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THE IMPLEMENTATION OF QUALITY
CONTROL CIRCLE CONCEPTS INTO AMERICAN INDUSTRY

BY

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ABSTRACT

In light of the growing worldwide competition among industrial manufacturers as developing nations become more technologically viable, it becomes imperative that we, as a nation, become more conscious than ever of quality and productivity.

Our most serious competitors, the Japanese, have developed a nationwide sense of quality consciousness and have evolved a management and manufacturing system to achieve their goals of superior quality that is currently unrivaled.

One important element of their productive system is the concept of Quality Control (QC) circles; generally described as a problem solving group of working people, who as members of a team, identify, solve, and implement solutions to work-related problems. Circles have served to tap a vast reservoir of energy, productivity, and ingenuity among the Japanese workforce, aiding them in their quest for manufacturing and quality superiority.

We must learn more about these circles, what they are, how they operate, what they can do for us, and how we, as a nation can apply them to our manufacturing problems. They have already been successfully transplanted into America by many firms and are achieving excellent gains in productivity, quality, and worker-management relations.

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INTRODUCTION

The majority of business establishments in the United States are not self-serving captive operations; by and large their ultimate objective is to consistently provide either a product or a service which satisfactorily meets customer demands. Workmanship of a consistently high quality is a necessary requisite for continued success in today's competitive business environment. No longer are we able to sit back in complacency and enjoy the security of a populace "buying American." The marketplace is now a worldwide arena in which we are facing heavy pressures from international competition in our own domestic market, while attempting to increase our own shares of an ever- expanding international market.

It has become apparent that inadequate or mediocre levels of quality will only encourage customers to seek alternate sources of supply, be it domestic or foreign. The loss of business is a highly visible consequence of generating low quality products. Just as significant, but less obvious, are the high manufacturing costs associated with the reworking of inferior products, together with the scrappage generated from unsalvageable parts. "Too few members of top management recognize that poor quality may well be costing them an average of 10 to 15 percent--and as

high as 20 percent--of their sales dollar." (Leek 1981)
The generation of inferior products can also have a
significant effect on the manpower requirements of a
production facility:

> A.V. Feigenbaum estimates that the 'hidden
> plant' in U.S. firms may account for from 15% to as
> much as 40% of productive capacity. By 'hidden
> plant,' he means the personnel and equipment which
> exists to rework unsatisfactory parts, or to
> re-test or re-inspect rejected parts. (Cole 1980)

It appears, then, that we should view rework lines as
indicators of inadequacy in our original production
operations. Many companies, recognizing that quality
problems exist within their production lines, have brought
in quality control specialists and initiated quality
control departments in an attempt to improve the situation.
This removes the responsibility for quality in workmanship
from the direct control of engineering and production and
places it into the hands of this separate entity; the
Quality Control Department. Their usual activity is
inspection, a control function conducted by a group which
is not responsible for either operational or testing
activities. We are now faced with a dichotomy, one group
of individuals charged with producing a product, and a
second, separate group telling them what they did wrong.
This can often lead to disharmony within the structure of a
production environment:

> In twenty-two years of industrial experience observing various industrial firms I have not found one where the work force did not resent a separate inspection organization. (Rubinstein 1971)

A personal experience would serve as a good example of the type of problem which can develop when the responsibility for quality rests with a separate functional organization. The firm that I work for is in the electronics field, producing quartz crystal resonators and filters; frequency control devices. When I began working for them, their special market niche had been monolithic crystal filters, with very little design experience in crystal resonators. They were approached by a major automotive manufacturer to produce inexpensive crystal resonators for an engine control microprocessor. Our firm assumed that since it understood the fundamentals of resonator design, it would be an easy device to produce. Unfortunately, the automotive manufacturer had specified quite stringent temperature performance requirements for the crystal. After obligating ourselves to produce many thousands of these crystals each day for a manufacturer who needed parts to keep his assembly lines rolling, we discovered that we could not design and produce a crystal which could be relied on to perform to the required specifications. The automotive manufacturer sampled test lots at incoming inspection, and if two of the sampled crystals failed over temperature the entire lot would be

rejected and returned to us for rework. After several lots had failed in this manner, our solution was to test every one of the thousands of crystals over the entire temperature range specified, instead of sampling small quantities of them as we had been doing. Even then, several lots were returned as a result of bad crystals apparently slipping through, so we began testing each crystal twice to insure that we caught all future rejects. We devoted more valuable time and effort into designing and building specialized test equipment which could handle this volume of components than we had in designing and building the crystal itself.

We found ourselves in a situation common to many U.S. companies today, we were testing quality in, not building it in. Some subtle design feature had escaped us, and we were forced to inspect every part twice in order to find those which performed reliably. This continued for the first year's order, until it came time to bid for the next year's production order. We were forced to include all the costs of testing and equipment design into the cost estimates for our bid. We were not able to be competitive with our bid and lost all further business for that part design. We were left with very specialized test equipment, for which we had no further use.

We found out later that we had lost that order to a Japanese competitor. We managed to obtain samples of their

product and tested them to determine their performance over temperature. They performed excellently, with no sign of the problems which had plagued our parts. We inspected them and could find no obvious difference between theirs and ours, some subtle, but significant design consideration had escaped our notice. But we did find out that their crystals were so reliable that they performed no testing whatsoever after manufacturing.

What had made the difference? Why did we have cabinets full of hundreds of thousands of rejected parts, while our Japanese competitor had virtually none? I believe that the answer lies in our differing approaches to quality. It is very simple. They designed the quality into their product, while we were content to test the quality into ours--at a very great cost! It lies with the attitude of every person involved, from the conceptual designer to all the workers on the production line. Real quality requires that each person, regardless of their position in the company, must take pride in knowing that they have done the best that they could to produce a high quality product.

A factor which has made a significant contribution to this attitude among workers in Japan is Quality Control Circles. These circles contribute significantly toward the positive motivation of Japanese workers, which in turn has helped them to achieve their efficient production record.

I. MOTIVATIONAL THEORIES

What influences people to behave the way that they do? Why do some people approach their jobs with a high sense of quality consciousness while others are indifferent to it? It appears that the emotional and psychological responses of individuals to specific situations is influenced by a vast array of environmental stimuli, as well as by intrinsic personality characteristics.

It is interesting to note that not until the Industrial Revolution did man become particularly concerned with determining the factors which influenced the motivational level of workers. Management had regarded long working hours and low wages as accepted prerequisites for low production costs. With the advent of the Industrial Revolution came a widespread increase in consumer demand and the consequent pressure for increased worker productivity. The search for a sound motivational theory to be used by industry had begun.

Frederick W. Taylor

The first approach to motivating industrial workers focused on using money as an incentive. Frederick Taylor attempted to apply the scientific method in characterizing worker attributes and industrial requirements.

6

Taylor presented his famous treatise in 1903
which stated that the maximum good for all society
can come only through the cooperation of management
and labor in the application of scientific methods
to all common endeavors....He felt that employees
should be scientifically and precisely trained to
improve their skill in so performing a job that a
predetermined standard of output could be met.
(Thomas 1976)

Taylor's premises tended to dehumanize the production

worker, to place him on the level of just another piece of

equipment on the factory floor.

Therefore, if each employee's activities were
'standardized' so that like a machine he could
'operate' at his most efficient level, and in
addition he were given a fixed increase in money
for some predetermined increase in production, the
employee would not only increase his productive
output but would also be more satisfied. (Russell
1967)

Taylor, in 1911, formalized his views in his book

Principles of Scientific Management. He apparently gave

little consideration for the human nature of the factory

laborer, who opposed his methods because of the high

productivity demands with little ensuing rewards.

Many people think of Taylor as an engineer
whose worst act was to develop the assembly line.
It is believed that he did the most to create
today's problem of employee boredom. (Thomas 1976)

Elton Mayo

In the early 1920s Elton Mayo, a sociologist at the

Harvard Graduate School of Business Administration,

developed a theory that workers cluster together into

informal groups in order to fill a void not provided for by

industrial organizations. Mayo advocated improved communication between management and workers so that there would be better understanding of each other's position. He felt that supervision should be placed into the hands of men who held respect for their fellow man. Mayo conducted a series of studies extending from the early twenties through World War II. The best known of these were conducted at the Hawthorne Works of the Western Electric Company, from 1927 through 1932. His focus was directed primarily at absenteeism, high labor turnover, low productivity, and poor worker attitudes. He initiated rest periods to combat physical fatigue, and allowed the workers to participate in scheduling the time of these rest periods. Significant benefits occurred; employee turnover dropped, productivity went up, and worker attitudes improved. Mayo was interested in group interactions and advocated the strengthening of the team spirit among workers. At the Hawthorne plant, he conducted experiments to determine the influence of environmental factors on worker productivity. In one experiment, he varied the level of illumination in the work area. The results were ambiguous, as the productivity varied basically the same with the control group and with the test group.

It soon became apparent that productivity was a function of changes in interpersonal and group relationships, and not of changes in the physical characteristics of the environment. The observation that productivity was a function of

certain human relationships as well as economic needs was fundamental in the study of human motivation in industry. (Russell 1967)

Abraham H. Maslow

In 1943, Abraham Maslow of Brandeis University suggested a theory of human motivation:

• Motivated behavior is a channel through which many basic needs are expressed or satisfied simultaneously. An act typically has more than one motivation.

• Man is a perpetually wanting animal. His needs arrange themselves in a hierarchy. Every need is related to its current state of satisfaction or dissatisfaction.

• A want that is satisfied is no longer a want--unsatisfied needs dominate motivation.

• Motivation classification is based on goals, not on drives or motivated behavior.

• Motivation theory is not synonymous with behavior theory. In addition to motivation, behavior is biologically, culturally, and situationally determined. (Weiss 1967)

Maslow arranged his list of man's basic needs into a hierarchical structure beginning with the lowest, most instinctive needs first.

1) Physiological Needs
A person's basic needs are their physiological or survival needs, i.e., food, clothing, and shelter. In most industrial economies these needs are satisfied through wages. Once satisfied, they cease to operate as the primary motivators of behavior and are replaced by motivational forces of a higher order.

2) Safety Needs
People have an instinctive need to protect themselves and their families and to make themselves as safe as they can from danger, threat,

and deprivation. These needs are satisfied through insurance, pension plans, religion, and police and fire departments.

3) <u>Social Needs</u>
     People are basically social animals who do not want to be alone, and so have a great need for belonging, for association, for acceptance, and for giving and receiving friendship and love.

4) <u>Ego Or Esteem Needs</u>
     Ego or esteem needs can be divided into two classes: those that relate to one's self-esteem, such as self-confidence, independence, achievement, competence and knowledge; and those that relate to one's reputation, such as status, recognition, appreciation, and respect.

