, and they both know that the other's yes means yes, and no means no.

The owner went on to say that he understands the concept of total quality management (TQM), but doesn't feel his company is fully operating under this model. It should also be pointed out that this company does not lay off its employees in slow times, but neither does it over staff. As a result, employees are willing to work extra hours during the busy times. This company has experienced growth in good times and bad.

I thought you may be interested in hearing that Just-In-Time does work, if given the opportunity.

Lesson Four Questions

1.   What is a team?

2.   How are baseball teams, football teams and basketball teams different from each other? Use organizational structure and interdependency in your answer.

3.   What is the difference between a team and a work group?

4.   Why would JIT be unpopular with production and purchasing managers?

5.   What benefits does JIT offer suppliers, buyers and manufacturing employees?

6.   What is sole sourcing?

7.   Why would you want sole-sourcing in your firm? Why not? Are you married? Is there a parallel here?

Lesson Five - Facilities, Cells and Equipment and Maintenance

Objectives

After this lesson, the reader should be able to:

- Describe the value of the U-shaped cell over traditional assembly lines

- Train managers on when to buy equipment

- Explain appropriate maintenance principles

Key Terms

U-shaped cell

Flexible manufacturing

Facilities Design - U Shaped Cell

Production and service requires optimum layout of equipment and people to best use resources. There is no one best layout for everyone. However, one best approach emerged during the paradigm shift to TQM and JIT and that is a U-shaped cellular design.

Material flows into the cell at one end and finished goods/modules flow out the other. Material transfer equipment and people are located close together along the inside of the U.

The U-shaped cell can be enlarged or reduced in size by the addition or subtraction of components. This allows greater flexibility. The graphic designates the work centers by letter. The letters could stand for anything you want. "A" could be a sawing operations, "B" could be drilling operations, "C" could be milling operations, "D" could be polishing and "E" could be finishing. The point is to demonstrate that with a U-shaped cell, like operations are performed by people in one process. Communication between employees doing like operations is improved. Cross-training is easy since all operations are in close proximity and the impact of one operation is easy to convey to other employees.
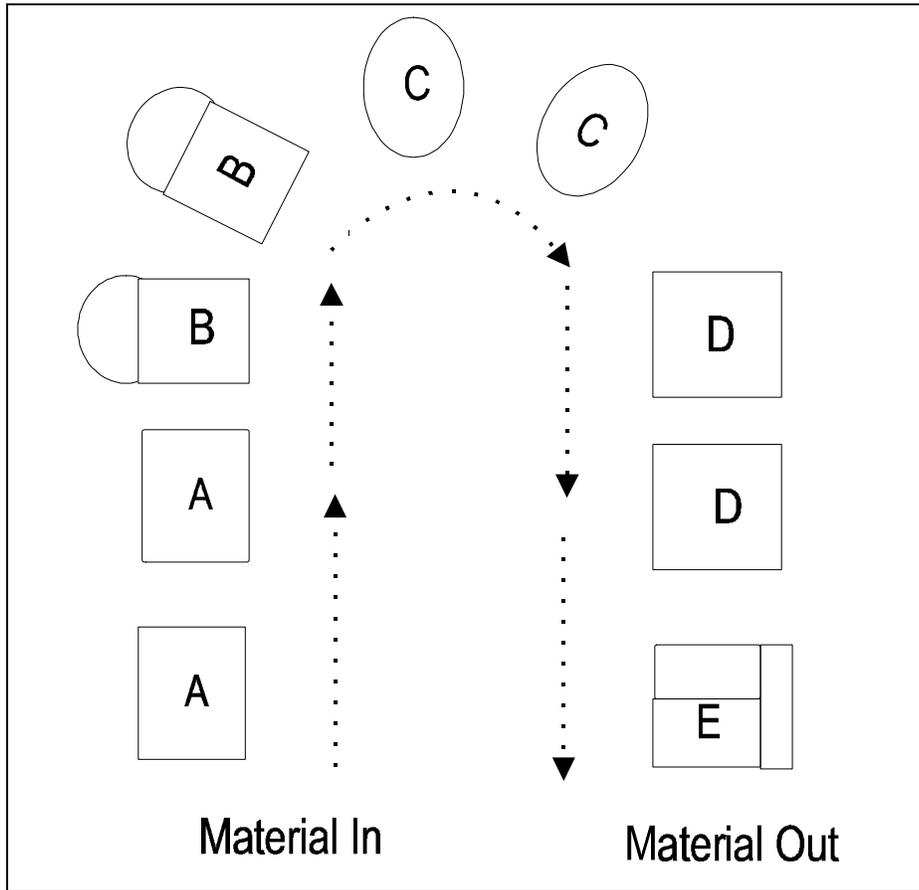
Cellular facility design is used in service firms as well. During "Parents Day" at my son's junior high school some years ago. I was pleasantly surprised to hear an excellent example of cellular service delivery in education. This particular junior high school was originally built to handle 750 students. As is the case in many other schools, this one was over crowded and handling 1000 students. Change was in the works to transfer the ninth grade students to the nearby high school which was under modification to handle the increase in students. The junior high school design before and after cellular conversion is below:

Before Cellular Conversion

A1	B1		B5	C1		C5	D1		D5	E1
A2	B2		B6	C2		C6	D2		D6	E2
A3	B3		B7	C3		C7	D3		D7	E3
A4	B4		B8	C4		C8	D4		D8	E4

J1	I1		I5	H1		H5	G1		G5	F1
J2	I2		I6	H2		H6	G2		G6	F2
J3	I3		I7	H4		H7	G3		G7	F3
J4	I4		I8	H4		H8	G4		G8	F4

After Cellular Conversion

B	B		D	D		F	F		H	H
B	B		D	D		F	F		H	H
A	A		C	C		E	E		G	G
A	A		C	C		E	E		G	G

O	O		M	M		K	K		I	I
O	O		M	M		K	K		I	I
P	P		N	N		L	L		J	J
P	P		N	N		L	L		J	J
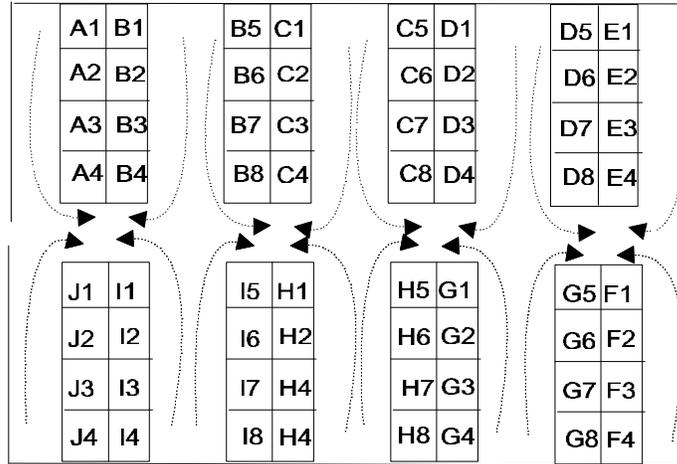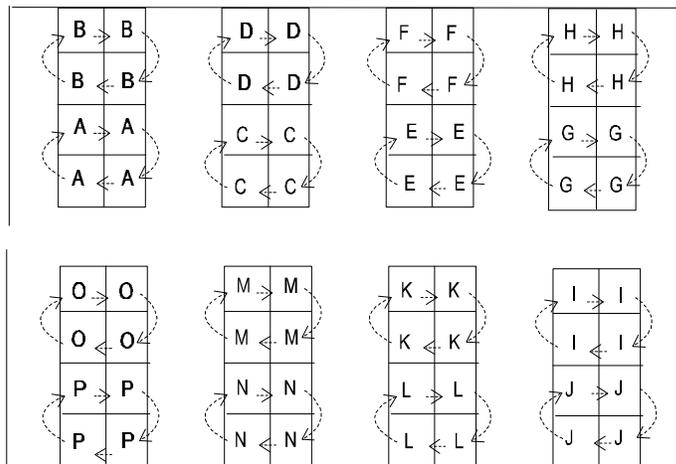
The first diagram shows the flow of students when each hall represented a subject. The halls were divided into 7th grade English, 8th grade English, Chemistry, Biology, History, etc. Every hour at 10 minutes till the hour, students left their classrooms and had 10 minutes to reach their next classroom that could be from the next hall to the other end of the building. Frequent accidents in the hallways occurred. The principal and all teachers took positions at the hall entrances and tried to control the flow of students.

The principal redesigned the "work flow" in the second diagram and grouped like-students together in grade levels. The letters represent teams of students -- four groups of 7th graders in "A", four groups of 8th graders in "K". The principal ordered doors to be put between classrooms thereby creating a circular flow of students. Each

team of students was assigned four teachers. Each teacher taught a different subject. The teachers communicated with each other about each student's progress. They dealt with academic problems before they became out of hand.

Some movement is still required in the new arrangement since the music room and the gym are visited by different groups of students in the day, however, the flow in the halls was reduced by over eighty percent. Frustration among students, faculty and administration dropped to near-zero.

The principal described the result of this redesign as seeing that the faculty and administration were there to teach students, not subjects. The organization of work flow complemented the changed mission and purpose.

Flexible Manufacturing System

Flexibility is a "buzzword" of the nineties. A concept called "Mass Customization" emerged from the application of flexibility to manufacturing. "Mass Customization" impacts every manufacturing operation. Using TQM and the JIT philosophy, you can create an ability to produce ever smaller lot sizes until the only logical lot size is "1." This means that every item produced in a plant is pre-sold to a client who is waiting. Thus you achieve "Mass Customization."

The auto industry is already operating with a lot size of "1." The Ford F-100 plant in Norfolk, VA, produces a pickup every few seconds. Each pickup is pre-sold to a dealer who special ordered all the options. Every truck moves through the assembly line receiving its own set of features.

Bicycle manufacturing is approaching this level of customization. Bicycles shops are beginning to learn that the ideal bicycle is unique to each individual. Shops now offer the service of measuring the customer and learning what options the ideal bicycle should have. The store stocks a small stock of frames, gears, wheels, tires, handlebars, pedals, etc. Within two hours, the customer's bicycle is built and tested.

This immediate customer service is possible in many other goods and services areas. The only requirement is the ability to look at what you are doing with a fresh approach and not be hindered by the "that's not the way we do it" syndrome.

Flexible manufacturing fits any operation where a group of people or robots can do a variety of tasks with little, or no, changeover and produce related, yet different, goods. An appliance manufacturer could adopt the Ford F-100 model and produce a variety of models one at a time and assemble them for pre-sold orders from dealers.

Flexible manufacturing fits service support facilities as well. Imagine an insurance company, who sells and services an intangible product, supported by tangible items such as policies. Several people working together could produce a life policy, followed by an umbrella policy for a small business, followed by an automobile policy, followed by a health policy, etc.

Look for similarities in process and then look for how those processes link together in the system.

Equipment and Maintenance

Purchase equipment to augment the human function. Many managers, unfortunately viewed equipment as they viewed robots as something to replace the problems of people. The old paradigm produced decisions to purchase even larger pieces of equipment. The belief was that the larger the equipment the greater the cost savings when the order quantity exceeded break-even.

The paradigm showed an anomaly when customers began to order smaller and smaller lot sizes. Suddenly, large pieces of equipment became albatrosses as order sizes continually fell below the BEQ for these monstrous machines.

Look at the graphic below. In a world of unstable economic variables and customers looking for lot sizes approaching 1 the latter curve makes more sense.

Capacity

Demand

Which would you rather be?

Capacity

Demand
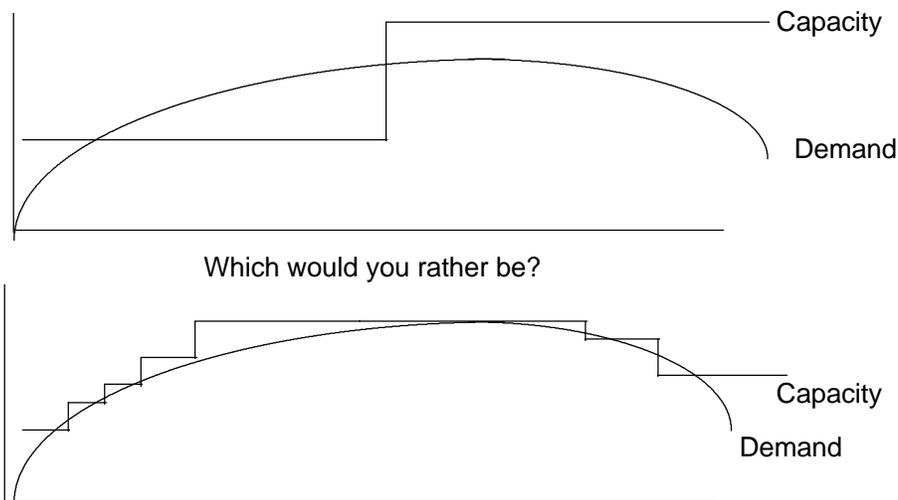
Smaller equipment fits the concept of flexible manufacturing and cellular designs. Smaller equipment is easier to sell to other companies than is large equipment.

Smaller equipment can be linked together into process flows when the speed of transfer is matched between them. This means that if one machine runs at 5,000 items per hour, the machine it is linked to must also run at 5,000 items per hour. You could, of course, create a myriad of combinations using multiple pieces of equipment. For example: the first machine produces 5,000 items per hour and delivers its goods to two machines each operating at 2,500 items per hour.

Lesson Five Questions

1.   Why would a firm produce more in two 8-hour shifts than in three?

2.   Describe three examples of U-shaped manufacturing cells.

3.   Why is it difficult for managers to think of smaller equipment rather than larger equipment.

4.   How does the EOQ formula play into equipment purchase?

5.   What are the reasons to purchase new equipment?

Lesson Six - Inventory, Scheduling and Robotics

Objectives

After this lesson, the reader will be able to:

- describe the different types of inventory

- devise a scheduling system based on the needs and wants of the system and the firm

- create an MRP and MRPII scheduling chart

- identify the appropriate type of robot for a given manufacturing situation

Key Terms

raw material inventory

work in process inventory

finished goods inventory

queuing

first-in first-out

latest schedule

critical ratio

bottleneck

kanban

manual manipulator robot

fixed sequence robot

variable sequence robot

playback robot

numerically controlled robot

intelligent robot

Inventory

Inventory is the accumulation of material waiting for further value- added operations or for sale to a customer. Inventory smoothes out the weaknesses in the operation process. JIT operation philosophy looks for ways to reduce all inventory to zero. Be cautious here and approach a zero inventory slowly. Few systems are good enough to run without any inventory, just as few finish carpenters are good enough to build without trim.

Robots improved conditions for humans by taking over dangerous, as well as tedious, work. American managers began to see robots as a replacement for people problems. This is unfortunate since a robot is unable to solve problems in the same way a person can. Robots have a place in today's production environment as an augment to human labor and a replacement for labor in situations which are not healthy to people.

Inventory Types

Raw material inventory is the amount of goods in storage which has no value added to it. There are several reasons for keeping an inventory of raw material. A steady supply near the production facility prevents shut downs waiting for work. Stockpiling in times of shortages insures that production can continue in the near future. Buying large quantities of material during periods of low price offers the potential for overall cost savings. We have learned that the savings is usually a myth when we add in the true carrying costs. This was covered in the section on economic order quantity.

Work in process inventory is that material which has some value added to it. You will find work in process inventory at each work station in a production plant. Items in transit from one work station to another fall into work in process inventory.

Finished goods inventory is that material which has finished the value- added processes and is awaiting purchase or shipment into the marketing channel (distributor - warehouse - retail).

Re-work inventory is that material which is found defective. The material is held until someone has time, or it can be scheduled, for correction and modification.

Inventory turnover

Inventory turnover, like asset turnover, is a useful tool to measure performance and continual improvement. It is an accounting tool but offers some use to operations managers as a conversion to JIT occurs.

$$\text{Turnover} = \frac{\text{Annual cost of material}}{\text{Value of current inventory}}$$

Many companies who thought that turns of 3-7 were good are now reaching 20, 30 and higher using JIT concepts.

Consider the example of a manufacturer who purchases $8,000,000 of materials a year and maintains $2,000,000 in raw material inventory. The turnover is 4. Consider the benefit to the company if, over time, you can increase the turn to 20. You will have freed up $1,600,000 in available capital. Most companies use an internal rate of return for capital at around 25%. This means that an additional $400,000 could be added to the end of year profit. I emphasize "could." What the firm does with the added capital can be debated for eternity. This kind of improvement can be done with no added cost.

Transfer systems (methods, processes and equipment used to move materials from one location to another) underwent significant change during the past 20 years. TQM and JIT philosophies call for the transfer to be automatic and to assist with the release of material to the next work station.

Queuing

Queuing is the lining up of material at a station or the people waiting for service. An advantage of JIT is that it focuses on queuing and bottlenecks. Bottlenecks exist any time you do not have a balanced, well maintained line. Bottlenecks result in increased queue length and therefore are a control mechanism for smooth system operation.

Queuing can be as obvious as people lined up at a grocery checkout line or bottles moving thorough a production line. Queuing can also be less obvious, such as the short delay in getting a long distance call switched. In this last example, you are not aware of the other callers in the system.

Queuing theory carries with it a massive amount of mathematics which can be used to define and work with queues. Queuing follows all three distributions: normal, Poisson, and exponential. Normal is the typical bell-shape curve. Poisson is a skewed distribution such as defects per 1000 items -- the heaviest concentration of occurrences is closest to zero. Exponential is a distribution rising, or falling, sharply from the zero point.

The intent of all the mathematics is to simulate the number of times that the product or customer will not be served within an appropriate time after queuing. This is important from a marketing stance when designing a service process. It is important from a manufacturing stance in designing production flows.

This type of simulation before a plant is built can save millions of dollars in production and improve customer satisfaction. Simulation can be performed after a facility is built, but usually offers less gain. C. D. Lewis's book *Scientific Inventory Control* is a good source of mathematical formulae to simulate amount in queue, length of queue and mean wait time.

The new method of examining this problem is to build modular designs and modular queuing flow to accommodate increasing and decreasing client flow within a presumed range.

Here is one example in which a grocery store increased its sales by using customer behavior in queue. The medium sized grocery store developed a marketing campaign capitalizing on the client's dislike for lines. The advertising copy read that "three is a crowd." If any check- out line reached three people, another check-out clerk was immediately summoned for assistance to move clients through.

For the first week, clerks were announcing on the intercom that "Three's a Crowd" and additional clerks would appear to move the queue through. Soon, if a clerk did not notice the queue, the client's did and shoppers would take up the cry of "Three's a Crowd." This is an excellent example of verbal KANBAN.

