A unique team productivity training program was developed and implemented for Electro-Scientific Industries, Inc. (ESI). This program was designed to train shop floor workers in teamwork skills and traditional industrial engineering techniques. In this way, problem-solving tools are available to the hourly manufacturing worker for use in improving communications, quality, and productivity. Potential improvements became apparent after the program was conducted.

The Japanese Quality Control Circle (QCC) movement and American QCC adaptations were analyzed to determine their components of success and failure. The uniqueness of this program lies in the depth and breadth of training and the use of these techniques at the ground level to gain productivity improvement. Previous programs in this area have provided a minimal amount of training and rarely focused on teamwork or group process skills. Additionally, past programs have provided the most intense training at the supervisory or first-line management level and have not provided a method of individualized productivity measurement. This program design included indoctrination periods for managers and supervisors. There was a three-stage approach of development, implementation, and evaluation. The training instruments and methodology
were developed for the program. A major emphasis was placed on problem-solving tools and small group dynamics. After the teams were designated, they were trained in productivity improvement techniques and developed group cohesiveness. The thesis includes the training packages, scheduling information, and a total description of the program as it was conducted.

Preliminary evaluations have been done on the training instruments, the overall program, and the initial results. Within all levels of ESI, there is enormous enthusiasm continuing for the program. A qualitative measurement indicates a significant increase in communications within and between all levels of employees. There appears to be a decrease in employee absenteeism and an increase in production quality. According to management assessment, no production output was lost over the training period.

Complete program results are not known at this time. Due to time limitations, an accelerated schedule had to be followed. A future study is recommended to determine if the program lives up to expectations over the long term.
The Development and Implementation of Team Productivity Training

by

Deborah G. Hanlen

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Typed by Joyce A. Rapkin for Deborah G. Hanlen
I would first like to thank the manufacturing personnel of Electro-Scientific Industries, Inc. for providing the opportunity to develop this program. Their commitment, trust, and assistance were invaluable. Without their cooperation, this distinct program would not exist.

Many thanks go to Dr. James L. Riggs for providing support and inspiration when it was needed. His astute direction prevented me from wandering too far astray.

Appreciation is extended to Joyce Rapkin, who spent long hours transforming my very rough drafts into clearly typed copy.

To my family and friends, I am sincerely grateful for their continuing belief in my abilities. Their long distance phone calls carried me over some very rocky roads.

Last, but not at all least, I wholeheartedly thank my husband, Richard. True to the vow of thick and thin, he provided space, time, and very patient tutoring to help me through this enterprise. I am ever grateful for his willingness to listen, empathize, and assist.
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THE DEVELOPMENT AND IMPLEMENTATION
OF TEAM PRODUCTIVITY TRAINING

I. INTRODUCTION

This research is based on the premise that the adaptation of Quality Control Circle concepts and activities to an American industry will contribute to productivity gains through a viable and successful program of training, implementation, and measurement.

The intent of this thesis is to take proven productivity improvement techniques used in Japan and amalgamate them into a more useable form conducive to American productivity gains. The impetus for initiating this revised training program came from the increasing and remarkable worldwide surge of interest in Quality Control Circle (QCC) activities and the acknowledged limited successes of these activities in the United States of America. Although the key concepts should be viable anywhere, there is a necessity to recognize that the QCC concepts are being transferred between very different cultural milieus. By recognition of and compensation for these cultural differences, it is firmly believed that these concepts will achieve high success in aiding U.S. productivity improvement. The adaptation of these concepts fits easily into the industrial engineering mission of effectively using all available resources to improve productivity. Envisioned is a shop floor full of trained workers, which are capable and adept at using industrial engineering techniques to solve their work-place problems. The worker would be taught the techniques at an appropriate educational level. In this manner, the tools and techniques would be widely available for application by the rank-and-file worker.
At the same time that the author was exploring the adaptation of key QCC concepts to American industry, the manufacturing and quality assurance managers of a pioneer Oregon electronics firm, Electro-Scientific Industries, Inc., were investigating QCC concepts. They were interested in a wider development and application of its fundamentals to their manufacturing division. After serious consideration of their needs and desires, the Electro-Scientific Industries manufacturing division, hereafter referred to as ESI, contacted the Oregon State University Industrial Engineering Department. This effort was made in order to initiate a cohesive program which would be planned and conducted in conjunction with Oregon State University (OSU) personnel. A pilot program was hammered out and designed for systematic implementation over a twelve-month period. ESI named this program People Action Links. The working groups were called PAL teams. In addition to preliminary ESI activities, there were concurrent ESI and OSU activities occurring to ensure a firm program foundation and smooth incorporation of the PAL team program concepts. A large portion of this distinctive program's success is due to the unstinting cooperation and contributions of the ESI manufacturing division and its Production Management Team (PMT).

The thesis is organized in chronological fashion. The first chapter consists of defining the thesis and intent, as well as giving an overview of the thesis content. The second chapter provides a review of past QCC applications in the U.S. and Japan. It explains the key differences between previous programs and the revised concepts designed and implemented at ESI. The framework design and program mechanics are described and justified in Chapter III. This is inclusive of both ESI and OSU activi-
ties. Chapter IV presents the meat of the team productivity training; this is the development and presentation methodology of the training packages. These training packages were each focused on a particular problem-solving or analytical tool. An evaluation of the pilot training program with regard to several defined topics is conducted in Chapter V. The lessons learned in retrospect are detailed in Chapter VI. These lessons can be extrapolated to other American companies. The final chapter highlights the key points of the thesis and makes recommendations for future changes and applications. On that note, future studies shall be left to the industrious and committed souls who believe that Americans can and will adapt to new and revised methods of management.
II. REVIEW OF THE LITERATURE

As U.S. industry attempts to cope with a negative productivity growth rate, many different management theories and productivity programs are touted as the universal antidote to its multitude of causes. During a review of the literature concerned with the Japanese Quality Control Circle concepts, a chronology of previous theories, programs and characteristics was discovered. It is these theories and programs, in conjunction with our economic realities, which set the stage for the development and implementation of a team productivity training program at Electro-Scientific Industries, Inc.

American Management Theories

Current American management has its roots in Frederick Taylor’s scientific management of the human worker as an extension of his machine and in the division of labor concept. Sociologists, psychologists, and behaviorists have added a plethora of new theories to management science. Prior to World War II, there were many family-owned businesses which were run under an often paternalistic, but strictly authoritarian rule. When authoritarianism and scientific management are coupled with the highly rewarded American ideas of individuality, competition, and John Wayne leadership, the common result is "conflict" management. Labor and management see themselves as adversaries in a battle of winning concessions from each other. Because the enormous past productivity gains of the U.S. were mainly due to technological innovation and entrepreneurism, American managers had paid little attention to the developing theories of social scientists and behaviorists such as Maslow,
Herzberg, Argyris, McGregor, and Likert. There is now a more widespread attempt to incorporate these ideas into American management styles. These theories emphasize respect for the individual's capacity to responsibly and intelligently attempt to meet their needs through their work without exterior authoritarian motivation. There is an underlying belief that significant gains can be made through motivation and extensive worker participation in the decision making process. There are others, such as Fein (1974), which question the proposals of McGregor and Herzberg as they have been applied to the non-exempt or hourly workers. Even while Fein refutes the concept of job enrichment, he lends credence to the QCC concepts of changed work climate, identification with management goals, and recognizable benefits and incentives.

The basis of many theories is the assumption that all people will be motivated and productive if they have meaningful and interesting work. Many behaviorists have, at one time or another, fallen into the same assumption. For example, McGregor (1966) admitted drawing heavily from Maslow when he wrote about workers' shifting their motivational emphasis to social and egoistic needs.\(^1\) McGregor (1960) maintained that:

\[\text{Unless there are opportunities at work to satisfy these high level needs, people will be deprived; and their behavior will reflect this deprivation. Under such conditions, if management continues to focus its attention on physiological needs, the mere provision of rewards is bound to be ineffective, and reliance on the threat of punishment will be inevitable.}\]

\(^1\) Several years later, Maslow questioned the validity of McGregor's concepts since they were based on the shaky foundation of Maslow's clinical studies done on neurotic people. A.H. Maslow, *Eupsychian Management* (Homewood, Illinois: Richard D. Irwin, 1965), p. 55.
Herzberg's two-factor theory of motivation-hygiene postulates that satisfaction and dissatisfaction are not opposite ends of a continuum. He defined factors which were satisfiers or dissatisfiers. Herzberg, et al (1959) contended that only satisfiers motivated while dissatisfiers just maintained or decreased performance. Satisfiers included achievement, recognition, responsibility, and the work itself. Dissatisfiers encompassed salary, job security, working conditions, supervision, and company policy. Herzberg goes beyond McGregor by saying that even if dissatisfier-maintenance factors, such as salary, job security, and working conditions, are improved, they will not act as motivators.

On the other hand, Fein (1976) suggests that only fifteen percent of all hourly workers are "achievers" who are motivated by their work content and are sympathetic to managements' goals. He further suggests that behaviorists are prescribing a normative set of values wherein all people are motivated by higher needs and that this simply is not true for the majority of hourly workers. Fein proposes that job security, income, and the absence of management-worker antagonism will encourage employee participation in managements' goals and company progress. Coupled with Argyris' concept of the Pygmalion effect of treating employees as adults rather than as children, these theories all provide the backdrop for various work improvement programs tried in the past.

**Previous American Work Improvement Programs**

There have been many work improvement programs in America's recent past. These include Work Simplification and Lincoln Electric's Incentive Management. Many programs were often developed by engineering educators...
and industrial engineers.

Work Simplification is described by Lehrer (1957) as a program to systematically analyze all of the factors effecting the work to be done. Its primary purpose is to save effort, time, and money. Lehrer (1957) states that the key individuals in a methods improvement or work simplification program are the first-line supervisors. These individuals must receive encouragement from management. There is the necessity, however, of ensuring that the workers understand how work simplification can benefit both them and the company. Workers must be assured that work simplification will not destroy their job security before their cooperation can be gained. In this way, workers will cooperate in meeting the objectives of making work easier, quicker, and cheaper.

In 1937, Allan H. Mogensen (1963) visualized training workers in work simplification techniques so that they could become improvement experts in the jobs immediately concerning them. To this extent, they could use their ingenuity to improve productivity and participate in the improvement process. Proposed twenty years prior to the Herzberg and McGregor theories, this program was at first warmly received by industry. As time passed, Work Simplification failed to become widespread on the plant floor. It did not reach its potential in the use of all employees' intelligence and experience. This failure was due in part to industry's application of the concepts mainly to supervisory and management personnel and few skilled workers.

Lincoln Electric (Fein 1974) changed its operations, in 1934, by a set of management concepts based essentially on the Golden Rule. By recognizing the needs and goals of its workers and sharing the fruit of their
combined labor, management has established and maintained credibility with its employees. The productivity of Lincoln Electric is extremely high but few companies have been interested in following their principles. This can be partly attributed to the fact that it is a very demanding management style. There is a larger burden on the first and second level managers. They must supervise workers whose job security is fully protected. Many workers actually supervise and check their own work. They actively participate in improving their work and methods. This type of partnership is somewhat alien to a traditional American company. Additionally, Lincoln Electric employees directly share in a large portion of the company profits. This type of incentive has not been frequently used elsewhere.

The American Present

As American industry struggles to cope with increased inroads into its markets and decreasing productivity, managers are finding a conflicting array of theories and ideas on how to become more productive. It is at this point that managers are looking at the highly touted Japanese Quality Circle concepts as a panacea to their problems. A careful look at the big picture will help to prevent wholesale imitation of a culturally framed concept.

The Japanese Picture

Little is known regarding pre-World War II management practices in Japan. What is known is that in the face of adversity following World War II, the Japanese studied, adapted, and utilized American statistical,
quality control, managerial and operations research techniques, as well as state of the art industrial developments. It is the adaptation and application of this information that has helped Japan rise to its present industrial strength.

During the 1950's, the Japanese introduced American management theories and statistical quality control techniques. They had listened to Dr. W. Edwards Deming tell them, in 1947, that the fastest and most effective way to rebuild Japan was through the use of statistical quality control techniques. Japanese statisticians heeded his words. In 1950 they invited him to teach these methods to their engineers under the auspices of the newly formed Union of Japanese Scientists and Engineers (JUSE). By his tremendous dedication to teaching them, these engineers became the disciples of statistical quality control techniques.

