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ABSTRACT

A strategy for increasing worker participation in an effort to remedy the problems of declining productivity and quality is the quality circles concept. The quality circles process involves small groups of employees who meet voluntarily on a regular basis to identify, analyze, and develop solutions to problems and to implement the solutions when feasible. The concept had its beginning in Japanese industry, using W. Edwards Deming's principles and practices of statistical quality control and Joseph Juran's "total quality control." The quality circles movement spread to the Far East and then to South America and the Western world. Nine organizational prerequisites that must be present for success have been identified. Both management and quality circles members share in the responsibilities of providing these. Key elements are management support, voluntarism, training, and union involvement. The quality circles concept combines behavioral science concepts and statistical quality circles analytical techniques. Three behavioral science theoretical bases form the foundation: participative decision making, goal setting, and team building. The vocational education system can facilitate the change to a total quality circles orientation by introducing and applying the concept. (Appendixes include quality circles tool skills and a list of organizations using the process.) (YLB)

Information Series No. 249

QUALITY CIRCLES: APPLICATIONS IN VOCATIONAL EDUCATION

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FOREWORD

Quality Circles: Applications in Vocational Education traces the development of both the quality circles concept and process, discusses the behavioral sciences theories upon which the concept is based, and describes the quality circles process. Recommendations are offered for implementing quality circles in both the administration of vocational education institutions and in vocational education classrooms.

This paper is one of ten interpretive papers produced during the fifth year of the National Center's knowledge transformation program. The review and synthesis in each topic area is intended to communicate knowledge and suggest applications. Papers in the series should be of interest to all vocational educators including teachers, administrators, federal agency personnel, and researchers.

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EXECUTIVE SUMMARY

The quality circles process involves small groups of employees who meet voluntarily on a regular basis to identify, analyze, and develop solutions to problems, and to implement the solutions when feasible. The quality circles (QC) process had its beginning in 1949, when the Japanese Union of Scientists and Engineers (JUSE) invited an American, W. Edwards Deming, to teach the principles and practices of statistical quality control to Japanese industry.

The subsequent work of another American, Joseph Juran, placed emphasis in Japanese industry on a concept known as "total quality control" (TQC). As a result, Japan experienced a growth of TQC throughout industry during the years 1955 to 1960. From three quality circles in 1962, the Japanese quality circles movement has grown to one hundred thousand registered circles involving one million employees. Estimates of additional (unregistered) quality circles and QC members in Japan are as high as one and ten million respectively. The QC movement first spread from Japan to the Far East, and then to South America and eventually throughout the Western world. Today, there are few industrialized nations where industry does not utilize the QC process.

Two fundamental values undergird the QC concept: "total quality control" and "people building." Nine organizational prerequisites (elements of the QC process and its environment) that must be present for success have been identified. Both management and QC members share in the responsibilities of providing these. Key elements are management support, voluntarism, training, and union involvement.

Although success stories about the QC process abound, little empirical evidence of effectiveness has been reported in the literature. However, extensive research exists on the theoretical bases that were used to formulate the QC concept. The QC concept is comprised of an interdisciplinary union of behavioral science concepts and statistical quality control analytical techniques. The three behavioral science theoretical bases that together form the foundation of the QC concept are participative decision making (PDM), goal setting, and team building. Participative decision making is clearly beneficial to both the employee and the organization. Deprivation of PDM leads to job dissatisfaction, high levels of tension, and lower job performance. Conversely, the presence of PDM results in significantly higher levels of job satisfaction and job performance, information flow, worker commitment, and acceptance of goals.

The empirical evidence on goal setting has verified (1) that goal setting increases performance; (2) that, under most conditions, both specific and difficult goals increase performance; and (3) that the setting of goals increases worker commitment. The research on team building similarly has shown that cohesive and mature teams (1) attain higher levels of job satisfaction and performance, (2) are able to gain a better understanding of themselves; (3) become better able to diagnose and solve their own problems, (4) become better communicators, (5) improve their managerial skills, and (6) obtain a greater awareness of interpersonal skills in working with others.

Implications of the QC concept exist for both the individual and the organization. Changes in value systems must occur that encourage individuals to recognize the importance of their contribution to the overall quality of the final product. In organizations, employees must be treated as human beings who are engaged in meaningful jobs in which they (1) can develop and display their abilities as they are given the opportunity, (2) can apply their wisdom and creativity to the work in which they are engaged, and (3) are given ample recognition for doing so.

If the United States is to control its economic destiny, a national resolve to reestablish human resource priorities and effect attitudinal and behavioral changes is needed. Japan invested a generation of effort in achieving the high levels of productivity and quality that are enjoyed there. The United States can best follow the example set by Japan through its educational system. The vocational education system is particularly suited to facilitating this change because of its occupational orientation.

INTRODUCTION

The United States's rate of productivity growth is declining rapidly. Unemployment and inflation remain alarmingly high, the rate of business failures continues to rise, and private sector budgets are being slashed as industry faces consistent losses. Present economic problems are the culmination of a series of events that have occurred over several decades. The Industrial Revolution triggered a wave of consumption of natural resources, the ramifications of which have been addressed only within recent decades.

Industrialized nations have begun to realize that the key to survival is effective and efficient use of resources. Initial attempts to achieve greater efficiency were focused on increased automation and the perception that workers were extensions of machines. It was during this "efficiency" era that Frederick W. Taylor initiated time-study experiments and developed the theory of scientific management. His experiments focused on worker efficiency. From a purely rational, technological perspective, a good case can be presented for the theory that more efficient workers will result in lower labor costs and increased organizational effectiveness. As Toffler (1980) points out, however, the assumption that the responses of people to their work can be programmed and controlled grossly underestimates several factors. Rosow (1981) suggests that the "Taylorization" of our work areas has, indeed, led to economies in the cost of production, but the major consequence has been an enormous underutilization of our most costly and valuable resource—people.

The attitudes of workers have changed since the time that scientific management was introduced. Susman (1976) summarizes this situation as follows:

> Those who actually produce goods and services in our economy no longer consider boredom, alienation, and lack of dignity as integral and necessary to their working lives. (p. 4)

Additionally, scientific management has failed to acknowledge the intensity of workers' reactions to simplified and routinized work. Absenteeism, turnover, sabotage, and labor disputes are all salient manifestations of job dissatisfaction, and the attendant costs are staggering.

In a business environment of ever-advancing complexity, personnel recruiting and training costs represent substantial investments in employees. In conjunction with a high turnover rate, these substantial investments become substantial losses. The implications are that, whereas in many instances, scientific management techniques have brought immediate and visible returns in terms of increased output on the production line, hidden costs are associated with their use. Short-term gains are won at the expense of long-term goals.

In addition to internal problems, companies are being forced by pressures from both foreign and domestic competitors to seek solutions to lagging productivity. According to Katzell and associates (1977), problems are widespread:

> Private and governmental organizations continue to experience problems associated with lack of quality, declining productivity, complacency, poor morale, absenteeism, and employee turnover. (p. 19)

Just as with any other critical resource, employee motivation should be a key area of management concern. Management should recognize, however, that the reapplication of traditional techniques will only intensify current labor problems.

In an attempt to alleviate these problems, American management has begun to adopt many of the organizational interventions suggested by the behavioral sciences. However, business and industry face internal obstacles to the widespread application of innovative concepts such as that of worker participation in management. Some of these obstacles are as follows:

- Worker participation is frequently regarded as being of questionable value.
- Because worker participation in management is new in many organizations, top executives lack skill in using it effectively.
- The concept is often viewed by executives, managers, and supervisors as a threat to their traditional authority.
- The problem of managing an increased conflict of ideas is frightening to many managers.
- Sharing power with workers creates anxiety among managers.

An equally serious obstacle to the success of such organizational interventions as worker participation is impatience on the part of management to achieve short-term economic gains while dealing with a sensitive new procedure that requires long-term processes. In addition, organized labor is concerned that the adversary relationship with management will be weakened, that the problems of collective bargaining will become more complicated, and that new problems for its membership will be created. The shortages of talented third parties who can win the necessary trust and provide the required knowledge to introduce and maintain these various organizational interventions provides still another obstacle. Finally, participation in such processes threatens the framework of conventional, hierarchial organizations and is often viewed as topsy-turvy management that may substitute consensus decision making for authoritarian rule.

A number of economic and sociological factors, however, point to the need for greater worker participation. Today's more permissive and affluent society has fostered a change in attitudes about authority roles. Employees have higher expectations and place intelligent limits on the exercise of authority over their lives. The decline of confidence in business, government, education, and other major institutions has affected employees who are members of such organizations. Rosow (1981) suggests that this relative decline in trust and confidence weakens performance on the job.

Another major sociological problem is a lessened commitment to the work ethic and greater public cynicism that has spread to all classes of workers, from blue collar to professional and top executives (Frederick 1981). Also, the area of rising entitlements has created a widespread feeling that jobs, income, employee benefits, and a higher standard of living are no longer privileges, but rights. Employee expectations for participation in decisions affecting their jobs have reached the point where a majority consider this a right. Sixty-two percent of young workers expressed this view in 1977 (Katzell et al. 1977).

Living within a free and open democratic system, American workers expect conditions within the work place to be compatible with political and social conditions in other aspects of life. Yankelovich (1978) suggests that American workers cannot live this double life of flexibility in the community and rigidity in the work place. Changes in American social values and mores have been rapid and penetrating during the past decade. In contrast, organizations are slow to change. This institutional lag must be corrected to bring organizational life into a more harmonious balance with society and its values. Work is under competitive pressure from other life-styles and interests. Rosow (1981) suggests that the high cost of an educated work force combined with lagging productivity presents a clear necessity to address the new sociology of work, and to achieve the goal of greater participation and more active involvement of the work force. A strategy that has been developed for increasing worker participation in an effort to remedy the problems of declining productivity and quality is known as the quality circles concept, a discussion of which follows.

THE QUALITY CIRCLES MOVEMENT

To understand the quality circles movement, one must consider the origin and development of the quality control circles (QCC) concept. Leading up to the initiation of the first QCCs (of which there were three) in Japan in 1962 were twelve years of preparation. In 1949, the Union of Japanese Scientists and Engineers (JUSE) invited W. Edwards Deming, of the United States, to teach statistical methods to Japanese industry. Deming based his approach on his experience with American industry, where the use of statistical methods had not spread beyond manufacturing departments. When given the opportunity to teach statistical methods to Japanese industry, Deming stressed the importance of using statistical methods *throughout* the organization, from the time the product is designed and materials are procured until a product is in the hands of the consumer.

In 1950, Deming assured fifty top Japanese executives that if they used statistical methods, they would be producing the finest quality of products in the world within five years. Within four years changes such as the following occurred:

- One manufacturer reduced the rework on wire to 10 percent of what it had been previously.
- A steel company reduced coal consumption per ton of steel by 28 percent.
- A pharmaceutical company tripled production on one of its products using the same machinery and the same number of workers.