Kanban

Kanban means visual record. It is a means of requesting additional material or WIP or to signal that more is coming to the next station. The simplest means of KANBAN is the verbal record -- "Give me more"; "Can I help the next person in line, please?"

Colors on cards, lights, or the tray used to hold the item can also be used as a signal that more material is needed. An example would be the workspace or the tray used to store and transfer material. An electronics firm produces sensitive measuring

equipment. The components are transferred from work station to work station. A cart carrying five units is rolled up to a work station. Transfer employees watch the work and when a cart is empty, they know that it means another cart of five units must be moved into place. This may be done by electronic means too. An example would be the computer record of an item sold and a picking system releasing the next item for delivery. Marketing enthusiasts will recognize the similarity of Kanban to a pull strategy.

Scheduling

Items in queue are usually worked on in a **"First In First Out" (FIFO)** scenario. There are other methods employed today.

In the **"Latest schedule"** scenario, any item arriving at a work station in which the item's scheduled delivery is earlier than any other is scheduled first. Rush orders are handled in this manner. A rush order is given priority to other orders since its due date/time is critical.

In **"Critical ratio"** an index of processing time to total remaining time before scheduled delivery is created. Employees process the order with the highest ratio. Remember that after each item is processed, new critical ratios are calculated. For example, consider an airport terminal with five gates. Five planes arrive at two o'clock. Plane one is due out in one hour, planes two and three are due out in one and one-half hours and planes four and five are due out in two hours. Each plane requires 45 minutes of servicing before departure. The answer here is simple, plane one is serviced first, then planes two and three and finally four and five. Most critical ratio calculations are not this simple but do follow the same logic. Queuing control requires that communication be maintained among all parties.

Queuing in service is a key quality measurement. Disneyland's image is as affected by the length of time a patron must wait in line for a ride as by the cleanliness of the park.

Service queuing consists of customers and servers. You can have four combinations:

Lines	Single Server	Multiple Server
Single Customer	SS	SM
Multiple Customer	MS	MM

Single Customer and Single Service arrangements are found in amusement parks. A "serpentine" or twisted line is found when space is a premium. Single Customer and Multiple Server lines are found in banks and some cafeteria-style restaurants (where there is one food line and several cashiers). Burger King uses this style. Multiple Customer and Single Server arrangements are rare. Some cafeterias setup this style when it takes longer to get food (as in several different sections, short order, salad bar and full grill) than it does to check out. Multiple Customer and Multiple Server lines are found in some grocery stores and some fast-food lines. McDonalds uses this style.

Inventory in Movement

Long movement lines and transfer systems have been standard in the manufacturing industry. JIT and cell layout bring a new dimension to the short transfer system. The reduction of inventory means that you can place equipment closer together. The space once occupied by WIP can now be converted to production. Short transfer lines are easier to install and maintain. The shorter distances improves communication and efficiency.

Bottle Necks

Bottlenecks occur when more material arrives at a work station than can be processed in the time before another item arrives. The bottleneck can be caused by: (1) slower processing time than the succedents; (2) breakdown of equipment; or (3) setup time.

The solutions for bottlenecks appear simple on the surface. You can increase equipment or add more hours to process accumulated material at the end of each shift. You can also increase maintenance in order to have more equipment time available. You could re-route work flow to sub-contractors.

The answer is all of the above and more. Bottlenecks must be examined carefully to determine what is causing the condition. Bottleneck solutions must also be examined to see if additional bottlenecks will be created downstream or if the bottleneck only will change. Eliyahu Goldratt's book, *The Goal,* is an excellent book written in a novel format to illustrate the battle against bottlenecks.

Robotics

Robotics have been used in the past to replace human workers. Today, direct labor is very low compared to overhead and there are very few labor disputes. Quality of Work Life (QWL) programs changed the way many employees view their job. Why then are firms still interested in robotics? Primarily for consistency and safety.

Robots can perform the same task with incredible precision over and over again. As we reduce variability of performance from target, robotics begin to make sense. Remember that is correct as long as there is no thinking involved.

Japan has treated the robotics additions as extensions of the employee and not as a substitute. The other major purpose for robotics is the removal of humans from dangerous work conditions. Working with elements such as acids or high heat where accidents can happen are excellent areas for robotics.

Types of Robots

Manual Manipulator

A manipulator is directly controlled by a person. Old science fiction movies show the scientist with his hands on the controls of a robotic arm inside a sealed chamber. The scientist manipulates the controls to cause the mechanical arm to pick up the dangerous chemical and pour into the beaker.

A pantograph is an example of a manual manipulator. A pantograph is a mechanical device which enlarges or reduces a drawing as a person traces the original drawing.

Fixed Sequence Robot

A Fixed Sequence Robot's actions are fixed by a non-changeable program. The only way to change it is to tediously re-program it. This type of robot is fine in an environment where no future change is required, only one product is manufactured and flexibility is not required.

Variable Sequence Robot

A Variable Sequence Robot is a robot whose actions are programmable by an expert programmer. Although the actions can be changed, it is inconvenient to do so. This type of robot is found in plants where change-over of the production process is rare and always well-planned. Many metal stamping processes use variable sequence robots.

Playback robot

A Playback robot is capable of repeating any and all actions which a person took it through. An example of this is the electronic keyboard. Play the music and the tape repeats it. Play the keyboard and the keyboard repeats the notes in correct sequence and timing. Embroidery machines are another example of playback robots. A seamstress executes a series of stitches and the machine then plays back the same stitches repeatedly for mass production.

Numerically Controlled Robot

A Numerically Controlled Robot is a robotics machine which executes a command based on numerical input as to three dimensional space and operation. The numerically controlled robot is very flexible and capable of minute movements.

Intelligent Robot

A robot with sensing and recognition capabilities. This robot would be programmed to recognize the difference between acceptable items and unacceptable items. It could be programmed to recognize the difference in shapes, sizes and colors of incoming material such as fruit for classification. An intelligent robot might recognize different colored metal sheets moving through an assembly process and execute different patterns of welds based on the colors. This would allow for unique discrete product assembly.

Lesson Six Questions

2. Describe the following types of inventory: (1) raw material, (2) WIP, and (finished goods).

3. What are the advantages of reduced inventories?

4. What is kanban? Give three examples of kanban?

5. Describe four types of robots and give examples of their use.

6. Four airplanes, numbered in the sequence they arrived, are waiting to be fueled. The time is now 3:00 pm. Given the data below, compute the re- fueling sequence which satisfies 'critical-ratio'.

7. Plane   Fuel time required   Time Plane due out

Plane	Fuel time required	Time Plane due out
1	30 minutes	3:35 pm
2	24 minutes	3:55 pm
3	45 minutes	4:05 pm
4	20 minutes	3:40 pm

Lesson Seven - Ten Lessons in Simplicity

Objectives

After this lesson, the reader should be able to:

- Train managers in the ten lessons of simplicity

Introduction

Life, business and management is simple. This bold statement does not mean that everything is easy. Many tasks are hard, but none are complex. Think back to the section on systems. When you understand the interaction of individual components in a system, the entire system makes sense. Unfortunately, people have complicated matters over the centuries. Consider the American legal system. There are millions and millions of laws and regulations on the books of town, city, county, borough, state and federal levels all trying to enforce the Ten Commandments from the book of Exodus and a handful of principles from the New Testament.

Strive for simplicity in your operation and you will see a sense of greater freedom and comfort in employees. God gave us Ten Commandments centered on essential relationships with God and man (in that order). Jesus gave us key principles in parable form for understanding spiritual and social order. The social order is directly applicable to work environment.

This chapter offers several lessons in simplicity.

Use As Little As Possible

The old adage "if a little is good, a lot must be better," does not hold true in the realm of management. There is a paradox of "little means more" which is in line with the Law of Greatness.[25] Those who would be the greatest among you must be the least. While this law refers to people and how they place themselves in comparison to others, I am convinced that it correlates with stewardship.[26] For a firm or department to produce the most, you must look for how you can use the least of all resources. Commonsense must be applied in that you must demonstrate stewardship of all resources: men, money, machines and materials. The optimum blend of all may require a perceived excess of one. To achieve the best of all four, you may have to spend more money or use more material or allocate more people or machinery to the project.

The point is to constantly look for ways to use less of all available resources and achieve a greater level of production or service as the result. This usually requires changing the way you work. TQM calls for a Just-In-Time (JIT) manufacturing philosophy so problems can be observed. JIT requires little, or no, inventory. Many firms, when beginning JIT, mistakenly believe that they must start out with no inventory. This leads to inevitable shortages and work stoppages. Rather, firms should adopt JIT and then begin the continual process of looking for ways to reduce inventory and have materials arrive just as they are needed.

Regent University's School of Business Distance Education Program (DEP) is an example of the optimization of all with the excessive use of some components. JIT calls for materials arriving at the point in time of need. DEP should have textbooks and tapes arrive one day before shipping so as to maximize the use of money and minimize the amount of inventory. This has never happened and probably never will. Are you shocked that I would expound the virtues of JIT and then tell you I will never use it in this program? -- Read on.

The Business School assumed responsibility for DEP's predecessor, The Center for Extended Learning, in August of 1991. At that time the Center operated with two writers, one administrator and a 20 hour a week graduate assistant. The Center could produce four courses a year and could handle 50 students enrolled in four different courses totaling 65 student-course enrollments. By 1994, DEP produced/modified 25 courses a year and handled 200 students in 15 courses yielding 265 student-course enrollments using one writer, one full-time telephone employee, one part-time administrator (me) and one 12 hour a week graduate assistant.[27] We accomplished more with fewer resources. By 1996, the same amount of work with no writers (we trained faculty to handle this step) and one part-time administrator handled all school management activity.

Audio producers worked with other school personnel seeking how they might improve the recording and editing process of distance course tapes. The net result of this improvement process was a reduction of production and editing time from 350 hours to 75 hours per course.

Analysis of the workflow over time revealed a lull in logistics during the fourth to the eighth week of the term. Materials arriving during this time can be unpacked, verified with faculty and processed without hiring additional people. (There are no other activities during this lull that the graduate assistant can be cross-trained for, thus removing the option of changing work flow to accommodate JIT.) Prior to the shipping date, the graduate assistant is busy with assembling studyguides and labeling audio tapes. Adding the arrival of textbooks places a bottleneck in the operation.

We study the process each term and look for ways to improve the system. We added an overhead packing material dispenser in the packing work area when we saw that the length of time it took to manually pour packing material was the greatest time component of the shipping cycle.

Thus, currently, the optimization of the system requires excess textbook inventory and early payment of publisher's invoices. Reduction in inventory would necessitate the hiring and training of additional people prior to the shipping date.[28] The cost of people exceeds the tangible and intangible costs of inventory in this case.

Another concept within this area of simplification is to do all jobs in small increments. Taylor discovered this during his time at Bethlehem Steel. Iron carriers carried more steel bars per shift when they carried lighter loads and took regular rest breaks than did employees who carried large loads with no breaks.

The air beetle is an example of small loads with repetitive tasks. The beetle takes small bubbles of air down to the nest-home it builds under the water. If the beetle tries to take too large of a bubble, it will not be able to drag it below the surface.

Manufacturers have begun to understand this. More work is produced with two shifts and a scheduled maintenance period than is produced with three shifts. The Japanese taught us this some time ago.

Allow People To Do What They Are Trained To Do

Dan Chamberlin, professor of management at Regent University, uses the phrase "don't buy a dog and then bark yourself." This means that you, as managers, should hire the people you need, train them in what you want them to do, establish the information/feedback controls and then let them do the work.

We must avoid the desire to micro-manage people. A manager's function is to manage the interactions between people rather than to manage the tasks and the way people work. When you feed a person, the person stops feeding himself, even if capable. Managers who think for their employees encourage employees to not think for themselves. "A mind is a terrible thing to waste." This adage comes from the Negro College Fund marketing messages, but it is appropriate here.

Place people in situations where they must think for themselves. Training will establish the controls for "proper" corporate goals and allowable activities. Managers should be free to manage and to interact at higher levels in the organization. This can only occur if managers free their employees to do what the employees were trained to do.

Employees must be the ones who determine how much training they want. Too often, managers select employees for promotion or expanded duties and employees are too afraid to say no. Employees are not interested in the new training and do not excel at the new opportunities. Management must learn to communicate opportunities and encourage employees to seek advancement and expansion of duties.

Avoid Programs -- Build A State Where Self-Improvement Is The Norm

TQM fails in firms where the "quality program" is institutionalized and people see it as a temporary state. TQM succeeds in firms where the principles are internalized and lived out in daily life. This can be frustrating to people when they cannot see the end to a process. TQM is not measured in days, weeks, months or years until quality is achieved. It continues forever.

Perfect quality and perfect system optimization cannot be obtained. We can only work to get closer. Christianity is like that. We cannot become "Christ-like," we can only continue in the process of sanctification striving to get closer.

Continually work to reduce inventory and work-in-process time. This will expose problems just as an ebbing tide exposes rocks. As you reveal and remove problems you will find the system working smoother.

Standardize Setup Operations

Shiego Shingo's work emphasizes the importance of streamlining setup operations. Economy of scale occurs when the lowest production cost per unit occurs. This

happens when the setup costs are spread out over more and more units. Thus, the old paradigm had us looking for ways to produce bigger and bigger lot sizes.

The new paradigm has us looking for ways to reduce the setup operations. Consider the metal stamping operation requiring 24 hours of conversion to a new product. Current in-use dies had to be removed and stored. New dies had to be located and installed. Test runs required hours and hours to test the performance for conformance to specifications.

Dies were made of the least amount of material necessary, thus, each die set was a different size. Dies need to stamp in the center of the press to produce even metal images. This required several hours to position and remount the dies within the press to insure high quality output.

Changes in die ordering required all dies to be the same size regardless of image, the image to be in the center of the die and standard bolting holes were made like the diagram below:
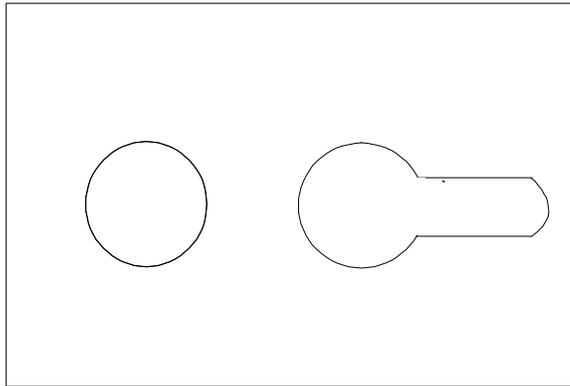
The circle with the slot allowed the bolts to stay in the die bed. The new die was positioned over the bolts, lowered to the bed and slid on to the slots. The bolts were tightened and the press operation continued. Positioning and pressure per square inch were the same as the prior job. This procedure, coupled with better die storage and retrieval systems, reduced the setup conversion from 24 hours to two hours.

Reducing the setup costs allows us to produce smaller lots with the same unit costs. The smaller the setup cost the smaller the impact per unit in larger lots. For example:

Before improvement	After improvement
Setup - 5 hours at $200 per hour (machine rate)	Setup - 1 hour at $200 per hour (machine rate)
Dies - many sizes at an average cost of $75	Dies - standard size at an average of $ 95
Standard unit cost of $5	Standard cost of $5
Net cost per unit at 100 units - $15.75	Net cost per unit at 100 units - $7.95
Net cost per unit at 1,000 units - $6.75	Net cost per unit at 1,000 units - $5.95

| Net cost per unit at 10,000 units - $5.11 | Net cost per unit at 10,000 units - $5.03 |

At the high end of the scale, the two methods do not show considerable differences. But at the low end there is a significant difference. If you can produce custom orders of 100 for your clients and deliver in two working days from time of order at $7.95 you have a competitive advantage over the firm who has not improved the setup process.

Build Upon a Strong Foundation

Successful organizations arise from a strong foundation of values and purpose. This makes sense intuitively. If everyone in the firm knows why they are working, for whom they are working and what the common beliefs are, it makes sense that the firm will be stronger than others who do not have these advantages.

Most firms give employees an orientation to explain the firm and what the firm does. Few firms follow up with a measure of retention to see how much of the orientation stayed with the employee. You know, as a student, that much of what you learn, read and hear is forgotten in a short time because of pressures from other sources, lack of application opportunity and poor communication. So why do we think it is no different with employees?

> *Hear, O Israel: The LORD our God, the LORD is one. Love the LORD your God with all your heart and with all your soul and with all your strength. These commandments that I give you today are to be upon your hearts. Impress them on your children. Talk about them when you sit at home and when you walk along the road, when you lie down and when you get up. Tie them as symbols on your hands and bind them on your foreheads. Write them on the door frames of your houses and on your gates.*
> *Deuteronomy 6:4-9*

Writing the commandments in places where you cannot help but see them daily causes you to focus on them. Few employees would forget the values, beliefs and purpose of their firm if they saw them above every door and heard them several times every day. do not truly know the reason the firm exists, could easily begin to work towards goals which could lead the firm to disaster--each employee meaning well, but mis-directed.

Successful TQM firms adopt a strong belief in the internal customer. They believe that the "next in line" has the right to receive materials and service greater than their expectation. This is easier said than done. Supervisors override employee decisions and produce lower quality product in an effort to keep the production line running. Employees, sometimes, do not have the best interests of the next employee (internal customer) in mind. Responsibility and mutual accountability are characteristics of mature employees. Only mature employees attain success in a TQM environment.

Managers are responsible for growing employees. Successful managers in a TQM environment recognize the need for maturity and spend time developing employees to higher levels of maturity. This mentoring process is a high energy, high time commitment. Managers know they must give time now to gain benefits later.

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Continually Seek to Reduce

This ties in to the first lesson on simplicity -- Use As Little As Possible. This goes beyond the job materials and moves to the heart of the business. Reduce physical, emotional, mental and spiritual distances within the firm. Several Japanese firms begin and end their work day with singing and exercise to build unity -- the desired state of this simplicity lesson.

American firms do not adopt this Japanese concept. Many people feel that America is the land of the rugged individualist, and that to show great unity to a group would be to shed our individuality. Yet, unity is considered a virtue in the Church, political parties, and military service. Why is it that when we come into the workplace, we don our badge of diversity and individualistic pride? Loyalty is a by-product of unity. A 1993 Industry Week magazine survey showed more than 96% of the 2,185 respondents consider loyalty an important factor in a company's success or failure, yet an overwhelming number of readers no longer think there is such an implicit or explicit social contract between themselves and their employers.[29] Similar studies in Europe and Australia show the same results. A Columbia University study recorded in Industry Week showed that, in 1989, middle managers in firms that had not experienced heavy layoffs felt a strong loyalty to the firm while those with heavy layoffs were not as loyal.[30] This is apparent on the surface and is brought to light only as a means of saying that loyalty is fragile. When management acts in the best interests of the firm and does not spend the time to ensure that employees also see it as the best for the firm, and thus themselves, trust declines and loyalty declines with it. Reduce the distances between managers and employees and watch the firm improve.