In 1954, another quality control expert, Dr. J. M. Juran, arrived in Japan to describe the management function in quality control. This meant practicing quality control concepts throughout the plant by teaching them to middle management. From 1955 to 1960, these concepts spread to most of Japan's major firms. During this time period, Japan made a critical adaptation to these concepts. They taught the statistical quality control techniques to every person in the firm. The rank-and-file workers began to participate in study groups to resolve quality control problems. This made quality control the responsibility of each worker rather than a function of a select minority. The study groups were predecessors of today's Quality Control Circles.

Of particular interest are the cultural, sociological, and economic settings which allowed this adaptation to flourish (Cole 1980). Con-
fucianist doctrines concern the perfectability of man and the use of education and ethical conduct to attain conformity and harmony under the natural law. Happiness is the result of harmony. There is a hierarchy in the Confucian system where superior rules inferior to maintain that harmony and conformity. These ideas allow a manager to perform his function and to participate in consensus decision making. Within this background, the Japanese manager can view the education and nurturance of his employees as methods of attaining their perfection while yielding economic benefit to the firm. The Confucianist doctrine is a distinct contrast to the Judeo-Christian emphasis on man's fundamental weaknesses and limitations.

The sociological contrasts are also significant. American management is primarily a white Anglo-Saxon Protestant group who view themselves as an elite by virtue of their education and breeding. They manage a labor force comprising diverse ethnic, religious and racial groups. Japan has a very homogeneous population in terms of race, religion, culture, and ethnic background. Their Korean and Eta minorities are mostly excluded from the manufacturing industries. The result is a Japanese manager who can easily identify with his employees. This has a strong influence on the apparent egalitarianism in Japanese industry. There is another interesting contrast to note. Whereas Americans expect directives from their superiors upon which they can act, the Japanese emphasis is on initiative from below. A Japanese subordinate is expected to submit a solution proposal for evaluation. The Japanese expect their employees to think. Americans often hire a set of skills or muscles without recognizing or valuing the related brain.
From the economic view, Japan has been operating in a labor short, high growth-rate economy. This enables company investments in education and training to be recouped as well as providing promotional opportunities. The system of lifetime employment for male workers, especially prevalent within large Japanese firms, enhances the value of investments made in workers' training and education. Americans are more conditioned to a sluggish economy, high turnover rates, and high unemployment. In this context, workers are often viewed as easily replaceable or inter-changeable parts.

### Quality Control Circles in Japan

As stated previously, Japanese workers began, in the 1960's, to participate in study groups to resolve quality control problems. It is this continuous study process operating in each work area that has spread swiftly throughout Japanese and now world-wide industries. The work groups involved in this process are called quality control or QC circles. QCC concepts have been advanced by the Union of Japanese Scientists and Engineers (JUSE) under the leadership of Dr. Kaoru Ishikawa, Professor of Engineering at the University of Tokyo. As a national organization, they have provided standardized and structured information on QCC concepts in the form of training materials, courses, and publications. The phenomenal growth rate of this movement can be seen from a few facts. In December, 1962, JUSE had twenty circles with four hundred members registered. In 1978, there were 88,000 circles with over 700,000 members. If unregistered circles and members are included in these totals, overall membership now exceeds five million workers.
A QC circle can be succinctly defined as a small group of workers and their supervisor who organize themselves in order to work on quality problems related to their work. As may be inferred from the definition, the Japanese have concentrated on inculcating QCC concepts in the hourly employees within the manufacturing portion of industry.

Characteristically, QC circles are organized in each work unit as small, voluntary, study groups and are often led by a foreman or respected senior worker. Circle members are taught elementary problem-solving techniques and statistical analysis methods. The term quality control circle is a misnomer since the group concentrates on solving a wide-range of problems related to their work area. Concurrently, circles focus on some self-development of members in terms of leadership skills, morale, motivation, and teamwork.

Incentive for participation comes solely from the recognition accorded members when they present their ideas to higher management. The meetings are held either during company time or after hours. Compensation for the overtime ranges from nominal to nothing.

The foremen or circle leaders are the most intensively trained in the statistical techniques and problem-solving tools. The leaders then teach these tools to their circle members. Professor Kaoru Ishikawa (1976) has identified the eight tools of problem-solving to be:

- Brainstorming
- Check sheet
- Pareto chart
- Cause-and-effect diagram
- Histogram
These are the tools taught to circle members from JUSE training materials.

The payoff from QC circles appears to be significant. Officials of the Nippon Electric Co. Fuchu plant say that productivity has doubled over a three-year period; twenty-five percent of this improvement is due to worker input. Nippon Kokan K.K. reports that the 8,000 workers, belonging to 1,480 circles, accounted for $86 million in cost savings over the past twelve months. Toyota Motor Co. estimated its return from the circles program to be in the range of $12.5 to $15 million in 1978. Nissan Motor Co.'s 4,161 circles effected a savings of $2.4 million. For these corporations, the reported payoff has been quite large indeed.

Before becoming wholehearted proponents of the entire QCC package, it is wise to consider some of the more significant repercussions of the QCC program. Even though the volunteerism aspect has been highly stressed in recent literature, there is a great deal of peer pressure to participate. Many companies still have top-down control which results in a minority of workers viewing the circles as a management-imposed burden. This is compounded by the little or no renumeration given for additional time spent in circle activities. Only Toyota Motor Co. speaks of monetary awards to the workers for their suggestions and implemented solutions. Although the theoretical emphasis has been equally placed on productivity and work development, productivity appears to play a much more prominent role. This has resulted in workers questioning the value of circles for them. There has also been a tendency towards stag-
nation when meetings lose spontaneity and become ritualistic.

**American QCC Adaptations**

American adaptations of the QCC concepts are as numerous and varied as the firms which are embracing them. QCC concepts were first brought to the U.S. in late 1973, by Wayne Rieker, then of Lockheed Missile and Space Company. Rieker (Arbose 1980) believed that the success of QCC concepts in Japan was due to universal principles. He made only minor changes in the Japanese model and had JUSE training materials translated for use at Lockheed. Rieker and his associate, Donald Dewar, used facilitators to introduce and promote QCC concepts and to train circle leaders. A facilitator provides training and assists the circle members in understanding how a QC Circle operates. From the start of the first circle in October, 1974, until 1977, when thirty circles existed, Lockheed estimated that the circles had saved them $3 million. The savings to cost ratio was 6 to 1. After these facts became known in the journal *Quality* in May, 1979, numerous companies studied the Lockheed program. Many were spurred into beginning programs of their own. These companies included a large number of aerospace industries which are typically very quality conscious. Later, Rieker and another Lockheed associate left the missile and space co. to set up their own consulting firms. Their purpose was to assist other companies wanting to try the QCC approach. Donald Dewar left Lockheed to establish a non-profit, QCC promotional organization, the International Association of Quality Circles (IAQC). Promotional activities take the form of publications and seminars. Other organizations, such as the American Society for Quality Control, are also promoting QCC concepts. Consultants Paul Plumb and
Sidney Rubinstein also promote the use of QCC concepts in American industry.

Companies now reporting successes with their programs include Hughes Aircraft, General Motors, Martin-Marietta Corporation, Honeywell, Rockwell International, Northrup, Cordis-Dow, Westinghouse, RCA, and American Airlines.

Characteristics common to these adapted programs include the concepts of training, leadership, voluntarism, and scope of problems tackled. All programs described in the literature provide varying amounts of training, depending on their source of training material. None of the programs are compulsory and all are held on company time. The work-group supervisor is the circle leader, but he may or may not provide the actual training to the team. The programs allow a variety of workplace problems to be attacked rather than keeping a strict focus on quality control.

Many problems have arisen as companies have introduced their programs. Rubinstein (1979), a QCC and Quality of Work Life consultant states, "It is easy to start such a system, but very hard to sustain it." This is because the program is often viewed as a panacea or quick-fix by management. Some managers and engineers see the program as a challenge to their intelligence, power, and authority. Cole (1980) states that middle management support is critical. Their resistance or loss of their support has spelled the demise for many fledgling programs. Another area of vital support is the workers' union. Even more important is the perception by workers that it is "their" program. If there is any suspicion of management manipulation, all participation is lost. An example of this manipulation is when the problems to be worked on are
chosen or decreed by management.

The ESI Team Productivity Training

With all of these possible problems, why and how should a viable program be developed and implemented?

The why is answered in a two-fold manner. From the workers' stand, a productivity program provides the opportunity for involvement and participation in resolving problems effecting them. Job security and profit sharing are also enhanced by program results. The company and management benefit through increased communications and productivity with the frequent additions of improved morale and decreased absenteeism.

How to develop and implement a viable program in American industry can be shown in the distinguishing characteristics of the program developed for ESI. The idea is to give longevity to QCC concepts by using more structure. There are three key conceptual areas that differentiate the People Action Links (PAL) program from its Japanese and American predecessors. The three key aspects are program context, training, and measurement.

The program was originated and implemented in the context that it was to become a way of life in the ESI manufacturing division. There was prior groundwork laid to obtain a first and second line management commitment to teamwork, shared responsibilities, and consensus decision making. The initial emphasis was to improve communications and morale so that at a later time quality and productivity could be improved. There was no concern about immediate payback for implementation and
The second difference is the amount, type, and level of training provided for both team leaders and team members. Through the facilitator's use of detailed written material, verbal explanations, general examples, and specific exercises, the participants could gain a working knowledge of each tool or technique. Working together during training exercises also builds teamwork skills necessary to problem solving. The training program is essential in any adaptation of QCC concepts. It serves a four-fold purpose by:

- Providing technical problem-solving skills.
- Aiding the development of cooperation and communication.
- Setting the stage for future team sessions.
- Demonstrating the company's interest and commitment via the time and materials provided.

The third aspect of the program is that of effective and individualized measurement for each PAL team. This measurement indexing system was developed for ESI, by James D. Simila of Oregon State University. This aspect of the program is explained and justified by Simila (1981) in his dissertation. Essentially, individualized measurement is a valid feedback indicator which lets team members know how they are doing in comparison to their past activities. It also allows management to somewhat assess the cost-effectiveness of the activities.

Japanese QC Circle vs ESI Team Productivity Training Program

The distinctive characteristics of each approach are diagrammed below. A more detailed development and explanation of the ESI PAL Team
program characteristics can be found in Chapters III and IV.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Japanese QC Circles</th>
<th>USA QC Circles</th>
<th>ESI PAL Teams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small Teams (4 - 12)</td>
<td>Yes</td>
<td>Yes</td>
<td>Mostly</td>
</tr>
<tr>
<td>Meet on Company Time</td>
<td>One-half</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Training:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QC Tools</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>People Interaction Skills</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>IE Tools</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Leader:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elected</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Assigned</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Frequency of Meetings:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weekly for one hour</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Productivity Measurement</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Reward System</td>
<td>None</td>
<td>Variable</td>
<td>None</td>
</tr>
<tr>
<td>Uses existing reporting channels</td>
<td>Yes</td>
<td>Variable</td>
<td>Yes</td>
</tr>
<tr>
<td>Uses outside consultants</td>
<td>Never</td>
<td>Most</td>
<td>Yes</td>
</tr>
<tr>
<td>Uses special circle staff</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>National organization</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Company-wide steering committee</td>
<td>No</td>
<td>Most</td>
<td>No</td>
</tr>
<tr>
<td>for project evaluations.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
III. THE DESIGN OF THE ESI PAL TEAM PROGRAM

The productivity program and structure was designed and implemented in close conjunction with ESI manufacturing management. The author developed the program mechanics and training packages. Mr. Wally Masters, ESI manufacturing manager, continued laying the necessary foundations within his group of managers to support the team concept and mode of operations.