Deming (1981) defines the forces that came together to cause the explosion in quality and productivity as follows: JUSE, statistical knowledge, the instructing of engineers, and conferences with top management. In 1962, a fifth force was added: quality control circles (QCCs). QCCs were the outgrowth of a long-used Japanese social custom. Kaoru Ishikawa (1980) formalized Japan's traditional group method and brought it to management's attention, along with the important contributions the groups were making in the improvement of work processes.

By 1954, the use of statistical methods was well known throughout Japan, but Japanese top management was far from being conscious of the importance of quality. Joseph Juran (1952), a management consultant from the United States, was then invited to Japan. In his work there, he emphasized the importance of making quality control an integral part of management, practicing it in the total context of management improvement. In his *Quality Control Handbook*, Juran (1952) called this concept "total quality control" (TQC).

Between 1955 and 1960, Japan experienced a significant growth of TQC throughout industry. In some companies, however, it took fifteen years to achieve TQC. The Japanese concept of TQC calls for everyone in the organization, from top management to hourly workers, to be knowledgeable of statistical quality control methods and to participate jointly in the upgrading of company-wide quality control practices. The Japanese now call this company-wide quality control (CWQC).

The growth of the Japanese QC movement since 1960 has been phenomenal. There are now over one hundred thousand quality circles registered with JUSE, and there are thought to be six to ten times that number, in addition, that are not registered (Ouchi 1981). Since each QC is comprised of approximately ten members, as many as 11 million workers are involved in the QC movement throughout Japan. It is quite apparent that Japan is now the world's leader in productivity growth, and in one generation Japanese industry has been transformed from the producer of inferior products to that of superior products. Japanese management made quality its number one priority and continues to enjoy the benefits of that commitment.

Quality Circles Outside of Japan

The growth of the QC movement outside of Japan began in the 1960s as news of Japanese success spread. Most of the early adoption of QC concepts occurred in the Far East: Taiwan, Korea, Singapore, Malaysia, Hong Kong, and the Philippines. In the Western world, Brazil was the first country where QCs were implemented. Today there are few industrialized countries where QCs are not being used, and industries in all of the world's industrialized countries have shown interest in implementing the process.

In the United States, the QC concept was first implemented by the Lockheed Company's Missile and Space Division. In 1972, a group of Lockheed personnel visited Japan to study the QC process and discuss the concept with Japanese managers. Convinced that the process would work, they purchased training materials, hired a facilitator, and formed a small department with the responsibility for implementing the concept. The QC process was implemented in 1974, and within two years thirty quality circles had been formed. A $500,000 investment in the program has resulted in estimated savings of $3 million.

The Lockheed success was widely publicized. The spread of the concept to other United States companies was slow, however, until three individuals who were experienced with quality circles left Lockheed to implement QCs throughout the country. Today there are over fifteen hundred private sector organizations that have some form of the QC process in operation. Unlike Japan, where most QCs are in manufacturing, many of those in the United States are made up of white-collar workers in service, engineering, and other nonmanufacturing areas.

European companies have been slow in adopting the QC process. England, Sweden, and the Netherlands were the first countries where QCs were formed—in the 1970s. In France, quality circles first appeared in 1980, and by the end of 1981, over 100 organizations had implemented them. Some organizations in Italy, Norway, Poland, Finland, and West Germany also have implemented QCs.

It is evident that a worldwide revolution in management has occurred. The Japanese initiated this dramatic change through the diligent application of statistical quality control principles, the adoption of the total quality control philosophy, and the utilization of the quality control circles process. A greater commitment to quality than to short-term profits has resulted in increased productivity, a larger share of the world market, and—ultimately—greater profits.

Quality Circles in the United States

One of the newest productivity enhancing techniques on the American scene, the quality circles (QC) concept, is described as follows (Katzell and associates 1977):

> This technique offers a significant potential for tapping the wealth of imagination and ingenuity that lies within each worker. Called "Quality Circles," it provides an environment for active participation of employees in areas of problem recognition and analysis, together with implementation of corrective measures. (p. 19)

The QC concept attempts to combine several organizational interventions developed in the behavioral sciences into one process that recognizes, involves, and develops the creative intelligence of workers. The QC concept in action is often referred to as a quality of work life (QWL) or an organization development (OD) program. Confusion about these three terms is common, probably because of their similarities. Thus, an attempt to define them is in order.

Quality of work life (QWL) is a generic term that refers to the objectives of organization development strategies. Specifically, it includes employees' perceptions about their work and work environment. The QC concept is implemented so that the quality of work life can be improved. Organization development (OD), on the other hand, is a field of study in its own right—a subdiscipline of applied social psychology. Originating from the behavioral sciences, it includes many concepts that have application in the organizational context. A variety of practical strategies for effecting changes in organizations has, in turn, evolved. The sum total of these socio-psychological theories, along with the strategies for introducing them, is organization development. One of the strategies available to the OD consultant is the quality circles concept.

OD is a widely divergent field and one that is variously conceptualized. A useful conceptual framework was developed by Leavitt (1965) and later modified by Friedlander and Brown (1974). It views organizations as being composed of (1) people who have varying sets of values, styles, and skills; (2) technologies with varying characteristics; and (3) varying processes and structures, each reflecting different kinds of relationships between people or between people and their work. Friedlander and Brown's conceptualization of OD speaks to the need for change in the technology and structure (technostructural change) and/or change in individuals and their interaction processes (human-processual change), rather than an attempt to change only the people, only the structure, or only the technology of the organization.

Human-processual change and technostructural change each have their own approaches, and these approaches converge at the interface of the organizational process and structure. The technostructural approach to organization development includes interventions (i.e., strategies for change, such as job enlargement and job enrichment) into the technology and structure of the organization. The human-processual approach to organization development, on the other hand, includes interventions affecting individuals as they interact with other individuals (intra- and intergroup), with technology, or with structure. The quality circles concept is a human-processual approach to organization development.

Quality Circles

Quality circles are comprised of small groups of employees who voluntarily meet on a regular basis to identify, analyze, and develop solutions to problems, and to implement those solutions when feasible. This definition may be further clarified by a description of the common elements of quality circles—size, voluntarism, meetings, tool skills, and problem-solving methodology.

Size

Quality circles typically range in size between three and fifteen employees, with the preferred size being at least five and no more than ten members. If the group is too small, the interaction among group members tends to be limited, resulting in a scarcity of ideas. If the group exceeds ten members, individuals are not usually afforded sufficient opportunities to participate, leading to apathy and disinterest.

Voluntarism

Workers typically are afforded freedom of choice in joining a QC. This freedom is an initial indication that management is committed to the concept. It is an indication both of how well management understands the QC philosophy and how deeply into the managerial structure the understanding has penetrated. When QCs are implemented on a voluntary basis, their achievements and benefits have a positive effect on the entire organization (given that the process has been properly implemented otherwise). The ultimate goal, of course, is that the QC process will become a way of life in the work place.

Meetings

A weekly one-hour QC meeting is the rule, but there are exceptions, of course. Established QCs sometimes meet less often because subcircle meetings are held to discuss progress during information collection, solution development, or some other phase of the problem-solving process. Decisions about the meeting schedule and location provide management with an opportunity to demonstrate commitment. Meetings should always be held as scheduled. Frequent postponement of meetings communicates to workers that QCs are not important. This also applies to the meeting location. QCs must have a suitable place to meet and must be provided with necessary supplies.

Tool Skills

During the problem-solving process, several tool skills are used by QC members. These are described by Deming (1981) and Ishikawa (1981) as "simple statistical" tool skills. They can be subdivided into two categories, basic and advanced. Basic tool skills* include brainstorming, cause and effect analysis, check sheets, data collection, graphs, histograms, multi-vari charts, and pareto analysis. Advanced tool skills used by QCs include control charts, sampling, and scattergrams.

The basic tool skills are taught to QC members during initial meetings. Six to twelve hours (meetings) are usually allowed for training in the basic tool skills and twelve to twenty-four hours for the advanced skills. The tool skills are at the very heart of the QC process, and it is important that QC members are very well trained in their use.

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*See Appendix A.

Problem-solving Methodology

The problem-solving process (identifying, analyzing, and developing solutions to problems and implementing those solutions when feasible) is basic to QC activities. After receiving training in the problem-solving process, QC members identify and develop a concise definition of a problem. The types of problems QC members attempt to solve range from simple housekeeping issues to complex changes in product or job designs.

The QC leader plays an important role in problem identification because if an intractable problem is selected, the group may experience frustration. Early success in solving problems helps to develop the confidence necessary for long-term QC effectiveness. Although the tools and techniques used are not complex, members unfamiliar with the structure and discipline of the QC process need time to adapt to them.

All members of the organization are invited to suggest problems for QCs to work on, but the choice of the problem must remain with the QC. This structure provides another opportunity for management to demonstrate support for the QC concept. If management selects the problems to be considered, the QC concept cannot survive.

The first step in problem solving is to identify, select and define a problem. Then a method of measurement is selected. This enables a QC to know when the problem has been solved to the members' satisfaction. They then identify possible causes of the problem and collect data to identify the actual cause. Collecting the information required may be time-consuming and difficult. The assistance of others in the organization may be needed to obtain the necessary information. In some instances, QC members use weekly meeting time to collect information rather than meeting in a group.

Once the cause of the problem is verified, a solution is developed. At this stage, the QC members have the opportunity to apply their knowledge and experience. (The QC concept assumes that the workers are experts on their jobs.) Controls are then established to prevent recurrence of the problem, and both the solution and controls are presented to management for approval. Upon securing approval, the QC members implement their solution. This is an important part of the process because it allows them to experience "ownership" in its fullest sense. Being deprived of this experience is detrimental to their participation the QC process. Of course, there may be instances where it is physically or legally impossible for QC members to implement the solution. In such cases, members should be allowed to maintain as much contact with the implementation process as possible by assisting the implementors (as appropriate), and the group should be provided with feedback throughout implementation. Subsequent to implementation, the approved solution is evaluated to determine its effectiveness. If successful, the solution is standardized to the extent possible and shared throughout the organization.

A final step in the process has QC members make presentations to management about the effectiveness of solutions they have implemented. There are two purposes for these presentations: to provide the QC members with recognition for their contributions and (also important) to keep management informed of the progress being made by QCs. When a QC is newly formed and recognition is most important, presentations should be made routinely. As the number of QCs increases, it becomes impractical to present the details of every solution formally to management.

Other key ingredients in the successful implementation of quality circles may be called organizational prerequisites. A discussion of these requirements for success follows.

Organizational Prerequisites to Success

Organizational prerequisites are those aspects of the quality circles process and the environment in which it exists that must be present for success. Nine prerequisites that are either the responsibility of management or of QC members are discussed next.