5) <u>Self-fulfillment Needs</u>
     Many people feel that they must fulfill a role in life. Self-fulfillment needs include the realization of one's own potentialities, continued self-development, continued creativity, and self-expression. (Thomas 1976)

The complexity of human nature does not allow the classification of man's wants strictly according to this simple five-point structure; many needs will overlap into several categories. For instance, money provided by wages will purchase food and clothing, thereby filling a physiological need; at the same time, in our competitive society, it can fulfill a need for status and recognition. In order to provide the motivation necessary for workers to aspire to the levels of quality and productivity desired by management, attention should be focused on the higher level needs. But it should always be remembered that these higher needs will be ineffective as motivating factors if management fails to adequately satisfy the requirements of the lower needs.

Frederick Herzberg

In 1959, Frederick Herzberg and his associates at the Psychological Service of Pittsburgh published the results of a study conducted on the work motivation of 200 engineers and accountants working for eleven Pittsburgh firms. (Herzberg 1969) He concluded that good feelings about a job were motivators and were derived from such things as responsibility, achievement, advancement, recognition, and the work itself. Bad feelings about a job, which he called hygienic factors, were derived from supervision, company policy, administrative practices, working conditions and relations with peers. He concluded that hygienic factors provide little or no effect in a positive direction, they only forestall serious dissatisfaction and make it possible for motivators to operate. Hygienic factors must be attended to carefully; when deprived of them, motivation deteriorated rapidly; when overemphasized, they led to a greater and greater focus on the extraneous rewards associated with a job, and not the fulfillment goals of the job itself. It was difficult to quantify the effects of motivators and dissatisfiers:

> When they felt positive about their jobs, they put more care, imagination, and craftsmanship into their work; when they felt negative, they were not necessarily careless, but neither did they worry about fine details. In a word, favorable attitudes brought out their creativity and desire for

excellence, while unfavorable attitudes dissipated their incentive to do more than comply with minimal requirements. (Weiss 1967)

The emphasis, then, should be placed on strengthening the motivating factors which lead to positive job attitudes.

Herzberg's prescription for a motivated work force is job enrichment or involvement. He points out that job enrichment actually means increasing the challenging content of the job that will cause the employee to grow both in skill and in his feeling of accomplishment. With job enrichment both the manager and the worker perform all three functions of planning, doing, and controlling. (Thomas 1976)

Douglas McGregor

There are two basic approaches to managing an organization. The classical approach is to define established lines of authority with clearly defined job responsibilities. The second, often called the participative approach, advocates the involvement of organizational members in decision making in order to more highly motivate them. The underlying assumptions to these two management approaches were theorized by Douglas McGregor of M.I.T., and published in his book The Human Side of Enterprise in 1960. (McGregor 1960)

McGregor called the assumptions upon which "traditional" organizations are based "Theory X," and described them thusly:

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

2) Most people must be coerced, controlled, directed, threatened with punishment to get them to put forth adequate effort toward the achievement of an organization's objectives.

3) The average person prefers to be directed, wishes to avoid responsibility, has relatively little ambition, and wants security above all.

Relating McGregor's Theory X to Maslow's hierarchy, we can see that with a system operating under Theory X, the employee needs which are important, those centering on the social, ego and self-actualization steps of the hierarchy are deliberately suppressed. The natural response of an employee in these circumstances is passivity and compliance without creativity.

> As long as Theory X dominates the manager's thinking, the full potential of average human beings are neither discovered nor utilized, and neither motivation nor quality motivation will be apparent except for occasional short-lived spurts. (Weiss 1967)

In opposition to Theory X, McGregor submits an alternative theory, called "Theory Y," which he believes to be more realistic in its assessment of people. The assumptions of Theory Y are:

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. The most significant ego and self-actualization needs can be the result of effort directed toward organizational objectives.

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 throughout the population.

6) Under the conditions of modern industrial life, the intellectual potentialities of the average human being are only partially utilized. (McGregor 1960)

The implications of Theory Y management can be equated with the higher steps of Maslow's hierarchy. It provides a framework for supervisors and managers to take full advantage of human growth and development, to allow cooperative adaptation instead of absolute, uncompromising control. McGregor's theories accentuate the fact that the philosophy or basic attitude of managers toward their people inevitably affects their view of management problems and the techniques they select to solve them.

It is clear, even from this brief chronology of the study of human motivation in industry, that the factors which influence human motivation are complex and only partially understood. Any program which attempts to motivate people to do their jobs more efficiently must take into consideration not only the psychological makeup of the individual but also the total work environment to which they are exposed. Managers must not make the assumption that all people have the same needs, and in the same proportions.

Individuals bring diverse backgrounds and emotional makeups to their work environment and each will find partial satisfaction of many needs at the same time, but to greatly varying degrees.

> For many enterprises, given the new needs of younger employees for more autonomy, and the rapid rates of social and technological change, it may well be that the more participative approach is the most appropriate. But there will still be many situations in which the more controlled and formalized organization is desirable. Such an organization need not be coercive or punitive. If it makes sense to the individuals involved, given their needs and their jobs, they will find it rewarding and motivating. (Morse 1970)

II. QUALITY CONTROL CIRCLES

The Japanese have made a clean break with a tired, outworn theory which plagues the West. This is the theory that the company's quality troubles are due to operator indifference, blunder and even sabotage. Under this theory, the operators could solve the company's quality problems if only the right motivational lever could be found and thrown. The Quality Control Circle concept starts with a different set of beliefs:

· We don't really know the cause of our quality troubles. Hence;
· We must teach people how to analyze the trouble pattern to identify the main troubles. Also;
· We must teach people how to list the suspected causes of the main troubles, and how to discover which are the real causes. Then;
· We must help people to secure remedies for these real causes. Finally;
· We must teach people how to hold the gains through modern control methods. (Juran 1967)

The concept of Quality Control Circles, like so many manufactured goods found on today's marketplace, has its origins in Japan. Quality Control (QC) Circles originally evolved as problem-solving groups of hourly employees, who dealt with relatively low-level problems, thereby freeing up the engineers and managers to do what would be, for them, more challenging and valuable work. QC circles have grown in scope from this initial concept to encompass higher company levels, so that today we see manager's circles, engineering circles, accounting circles, teacher circles, and circles of numerous other professional disciplines.

But in Japan, it started on the factory floor:

> ...as the quality control activities of the
> first-line workers on the shop floor whose
> responsibilities are to prepare the quality of
> manufactured products: the QC circle consists of a
> group of workers and foremen who voluntarily meet
> to solve job oriented quality problems. (Kondo
> 1976)

A similar definition, taken from a training manual prepared for the instruction of U.S. circles, describes them as: "A group of people who voluntarily meet together on a regular basis to identify, analyze, and solve quality and other problems in their area." (Dewar 1979)

There are two commonalities apparent in these two definitions, the first being the emphasis on the voluntary nature of circles. Circle activity is not to be viewed as another job-related assignment tacked on to a worker's job description by management, it is totally voluntary. Typically, people working together in one area of the company volunteer to form a small group to meet, either on their own time, or on the company's time, to solve problems in their work area. And that is the second common aspect; they work on problems occurring in their own work area. They do not attempt to solve the problems of personnel, payroll, or the unions. The group process used for problem solving by circles provides an essential combination of skills and abilities which are integrated into an effective team. The objective of these circles is to improve the ability of people to perform their assigned jobs. This

makes their jobs easier, more interesting, and results in yield improvements, quality improvements, and cost savings for the company. It has often been described as "working smarter," not "working harder."

In striving for these objectives through voluntary circle activities, with the support of management, additional benefits are realized in the behavioral areas. By recognizing individuals as having the potential for attaining company objectives, management gains an increase in employee motivation, improved work attitudes, and a real sense of personal worth among their work force. It allows the individual a degree of creativity in an otherwise boring routine and thereby fosters an atmosphere conducive to self-improvement. "The QC Circle restores a critical but long since removed dimension--the opportunity to think, to commit one's mind as well as one's hands to the job." (Amsden and Amsden 1976) A strengthening of relations between the employees and the company results from this positive attitude, together with an improvement in company performance.

History of QC Circles

QC Circles in Japan

Following World War II, the Japanese began to study the industrial techniques of other nations in an effort to improve their economic recovery. They also recognized the

low level of quality evident in Japanese products being exported; "Made in Japan" had connotations of inferior products at cheap prices. Accepting an invitation by the Union of Japanese Scientists and Engineers (JUSE) in 1950, Dr. W. Edwards Deming gave a series of lectures in Statistical Methodology. This was followed by Dr. Joseph M. Juran's lectures on the Management of Quality Control in 1954. These constituted Japan's introduction to modern quality control methods. Dr. Kaoru Ishikawa, of Tokyo University, under sponsorship of JUSE, then tied these statistical and quality sciences together along with the theories of behavioral scientists such as Maslow, Herzberg, and McGregor.

The Japanese management philosophy differed somewhat from the view held by American management at that time; they left a good deal of the planning and creativity to be carried out by the production force. When Dr. Ishikawa wrote his textbook, Introduction to Quality Control, in 1952, his intention was to teach quality control methodology to managers in all functions. He envisioned the Quality Control Department as having primarily an advisory, consulting, and promotional role. He also felt that they should be responsible for a periodic quality audit throughout the company. He saw the next logical step as the extension of training in quality control to the "Gembo-cho," or working foremen. Dr. Ishikawa's group of

consultants in JUSE edited a quality control textbook for foremen, which then became a series of radio broadcast courses in quality control. Ninety-one lessons, each fifteen minutes in length, were broadcast daily from June through September 1956. The series was repeated later that year, and became so popular that it was repeated annually through 1962. The radio text for the course sold over 100,000 copies. A series of weekly TV lectures was broadcast from April 1960 to March 1961, each thirty minutes long.

The journal, <u>Quality Control for the Foreman</u> (<u>Gembo to QC</u>) was begun in 1962 on a quarterly basis, and later changed to monthly. An annual Foremen's QC Conference was begun in November 1962. The editors of <u>Gembo to QC</u> took the initiative for the QC Circle concept, recognizing "...in the non-supervisors an immense potential for contribution through training and motivation." (Juran 1967)

The QC Circle concept was born in 1962, with the official registration of the first QC Circle. The ideas behind the educational activities which led to the formation of this first circle, and the hundreds of thousands which followed it are summarized by Dr. Ishikawa:

1) Products won't improve in quality unless a large number of workers who actually manufacture them at workshops are well aware of the necessity of better quality and practically knows how to improve product quality continuously.

2)   To this end, it is more essential to educate and train first of all foremen or leaders of operators rather than to train the ever-increasing number of operators.

3)   It is far more effective to have well-trained foremen teach and guide operators in quality control and other functions at the workshop....it is supposed that such guidance and teaching of operators by foremen might be conducted more fruitfully through OJT plus small group activities rather than formalistic collective education in external seminars.

4)   Generally speaking teaching and learning won't turn out useful and fruitful unless what has been taught and learned is applied to practice at the workshop.

(Ishikawa 1968)

QC Circles in the United States

Following the inception of QC circles in Japan in 1962, a few U.S. firms tried to utilize the techniques to their advantage, but at that time it was felt that you could not simply "transplant" the concept of QC circles from Japan to the United States. It was felt that circles were too closely bound to the Japanese culture and simply would not work in America. Therefore, they were very heavily "Americanized," and in so doing lost most of their successful attributes. These attempts invariably met with failure, and nothing of consequence was accomplished.