Reduce inventories. This has been covered in JIT, but deserves to be mentioned here again. It is a simple lesson -- learn to work with less materials around you. The simpler the work area, the more work can be done. Firms employing this lesson produce multiple times the amount of goods and services in the same space as competitors. Smaller operations can be strategically located near their customer base, thus yielding shorter response time and greater service to customers.

Automate

Look for ways to cause things to happen automatically. Develop management information systems (MIS) which deliver the desired reports on a set time schedule so people have the information without thinking how to get it. This is not a picture of a mindless set of people unable to think for themselves. What I am trying to paint here is a group of people so intent on thinking about tomorrow that spending time thinking about today seems wasted. Many managers I've met over the years are so busy trying to solve today's problems that they have no time to think about tomorrow. Yet, much of what I see them struggling with could be avoided by better planning for the next few days' work. The resulting improved operation would be smoother, cheaper, more relaxed and would give the manager even more time to think about other tomorrows.

Automate materials ordering

Establish partnerships with your vendors. They should also seek smaller lots, shorter cycle times and smoother operations for you as well. Use computer to computer

ordering systems and establish good monitoring control systems to insure success. Remember that even though you establish automatic ordering and MIS flows, you are still responsible for the operation of your firm.

Automate training

People learn best when they need to learn. Make your training accessible by individuals on an "as-needed" basis. You know, as a student, you want to learn the most just before an exam so you can do well. The secret of learning on the job is to create a continual series of exams where employees must use their learning to be successful. This continual examination requires employees to continually expand their knowledge. Thus, work assignments must be rotated and expanded on a regular basis to give each employee an opportunity to learn more. This "complex-organization" as it is called is nothing more than a simple organization with high growth, empowered people who are able and willing to perform a myriad of functions and handle many responsibilities as needed by the organization.

There are trade-offs in this. Complex organizations create high stress conditions and accompanying high levels of conflict. Employees must be trained to recognize stress and neutralize its debilitating effects and understand conflict and how to deal with it. These areas are subjects for other courses. My intent is to remind you, the student/manager, to learn how to accomplish these people skills early on in your career.

Make learning comfortable and do not let the learning delivery system make the employee feel stupid as they are just trying to get started. I observed an automated learning system in one firm some time ago where the menu system to find a lesson was so complex and frustrating that I felt too stupid to understand the material if I ever did find it. I ultimately gave up and never did complete the lessons. A major goal of learning is to foster a greater desire to learn more. Thus success (success in what?)must occur. Few people, in their right mind, seek failure after failure. Rather, people seek success after each success, therefore you must build success into your training delivery system.

Automate Record Keeping

Establish ways to capture data automatically and avoid handposting. Use bar code readers, automatic data entry at point of sale, telephone data entry systems, modems to receive data from field personnel, and voice input. While not every firm has all these tools available, the technology is rapidly placing them into your hands. Duplicate handling of information is slow, costly and increases errors.

Allow everyone access to this information. The old paradigm of management said that there is power and competitive advantage in information. To hold information is to hold power. To give information to your employees is to give up your power. The new paradigm agrees that there is power in information but give it freely to your employees so that you can magnify the power.

> *Give, and it will be given to you. A good measure, pressed down,*
> *shaken together and running over, will be poured into your lap.*
> *For with the measure you use, it will be measured to you*
> *Luke 6:38*

Give power and your employees will give more power to you by collectively using the information for the greater good of the firm. A caveat here -- this presumes you have mature employees committed to the good of the firm! Bring your employees to a level of trust and commitment and then share all with them.

This brings me to the next lesson in simplicity.

Measure What Is Important To You

Start with your mission statement and ask yourself what should be measured to get you there. Managers have measured the wrong things for decades. For example, I met with a manager and his three supervisors in a medium-sized printing company to discuss their operation. The manager asked me to attend a meeting where they would set out their production objectives for the coming fiscal year.

I asked the manager what they were in business for and was pleased to hear him say: " . . . we are in business to serve our customers and bring glory to God in the process."

"Very good!" I said. "Now what objectives have you considered that would help you meet this?"

"A point, first," responded this manager, "we gathered data in our bindery operation for the past three years and I would like us to do something with it. Does anyone have an idea what we can do with this data?"

There was silence around the table. I asked what data they had gathered. The manager answered, "Times and production data on all the jobs we completed. I thought we might be able to estimate better if we had this material."

I turned to the bindery supervisor and asked if she knew how long it took to do each of the job steps in her department. She answered that she did. I then turned and asked the production planning supervisor if his estimating was accurate for the last year. He showed me a report where his estimates were within 5% of actual for the year and assured me that there was a small variance in the numbers. (Remember that variance tells you how much spread in the data around the mean you have.)

I turned to the manager and asked what data they gathered on customer satisfaction and what data they could show me to indicate the level at which God was pleased with their work.

As you might guess, the manager had none. I told the manager that he was measuring the wrong things. The manager acknowledged this and asked if we could continue. I asked what concerns customers had told them during the past year and what areas of improvement did they recognize as a result of those concerns.

The manager answered quickly, "Last year we set out to improve efficiency and increase productivity. I think we met our goals. This year, I would like us to achieve a 10% increase in productivity again."

I spoke to the manager, "Productivity improvements are great, but they are the result of doing your work better. Remember, it doesn't matter how productive you are if your clients are leaving you and going elsewhere. Remember, several excellent carburetor manufacturers went out of business even though they improved efficiency and productivity. Fuel injection systems made carburetors obsolete. They did not listen to their customers. Now what do your customers say you should do next year?"

Again, as you might guess by now, the manager could not answer.

I turned my attention to the supervisors and began to ask questions about their service to internal and external customers. Which customers seemed the toughest to serve and why? I asked what would happen if they invited representatives from their major accounts to meet with the supervisors at this table to discuss how this printing company might be able to serve key customers better. During this dialogue, each supervisor listed three things that they knew bothered customers. We discussed issues of on-time delivery, packaging, accuracy of production data and the like. Each supervisor believed these problems could be eliminated, or the impact lessened, during the coming year.

This firm's production objectives were unfolding before them and they still needed to talk to the customers. Unfortunately, as I was leaving, I heard the manager say, "Well, this has been a most interesting meeting, we will still have to have some efficiency and productivity goals for next year."

Perhaps I planted a seed in the supervisors' minds.

This short anecdote illustrates that you must measure those things which lead you to your mission statement, customer satisfaction and employee capability. Post the measurements in a chart form for all to see. Let the world know what you are doing.

Let me add a comment to the prior lesson in simplicity. Your competitive advantage comes from people, not information. Old paradigm managers treat their information better than they treat their people. The new paradigm reverses this.

Work As If Working For God

> *Whatever you do, work at it with all your heart, as working for the*
> *Lord, not for men.*
> *-- Colossians 3:23*

This lesson consists of responsibility and responsiveness.

God equipped each of us with skills and abilities so that we might work together to glorify God. Whatever you do, know that you have the ability to bless God by your performance. Some managers, unfortunately, use their skills and gifts as weapons against their employees. A manager who can discern conditions of danger and opportunity in the marketplace should know that not everyone has that gift and thus should not berate an employee who did not recognize the same signs.

The other part of this lesson is responsiveness. When God calls, answer Him.

> *Then the LORD called Samuel. Samuel answered, "Here I am."*
> *-- 1 Samuel 3:4*

This simple verse calls us to respond positively when God calls. This is the crux behind my reluctance for people to make long-range plans for themselves. Companies should make long-range plans because many people can implement them. We must be ready to go when God calls.

An offshoot of this lesson, then, is that you must train someone to take over for you should you know that it is time to leave. When the organization is so lean that you do

not work with subordinates and therefore have no one to train, then leave detail operating notes so someone can perform satisfactorily in your place.

Give Freely

Luke 6:38, quoted above, comes to mind here as well. The law of reciprocity[31] demonstrates the paradox of scripture that every action has an opposite, but not always equal, reaction. "Give and it will be given unto you. . . " Jesus said. He also told us to forgive because as we forgive, so will we be forgiven (Luke 6:37). Give freely of your love to those who work with you in the firm's system. Do not wait until you are asked or until you have received advance payment. Give.

Give of the fruits of your wisdom. Mentor those who are younger and desire to learn. Wisdom is only given by God, but you can demonstrate to those in your care the power of wisdom. Seek wisdom from God and then demonstrate it daily to those whom you train.

Give of your knowledge. Knowledge is power, the more you have, the more you want. Be careful in the pursuit of knowledge. Carefully give your knowledge to those who seek it. Do not hide your knowledge for fear that someone will take it away, for knowledge can never be taken away, only spread among more people.

Give of your time. When someone in the firm needs your assistance, give it. If the present time is not acceptable, then schedule a time when you can satisfy the needs of those around you. Do not put off until tomorrow what you can do to help someone today. Consider the last time you asked for assistance with a project and the person you asked helped you immediately, how did you feel?

Give your praise. Too often the only time your coworkers/ subordinates/employees hear from you is when they do something wrong. When a positive action occurs, step forward and compliment the people involved. Compliment the team as a whole. Do not give praise to one and ask that the recipient share it, give it yourself.

Finally, give your commitment. Managers are too willing to jump ship at the slightest sign of trouble or discomfort. Jesus showed commitment to us. It is this model of servant leadership which you must demonstrate to those with whom you work.

Spend Time Adding Value

American workers spend an inordinate amount of time fixing problems and not contributing to the well being of the company. Hewlett Packard (HP) is an example of a firm seeking ways to increase the amount of time spent in value-added activity. Twenty-two clerks in an HP office where orders were taken by telephone agreed to participate in a work study to determine how much time was spent on value-added or non value-added activity.

Managers in this department set wristwatch alarms to ring every 42 minutes. At the sound of the alarm, three employees were chosen by random method and their activity logged. Three days of data collection netted 130 observations. The activities were grouped by major category and counted. Sixty-five percent of employees' time was spent in non value-added activities such as processsing returns, converting backlog, expediting shipments and checking order status. Only thirty-five percent of

employees' time was spent in value-added work of entering orders, changing orders and taking orders.

Managers and employees worked together, and with the help of the Quality Tools, they tackled the non-value activities and sought their causes so as to remove them.[32]

Lesson Eight - Forecasting and Planning

Objectives

After this lesson, the reader should be able to:

- identify the sources for information regarding forecasting demand

- explain to others the importance of absolute error

- calculate the time to produce a given unit based on the appropriate learning curve model

- calculate the desired amount of perishable material based on the newsboy model

- explain the difference between level employment and chase demand and give examples of both

- produce an MRP or MRPII chart

Key Terms

forecasting

jury of peers

trends

cyclical

seasonality

error

absolute error

aggregate demand

learning curve

Newsboy Model

Level employment

Chase Demand

Materials Requirement Plan (MRP or MRPII)

Introduction

While the marketing managers typically oversee forecasting for the company, operation managers must participate in the process to provide capacity information and look for ways the firm's marketing demand might be met. Forecasting is, at best, an educated guess. Good forecasters, over time, become quite accurate, forecasting sales and production within two to three percent of actual.

Forecasting assists the operations manager to understand raw material and component needs allowing better relationships with suppliers. Suppliers, like friends, do not like surprise demands. An occasional unexpected request should always be accommodated, but repeated cries for help and overstocking indicate a one-sided relationship which is not good for both parties.

Forecasting assists with labor planning. Too few labor hours available leads to missed deliveries. Too many labor hours lead to layoffs and downsizing. Downsizing comes as a shock to many employees and communities because little is said by upper management. Better transition of labor hours out of the firm could occur with accurate forecasting, planning and implementation of labor strategies.

The emphasis of forecasting should always be twofold: (1) improved customer satisfaction and (2) improved operational efficiency.

Simple Types of Forecasting

Forecasting can be as simple as asking what the firm expects. Salesman, production planners, and customers can all give information about future period sales/operation volume.

Jury of Peers

Jury of peers is a technique where you simply ask those people in similar positions as yourself what they think might occur. Your peers include people in similar positions as yourself within the firm as well as those people in similar positions with competing firms.

Expert Testimony

Expert testimony consists of asking your customers or consultants who specialize in forecasting within your industry. Customers are wonderful people full of knowledge and wisdom. They possess a great need for you and your firm to do well. When a supplier-buyer relationship is established, each depends on the other for success.

Call your customers and ask them what they expect their needs to be for the upcoming time periods. Probe with open-ended questions to learn why your customers believe what they believe, especially if several customers answer in similar fashion. What economic, social, demographic, technological events drive their comments.

Consultants earn their fees by helping firms do a better job, or at least, that is how it is supposed to work. My cynicism derives from the practice of many consultants who, unfortunately, fit the old joke that a consultant takes your watch, tells you the time and then sells the watch back to you. Good consultants maintain a strong dynamic base of industry information which can assist in forecasting future sales activity.

Delphi Technique

The Delphi technique is based on the theory: "New information, new decision." This technique works with a jury of your peers or with expert testimony. The Delphi technique works at removing variation in different estimates by assuming that when a person is presented with new information on an issue, they will re-evaluate their prior decision on that issue. The process is simple: (1) ask each member of the forecast panel

to write down a forecast for the period in study, (2) ask each to read the forecast, (3) record the forecast on a flipchart or white board, (4) ask each member to restate the forecast and briefly defend the answer, (5) ask each member to re-calculate a forecast in light of the additional information from other panel members.

Caution About Forecasting

Scripture admonishes those who become too sure of their forecasts:

> *Now listen, you who say, "Today or tomorrow we will go to this or that city, spend a year there, carry on business and make money." Why, you do not even know what will happen tomorrow. What is your life? You are a mist that appears for a little while and then vanishes. Instead, you ought to say, "If it is the Lord's will, we will live and do this or that." As it is, you boast and brag. All such boasting is evil. Anyone, then, who knows the good he ought to do and doesn't do it, sins.*
> *- James 4:13-17*

So, should we forecast? James' advice is to not plan as if we control our destiny. God's plans are superior to ours and we must be prepared to change our plans to meet His. Planning and forecasting should occur under the wisdom of: "As things exist today and as things appear to be in the near future, we can conclude that this is what will happen next, and we will prepare for it with the understanding that we must be ever vigilant and recognize unforeseen changes God may bring our way."

Plan, but plan wisely!

Components of Demand

Historical data assists in predicting future operation level. Good operations managers plot historical data on a variety of charts to gain insight from history to aid future work.

> *History repeats itself, and that's one of the things that's wrong with history.*
> *--Clarence Darrow*

Clarence Darrow is correct that history does repeat itself, and that is the importance of history for the operations manager. Historical graphical displays of operation can show:

Trends - long term shift in value

Cyclical Patterns - long term shifts in value spanning several years

Seasonal Variations - cycles within a year and repeating year to year

Random events either explained - weather, accidents, etc.; or unexplained - no <u>known</u> cause

Examine the graphic below. Section AB shows an upward trend in plant output. Section AC shows cyclical change, and AD shows seasonal variation
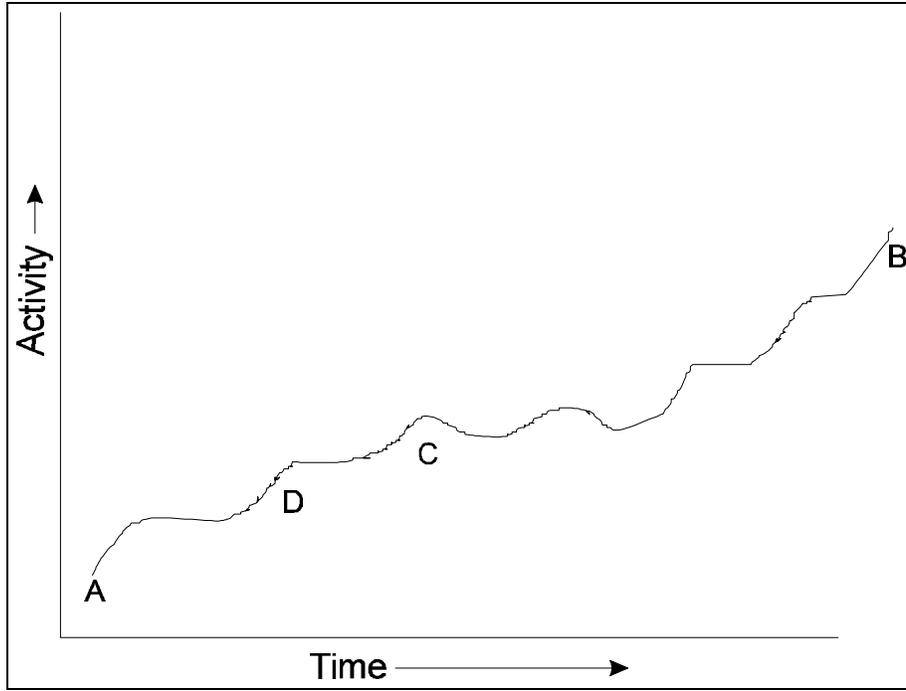
Forecast Error

Forecast error is the difference from planned to actual. Understanding the amount of error in your forecasts is important. Imagine an operations manager for a bolt and nut manufacturer. Demand is forecast and operations planned as the following chart shows:

	Actual	Forecast	Error	Absolute Percent Error	Absolute Error
January	1000	900	100	10.00%	100
February	1200	1320	-120	10.00%	120
March	1300	1230	70	5.38%	70
April	1500	1400	100	6.67%	100
May	1800	1950	-150	8.33%	150
June	1200	950	250	20.83%	250
July	1500	1700	-200	13.33%	200
August	1400	1500	-100	7.14%	100
September	1900	1850	50	2.63%	50
October	2000	2300	-300	15.00%	300
November	1300	1400	-100	7.69%	100
December	1400	1400	0	0.00%	0
Average	1458.33	1491.67	-33.33	9.00%	
Mean absolute error			128.33		
Standard Deviation of the Mean			148.17		

You forecast 1458.33 units of production and actually incurred 1491.67. Seems close, so pat yourself on the back. But look at the absolute error, when you estimated demand higher than actual you could hold the inventory and use it next month.

Imagine you are a food vendor and must make your day's inventory in the morning and sell it until evening. Use the same data and ask whether or not the pat on the back is still deserved.

Every day where actual demand is greater than forecast yields a negative number which implies lost sales. If you do not have the food to sell, you cannot make the sales. Every day where actual demand is less than forecast yields excess food which must be thrown away or given to the local mission.

Now, the error takes on a different meaning. Error on either side of the forecast is bad. That is why we use the column labeled "absolute error." We are interested in total error on either side.