Management Responsibilities

Management sets the climate in any organization, either by plan or by default. The QC process survives and thrives only in organizations where the climate for worker participation is planned and carefully managed.

Support. Perhaps the primary element necessary to the success of the QC process is management support. Without continual management support, QCs may lack the necessary incentive and energy to continue. Management support (or lack of it) manifests itself in numerous ways, but can best be exemplified within the context of the steps an organization goes through in considering adoption of the QC concept. Preparatory to a decision to implement the QC process, management can demonstrate its support as follows:

- Contributing the time to listen to and understand the philosophy of QCs
- Visiting other organizations that have implemented the QC process successfully
- Investigating the benefits realized by other organizations that have implemented QCs successfully
- Studying the reasons why some QC programs have failed
- Surveying the support of all levels of management for the QC process

Immediately subsequent to a decision to implement the QC concept, management can exhibit its support by doing the following:

- Becoming actively involved in the formation of a QC steering committee
- Writing an implementation plan
- Taking steps to ensure that all aspects of the implementation plan are clearly understood, especially with respect to the voluntarism concept
- Taking the necessary precautions to ensure that common causes of failure are avoided
- Involving unions in order to build a strong foundation of ownership and mutual trust
- Taking the steps necessary to gain the support of all levels of management for the QC concept

When the QC process is fully implemented, a number of means are available to management to reinforce its support. Among these are the following:

- Demonstrating behaviorally its commitment to the voluntarism concept

- Providing the resources (time and funds) for training in the QC process
- Creating a position for and employing a QC facilitator
- Providing employees time to conduct weekly QC meetings
- Providing QC teams with a satisfactory meeting place and necessary supplies
- Providing QC members with time to collect data during working hours (when feasible)
- Providing assistance to QC members when data collection (or some other task) is difficult
- Recognizing consistently the accomplishments of QC members and leaders
- Encouraging and attending management presentations wherein QC members make formal presentations of recommended changes
- Providing detailed rationales to QCs when their recommendation(s) cannot be implemented
- Attending QC meetings periodically
- Not interfering with scheduled QC meeting times
- Supporting the establishment of a measurement system
- Following up to ensure that support from all levels of management is sustained

Voluntarism. Voluntary participation is an underlying principle of the QC concept. Most QC activities occur on a voluntary basis. Employees are given the freedom to choose both (1) to join or not as the opportunity is presented and (2) to drop out at their discretion without any fear of retribution. Sikes and associates (1980) suggest that the need for voluntary participation is not universal. Since organizational climates vary considerably, exceptions are possible, but in most instances QCs based on voluntary participation are most effective.

If employees are directed to participate in an activity like the QC process, the organization becomes vulnerable in the following ways:

- Some of the participants lack the commitment necessary to succeed.
- Such a directive is often perceived as manipulation.
- When employees have no say in the design and conduct of an activity, they do not contribute their energy and creativity to it.
- Such a management policy is likely to elicit the classical adversarial response from unions. The resulting conflict too often creates a win-lose dilemma in which both parties become entrenched in polarized positions.
- The demand that all employees participate in QC activities is inconsistent with the QC philosophy, and the resultant perceived hypocrisy is destructive throughout the organization.

For the QC process to improve productivity significantly, it is imperative that it eventually permeate every facet of the organization. When this occurs, the QC process becomes an accepted way of operating and a natural part of everyone's daily routine.

Training. Goodfellow (1981) reports that only eight of twenty-nine companies studied experienced success in implementing a QC program. The apparent reason for the lack of success of the remainder was the failure to train the QC leaders adequately. QC facilitators, leaders, and members require training in the following skills:

- Problem-solving methodologies
- Problem-solving tools
- Statistics
- Group process issues
- Pedagogical techniques
- Management presentations

QCs are repeatedly faced with the challenge of solving problems that have eluded resolution for some time. Apart from the proper application of the problem-solving methodology and the discretionary use of appropriate QC tool skills (including statistics), problem resolution will continue to be elusive. QC participants thus need intensive training in order to be successful problem solvers.

In QCs, problem solving takes place in the context of group interaction. This added dynamic introduces potential group process problems. Traditionally, training in group process has been reserved for the company QC facilitators. The complexities of group process are too formidable, however, for a company QC facilitator to resolve them unassisted. When QC leaders and members are also trained in group process skills, the QC can collaborate in resolving these group process issues.

It is imperative that QC members receive training in how to deliver effective management presentations. Management presentations are one of the more important sources of recognition for QC members. Poorly organized management presentations not only thwart the members' sense of reward, they may place the entire QC process in jeopardy.

Union Involvement. An adversarial relationship is likely to develop without early union representation in planning for implementation of the QC concept. Conflict emanating from such a relationship creates a win-lose situation in which the QC process is the victim. It is encumbent upon management to initiate a collaborative relationship with unions and upon union leadership to cooperate.

Patience. According to Amsden and Amsden (1980), "The most sage advice when implementing QC Circles in a company is to go slow" (p. 156). Not infrequently, management lacks the patience to limit intentionally the scope of a process it regards as promising—that is, to wait for results. It may take approximately a year for a QC to mature and experience some successes before it can attempt to solve difficult problems. If management is impatient, the QC will ultimately fail. Change is usually a slow and painstaking process.

QC Responsibilities

Cooperation is required of QC leaders and members to maintain an environment in which QCs can be effective. The organizational prerequisites to QC success that are the responsibility of QC members are discussed next.

Compliance with QC norms. Quality circles function in the context of group interaction. Therefore, the behavior of group members becomes a crucial ingredient in their success. Typically, QC members mutually define behavioral norms; that is to say, they agree upon behavior that will enhance the effectiveness of the QC. If there is not compliance with QC norms, members may become disenchanted and ultimately resign.

Accountability. As with individuals, the success of QCs is greatly facilitated by accountability. Goals established by QCs should be the framework for their activities. The QC that provides itself with feedback (i.e., timely information) on how performance compares to goals can modify its behavior in order to bring actual performance in line with goals. QCs must be accountable either to their own goals, their leader, the facilitator, management, or to some combination of these.

Discipline. Much of the success of the QC process can be attributed to the diligent execution of the QC tool skills and the statistical principles of quality control in the context of a problem-solving methodology. There is no magic at play; perhaps there is not even a synergy. Rather, there is the self-imposed discipline of individual QC members—discipline in the faithful application of the skills they have learned. When QC members consistently and significantly depart from a disciplined approach, problem resolution diminishes, and the group becomes discouraged.

Work-related problems. If a QC departs from its charter of addressing work-related problems and ventures into areas beyond its immediate sphere (e.g., compensation systems, hiring policy), its success rate may be drastically reduced and accompanying discouragement may propel it into failure. Such ventures beyond the scope of legitimate QC interests may elicit management disapproval, as well.

Patience. Much the same as management, QC members must enter into the QC process with considerable patience. They must understand that problem solving is accomplished neither easily nor quickly. Failure to understand at the outset that they may not expect immediate changes in any but the smallest of problems can result in extreme frustration.

The presence of the nine prerequisites does not guarantee success nor does their absence guarantee failure. However, individually and collectively their presence will greatly enhance the probability of success. An understanding of the theoretical bases of the QC concept is another ingredient of a successful QC program. A discussion of the behavioral theory underlying the QC concept follows.

Quality Circles in Practice

Accounts of successful QC programs are currently found in weekly news magazines, trade magazines, and newspapers. Anecdotal evidence suggests that quality circles appear to have many positive effects. QCs are credited with sizable cost savings, and documented return on investments has been reported to be between two and eight to one. Reduction of product

defects, increased product quality, and greater safety awareness have also been reported to have resulted from QC activities.*

Nelson (1980) reports that most companies using QCs cite supervisor observations and meeting schedules as success indicators. Patchin (1981) notes that Northrop and associates cite personnel benefits, such as marked reductions in absenteeism, grievances, and terminations. Schleicher (1977) reports that attitudinal surveys reveal that a majority of participants believe that participation in a QC makes their jobs more enjoyable, improves communication with management, and improves relationships with coworkers. Almost all worker respondents believe that the programs should be expanded.

Rieker (1976) reports that the Lockheed Company developed measurement techniques to assess the effects of the QC program in its manufacturing operations. Schleicher (1977) summarizes some of the findings from this effort as follows:

- Eighty percent of the members believe that the program has had a positive effect on the quality of the work within their work team.
- Seventy percent believe that the quality of their own work has improved.
- Ninety percent believe that communications within the work team have improved as a result of the experience.
- Eighty percent believe that the cost of the program has been justified by improvements in the products turned out by their organizations.
- Twenty-five percent have given up their own time to the program.

In June 1979, the Norfolk Naval Shipyard introduced the QC process to its twelve thousand employees. For every $1 invested, the QC program is estimated to have saved nearly $4 (Francis 1980). Law (1980) notes that the net savings after operating the program, including staff time and travel, was $150,000 in the first year.

Studies in both Japan and the United States have consistently claimed the following advantages of using QC programs:

- Improved communcations at all levels up and down the line
- A reduction in conflicts among employees, supervisors, and management
- Improved quality
- Greater awareness of cost

In Toyota Motor Company's quality circles and suggestion programs, over five hundred thousand suggestions were submitted in one year with 86 percent of them being adopted. About $2.5 million was awarded to workers for suggestions. The estimated return to the company exceeds that figure by five or six times.

*Examples of problems solved by QCs are found in Appendix B.

THE QUALITY CIRCLES CONCEPT

The quality circles concept is based on the beliefs that quality must be (or become) a way of life, and that management has a responsibility to create an environment in which workers can experience personal growth and fulfillment. For quality to become a way of life, a commitment to the concept of "total quality control" (TQC) must be made (Juran 1952). Very simply, TQC implies that all employees understand that they have an influence on the quality of the organization's final product or service. To that end, jobs must be designed so that employees have maximum control over their work procedures. Workers must be able to influence the quality of their output.

Often, workers have little or no control over work procedures. They do not understand their assignment (have not been given proper instructions, supplies, and tools). They do not receive accurate feedback on their performance, and are not provided with an environment conducive to productive work. Juran (1952) asserts that management is the cause of about 85 percent of such problems.

The notion of making quality the number one concern means, in industry, placing quality at a higher priority than short-term profits. In nonprofit organizations, it means making decisions in terms of long-term rather than short-term effects. Evaluation systems that reward individuals based on the results of their short-term decisions often neglect long-term effects. Many times the short-term effects of a decision are desirable, but those over the long-term may be quite undesirable.

It is simply not possible to have a TQC environment without making quality the number one priority. If quality is not the first concern, if management does not clearly and consistently communicate that fact and demonstrate commitment to it through decision-making procedures, and if quality is not rewarded, then eventually quality will be sacrificed when a crucial decision must be made. Workers will quickly discern where management has placed its priority, and will then simply reflect it.