In 1973 a team of Japanese QC Circle leaders visited Wayne S. Rieker, then MSD Manufacturing Manager of Lockheed Missiles and Space Co.,Inc., Sunnyvale, California. Just prior to their visit, Lockheed had experienced both cost

overruns and reliability problems with their Poseidon Missile program under government contract. The Quality Control department had responded to upper management enquiries by saying that they "couldn't inspect quality into a missile, it had to be built in" and laid the blame on manufacturing. Rieker, in his capacity as MSD manufacturing manager, found that company morale was low. In his words, "It seemed to me that I needed the cooperation and willingness of the whole work force. I was conscious of feelings which seemed to say, 'I just do what is forced on me,' or 'Lockheed isn't interested in me, so I'll do the minimum,' etc." (Rieker 1976) He wanted a way to convince his workers that "what was good for Lockheed was good for them." Then, with the visit from the Japanese QC Circle leaders, he realized that the converse was also true, "What was good for the employees might also be good for Lockheed." What he heard from the Japanese team motivated him to study the QC Circle concept further. He investigated U.S. involvement and found that the few U.S. attempts had been failures. His next step was to assemble a team of six Lockheed managers in November of 1973, and visit eight major Japanese companies to study their QC circle activities. The visit made a great impression on all of them, Rieker and his team became committed to the idea and met with members of JUSE and with Dr.Ishikawa to

obtain Japanese training material which could be incorporated into an envisioned program at Lockheed.

During the first portion of 1974, the training material contributed by JUSE was translated into english. The decision was made to copy, with no modifications, the techniques implemented by the Japanese firms which they had visited. Rieker had come back "convinced that people were people, regardless of nationality", and that what worked in Japan would work in the United States. The necessary supporting corporate infra-structure was developed, and late in 1974, the first successful U.S. circle became a reality at Lockheed. Within a year there were fifteen circles, and by the second year that had doubled to thirty circles.

The success at Lockheed became a model for many other corporations, and Lockheed managers shared their growing expertise with many who wanted to form QC Circles. As U.S. involvement grew, the International Association of Quality Circles (IAQC) was formed in 1978. This organization issues a quarterly journal and publishes training material for QC Circle start-ups. It also sponsors seminars and annual conferences.

Some individuals in the United States have felt that inclusion of the word "Control" in the title of circles had negative connotations, and have accordingly dropped its use, calling themselves simply "Quality Circles."

Structure of QC Circles

A typical QC circle activity is made up of these components:

> 1) Steering committee
>
> 2) Facilitator
>
> 3) Circle Leader
>
> 4) Circle Members

1) <u>Steering Committee</u>—consists of representatives from major departments within the company, usually managers or top level staff people. They set overall goals and objectives for the QC Circle activities as well as establishing operational guidelines.

2) <u>Facilitator</u>—an individual responsible for coordinating and directing QC Circle activities within an organization. The facilitator is responsible for training the Circle leaders and acts as a back-up for leaders during member training. Some companies refer to this position as Program Coordinator.

3) <u>Circle Leader</u>—an individual responsible for the smooth and effective operation of a QC Circle. The initial leader is usually the existing supervisor, as that person is already recognized in a leadership role.

4) <u>Circle Member</u>—a group of people, ideally seven or eight in number, from the same work area, engaged in similar work who voluntarily meet on a regular basis to solve

work-related problems in their areas. They should all be involved in similar work so that the problems selected by the group will be familiar to all of them.

The list of individuals making up a QC Circle system is incomplete without the mention of a key element--the managers. Without the support of management, any QC Circle endeavor is doomed to failure; it will only be perceived as another "gimmick" to get more work out of the employees. Rieker felt that this was of paramount importance after his visit to Japan: "We were convinced that to bypass either the manager or foremen training prior to the implementation of QC Circles would have doomed the entire Japanese program to an early demise." (Shearman 1975)

QC Circle Activities

QC Circles are formed with the recognition that problems exist within the current work environment which either increase the cost of products or services, or decrease their reliability or quality. The explicit purpose of the circle teams is to address selected problems, analyze them, and attempt to implement a solution. In achieving this objective, the sense of teamwork and accomplishment which each individual feels, provides the satisfaction and encouragement to address yet other problems, further benefiting both the individual and the company.

The sequence of steps which are typically used by trained circle team members in addressing perceived problems is shown in Figure 1. (Amsden and Amsden 1976)

1) Identify goals
2) Collect data
3) Analyze data
4) Brainstorm causes
5) Experiment
6) Analyze results
7) Test solutions
8) Implement solutions
9) Design and implement safeguards

Figure 1. Steps in Problem Solving.

Identify Goals

The first step is the identification of goals. This includes the recognition of one or more conditions at variance with the optimum. Of the many possible problems discovered, a single one is then selected to be addressed by the team. The nature of the problem must be understood well enough to set realistic achievement objectives for the circle. The topic can be chosen by the circle members themselves, or can be suggested by an external source such as management. When Toyota management recognized a decline in circle activities in its plant in 1967, it restimulated the program by "assigning" the handling of customer complaints to appropriate circles. (Shearman 1975) The actual subject for circle projects can vary depending on the skill and knowledge level of the group members. In 1980, JUSE published its thirteenth "Reports of QC Circle

Activities," in which it broke down the categories of circle topics for 508 Japanese plants surveyed in 1979. The list ran as follows:

45%	Cost reduction
30%	Quality improvements
5%	Tooling upgrading
4%	Skill upgrading
3%	Safety
3%	Morale
3%	Enhancement
3%	Environment
4%	Other subjects

(Patchin 1981)

As can be seen, QC Circles are not limited to quality only, but can encompass a broad spectrum of company activities. With newly formed circles, the first projects are usually devoted to improving control of the local processes which are within the control of the circle members.

Data Collection

Once a problem has been chosen, and goals for its solution have been agreed upon, the next stage is to learn enough about the process to gain an understanding into the causes of the problem. The circle members must understand the purpose for the data collection so that correct and relevant data is acquired. Reams of meaningless figures will serve no purpose except to divert attention from the real causes. Therefore, careful consideration must be given to the purpose for which the data will be used, so that a proper interpretation of the facts can be achieved

through analysis of the data. This is where a basic understanding of statistical procedures by all circle members is important.

Analyze Data

Data, once collected, must be organized and arranged in a meaningful manner so that insight into the solution of the problem may be gained. There are many statistical tools which are taught in QC Circles. Some of the more commonly used techniques are:

> Check sheets
> Graphs
> Histograms
> Scatter Diagrams
> Multi-vari charts
> Control Charts
> Pareto analysis

There is nothing revolutionary about these techniques. Most of them have been applied by problem solvers for a long time, and will not be elaborated on. The last item on the list, Pareto Analysis, was a term minted by Dr. Joseph Juran, and named for an Italian economist, Vilfredo Pareto. Pareto had shown that a relatively few individuals controlled much of the wealth, whereas the rest of the people had comparatively little wealth. Many people have used this same concept in a variety of disciplines, calling it a 70/30 rule or 80/20 rule. That is, eighty percent of the value will come from only twenty percent of the items, or seventy percent of

sales originate from thirty percent of the customers. The concept is used by QC Circles to graphically separate the few strategic or important parts from the many, lesser items.

To illustrate the technique, Table 1 shows weekly yield data for quartz crystals out of one department in our plant.

TABLE 1

WEEKLY YIELD REPORT

Reason for Reject	Scrap Quantity
Broken	4
Resistance	7
Shorted	339
Rattle	54
High frequency	23
Scale/count	14
Radiflo	1
Fo error	16
Low frequency	12
Insertion loss	2
Total	472

The first step in preparing a Pareto distribution and Pareto curve is to order the elements according to their measure, not their classification. This has been done and is illustrated in Table 2.

TABLE 2

WEEKLY YIELD, ORDERED BY VALUE

Reject Cause		Scrap Quantity
A	Shorted	339
B	Rattle	54
C	High Frequency	23
D	Fo Error	16
E	Scale/Count	14
F	Low Frequency	12
G	Resistance	7
H	Broken	4
I	Insertion Loss	2
J	Radiflo	1
	Total	472

The data assembled in Table 2 can be conveyed graphically as shown in Figure 2. The final step is to tabulate a cumulative distribution for the number of reject causes and the number of rejects. This has been done in Table 3 and graphed in Figure 3 to form a Pareto curve. The Pareto curve gives an easily understood visual illustration of the percent of reject causes responsible for any quantity of rejects. It is very readily apparent that cause "A", shorted crystals, would be a good candidate for QC circle action.

TABLE 3

WEEKLY YIELD, CUMULATIVE

Reject Causes	Percent of Causes	No. of Rejects	Total Rejects	Percent of Rejects
A Shorted	10	339	339	71.8
B Rattle	20	54	393	83.3
C High Frequency	30	23	416	88.1
D FO Error	40	16	432	91.5
E Scale/Count	50	14	446	94.5
F Low Frequency	60	12	458	97.0
G Resistance	70	7	465	98.5
H Broken	80	4	469	99.4
I Insertion Loss	90	2	471	99.8
J Radiflo	100	1	472	100.0
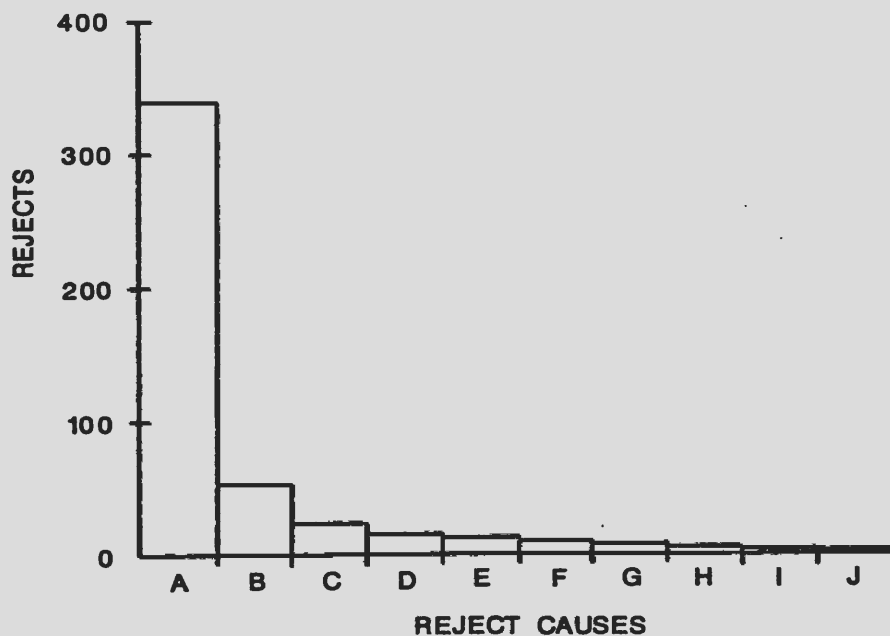
Figure 2.   Pareto Distribution of Crystal Reject Causes.
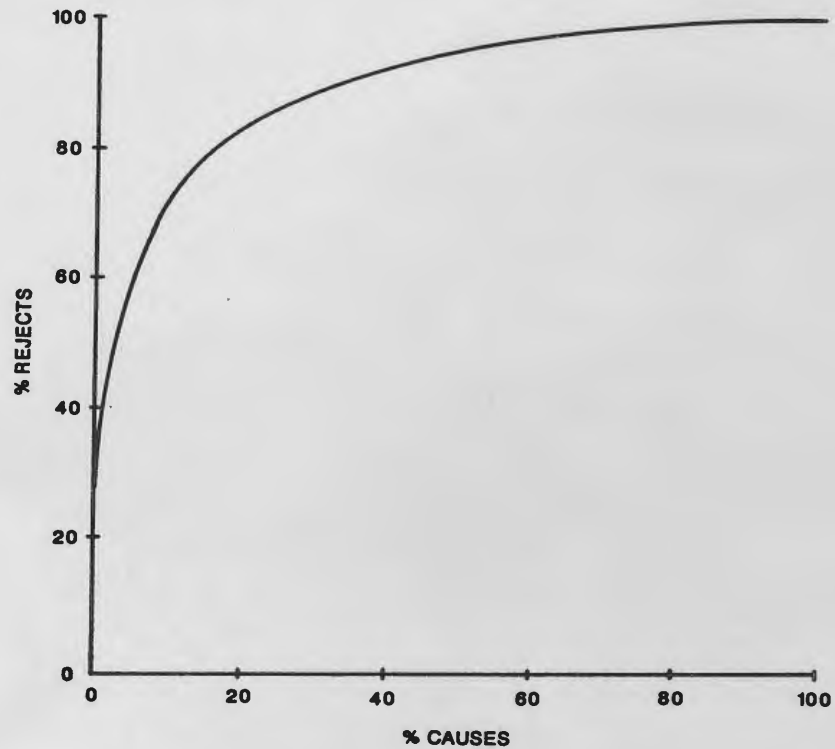
Figure 3. Pareto Curve.