The Initial Steps

The impetus for the ESI team productivity training program came from Mr. Wally Masters and Mr. Horst Raustein, Quality Assurance Manager. Mr. Masters' previous management experience had convinced him of the utility of a team approach. As he learned more about the QCC concepts, Mr. Masters felt that the team participative management concept could be coupled with productivity training and spread throughout his entire division. At this same time, Mr. Horst Raustein, was looking at the Quality Control Circle concepts as a means of improving his groups' effectiveness. After much investigation and thought, these two men determined that a firm foundation for the team concept must be in place before initiating a team productivity program for the manufacturing hourly employees. Furthermore, this team management approach must have the full support of higher management if it were to succeed and remain in place. Having received the blessings of the ESI governing body, the Administrative Committee (AC), the first step taken by Mr. Masters was to build a manufacturing management team consisting of his second-level
The Three Phases of Team Building

The management team building took place in three ways. The first phase was to fill managerial vacancies with individuals willing to commit to the team management concept. This was accomplished by mid-April, 1980.

The second phase was to hold a formal, two and one-half day, sequestered "Team Building" session in September, 1980, for the second-level managers (Masters 1981). The session encompassed such objectives as:

- Stating the rational for the team-building session.
- Building trust and communication channels.
- Increasing awareness of others' job objectives and key areas of responsibility.
- Team building to overcome resistance to change.
- Obtaining an initial buy-in of the team concept from all managers, both new and old.
- Writing a rudimentary statement of team objectives.
- Planning strategy and long-term activities.

Team participative management was defined as having the second-level managers work with their manager, Mr. Masters, as a team, to reach corporate goals set for the manufacturing division. The second-level managers would be kept informed by open communications and regular meetings. They would be allowed input into manufacturing activities and decisions. In return, they are expected to share the responsibility for performing those activities and achieving the manufacturing division goals. These persons still retain their individual managerial responsi-
bilities. But team participative management, when it is well established, enables each one to trust that all of the other managers are working towards the same goals and are willing to communicate with them.

The most crucial group to convince were the first-line managers. They were wary of both the program and the key concept of participative management. A special, two and one-half day, "Team Building" session was held for the first-level managers and supervisors on November 5, 6 and 7, 1980, at a local resort. This session had two objectives: Provide evidence of upper management's support for participative team management, and demonstrate the value of team management activities (Masters 1981). The first-level managers were interested and somewhat enthused. But, they retained a "wait and see" attitude.

The third phase involved a five and one-half hour session on "Shared Responsibility" in late January, 1981, for the manufacturing second-level managers, hereafter referred to as the PMT or Production Management Team. This session covered the benefits and implications of sharing responsibility as well as the drawbacks (Karns 1981). There was a participative exercise to vividly demonstrate the key points. This exercise involved dividing the managers into three groups. They were informed that they had been involved in an airplane crash on a mountain. They were told to organize themselves and then each individual was to rank fifteen items in order of their importance to survival. After this, each group was to rank the same fifteen items. However, each group was told a different way to organize themselves. Group One was just told to survive; no leadership style was recommended. Group Two was told that a strong leader was best; they were to choose a leader. This leader
could veto any group decisions. Group Three was told that the best situation was consensus; the group should utilize all the skills available to them. At the end of the exercise, the group and individual rankings were compared to a key and scored. Groups were rated by taking the difference between the group score and the lowest individual score in the group. The upshot of this was that Group Three had the highest productivity and lowest rating. Groups One and Two spent the majority of their time choosing a leader. They barely completed ranking the fifteen items. Group Two contained some members who had information they would not share for the group ranking process. These members were mad about the way the group leader had emerged. The biggest difference between the group and low-individual scores was in Group Two. The exercise was followed by a discussion of what happened in each group. The managers also shared the implications of their various leadership styles. This resulted in individuals setting up a contract for change in their management and leadership style.

The bottom line of the session was actually like the steel fist in the velvet glove. The session leadership inferred that decisions had been made higher up to put a high value on cooperative, participative management, i.e. sharing some responsibilities and recognition with their coworkers and employees. There was the strong implication that those resisting this concept and activity were making career decisions. Interestingly, as the manufacturing manager shared management responsibilities with the second-line managers, these people often were more willing to share their responsibilities with their subordinates. While the program was implemented, the first-line managers became more sure
of themselves and in how to share some of their responsibilities. The problems of first-line management will be examined in Chapter VI.

The OSU Activities

As ESI moved from early 1980, to the summer months, Oregon State University (OSU) entered the picture, in order to provide a systematically implemented, team productivity training program. A time line of the OSU and ESI activities can be seen in Appendix A.

The what and why of both successful and failing American and Japanese QCC programs was significantly researched. The author also spent time investigating the operations of the ESI manufacturing division. As a result, a series of structural options for the program was submitted to the ESI Production Management Team (PMT), along with comments and recommendations (Hanlen, 1980). The implications of these options were discussed and deliberated; then the pilot team productivity training program was formalized. The formal program was presented to all first-line manufacturing managers on January 14, 1981 (Hanlen 1981). At this point, all questions were answered and interested first-line managers were asked to volunteer to be part of the pilot People Action Links (PAL team) program.

Pilot PAL Teams

The pilot program was limited in size to ensure its success and to allow for time constraints. There were five pilot PAL teams. The teams were facilitated and trained by the author, Jim Simila, and Bill Karns. Mr. Simila is an OSU graduate student; he wrote and presented
five of the fifteen training packages. Mr. Karns is a member of the ESI Human Resources Department. Three of the pilot teams were directed solely by OSU personnel. Mr. Karns handled the remaining two teams. The ESI work schedule and the commuting time from Corvallis to Beaverton placed constraints on the amount of available training time. These were factors in limiting the program size.

Acquiring work groups for the PAL teams was done in a two-phase manner due to the PAL team structure. The first-line manager or supervisor was to be the team leader for a team formed in their work group. This necessitated having an interested and volunteering manager. Those first-line managers which expressed the most interest, and had a very willing second-line manager, were chosen to lead pilot PAL teams.

After the five team leaders were chosen, Mr. Masters and Mr. Karns gave a presentation entitled "An Introduction to PAL Teams" to the five assembled work groups. The handout for this presentation can be found in Appendix D. This presentation defined the PAL team pilot program. It delineated the boundaries and the mode of training and operations, and defined the roles of each participant. It also described the potential benefits to the participants and outlined the groundwork which had occurred to ensure the program success. The mission statement of the presentation is "To create a work environment and formal program in which employees within Production can participate using their creative ideas to solve work related problems." It was also stated that "The direct benefits of a successful program will be improved communications, improved quality levels, and improved productivity." These are the stated goals of the team productivity train-
ing program. At the conclusion of the presentation, questions were answered and clarifications made. The employees were given two days to consider the program and volunteer to form a team under the team leadership of their work group manager. As a result, there were five PAL productivity teams formed which began the training sessions on February 19, 1981. The training sessions were completed on May 6, 1981.

The time schedule for the program design and implementation was not ideal. A major factor in the sequential presentation of the training packages was that the author would be departing the university in June of 1981. An analysis of the training schedule's impact will be seen in Chapter VI.

The Team Leader

The work group's immediate supervisor or manager was chosen to be the team leader for several important reasons. When the supervisor is the team leader, he demonstrates an active support of team activities and team members. This also provides a communication channel so that the supervisor is very familiar with what the team is working on during the team meetings. In this way, a power struggle, arising from any misunderstandings, is avoided between a supervisor and a voted-in team leader. The supervisor or manager can be a natural resource person, who can direct team members to appropriate support groups for information. Although the supervisor is the team leader, his vote carries no more weight than any other team member during the team meetings.
The Facilitator

The facilitator has a more defined role in the ESI program than in past QCC adaptations. There were several reasons for this. The facilitator had time available to become very familiar and involved with the PAL team program. As a representative of the PAL team, the facilitator could function as a communications link with support groups. He could also promote the program to other portions and levels of the company. Most importantly, the facilitator had the requisite background in training and group processes to ensure that the teams got off to a sound start. The work groups were being introduced to the egalitarian idea of teamwork. This is decidedly different from the normal hierarchy and cliques present in their work groups. For these reasons, the facilitator performed the role of a process "watchdog" to ensure the teamwork and group leadership concepts were practiced and adhered to. The facilitator, not the team leader, trained each team in statistical quality control, traditional industrial engineering problem-solving tools, and the processes of inter-group dynamics. The facilitator attended and will continue to attend every PAL team meeting. The role of facilitator encompassed the functions of:

- Member of the PAL Team program steering committee
- Trainer/Teacher
- Team Meeting Process "Watchdog"
- "Shadow" Leader
- Support Resource
- Coordinator
- Communicator
Promoter/Enthusiast
Statistician
Coach/Counselor
Catalyst

The author and Jim Simila facilitated three teams during the training sessions and Bill Karns facilitated the other two teams. At the end of the training session, Marsha Devlin, of the ESI manufacturing division, became the sole PAL team program facilitator. Ms. Devlin was given extensive training and practice in this role prior to May 6, 1981.

The author also served in the role of coordinator by continuously communicating with the PMT and adjusting program components where necessary. The coordinator served to remove any inconsistencies from the program and clear up any gray areas of question.

**Team Size and Demographics**

Each team was drawn from a distinct work area under one supervisor. This differs from the Martin-Marietta Corporation adaptation where members are drawn from various but related work groups, much like an operations research team would be. An underlying premise of the ESI program is that the person closest to the job is most expert in the work process. This person is very qualified to solve problems related to the work. People in a work area do similar or related tasks so that they speak the same language in terms of their jobs. This familiarity with each other and the work often aids the communications process. These workers are also familiar with each other so that an initial work-
ing relationship is usually present. The program was designed to have an optimum team size of eight to ten people. Consideration of work group sizes and make-up, as well as current research on small group dynamics, led to the formation of teams ranging from five to sixteen volunteer members.

The age, educational level, and gender of volunteers was not considered in forming teams. The heterogeneous mixture of age, experience, and gender present was considered to be an asset for team creativity and problem-solving.

Support Structure

The program developed for ESI utilized the existing organizational structure wherever possible. This was beneficial for program acceptance. It also alleviated incurring additional duties for those who would only be involved occasionally. The managers of the PMT received assurances of cooperation from groups outside manufacturing such as Safety, Finance, and Quality Assurance. These groups would act as support groups to provide information and consultation to individual PAL teams as the need arose.

When the PAL teams cannot solve a problem by themselves or need more detailed information, they contact a support group. Often the facilitator or team leader can provide direction to the appropriate group. A PAL team member contacts the support group and describes what is needed. At a mutually convenient time, the PAL team meets with a person from the support group to discuss the problem. With this type of input available, the probability of analyzing all problem
facets is increased. This structure aids the growth of communication links throughout the company.

The PMT acts as the PAL team program steering committee. In this role, they approve final PAL team program components. They also evaluate major team projects which require significant financial investment or operational changes. In other QCC adaptations, steering committee membership is drawn from the company at large. This was not done at ESI since the program, at this point in time, is for incorporation solely in the manufacturing division. An illustrative diagram of the PAL team support structure is shown in Appendix B.

**Team Problem Solutions - Evaluation and Implementation**

All team problem solutions are subjected to evaluation before implementation. When the team arrives at the best problem solution, they write all of the necessary details on a Team Action Plan or TAP (Simila 1981). They describe the problem, the solution, and the solution impact. A sample TAP form is found in Appendix C. The TAP and supporting data are then routed to any support groups which may be able to contribute comments or information and to the second-level manager. Depending on economic or operational impact, the TAP may be approved at one of two different levels. The first-line manager, who is the team leader, can approve expenditures of up to $500. He can also approve work process and procedural changes. The team leader will usually inform his second-line manager of these costs or changes. If the capital costs exceed $500 or the operational changes are significant, the TAP goes to the PMT for evaluation. After this evaluation,
the PMT decides whether or not to submit an Authorization for Expenditure form to the Administrative Committee (AC). The AC is the top level, governing body of ESI. If the form is not submitted, the PMT will explain their reasons for this directly to the PAL team. If the authorization is requested, then the AC will consider the proposal and evaluate it. Proposals, which are approved, are then implemented. Otherwise, the AC denies the request and sends its reasons back to the team through the PMT. A training session on implementation and planning was presented to the teams. This was done to aid them in putting the solution into effect.

**Team Meetings**

The team meetings are held on regular company time. The teams met for two one-hour sessions per week during the thirteen-week team training period. After the initial training period, the teams will meet for one hour per week during their normal work hours.