Aggregate vs. Item Demand

We use two terms when discussing demand -- aggregate and item demand. For demonstration purposes, let us use a Mexican food vendor in our food vendor example above. The vendor uses a meat mixture, lettuce, cheese, refried beans and tortillas (both corn and flour) to make all the menu items. Our vendor may also forecast the individual menu items and then calculate the total of all components. After calculating item demand for the individual finished products, the vendor may also determine a total aggregate forecast by combining the individual results.

Another phrase used in demand forecasting is "decomposition of the aggregate," which means the breakdown of the aggregate forecast into the components. Perhaps our Mexican food vendor chops lettuce differently for tacos than for salads. The aggregate demand is used to determine how many heads of lettuce to buy, and the decomposition of the aggregate specifies how much of the lettuce should be cut (or torn, if you are a real lettuce gourmet) for each menu item.

Production Scheduling

What does each pattern of letters below tell you?

<div align="center">

AAAAAAAAAAAA -- BBBBBBBBBBBB

AAAABBBBAAAA

ABABABABABAB

</div>

Take what you just read about demand and forecast error. Think about a manufacturing or service process and see which of the above manufacturing processes offers the best opportunity to meet customer needs and avoid over/under stockage problems.

The first example shows large batch processing. This is a common approach by many firms because of large setup costs and their inability to see how to reduce those costs. The second example shows smaller batches in the process. This can occur when the system accommodates quick turnover. The third example demonstrates a truly flexible manufacturing system which allows for the rapid changeover from one product to another. This last example should be the goal of any manufacturing/service system.

Learning Curve

Each time you perform an activity you can perform it a little faster. When mastered, the decrease in time seems negligible, but still exists. This decrease in production time is referred to as the learning curve.

The graph below shows several learning curves.
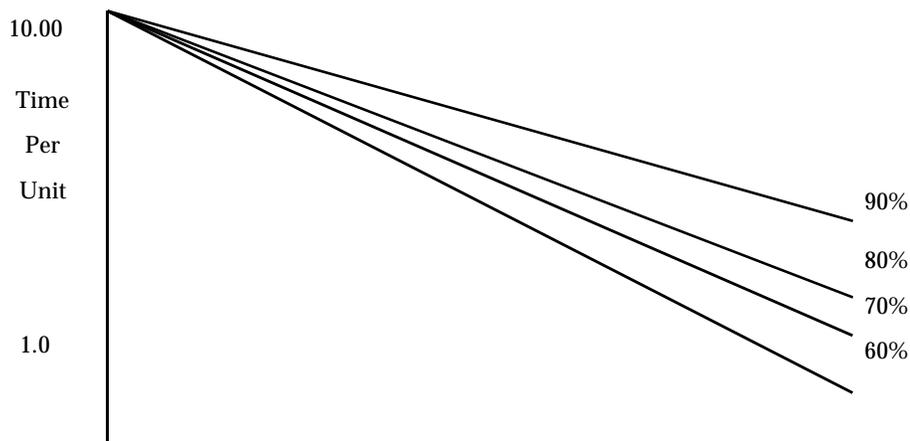
Increasing number of units -->

Every time you double the production number the production time declines by the percentage of the learning curve. The most common is the eighty percent curve. Thus, if the first unit takes 10 hours to make, the second takes 8 hours, the fourth takes 6.4 hours, the eighth takes approximately 4.9 hours, the sixteenth takes 3.3 hours and so on. See that when you begin doubling very high numbers, the impact of each additional production unit does not impact the production time much.

Knowing the learning curve and how it will affect your production schedule is crucial in large scale manufacturing systems like airplanes, mainframe supercomputers and office buildings. Operations managers must plan longer times in the beginning than when everyone is experienced with the process and product.

Capacity Planning

Should the firm plan capacity to "just meet" the forecast customers' demand? The answer to this question lies in the firm's mission and purpose statement. If rapid response and speed of completion is a key variable in the firm's marketing position, then you must have excess capacity. If medium to slow response and low price are cornerstones to the marketing position, then you must plan for slightly less capacity than forecast to insure a steady backorder of production giving the greatest efficiency possible.

Newsboy Model

Returning to our Mexican food vendor example above, a decision must be made if we should plan for over capacity (have extra food each day) or plan for under capacity (lose some business each day but always sell out our stock).

The Newsboy Model can help in the calculations if you are certain you have correct demand numbers. The name "newsboy" comes from the street newspaper sales (usually young boys) of a long-time ago. (Since I was a newsboy in the mid to late 1950s, this model is near and dear to me.) Today, newspapers are sold at newsstands, but the model still holds.

The correct amount of a perishable good is:

$$Amount = \overline{X}_{demand} + F_Q s$$

The equation for the function is:

$$F_Q = \frac{C_U}{C_O + C_U}$$

Where

F_Q = the number of standard deviations from the average historical demand

C_o = overage cost (loss from throwing out inventory)

C_u = loss per item from stocking out (loss from missed sales' gross margin)

Our Mexican food vendor must know the costs of the menu items in addition to their sales price and, (here is the difficult part) the actual demand, regardless of sales. The latter is difficult because when you run out of food, you usually pack up and go home. You must calculate the missed sales that you might have gotten had you brought enough food.

Here is an example to help: (I standardize some of the numbers to make it easier to explain)

Menu item price = $1.00

Menu item cost = $0.45

Co = $0.45

Cu = $1.00 - 0.45 = $0.55

Historical demand averaged $450.00 in sales, or 450 units ($450/$1 per item).

Historical standard deviation = $50, or 50 units ($50/$1 per item).

We calculate:

$$F_Q = \frac{C_u}{C_o + C_u}$$

$$F_Q = \frac{.55}{.45 + .55}$$

$$F_Q = .55$$

This means we should plan for the average of 450 plus (50 x 0.55) or 477 units which translates to $477 in projected sales.

Note: should demand for a day exceed $477.00 you will stock out. Should demand be less than $477.00 you will throw food out. The model gives you the safe target to gain the most and lose the least.

Let me caution again that the key to this is forecasting <u>demand</u>. If you use average sales, the model establishes a declining spiral and you soon plan for zero sales. Why? Because the model always excludes the upper end of the normal distribution curve, thus removing the high demand/sales days and forcing the average lower each time you calculate it.

Level Employment vs. Chase Demand

Labor planning hinges on two key questions (1) are people available and (2) do they have the skills or are the skills easily trainable? Amusement park employees (those cleaning, selling tickets, selling snacks and drinks, waiting tables, running rides) receive their training in a matter of days, or even hours. Summer, a peak season for amusement parks, provides a wealth of temporary employees out of school for the summer and living in the communities near the park.

On the opposite end of the scale we might find an organization like hospitals. Emergency room nurses are not plentiful in the job market and the skills are difficult to teach. Thus, if there is a lull in demand for emergency room services for a few days, nurses are not terminated. It is too difficult to replace them when demand increases.

The first example of employment planning is called chase demand. We "chase demand" with employees. When demand goes up, we hire more people, when demand goes down, we remove people from the payroll. This up and down segment of the firm's workforce is a temporary fringe of people around a central core of people who do not change.

The second example is level employment. We maintain the same number of people. Thus, the operation manager strives to level operation output to match people, (in industries where inventorying can happen). Remember the bolt and nut manufacturer example earlier? The use of inventory allows level employment from month to month. This goes against the JIT philosophy of "make only what you can sell." The blend of level employment and JIT comes in cross training people to use fewer people in the entire plant, but still increase departmental employment when necessary. Thus, staff employees and line employees in departments with low demand move to departments where demand increases. This requires flexible manufacturing facilities to work.

Temporary employees buffer the firm in high demand periods. A hotel may hire several temporary housekeepers to clean rooms and make beds during big conferences and then not employ them between conferences. These temporary employees buffer the core staff from the difficulty of high demand periods.

Material Requirement Plan

Operations managers must plan to have the <u>right</u> materials to the <u>right</u> person at the <u>right</u> time to produce the <u>right</u> good or service -- <u>right</u>. Planning charts help with this. These planning charts called Material Requirements Plans (MRP) show the amount of material and subcomponents and when they were ordered or manufactured. Later, operation managers add employee allocation to the charts and the charts became MRPII charts. The following charts show their use in planning.

The first chart shows the skeleton beginnings of a bicycle shop. The owners of the bicycle shop forecast sales demand in weeks 4, 5, 6, 7, 8, 9, and 10 as 10, 15, 20, 10, 9, 8. and 10 respectively. I intentionally left out weeks 1, 2, 3 to show how the chart builds. I include weeks beyond as well.

A bicycle takes two wheels, one frame, one handlebar, two pedals and one gear system. (There are numerous other small pieces which I leave out to simplify the example.) Look at the following MRP and find the demand line at the top. The chart contains information telling us how much labor is required to make each component.

(Note: Weeks 12 - 16 are not shown on the chart, but do contain estimated demand of 16, 18, 9, 10, and 5 respectfully. These demand amounts drive the release information for weeks 8, 9, 10, and 11.)

Weeks -->	1	2	3	4	5	6	7	8	9	10	11
Bikes					15	20	10	9	8	10	15
Wheel											
frame											
handlebars											
pedals											
gear system											

Component	Lead Time	Labor required
Wheels	1 week	2 hours per wheel
Frame	2 weeks	3 hours
Handlebars	2 weeks	2 hours
Pedals	3 weeks	1 hour per pedal
Gear System	4 weeks	4 hours
Assembly		4 hours per bike

Look at the next chart. The release orders for wheels, frames, handlebars, pedals and gear systems show when each quantity must begin to meet forecasted demand.

This next chart is an MRPII because it includes labor. Look at the row for wheels. Each bike needs two wheels. We forecast demand in week 4 for 10 bikes, thus, we need 20 wheels. It takes one week to produce wheels, so we release the wheel order in week three for week four use.

This MRPII presumes a chase demand for labor and you can see the varying labor needs. Wheels take two hours per wheel to make, so, we "book" 40 hours of labor in week 3 to make wheels. Dividing the labor hours by 40 determines the number of people needed.

Since all the wheels go into production of finished goods in week 4, no wheel inventory exists. The process of releasing orders for components and calculations for labor continue for the entire chart. Study the chart for a minute and trace each component to its targeted demand.

(Note: not all weeks have all data because of the structure of the chart for display purposes.) Total people comes from adding all the component labor and the assembly labor and dividing by 40 hours a week.

	Order Release for chase demand										
	1	2	3	4	5	6	7	8	9	10	11
Bikes					15	20	10	9	8	10	15
Wheel				30	40	20	18	16	20	30	32
frame			15	20	10	9	8	10	15	16	18
handlebars			15	20	10	9	8	10	15	16	18
pedals		30	40	20	18	16	20	30	32	36	18
gear system	15	20	10	9	8	10	15	16	18	9	10
Labor											
Wheel	0	0	0	60	80	40	36	32	40	60	64
frame	0	0	45	60	30	27	24	30	45	48	54
handlebars	0	0	30	40	20	18	16	20	30	32	36
pedals	0	30	40	20	18	16	20	30	32	36	18
gear system	60	80	40	36	32	40	60	64	72	36	40
Assemble	0	0	0	0	60	80	40	36	32	40	60
Total People	**1.5**	**2.8**	**3.9**	**5.4**	**6**	**5.5**	**4.9**	**5.3**	**6.3**	**6.3**	**6.8**

Consider a change to the labor pool. Let's examine the same MRPII but with level employment. The next shows what _might_ happen if we schedule a constant production of components across all weeks. Now we create an inventory of components. Look at the chart and see when material orders release and whether or not you create a stock out situation.

Stocking out (negative inventory) results in missed sales. Since this condition is unacceptable to our bicycle shop owners we must do something different.

(Note: not all weeks have all data because of the structure of the chart for display purposes.)

Order Release for Constant Employment (First Pass Iteration)

	1	2	3	4	5	6	7	8	9	10	11
Bikes					15	20	10	9	8	10	15
Wheel				24	24	24	24	24	24	24	24
frame			12	12	12	12	12	12	12	12	12
handlebars			12	12	12	12	12	12	12	12	12
pedals		24	24	24	24	24	24	24	24	24	24
gear system	12	12	12	12	12	12	12	12	12	12	12
Labor											
Wheel	0	0	0	48	48	48	48	48	48	48	48
frame	0	0	36	36	36	36	36	36	36	36	36
handlebars	0	0	24	24	24	24	24	24	24	24	24
pedals	0	24	24	24	24	24	24	24	24	24	24
gear system	48	48	48	48	48	48	48	48	48	48	48
Assemble	0	0	0	0	60	80	40	36	32	40	60
Total People	1.2	1.8	3.3	4.5	6.0	6.5	5.5	5.4	5.3	5.5	6.0

NOTE: Six people must be employed full-time with no cross training

Inventory of components (adding released orders and subtracting demand
for the affected period)

	1	2	3	4	5	6	7	8	9	10	11
Wheel					-6	-22	-18	-11	-3	1	-5
frame					-3	-11	-9	-6	-2	1	-2
handlebars					-3	-11	-9	-6	-2	1	-2
pedals					-6	-22	-18	-11	-3	1	-5
gear system					-3	-11	-9	-6	-2	1	-2

Using general formulas have taken us as far as we they can now. Next, we must use our knowledge and intuition to adjust final production scheduling. The next MRPII chart shows the changes from the previous chart. We produce more in some periods to generate small amounts of inventory to prevent stocking out in later periods.

(Note: not all weeks have all data because of the structure of the chart for display purposes.)

Order Release for Constant Employment (second pass iteration)

	1	2	3	4	5	6	7	8	9	10	11
Bikes					15	20	10	9	8	10	15
Wheel				35	35	24	24	24	15	20	40
frame			15	20	10	9	12	16	12	15	14
handlebars			15	20	12	12	12	12	13	12	12
pedals		34	36	24	16	16	20	32	32	32	24
gear system	15	22	12	12	8	10	12	12	18	12	12
Labor											
Wheel	0	0	0	70	70	48	48	48	30	40	80
frame	0	0	45	60	30	27	36	48	36	45	42
handlebars	0	0	30	40	24	24	24	24	26	24	24
pedals	0	34	36	24	16	16	20	32	32	32	24
gear system	60	88	48	48	32	40	48	48	72	48	48
Assemble	0	0	0	0	60	80	40	36	32	40	60
Total People	1.5	3.1	4.0	6.1	5.8	5.9	5.4	5.9	5.7	5.7	7.0

NOTE: Six People must be employed full-time with no cross training

Inventory of components adding released orders and subtracting demand for affected period

	1	2	3	4	5	6	7	8	9	10	11
Wheel					5	0	4	10	19	14	4
frame					0	0	0	0	4	10	7
handlebars					0	0	2	5	9	11	9
pedals					4	0	4	2	2	2	4
gear system					0	2	4	7	7	7	4

Lesson Eight Questions

1.	Why do we forecast? Who should be involved in the forecasting process?

2.	When would you use Jury of Peers compared to Expert Opinion?

3.	Give four examples (not found in the text) of chase demand and level employment planning.

4.	When would the Newsboy Model be used?

5.	The Mama's best cookie company makes cookies and sells them in the Atlanta area. Mama has estimated sales during the next four months of 820,000, 1,360,000, 610,000 and 900,000 cookies. During the past 46 day period when there were 100 workers, the company produced 1.7 million cookies. The upcoming four months have 25, 23, 20, and 16 days respectfully. Mama has 100 employees. What is the minimum constant work force required to meet demand over the next four months?

6.	What are the purposes of master planning?

7.	What is forecast error? You are recently hired to fill the role of operations manager in an established company. Why would you want to know forecast error? The president of your firm has just handed you Marketing's forecast of sales and asks you to be ready to support the sales team? What information do you want to receive before setting up a production schedule?

8.	Students, Inc. recently formed to build modular desks for resale. They have never build desks before and believe they can learn as they go. The first desk takes 15 man hours to build. Based on the 80% learning curve theory, how long will it take for the 16th desk to be built? (hint -- think of 1 - 2- 4 - 8 - 16)

Lesson Nine - Set up, Bottlenecks and Lot Sizings

Objectives

After this lesson, the reader should be able to:

- explain what constitutes set up

- demonstrate to others how to reduce set up in all operations

- explain why lot sizes should continual move toward "1"

Key Terms

set-up

Single minute exchange of die (SMED)

lot size

Set-up

Field Container (a frozen ice-cream product carton producer) used TQM techniques to improve setup time. An article in Training Magazine highlights:

> "Employees first attacked the enormous sheet-fed printing presses that dominate the shop floor. These presses cost $300 an hour to run, but must be stopped to change inks [and plates] between each printing run. This process of preparing the press for the next job is called a changeover or make-ready. The printing industry average for make-ready time [for this size press] is an hour and a half per color. So a six-color job would take nine hours to prepare.

> The process teams were taught some cycle-time reduction skills. Then, on their own, they came up with the idea of video-taping a changeover to look for inefficiencies. The result? Make-readies were reduced from nine hours to four hours, all due to workers critiquing themselves on tape. There was no management intervention, no coercive 'suggestions.' The current goal of the process teams is to reduce make-ready time to an hour."

The article goes on to describe the same teams studying another set of presses built to need four hour changeovers and reducing changeover time to one hour.[33]

SMED

SMED (Single Minute Exchange of Die) refers to the ability to changeover any piece of equipment in less than ten minutes. This concept, developed by Shiego Shingo, requires all operations managers to seek ways to improve set up time.

Set-up refers to the time from good production to good production.

"Mr. Shingo, in the fall of 1984, while giving a seminar in Helsinki was approached by Mr. Sarasute, the chairman of the Council of Finnish Machine Industries. Mr. Sarasute disputed the Toyota production system claim that all their setups could be done in less than ten minutes. And, he continued, if it was true the cost must surely be prohibitive.

Mr. Shingo offered to meet him the next morning at a plant of Mr. Sarasute's choosing. They met at the G Safe Company (the name is probably false). Mr. Shingo assembled the engineers and shop foremen. He asked for two dies and had them perform a number of tasks, including:

- Standardizing the die heights

- installing stoppers for centering

- carrying out functional standardization of clamping sites

After the seminar ended at 3 pm the two men and 80 of the attendees returned to G Safe Company and observed the setup of the first new product being carried out and production beginning after only 6 minutes and 28 seconds. This operation previously required and hour and a half. Total cost for materials used in the morning's three steps = $87.00.

Mr. Sarasute during a follow-up session that day asked Mr. Shingo: "In your book you say that 'the Toyota production system wrings water out of towels that are already dry.' Is that really possible?"

Mr. Shingo took Mr. Sarasute through the plant and suggested 10 things that could be improved. The people in the plant told them both: 'We thought we had improved a lot, but everything you've pointed out seems quite reasonable. Clearly, we have to do some more thinking.'"[34]

Bottlenecks

Bottlenecks occur when the flow of goods and services through a system is constrained causing material to backup much like water behind a dam. An offshoot of JIT is the operation of a firm according to the Theory of Constraints. The Theory of Constraints states that production improvement can only occur when the largest bottleneck is identified and removed. What good does it do to improve lesser functions and still constrain the system?