The large majority of QC Circle members are hourly paid employees with an educational level equivalent to high school or less. Most of them will be unfamiliar with some or all of these techniques used in data gathering and analysis. The techniques mentioned above were originally chosen as concepts easily teachable to the circle leaders and members. They limited them, therefore, to concepts which do not presuppose either a strong statistics or mathematics background. In Japan, JUSE offers a six day QC

Basic Course for Foremen and an eight day advanced course. A variety of other courses are available, as well as correspondence courses. In the United States a variety of courses have been available which teach many of the basic problem solving concepts. However, the courses are not as complete and clearly defined for QC Circles as those offered by JUSE. Whether the training is given to circle members as an in-house program or external seminars, it is imperative that they understand these fundamentals. Without the proper tools, they cannot be expected to perform to the level of their Japanese counterparts.

Brainstorm Causes

The reason for having brainstorming sessions is to get all the members of a team to share their knowledge and ideas of the process and problem at hand. The operators on the line are often more aware of the subtle effects caused by various factors than the engineer who designed it. Thus, each member of the team may have a clue which, when combined with those of other members, yields a solution to the problem. Each circle member in rotation, is asked to contribute until all ideas are brought out. No ideas are considered too wild or stupid and no evaluations are made at this stage.

What makes brainstorming sessions so successful in QC Circles is the use of a technique developed by Dr. Ishikawa

at the University of Tokyo in 1950, known as a Cause and Effect (C&E) diagram. He was teaching the basic principles of process control which often requires many factors in a process to be under close control. The relationship between all these factors is often poorly understood, making it difficult to control the overall process. In 1953, while consulting at Fukiai Iron Works, he recommended that the engineers draw cause and effect diagrams for all the processes. This was the first application of this technique in industry and since has been used by virtually every QC Circle in Japan.

> The Japanese name of this diagram is Tokusei Yoin Zu (characteristics and factor diagram). The cause and effect diagram has also been nicknamed Sakana No Hone (fish-bone or fish-skeleton) and Dr.J.M. Juran named Ishikawa diagram for causes in his "Quality Control Handbook."
> (Ishikawa 1969)

A C&E diagram is constructed as follows:

1) Identify the effect or problem for which causes are sought in clear, concise terms. This could have been the most significant factor on a Pareto Chart, or it could have been selected by the circle team in some other manner.

2) Construct the baseline for the C&E diagram by drawing an arrow horizontally with the arrow pointing to a box on the right in which the effect or problem has been written, as in Figure 4.

Figure 4.   Baseline for C & E Diagram.

3)   Draw two or three diagonal branches on both the top and bottom sides of the arrow.   At the free end of these branches, draw a box.   In each box write the principal factors, operations or activities which have a significant bearing on the problem.   For new circles, it is convenient to begin by drawing four branches and labeling them manpower, method, material, and machines as in Figure 5.
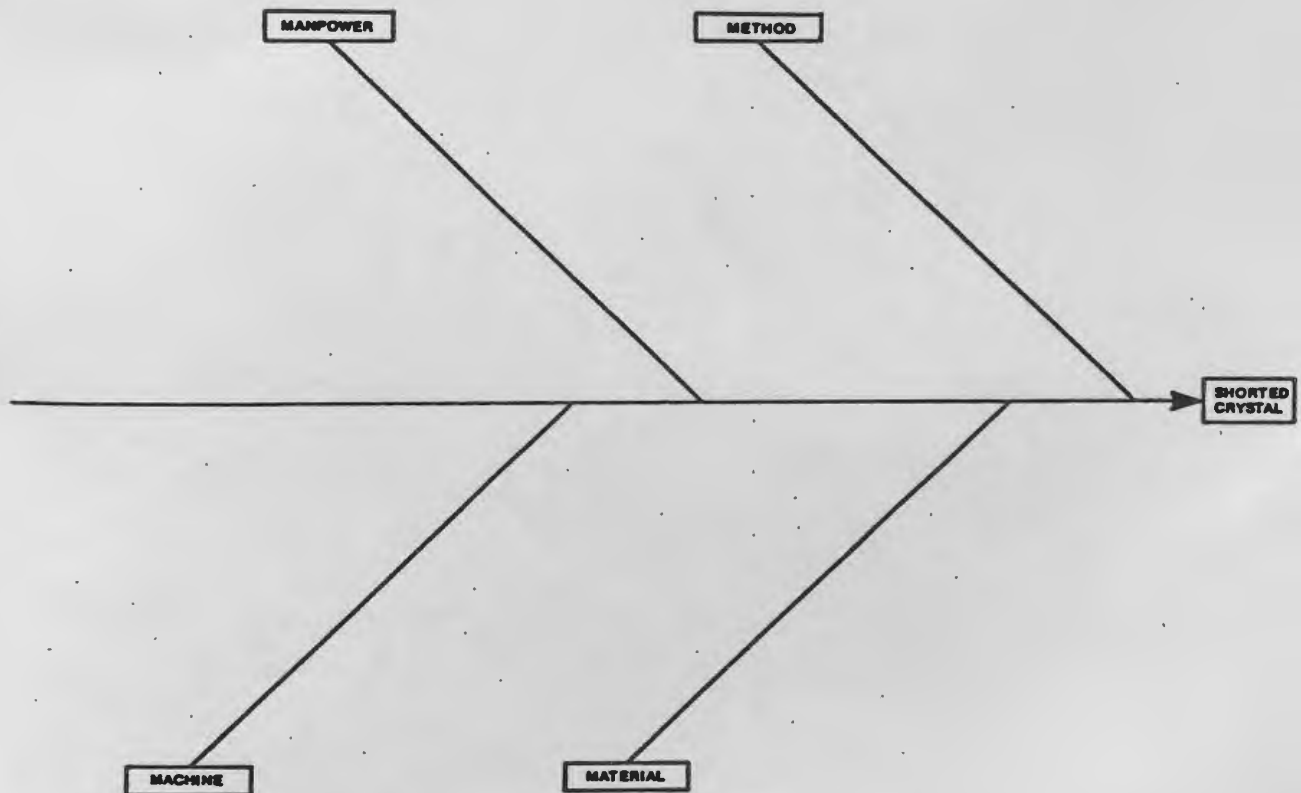
Figure 5.   Principal Branches on a C&E Diagram.

From the principal branches, draw other branches for sub-causes. A partially completed C&E diagram is shown in figure 6.
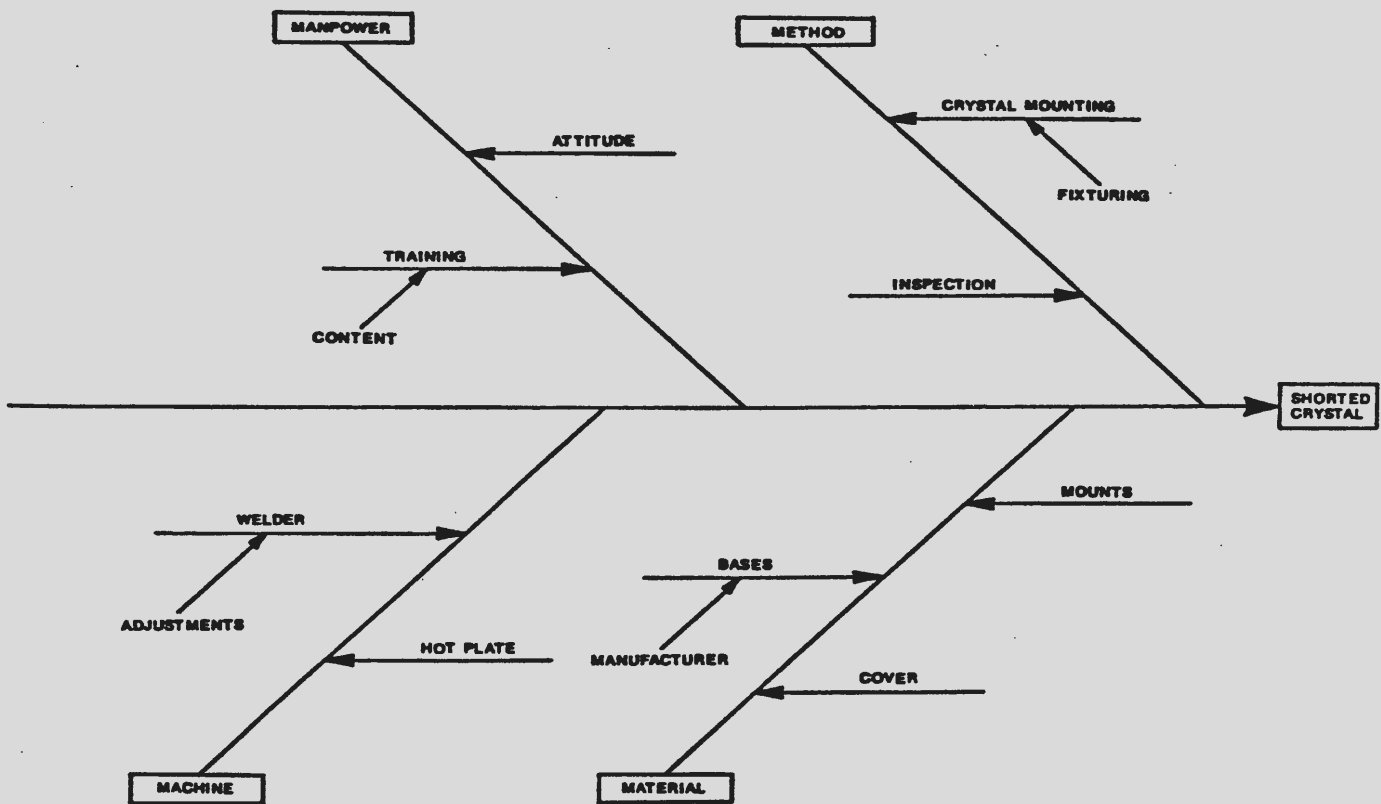

Figure 6. Partially Completed C&E Diagram.