**Training**

The team leaders were trained by two exposures to the material. The PMT and team leaders received each training presentation two weeks prior to the team. They reviewed and critiqued each package so that appropriate changes could be made prior to the team training session. The team leaders and members then received the training presentation during their normally scheduled hour. The team productivity training will be discussed in depth in Chapter IV.
IV. TEAM PRODUCTIVITY TRAINING

The Purpose

There was a three-fold purpose in the development and presentation of the fifteen training packages. The first was to teach a topic or analytical tool applicable to problems which the PAL team would be working on. A second purpose was to provide team members with an awareness of day-to-day operations by considering economics, safety, etc. Third was the idea of demonstrating and teaching group leadership skills which could become active in the work area outside of PAL team meetings.

The Facilitator

The role of the facilitator has multiple characteristics. As the facilitator took on the roles of process "watchdog" and "shadow" leader, the desired group leadership skills (Bradford 1976) were demonstrated and reinforced to the team members. A conscious effort was made to do this in order that the program become an integrated way of life for ESI manufacturing personnel. Hopefully, leadership skills learned in the teams would carry over into the normal work relationships. At particular points in a training session, the facilitator needed to intervene to remind team members of how they had agreed to operate in a team. This agreement to cooperate, participate, and really listen to one another also effects the members' non-team activities.

As a trainer, the facilitator demonstrated the concepts and solicited feedback from the members. Often, feedback was in the form
of a related experience. This was very useful in tying the concept to something concrete for the other members.

The facilitator also served as a promoter and enthusiast for the team productivity program. He explained the program and team activities to non-participating ESI personnel in a very positive manner.

The coordination between the PAL teams and the PMT managers was done by the facilitator. He served as the communication link for planning management presentations and other activities.

As a support resource, the facilitator could contribute information to the teams. The facilitator's overall knowledge of the company provided a valuable source of information and contacts when the team needed outside assistance. In both a support and leadership role, the facilitator assisted the team in considering all options for a problem solution. This was done by verbally pointing out when the team was limiting discussion, not listening to a member, or narrowly focusing on an area. Through the use of brainstorming techniques and finding out "who knows what" in the company, the teams learned to consider many alternatives.

The roles of coach and counselor allowed the facilitator to deal with individual team members on a one-to-one basis. This became necessary for several different reasons. A member could be very disruptive, continually withdrawn, or confused over the training material. At these times, the facilitator worked with the individual to solve the problem.

In the role of facilitator, the author also performed these various
functions. Additionally, she prepared training materials and wrote these at the necessary educational levels.

**Team Composition**

The composition and demographics of the five pilot teams is varied, although they all come from within the manufacturing division, which has 350 employees. The author dealt with the teams from the System Sub-assembly group, the Instrument Test group, and the Production Model Shop. The ESI facilitator, Bill Karns, dealt with the Finishing Department and the P.C. Board Assembly groups. The respective sizes of these groups are 5, 14, 9, 12, and 16. All five teams are in some way involved in the production of precision instruments and laser-trimmer components. The System Sub-Assembly and P.C. Board Assembly groups do much wiring, soldering, and kit construction. The Instrument Test group performs tests and calibration checks on precision instruments. The Model Shop machines fixtures, jigs, tools, and models for use in production runs. The Finishing Department performs metal-finishing tasks such as painting and chemical coating. The ages in the groups varied from the late teens to the early 60's, although most groups ranged from the early 20's to mid 40's. The age differences impacted the problem-solving process, as will be shown later. Four of the teams contained at least one person who was or is a foreign national. This was a consideration in the written presentation of the training packages. Although the written material was aimed at achieving a ninth grade English reading level, the oral presentation elaborated on the material more, in order to reach those with poor English skills.
This also aided those whose educational levels were lower than most of the team members. The educational level of team members varied from high school drop-outs to college-educated. This posed some problems in holding everyone's attention during a presentation. However, the use of examples common to all team members' experience helped to overcome this.

Training Session Setting

Training sessions were consistently conducted in a large conference room where tables and chairs could be comfortably arranged. The use of carpet and drapes served to deaden intruding noises from the remainder of the building. This allowed the team to focus in on the presentation or application without distractions.

The training packages were presented by the use of detailed handouts, overhead transparencies, large flip charts and a blackboard. The use of transparencies was extremely useful when a graphical drawing was necessary. A water-soluble ink allowed easy erasure between training sessions. The flip charts and brightly colored marking pens were by far the most popular and attention-getting medium. The size of the flip chart ensured succinctness in stating the key points, yet it was highly visible to all team members.

Training Packages

The fifteen topics and analytical tools covered in the training packages were chosen for their applications potential at ESI. The process of topic selection occurred in two stages. After studying and
observing the manufacturing division operations, a large group of potential topics were submitted and explained to the ESI Production Management Team. After clarification of certain concepts, the PMT selected the fifteen productivity training package topics to be developed for the pilot program. These topics were the most useful for industrial application at ESI. The topics and level of presentation would need to be individually adjusted for application at other companies.

The topics and analytical tools developed for the training sessions are:

1. Small Group Operations
2. Creativity-Brainstorming
3. Problem Selection Through Pareto Analysis
4. Problem Analysis
5. Data Collection
6. Data Formation
7. Decision Analysis
8. Economic Factors
9. Group Productivity Measures
10. The Management Presentation
11. Implementing Our Team Idea
12. A Review of the Process
13. Basic Statistics
14. Cause and Effect Diagrams
15. Human Engineering

The topics were ordered in this way in hopes that they could be applied
concurrently to a problem the team chose to work on.

Training Package Presentation

Each training package was first presented to the PMT and the PAL team leaders. This allowed team leaders to become comfortable with the new material prior to the team presentation. Revisions and corrections were made to both the written training material and to the facilitator's delivery style. After incorporating these changes, the training package was presented to each of the pilot teams.

An initial session was developed by ESI management and presented to prospective members prior to the formal training program. These prospective members were all of the employees of the five volunteer team leaders. Mr. Masters presented these employees with this first session entitled "Introduction for PAL Teams" and answered their questions. At this time, interested personnel volunteered for team participation and productivity training.

The methodology of presenting the topics can be summarized by the words "present, give example, review, exercise, apply." Each topic was presented in three mediums. Prior to each training session, a handout was distributed to each team member. The handout detailed the topic, explained the concept by use of an example, and provided an exercise to work to ensure understanding of how to use the tool. The facilitator presented the handout material orally during the training session and elaborated on any unclear points. During the oral presentation, the facilitator used visual aids to expand upon the key points. The example contained in the handout was worked through next
for elucidation. Then comprehension of the key concepts was checked by the use of review questions. The review questions were self-graded. They provided the basis for discussion and clarification. If many members had problems with the questions, then the facilitator realized that he had not presented the material well. He could then repeat the material using a different approach. If only one or two people had problems understanding the topic, they could be worked with on a one-to-one basis. After all team members indicated understanding, the review exercise, contained at the end of the handout, was worked through and discussed. The steps of: present, work example, review, and work exercises, took place during the first training session of the week. The second session of each week was used to implement the tool by applying it to a problem the team chose to work on.

The training package handout varied slightly for team leaders and members. The team leader's handout for each training package contained additional comments needed to address subtle but key points. They also contained the answers to the review exercise. This was done to aid the team leader in reviewing the material when a facilitator was not available to help. The team members' handouts are missing these two items. The author's training packages are contained in Appendix E.

The formalized classroom posture was strictly avoided. The training sessions were conducted in a workshop format with a great deal of give and take between team members and the facilitator. This was advantageous to both parties. The team members lent their own experiences as examples during the discussions. This helped to clarify the concepts or mechanics. This technique gave evidence to some of the key
PAL program ideas, such as:

Each person has unique and valuable experiences and knowledge to share with team members in order to solve problems more effectively. Responsibility for defining and meeting some goals can be shared among team members.

Sharing responsibilities could only be done by team members who felt affirmed as responsible, capable, and equal adults. The posture of an expert lecturing to the ignorant would have stifled team participation and interest.

Using the outlined methodology, the productivity training was conducted over the first twelve topics and analytical problem-solving tools previously listed. The additional three training packages have been held back as supplementary training material for use this summer.

**Training Schedule**

The team productivity training sessions took place over a thirteen-week period. These were two one-hour sessions per week. The first session of each week was used to present the technique in both written and verbal form, go through an example, have the team answer review questions to ensure their understanding, and then to work through an exercise using the key concepts. Although it was known to be compressed, the decision was made to use the twice-a-week, thirteen-week schedule. This schedule was necessitated by the time constraints involved. The OSU personnel would be unavailable for the program after June 13, 1981. Chapter VI will discuss the ramifications of this decision.
Level of Training

There were many different viewpoints expressed at ESI regarding the difficulty level of the training packages. The second and first-line managers were concerned that not all team members would come away with a complete understanding of each technique or tool. This conflicted with other ideas expressed. These ideas were to pitch the material at a ninth to tenth grade level and to not expect that everyone would have the same interest or ability in mastering every one of the training packages. This is where "team" work comes into play. Each individual does not need to be an expert in each technique; the team will still move forward. There was a fine line between "mothering" the team members with very watered down materials and needlessly challenging them with overly complex concepts. The use of the PMT and the team leaders to review and critique each training package before its presentation to the team really aided in the task. Team member responses to the training packages is addressed in Chapter V.
V. EVALUATION

The evaluation of the team productivity training program has taken place over the period of incorporation. The author, the PMT, and the team members have all evaluated the PAL team program from their distinct viewpoints. The evaluation has been done in terms of qualitative measures. Verified opinions and comments are stated in the following sections.

**Team Responses**

It is critical to realize the individuality and uniqueness of each team. The differences in intellectual levels and temperaments often influenced their evaluations of the training packages and presentations, their growth in leadership and teamwork skills, and the types of problems they were able to resolve.

The team productivity topics were well received. They were only occasionally perceived as being complex or repetitious. There was a general consensus that the techniques and tools were useful, but that more time was needed to apply them. At their management presentations two members said, "Training was too short; we needed more time to apply it" and "Training sessions needed to allow more time to practice the stuff." One team took it upon itself to find applications for the tools and work up a sample of the application on paper. Only one group of the five requested more topics concerning group dynamics and people inter-relationship skills. This group was one of the largest in size and took the longest to coalesce as a team. Brain-
storming was the most useful tool in terms of developing teamwork and solving problems. There was a distinct split on the type of examples to use. Half of the team members preferred general real-life examples, whereas the others wanted a specific ESI job-related example to identify with. The most frequent responses were with regard to a change in meeting time and allowing more time between each training package for application.

The teams felt strongly about being allowed to tackle problems in their work area. During the training session, one group spent all of their time working out the team "process" bugs. As a result, they were unable to apply the task tools on a problem to their satisfaction. The other teams did work through several problems which were frustrating them. Although some of these problems appear quite trivial to the outsider, they were like a pebble in the shoe to the team members. The best part of solving these problems was that the team relieved themselves of frustrating situations. This reinforced the concept to them that they could effect change. At their management presentation, some team members stated feeling that they could give valuable input to another member's problem that was not directly theirs. They felt that this distance provided a different insight into the problems. A woman from the Instrument Test Team said, "I feel that we can help out on each others' problems. The distance gives us a different perspective." This woman is one of three women on a fourteen member team.

It was during the first management presentation that attitude and feeling changes were voluntarily addressed. The most highly stressed changes were in communications and trust. From a team, which said that
initially they were isolated and not really listening to one another, came the comment that they were "like a close family now." These team members felt that they had learned to be willing to listen, to trust, and to risk speaking out. They had also received a better understanding of each others' jobs and responsibilities. The Finishing Shop team members carried this idea further by saying that before the team productivity training program, they were "reluctant to learn new jobs." Now they are "doing some job rotations and can fill in for each other." Other significant evaluations concerned increased feelings of self-worth, the perception of management support, and appreciation for the program as an action vehicle. The employees realize the highly competitive nature of their industry. The ability to alleviate frustrations and possibly impact their profit-sharing program seems to provide incentive for participation.

The enthusiasm portrayed by the teams at their management presentations generated even more enthusiasm in the managers. The managers appear to welcome any interest by team members in sharing responsibilities for improving ESI manufacturing and helping to meet company goals.

**PMT Evaluation**

Initially, the PMT had set improved communications as their first objective. Improved levels of quality and productivity were the second and third objectives. A desired spin-off from these would be improved morale and skill levels.