For example, consider a system with six machines adding value to material. Machines 1-4 produce 1000 items an hour, machine 5 produces 800 items per hour and machine 6 produces 1100 items an hour. The system is constrained to operate at no more than 800 items per hour. If machines 1-4 operate at 1000 items per hour, a large work in process (WIP) supply of material accumulates at machine 5.

The Theory of Constraints requires the operation manager, in the example above, to work at improving machine 5. The manager could seek outside sources to assist in converting products coming off of machines 1-4. These machines could run at 1000

units per hour and the extra 1600 units (200 units times eight hours a day) sent to another site for processing. The manager could install a second machine 5 thus giving item capacity of 1600 items per hour at that location. The entire system constraint is 1000 items per hour because of the speed of machines 1-4. A cost benefit analysis requires you to weigh the cost of a second machine 5 to the benefit of producing 200 more items per hour.

Lotsizings

Economic Order Quantity models work with manufacturing as well. Manufacturing replaces the order cost with setup cost. American manufacturing, for the past four decades, looked toward bigger and bigger lots to reduce the impact of setup.

The new paradigm looks toward reducing the setup to reduce the lot sizes. Flexible manufacturing requires small lot sizes for effectiveness. I use a demonstration in the classroom to demonstrate the advantages in small lot sizes. While it is a contrived classroom experience, it demonstrates the concepts of JIT, TQM philosophy.

The demonstration selects seven students as participants: three manufacturing students, a trucker for transportation, a salesperson, a customer and an accountant. Our product consists of a piece of corrugated cardboard sandwiched between two pieces of white index paper with two colored circles on each side. There are three colors available -- red, green and black. The circles appear in different locations on the three varieties. The three manufacturing people operate in separate areas of the plant (we separate the work tables for effect). Each of the three perform a different task. The first collates the three components together and groups them in designated lot sizes, the second tapes the three together into a single piece, and the third colors the circles on both sides using a template.

The simulation presumes a marketing demand forecast of 50% black, 25% green and 25% red for product mix. We start the first round of the simulation with a lot size of 8. We must make 8 red, then 8 green and then 8 black. But since the marketing forecast shows a 2:1:1 ratio, we agree to manufacture a sequence of 8 black, 8 red, 8 black, 8 green, etc. This allows the correct manufacturing supply to meet demand.

The simulation allows the customer to purchase from the salesman from a set time interval. The customer randomly selects a color from an envelope of colored paper (which has the same 2:1:1 ratio of color). Stock outs cost the firm money, WIP costs the firm money and sold goods generate profits.

While I won't tell you the results of the simulation, since it is an in-class exercise, the effects are dramatic. By carefully planning production, increasing customer contact, and cross-training employees we significantly increase production and sales, lower WIP, lower stock outs and increase profits, all the while improving the quality of worklife with fewer employees. The released employees go to work in other parts of the company where expansion calls for more personnel.

The American manager is so geared to see people working frantically and large amounts of product coming off a production line that the concept of producing less is unfathomable to most. We must change our own managerial mindset before we try to change the minds of our employees.

Lesson Ten - Project Management

Objectives

After this lesson, the reader should be able to:

- explain the value of PERT and GANTT charts to the project manager
- create a PERT or GANTT chart given the operation steps

Key Terms

PERT

GANTT

matrix management

Project Management

Project management differs from assembly line manufacturing in that there is a definite beginning and end to each project. Projects vary in scope from a three day job-shop environment such as a small printing company or appliance repair to a ship yard building a nuclear carrier. Typically, we think of project managers dealing with long projects. But, many project environments are short term. Students attending classes participate in project management. A class is a classic project with a definite beginning, end, and milestones.

Project management requires:

- the ability to see the big picture
- an appreciation of detail
- an appreciation for budgets and accounting   constraints
- an ability to see how this project impacts future   projects
- an ability to see the end of the project and   welcome the conclusion with open arms
- an ability to talk with several internal and   external publics at the same time

Traits of project mangers:

- flexibility and adaptability
- preference for significant initiative and   leadership
- aggressiveness, confidence, persuasiveness,   verbal fluency
- ambition, activity, forcefulness
- effectiveness as a communicator and   integrator

- broad scope of personal interests

- poise, enthusiasm, imagination, spontaneity

- able to balance technical solutions with time,   cost and
  human factors

- well organized and disciplined

- a generalist rather than a specialist

- able and willing to devote most of his/her time   to planning
  and controlling

- able to identify problems

- willing to make decisions

- able to maintain a proper balance in the use of   time

Conflict

Conflict is a by-product of project management. Project managers typically take control of the project after other line officers complete preliminary phases, such as marketing, sales, etc. Often, time is used by these preliminary departments leaving the project manager behind schedule before he, or she, even begins. During the project communication becomes critical. Mis-communication about start and end dates, budget adjustments, personnel, and technical changes create nightmares for project managers and the people he, or she, employs.

Conflict resolution requires the project manager to continually monitor the stress levels of the project team and the external publics. The project manager must act quickly when conflict surfaces. Most conflict in a project revolves around resources and control of sub-projects. Procedures and policies must exist as a framework to resolve conflict. Policies in a project environment must not be stiff and stifling. Policies must guide rather than determine action. Clear levels of authority must exist for each sub-project manager providing a simple understanding of who to report to during each project phase.

Conflict resolution begins with a clear understanding of the nature of conflict, such as whether or not the conflict is philosophical (how something should be done) or factual (interpretation of the policies or allocation of resources). Following this, the parties must agree on the process by which the parties will resolve conflict. Unions call this the grievance procedure. Unlike unions, project management must resolve conflict quickly. Last, there must be a high level of maturity among all project members to accept the outcome and continue with the project. Hurt feelings and a sense of retaliation destroy projects.

Project management requires the use of matrix management. Matrix management is the foundation of self-improvement and cross-functional teams.

Matrix Management

Matrix management is an ad-hoc grouping of key personnel from several functional areas temporarily assigned to a project manager. These personnel still report to their

functional managers for general work concerns but must perform daily work assignments to the satisfaction of the project manager.

> *No one can serve two masters. Either he will hate the one and love*
> *the other, or he will be devoted to the one and despise the other.*
> *You cannot serve both God and Money.*
> *Matthew 6:24*

Man cannot serve two masters. Conflict is bound to result. Matrix management requires maturity of functional managers to assign and then let go of the people who work for them. Functional managers must be careful not to place their employees in a position of choosing between functional and project managers.

Self improvement teams and cross function teams looking at processes epitomize matrix management. People from various walks of life within the firm come together to make improvements or solve problems. With their task complete, they move back to their functional areas resuming prior activities.

PERT/CPM

PERT stands for Program Evaluation and Review Technique. CPM stands for Critical Path Method. The two systems, although developed separately, have many similar features and today are blended together by most people.

A project consists of tens, hundreds or thousands of individual steps. Many are dependent on other steps, some are independent. Charting the flow of the project with a PERT/CPM diagram allows the manager to graphically see the relationships of the elements, one to another. It shows which steps are critical to the successful completion of the project in order that it remain on schedule. Grouping of several steps or tasks yield sub projects which may need additional care and supervision.

PERT diagrams contain only one start and one end. All activity at an event must wait until all succedent activity is complete. If activity can be started prior, it represents a separate succedent.

The longest time of each path adds up to the critical path. Those paths whose total time is less than the critical path are said to have slack time. If these paths take longer because of some delay, it will not slow down the overall project.

For an example, let's build a house. If you are a contractor, please forgive the obvious flaws in this simple example. This example begins after the foundation slab sets.

Activity	Description	Length (in days)
A	Frame walls	2
B	exterior plywood and moisture seal	3
C	run electrical	3
D	insulate	4
E	sheetrock	3
F	frame roof	3
G	roofing material applied	4
H	install plumbing fixtures	1
I	tile bathrooms	2
J	pour driveway	2

K	install windows	2
L	carpeting	1
M	paint	3
N	landscape	4
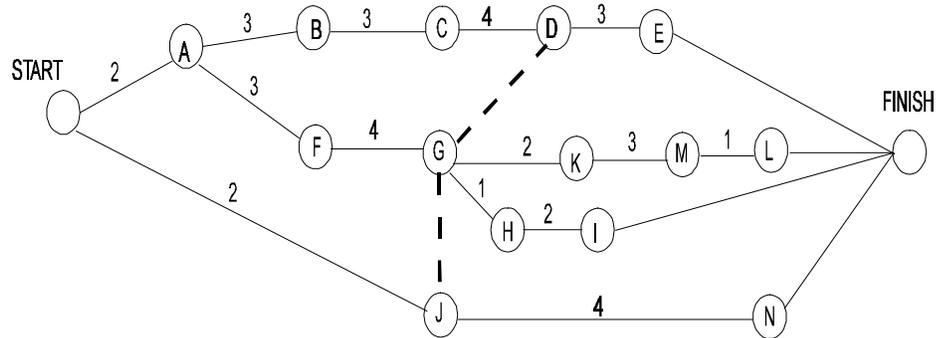
Look at the diagram. The dashed lines in the PERT diagram represent dummy activities. This implies that one activity cannot begin until the other is complete. The activity "J" cannot begin until the activity "G" is complete. Likewise, the activity "G" cannot begin until the activity "D" is complete. Thus, the length of time for a path with "G" in it must include the longer of "A-B-C" or "A-F." Here, "A-B-C" is the longer. The critical path then is "A-F-G-K-M-L" which is 18 days. Note, I included the length of "A-B-C" in calculating the critical path.

Since "A-F" takes 5 days and "A-B-C-D" takes 12 days. "A-F" is said to possess 7 days of "slack." Slack is the amount of time which a path can be delayed without increasing the total length of the project.

GANTT

GANTT is a bar chart of activity times. It provides a graphical expression of how long each component takes and the total project.

Unlike the PERT/CPM diagram, you are not able to see the interrelation. It does give a better appreciation for the time span. Better understanding of the project comes from using BOTH PERT and GANTT to graphically depict the project. Below is the GANTT chart for the same project for which we drew the PERT diagram.

Activity	2	4	6	8	10	12	14	16	18	20
Frame walls	___									
exterior		___	_							
run electrical				___	_					
insulate					__	___	__			
sheetrock							__	___		
frame roof		_ __	_							
roofing			_ __	___						
install fix.					__					
tile bath					_	_				
driveway					___					
windows								__	_	
carpeting										_
paint									___	__
landscape					___	___				

Financial Considerations

A key element in TQM and JIT philosophy is measuring what is important. When tracking WIP time it helps to establish financial measures tied to WIP. Financial allocation of overhead is important as outsourcing and vendor-partnering occurs.

Take the following as an example:

```
Item A
high tech component          300.00
low tech parts               100.00
time in shop     1.00 day (no queue time)
Labor @ 20/hour         160.00
                             560.00
```

```
Item B
Low tech parts               200.00
time in shop     5.00 days (3 days queue time)
Labor @ 10/hour         160.00
                             360.00
```

Accounting has determined a 1:4 ratio of direct to indirect costs in your company. Therefore, you must add 4 times your direct cost in order to absorb your "fair" share of overhead.

Therefore, our Item A carries an overhead burden of $2,240.00. Item B carries an overhead burden of $1,440.00. If the market sales price is $2000 each, what is the logical outcome of demand and what will happen to WIP, cost of carrying, MIS cost, etc.?

Consider the same set of items but allocating overhead based on the throughput time. Our mythical company has determined that overhead is really a function of the length of stay -- the "motel allocation method." Our company has determined that this week's output will equal some 5000 units and overhead equals $10,000,000 for the

week -- rent, heat, lights, indirect cost payroll and benefits, WIP handling equipment, damage, reworks, etc. Therefore, overhead equals (10,000,000 ∕ 5000) ∕ (5) days = $400 dollars per unit per WIP day.

Now our item A carries an overhead burden of $400.00 and a total cost of $960.00, while Item B carries an overhead burden cost of $2,000.00 and a total cost of $2,360.00. With a sales price of $2000, what will be the expected high and low sales items? What will happen to WIP, cost of goods sold, number of units sold per day and change in overhead (remember to analyze overhead as to its components listed above)?

The objective of a cost management system is to measure the cost of resources consumed in performing significant activities of the business. Reporting must be sufficient to satisfy internal and external requirements, such as making strategic business decisions, planning and controlling routine operations, and determining income and financial position.

The cost of non-value-added production and support activities should be identified to provide the visibility and basis for their reduction and elimination. Holding assets (like inventory) represents important non-value-added costs. These assets must be financed with internal cash or external debt. The cost can be calculated as an imputed cost for management reporting purposes.

The usefulness of cost information is directly related to the accurate traceability of the costs to management reporting objectives. The intent is to capture them directly to the projects, processes and products that use them . Accurate direct traceability demands that all fixed and variable costs be assigned. Separating costs into fixed and variable components is not meaningful for routine decisions. This becomes easier as JIT allows more staff functions to decentralize and move to the outlying departments. Cross-training allows people to handle multiple activities which were previously handled in a central office. Significant activities can be identified and separated by the organizational units that perform them. The same activity may be performed in several cost centers, but the activity transactions will be collected once for the individual cost center performing the work.

A company should measure the progress in meeting established target costs. This feedback is critical if a company expects to reduce cost over the period allotted to achieve the target cost.

The objectives of performance measurement are (1) to measure how well business activities are being performed in relation to specific goals and objectives developed in the strategic planning process, and (2) to support elimination of waste. A company requires both financial and non financial information to measure performance. The information must be consistent if it is to be meaningful. In other words, performance improvement (such as reduced lead times) should be understandable in financial terms. To reach the desired performance measurement objectives, the following principles have been identified.

Performance measures should provide the link between the activities of the business and the strategic planning process. Measures should be consistent with stated business objectives and should consider both internal and external factors required to achieve these objectives. The axiom "you get what you measure" should be remembered. The performance measures established should be totally within the accountability of the person performing the activity. The measures should cover the span of responsibility of the activity and should not overlap the responsibilities of others.

Measures should be few, quantifiable and easy to understand. Measures should be defined and expressed in relevant units of measure. Many measurements are best expressed as physical terms (e.g. time, transactions), however, these measures should be capable of being converted to financial terms.

It is difficult for managers that have been taught to use traditional accounting principles to measure performance to change to new concepts.

Lesson Ten Questions

1.   Construct a network for this project. Label the critical path. What activities
          will have to be completed by day 60 to guarantee the project will not be
          delayed. Analyze the diagram and give pertinent comments about what it
          tells you.
          You have been asked to coordinate and plan the production for a high
          quality annual book for the school of business here at Regent University. You
          have determined that there are seven activities involved. The activities, the
          production times and the predecessors are listed below.

Activity	time (days)	Immediate predecessors
A	32	---
B	21	---
C	30	---
D	45	A
E	26	A,B
F	28	C
G	20	E,F

Lesson Eleven - Continual Improvement: a Strategic Decision

Objectives

After this lesson, the reader should be able to:

- explain the concept of Kaizen

- explain the key issues in joint ventures

- explain what a "Learning Organization" is

Key Terms

Kaizen

learning organization

Continual Improvement

Kaizen is a Japanese word implying continual and gradual improvement. It has become a synonym for the total management approach introduced in this course. A book by the title *Kaizen*, written by Masaaki Imai, is an excellent reference to see how this philosophy is pulled together into general management.

In Kaizen, top management should:

- Adopt and support the concept of Kaizen

- Establish policies for cross functional goals

- Build the systems which support continual improvement

In Kaizen, middle management should:

- Implement the concept of Kaizen as directed by top management

- Establish controls to insure the policies for cross functional goals are realized and improved

- Establish training programs to insure that all employees are trained in the tools and understanding of Kaizen including problem solving

In Kaizen, supervisors should:

- Employ Kaizen concepts in all activities

- Establish and improve constantly the communication among all employees, cross functional supervisors and upper management

- Encourage and sustain the concept of suggestions

In Kaizen, workers should:

- Participate in small group improvement teams
- Demonstrate discipline in their daily duties and functions
- Improve problem skills in practice and simulation
- Engage in continual training and retraining
- Provide suggestions for improvement to upper management

Kaizen refers to three Japanese words: Muda (waste), Muri (strain), and Mura (discrepancy). These three words represent areas of poor management that drain a system of its strength.

Kaizen looks at problem solving in the four traditional areas: Man, Machine, Material and Method. The following is a list of questions posed by Masaaki Imai in *Kaizen*.

Man:

- Does he follow all instructions and procedures?
- Is he qualified?
- Is he quality-conscious?
- Is he teachable?
- Is he physically and mentally well?
- Is he relocatable to another task?

Machine:

- Does it meet production needs and requirements?
- Can it maintain an acceptable C_{pk}?
- Is maintenance adequate?
- Have inspections been made as scheduled and recorded?
- Is it stopped because of mechanical error or quality level?
- Is this machine part of a bottleneck?

Material:

- Is volume and grade correct?
- Is incoming quality at or above specified limit?
- Is incoming quality variation within tolerance?
- Is handling equipment satisfactory?
- Is arrival timing adequate?
- Is positioning of material at the work site correct?

Method (Operations):

- Are work standards posted, accessible and adequate?

- Are working conditions safe, clean and improvement oriented?

- Are waste, strain and discrepancy removed?

- Has setup been reduced to lowest perceived level?

- Can setup be reduced further and are efforts under way?

- Is communication between departments adequate?

Problem Solving -- the five W's and one H

Who	What	Where	When	Why	How
Who is doing it?	What is being done?	Where is it done?	When is it done?	Why do it?	How is it done?
Who should be doing it?	What should be done?	Where should it happen?	When should it happen?	Why should it happen there?	How should it be done?
Who else can do it?	What else can be done?	Where else can it be done?	When is another time it could be done?	Why do it then?	How else could it be done?

Kaizen offers four principles (each starting with "S" in Japanese). *Seiri*, meaning to straighten up. This includes work in process, tools, machines, documentation, and scrap. *Seiton*, meaning to put things in order. The adage of "everything has a place and everything in its place" fits here. Hours are wasted in Western plants because tools and records are not in the place where they should be for rapid retrieval. *Seiso*, meaning to clean up, applies to workplace, tools, machines, and charts. *Seiketsu*, meaning personal cleanliness, refers to being neat and tidy, removing spills and not wearing loose clothing. *Shitsuke,* meaning discipline, is necessary in following procedures and instructions so each step is identical to the part ahead of it. If variation in process occurs, process problems cannot be solved. Suggestions and improvements should be decided upon and agreed to by the group. Individualism is reduced.