The C&E Diagram is normally generated during a brainstorming session and is used as a visual record of that session. It aids in illustrating in a clear and precise manner how the factors which affect a problem are related.

It should be mentioned that the application of C&E diagraming should not be restricted to problem solving. In fact, this tool is equally useful in the identification of those factors which cause a desired effect. As frequently happens in nearly every process, some results are more desirable than others. All too often the good results are attributed to chance, when in reality they are the result of some variation or change in the process. Stating the desired result as the effect and then seeking its causes can also help identify undiscovered changes which have influenced production or costs.

Experiment, Analyze Results, Test Solutions

After brainstorming, the circle members must select the dominant causes; or classify the causes as major, minor, or trivial, by voting or consensus. Sometimes it is necessary to get the opinion of an engineer or other specialist to aid in the decision making. When the major causes have been decided on, the circle may study them and decide if experiments or further data gathering is necessary to arrive at a solution. When a tentative solution is arrived at, it may then be desirable to make trial adjustments to the process to determine the validity of the solution.

All of these steps are interrelated and may require further use of the statistical tools described above through several iterative cycles before a definite solution is arrived at.

Implement Solutions

Once a circle team has gone through the steps of identifying a problem, analyzing it, and arriving at a solution, it must then implement that solution. But the typical QC Circle is made up of hourly employees; they alone cannot implement changes to production processes or whatever aspect of company business was chosen for their problem. It is management who must make the decision to implement change, and to make that decision, management must be informed. Probably the most important single step in the QC circle activity cycle is the presentation to management, where all the circle members, operating as a team sell their solution to their manager. All of their effort thus far is valueless until the people responsible for decision making have been convinced:

1) That a problem does exist.

2) That the QC circle has recommended a viable solution.

3) That a change should be made to implement that solution.

This is another necessary training area for circle members; the techniques to make an effective sale. It is during this presentation that all the charts and diagrams

which have been used as visual aids for the circle members can be used to show management exactly how they arrived at their solution. All the data and logical processes which were used by the circle members are brought out to demonstrate the thoroughness of their analysis. They end their presentation with a recommendation to management. At this point it is up to the manager to evaluate the recommendation and give a timely response to the circle members concerning his decision.

The presentation to management promotes communication; managers are personally informed of the circle's activities and accomplishments and the circle gains recognition for its contributions. Morale is bolstered by this periodic opportunity to deal directly with the manager and to be reassured of support for the QC Circle activities.

Design and Implement Safeguards

If the QC Circle members were successful in selling their solution, and the recommendations to management were implemented, it would be a mistake to consider that their task was finished. We are all too human, and we have a nasty habit of slipping back into our old ways. In my own experience I find myself repeatedly asked to help solve a problem, only to find that it was the same problem which was solved six months or a year ago. Investigating, I find

that somehow the process reverted back to what it had been before the last change. To prevent periodically "re-inventing the wheel" safeguards should be planned which will insure the continued implementation of a solution.

It all adds up to a team effort, with each group member contributing their talents for the benefit of both themselves and the organization for which they work.

"What is astonishing is the degree to which the Japanese have succeeded in harnessing the energy, ingenuity, and enthusiasm of the work force to the unsolved problems of the company." (Juran 1967)

III. THE JAPANESE EXPERIENCE

In recent years both the American public and American
industrial managers have perceived Japanese manufacturers
as a direct threat to American industry. The Japanese
continue to capture ever larger portions of the American
market for such items as cameras, televisions, stereos,
automobiles, and other consumer products. In the post
World War II era they were known as merchants of junk. The
slogan "Made in Japan" had negative connotations, bringing
to mind cheap, poorly made, low quality merchandise.
Today, the reverse is true, they are under selling us with
high quality, high tech merchandise, and everyone now asks,
"How do they do it?" In August 1980 the Japanese Labor
Ministry published a paper citing three major, overall
reasons for the great productivity of Japanese industry,
the reasons the Japanese themselves give for their success
are:

1. Development of a unique Japanese style of
management. This style is very people-oriented and
it is dedicated to involving the whole of the work
force in improving the operation of industry.

2. Support of the workforce. Partly because of
culture and partly because of the Japanese style of
management, the workforce does not resist efforts
to automate and improve productivity. Most of them
enthusiastically participate in it.

3. <u>Automation and technical development.</u> Japanese industry has embraced any technology they are capable of managing in order to improve both efficiency and effectiveness. (Hall 1981)

These three statements are an attempt to explain, to the satisfaction of the Japanese, the reasons for their industrial success. But, going deeper, what are the underlying causes which drive the Japanese people in their quest for manufacturing superiority. For this we must look not only at the Japanese people, but also at their environment.

Limited Space

Japan is comprised of a relatively small group of islands, smaller than the state of Montana. The total land area is four percent of the land area of the United States, yet they have fifty-two percent of the population of the United States. Whereas the United States averages 62.5 people per square mile, Japan averages 803 people per square mile, nearly 13 times greater. (Funk and Wagnalls 1983) The majority of this population is crowded into the non-mountainous region in the southernmost portion of the island of Honshu. This leaves the Japanese people with very limited amounts of space for living, manufacturing, and storing goods. Efficiency has become extremely important. For example, inventory stored in warehouses is a waste of space, and scrap is useless inventory, therefore scrap is a double waste. This has helped to mold a people

who strive for the highest production yields and the lowest just-in-time inventories.

Few Natural Resources

The islands making up Japan have no oil or coal and very few natural mineral ores. All of the resources required to build a modern technological nation must be imported from other nations. In order to pay for these imported goods, the Japanese must have a way of generating capital. The only practical way of doing this is for them to export goods to other nations. They have chosen to export manufactured goods. That is, they import raw materials, add to it the value of their labor and expertise, and export it at a profit. "Since there are no natural resources to capitalize upon, the Japanese have nothing to sell the world marketplace except superior performance. It is an absolute necessity to be the best at what they do." (Hall 1981)

Common Culture and Race

The United States is proud of its heritage as a "melting pot," where people of all races and nationalities have blended into a heterogeneous mixture. It is felt that each culture brings to this country its own particular contribution, combining many talents to make a fruitful whole. But this type of society is not without its problems. Racial, cultural, and ethnic clashes have marred

the harmony in our society, and are often reflected in the productivity of our factories. Our government even feels pressured to issue edicts and laws to force "equality" among groups, often to the point of creating more inequality.

The Japanese do not have major disruptions because of cultural or ethnic clashes. Most Japanese are descended from a very common heritage compared to that of most Western nations, especially the United States. The main inequality which westerners may perceive among the Japanese is the status among men and women. The men run the businesses and the women run the households. This division of duties leaves the men free to devote themselves to their work lives. Women who are employed are considered only as temporary help. After marriage, their primary task is the management of the household.

Group Oriented Culture

The Japanese often put their feelings as members of a group above their feelings as individuals. This is instilled in them at home and at school during childhood. The cultural tradition for this attitude is the old Japanese practice of wetland farming of rice and other crops. For irrigation farming in small land areas to proceed smoothly, local groups of farmers had to agree on who would get how much water, and when they would get it.

Today, in the work environment, group consensus is often used by the Japanese to decide on major issues. This consensus process of decision making is slow, but since a group consensus supports the decision once it has been made, implementing it usually goes smoothly. This is because they have already worked out the emotions which might cause some of the group to passively resist carrying out the decision. "The buck-passing, blame-casting and bluffing so common in American factories is replaced by an atmosphere of subtle peer pressure to perform and carry out obligations to the group. (Hall 1981)

Structure of Japanese Business

In the United States, employment is often regarded as an undesirable chore, something which one must do to pay the bills, but something which one would rather not do at all. In Japan, employment is nearly an extension of an individual's social life. Japanese companies often assume a paternal role with respect to their employees, providing company housing, training, uniforms, and even organizing extracurricular social and athletic activities. All of this serves to give the employees a sense of camaraderie and team spirit. One important example of this paternal attitude is the concept of lifetime employment. Most of the larger Japanese companies guarantee lifetime employment to every employee up to the age of fifty-five. This covers

between one-third and one-half of the work force. (Bhasavanich 1985) The balance of the workers are considered temporary and consist primarily of unmarried women, and men over the age of fifty-five who have been subjected to mandatory retirement. This lifetime employment guarantee becomes a major consideration in all management decisions. There is a strong incentive among the Japanese to maintain full employment and this becomes a goal of both industry and government.

It should be realized that this lifetime employment agreement works both ways. The company agrees to take care of the employee, and there is also the understanding that the employee for his part agrees to not abandon the company if its prosperity temporarily takes a turn for the worse. As labor requirements fluctuate, it is the temporary employees that are hired and let go; the permanent employees are reassigned to other tasks as needed.

Most of the large Japanese companies break themselves into smaller operating subsidiaries in order to more effectively practice their particular style of management. The relatively small size of these subsidiaries makes it easier for the Japanese workers to relate to the fortunes of their company. It is understood by them that their lifetime employment is very dependent on the continued good economic health of their company.

The influence of the lifetime employment agreement runs deeply through many areas of the Japanese business system. One example of this is the job flexibility of both workers and engineers. In order to maximize the utility of employees over the expected period of their employment, Japanese companies cross train them as multi-purpose workers, able to perform many jobs throughout the factory. Professional employees are usually moved through several positions within the company. This allows them different points of view and serves to promote greater understanding and cooperation between functional groups. As an example of this approach to maximizing the effectiveness of employees, an american engineer with Westinghouse Corporation took part in an engineer exchange program at Mitsubishi Electric Corporation (MELCO) in Japan:

> My project team was at the point of filing patent applications...rotated through the patent section for training...R&D on proof of principle, marketing to generate specifications, design to produce working prototypes, and manufacturing to achieve economical production.....The successful integration of manufacturing, design, and marketing at MELCO can be attributed in part to freedom for the professionals to roam in and out of different disciplines informally. (Bhasavanich 1985)

It is not surprising that in Japanese companies, worker's pay is not based so much on a particular job description as on a combination of seniority and merit. A large fraction of this base pay, often up to sixty percent, is generally paid as two bonus payments each year. This

means that a large portion of each family's income comes in two semi-annual lump payments. There is no Japanese equivalent of the American tradition of living from "paycheck to paycheck." Everyone must save part of their bonus payments in order to survive. This system of pay accounts in part for the high savings rate for which the Japanese are renowned. And this high rate of savings eventually finds its way reinvested into Japanese industry.