The PMT members all felt that both communication and morale had
improved tremendously. Wally Masters agreed that "they had met the
goal of improved communications." Rank-and-file workers are showing
much less hesitancy in discussing problems and ideas with second-line
management. The second-level managers also noticed team members "spend-
ing more of their lunch and coffee-break time together as a group."
Chris Nawrocki, a second-level manager, noted that "the existence of
small cliques has diminished." The general work climate was per-
ceived to have changed dramatically. Where the manufacturing manager,
Mr. Masters, previously felt antagonism when walking through particular
work areas, he now feels welcome.

Managers had often previously observed their employees as working
in isolation. Duane Froeber, a first-line manager, now observes "team-
work present on the job as the guys ask one another for assistance for
particular problems."

One first-line manager was heavily assisted in making a change in
his supervisory style. The change from authoritarianism to shared re-
sponsibilities has drastically improved overall work relations between
the team leader and his people. At their management presentation, this
team admitted that before the PAL teams, they "had personnel problems"
and "any work problems were the manager's problem." Now they feel that
"they can talk things over" and "vote to resolve problems." This
consensus is shared by the team's second-level manager.

No hard numbers are available to substantiate the claim of re-
duced absenteeism. However, a particular team member, with a past his-
tory of acute absenteeism, has not been absent since the program com-
enced. The second-level manager attributes this to the impact of both
the PAL teams and to some one-on-one work by the manager. One team member has asked her manager if she can come in to attend team meetings while off on a scheduled leave.

Work output has not decreased during the implementation of the program. Particular managers believe that their quality level has improved. Dick Schultze, manager of Producibility Engineering stated, "I have observed improved quality over the implementation period of the pilot PAL team program. I suspect that at least a portion of it is from a better understanding of the job and the improved morale, cooperation, and team spirit that exist now in this department." The P.C. Board Assembly team in that department is collecting data to show how their quality level has increased over the past two months.

The PMT was interested and pleased with the problems being attacked and resolved. They are well within the boundaries defined by the program and the PMT. The boundaries prescribed in the PAL team introductory session are that teams are to address work-related problems and disregard employee personnel actions, company policies and procedures (wage/benefit policies), and problems in "other groups." The problem resolutions have the potential to improve production and increase cost savings at ESI. One PAL team is now collecting data to show where time savings can be gained by the reduction of trips made to the stockroom for missing kit parts. The PMT evaluation of the training program was that it was of the proper depth and scheduling. The other managers concurred with Dick Schultze when he stated his belief that "the training schedule provided task training and served as a catalyst for resolving the intra-group conflicts." Most second-line
managers did not realize the depth of the issues between their employees. The tightly scheduled training topics "provided some meat to the meetings" as a focus for learning teamwork skills and resolving conflicts. Bill Karns believes that "the process could not have been taught first through people-building skills or sensitivity analysis. These employees would not have trusted it." The task topics provided the setting for learning the teamwork process.

The overall response of the PMT to the team productivity training is very positive at this time. When asked if the time spent in the training sessions effected the production schedule, Wally Masters replied, "ESI has not missed one hour of time spent in PAL teams."

**Author Evaluation**

The author's program evaluation took place over the course of the training period. The areas of evaluation included teamwork skills, communications, attitudes, problems solved, productivity index measurements, and team training.

The desired improvement in teamwork skills and sharing group leadership responsibilities took the full thirteen weeks. Through the application of the topics to their problems, team members became cognizant of their responsibilities. The concept that team tasks were to be equally shared took one group eight weeks to understand. Previous to that, they believed that whatever tasks they didn't volunteer to do, the team leader would automatically assume. By the end of the thirteen weeks, the teams had also become effective listeners. In the past, there were disruptions from many people talking simultaneously.
or dominating the conversation. Teamwork skills began to materialize in the form of team members updating and teaching members who missed the previous meeting. They also helped out when other members had problems with the English language.

Improvements in communications could be seen by the way team members began to actively listen to each other. They looked directly at the speaker, remained quiet and wrote down any thoughts or questions. In the beginning of the program, when one person would speak, other members would stare at the ceiling or out the windows, interrupt with thoughts or questions, or carry on unrelated conversations at the same time. Attitude changes were apparent in the way reticent members began speaking out and dominant people began to listen. Twice, sick employees showed up for the team session and then returned home. The enthusiasm and methods of approaching problems changed and grew with each small success. The members appear to be recompensed for their efforts by the ability to actively make changes in their work area problems.

The teams all had minor successes in their problem-solving attempts. Two of the author's three teams had significant success in resolving problems that were frustrating them. These problems might be viewed as minor from the outside. But resolving them alleviated current problems for the teams and provided a medium for practicing the training tools. The smaller successes provided the confidence to tackle bigger projects. Some of the problems resolved included:

- A safety hazard door.
- Secure locking devices for precision-machining equipment.
• Stencil identification for components.
• Procurement of a work table to rest equipment on during trace testing.
• Learning to use an Engineering Change Order form to activate changes.

All of the teams have brainstormed lists of problems they want to try and solve. These problems have been prioritized by the team members in their order of importance. Some future problems to be resolved include:

• Reducing the number of rejected pieces.
• Improving the work group's safety record.
• Reducing the number of trips to the stockroom by obtaining work area stock bins for open stock.
• Designing an identification and tracking system for test equipment and standards.

The teams can also be evaluated on the basis of productivity index measurements (Simila 1981). This measurement process is still in progress at this time. However, one team has chosen to measure itself on the basis of

\[
\text{Production$\ \text{value} = \frac{\text{Production}\ \text{value}}{\text{Unit Time}} \quad \text{and} \quad \% \text{Minor Defects} = \frac{\% \text{ Minor Defects}}{\text{Total Units}}.}
\]

Another team is looking at

\[
\text{Absence$\ \text{Hours} = \frac{\text{Absence Hours}}{\text{Monthly Man-hours}} \quad \text{and} \quad \text{Rework$\ \text{Hours} = \frac{\text{Rework Hours}}{\text{Total Hours}}.}
\]

These personalized indexes are designed by each particular team and assigned weights by the first level manager. They will provide realistic feedback with which the teams can compare and measure the effects of their actions.

The training sessions brought several key points home to the
author. Each team was very unique and different from the others. Flexibility was the key to each training session. Each team had different problems with the topic or the process. Scheduling training sessions in a warm meeting room right after lunch produced some sleepy participants. The training packages were reasonably well received, especially when they were amplified by examples relating to team members' own experiences. The level was such that some members were bored by the simplicity and others were worried by the complexity. In such a range of educational levels, a happy medium may not exist.

From these evaluations, there are some ramifications to be examined in Chapter VI.
VI. CONSIDERATIONS IN RETROSPECT

The opportunity to facilitate, train, and participate in the program implementation has provided many valuable insights. There are several critical factors which favor program success. The most significant are listed below.

**Dominant Success Factors**

1. Building communication and teamwork within middle management prior to the program start.
2. Receiving top management support prior to program implementation.
3. Utilizing middle-management input in structuring the program.
4. Totally voluntary participation by team members.
5. Selection of team memberships on the basis of shared work activities.
6. Defining the boundaries and process of the team program to the members.
7. Prior agreement from non-manufacturing groups to provide information to the teams in a support function.
8. Close rapport with an able company facilitator, who possesses well developed training and group process skills.
9. Use of a facilitator, rather than the team leaders, to train the teams.
10. Determining and tailoring the appropriate topics and techniques to suit the ESI manufacturing division, e.g. Decision Analysis.
enables comparisons to be made between different brands and models of equipment to be purchased.

11. Providing a detailed and in-depth handout on each training topic to every team member.

12. Use of an informal, workshop atmosphere during training sessions.

13. Holding team sessions during normal company working hours.

14. Flexibility in team size restrictions.

15. Use of comfortable, sequestered conference rooms to conduct team meetings in.

16. Use of commercial facilities to introduce first-line managers to teamwork and shared responsibility concepts. This supported the idea that upper management really wanted to work with them.

Lessons Learned

The author's direct participation in almost every facet of the team productivity training program provides some acute hindsight. The program can be improved by making revisions in the following areas.

The Training Schedule

The training period should be lengthened. The tight training period for the pilot teams served as a time for each work group to become a team. But there was little time available, in the thirteen week period, to effectively apply what was learned. The thirteen week training schedule should be lengthened to six months. Six of the most basic topics would be covered in the first six weeks. The other nine
tools would be covered in the remaining eighteen weeks at a rate of one every two weeks. The remaining four sessions per month would be used for PAL team sessions where the tools could be applied more to work problems. The first six basic tools to train members in are listed below.

- Small Group Operations
- Creativity-Brainstorming
- Problem Selection Through Pareto Analysis
- Cause and Effect Diagrams
- Data Collection
- Implementing Our Team Idea

The remaining nine tools are found listed in Chapter IV.

The longer training period would serve a two-fold purpose. The teams would have some basic problem-solving tools at their disposal with the opportunity to become more deeply involved in their applications. Each tool will be learned in more detail by this use and application. The training period and topics would still provide a catalyst to team formation as members learned group process skills. The pilot groups needed six to eight weeks before they worked through all of their conflicts. After that, they coalesced into cohesive teams. The application of the six basic training tools to team selected problems will serve very adequately as a vehicle for learning teamwork.

**Incentives**

There should be a defined incentive program for PAL team participation. The main objective would be to reward the entire team for
improvements implemented as a result of their team efforts. The only incentives existent at this time are derived from the value which team members place on the ability to:

- Acquire new task skills.
- Actively participate in resolving job-related problems.
- Personally grow in leadership and group process skills.

These benefits may provide incentive for a period of time. However, as the new skills are acquired and the most serious team problems are resolved, the impetus to drive forward may slacken. The PAL team meeting may become stagnant and ritualistic after approximately one year.

A four-tiered incentive program based on quantitative measurements should be instituted to reward team efforts. This incentive program would not be tied in any way to the regular pay structure. Most importantly, these rewards would be shared equally among all of the team members. The four tiers of incentives and examples of each are shown below.

Incentives Structure

1. Monetary: Cash bonuses for major cost saving suggestions.
2. Non-monetary: Material gifts - such as a night out for dinner, belt buckles, or cigarette lighters. Privileges - such as an extra coffee break for a week, free lunch with the boss, or a reserved parking space.
3. Recognition: Public recognition through the use of certificates or announcements in the company newspaper.
4. Intrinsic: Personal gratification from learning new skills and participating in an action oriented program. These incentives can provide significant motivation to share in many of management's goals.

Training Topics

The addition of several topics would enhance the program. These topics cover the areas of effective listening, time management, critical path scheduling, and breakeven analysis.

A training package on "Effective Listening" should be added to the program. Listening skills were taught within the training process. The facilitator had to be alert to the appropriate times to work listening skills into the training session. An effective listening package would create an awareness in team members of how people normally listen to each other. This package would help the group coalesce faster. In a study of 29 American QCC adaptation programs, Matthew Goodfellow (1981) found that only eight produced satisfactory results. The common thread in the eight unquestionably successful programs was the "How To Listen" training provided to the foremen and supervisors. These companies found that their people were much more motivated by a team leader who really listened to them. This training can provide significant benefits for all when it is provided for the entire team.

Time management training would be effective in demonstrating how employees can control the time they spend. It is also useful in making people aware of how they are presently utilizing their time. This can be valuable training for both managers and hourly workers.
Scheduled production work is often a problem for both the workers and management. The employees do not always understand how or why the schedule was formed as it was. The manager is not always aware of all of the activities, restrictions, and time requirements involved. Team members trained in critical path scheduling may be able to add valuable input to the Scheduling Department. They are the most familiar with the work and could suggest cost saving changes in the order, the methodology, and the time requirements of the activities.

Breakeven analysis training would allow teams to justify the profit value of their suggested improvements. It would also let team members know when an idea would not be cost efficient. Team use of breakeven analysis can save management time in evaluating team projects. Also, it familiarizes the team members with a constant management concern -- money.

Training in these additional areas can be valuable to problem-solving teams.