The second of the values comprising the QC philosophy is management's commitment to providing employees with an environment conducive to personal growth and fulfillment. Called "people building" by some writers, this is a philosophy in which respect for the individual prevails wherever people are working—that is, a humane environment is created and maintained. Ishikawa (1980) identifies the following characteristics of such an atmosphere:

- People are treated as human beings who are engaged in meaningful jobs in which they can display their abilities and truly feel like devoting themselves to exploring their full potential.
- People can use their wisdom and creativity in the work in which they are engaged.
- People can develop their ability as they are given the opportunity.

- People are not isolated from each other. People in the same workshop are organized and act as a group. This creates harmonious relations based on constructive interpersonal relationships.
- People can mutually educate themselves by sharing experiences.
- People are given an opportunity to be recognized by their colleagues, superiors, subordinates, people in other workshops, and also by people outside the company. (pp. 22-23)

These two elements—total quality control and people building—comprise the philosophy of the quality circles concept. Without the adoption of this philosophy, an organization cannot succeed in implementing the QC concept. The TQC/people-building environment provides the context for the implementation of quality circles.

The QC process is based primarily on three important organization development strategies—participative decision making (PDM), goal setting, and team building. Extensive studies attest to the effectiveness of each of these strategies in improving efficiency in organizations. It may be inferred that the positive outcomes associated with PDM, goal setting, and team building, individually, will also result from their synergistic interaction in the QC process.

Participative Decision Making (PDM)

The QC process enables workers to participate in decision making on matters previously regarded as the sole responsibility of management. Participative decision making (PDM) is defined by Lederer (1978) as "a process by which workers are brought into their organization's decision-making process to varying degrees, but primarily on matters that directly affect them" (p. 51).

Three questions form the basis for the majority of the research on PDM:

- What effect does PDM deprivation have on employee performance?
- What benefits can be gained from PDM?
- Does the situation, complexity of the task, or managerial level of application of PDM have an effect on performance?

In relation to the first question, Ivancevich (1979) reports that PDM deprivation results when employees take part in fewer decisions than they would like. Hrebiniak's (1974) study of the relative effect of perceived PDM deficiency and job level on individuals and of the effects of PDM deprivation in various levels of the organization reveals a strong, positive relationship between job level, trust, and commitment. As employees ascend the organizational ladder, they become more committed to company goals and increased trust is exhibited between fellow workers. However, job level and perceived PDM deficiency have differential effects on work-related attitudes. Regarding the line worker, the data clearly reveal that individuals who are PDM-deprived definitely want more influence, at the expense of the unit leader. Workers become frustrated because they perceive that they have absolutely no say in decisions that directly affect their work.

The results of a study completed by Ivancevich and McMahan (1977) also suggest that PDM deprivation leads to job dissatisfaction and high levels of job tension. When workers feel they have no say in decisions that directly affect them, they are less likely to perform at top efficiency. Although the effects of PDM deprivation vary among task levels and companies, in every instance deprivation causes higher job-related stress and lower job performance.

It has also been demonstrated that the introduction of PDM can have a positive effect. Several authors have investigated the effects of implementing a PDM policy. Shuler (1980) reports that PDM has a significant positive effect on job satisfaction, and that a high level of PDM is more satisfying than low participation. The study also reveals that the less repetitious the task, the more satisfied the workers are when involved in PDM. Hines (1974) found that a positive relationship exists between high PDM and high job satisfaction. As workers' perception of their organizational status increases, their job satisfaction likewise improves. This may be due to the fact that the employees see the company as a friend and thus increase their commitment to the organization. Saskin (1979) reports that the benefits realized from a PDM program include increased job satisfaction; improved task performance; improved information flow; increased worker commitment; and increased acceptance of goals, decisions, and problem solutions by workers.

PDM is clearly advantageous to both the individual and the organization. There are, however, differences in the effectiveness of its application, depending on the situation. Ivancevich (1979) notes that "Not all research on PDM points to the unequivocal superiority of increased decision-making involvement" (p. 254). Various factors such as education, social background, personal values, and task complexity have a bearing on the effectiveness of PDM (Jerdee and Rosen 1978).

Jerdee and Rosen (1978) point out that "the relationship between participation and performance is moderated by factors such as task complexity and subordinate's independence needs and intellectual capacities" (p. 722). Ivancevich (1979) reports that participation in too many decisions can decrease a worker's performance. Workers are usually interested only in decisions that directly apply to their tasks. If they are required to participate in all company decisions they tend to lose interest, and PDM has a negative effect. Ruh and associates (1975) suggest the following caution:

> Participative management . . . should be applied selectively for those individuals who according to their needs, values, and expectations would be expected to respond positively to such approaches. (p. 310)

In the context of quality circles, PDM requires management to provide QC members with the training and the time to help solve problems. As the QC members "resolve problems, management gains a new respect for their capabilities, and as their suggestions are acted on the workers can see their influence on the work process . . ." (Patchin 1980, p. 6). That combination gives a real basis for the development of new attitudes on the part of both parties. Juran (1976) suggests that the QC concept functions best in organizations with a participative management style and mutual loyalty and respect between workers and management.

Goal Setting

Goal setting can be defined as the deductive formulation of desired outcomes. Empirical research has dealt with (1) the effects of the relative degree of participation in the goal-setting process, (2) the effects of various attributes of goal setting (goal difficulty, goal clarity or

specificity, and feedback), and (3) the effects of the relative degree of commitment to goals. How are incentives used to help instill commitment has also been researched.

A useful framework for a goal-setting theory is based on the premise that peoples' conscious intentions regulate their actions or task performance (Locke 1978). The theory asserts that goals may be viewed as follows:

- Specific goals result in greater output than general goals.
- Difficult goals result in greater output than easy goals.
- Goals serve to motivate performance only if they are accepted. (ibid.)

Research on the effects of the relative degree of participation in the goal-setting process on performance has resulted in the following conclusions.

- The amount of subordinate participation in goal setting is not as important as the actual setting of the goal itself. Employee participation in goal setting may be important because it helps in goal acceptance and commitment (Latham and Yukl 1976).
- Formal goal-setting—both participative and assigned—results in reduced service complaints, lower cost of performance, and better safety records, as well as higher satisfaction with work and supervision (Ivancevich 1977).
- Those employees who participate in goal-setting tend to set more difficult goals than are assigned to others (Latham et al. 1978).
- Goal attainment is reported to be higher in assigned than in participative groups (Dossett et al. 1979).
- Goals have a positive effect on performance, whether the task is interesting or not (Mossholder 1980).
- Workers who are arbitrarily reassigned to a goal improve their performance, and those workers who are given their choice of a work goal produce at the lowest rate (Bassett 1979).
- Participative goal setting results in more difficult goals being set than those assigned (Latham et al. 1978).

Studies of the effects of goal difficulty on task attainment have obtained the following results.

- Task difficulty can affect task performance, but this is probably due to increased task knowledge, not a motivational process. The implication is that an individual should be provided with difficult tasks, even if failure is a likely result (Campbell and Iiger 1976).
- More difficult goals are more likely to be considered as difficult—rather than impossible—by subjects with a high need for achievement (Ivancevich and McMahon 1977).

Research on the effects of goal specificity on performance has resulted in the following conclusions.

- Specific goals, if accepted, lead to a greater increase in performance than generalized goals (Ivancevich 1977).
- Specific goals lead to higher productivity (Latham and Baldes 1975; Latham and Kinne 1974).
- Setting a specific goal is more effective in obtaining high performance than either setting a "do-your-best" goal or setting no goal (Latham et al. 1978).
- Apparently, goal specificity is effective because it helps workers to understand what is expected (Latham and Saari 1979; Steers 1976).
- Focusing effort through a specific goal improves performance on complicated problem-solving tasks. However, specificity has no apparent significant effect on more routine, repetitive performance (Frost and Mahoney 1976).
- Goal specificity relates to performance for individuals with high need for achievement (Ivancevich and McMahon 1977; Steers 1975).

Another major attribute of interest in goal setting is feedback. Studies of the effect of feedback have resulted in the following conclusions.

- Feedback does not lead to a significant improvement in performance (Dossett et al. 1979).
- When goals are participatively set, individuals with high self-esteem who receive feedback on progress attain their goals more often than individuals who have low self-esteem (Dossett et al. 1979).
- Feedback is related to job satisfaction but not to job involvement (Ivancevich and McMahon 1977; Steer 1975).
- Feedback affects performance only if it is used to set specific goals (Latham et al. 1978).
- Feedback is most powerful when it comes directly from the work itself (Hackman and Morris 1974).
- Feedback provides vital information to energize the goal-setting process, and it reinforces progress toward meeting a goal. Without this reinforcement from feedback, it seems unlikely that people would pursue goals as desirable outcomes (Umstot et al. 1977).

The effect of commitment, in the context of goal setting, probably represents the most wide-ranging area of research in goal-setting theory. Where studies of the other characteristics of goal setting have focused on specifics of how goals are set—goal difficulty, goal specificity, and feedback—studies of the factors leading to commitment range across a spectrum of motivational concepts. In fact, this area of goal setting theory begins to merge with many other behavioral theories. As a result, only selected research directly related to goal setting is included in this discussion.

- Goal setting affects performance because it increases the individual's intentions to perform the task (Organ 1977).

- Identification with the profession, the organization, or one's peers is directly associated with goal congruence. This suggests that even if employees identify with neither the organizational philosophy nor with their fellow workers, this may be comparatively unimportant if the organization provides the opportunity for professional identification (Jauch et al. 1980).

A related area includes the study of incentives with respect to increasing commitment to goals.

- Goal acceptance is more important in job performance for individuals with low need for achievement (Ivancevich and McMahon 1977; Steers 1975).

- Once goals are accepted, the more difficult goal results in higher performance (Latham et al. 1978; Oldham 1975; Montowildo et al. 1978).

- Goal-setting procedures should not replace financial incentives as a means of reinforcing performance in organizations (London and Oldham 1976; Terborg and Miller 1978).

The empirical evidence supports the theory that goal setting increases productivity. Goal setting tends to make the worker focus on objectives and accomplishments rather than on activities. This apparently creates a sense of wholeness in the job that may have been previously lacking. Goals also appear to enhance employees' perceptions of meaningfulness in their jobs by making them aware of their contributions to the organization. Umstot and associates (1977) summarize these notions as follows:

> By seeing the "big picture" employees may better understand the significance of their job and may thus have an enhanced sense of worthwhile contribution to the organization. (p. 8)

A goal-setting program permits employees to be responsible for the outcome of their work (i.e., to have increased autonomy). However, when existing jobs are changed to add goals without worker participation in setting those goals, no significant change in autonomy occurs. Apparently only participative goal setting results in an increased sense of autonomy.