One of the problems in the West is that automation is always feared to bring with it some reduction in employment, or at least demotion in job status, which may lead to a reduction in pay. This causes workers to have a negative attitude about equipment or process changes which they perceive as potentially reducing or eliminating their jobs. In Japan, the lifetime employment guarantee virtually eliminates this fear. We have, instead a nation whose workers are eager to assist the company in developing automation because they see it as in their best interest to preserve long-term employment.

Unlike many of their American counterparts, Japanese firms actively encourage suggestions and inputs from their line workers. The responsibilities for all phases of manufacturing are generally passed to the lowest levels capable of handling them, and this is often the worker and foremen categories. For example, the production control staff may develop and present a schedule for manufacturing,

but they do not do any reviewing or expediting. That is left to the foremen and the work force. The floor work force is usually entirely responsible for executing the schedule. The same is true in other areas, such as quality control. Unlike the west, Japanese staff specialists in quality control do not oversee the work of inspecting anything, they serve only as advisors and instructors. "The foremen and individual workers are responsible for the quality of what they produce." (Hall 1981) This practice puts the burden of quality control right at the source from which the parts come--the individual operators at their own work centers. It is common practice (and expected) for a Japanese worker to stop a production line if he or she notices something wrong. This allows corrections to be made before they become costly.

With this encouraging attitude toward the individual workers, it is easy to see how the concept of organizing the work force into small, troubleshooting, problem-solving groups emerged. Call them Quality Control Circles, or Small Group Improvement Activities as Toyota does, or even Jishu Kanri (as they are known in the Japanese steel industry). They are an extremely effective way of involving the total workforce in productivity and quality improvements.

IV. THE AMERICANIZATION OF QC CIRCLES

Can QC circles, an innovative concept developed by the Japanese, successfully be implemented in United States industry? Is there really a need for them in the first place?

The Need for a Change

There has been no doubt for years now that U.S. manufacturers have increasing difficulties competing with foreign producers in both the domestic and international marketplace. Excuses have been bandied about and accusing fingers have been pointed. The government has been asked to "protect us from the unfair foreign competition" by imposing trade regulations. Why is it, in reality, that we cannot compete without government regulations? For years it was said that the Japanese had "cheap labor." That was true enough years ago, but not any longer--the Japanese labor rates are now not much different than our own.

We have often searched for an easy way out of our dilemma. We have looked to our government for artificial barriers; not facing the real problem of our own national productivity. We have believed our own propaganda and moved many of our factories to offshore locations where "labor is cheap," as if labor rates were the real problem.

We should not attempt to place all the blame for our own problems with the other guy, he's doing things right. The real problem has been with ourselves. We have grown complacent over the years. We are a large nation, rich in natural resources, with many people to serve as a ready marketplace. Since World War II we have been technologically ahead of most other nations. We have ourselves been the most ready source of all the products our populace has needed. We have gotten used to easy markets; we have not had to work at it very hard.

The situation reminds me of my attitude towards education as a youth. I found high school relatively easy and so did not work very hard at it. My study habits were poor, but they got me by with good grades. I found I had been sheltered, when I went to college I was rudely shocked into the real world. No longer was the going easy, the habits I had developed didn't work any longer I was forced to change. So it is with us as an industrial nation, there are no easy markets any longer: The world is growing up; many nations are developing into serious competitors for our own home markets. We cry "unfair," they aren't playing by our easy rules; in fact, they have changed the rules.

The problems of our own productivity lie both with the managers and with the workers in our many industrial complexes. They are both caught up in our "system," which has been evolving into ever-increasing degrees of

specialization since Taylor's first visualization of scientific management and Henry Ford's first assembly line.

As a result of all the specialization which has occurred within and between organizations, teamwork has suffered. We now have layers of stratification within our society based on occupation; blue collar versus white collar, workers versus management, line versus staff. While we may have improved the efficiency of individual specialized job functions, the integration and teamwork also necessary to produce the product has often suffered.

All too often, management has viewed the general workforce through the eyes of McGregor's theory X--they inherently dislike work, they must be coerced into doing it, and they prefer to be directed, avoiding responsibility. Sadly enough, our workforce often plays the part imposed by the system, and everyone suffers. It is evidenced by indifference, carelessness, and lack of motivation. It can be summed up as a lack of pride in their own work. I have seen it nearly everywhere that I have worked, people who feel no ties to their company, no sense of responsibilities for its fortunes, who only do enough to earn their pay, and often not that much. This attitude is a reflection of the system, of the management who does not demand better of themselves or of their workers.

At my own company I recently noticed a production lot of quartz crystals cycle seven times through a single metallization process where electrodes were applied. Each time they were rejected by quality inspectors, to be stripped of their plating, cleaned, and plated again. I am afraid that this in not atypical for this particular manufacturing step. The problem varies, sometimes it is operator error, but more often, it is equipment malfunction. Regardless of the cause, the result is the same--inefficiency. The price structure of our product assumes only a single operation at that stage, not as many as seven. It is no wonder we have trouble competing.

Another example from my own experience is the seeming indifference of workers toward the value of their product. We manufacture quartz crystals which range from less than a quarter of an inch in diameter to over one-half inch, each one being very thin. Although physically small thousands can fit in a very small box. They can be worth anywhere from one to ten dollars apiece at various stages of production. What amazes me is the carelessness with which many employees handle these crystals. Hundreds, sometimes thousands daily are broken, dropped or just lost. I have often thought that if those same employees were handling dollar bills which belonged to them, they would take more care. The reality is that they are dollar bills, and they do belong to them and every other employee.

The problem is to educate and motivate those employees. QC Circles can serve as an excellent vehicle to accomplish just these objectives.

Defensive Myths

Both industry publications and the general press have for years been telling of the accomplishments of the QC Circles in Japan. Yet many industrial managers choose not to try them in their companies. Their excuses usually take one of two forms.

The Japanese are Different

The basic tenets of QC Circles are not dependent on racial or cultural suppositions, they are based on observations of the behavioral motivation of individuals in general, as described by McGregor's Theory Y. Dr. Kondo, of Japan's Kyoto University, has been actively engaged in Circle activities with the Union of Japanese Scientists and Engineers (JUSE). He also spent two years in the United States as a visiting professor at the Massachusetts Institute of Technology. He states: "QC Circle activities are not the specialty of Japanese people, but are based on inherent human nature itself." (Dewar 1981)

It is not so much that the Japanese are different, it is more a matter of what they do differently. It is their system that is different; a system that emphasizes the value of their workers. It should be remembered that

manpower is the most important resource for Japan, which lacks other natural resources. They invest in this "human capital" as we invest in developing our other natural resources. The investment takes the form of training and personal development. The end result is an asset more permanent and valuable than machinery, as their employees usually work with the same company for a lifetime.

The difference is one of priorities, and management styles, both of which can transcend national boundaries. Instead of emphasizing our differences, we should emphasize the commonalities which we share.

Our Idea

A second myth that often is repeated is that the Japanese just got the idea for QC Circles from the United States anyway. This refers to the series of lectures by Dr. Deming on Statistical Methodology in Japan in 1950 and by Dr. Juran on the Management of Quality Control in 1954. The statement is usually made in a defensive way, as if to say, " well, it's nothing special anyway, they just got it from us in the first place." This is almost like Einstein's high school teacher taking credit for the Theory of Relativity because he taught him physics. The Japanese turned to us for basic concepts, but then built a whole industrial management structure based on these fundamentals.

>...the success of Japanese techniques for quality management has derived not just from some specific techniques adopted from the West, such as statistical quality control, but from their adaptation of them. (Hull et al. 1985)

Early U.S. Programs

Several programs designed to improve the quality of the manufactured product were developed and in use in the United States in the early 1950s. One such program, developed by the Western Electric Company, Inc. took the tools of statistical quality control, normally reserved for inspection processes, and used them for engineering and operating applications in order to better the manufacturing processes. (Western Electric Co.,Inc. 1956) The principal statistical tool utilized was the control chart. Control charts were conspicuously placed in selected work areas to visually display key operating statistics for the area of interest. These served several functions. First, they kept the workers informed of the performance levels of their respective operations. Secondly, they alerted manufacturing engineering to any abnormal conditions in the particular process involved by displaying unnatural patterns. It also served to determine the process capability by determining a baseline for performance. "The natural behavior of the process after unnatural disturbances are eliminated is called the 'process capability'." (Western Electric Co.,Inc. 1956)

The system also made use of "Quality Control Teams" which were set up by management to oversee the programs in each work area. Each team consisted of a product engineer, the area operating supervisor, and a quality control engineer. The team was responsible for all quality control applications in its area. They met on a regular basis to review the control charts, and if any abnormalities were apparent, they decided on a corrective course of action to restore the process to its normal state.

This early program differed from the concept of QC Circles in several important ways. It was a totally management-directed program; management selected the area, set up the "team", stated the goal, and guided the program. Even more important, there was no direct worker involvement, the only active participants were engineers and supervisors. The only training which the workers received was a short talk by the quality control team explaining what a control chart was, and why they were being installed in their work area. There was no creative contribution from the general workforce, and no ensuing motivation to improve the efficiency of the process or the quality of the product on the part of the workers.

An early program which more closely approximated the QC Circle concept was implemented at IBM's Lexington typewriter plant in the mid-1950s by its manager, Claire F. Vough. The basic principles of Vough's total productivity

system were:

1) Pay for productivity
2) Promote for productivity
3) Work simplification & suggestion system
4) Training for quality workmanship
5) Total responsibility
6) Departmental workshops

(Hamson 1986)

Both base pay and pay increases were based on productivity alone. The idea was to eliminate favoratism, who-you-know, time-on-the-job, and education alone as factors influencing pay rate and position within the company. He believed that this established a trust in the personnel policies of the company, and served as a base upon which to build the rest of his system.

The work simplification and suggestion system were begun in 1958, and were based on Vough's idea that:

> A person who does a job knows that job better than any expert, and work performed only by a person's hands--without the use of his mind as well--is a sheer waste of talent. What would happen if we helped people become their own industrial engineers? The basic principles of motion efficiency were not beyond the comprehension of anyone in our plant. After learning these principles, if each person were to decide for himself how to do his job better, he'd really do it better.   (Hamson 1986)

IBM invested 65,000 manhours in a plantwide work simplification training program for the workers. The program took two and a half years to complete. The result was a fifteen hour training course. This training program

also prepared the employees to participate in the company suggestion system.

In addition to the work simplification program, Vough designed and set up a plantwide education program to train all employees in workmanship analysis. The employees were trained to evaluate their workmanship themselves, and to be aware of the factors which could affect the quality of their work. They were also educated as to how their operation fit into the total production system.