Organizational Learning

This text concludes with a section which could be a book unto itself. Much is already written about organizational learning. I recommend you read Peter Senge's book, *The Fifth Discipline,* and many of the journal articles on organizational learning, organizational culture and organizational change.

Organizational learning involves the shared insights and new knowledge gained by people in the organization. These insights and shared bits of knowledge help to bring about paradigm shifts through the continual realization of anomalies in old paradigms and new problems unlovable by current thinking. The old adage "new information -- new decisions," applies to organizational learning.

Organizational learning fuels change by showing the people of the organization what could be and by showing how improvement helps to reach new goals. Collective cognition (no, I am not approaching the New Age thinking here, but recognizing that each person in the organization is created by God with God's gifts and talents) offers a greater whole than what can be created by a few key managers. Putting our minds

together to learn new organizational lessons is an exciting opportunity derived from TQM.

Organizational learning interacts with organizational cultures (the accepted norms and values shared, or accepted, by the organizational inhabitants). Learning occurs only when the culture accepts and encourages change and growth. Complex organizations find it harder to change because of the myriad networks of relationships among the firm's employees. Yet, change can occur if the senior management team encourages and embraces change.

As a close and an introduction to an article that I request you locate and read, allow me to quote from Fred Kofman and Peter Senge's Organizational Dynamics, Autumn, 1993 article "Communities of Commitment: The Heart of Learning Organizations:"

> "We believe a learning organization must be grounded in three foundations (1) a culture based on transcendent human values of love, wonder, humility, and compassion; (2) a set of practices for generative conversation and coordinated action; and (3) a capacity to see and work with the flow of life as a system.
>
> In learning organizations, cultural norms defy our business tradition. Acceptance of the other as a legitimate being -- a Thou -- (our meaning of love), replaces the traditional will to homogeneity. The ever-surprising manifestations of the world show up as opportunities to grow, as opposed to frustrating breakdowns for which somebody must take the blame (wonder). People understand that life is not condensable, that any model is an operational simplification always ready for improvement (humility). And when they encounter behaviors that they neither understand nor condone, people are able to appreciate that such actions arise from viewpoints and forces that are, in some sense, as valid as the viewpoints and forces that influence their own behaviors (compassion).
>
> Learning organizations are spaces for generative conversations and concerted action. In them, language functions as a device for connection, invention, and coordination. People can talk from their hearts and connect with one another in the spirit of dialogue (from the Greek *dia + logos* -- moving through). Their dialogue weaves a common ongoing fabric and connects them at a deep level of being. When people talk and listen to each other this way, they create a field of alignment that produces tremendous power to invent new realities in conversation, and to bring about these new realities in action. (page 16)

Take time to locate and read the entire article.

In all things, continually improve.

Appendix

Terms

Aggregate demand -- the need for a group of similar products or services comprising the line by consumers (collectively). The importance of aggregate vs. product demand is to ascertain what adjustment of production schedules and supply planning will be necessary. Example -- cookie manufacturer.

Automation - replacement of human activities with machines.

Backward integration -- defines the steps necessary for a company to manufacture the components it once bought. This may mean setting up an operation or buying an existing one.

Backward scheduling - scheduling the start of a task based on when it must be finished.

Break even analysis -- D = Fixed cost / (price - variable cost) show example. This is used in marketing to learn at what sales level and at what price the item/service will return a profit to the company.

In operations management it is combined with another formula to determine at what level it is better to make or buy a component. Be careful that all costs are included in each of the formula.
To buy has a cost of price x units.
Combine the two formula and solve for demand:
$TC_{buy} = P \times D$
$TC_{make} = (VC \times D) + FC$
$P \times D = (VC \times D) + FC$
Derives to $D = FC / (P - VC)$

Business units -- a nearly autonomous group within a company. The BU will have its own marketing, finance and other staff departments. The head of the BU will report to the company president. In organizations with many BU's there is a group president who reports to the chairman. *In Search of Excellence* (an overrated book, even stated so by the author) had one clear message: Small company approach within a large company environment provides a fertile ground for success. The BU is an attempt at creating a smaller company within a company. The ability to react quickly and stay close to the heart of the consumer is critical.

Capacity -- the amount of product or service which can be produced in a plant given a set amount of resources such as people, materials and machinery.

Capacity planning -- the process of adjusting the amount of people, materials and machinery to meet expected levels of product/service demand.

Cell -- a combination of workers who are linked machine to machine or hand to hand in the production of a product or service. Example -- Adam's school. Room assignments by type of course. Problem in item flow. Change to quads.

Chase demand -- keeps production variable based on demand. Inventory levels are low but setup and labor changes are high.

Consumer -- the final customer. One who uses (disposes) of the product or service.

Continuous or repetitive - batch -- a type of production or service where the products are uniform each to each or group to group.

Customer - Simply put, the next process in the flow. Traditionally, we see the customer as the consumer, the final disposition of the product or service. This has produced an ambivalence among employees toward the next process. Extensive work in process and rework departments have exacerbated the condition. This philosophy sees the customer as the next link in the chain of producing a good or service.

Distinctive competency -- sometimes called Unique Selling Proposition. This is relative to the market niche. From an operations view, it is the specific skills and abilities possessed by the firm which allows it to create products and services better than its competitors. The term better is difficult to work with. Better may imply more attractive to consumers, stronger, etc.

External Failure -- the reject or failure of a finished good or manufactured component by the distributor or consumer. This results in warranty cost and lost consumer goodwill.

Finished goods inventory -- complete items with all value-added complete waiting for shipping off to distributors, retailers or consumers.

Flexible manufacturing Cell -- the use of the same cell, equipment, and components to produce a family of products with variable demand. This approaches N=1 mentality.

Focused factories -- plants dedicated to producing just one model or one product or product family.

Internal Failure -- the rejection or failure of a finished good or manufactured component while it is still within the company and before it is shipped to the distributor or consumer.

Inventory turnover = T = $\dfrac{\text{Cost of Goods Sold (annual)}}{\text{Average inventory value.}}$
Industries measure inventory turn in numbers of times the average inventory is turned (i.e. 4 times a year).

Irregular -- to schedule a plant to produce an item in specific quantities, then change over to another item. Quantities are set high enough to meet EOQ formulas such as AAAABBCCCCABBBCCCBBBBA.

Jobs - small unique products or services with similar components. Items may use the same components in unique patterns. Require little advance planning and extreme flexibility.

Learning curve -- the process of adapting to a new operation. 80/20 rule states that doubling the time results in the process taking only 20% as much (20% as much what?)as the previous.

Level capacity -- keeps the production smooth at some level and allows demand to vary. This produces higher finished goods inventory and reduces setup and labor.

Line vs. Staff -- Line should include those people directly responsible for generating the goods and services characteristically placed within the group. For example, in a restaurant, Line would include the head chef, assistant chefs who prepare parts of the meal, the waiter(waitresses) and bus boys. Staff would include the advertising people, accountants etc. It is true that the advertising people are essential as are the accountants. Finance has line authority with regard to investment, accounting information systems, etc. Staff are seen as providing information and support necessary for line people to make decisions regarding the product or service.

Mass production -- usually continuous or repetitive production.

Master Schedule -- also called the Master product Schedule or the Master Resource Capacity Plan; it is the "final" plan representing what the company plans to produce/service expressed in specific configurations, quantities and dates.

Mixed model -- a pull schedule for a plant in which it closely approaches synchronized scheduling.

Model - any graphic representation of how a process operates. We will use models to depict how a production process operates.

Operation - a single step or task in a job.

Organization -- use a five star shape, as opposed to the traditional rake style. The five points should be: operations, finance, marketing, legal and human relations management.

Ownership - this is opposed to the Taylor view of work. Taylor viewed work as the responsibility of management. This philosophy views work as the responsibility of the worker.

Process ownership -- Under Taylorism, the employee has no ownership of what goes on around him. Thus we saw the influx of time and motion study personnel, quality inspectors, and accountants. The transfer of ownership to the production employee is a difficult step for many companies, it requires extensive training and retraining. It also requires unity and a strong vision keeper (usually the CEO).

Processing -- definition?

Product demand -- the need for a given product or service within a line by the consumer.

Product ownership - rarely does one employee create the entire product. Examples - insurance policy, ministry, toaster, computer. By placing ownership of product or service with the employee, we have established an environment of continual improvement. Not even the process will be considered to be sacred.

Production lines -- Assembly or creation process for service where a fixed part of a plant or operation is dedicated to one item or service. There may be several lines within a plant. Each line is dedicated to one item.

Production plan -- a first pass attempt at scheduling the resources and the output to see if demand can be met.

Productivity -- the ratio of inputs to outputs. How much went in compared to how much went out.

Projects -- Large scale single items, such as buildings; require extensive planning and scaling.

Quality --a state of existence. It is an evolving condition. It is dynamic and ever changing. There are numerous considerations and measurements of quality. I prefer the definition of quality as: "Giving the customer slightly more than expected." The customer defines quality by his, or her, expectations.

Kaoru Ishikawa, in his book *What is Total Quality Control -- The Japanese Way*; on page 44 cites the Japanese Industrial Standards definition quality control as:

"A system of production methods which economically produces quality goods or services meeting the requirements of consumers. Modern quality control utilizes statistical methods and is often called statistical quality control."

Contrast this to Ishikawa's definition of quality control:

"To practice quality control is to develop, design, produce and service a quality product which is most economical, most useful and always satisfactory to the consumer."

Quality Circles (QC) and Small group improvement activities (SGIA) -- small groups or project teams formed to seek solutions to perceived problems in quality and process. They are ad-hoc; consist of people from several areas within a company and many times include vendors and clients.

Quality control and correction -- usually the first aspect of process ownership to be transferred. Followed by WIP control. Process ownership projects an image onto the employee that the process itself is the important aspect. A better option is product ownership.

Raw material inventory -- those components which will be used and have value added to them. They are traditionally in the same state as they were when they arrived from the supplier.

Repetitive -- schedule a plant to rhythmically produce quantities of several items in a set proportion which will meet demand, such as AAABCAAABCAAABC.

Resource requirements planning -- deals with forecasting the needed amount of people, materials and machinery.

Setup -- the total time to convert a machine, cell, line, etc. from good product to good product. This will be crucial to the total implementation of this philosophy.

Staffing off -- Traditionally, staff has received greater and greater power over line positions. (Another impact of Taylorism.) This is seen as the emerging bureaucracy of organizations. It is wrong for accounting departments to dictate when and how operations managers and workers will spend allocated funds and how costs of overhead will be shared among products. We will examine this in more detail later.

This philosophy states that staff positions should be servants to the line departments providing the material and information asked for and not

interfering. This means HRM departments should provide benefit assistance to employees, assist with legal advice and provide updated information to line mangers about changing laws.

Standardization -- the process of reducing the many to a few. It applies to parts, departments, vendors, lines, cells, etc.

Strategic Triangle -- from the writings of Ohmae. Ohmae has been called a global leader in corporate strategy. He heads the Japanese office of McKinsey. The triangle consists of Corporation, customers and competitors. (What's the purpose of the triangle? What's it used to show?)

Synchronized scheduling -- The ideal is to balance operations such that we make an item, deliver an item and use an item.

Throughput time -- the length of time necessary for raw material to have value added and reach the consumer, distributor or retailer.

Tolerance -- the amount of variation acceptable.

Tolerance stackup -- the cumulative effect of tolerance for many components within an item.

Value added -- the process of taking a resource (product, component, raw material, or service) and adding value for which a consumer will pay and a customer will accept.

Variation -- the difference of a product or service's features from the expected performance level. This may be measured in dimension such as size, volume, time, etc. or in standard deviation's or sigma's.

Work in process inventory -- raw materials which are in the process of having value added to them and are not complete. They may be being worked on at the moment or waiting for the next step.

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TABLE 1 Normal Curve Probabilities
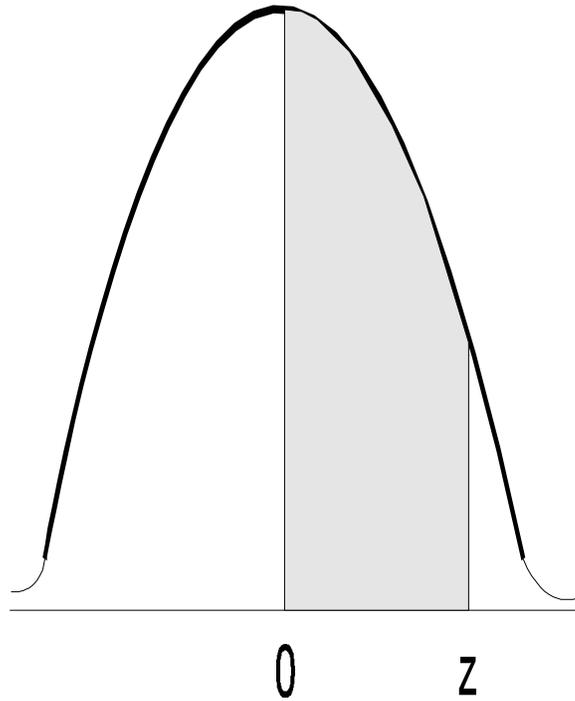
z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0753
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.2019	.2054	.2088	.2123	.2157	.2190	.2224
0.6	.2257	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2517	.2549
0.7	.2580	.2611	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2995	.3023	.3051	.3078	.3106	.3133
0.9	.3159	.3186	.3212	.3238	.3264	.3298	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3487	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952

2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4977	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4983	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4988	.4988	.4988	.4989	.4989	.4989	.4990	.4990

TABLE 2 Control Chart Constants

Subgroup Size, n	A_2	A_3	A_6	B_3	B_4	C_4	d_2	d_3	d_4	D_3	D_4	D_5	D_6	E_2
2	1.880	2.659		0.000	3.267	0.7979	1.128	0.853	0.954	0.000	3.267	0.000	3.865	2.660
3	1.023	1.954	1.187	0.000	2.568	0.8862	1.693	0.888	1.588	0.000	2.574	0.000	2.745	1.772
4	0.729	1.628		0.000	2.266	0.9213	2.059	0.880	1.978	0.000	2.282	0.000	2.375	1.457
5	0.577	1.427	0.691	0.000	2.089	0.9400	2.326	0.864	2.257	0.000	2.114	0.000	2.179	1.290
6	0.483	1.287		0.030	1.970	0.9515	2.534	0.848	2.472	0.000	2.004	0.000	2.055	1.184
7	0.419	1.182	0.509	0.118	1.882	0.9594	2.704	0.833	2.645	0.076	1.924	0.078	1.967	1.109
8	0.373	1.099		0.185	1.815	0.9650	2.847	0.820	2.791	0.136	1.864	0.139	1.901	1.054
9	0.337	1.032	0.412	0.239	1.761	0.9693	2.970	0.808	2.915	0.184	1.816	0.187	1.850	1.010
10	0.308	0.975		0.284	1.716	0.9727	3.078	0.797	3.024	0.223	1.777	0.227	1.809	0.975
11	0.285	0.927	0.350	0.321	1.679	0.9754	3.173	0.787	3.121	0.256	1.744			
12	0.266	0.886		0.354	1.646	0.9776	3.258	0.778	3.207	0.283	1.717			
13	0.249	0.850		0.382	1.618	0.9794	3.336	0.770	3.285	0.307	1.693			
14	0.235	0.817		0.406	1.594	0.9810	3.407	0.762	3.356	0.328	1.672			
15	0.223	0.789		0.428	1.572	0.9823	3.472	0.755	3.422	0.347	1.653			
16	0.212	0.763		0.448	1.552	0.9835	3.532	0.749	3.482	0.363	1.637			
17	0.203	0.739		0.466	1.534	0.9845	3.588	0.743	3.538	0.378	1.622			
18	0.194	0.718		0.482	1.518	0.9854	3.640	0.738	3.591	0.391	1.608			
19	0.187	0.698		0.497	1.503	0.9862	3.689	0.733	3.640	0.403	1.597			
20	0.180	0.680		0.510	1.490	0.9869	3.735	0.729	3.686	0.415	1.585			
21	0.173	0.663		0.523	1.477	0.9876	3.778	0.724	3.730	0.425	1.575			
22	0.167	0.647		0.534	1.466	0.9882	3.819	0.720	3.771	0.434	1.566			
23	0.162	0.633		0.545	1.455	0.9887	3.858	0.716	3.811	0.443	1.557			
24	0.157	0.619		0.555	1.445	0.9892	3.895	0.712	3.847	0.451	1.548			
25	0.153	0.606		0.565	1.435	0.9896	3.931	0.709	3.883	0.459	1.541			
> 25	$3/\sqrt{n}$			$1 - 3/\sqrt{2n}$	$1 + 3/\sqrt{2n}$									

TABLE 3 Orthogonal Arrays L_4, L_8, L_{12} and L_{16} (2-level) and L_9, L_{18} and L_{27} (3-level)

Table 3a - L_4 (2^3)

Column

Condition	1	2	3
1	1	1	1
2	1	2	2
3	2	1	2
4	2	2	1

Table 3b - L_8 (2^7)

Column

Cond	1	2	3	4	5	6	7
1	1	1	1	1	1	1	1
2	1	1	1	2	2	2	2
3	1	2	2	1	1	2	2
4	1	2	2	2	2	1	1
5	2	1	2	1	2	1	2
6	2	1	2	2	1	2	1
7	2	2	1	1	2	2	1
8	2	2	1	2	1	1	2

Table 3c - L_{12} (2^{11})

Column

No.	1	2	3	4	5	6	7	8	9	10	11
1	1	1	1	1	1	1	1	1	1	1	1
2	1	1	1	1	1	2	2	2	2	2	2
3	1	1	2	2	2	1	1	1	2	2	2
4	1	2	1	2	2	1	2	2	1	1	2
5	1	2	2	1	2	2	1	2	1	2	1
6	1	2	2	2	1	2	2	1	2	1	1
7	2	1	2	2	1	1	2	2	1	2	1
8	2	1	2	1	2	2	2	1	1	1	2
9	2	1	1	2	2	2	1	2	2	1	1
10	2	2	2	1	1	1	1	2	2	1	2
11	2	2	1	2	1	2	1	1	1	2	2
12	2	2	1	1	2	1	1	2	2	2	1

Table 3d - $L_{16} (2^{15})$

Column

No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
3	1	1	1	2	2	2	2	1	1	1	1	2	2	2	2
4	1	1	1	2	2	2	2	2	2	2	2	1	1	1	1
5	1	2	2	1	1	2	2	1	1	2	2	1	1	2	2
6	1	2	2	1	1	2	2	2	2	1	1	2	2	1	1
7	1	2	2	2	2	1	1	1	1	2	2	2	2	1	1
8	1	2	2	2	2	1	1	2	2	1	1	1	1	2	2
9	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
10	2	1	2	1	2	1	2	2	1	2	1	2	1	2	1
11	2	1	2	2	1	2	1	1	2	1	2	2	1	2	1
12	2	1	2	2	1	2	1	2	1	2	1	1	2	1	2
13	2	2	1	1	2	2	1	1	2	2	1	1	2	2	1
14	2	2	1	1	2	2	1	2	1	1	2	2	1	1	2
15	2	2	1	2	1	1	2	1	2	2	1	2	1	1	2
16	2	2	1	2	1	1	2	2	1	1	2	1	2	2	1