Team Building

Baker (1979) points out that the basic purpose of team building is to provide a means by which the members of a group can examine their own behavior and develop courses of action that will improve task accomplishment. The most significant breakthrough in organization theory came in the late 1920s and early 1930s with the now-classic Hawthorne Studies, conducted at the Hawthorne, Illinois plant of the Western Electric Company. The purpose of the research was to study the relationship between the quality and quantity of illumination and the efficiency of industrial workers. As reported by Roethlisberger and Dickson (1939), the research resulted in unexpected findings. The most significant factor in increased production was found to be the building of a sense of group identity—a feeling of social support and cohesion—that comes with increased worker interaction.

McGregor (1960) emphasizes the importance of the team concept in organization and management theory. His study of top management groups reveals that 85 percent of the communications within the group take place between individual subordinates and superiors, and only 15 percent laterally between the subordinates.

A study by Hackman and Morris (1974) indicates that benefits can be achieved in group performance effectiveness studies by means of an approach involving the experimental creation of nontraditional patterns of behavior in groups. Groups that are artificially forced into interdependent action and coordination display higher levels of production and more satisfaction with the task and with each other than do the groups that are left to their own devices. This suggests that groups can be induced to attain higher levels of job satisfaction and performance if interdependent action and coordination is designed into the task.

The influence of the group (team) on the individual can profoundly affect thoughts, feelings, and acts. Hare (1976) reviews several studies suggesting that the group is usually better at task performance than the average individual. According to Hare, the group (team) problem-solving sequence involves the three stages of definition, discussion, and working-through. Since these stages require interdependence among group members, each member must reexamine his or her individual view of the problem in the light of the views of the group. This results in innovative solutions previously unavailable.

Argyris (1970) asserts that a good team is characterized by (1) task specialization and (2) division of labor. Each person accepts responsibility for a different part of the job, with each having full responsibility for the success of the venture. Argyris suggests that the overall goal of any team development program is to improve the effectiveness of a group that must work together to achieve results.

According to Dorey and Pattern (1977), successful team-building activities result in improved team member understanding of the ways authority, control, and power affect problem solving and data gathering. Further, team building enables the members to gain a better understanding of themselves and become better able to diagnose and solve their own problems. Dorey and Pattern (1977) report that seven one-week team-building seminars have helped team members to understand people better, become better communicators, improve managerial skills, and become more aware of interpersonal skills.

According to Lewis (1975), the use of a team-building strategy is not always appropriate. Lewis identifies the following basic assumptions that must be present for a team-building strategy to be effective:

- Current patterns of communication and interaction among members of a group are inadequate for group and organizational needs.
- The concept of being (or desiring to be) an integrated team exists in the minds of the executive and managers in the group.
- Significant face-to-face interaction among members of the group is expected by the executive and/or is required by the needs of the organization.
- The executive can and will behave differently as a result of the development effort, and team members can and will respond to his [or her] new behavior.
- The organizational tasks assigned to the group require close and frequent coordination laterally among group members in such matters as planning, problem solving, and decision making.
- The benefits in terms of group effectiveness and member satisfaction to be gained from team development outweigh the costs incurred from altering existing role and social network arrangements to which the group has accommodated. (p. 14)

Green (1975) reports that performance of interacting groups with permissive leaders is significantly greater in terms of the number of unique responses than performance of nominal groups.* The performance of interacting groups with authoritarian leaders is reported to be superior to that of nominal groups when several performance criteria are used. Thus, when members of a group (team) interact and possess an attitude of willingness to communicate by sharing their knowledge, team performance is superior to individual performance. The implications of this study for quality circles are profound.

According to theorists, team building provides a promise for increased organizational effectiveness. This is primarily so because the team regularly receives feedback. Bowers and Franklin (1976) suggest that the use of feedback for group interventions in organizations is based on the view that receiving feedback is a potentially significant event in the life of a group performing work. Bowen and Siegel (1973) found that feedback is related to increases in motivation and group effectiveness.

Likert (1961) has developed the notion that organizations are a series of interlocking groups with the manager as a "linking pin," and he suggests that managers must learn to cope with a totality of people under their direction and not simply manage individuals one to one. Likert has also identified performance characteristics of the ideal, highly effective group. Some of the most significant of these characteristics follow:

- The members of the group are attracted to it and are loyal to its members, including the leader.
- The members and leaders have a high degree of confidence and trust in each other.
- The values and goals of the group are a satisfactory integration and expression of the relevant values and needs of its members. They have helped shape these values and goals and are satisfied with them. (p. 58)

*A nominal group involves several individuals in a problem-solving process who work in each other's presence but do not interact verbally with one another except at specified times.

QUALITY CIRCLES IN VOCATIONAL EDUCATION

American scholars and Japanese industrialists developed the principles, practices, and philosophy of the quality circles process. The major difference between Japanese and United States companies is that the Japanese, over a generation ago, sought the means to increase both quality and productivity and applied what they learned.

The incentive to follow the Japanese example is now developing in the United States. Given the existence of a positive work ethic,* the United States has at its disposal the resources necessary both to improve the quality of its goods and services and to increase its productivity. The existence of a prevailing positive work ethic in the United States today is subject to question, however. American workers have traditionally viewed a day's labor as honorable. In the past decade, however, a growing number of younger employees have seemed to manifest a new attitude. The intrinsic desire to do a good job has become somewhat less prevalent.

The responsibility for the reversal of this trend lies with America's social units—primarily with its families and schools. The educational system is the one institution with which virtually all Americans come into contact. Vocational education, with its occupational orientation, is a particularly fertile ground in which to attack problems of worker attitude that may affect productivity and quality.

The quality circles concept is one of change—a purposive, systematic process of planned organizational change. A product of this organizational change process—individual change—is also a necessary ingredient of it. Fundamental shifts in individual value systems are required. Individuals must come to recognize the importance of their contribution, however seemingly insignificant, to the overall quality of the final product. This sort of attitude is, again, what Juran (1976) defines as "total quality control" (TQC). It has taken Japanese industry a generation to bring about a TQC attitude among Japanese workers. The United States apparently is now also faced with the task of bringing about such a change.

Vocational education has a unique opportunity to facilitate the change to a TQC orientation. How can vocational education meet this challenge? The notions of *total quality control* and *people building* must be introduced into both the administrative systems and classrooms of vocational education institutions. The implication, of course, is that staff and instructors must themselves exemplify the value system implicit in these concepts. Students learn primarily in three ways: (1) cognitively (e.g., texts and lecture); (2) experientially (e.g., practice); and (3) through observation (e.g., role models). This means that the faculty and staff of vocational education institutions must outwardly express their inner commitment to the precepts of TQC and people building.

Educators should ideally already be practicing TQC principles, as the concept has applications for educators in virtually every aspect of their mission. Teachers who diligently maintain currency in their fields through study, research, and consulting, and who prepare for

*Krapp (1981) defines *work ethic* as "to have our employees maintain a positive attitude, do their job well, and assist others in their tasks so that the team is a winner" (p. 123).

instruction through detailed planning and execution are practicing TQC. "People building"—a term that lacks a universally accepted definition—should be an accepted part of teaching practices, as well. People building suggests an environment in which genuine concern exists for the needs of faculty, staff, and students. People building occurs in environments in which personal growth is facilitated; that is, where individuals are afforded the opportunity to acquire new skills, to develop a sense of achievement, and to enhance their sense of self-worth. People building occurs when faculty, staff, and students are given encouragement and recognition and when mutual respect and trust are fostered. Such an environment is vital in maximizing the effectiveness of the learning process.

Vocational education institutions should give every consideration to the application of the QC process to their own organizations as an effective means of problem resolution and productivity enhancement. The QC process has been effectively used by many school districts. For example, a midwestern school district has used the QC process to solve problems that resulted from declining enrollments and escalating costs (Rehg 1982). Ten quality circles made up of administrators, faculty, staff, and citizens met to develop solutions, which were then compiled and distributed to the ten groups. Consensus was reached, and the proposed solution was then presented to the public for review. The school board adopted the solution essentially as proposed by the quality circles. No complaints were received nor were any grievances filed despite the facts that some teachers were reassigned and some terminated, and that some schools were closed. In contrast, the school board in an adjoining district facing a similar problem made a unilateral decision to close certain schools. In response, a citizen's group filed a lawsuit in an attempt to block the closings.

Perhaps the most important contribution vocational education can make to the slow process of initiating change is to teach and demonstrate the principles and practices of the quality circles process. During the first two years of the traditional vocational education program (when core courses are taught), it is recommended that no formal courses on the QC concept be presented. Rather, awareness of the QC precepts (e.g., participative decision making, goal setting, and team building implemented in a TQC/people-building environment) should be effected through the day-to-day observation of role models (i.e., faculty and staff), the design and conduct of the vocational education organization, and classroom activities. As the students observe the faculty and staff applying QC precepts both in the classroom and throughout the organization, the QC process will become a credible and accepted way of doing things.

During the final year of vocational education programs, it is recommended that both the theoretical bases and the practical applications of the quality circles process be taught. Table 1 shows a suggested curriculum. QC classes should be taught using the experiential learning model, wherein students are placed in a structured experience (simulation) revealing the need for certain knowledge and skills. A lecturette should then be delivered in which principles and concepts are presented. A second simulation (during which students can apply what they have learned) should then be presented, followed by a discussion. A recommended course (by quarter) for this one-year program is presented in table 2.

During the first three quarters, students from different vocational programs can be grouped in any manner. During the fourth (final) quarter, however, it is recommended that students be grouped into teams according to their occupational group. Occupational grouping will facilitate learning the QC process, as students who are interested and experienced in common areas interact.

This curriculum can be adapted to use with part-time vocational education students. It is recommended that classes for part-time students be conducted two times each week for two hours each meeting.

In addition to this curriculum it is suggested that vocational education systems offer advanced one- to three-day workshops in the following areas:

- An executive perspective of quality circles (for managers)
- Advanced statistics
- Alternative problem-solving methodologies
- Listening
- Trust
- Conduct of effective meetings
- Advanced analytical tools
- Measurement and evaluation
- Interviewing (sensing)
- Facilitation skills

Some organizations implement a QC program with existing organizational resources by acquiring as much information as possible and developing their own materials. Many organizations, however, do not have the necessary expertise for this approach. This latter group may either hire a QC consultant or send a staff member to a QC workshop to be trained in implementing and facilitating the QC process.

Should they elect to use a QC consultant, administrators should consider the following points:

- Has the consultant implemented quality circles in other organizations? (If so, contact them to determine their success rate.)
- Does the QC consultant include training in group processes as well as problem solving?
- Is the QC consultant experienced in quality control, both managerial and statistical?
- Will the QC consultant be available after the training has been completed to respond to questions or problems that arise?
- Are follow-up consultations to evaluate progress included in the program?