Vough believed in "Total responsibility", he organized each work place as much as possible into vertical lines of responsibility, so that each person or department was responsible for a single complete product. The objective was to provide a positive motivational factor by allowing each individual a greater degree of personal identification with the product of their efforts.

He also set up a system of non-voluntary departmental workshops, which were department meetings held only when managers perceived a problem which needed to be addressed. All employees would then utilize their training to brainstorm the problem for a possible solution. The philosophy behind this total quality system can be summed up in the following quotation:

> Vough looks upon traditional quality control departments as being cost generators that really only perform two tasks: sort good from bad and ask

everyone for reports. Vough maintains that quality is the job of the individual employee and the employees in his or her group. (Hamson 1986)

The main difference between Vough's departmental workshops and quality circles were the fact that the workshops were non-voluntary, involved the entire department, and met only when the department manager felt the need to address a single problem. They were similar in the degree of training received and the responsibilities which the employees were encouraged to assume. The positive motivational factors necessary for the success of circles were there, as was the support system for total quality.

Total Quality System

The concept of QC Circles developed slowly in Japan, and that is important to remember. It did not spring forth, fully developed, to be implemented by an expectant industry. It grew in an environment conducive to its growth, a people-oriented manufacturing system where the accent is on personal and collective responsibility for quality and not upon an inspection model which relies on the talents of the specialized few. QC Circles were never intended to be used alone, or to be a panacea for all quality and production problems. They grew as an important, yet finite, portion of a whole management philosophy. They exist within an organizational context which reinforces and augments them in many ways. QC

Circles provide one important vehicle for unlocking the potential for worker contribution within an organization.

There is a need in America for a vehicle such as QC Circles. But in our haste to save our industries, we should not grab unprepared at any concept perceived to be a salvation for us. QC Circles have been shown to be effective in unleashing the potential problem-solving capabilities of workers; But the context in which they are used is important. They act as a focal point for the quality motivation of the workforce. But under the wrong conditions, they may be an inappropriate response to a company's quality problems. They cannot just be plucked out of context and inserted into an otherwise quality-hostile work environment. Many companies in the past decade have perceived them as the current fad, jumped on the bandwagon and started circles. Often there was initial enthusiasm, maybe even some beneficial results. But there was no nurturing provided, and like an isolated organism deprived of sustenance, they withered and died. That is the problem encountered when QC Circles are thought of as a fad or just another program. Programs have beginnings, and endings--only to be replaced by other programs. The Japanese have institutionalized QC Circles as the normal way of doing business. After twenty-five

years in operation in Japan, QC Circles show no signs of
fading from the scene.

In order to successfully implement QC Circles into
American industry, the stage must be set for their growth.
Management attitudes must be receptive to the idea of
giving the workers a degree of freedom in addressing
problems in their workplace. Middle management and
engineers often feel threatened by the idea of workers
encroaching on their territory. Without genuine support
and faith, if there is lip service only, the circles will
be just another program, and fade.

If the objective of the company is to achieve high
quality products, with the resulting benefits of efficiency
and high product yields, they must remember that QC Circles
operate as part of a whole.

> ...I believe the key to long-term success is in the
> integration of QC Circles into the mainstream of
> organizational operations....Quality control refers
> not only to the product being produced or the
> ultimate service provided, but to every job in the
> company. (Rieker 1983)

An appreciation of quality must become instilled
throughout the workforce, integrating and mobilizing all
resources to strive for continuous improvement toward
organizational excellence. In Japan, the objective of
quality pervades all aspects of the business. "The
Japanese advantage in quality begins with concentration on
specific market segments, which enables manufacturing

operations to be more specialized." (Hull et al. 1985) Whereas many Americans do not think in terms of quality until the manufacturing of a product, the Japanese target a market with optimum quality in mind. Vendors who supply parts to Japanese firms are also a part of their quality consciousness; a partnership develops which assures manufacturers of getting zero defects from their suppliers. The standard practice in the United States is to obtain parts from the supplier with the lowest bid, quality takes second place to cost.

The optimum utilization of the QC Circle phenomenon usually requires a rethinking and restructuring of the organization. This requires a strong commitment from management to support the implementation of the circles.

Implementation in the United States

The introduction of QC Circles into U.S. industry does not happen spontaneously--it requires the initiative and hard work of individuals--people make it happen. Let us assume that the members of a firm have an interest in utilizing the benefits of QC Circles in their organization; where do they begin? Any guidelines which can be given for the implementation of QC Circles within an organization are just that--guidelines. Each company is a unique entity, and its particular situation must be carefully considered

when designing a successful quality system. The Japanese themselves first observed and studied what was being done in other nations, and then set about designing a system that meshed with their own unique culture and concerns. The implementation of a successful system does not come easy, it requires much thought, study, and planning before any actual changes are made within the company.

The basic stages of progression which are helpful in initiating and maintaining a viable QC Circle activity can be listed as follows:

1) Study.
2) Involve managers and leaders.
3) Lay the groundwork.
4) Training.
5) Indoctrinate employees.
6) Form circles.
7) Act on circle output.
8) Monitor circle progress.

In theory, QC Circles sound like a cure for many of our industrial ills; in practice, there are many less obvious complications to be considered and resolved before circles can be considered a success. Management should give careful consideration to the organizational impact of the participatory nature of circles. It must be determined

if there is a readiness on the part of management to accept
and reinforce the desired change. In order to understand
these effects, those responsible should study the theory
and application of QC Circles by reading, utilizing a
consultant, visiting firms with working circles, or
attending seminars and conferences.

The eight stages enumerated above should not be
thought of as separate, sequential phases; in reality they
overlap and are often coexistent. For example, the study
stage is an ideal time to get the appropriate managers,
prospective facilitators, prospective circle leaders, and
concerned union representatives involved. As Wayne Rieker,
founder of Lockheed Missile Systems QC Circles stated:

> If the Quality Assurance people had come to
> me proposing this program and asked me to devote my
> time to support their goals, they probably would
> have struck out. But somehow I have been conned
> into thinking this is my program to support my
> goals, and, of course, in that case I will devote
> all the time it takes to make it successful.
> (Rieker 1976)

There must be a sense of ownership by all members
involved before the necessary level of commitment is
obtained. In a study performed by International Resource
Development, Inc. for the Department of Defense, a panel of
ten U.S. experts on QC Circles was surveyed and it was
found that:

Seven of the fifteen conditions that the panel rated most important deal with the level of support within an organization for the quality circles process. (Sealye and Sween 1983)

This support must include upper management, middle management, technical support management, supervisors, prospective circle members, and union leaders. Lack of support or apathy from any of these groups can adversely affect the success of circles. For small companies with few resources, it may be advisable to make use of one of the many consulting firms available for a thorough coverage of QC Circle activities. It is impractical to attempt to force key people to believe in circles; they must be educated and shown the many successes which exist until they, too, have an honest commitment.

It must be remembered that QC Circles cannot exist in a "quality vacuum"; they must be part of a company-wide quality consciousness in order to succeed. The quality goals of the organization must be considered, not merely the concerns of a single department or group. When Matsushita Electric took over the U.S. Quasar Television plant in Illinois in 1976 they found that communications were poor between the American managers and workers and that quality consciousness was extremely low. They decided to undertake a slow educational program to improve the situation to a point where circles would have a reasonable chance of success.

They began by issuing a monthly 'Quality Bulletin' to workers and proceeded simultaneously to increase the sharing of information with workers on production and cost-related matters. (Cole 1980)

A careful study by management of both the requirements of QC Circles, and the current environment within the company will reveal the next steps to be taken. A decision can then be made either to initiate circle activity or to take further steps which may be necessary to ensure the success of circles. It would be imprudent to pursue circles prematurely. If the attitude within the plant is hostile toward the participative management style required for circles, it would be a mistake to attempt to start them. The support would not exist; they would limp along for a time, and fade away. They would then be considered as a program which had failed, and they would not be pursued again. This is the groundwork which must be laid; if they are to succeed, careful preparation must go into their formation. Suitability for circle formation must be considered on a case by case basis, no two companies share the same management-worker relationship, or the same company-wide attitude towards quality.

Let us assume that the decision has been made, and agreed upon by all those responsible, that the first circle should be formed. There are many details which must be worked out. It is usually wise to start small; a group or

section within the company should be selected to form the first circles. Administrative details must be worked out. These include: organizational responsibilities and structure; facilitator responsibilities; meeting place; frequency, time and duration of meetings; technical support; financial support; and sources of training materials. All of these factors must be tailored to the individual organization; no one combination works in every case. Some companies hold meetings during working hours; others hold them after hours; with or without overtime pay. Larger companies with the resources often develop their own training aids, while small companies usually purchase them from consulting firms. Many companies hire an outside consulting firm to attend to all these details; studying the company and making their recommendations to management.

Along with the administrative and organizational details, the personnel preparations must be made. This includes the selection and training of circle steering committees and facilitators. The implementation of circles is not easy, it requires skills frequently not emphasized by the company in the past. Training will necessarily be an on-going requirement for the benefit of all. Managers must learn to become effective coaches and supporters of team leaders, supervisors must learn to be effective team leaders, and employees must learn to be competent

facilitators and effective team members. All must learn to work together.

Once the leaders are trained in the fundamentals of circle activities, motivation, and communication skills, it is time to work with the employees. They must receive indoctrination into the concept of QC Circles--what they are, what they can do for everyone, and how employees can volunteer for them. In order to receive the support of the workforce in this endeavor, trust in management had to have been previously established. If the workers see circles as a sham or merely as lip-service to get more out of them, they will not be willing to participate.

The number of initial circles formed will depend on the degree of response from the workforce. Initial circle size should be limited to ten. If there are more respondents, either additional circles should be formed, or the extra volunteers must be turned away. The careful nurturing of these first circles is important, improper guidance can allow them to become discouraged. A leader should be selected for each circle; with new circles, it is usually best to select the foreman or supervisor for that area as that person is already recognized in a leadership role. The ground rules should be established, and certain areas should be delineated as "out of bounds" for the circles, such as personnel policies and union activities. Early meetings should emphasize training: circle members

should be taught simple basic quality control methods, group processes, problem solving, and communication skills. Training manuals and workbooks are available from a variety of organizations which effectively cover these basic skills. Members should keep meeting minutes and periodically the leader and facilitator should issue a report to circle members and responsible management, advising everyone of the status of circle activities and the progress which has been made. After the circle members become introduced to the analytical and problem-solving tools available to them, they should select a problem to address as a team. Initial problems should be relevant to those involved, and within the experience of the participants. The subject should not be so difficult that members become discouraged or lose interest.

As the circles grow in experience and competence, the problems which they have addressed will be successfully solved and require implementation. This is the point where the communication skills they have learned become valuable. They must convince management of the desirability of their plan of action in a formal management presentation. This is an opportunity for management to listen to members and to recognize their various abilities and talents, as well as accomplishments as a team. The circle members can feel a sense of pride in having accomplished an objective which

they chose to address, an accomplishment which benefits both them as individuals, and the company for which they work.