Table 3e - $L_9 (3^4)$

Column

Condition	1	2	3	4
1	1	1	1	1
2	1	2	2	2
3	1	3	3	3
4	2	1	2	3
5	2	2	3	1
6	2	3	1	2
7	3	1	3	2
8	3	2	1	3
9	3	3	2	1

Table 3f - L_{18} (3^8)

Column

No	1	2	3	4	5	6	7	8
1	1	1	1	1	1	1	1	1
2	1	1	2	2	2	2	2	2
3	1	1	3	3	3	3	3	3
4	1	2	1	1	2	2	3	3
5	1	2	2	2	3	3	1	1
6	1	2	3	3	1	1	2	2
7	2	3	1	2	1	3	2	3
8	2	3	2	3	2	1	3	1
9	2	3	3	1	3	2	1	2
10	2	1	1	3	3	2	2	1
11	2	1	2	1	1	3	3	2
12	2	1	3	2	2	1	1	3
13	3	2	1	2	3	1	3	2
14	3	2	2	3	1	2	1	3
15	3	2	3	1	2	3	2	1
16	3	3	1	3	2	3	1	2
17	3	3	2	1	3	1	2	3
18	3	3	3	2	1	2	3	1

Table 3g - L_{29} (3^{13})

Column

N0	1	2	3	4	5	6	7	8	9	10	11	12	13
1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	1	1	1	1	2	2	2	2	2	2	2	2	2
3	1	1	1	1	3	3	3	3	3	3	3	3	3
4	1	2	2	2	1	1	1	2	2	2	3	3	3
5	1	2	2	2	2	2	2	3	3	3	1	1	1
6	1	2	2	2	3	3	3	1	1	1	2	2	2
7	1	3	3	3	1	1	1	3	3	3	2	2	2
8	1	3	3	3	2	2	2	1	1	1	3	3	3
9	1	3	3	3	3	3	3	2	2	2	1	1	1
10	2	1	2	3	1	2	3	1	2	3	1	2	3
11	2	1	2	3	2	3	1	2	3	1	2	3	1
12	2	1	2	3	3	1	2	3	1	2	3	1	2
13	2	2	3	1	1	2	3	2	3	1	3	1	2
14	2	2	3	1	2	3	1	3	1	2	1	2	3
15	2	2	3	1	3	1	2	1	2	3	2	3	1
16	2	3	1	2	1	2	3	3	1	2	2	3	1
17	2	3	1	2	2	3	1	1	2	3	3	1	2
18	2	3	1	2	3	1	2	2	3	1	1	2	3
19	3	1	3	2	1	3	2	1	3	2	1	3	2
20	3	1	3	2	2	1	3	2	1	3	2	1	3
21	3	1	3	2	3	2	1	3	2	1	3	2	1
22	3	2	1	3	1	3	2	2	1	3	3	2	1
23	3	2	1	3	2	1	3	3	2	1	1	3	2
24	3	2	1	3	3	2	1	1	3	2	2	1	3
25	3	3	2	1	1	3	2	3	2	1	2	1	3
26	3	3	2	1	2	1	3	1	3	2	3	2	1
27	3	3	2	1	3	2	1	2	1	3	1	3	2

Note: full orthogonal arrays for other combinations are available from American Supplier Institute, Inc.

Total Quality Management

A Student's Answers to End of Chapter Questions

These answers come from one student. Please use them as a measure against your own answers. If you differ, try to resolve who is right. If unsure, contact the author.

Lesson 1

1.) **Deming's points** cannot be separated and used as one feels they apply. Each point is part of a greater whole. Each one alone is not complete without the others. All but one of the points is not complete without that one because they were written and meant to be used together. Taking one point out and applying it may seem realistic but upon further study into Deming's points you'll find that each point builds on the others and each one is enhanced by the others. Deming's 14 Points don't compare to the Ten Commandments because of their context, but they compare because each one stands alone but cannot be separated of its parts. When God gave Moses the Ten Commandments he did not give them to his people as an option, a list of rules in which to pick and choose which ones apply. Rather, the entire Ten Commandments is a standard in which each Christian must hold himself up to, be responsible for keeping each commandment, and be accountable for breaking any of them. In the same way, I believe Deming wanted people who called themselves total quality managers to adopt the entire 14 Points, be responsible for not ignoring any of the points, and accountable if he applied some and not the others.

2.) **Lack of constancy of purpose -** As a graduate assistant at an east coast graduate school, I never had the feeling that I contributed to the overall mission of the school. I didn't know why we existed except for the obvious, and I certainly did not feel that there was constancy of purpose. At the very most I think I felt that my contributions benefited the department in which I worked, but even then it stopped there. I don't think I was the only one either. Each department seemed to kind of run on its own toward the betterment of the department but not really looking at the big picture of how each department together with the other departments met the overall mission of the university.

At this same school, I noticed often the practice of awarding business on the price tag alone. The purchasing department decided to accept bids from travel agencies and office supply companies. While there had been some problems with the former travel agent, we had received excellent service from the office supply company. The University unfortunately measured companies on the basis of their bid price rather than measure them on who would give the best service and quality products. Currently we have a travel agent who has done pretty well, few complaints. But the office supply company is much slower. Orders often take several days to deliver the products where the original company had orders turned over the next day.

Fear - Before coming to graduate school, I worked as a receptionist for an HMO for the summer. Needless to say, I was viewed by some as that girl who just sits there and answers phone calls all day. When they finally decided I could handle more work , they started giving me projects. One day I was assigned a project on the computer. I was to finish something that one of my bosses had started the night before. I did not fully understand what she wanted, but I was too afraid to continue asking her for clarification so I just gave up and decided I would figure it out. I ended up erasing all that she had done the night before. She went ballistic, but she had no idea that I had done it. She thought she had forgotten to save it. But she was so mad at the entire situation anyway, there was no way I was going to say, "I screwed it up because I didn't understand what you wanted." It was no big deal really. I offered to retype the entire document. I didn't mind. But instead of just letting it rest she just went on and on about how unhappy she was. I was afraid to ask her for more clarification in the beginning because she was so intimidating, and I was afraid to own up to it when I finally realized I had screwed up. I learned a huge lesson about how NOT to treat those you consider at the bottom of an organization.

3.) **The cost of fear -** I think employers who allow their employees to operate in an environment of fear stand to miss out on a great many number of ways to improve the organization. Employees who function in fear are afraid to tell their employers how the company can be improved. They are afraid of rejection, and will keep their ideas to their close co-workers are even further at home with their families. Also, I think a great many mistakes could have been avoided if the employee felt comfortable asking the employer to clarify what he wants done before the employee proceeds in carrying out a task. A company who allows fear to infiltrate will never know the money they paid out covering mistakes or doing things inefficiently because employees were afraid to ask or suggest. But when you talk to companies who allow their employees to speak out and ask questions, they'll be able to tell you how much money they saved each year on employees' suggestions and the savings on the reduction of defects and errors. Successful companies like Toyota and Wal-Mart work hard to remove fear from their organizations, and they will tell you that they have been successful in large part to the many outstanding ideas of their employees.

4.) **Fear in the classroom** prohibits students from asking questions of the professor and making comments in class for fear of rejection. It also keeps students from going to the professor outside of class for clarification on points or clarification on assignments. Unfortunately fear keeps students from complimenting their professors on things that they really enjoy in class or things they really appreciate their professors teaching. I know professors often hear only the bad and they don't know what they do that students like or what things they do that make a difference. Perhaps they never hear the good because students are afraid they'll be seen as a "brown-noser." Finally, I think professors may not hear quality critiquing. Rather they hear the often irate students who have kept their frustrations over a class bottled up all semester such that one day they just snap. I actually had a professor that insisted that we tell him what we did not like about

his class. He awarded points for telling him the negative and for offering suggestions. It was a major paradigm shift from my former classes. I thought we were supposed to reserve the negative for course evaluations. He listened to complaints all semester and made improvements as needed. That was the only class in which I felt comfortable critiquing the course to the professor without fear that it may hurt my end of semester grade.

5.) As Christians we never get to a point where "we have arrived." We are instructed to be like Christ. A goal that none of us will ever perfect, but we are to continue always to be more like Christ…to constantly improve and strive to be more like Him. TQM reflects this in that there is never a point in which a company can boast, "we've completed TQM." No company will ever complete or master the concepts of TQM because they are timeless and intended to drive an organization to continue to improve. Once they have improved, they are to continue to improve again. The process never ends - just like Christianity.

6.) **The Walrus -** Anyone in a position of leadership has a duty to be in contact with his employees. He/she must descend down from the high tower, get down there on the floor with the people, and find out how things really are. Fear kept the second ranking walrus from being honest with the big walrus. If the chief had not created this atmosphere of fear within his people, they would not have been afraid to tell him the current problems. The fear was so great that they were willing to let the organization as a whole fail rather than face the wrath of the leader. They even knew that he could solve the surmounting problems, but saving the organization was obviously not worth dealing with his anger. Now the top man has lost everything and even his sole follower who has remained loyal to him is still afraid to tell him what happened because even now it's just not worth it. Leaders must remain close to those they lead and make it his business to know what's going on in an organization.

7.) **Eliminate slogans, exhortations, and targets for the work force.** I think the reason this is hard for me is because I know of so many companies with slogans and they seem to work. I know that a saying that leads to the mission is acceptable, and that what Deming is talking about is empty slogans created by management and passed down to the people. But even still it's hard for me to differentiate between those sayings which are positive and those which are empty.

Also, **Deming's 3rd deadly disease on evaluation by performance, merit rating, or annual review of performance** is hard for me. I think the reason being is that I have worked in positions on and off for the past seven years and have never received a performance evaluation. Being in school for the past 19 years, I've really become accustomed to knowing how I'm doing and having my performance measured regularly. I know that Deming's whole thought is not that I will never know how I am doing, but that I should know how I'm doing on a daily basis so that I can improve constantly instead of once or twice each year.

Yes, that makes sense to me, but I find too many people to be non-confrontational, and I don't think they will be completely honest on a daily basis about employees' performance. Also, I find myself as an employee trying to "read the mind" of my employer to determine if he/she really is pleased with my performance. That's frustrating.

Lesson 2

$$EOQ = \sqrt{\frac{2DS}{IC}} = \sqrt{\frac{2(15,000)(25)}{(.15)(5)}} = \sqrt{\frac{750,000}{.75}} = \sqrt{1,000,000} = 1,000$$

$$EOQ = \sqrt{\frac{2DS}{IC}} = \sqrt{\frac{2(30,000)(40)}{(.18)(15)}} = \sqrt{\frac{2,400,000}{2.7}} = \sqrt{888888.88} = 943$$

Annual order costs

$\frac{30,000}{943} = 32$ purchases of 943 units

$= (32 * 40) + (471.5 * 2.7) = (1280) + (1273.05) = \$2553.05$

By definition, annual carrying costs equal annual ordering costs (\$3,826.10).

3.) **Carrying costs** should include rent + allowance for what that space could yield if it was converted to production space, utilities for light and heat, and some miscellaneous.

4.) **Small lots** allow defects to be captured before there is failure. They also allow more flexibility to customer demand. Large amounts of waste are seen in companies that produce in large lot sizes.

5.) **Process theory** better serves the TQM philosophy because TQM looks at the big picture and strives to do all things which make the organization as a whole benefit. Traditional management philosophies are seeking the good of each department. Managers will not sacrifice the performance of their department to better another department because they are each measured upon how well his department runs, not how well the organization as a whole does.

   Systems theory says that unity must exist between the parts and that it is necessary to look at the relationships between the parts to understand the entire system. This is in-line with TQM in that the total picture must be looked at so that the system as a whole can better function and improve the entire organization. Traditional management wants to again separate the individual parts and let them function separately so he can better control them.

6.) Managers act as agents for the shareholders, investors, contributors, etc. in an effort to make decisions for them which make the company operate better. The

manager must lay aside his biases and his own personal wants and needs so that his decisions are based solely on the good of the organization and operate outside what is best for him personally. The manager must be a servant to those who have placed their trust in him to do what is right for the organization.

Lesson 3

1) In the words of Sam Walton, "the customer is boss." The customer can tell you exactly what they want, when they want it, how they want it, and where they want it. If the customer is pleased, then you know that you are doing things right. Also, the customer can keep an organization up to speed on how demand and service are changing. This keeps the company always moving toward pleasing the customer and serving his wants and needs. This gives the company the best tool in which to measure itself by.

2a.) <u>Standard Time</u>   or   <u>Actual Units</u>

    Actual Time   Standard Units

    <u>80 minutes</u>   or   <u>80 passengers</u>

    60 minutes   60 passengers

Efficiency rating = 1.33 in minutes or passengers

b.) Productivity = efficiency * utilization

    =   1.33 * 90%

    =   1.197

c.) 10. Would typically need 12, but since they are operating at 1.197, they will only need 10.

d.)

3.)

Day	Diameter	Moving R
1	11.0	
2	10.0	1.0
3	9.5	.5
4	9.2	.3
5	8.0	1.2
6	8.5	.5
7	10.0	1.5
8	11.0	1.0
9	11.5	.5
10	10.0	1.5

Total R = 8.0

Average R = .89

Average Diameter = 9.87

$$UCL_x = X + 3 \left(\frac{R}{d_2} \right) \qquad\qquad LCL_x = X - 3 \left(\frac{R}{d_2} \right)$$

$$UCL_x = 9.87 + 3 \frac{(.89)}{(1.128)} \qquad\qquad LCL_x = 9.87 - 3 \frac{(.89)}{(1.128)}$$

$$UCL_x = 9.87 + 2.37 \qquad\qquad LCL_x = 9.87 - 2.37$$

$$UCL_x = 12.24 \qquad\qquad LCL_x = 7.5$$
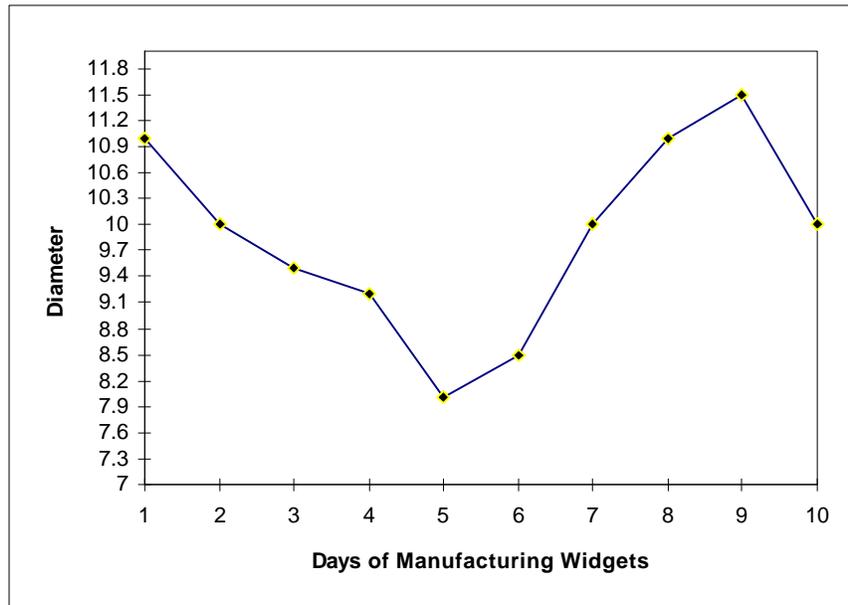
4.) When an employee knows that his work will be inspected, he will obviously be less conscientious because he knows someone will eventually catch any defects. Employees who know that after they have done the work the customer will be the inspector will take much more pride and responsibility in doing the work right the first time. Inspectors should be removed from their current positions and placed in other areas of the company. All employees should take on the responsibility for being a quality inspector of his or her own work and seek to make products right the first time. Problems in the system should be corrected immediately rather than allow defects to continue to pile up in a defect bin.

5.)