Organizations that have successfully implemented a QC program are excellent sources of information about qualified and effective consultants (see Appendix C). The names of QC consultants may also be obtained from the International Association of Quality Circles, P.O. Box 30635, Midwest City, OK 73140.

TABLE 1

SUGGESTED QUALITY CIRCLES CURRICULUM

CONTENT

- Organizational Theory/Organizational Behavior

  Management
  Leadership
  Organization Design
  Job Design
  Goal Setting
  Group Process Skills (e.g., listening, effective meetings, etc.)

- Statistics

  Central Tendency (and Measures of)
  Variation (and Measures of)
  Confidence Limits
  Control Charts
  Simple Tests of Significance
  Sampling
  Statistical Quality Control

- Problem Solving

  Creative Problem Solving
  Methodological Procedures
  Problem-solving Tools

METHODOLOGY

- Lecture
- Case Study
- Experiential Exercise
- Simulation
- Skit
- Workshop
- Practicum

TABLE 2

SUGGESTED ONE-YEAR QUALITY CIRCLES COURSE

First Quarter

Management
Organization Design
Goal Setting
Listening I
Conflict I

Second Quarter

Leadership
Job Design
Listening II
Conflict II
Trust

Third Quarter

Statistics
QC Problem-solving Methodology
Conduct of Effective Meetings
Team Building
Teaching Practicum

Fourth Quarter

Statistical Quality Control
Principles and Practices of the Process
Analytical Tools
Simulation
Implementation of the Process

The recommended procedure for implementing the QC process in vocational education institutions is as follows:

1. Provide information to the administration. Obtain administrative support.
2. Form a QC steering committee.
3. Select a QC facilitator.
4. Arrange for key staff to visit organizations where the QC process has been implemented (see Appendix C).
5. Propose a pilot study program to the administration. Obtain administrative approval.
6. Ask for QC volunteers.
7. Provide QC training to volunteers.
8. Implement QCs within the administrative structure.
9. Draft a QC curriculum for use with vocational education students.
10. Obtain approval of the QC curriculum.
11. Implement the QC curriculum.
12. Evaluate the effectiveness of the QC process both in the vocational education administrative system and in classrooms.

Clearly, the quality circles process is an eclectic approach to management and administration. It is not a new, mystical panacea for all that ails an organization. It employs very basic problem-solving and statistical quality control principles and techniques that allow employees (at all levels) to define, analyze, and solve problems in their work areas. Quality circles concepts draw upon the theoretical concepts of participative decision making (PDM), goal setting, and team building. When these principles are used in combination within the structure of the quality circles process, they create a synergistic interaction that generates new insights.

Most supervisors and teachers have used one or more of these concepts. However, the QC process formalizes the process of training for problem solving, integrates these principles and practices, and provides organizations (including schools) with a new strategy for use in the resolution of day-to-day problems. If United States companies and schools can begin to effect individual and organizational changes in attitudes, so that tomorrow's workers embrace the value systems of total quality control and people building and put into use the QC process (including PDM, goal setting, and team building), then the United States will be well on the way to solving the problems of lagging productivity and quality control.

APPENDIX A

QUALITY CIRCLES TOOL SKILLS

Brainstorming

Brainstorming is a method of creative thinking. The purpose of brainstorming is to facilitate unrestrained participation in the generation of ideas by all group members. Ground rules specify that any idea is acceptable. Group members share their ideas without evaluative comment from others. The rules that must be observed during the brainstorming session follow:

- **Do not criticize** anyone's ideas by word or gesture.
- **Do not discuss** any ideas during the brainstorming session, except for clarification purposes.
- **Do not hesitate** to suggest an idea, even if it sounds unrealistic. (Many times such ideas lead to a solution.)
- **Take turns.**
- **Only one idea** should be suggested at a time by each team member.
- **Do not allow negativism.**
- **Do not allow the discussion to be dominated** by one or two individuals. Everyone must get involved.
- **Do not let the brainstorming session become become a gripe session.**

Brainstorming is useful during many phases of the problem-solving process, and is an invaluable tool in the quality circles (QC) process. In QCs, brainstorming is used for several purposes, depending upon need. It is important that employees who are not QC members have an opportunity to contribute their ideas on the following:

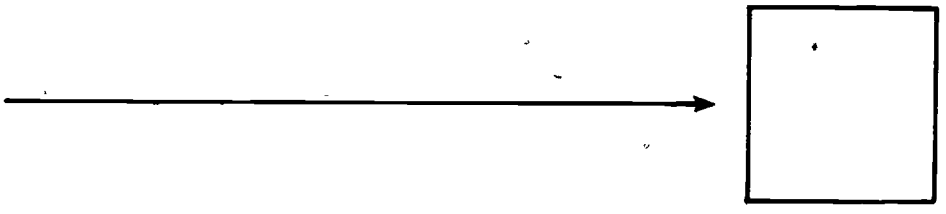
- Problems to work on
- Possible causes of a problem
- Solutions to a problem
- Ways of implementing solutions

Cause and Effect (C and E) Diagram

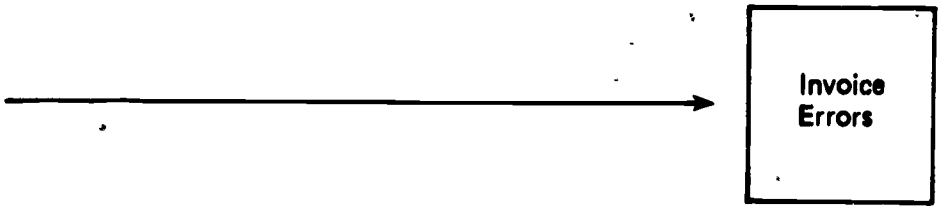
A cause and effect diagram is a means for collecting and organizing the possible causes of a problem. The diagram displays many "causes" but only one "effect." The effect is the problem identified during a brainstorming session; it is what needs to be corrected or changed. The causes explain the effect; that is, they are the potential reasons why the problem exists. While there may be only one or two actual causes of the problem, there are many possible causes that could appear on the C and E diagram. The construction of a C and E diagram is completed as follows:

Step 1: Draw an arrow pointing to the right:

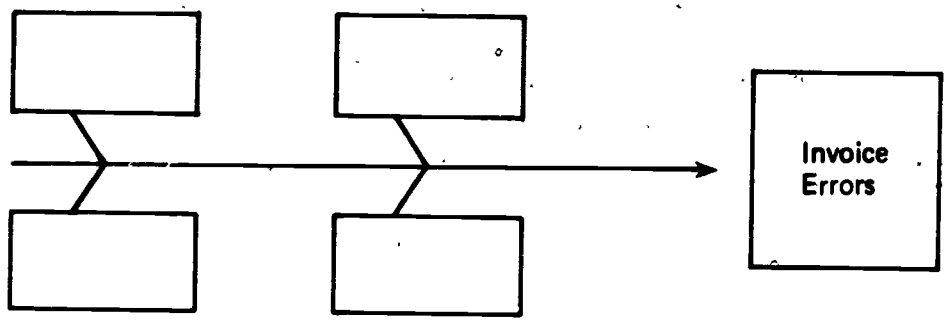
Step 2: Place a rectangle at the point of the arrow:



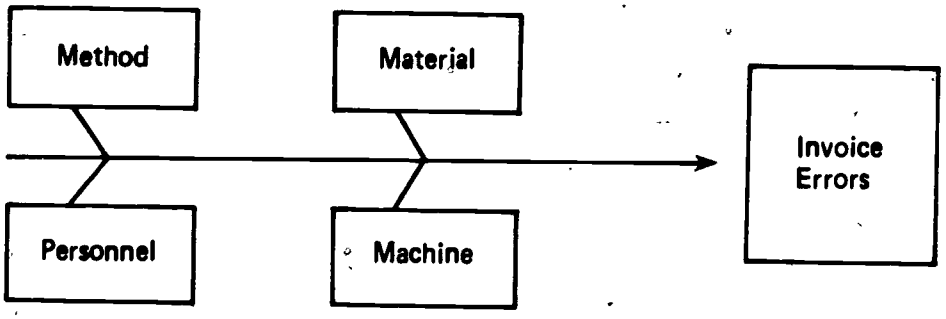
Step 3: Write the effect (problem) in the rectangle (e.g., invoice errors):



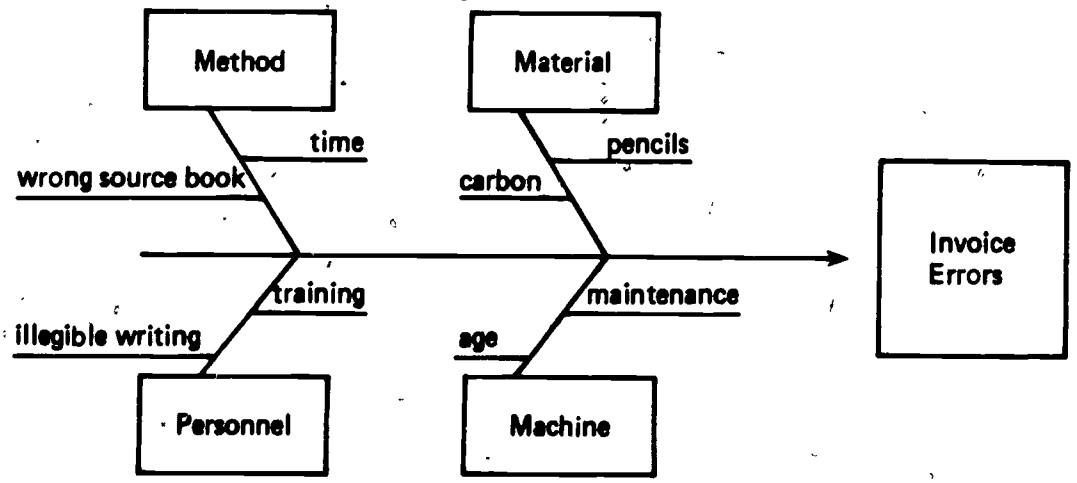
Step 4: Draw diagonal lines (branches) attached to the horizontal line and attach rectangles at the ends of the diagonals:



Step 5: Inside the rectangles, write the relevant categories:



Step 6: Potential causes are identified by brainstorming. As they are identified they should be written on horizontal lines (twigs) attached to the branches. For example, when the causes of "invoice errors" are written on twigs, it might look like this:



Check Sheets

Check sheets are forms for collecting information. For example, if additional information about a classroom is needed (see Pareto Analysis), the qualitative data collection check sheet might contain the following questions:

1. What activities take place in classroom E?
2. What type of supplies are required for those activities?
3. When, where, and how are the supplies needed in classroom E used?