**Training Session Time of Day**

The training sessions should optimally be scheduled at the beginning of the work day or in the mid-morning hours. Sessions which were held just after lunch or immediately prior to quitting time resulted in several sleepy, tired, anxious, or uninterested participants. The team members volunteered feedback on this matter throughout the program. The mid-day schedule adhered to during the program implementation was due to commuting constraints on the OSU facilitators.
Training Methods

The written training handouts should continue to be distributed one week prior to the training presentation. Many team members read and think about the material before it is covered. This advance distribution allows the members time to formulate any questions they might have on the material.

The use of some visual aids aided the training presentation. Use flip charts for presentations of graphs, diagrams, and key ideas. Flip charts and bright markers are a highly visible and concise medium. They were the most popular visual aid used during the training sessions. Use a minimum number of overhead transparencies. The lettering is often so small as to make reading difficult. Also, darkening the warm conference room for an after-lunch session increased the loss of participation and attention. Films and slide shows are not recommended. They are a one-way medium requiring only a passive audience. Films and slide shows do not allow the members to interrupt with questions or give feedback. They would be a negative factor in this training program.

Examples gleaned from the team member's work place or experience are valuable training tools. They increase participation and better the rapport between facilitator and team members. The team members should be encouraged to actively seek examples for each training package as it is handed out in advance. This can be done by quickly summarizing the material when it is handed out, and then asking members to think about it.
Other Considerations

There are a few minor areas to consider in implementing such a program.

The PMT went to great lengths to incorporate the team and shared responsibility concepts in the first-line management. This included the days spent sequestered away from ESI to work on the ideas. It is not likely that many companies are willing to invest their time and capital in this way. A viable team productivity training program can be implemented without this extensive and expensive investment. An alternative method might be to cover the concepts in a two-hour session and reinforce them by the actions of second-level management. Teamwork and shared responsibility are demonstrated and taught much more vividly by actions.

The use of detailed, written training materials, which each member collected in his own PAL team notebook, was valuable. Team members were able to refer back to the descriptions when they were learning to apply a particular technique. The use of the PAL team notebook aided the collection, storage, and use of the handouts.

Every team productivity training program needs an ear-catching name or slogan. It is essential to be able to identify with and put a name to the team training and activities. People have always labelled themselves and belonged to groups. If the program is not christened at the start, the participants will find their own names for it.

A company-wide publication is needed to promote and recognize
PAL team activities. This would provide recognition for PAL team efforts. It would also encourage the formation of more PAL teams. If a PAL team gazette is not possible, then a column of the ESI newspaper "Closed Circuit" could be devoted to PAL team activities. The newspaper reporting can provide incentives to the teams through recognition, friendly competition and providing new ideas.

The training topics used in the PAL team program are not suitable for all types of business concerns. They were selected with ESI manufacturing in mind. There are other forms of these basic tools which would be applicable to white-collar or service industries. A competent Industrial Engineer could adapt and tailor these tools for any company who desired it. The main emphasis is to make these techniques available where they can do the most good—to the lower-echelon workers performing the actual tasks.

A company facilitator should be competent in both training and group processes. This takes a special and versatile type of person. If the requisite personality can be found, the company can always provide outside training and experience in trainer and group process skills.

A method is needed to incorporate new members into an existing, trained team. This is an area not previously addressed. It is now coming to the forefront as the success and enthusiasm of the pilot PAL teams spread. One method is to have the facilitator work one-to-one with interested individuals on the training topics. The potential member could learn the teamwork and group process skills by attending team meetings. Another, less desirable method, is to provide the training to a group of interested individuals and then send them back to the
PAL team in their work area. This method has significant problems associated with it in terms of problems to be tackled and group dynamics. It is recommended that the interested individuals study the training handouts and work with the facilitator to clarify any obscure points. The person can concurrently attend the team meetings in their work area.

Finally, the use of "outsiders," non-ESI personnel, had advantages and disadvantages. The disadvantage was that the OSU personnel were not as familiar with the actual work being done in each area as Bill Karns was. This meant that teams needed to explain in more detail what the problem was that they wanted to solve. This is also an advantage in the sense that team members had to be specific and clarify their ideas. This allowed other team members to fully understand the problem as well. Some other advantages were that the OSU personnel came in with no preconceptions or knowledge about the participants. This allowed a fresh start for some individuals with reputations for non-participation. A major advantage was the very lack of ties to ESI management. Initially, the team members were more willing to trust and share their problems with the OSU personnel than with ESI personnel whom they perceived as possible spies for management. This enabled the groups to become cohesive a bit faster. The ESI-facilitated groups did learn to trust and share with their facilitators, but it appeared to take more time and upheaval. This process may also have been due to the unique composition of each team.

An intensive booster program should be developed to supplement the existing program. When meetings become commonplace and the biggest
problems have been solved, the team members will need some additional impetus to continue at their initial levels of activity. A booster program could provide this. There are many components that could be used in structuring the boost. One idea is to bring in team members from programs in other companies similar to ESI to present their activities and ideas. This would allow an exchange of thoughts and inspire new surges in creativity. This could also lead to adaptation of other teams' viable solutions. Another possibility is to schedule a review of team accomplishments. This could raise thoughts of other improvements which can be made or extended. A third idea is to introduce some additional training materials on areas which have not yet been touched on. This would give the team several new approaches to their problems. A review of the first training packages might also be in order. A booster program can provide a necessary shot in the arm to encourage PAL team participation until it is firmly established as a way of life at ESI.

Finally, it is recommended that a future study be done at ESI, beginning in January, 1982. This study would evaluate the PAL team productivity training program one year from the start of the pilot program. Comparisons should be made between the past and present status of these areas listed below.

- The program structure, including team formation, training methodology, incentives and idea evaluation and implementation.

- The subjective evaluations of attitudes and morale.

- The benefit of improvements made on the facilities and
processes.

- The rate of absenteeism.
- The level of work quality.
- The rate of production.
- The Productivity Index measurements.

The comparisons could provide a cost savings analysis to validate this bottom-level measurement oriented productivity program.

These proposals will enhance the PAL team program. They should be evaluated by ESI management for implementation in the near future.
VII. HIGHLIGHTS AND RECOMMENDATIONS

Key Points

The intent of this program has been to create a shop floor filled with trained analysts. These workers have been trained in the industrial engineering techniques and group process skills necessary to effectively solve their workplace problems. The program involves three phases: training, implementation, and measurement. The purpose of the three phases has been to promote teamwork, communication, and action in order to increase participation, quality and productivity.

The literature reveals a variety of theories and QCC adaptations. This program differs in the:

- Foundation built.
- Depth and breadth of training.
- Written and verbal emphasis on group leadership skills.
- Use of facilitators to train and support teams.
- Use of Individualized Team Productivity Index Measurements.

The team productivity training program utilized facilitators to provide team training in problem-solving techniques and group process skills. Training topics were tailored to fit ESI manufacturing operations. The work group manager filled the role of team leader to provide support and continuity with the existing management structure. The structure of the program was designed with prior QCC applications in mind.

The response by all involved ESI employees has been tremendous. Communication, trust, and a sense of hopefulness are most evident.
These are some of their verified opinions.

"This is the best program to hit ESI in 25 years!"

-- Team members Paul Clayton and Eric Richardson

"How do you spell 'relief'? - PAL."

-- Team leader Judy Lehrer

The training tools are receiving application through enthusiastic use by team members. This enthusiasm and optimism is built on their recognition that they can make changes.

However, proof of the value of problem identification and solving tools awaits occasions for applications. Successive applications of these tools will provide a basis for their evaluation.

Recommendations

Suggestions for program revisions can be found in Chapter VI. The implementation of these revisions is recommended. Regardless of whether or not these changes are instituted, it is very highly recommended that a future study be done at ESI in January, 1982. The study would evaluate the program one year from its inception. This evaluation should be based on changes evidenced in:

- Work quality.
- Production Schedules.
- Absenteeism.
- Attitudes and morale.
- Cost savings of implemented improvements.
- Productivity Index measurements.
- Types of problems resolved.
These comparisons can provide the validation for this bottom-level measurement oriented program. The Hawthorne effect implies that short-term improvement often comes just from paying attention to the situation. It is believed that long-term evaluation of the program will provide vindication of the team productivity training concepts.


Talking in circles improves quality. *Industry Week.* Vol. 192, No. 4. p. 62-64.


APPENDIX A

Team Building
Employee Introduction
Manager Training
Facilitator #1 Training

Leader Training
Team Training
Facilitator #2 Training
Program Continuation

Training Program Construction
Team Training
Measurement Evaluation
Thesis

Design and Present
Program Structure
Training Program Construction
Support Development
Measurements Development

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September October November December January February March April May June

PRODUCTIVITY PROGRAM TIME LINE
TEAM SUPPORT STRUCTURE:
How will we make certain that our team gets the outside (of team membership) assistance they might need?

PRODUCTION MANAGEMENT TEAM

1st SUPPORT GROUP
eg. Producibility Engr.

2nd SUPPORT GROUP
eg. Quality Assurance

3rd SUPPORT GROUP

4th - - -

5th ---

Resource Person Invited to Team Meetings as Needed

Forwarding Ideas
Feedback
Support Functions
## TEAM ACTION PLAN
(TAP FORM)

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<th>TEAM LEADER:</th>
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Please Route To These People

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<th>PLANS INITIATED</th>
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MANAGER’S COMMENT
(Approved, Forwarded, Returned, etc.)

Additional Comments:

**BE SURE TO INCLUDE:**
- Problem: What & Where
- Solutions: What, Where & Who
- Impacts: Improvements, Other Effects

**PLEASE HELP OUR TEAM BY RESPONDING WITHIN 7 DAYS**

**IF THIS BOX IS CHECKED:**

APPENDIX D

INTRODUCTION TO PAL TEAMS

"PAL TEAMS"

A PILOT PROGRAM IN FY-81

A PROGRAM TODAY OUR WAY TOMORROW
TODAY YOU HAVE THE OPPORTUNITY TO VOLUNTEER FOR ONE OF ESI’S PILOT PAL TEAMS!
INTRODUCTION

PEOPLE WORKING TOGETHER
PEOPLE ACTION LINKS
PAL TEAMS
GROUPS OF INDIVIDUALS
PAL TEAMS ARE STRUCTURED
WITH TRAINING
WHAT MAKES A PAL TEAM

1. A GROUP THAT VOLUNTEERS TO FORM A PAL TEAM
2. A MANAGER WHO WANTS TO BE A TEAM LEADER
3. A FACILITATOR
4. A STEERING COMMITTEE
5. A STAFF OF SUPPORT PEOPLE AVAILABLE ON REQUEST

A GROUP OF EMPLOYEES IN ONE DEPARTMENT THAT ARE INTERESTED IN HOW THEY CAN CONTRIBUTE THEIR IDEAS TO IMPROVE THEIR JOBS.
HOW A PAL TEAM WORKS

IMPLEMENTING PAL TEAMS REQUIRES A CHANGE FROM BEING MANAGER-CENTERED TO BEING EMPLOYEE-CENTERED IN PROBLEM IDENTIFICATION AND SOLUTION. TO ACCOMPLISH THIS CHANGE WE MUST CREATE NEW WORKING RELATIONSHIPS THAT BUILD TRUST BETWEEN EMPLOYEES AND MANAGERS.

1. DURING THE FIRST 13 WEEKS, PAL TEAMS MEET TWICE PER WEEK TO BE TRAINED AND TO PRACTICE EACH NEW SKILL.
2. AFTER THE TRAINING PERIOD EACH TEAM MEETS ONCE PER WEEK AND IS ALLOWED UP TO ONE HOUR FOR THE MEETING.
3. SOME ADDITIONAL TIME IS ALLOWED DURING THE WEEK FOR DATA GATHERING, RESOURCE CONSULTING, AND MISCELLANEOUS ACTIVITIES. YOUR MANAGER COORDINATES AND PROVIDES THE TIME.
4. EACH PAL TEAM WILL BE ASKED TO REVIEW THEIR ACTIVITIES ONCE PER QUARTER.
TEAM SUPPORT STRUCTURE:

How will we make certain that our team gets the outside (of team membership) assistance they might need?

PRODUCTION MANAGEMENT TEAM

1st SUPPORT GROUP
eg. Productibility Engr.