<u>Smith Electrical Supply</u>

Sample #	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Mean	Range
1	5.002	5.003	5.000	5.001	5.004	5.002	0.004
2	5.003	5.001	5.000	5.004	5.002	5.002	0.004
3	5.001	5.002	5.003	5.002	5.001	5.002	0.002
4	5.000	5.001	5.000	5.001	5.002	5.001	0.002
5	5.003	5.002	5.001	5.002	5.002	5.002	0.002
6	5.001	5.002	5.001	5.003	5.004	5.002	0.003
7	5.002	5.004	5.001	5.002	5.004	5.003	0.003
8	4.998	4.999	5.000	5.001	5.002	5.000	0.004
9	5.000	4.998	5.002	5.001	4.999	5.000	0.004
10	5.002	5.001	5.004	5.002	5.000	5.002	0.004

Average Mean   5.002

Average Range   0.0032

$UCL_x = X + (A_2)(R)$ $UCL_R = (D_4)(R)$

$LCL_x = X + (A_2)(R)$ $LCL_R = (D_4)(R)$

$UCL_x = 5.002 + (.577)(.0032)$ $UCL_R = (2.114)(.0032)$

$LCL_x = 5.002 - (.577)(.0032)$ $LCL_R = (0)(.0032)$

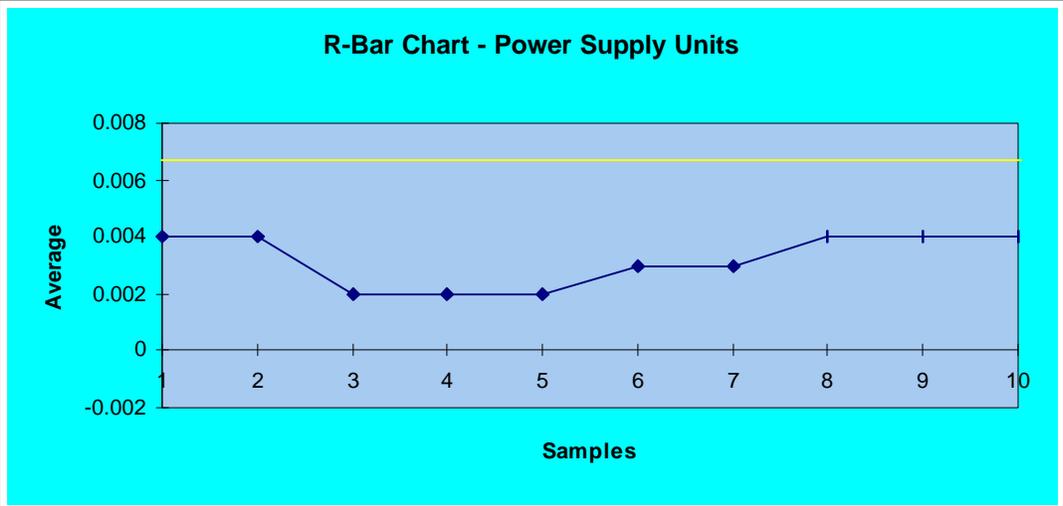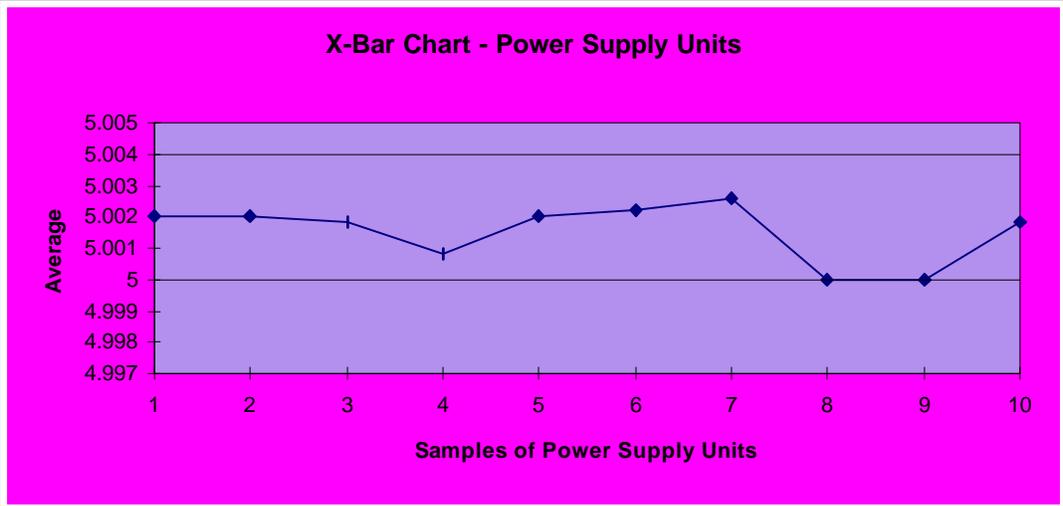$UCL_x = 5.002 + (.0018464)$ $\mathbf{UCL_R = .0067648}$

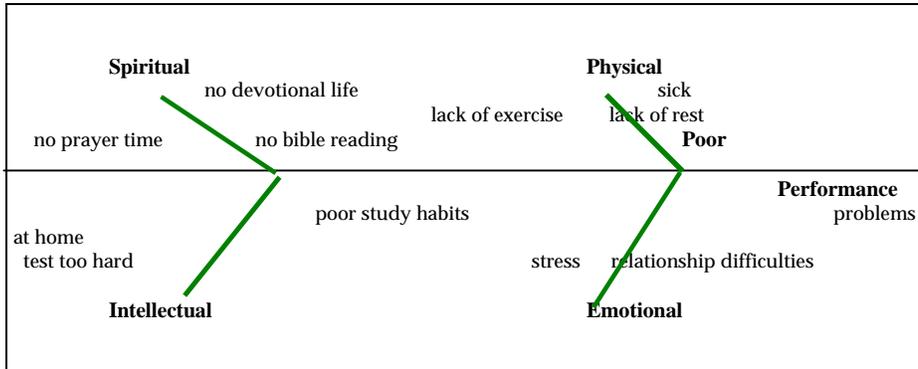$LCL_x = 5.002 - (.0018464)$ $\mathbf{LCL_R = 0}$

$\mathbf{UCL_x = 5.004}$

$\mathbf{LCL_x = 5.000}$

X-Bar Chart - Power Supply Units

R-Bar Chart - Power Supply Units

6.) Cause-and-effect diagram for why a student may not do well on an exam:

Spiritual
no devotional life

Physical
sick
lack of exercise   lack of rest
no prayer time   no bible reading   **Poor**

Performance
poor study habits   problems

at home
test too hard   stress   relationship difficulties

Intellectual   **Emotional**

7.) Flowchart for preparing, writing, and submitting a class paper:

Select topic
for paper

Go to library

Research topic

Make copies

Take notes

Outline paper

Type paper

Proof paper

Print paper

Compile all
components
into neat stack
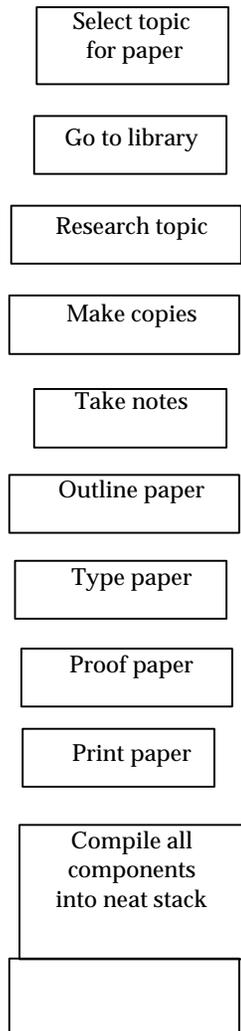
Staple paper

Take to class

Deliver to Professor

8.) Histogram of height in inches of the eighth grade class.

Heights (in inches) of the 8th grade class

Number of students in each height category

| 1 2 |
| 1 0 |
| 8 |
| 6 |
| 4 |
| 2 |
| 0 |

4 0   5 0   6 0   7 0

Height in inches

9.) Characteristics of quality

- **laundry soap manufacturer -**

* more customers recommend your detergent due to overall ability to get rid of stains over all other laundry soaps

* environmentally safe

* softens fabric as it cleans

- **cookie baker -**

* chewy cookies that when held on one edge begin to bend

* exact consistency of ingredients

* more additions (raisins, chips, nuts) than other brands

- **insurance company -**

* 99.8% of customers say that their overall experience was pleasant

* 100% of customers say they would recommend the insurance co.

* sign-up a customer within 30 minutes

- **church -**

* 100% of respondents say that their spiritual needs are being met by the church

* programs offered for all age groups represented in the church

* clean facilities throughout

- **publisher -**

* only 1 defective copy every 1 million copies

* 50% of books published find themselves on the best-sellers list

* books published within 2 weeks of contract

- **university -**

* 0 attrition rate

* 100% placement rate

* 25% increase in enrollment annually

Lesson 4

1. A **team** is a group of people brought together to accomplish a common goal and purpose. All members of the team possess certain skills that together with all the others creates synergy. The team is mutually accountable and collectively responsible for the achievement of the assigned goals and objectives. The team typically consists of 3 -10 people.

2. **Baseball teams** are very independent . They work on their individual performance more so than the performance as a team. Their organizational structure is very specific and rarely changes. A **football team** is more interdependent than the baseball team. While not as dependent as a basketball team, a football team still has to rely on the help of others to accomplish the goal of the whole group to gain a touchdown. Structure exists at the beginning of each play. Then the team moves freely around the field. A **basketball team** is very interdependent. The players are constantly passing the ball and looking for someone who can take it next. The organizational structure is very loose as they are all over the court trying to make a basket.

3.) A team works together for a common goal. Work groups include a collection of people who may have private agendas, therefore, they are unable to work together towards one common goal and synergy cannot exist.

4.) JIT would be unpopular with **purchasing managers** first of all because they see it as a way to eliminate their job. Other than that, they believe suppliers will not perform unless monitored closely and will cheat the company if given an opportunity. They also presume that suppliers' prices are inflated and high pressure negotiation tactics are required to get the lowest price. Purchasing agents also like to get bids from several different suppliers and then take the best one. This makes them feel very good because they have (they believe) saved the company money.

   Production would not invite JIT because they like to have plenty of supplies at their disposal. JIT allows only the amount of material, components, or finished goods to be moved, produced, or stored which can be instantly used by the next process step. This would probably make production nervous for fear that the necessary supplies would somehow not arrive just-in-time and then they could not produce as quickly which could effect their total pay if they are paid per unit, etc.

5.) Suppliers are guaranteed a long-term contract. They know they can trust the buyers because both firms have made an agreement and that the well-being of both is essential for success. Buyers have less paperwork to deal with, fewer

people are required to complete the purchasing function, a reduction in variation, subsequent improvement in quality, and overall production costs are decreased. Manufacturing employees now have the supplier's personnel becoming no-cost consultants to the manufacturing firm's designers and producers, and low-cost savings are passed on to the manufacturer.

6.) Sole sourcing means using one vendor to supply a particular item or service. Purchasing people visit suppliers regularly to inspect manufacturing process and planning steps. Good relationships are based on trust and willingness to allow a friend to visit and ask personal questions and give answers.

7.) Sole sourcing allows the establishment of a long-term relationship. Buyers need not be skeptical of the supplier and wonder if cost-savings can be found with another supplier. The benefits of trust, access, and relationship far outweigh any costs savings that another supplier may provide.

The parallel to marriage is that husbands and wives work together. When one let the other down, they work together to straighten things out. The wife/husband does not go get another husband/wife to replace the one who was disappointing. There is an element of trust established, and they will work things out. The idea of sole sourcing says that the same should hold true between supplier and buyer. They have, in a sense, established a "marriage" and should both work to make the relationship successful and pleasing to both parties.

Lesson 5

1.) Why would a firm produce more in two 8-hour shifts than in three? I don't know. Nothing in this lesson refers to producing more in less time.

2.) Describe three examples of U-shaped manufacturing cells. I don't know of any specific examples, but I would assume they could be used in car manufacturing and electronics manufacturing.

3.) Companies believed that the larger the equipment the larger the cost savings when the order quantity exceeded break-even.

4.) **Smaller equipment** allows for the flexibility of being linked together into process flows when the speed of transfer is matched between them. After finding the EOQ, the equipment can be linked to produce at that amount.

5.) New equipment should be purchased if it can enhance the human function. Equipment should never be purchased to replace people or the problems of people.

Lesson 6

1.) **Raw material inventory** is the amount of goods in storage which has no value added to it. A steady supply of raw material near the production facility prevent shut downs waiting for work. Stockpiling in times of shortages insures that production can continue in the near future. **Work in process inventory** is the material which has some value added to it. Items in transit from one work station to another are considered work in process inventory. **Finished goods inventory** is the material which has finished the value-added processes and is waiting purchase or shipment.

2.) The advantages of reduced inventory include an increase of inventory turnover which in turn leads to cost savings.

3.) **Kanban** is a visual means of requesting additional material or WIP or to signal that more is coming to the next station. Examples include the different colored lights above a patient's room at the Doctor's office, grocery story cashier lights, restocking shelves at the grocery store when the shelf is empty, and ordering office supplies when the box becomes empty.

4.) **Fixed Sequence Robot**

Example = toaster

Variable Sequence Robot

Example = VCR

Playback Robot

Example = electronic keyboard

Artificial Intelligent Robot

Example = space robotics and advanced terrestrial applications

5) The re-fueling sequence which satisfies "critical-ratio" would be Plane 1, Plane 4, Plane 2, and Plane 3. The textbook doesn't discuss how many can be done at the same time. Can you refuel 17 planes at the same time if need be? Or just two or even one? I assumed that they had to be done one at the time which makes this little question a bit difficult to compute. Could you maybe discuss that in the text and explain if that's an issue for critical ratio? What am I missing because "critical ratio" seems more like "common sense." Isn't it a given that you re-fuel the first one going out and the next one and then so on until they are all complete?

Lesson 7

No Questions…

Lesson 8

1.) **Forecasting** assists the operations manager to understand raw material and component needs allowing better relationships with suppliers, assists with labor planning, improves customer satisfaction, and improved operational efficiency. Those involved in forecasting include marketing managers, operation managers, salesmen, production planners, and customers.

2.) **Jury of Peers** would be used when you simply want the opinion or educated guess of those in the industry. **Expert opinion** would be used when you wanted an expert's opinion. This includes customers or consultants who specialize in forecasting within the industry. Also, the expert opinion method removed a lot of bias that would be found within the jury of peers.

3.) Hecht's, The Limited, and Farm Fresh use **chase demand** during the Christmas season. They hire extra people specifically for the season and when the season is over, those people are terminated. Summer camps hire the amount of counselors needed for the camps and after the camps are over, the people are terminated. The YMCA hires extra people during the summer to run the many kids programs. Institutions using **level employment** include universities, churches, automobile manufacturing plants.

4.) We would want to use the **Newsboy model** when we are certain we have correct demand numbers, and we simply want to know how many units we should make within one day's time. We know that if the demand for a day exceeds this amount we will stock out and not be able to provide for our customers. However, when the demand is less than the amount calculated, we will have to throw away finished goods.

5.) Mama's cookies

Month	November	December	January	February
Days	25	23	20	16
Cookies/Month	820,000	1,360,000	610,000	900,000
Cookies/Day	32,800	59,130	30,500	56,250
Workers Needed/Day	89	160	83	153

At this point Mama can decide whether to use level employment at the highest number needed (160) for the entire four months or use chase demand where she hires 83 full-time and then hires more for the other months on a temporary basis.

However, if the cookies can be preserved, she could decide to produce the same amount each day with the same amount of people. The calculations then are as follows:

Total Number of Cookies needed for the four month period =	3,690,000
Total Number of Days in the four month period =	84
Total Number of Cookies to be produced per day =	43,929
Total Number of Workers Needed =	119

1,098,225 Cookies would be produced in the month of November with an excess of 278,225 cookies
1,010,367 Cookies would be produced in December with a shortfall of 71,408 cookies
This shortfall spread out during November & December would mean a shortfall of 1,488 cookies per day.
To make this shortfall up, four more workers would need to be hired. The new total are as follows:

Total Number of Cookies to be produced per day =   45,510
Total Number of Workers Needed =   123

New Production levels:

	November	December	January	February
Cookies Produced	1,137,750	1,046,730	910,200	728,160
Cookies Needed	-820,000	317,750	4,480	304,680
		-1,360,000	-610,000	-900,000
Excess	317,750	4,480	304,680	132,840

Planning this way would require that there is ample inventory space for the greatest amount of storage.

6) **Purposes of master planning -** show the amount of labor hours required, the amount of people required to produce the demand, shows the amount of material and subcomponents and when they were ordered or manufactured. This allows for the correct planning of materials to be shipped, people to work, and for work to be completed on time for the customer. The result is cost savings across the board and added efficiency.

7) Forecast error is the difference between the planned demand to the actual demand. Knowing the forecast error helps to show if the forecast was above or below the actual demand. After additional tweaking each year and better forecasting the company can strive to constantly reduce the forecast error. When the error is excessive it will always mean a cost to the company: either in inventory cost to stock the extra units, cost of additional units that had to be throw away due to lack of demand, or loss of sales when the forecasted demand is too low. Before setting up a production schedule I would want to know about each project ordered but not filled, deadlines for the projects, the amount of labor hours required for each project, the amount of people required for each project, lead time, components available, scarcity of materials, accuracy of the demand, etc.
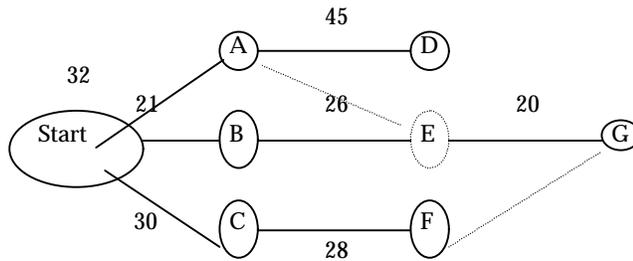
8.) **Students, Inc.**

1st desk   15   hours to build

2nd desk   15 *   .80   =   12.00   hours

4th desk   12 *   .80   =   9.60   hours

8th desk   9.6 * .80   =   7.68   hours

16th desk   7.68 * .80   =   6.14   hours

Lesson 9

No Questions

Lesson 10

AEG would be the critical path. ABCEF should all be completed by day 60 to be sure the project ends on time.

Endnotes

1.   [1]   Mullin Ralph, George Wilson, and Michael Grelle, "TQM: Revolution or Just Another Fad?' A Commissioned Paper for the American Association For Higher Education Conference On Assessment in Higher Education, Chicago, Ill June 9-12, 1993, Published by AAHE Washington, DC

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1.   [4]   McGregor, Douglas. The Human Side of Enterprise; McGraw-Hill, New York, 1960

1.   [5]   MA: 1966, pp. 159-160

1.   [6]   Kilian, Cecelia, The World of W. Edwards Deming, Second Edition, SPC Press, Knoxville, TN: 1992

1.   [7]   Walton, Mary The Deming Management Method, Putnam, New York: 1986 p 6

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1.   [9]   Dobyns, Lloyd and Clare crawford-Mason; *Thinking about Quality: Progress, Wisdom and the Deming Philosophy*; New York: Random House; 1994 page 33

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1.   [11]Swindoll, Charles; Living Above the Level of Mediocrity; Word, Waco, TX: 1987 pp.150-51

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1.   [18]Ibid

1.   [19]Juran, J. M. *Juran on Planning for Quality*; New York: The Free Press, 1988

1.   [20]Zeithaml, Parasuraman, Berry; *Delivering Quality Service*; New York, Free Press: 1990

1.   [21]Ishikawa (page 49-55)

1.   [22]   Lamprecht, James (1992); *ISO 9000 Preparing for Registration*; Milwaukee: ASQC Quality Press p. 4

[23]   Harmon, Roy L. (1992); Reinventing the Factory II; New York: The Free Press, p 126

[24]   Barrier, Michael (1991); :overcoming Adversity," Nations Business, June pp.25-29

[25]   Robertson, Pat; The Secret Kingdom

[26]   The parable of the Talents - Matthew 21: 33-41; Mark 12: 1-11 and Luke 20: 9-16

[27]   Please note that at this writing (Summer, 1994) the Business School is re-structuring to a process flow model and the one full time telephone employee moves to the admissions and registration function of the school. The 12 hour a week graduate assistant moves to 20 hours a week and all outbound mail and shipping is coordinated by the part time administrator.

[28]   This hiring may still occur as Regent University moves to semesters from quarters. Semesters require more students taking classes each term since there will be three terms instead of four. We must observe the process in the semester environment and determine what system modifications are necessary to maintain optimization.

[29]   Moskal, Brian S. (1993); "Company Loyalty Dies, A Victim of Neglect;" Industry Week, March 1, 1993 242 5 pp. 11-12

[30]   Sheridan, John H. (1989) "Loyalty Crisis;" Industry Week June 5, 1989 238 11 pp. 47, 50

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[34]   Shingo, Shigeo, (1988), *Non-Stock Production: The Shingo System for Continous Improvement*, Cambridge: Productivity Press