Check sheets can take other forms, depending upon the information that is required. They can be used to keep track of job assignments, tasks completed, and scheduled activities in a QC, for example.

Data Collection

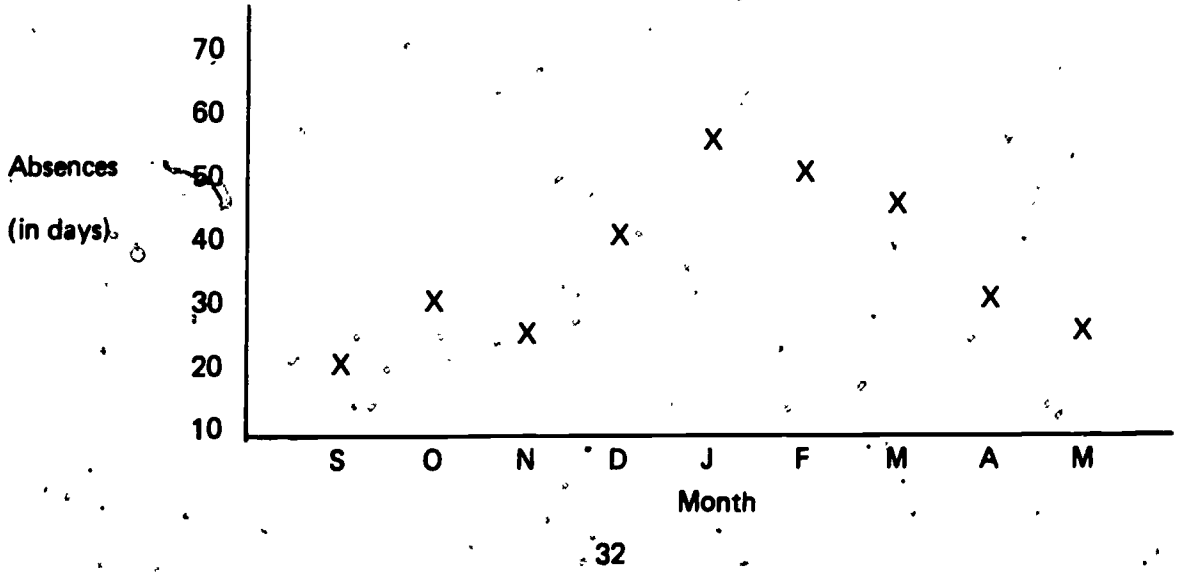
Data collection refers to the process of gathering information necessary to solve a problem. Check sheets (previously discussed) may be used to record the information collected.

Data may be categorized as qualitative or quantitative. In problem solving, qualitative data collection is used to identify problems (i.e., What's wrong?) and determine their extent (i.e., When and where did it happen?). Quantitative data is usually collected to determine the exact cause of a problem. During data collection activities in a QC, the group is usually divided into subgroups to ensure full participation and maximum efficiency.

During the process of solving a problem, several methods of data collection will be used. The methods usually used are: questionnaires, personal interviews, observations, experiments, and record searching.

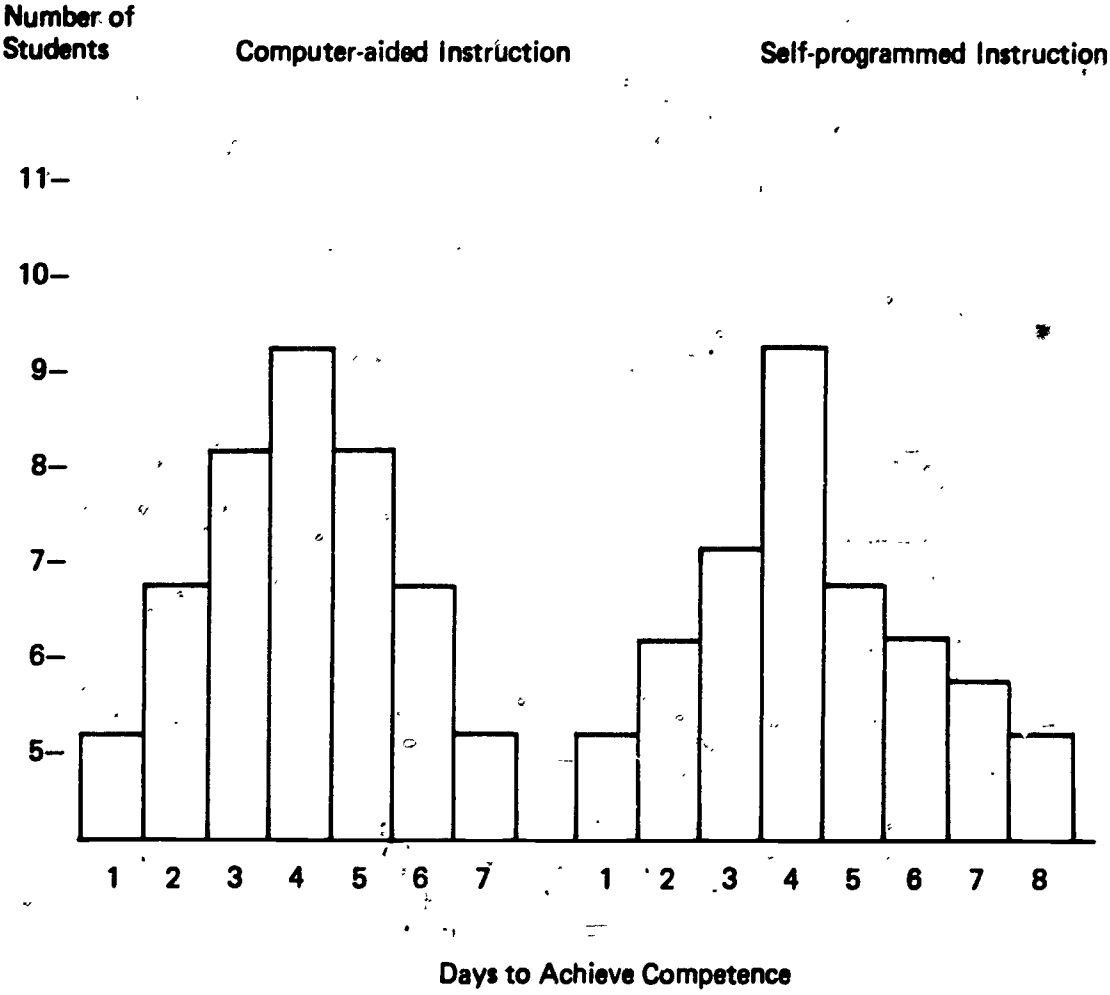
Graph

A graph is a diagram representing successive changes over time in the value of a factor. Graphs are constructed by plotting individual measures or averages at regular checkpoints. The following graph displays faculty absences for each month.



Histogram

A histogram is a graphic representation showing the pattern of data distribution. A histogram is constructed by first making a tally sheet and then replacing the tallies with rectangles proportional in height to the tallies. In the example below, the histogram illustrates the learning time in days of two classes, one using computer-aided instruction, and the other using self-programmed texts.

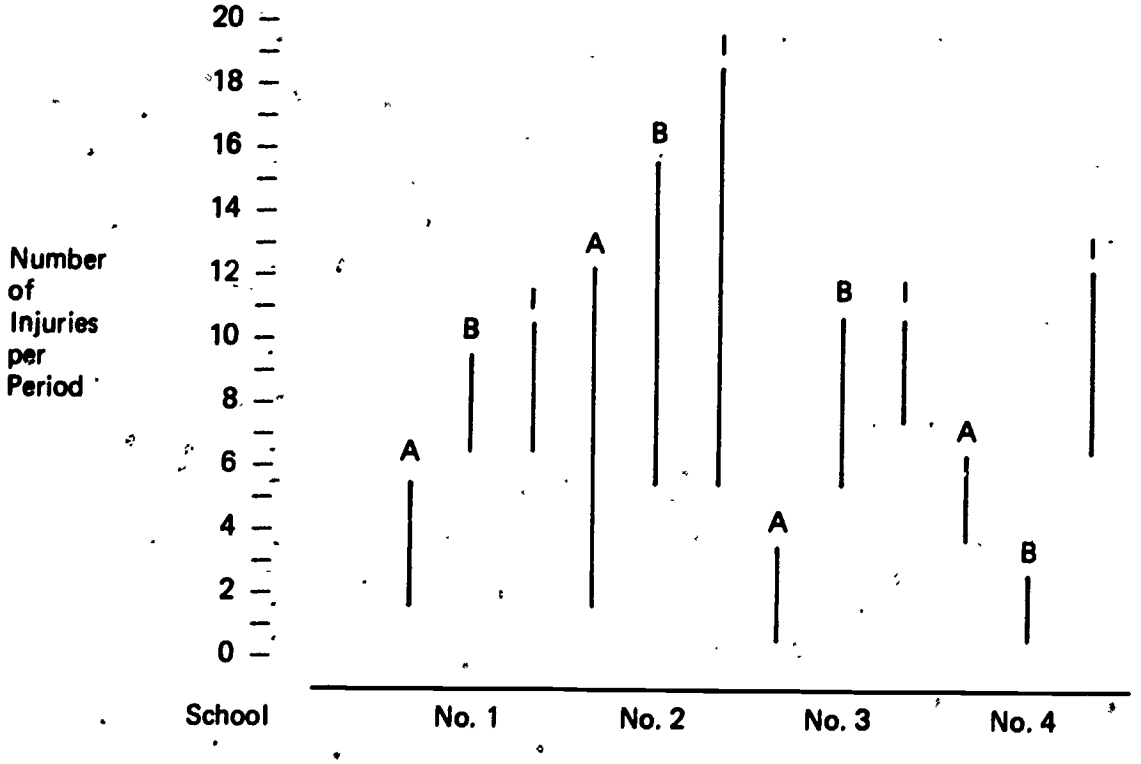


Multi-vari Chart

A multi-vari chart is another type of graph used in data analysis. To illustrate, suppose injuries are reported at the end of each six-week period for students in automotive (A), building trades (B), and industrial (I) programs in four schools within a district. The data collected after eighteen weeks are listed in the multi-vari chart that follows:

Period	School											
	1			2			3			4		
	A	B	I	A	B	I	A	B	I	A	B	I
1	3	8	10	2	6	18	2	10	8	4	2	7
2	5	7	7	7	10	6	3	7	7	6	1	12
3	2	9	7	12	15	12	1	6	10	5	1	9

The multi-vari chart that results from the data is constructed by plotting a vertical line for each program (by school) that represents the range of injuries. The multi-vari chart enables one to observe (in this case) variation by school, by program, and within the same program across the four schools.



Pareto Analysis

Pareto analysis is a method of separating the most important characteristics from the least important characteristics of an event. It can be used to decide what problem to work on, to find the defect that has the highest cost, or in any other way that is useful.