2nd SUPPORT GROUP
eg. Quality Assurance

3rd SUPPORT GROUP

4th

5th

Resource Person Invited to Team Meetings as Needed

Forwarding Ideas
Feedback
Support Functions
## ACTION PLAN - PAL TEAMS - PILOT PROGRAM

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**PROGRAM REVIEW-A.C.**
ROLE OF THE PRODUCTION MANAGEMENT TEAM

ACT AS A STEERING COMMITTEE
- SET GOALS AND OBJECTIVES FOR THE PROGRAM
- ESTABLISH OPERATING GUIDELINES, CONTROLS
- SET RATE OF PROGRAM GROWTH

ULTIMATE GOAL:
TO CREATE ORGANIZATIONAL CLIMATE IN
WHICH THE PROGRAM CAN SUCCEED
ROLE OF THE FACILITATOR

0 MEMBER OF STEERING COMMITTEE
0 COACH
0 COUNSELOR
0 COMMUNICATOR
0 TEACHER
0 CATALYST
0 COORDINATOR
0 ENTHUSIAST
0 PROMOTOR
0 STATISTICIAN

IN-MEETING ROLE

0 TRAINER
0 "SHADOW-LEADER"
0 PROCESS "WATCHDOG"
0 SUPPORT RESOURCE
ROLE OF TEAM LEADER

ROLE IS VERY SIMILAR TO FACILITATOR - PLUS
- ASSURES SMOOTH, EFFECTIVE OPERATION OF THE TEAM
- "GENTLE-GUIDE"
- SHARES TRAINING RESPONSIBILITIES
- ENSURES JOB ORIENTATION OF MEETINGS
- ENCOURAGES PARTICIPATION
- CREATES ATMOSPHERE IN WHICH MEMBER CAN GROW
- ENCOURAGE SHARED LEADERSHIP
- ASSURES ASSIGNMENTS ARE UNDERSTOOD
ROLE OF THE TEAM MEMBER

- Participate in training
- Be present and active in meetings
- Accepting assignments
- Share responsibility for results
- Supports the team's charter or ground rules
- Acceptance of group decisions
- Provide clear feedback about the PAL process
As a member of a PAL Team you will utilize your unique knowledge and experience to:

1. Help identify work related problems
2. Help prioritize and select problems for the team to solve.
3. Apply new skills to solve these problems
4. Recommend or implement solutions
5. Present results to management
BENEFITS FOR THE INDIVIDUAL

1. AN OPPORTUNITY FOR YOU TO PARTICIPATE IN RESOLVING JOB RELATED PROBLEMS IN YOUR DEPARTMENT
2. YOU WILL LEARN NEW SKILLS THROUGH TRAINING
3. YOUR TEAMS SUCCESSFUL PROJECTS WILL BE MADE VISIBLE TO OTHERS AT ESI
4. EACH INDIVIDUAL WILL EXPERIENCE PERSONAL GROWTH THROUGH PARTICIPATION
WHAT WILL A PAL TEAM WORK ON

Problems within the direct sphere of influence and control of the PAL Team (e.g., design and process related problems)

Identification of problems not within the teams scope to solve, but affecting its operation

WHAT WILL A PAL TEAM NOT WORK ON

Problems in "other" groups

Company Policies and Procedures (e.g., wage/benefit policies)

Employee related personnel actions (e.g., team member wages)
MISSION STATEMENT

To create a work environment and formal program in which employees within Production can participate using their creative ideas to solve work related problems.

THE DIRECT BENEFITS OF A SUCCESSFUL PROGRAM WILL BE

- Improved communications
- Improved quality levels
- Improved productivity

THE SPIN-OFF BENEFITS WILL BE

- Improved morale through employee involvement
- Improved skills for managers and employees
- Creation of a training ground to identify and develop leaders
WILL THE PAL TEAM CONCEPT LAST?

TO ENSURE THAT THE PROGRAM BECOMES A PERMANENT WAY OF LIFE AT ESI, THE MANAGERS HAVE SPENT THE PAST YEAR IN EDUCATION, DEVELOPMENT, AND TRAINING, INCLUDING:

1. STUDY OF VARIOUS PEOPLE INVOLVEMENT PROGRAMS
2. DESIGN OF A PROGRAM TO FIT ESI'S UNIQUE NEEDS
3. TRAINING SESSIONS ON "TEAM WORK"
4. TRAINING WORKSHOP ON SHARED RESPONSIBILITY
5. SELECTION AND TRAINING OF A ESI FACILITATOR
6. CONTRACT WITH OREGON STATE UNIVERSITY FOR DEVELOP DEVELOPMENT AND PRESENTATION OF DETAILED PAL TEAM TRAINING

THE MANAGERS HAVE COMMITTED TO A CHANGE FROM INDIVIDUAL CENTERED TO GROUP CENTERED MANAGEMENT, INCLUDING THE SHARING OF SOME KEY OPERATIONAL RESPONSIBILITIES.
TODAY YOU HAVE THE OPPORTUNITY TO VOLUNTEER FOR ONE OF ESI’S PILOT PAL TEAMS!
SESSION OVERVIEW

In group-centered management, there is a sharing of goals, ideas, and key operational responsibilities. We can be a more effective group or team, if we are aware of what group-centered leadership is and how small groups operate.

This session will describe:

1) "Traditional Leadership" vs. "Group-Centered Leadership".
2) The three group operations of task activity, maintenance, and team building.
3) Problems or activities that can disrupt the team work or meetings.

We will review these ideas at the end of the session and discuss them with the help of some questions and exercises.

LEADERSHIP

Leadership in a team is a shared activity. It is not something that just the designated team leader does. Leadership happens when any team member, including the leader, helps the group progress towards any one of its three goals: accomplishing a task, resolving problems between members, and working well together as a team. This is a service or helping type of position. Since no one person can be sensitive to all the problems that exist in a team at one time, all the team members need to help do this.

However, the designated team leader is not abdicating, or resigning, his or her managerial activities. As we discussed in Session One, "Introduction to PAL Teams," there are some areas that the teams will not work on. These areas included performance standards, discipline, cost and budget expenditures, wages, and personnel actions. The team leader and their manager still keep these responsibilities. Remember though, from the PAL Team Support Structure drawing (Session One), that the manager is a resource person for the team to utilize and also make suggestions to.

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There are 6 characteristics that we want to compare for traditional and group-centered types of leadership. In our team program, we want to stress the benefits of group-centered leadership. Here are our 2 types of leadership.

**TRADITIONAL LEADERSHIP**

1. The leader directs and controls the members and leads them to the decision he feels is best. It is his team and he has the authority and responsibility for decisions.

2. The leader keeps everyone on track and makes sure the task gets done. He prevents the meeting from wandering and does all the work to get the team to arrive at the proper decision.

3. The leader plans the meeting and uses rules of order to keep the meeting always on the agenda.

4. The leader thinks that emotions and feelings will disrupt the meeting and tries to suppress them. He focuses on objective and logical thinking.

5. The leader takes care of a member's disruptive behavior by talking to him away from the other team members. He believes it is his job to do it.

6. The leader considers the task and decision being worked on as more important than the needs of the individual group members.

**GROUP-CENTERED LEADERSHIP**

1. The team is "owned" by all of the team members, including the designated leader. All of the members help to make the team effective.

2. The team members are responsible for getting full participation in making a decision. The leader helps the group to do this.

3. The team members all take responsibility for getting a task done, assigning tasks, deciding the methods to use and planning how to use the available meeting time.

4. Team members and leaders see conflict, emotions, and feelings as genuine facts and situations that should get as much serious attention as the task at hand.

5. The team leader believes that all problems in the team must be faced and solved within the team by all of the members. As the members develop trust in each other, individuals will find it easier to discover the ways their actions or behavior bothers the group.

6. The members use the leader's encouragement and help to realize that the needs, feelings and purposes of all team members should be met. In this way, the group will grow to be more and more of a team.

As you can see, group-centered leadership needs the full participation of all team members. But, it has the benefits of helping us to have a very effective, caring, and communicating team.

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***Ask team members what they feel are the advantages and disadvantages to both types of leadership.***

**GROUP OPERATIONS**

There are three types of operations or activities that need to happen in our team, if it is to be effective as a team. These are:

1) Task activity.
2) Team maintenance.
3) Team building.

Task activities include many different functions. Some of these are:

1. Developing an agenda (listing topics, setting priorities, and budgeting time).
2. Getting the discussion started.
3. Seeking information from others.
5. Giving opinions.
6. Elaborating or helping to develop parts of ideas.
7. Coordinating or building bridges between different members' ideas.
8. Evaluating ideas, not individual team members.
9. Helping to energize the team by ideas, actions, or a statement of your feelings about the topic.
10. Suggesting different methods or structures for the team, such as using small, temporary sub-groups to collect information.

The more that team members share these activities, the more effective they will be as a group.

**Ask team members how they would distinguish between facts and opinions.***

Team maintenance and building is the act of keeping our human relationships in good working order. Here we focus on how the team operates. Maintenance and building functions are the responsibility of all team members. When we don't look after our personal team relationships, we end up with conflict, apathy, antagonism and lack of cooperation. There are many ways of maintaining the group and meeting members' needs. We need to be sensitive to the other team members to keep our team healthy. Some things you can do are:

1. Keep the door open for discussion so that less talkative or shy members can contribute if and when they want to.
2. Encourage participation of team members by asking them to elaborate on their ideas.
3. Help to resolve inevitable conflicts by finding a common ground and using the best ideas from both sides.

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4. Encourage a "best for all" consensus decision that every team member helps to reach. Competition to have your idea win leads to lose/lose situations for the whole team.

5. Give and receive feedback to make sure that what you heard is what the other person meant.

6. Remind the team, when needed, about its commitment to open communication, fairness, no criticism of persons, and efficiency. This may be needed, especially when the team has new or leaving members.

7. Volunteer to observe the team meeting and summarize your perceptions of how the meeting progressed. In this way, the team can get a quick review of what happened during the meeting.

We can help build a strong team by being involved and being responsible for our behavior. When we actively listen and utilize all of our different resources (different team members), we get a better solution to our problems. It is harder for us to deal with differences and accept new team members, but this is also important in building a strong team.

***Ask team members to suggest other ways to help build our team.***

DISRUPTIVE BEHAVIOR

When the team members do not feel responsible for their team and not enough attention is paid to their own problems, then the meetings will get disrupted by very self-oriented behaviors. When these disruptions happen, it is the responsibility of all of the team members to bring the problem out into the open, discuss it with caring and concern, and resolve it. This will allow the team to get back to its task with better team spirit and participation.

Some of the disruptive behaviors that can occur include:

1. Blocking team progress by going off on tangents, arguing a point to death, or focusing in on irrelevant trivia.

2. Seeking power and authority by splitting the team into an "us" and "them".

3. Seeking personal recognition by talking excessively, suggesting extreme ideas or behaving in an unusual way.

4. Dominating the meeting by using loud voices, absolute pronouncements, and endless speeches or lobbying for a pet project.

5. Constantly clowning around, telling jokes, or seeking attention or sympathy.

The best way to handle disruptive behavior is with care and concern while confronting the individual with how their behavior is affecting the team. We do not want to punish or attack the person. We do want to call attention

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to the behavior, ask the team member to examine it and its effects, and suggest other behavior that would be more productive for everyone. Often, the person is not aware of the negative impact of their behavior. A friendly confrontation will keep communication lines open and help to resolve, rather than bury, the problem.

***Are there other behaviors that the team feels are disruptive?***

**SUMMARY**

As a team, we want to focus on people building as well as problem solving. By being patient with each other, actively listening, and critiquing ideas, not people, we will be able to work well together as a team and build trust and communication channels. This can help us to avoid interpersonal attacks, apathy and discouragement.

***Ask team members to answer the Review Questions at this time. Then read and discuss the Review Exercises.***

**EXERCISES**

1. What are some non-threatening ways we can give each other feedback?

2. What needs to happen for you to feel that this is your team, too?

3. What do you expect to contribute to the team? Are there some activities that you feel are a very important part of teamwork?
REVIEW QUESTIONS

1. In Group-Centered Leadership, who owns the team?
   a. The team leader.
   b. All of the team members.
   c. No one.

2. The purpose of a designated leader is to aid and help the team work together effectively.
   True_______  False_______

3. What are the three primary group operations?
   a.
   b.
   c.

4. Who is responsible for planning the team meeting agenda?
   a. The team leader.
   b. All the team members.
   c. Planning and Scheduling dept.