At this point it becomes important for the manager to respond to the circle output generated by the management presentation. The manager should, in a timely manner, either act positively on any suggestions, or explain why action should not be taken at this time. Praise and recognition should also be given to circle members for a job-well-done. This encourages the circle members to gain from their experience and move on to other problems awaiting solutions.

The last step in the process is an ongoing one; the continual monitoring and upgrading of all circle activities. The number of circles can be gradually expanded as the member enthusiasm grows. The training programs can be upgraded, more advanced problem solving tools can be generated by encouraging participation in local, regional, and national QC circle meetings and symposiums.

All of the above steps are necessarily a generalized description of the implementation of QC circles into any organization. Adaptation to individual requirements is a must. Each company must evaluate the suitability of different modes of operation to their particular situation and needs.

QC circles have been initiated by more than twenty-five percent of the major American corporations. (Hull et al. 1985). This, together with the many smaller firms represents many thousands of circles operating within the boundaries of the United States. What fraction of these are effective, it is hard to tell. In spite of all the publicity which the Japanese circles receive, they are not entirely successful either:

> Even in those plants recognized as having the best operating programs, management knows that perhaps only one-third of the circles are working well, with another third borderline and one-third simply making no contribution at all. (Cole 1980)

Just as the Japanese originally designed QC circles to fit their industrial requirements, so the many U.S. firms have adapted and modified their circles to fit their needs and situations. Often the names were changed, giving each company a sense of ownership in its system.

A brief description of the manner in which several U.S. firms have handled the implementation of circles or circle-like structures will serve to illustrate some of the ways in which American managers have adapted them for their own use.

At Loopco Industries, Inc., Twinsburg, Ohio, quality circles were started after the company president completed a QC study program. The results: "Not only has employee

morale improved, but production costs have been reduced by seventy percent on two recent projects." (Pascarella 1982)

The Pamona Division of General Dynamics has had a long history of employee involvement through standard quality circles. Recently, as part of their "Production Quality Improvement Program," they launched fifty separate task forces all with the goal of reducing scrap and rework. These task forces were overlaid on top of their existing quality circles in order to benefit from the training and problem solving which had already been developed there. The problems to be addressed were given by management, rather than being selected among themselves, in the form of a monthly listing of the "top 10" scrap and rework problems in their areas. (Letize and Donovan 1986)

At Honeywell's Chandler Facility, a different approach was taken. Instead of soliciting for volunteers, all 120 employees were placed into small teams (8 to 10 people/team) according to the job tasks which they were performing. Each team was composed of the workers in an area, their supervisor, and their technical support engineers. Each team learned quality circle problem-solving techniques and applied those techniques to problems in their own work area. Each team followed the process through to management presentations and implementation. The results were impressive:

During the first ten-month period; productivity increased by more than 40%; product yield climbed from 78% to more than 95%; and the actual cost of the product was reduced by more than 40%. Employee attitudes improved in almost all areas...After three years, the Chandler plants' productivity was up by 330%. Product yield was better than 98%. The cost of the product was less than 50% of what it had been. (Stinnett and Van Horn 1986)

Total employee involvement has been successfully operating at Honeywell for over five years now.

Westinghouse Defense & Electronic Center has implemented a digression from the standard QC circle concept in the form of REACT TEAMS (Respecting Employees Answers Communicates Teamwork and Team Effort Accomplishes Many Solutions). Unlike QC circles the program is informal, there is no training given to the participants in quality, statistics, or problem solving methods. The employees are asked to volunteer, and then are given tasks with defined objectives. They are expected to brainstorm, solve the problem, implement the solution, and then give a presentation.

Some of the benefits resulting from this program during the period of 1982 to 1984 were: a reduction in absenteism and tardiness by 24%, efficiency improved from 79% to 90%, quality yields improved from 97.7% to 99.5%. (Jenkins 1985)

Hewlett-Packard started using participative management techniques during its early years with small

group meetings to identify problems and discuss their resolutions. This pre-existing framework made them receptive to QC circles. The first circles were started in a Japanese division in 1973. It was not until 1979 that the first "pilot quality teams" (Hewlett-Packard's name for QC circles) became operational in the United States. Hewlett-Packard is decentralized, therefore there is no central group to oversee and assist the individual operations, which leaves each division to determine its own format. Most have retained the traditional QC circle format, while some have developed their own particular style. The initial programs predominantly started in manufacturing operations but have spread across the organization. Circles can now be found in engineering, information systems, sales, accounting, and other departments. Although there is no formal reporting procedure, over 95% of all management presentations are accepted by management as a result of circle presentations, with the approval to go ahead. (Riley 1983)

The Santa Clara, California, division of Hewlett-Packard is one of the groups which has deviated from the normal implementation of QC circles. Their operation produces high precision quartz resonators, the same type of product which the company I work for manufactures. They have combined statistical quality control with other analytic and decision-making techniques

current average repair time is 2.1 days. The average repair time for precision oscillators was cut from 100 days to 15 days. Polished crystal yields went from 75% to 95%, clean room yields climbed from 57% to 90%, and during the three years TQC has been operational overall yields increased from 35% to 75%. In addition, the overall performance characteristics of the product improved.

Perhaps the most interesting examples of QC circles at work in the United States are with Japanese companies operating in America. There are currently about 500 Japanese companies now manufacturing or assembling here (Holstein 1986) In many cases, the Japanese have purchased failed or failing U.S. concerns; in others they have gone into partnerships with existing U.S. companies. What makes it interesting is that now we have a Japanese manufacturer who is utilizing American soil, with a combination of American and Japanese technology and leadership. These Japanese appear to have skillfully transplanted their production techniques into the American workforce.

> The Japanese approach to production, emphasizing flexible teams, just-in-time deliveries, and attention to quality, demands extremely high employee loyalty, which is a sharp departure from the traditional adversary relationship in most U.S. factories....But Japanese methods seem to produce more results than the confrontational approach still taken by many U.S. employers. (Holstein 1986)

Apparently Japanese management has learned how to translate Japanese methods to fit the American values of equality and individualism. The results show it. Toyota Motor Corp. has entered a joint venture with General Motors called New United Motor Mfg., Inc. (NUMMI) The Japanese management set up a typical Toyota assembly line at an old GM plant to assemble Novas. The company states that its costs of production is "comparable" to Toyota's costs in Japan. When GM operated the plant, there were usually 5000 grievances outstanding and absenteeism was running twenty percent. Today there are an average of two grievances outstanding, and absenteeism is now running under two percent. It is estimated by Integrated Automotive Resources Inc., a Wayne, Pa. consulting firm that it takes NUMMI employees about 21 man-hours to assemble the Nova, while GM's most comparable model, the Chevrolet Cavalier, takes 38 man-hours.

> 'Now management's given us a voice and more responsibility and listens to us.' Says a NUMMI executive: 'The difference between now and under GM is like night and day.' (Holstein 1986)

The arrival of Japanese manufacturers in the United States will undoubtedly intensify the pressure on American managers to make crucial choices about the structuring of their companies and how they do business. There can be no argument about whether the system can work in America, it is merely a matter of the proper implementation. "Neither

U.S. labor nor management can argue that Japan out competes them only because Japanese workers live in tiny houses and skip vacations." (Holstein 1986)

The Future

What does the future hold for us as an industrialized nation facing the tremendous competition from the many developing nations worldwide? Are we succumbing to the pressure? There are many who suggest that we are becoming a service- and information-oriented nation. Are we to relinquish our production capability and base our economy on another nation's natural resources? Some feel this way, but there are many who are responding positively to the pressures. I am reminded of the Japanese Admiral who said of the United States during World War II, "I fear we have awakened a sleeping giant!" Often it takes our backs against the wall to bring us to reality. We must grow and compete. The answers are there, the Japanese are showing them to us and the rest of the world. We must learn the lessons that they are teaching us.

The Japanese have a more than ten-year lead on us in the area of QC circles and employee development. This shows us a bit of the future; where are they now?

> ...today, the objectives of various Japanese companies are 'to enhance leadership through self and mutual-enlightenment of members,' 'to make the workshop more vital,' 'creating an open-minded working atmosphere, where every employee can feel his work worth doing,' 'raising morale of employees

by upsurging their senses in management
participation,' 'creating a happy and bright
workshop,''...thinking much of humanity,' and
training of successors.' You don't see quality of
product or cost reduction there at all. What you
do see is what we call quality of work life in this
country. (Patchin 1981)

Over the past twenty-five years the Japanese have
moved through phases, they have grown, too--from a single
purpose focus on product quality to the Tcurrent quality of
work-life objectives.

Many of us are still at the first stage--the pursuit
of quality. We must grow, too, and progress through those
same phases in order to achieve a meaningful position in
the world marketplace.

V. CONCLUSION

With today's consumers demanding quality products, and the fact that they now have a broad marketplace to search for quality, U.S. manufacturers must be more conscious than ever of quality in their products and productivity in their factories. In the United States, a "good enough" attitude, coupled with the inability to see quality as an asset rather than a problem has jeopardized our position in both the domestic and world markets.

Our most serious contenders, the Japanese, have started from a position as exporters of "dimestore junk" prior to World War II, to become the epitome of quality and productivity in the world showcase.

We must not let our pride obstruct good sense; we must be willing to learn from them the lessons which they have to teach us. One of their "tried and true" techniques of harnessing the energies of their work force is QC circles. Circles have developed and grown in Japan, as part of a company-wide quality program, and have enhanced both the products of the manufacturer and the work-life of the employee.

The introduction of these QC circles into American industry will not happen spontaneously. It will require both initiative and hard work by key people within an

organization to be able to adapt both their organizational structure and the circles themselves, so that the two mesh into one functional structure. QC circles are participatory by nature, and the management style within an organization must be supportive of this degree of participation by the workers before circles have a chance of working.

The other prime requisite for circles to thrive is a company-wide quality consciousness--an attitude that the quality of the product is dependent on the daily actions and performance of each and every employee.

In order to successfully implement QC circles within a company it is helpful to progress carefully through various stages of development; a typical sequence of activity might be as follows:

1) Study.

2) Involve managers and leaders.

3) Lay the groundwork.

4) Training.

5) Indoctrinate employees.

6) Form circles.

7) Act on circle output.

8) Monitor circle progress.

A detailed description of these stages was given in section IV; they will not be repeated here. These are not "hard and fast" rules, they are simply guidelines which overlap each other in many areas, and may even be performed concurrently. Depending on the strengths of the organization, a company may elect to perform these tasks with their own personnel, or they may hire the outside talents of a consulting agency. What needs emphasizing is that the system should be tailored to meet the needs of the specific company involved.

Circles have been shown to work as effectively in the United States as they have in their native Japan. The Japanese have even brought these same techniques with them to accomplish the same high levels of productivity in the American plants which they now own and operate here on our soil, as they have demonstrated in their homeland.

It is too late for the tariffs and regulations to protect us, for even if we close the doors of our nation, we will find that the Japanese competitors are here already, manufacturing their products in our own cities and states.

It is imperative, then, that we develop the management styles and techniques necessary for us to implement these valuable lessons which can be learned

into our own factories, so that we, as a nation, may once more become competitive among the world's manufacturers.

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