Pareto analysis is a way of separating the vital factors from the trivial factors. The vital factors account for a large percentage of the effect. For example, suppose the weekly cost of supplies for eight classrooms is as follows:

Classroom	Expenditure	
E	$22.50	$32.69 or
B	10.19	(67% of the total)
C	8.16	
A	3.40	
F	1.50	
D	1.12	
H	.90	
G	.49	
Total	$48.26	

Classrooms E and B are responsible for 67 percent of the total expenditure. Classroom E and B expenditures are the *vital* factors, and the other classroom expenditures are the *trivial* factors. Usually a few factors account for a large percentage of a problem and are therefore referred to as "the vital few." The remaining factors are usually known as "the trivial many."

Pareto analysis points to the direction for further investigation. In the example just given, classrooms E and B would be investigated to find out why their costs account for such a large percentage of the total cost of supplies. To make the vital factors readily apparent, the results might be displayed graphically.

APPENDIX B

EXAMPLES OF SAVINGS EFFECTED THROUGH QUALITY CIRCLES PROGRAMS

The examples presented in this appendix are based upon experiences of both blue-collar and white-collar workers. Some of the examples involve operations that are common to both education and industry.

- An estimated $636,000 was saved by the purchasing department at Westinghouse Electronics Systems Center in Baltimore, Maryland, by initiating a new procedure wherein overshipments by vendors are returned to them at their own expense. This procedure was suggested by a QC committee (J. Nelson 1980).

- At Honeywell, in St. Petersburg, Florida, where approximately 130 QCs are active, savings were documented in actual product cost reductions of over $500,000—a six-to-one return on investment (J. Nelson 1980).

- The General Electric Company's room-air-conditioner plant in Columbia, Tennessee, achieved a $15,000 annual savings by solving a weld-leak problem (J. Nelson 1980).

- A QC at Northrop solved the problem of continual breakage of bits used to drill holes in titanium for airplanes. By changing the drilling angle and using bits made of harder steel, the QCs ended estimated losses of $28,000 in lost time (Gottschalk 1980).

- Management of a General Motors plant in Tarrytown, New York was considering closing the plant down because of high absenteeism and poor product quality. The number of outstanding employee grievances against management totalled two thousand. Since QCs began to hold meetings to discuss complaints and ideas for boosting efficiency, the number of outstanding grievances has dropped to thirty, and absenteeism has been reduced to 2.5 percent ("Stunning Turnaround at Tarrytown" 1980).

- At the Lockheed Company, a QC made up of machinists determined that the installation of travel-dial indicators on four machine tools would improve the quality of their products. The indicators not only improved product quality, but also increased machine efficiency by 20 percent. This resulted in better quality products at a savings of $3,000 per year. (Taken from an internal unpublished report at Lockheed Missile and Space Company, Inc., Sunnyvale, CA, "Lockheed QC Circle," 1976, p. 4.)

- At the Continental Bank in Chicago, Illinois, annual cash savings ranging from $1,700 to $30,000 have resulted from only eight months of QC activities. The problems addressed included phone procedures for customer inquiries and complaints, more effective use of automated systems, and faster servicing of personal banking (Aubrey and Fencel 1982).

- At Sherman-Williams in Richmond, Kentucky, productivity increased by 30 percent, unit cost of paint decreased by 45 percent, failure costs were reduced by 25 percent, and the percentage of goods returned was down by 75 percent. These benefits were achieved through utilizing the plant's human resources in QCs (Poza 1981).

- At the Lockheed Company, a QC developed a method to mold a plastic part assembly in two instead of five steps. The redesigned assembly is lighter and stronger than its predecessor, and has resulted in an estimated savings of $160,000 over the life of the contract. Since 1974, Lockheed's savings from its QC program are estimated at almost $3 million, six times the cost of operating the program (Reiker 1976).

APPENDIX C

ORGANIZATIONS USING THE QUALITY CIRCLES PROCESS

The organizations listed below have implemented quality circles programs.

Public Sector

Covington Airway Facilities Sectors (KY)
Defense Logistics Agency (MI)
Federal Aviation Administration (GA)
Office of Personnel Management (IL)
United States Air Force:
- Air Reserve Personnel Center (Denver, CO)
- Ogden Air Logistics Center (Hill AFB, UT)
- Oklahoma Air Logistics Center (Tinker AFB, OK)
- Sacramento Air Logistics Center (McClellan AFB, CA)
- San Antonio Air Logistics Center (Kelly AFB, TX)
- Warner Robbins Air Logistics Center (Robbins AFB, GA)
- Homestead AFB (FL)

United States Army:
- Depot Systems Command (All locations)
- Automated Logistics Management Systems Activity (MO)

United States Navy:
- Charleston Naval Shipyard (SC)
- Naval Air Rework Facility (CA)
- Naval Ordinance Station (KY)
- Norfolk Naval Shipyard (VA)

Private Sector

AC Spark Plug (Flint, MI)
Alcan (Canada)
American Airlines
American Biltrite, Inc.
Amerock (Canada)
AMF-Harley Davidson
AMPEX (El Paso, TX)
AMPEX (Redwood City, GA)
AMP, Inc. (Harrisburg, PA)
AMP (Winston-Salem, NC)
ARMCO National Supply Company (Torrance, CA)
Armstrong Cork (Lancaster, PA)
Armstrong Cork (Marietta, GA)
A/V LK-NES (Denmark)
AVX Corporation (Myrtle Beach, SC)
Babcok and Wilcox Company (Barberton, OH)
Bendix Corporation (Ft. Lauderdale, FL)
Bendix Corporation (Utica, NY)
Boeing Company (Richland, WA)
Borg and Beck Division-Borg Warner

Brownie Mfg. Company, Inc. (Waverly, NE)
Campbell Soup Company (Salisbury, MD)
Carlton Company (Milwaukee, OR)
Chrysler (Highland Park, MI)
Cincinnati Milacron (Cincinnati, OH)
Cleveland Range Company (Cleveland, OH)
Cordis-Dow Company (Hialeah, FL)
Coors (Golden, CO)
C. T. S. (Elkhart, IN)
Cutter Labs (Berkeley, CA)
Dayton Tire and Rubber Company (Dayton, OH)
Delco-Remy (Anderson, IN)
Dickey-John Corporation (Auburn, IL)
Dover Corporation (Cincinnati, OH)
Dover Corporation (Memphis, TN)
Dow Corning Corporation
Dresser Industries (Franklin Park, IL)
Eaton Corporation Air Controls Division
Eaton Corporation (Glasgow, KY)
Eaton (Southfield, MI)
Eaton Yale Ltd.
EES (Sacramento, CA)
Eltra Company (Toledo, OH)
E. I. Company (Ireland)
ESCO Corporation (Portland, OR)
Fairchild Camera and Instrument
Ferranti-Packard Ltd. (Ontario, Canada)
Firestone (Des Moines, IA)
Fisher Controls Company
Ford Aerospace (Bedford, IN)
Ford Casting Division (Cleveland, OH)
Ford Metal Stamping Division (MI)
G. E. Major Appliances
General Dynamics (East Camden, AR)
General Dynamics (Pomona, CA)
General Foods Corporation
Gilbar Company (Greensboro, NC)
G. K. N. Powdermet
G. M. Buick Motors Division (MI)
G. M. Delco Products (MI)
G. M. Fisher Body (MI)
G. M. Oldsmobile (MI)
G. M. Pontiac (MI)
Graco Inc. (Minneapolis, MN)
GTE Lenkurt (El Paso, TX)
Hawaiian Dredging and Construction (HI)
Hewlett Packard (Palo Alto, CA)
Hewlett Packard (Penang, Malaysia)
Honeywell (Clearwater, FL)
H. P. Hood (Boston, MA)
Hughes Aircraft (Los Angeles, CA)
Hylsa (Mexico)
Intel Semiconductor (Santa Clara, CA)
Inter North, Inc.
James B. Lansing Sound Company (CA)
J. B. L. (Northridge, CA)
J. C. Penney Company (New York, NY)
Joy Manufacturing (Denver, CO)
Keene Products Inc. (Middlebury, IN)
Marion Dresser (Marion, OH)
Martin Marietta Aerospace (Denver, CO)
Martin Marietta Aerospace (Michoud, LA)
Martin Marietta Aerospace (Orlando, FL)
McDonnell Douglas Corporation (St. Charles, MS)
McDonnell Douglas Electronics
McGraw-Edison
Memorex Corporation
Mercury Marine
Metal Level S/A (Sao Paulo, Brazil)
Michigan Bell Telephone Company (Troy, MI)
Mohawk Data Sciences (Herkimer, NY)
Morton Chemical
Narclif-Thayer (St. Louis, MO)
National Supply Company
Northrop (Hawthorne, CA)
Norton Company (Worcester, MA)
Peabody Floway
Peabody Magnaflux
Pentel of America
Perfex (Washington, IA)
Perkin-Elmer (Norwalk, CT)
Pertec
Phillip Morris (Richmond, VA)
Polaroid Corporation
Ralph Wilson Plastics (Temple, TX)
RCA-Consumer Electronics
RCA-Picture Tube Division
Rego Company
R.J. Reynolds Tobacco (Winston-Salem, NC)
Roane State College
Rockwell International (El Paso, TX)
Rockwell-Power Tool Division (Tupelo, MS)
Rockwell International-Space Shuttle (FL)
Salt River Project (Phoenix, AZ)
S. Bent and Brothers, Inc. (Gardner, MA)
Senco Products
Signode (Glenview, IL)
Singer-Kearfott (Little Falls, NJ)
S.K. Wellman Corporation (Redford, OH)
Solar Turbines International (San Diego, CA)
Spectrum Inc. (Clinton, MA)
Sperry-Vickers (Jackson, MS)
Sperry (Waterbury, CT)
Sperry Wheeler (Waterbury, CT)

Sunstrand Aviation Operations
Super Sagless Corporation (Tupelo, MS)
Sylvania (Muncy, PA)
Tektronix (Beaverton, OR)
3M Company (Weatherford, OK)
Torrington (Cairo, GA)
Truth, Inc. (Owatone, MN)
TRW (Dayton, OH)
Turrington Company (South Bend, iN)
Union Carbide Corporation (Greenville, SC)
Uniroyal (Geisman, LA)
Uniroyal (Moncks Corner, SC)
Verbatim Corporation (Sunnyvale, CA)
Victor Business Products (El Paso, TX)
Visual Graphics (Tamarac, FL)
Warner Lambert
Water Associates
Western Electric (Shreveport, LA)
Westinghouse (Hunt Valley, MD)
Westinghouse Electric Corporation—Defense Organization
West Publishing Company
Williams Research Company
Wilsonart (Temple, TX)
Woodward Governor Company
Yazaki (Australia)
York Automotive (Decatur, IL)

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