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5. Team members can deal with feelings, conflicts, and emotions, and task-oriented facts during the meeting.
   True_______   False_______

6. What kinds of behavior disrupt the team meeting?
   a.
   b.
   c.

7. Developing an agenda and getting information is a task activity.
   True_______   False_______

8. Resolving conflicts and encouraging participation are maintenance and team-building activities.
   True_______   False_______

9. Feedback can be verbal, written, or non-verbal body language.
   True_______   False_______

10. Team Work means "Everybody Wins."
    True_______   False_______

11. Leadership is a shared responsibility.
    True_______   False_______
SESSION OVERVIEW

Pareto analysis is one of the most helpful tools for separating the few important problems from the trivial many. A Pareto chart convinces people because it has a strong visual impact. The important problem areas really stand out on a Pareto chart.

We will take a careful look at Pareto analysis during this session to see how it can help us choose the most important area, problem, or part to work on. Pareto charts may also become a valuable tool for our team's management presentations.

The important points we want to cover today are:

1) The PURPOSE of Pareto analysis.
2) WHEN TO USE Pareto analysis.
3) HOW to construct a Pareto chart.

At the end of this session, we will review the key points by doing a sample exercise and answering several written review questions.

PARETO ANALYSIS

It can be very difficult to select our most important problem to focus on. The purpose of the Pareto chart is to highlight the number one problem. The Pareto chart makes the data into an easy to understand picture. This picture shows how important each problem or area is, compared to all the others. (Sometimes a picture is not only worth a thousand words - it can be worth a thousand dollars in savings!) When we collect data and draw a Pareto chart, we are doing Pareto analysis.

We use Pareto analysis when we want to find out what our biggest, most important problem is. We do this by collecting facts and drawing our graph. With Pareto analysis we can look at several possible problems or parts of a problem. It will help us organize our data and see the most important problem. Suppose that in our brainstorming session, we voted that our most serious problem was...
our high daily reject rate and that we wanted to solve this problem. By
collecting data and using Pareto analysis, we could focus in on the real
problem. It may be that we are having most defects appear on one particular
part or the defects occur mostly on one work shift. We can then see this
and select that as the problem to solve.

The Pareto chart is often mentioned together with the 80/20 rule. This is
because Mr. Pareto, a 19th century Italian, demonstrated with graphs that
80% of his country's wealth was controlled by just 20% of the people. Here
is an example of this kind of graph.

***Put the Italian Wealth Pareto chart on the overhead.***

![Italian Wealth Pareto Chart](image)

Many other people have found that this 80/20 rule is seen in many other parts
of our lives. For example: 80% of the meals we eat repeat 20% of the
recipes we know, 80% of product defects come from 20% of the process operations.

***Stop and ask team members if they can see anything in their lives that
the 80/20 rule applies to.***

CONSTRUCTING A PARETO CHART

***Put Pareto chart construction steps on overhead.***

**Step 1.** Determine what length of time you will use to collect the data.
Sometimes a few hours are all you need, but it may even take days or months.
We need enough data to have a good picture of what is really happening.
Step 2. Decide exactly what you want or need to know. Knowing exactly what data you need will simplify the task of collecting it.

Step 3. Design an easy to use check list or check sheet that will allow us to collect the data we need. A later session will describe how to design your own check sheets, graphs, and charts when you must collect your own data. Often the data you want may already exist. Talk to Quality Control, Engineering, Accounting, or any other support groups to see if they have that data.

***Let team members know that Session Six will explain more about drawing up check lists and check sheets.***

Step 4. Record the data you collect on the check sheet.

Step 5. Use the data on the check sheet to construct the Pareto chart by adding up the data for each item or category and plotting it on a graph. The horizontal line on the bottom of our graph is divided up into equal parts and labelled for each category we looked at. The up and down, or vertical, line on the left hand side of the graph will be as tall as the total number of items that have the quality we looked at. Then, when we plot the data, we will have a column above each item or category that is as tall as the number counted for it. We should always plot these numbers in decreasing size, from big to small, starting at the far left hand side of the graph. The Pareto chart needs at least two columns. There is no maximum number of columns, but too many can clutter up our chart. Sometimes we can combine several categories together and label it "Others."

Step 6. Label the Pareto chart with your team name, the date, when the data was collected, and where or who the data came from.

EXAMPLE

During our brainstorming session, our PAL team decided that our high daily reject rate was a problem we wanted to attack. How do we know which part, if any, we are having the most rejects on? Or, is the problem maybe due to the time of day it is made, or due to a particular machine we use?

Step 1. Since we want to look at our daily reject rate, we will probably want to collect data over one typical day.

Step 2. The data we want to collect might include the part number, the cost to make each part number, and the number of rejects for each part number. The cost to make each part is also the cost of scrapping it when the part is rejected.
Step 3. One way to collect this kind of data would be on a sheet like the one shown below.

<table>
<thead>
<tr>
<th>Part #</th>
<th># of Rejects</th>
<th>Standard Cost/Each</th>
<th>Total Cost of Rejects</th>
</tr>
</thead>
<tbody>
<tr>
<td>41917</td>
<td>29</td>
<td>$14.43</td>
<td>$418.47</td>
</tr>
<tr>
<td>41957</td>
<td>26</td>
<td>586.80</td>
<td>15,256.80</td>
</tr>
<tr>
<td>42059</td>
<td>81</td>
<td>242.66</td>
<td>19,655.46</td>
</tr>
<tr>
<td>43978</td>
<td>16</td>
<td>136.88</td>
<td>2,190.08</td>
</tr>
<tr>
<td>Total</td>
<td>152</td>
<td></td>
<td>37,520.81</td>
</tr>
</tbody>
</table>

Data Collection Sheet

Step 4. Record the data on the check sheet by simply finding out the information and making a tic mark on the sheet for each unit counted. For large number counts, an x was used to represent 10 units.

Step 5. We now add up the number of count marks in each box. We can place the number in ( ) inside each box. We are interested in the parts which add the most to our number of rejected parts. Now we want to plot the number of rejects for each part number on our graph. We should plot the numbers in decreasing order, starting with largest number of rejects on the far left. Our graph will look like the one below.

***Put Pareto Chart I on the overhead.***
Step 6. Label our Pareto chart with the team name, date, collection period, and source of data.

Part number 42059 seems to have more than half of the rejected parts. But we might want to check whether it would be worth our time to look at that part number and the work we do on it. We can look at the value of the parts we make. A part number may have many rejects, but cost us less to make or scrap than a different part.

Now, if we plot the part numbers and the cost of their rejects on our graph, we will have another Pareto chart that easily tells us what part number rejects cost us the most money.

***Put Pareto Chart II on the overhead.***
We can clearly see from this second Pareto chart that scrapped rejects of part numbers 41957 and 42059 cost us the most money. Since both Pareto charts show part number 42059 as a major problem, our team may now want to look more closely at the way we make this part and what machines and materials we use in the process. We can do this using both the problem analysis tools that will be covered in the next handout and the brainstorming tips that were talked about during the last session.

***Have team members complete the written review questions.***

**REVIEW EXERCISE**

***Ask team members to get together in a small group or groups to work on this exercise.***

The following data was collected by team members to determine if any parts they worked on had a high reject rate. The team members felt that there was a problem in this area. They wanted to see if the data would also show that a problem existed. The check sheet shows the data that the team members collected.

<table>
<thead>
<tr>
<th>Part #</th>
<th># of Rejects</th>
<th>Standard Cost/Each</th>
<th>Total Cost of Rejects</th>
</tr>
</thead>
<tbody>
<tr>
<td>04858</td>
<td>(176)</td>
<td>$3.48</td>
<td>$612.48</td>
</tr>
<tr>
<td>06990</td>
<td>(749)</td>
<td>$11.19</td>
<td>8,381.31</td>
</tr>
<tr>
<td>41864</td>
<td>(19)</td>
<td>86.63</td>
<td>1,645.97</td>
</tr>
<tr>
<td>41905</td>
<td>(30)</td>
<td>145.27</td>
<td>4,358.10</td>
</tr>
<tr>
<td>Total</td>
<td>974</td>
<td></td>
<td>14,997.86</td>
</tr>
</tbody>
</table>

Data Collection Sheet

We want to use the blank charts to plot our data. Please plot the data on the charts. Which part number or numbers are the team's biggest problem?

***Ask team members why they feel the parts they chose are the most important problems.***

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Pareto Chart I
NEXT SESSION

We will start to apply Pareto analysis to the problem area our team wants to look at. This problem area often is the one that got the biggest number of votes during the brainstorming session. We will review Pareto analysis and answer any questions.
REVIEW QUESTIONS

1. Columns should be arranged in descending order from either left to right or right to left.
   True_____    False_____

2. What should we usually do just before drawing our Pareto chart?
   a. Brainstorming
   b. Collect data on our check sheet
   c. Problem analysis

3. The columns of the Pareto chart can be arranged by what is most useful. For example, by dollar cost instead of number of rejects.
   True_____    False_____

4. The purpose of the Pareto chart is to highlight the number one problem.
   True_____    False_____

5. If no problem stands out on the chart, we should look at the data in a different way and plot the columns by some different characteristic on the left hand side.
   True_____    False_____
6. The maximum number of columns a Pareto chart can have is:
   a. Seven
   b. Ten
   c. No limit

7. The least number of columns that our Pareto chart can have is:
   a. Two
   b. Three
   c. Five

8. There are times when the results of our Pareto chart suggest we draw another Pareto chart.
   True_______ False_______

9. Pareto analysis helps us organize our data into an easily understood picture.
   True_______ False_______

10. Pareto analysis is named for Mr. Pareto,
     a. a psychiatrist.
     b. a 19th century Italian.
     c. an American draftsman.

11. Each Pareto chart should be labelled with:
     a. the team name
     b. the date
     c. the time period when the data was collected
     d. where the data came from
     e. all of the above (a,b,c, and d)
SESSION OVERVIEW

After we have used Pareto Analysis to find our number one problem, we must still look at the problem in more detail to find the true cause or causes of the problem. Problem analysis is what we do when we take a problem apart and look at everything which contributes to it.

In today's session we will look at:

1) The PURPOSE of problem analysis.
2) WHEN TO USE problem analysis.
3) HOW to analyze and take a problem apart.

After we cover these three points, we will answer some written review questions and work through an exercise together.

PROBLEM ANALYSIS

To get the best solution to our problem we need to take some time to sit down and think carefully about the problem. The purpose of analyzing a problem is to make sure we consider exactly what the problem is and to look at all the things that help cause it.

We want to use problem analysis when we want the best answer to an important problem. This way we can consider all possible ways to solve the problem. For example, what kind of sandwich to have for lunch is not always an important problem to us. But, buying a new car that fits all of our needs and wants can be a big problem.
As we go through the steps of analyzing a problem, we will use brainstorming which we learned in Session Three. We should write what we do at each step on a large sheet of paper so everyone can see it. This will also be a permanent record of our analysis. Be sure to title and date the large worksheet for future reference. To analyze our problem, we start with these steps:

***Place Problem Analysis steps on overhead.***

**Step 1. State the problem as exactly as you can.** This will save time as we look at the causes of the problem. It will also aid us in finding a successful solution. The team will discuss the definition of the problem and vote on the statement that describes the problem the best.

**Step 2.** Decide on major groupings which we can list all the causes or contributors to the problem under. If the problem is a general one, we could start with the 4 M's as headings. The 4 M's are: Materials, Methods, Machines, and Manpower. We are not limited to using the 4 M's. Any groupings that fit the problem better should be used.

**Step 3.** Brainstorm and list all the possible causes of the problem under the groupings they belong to. Sometimes, several small causes can be listed under a major cause in our groupings. When we look for causes, it helps to look for changes, patterns, and similarities. Before starting the brainstorming step, it will help to review the rules of brainstorming.

***Review the rules for Brainstorming with the team members.***

**Step 4.** Carefully look at the brainstorming results. Identify the 3 most probable big causes of the problem by team voting. Each team member can vote for as many of the causes as he or she thinks is important. Now circle the 3 causes that got the most votes. We could do more than 3 causes if the team felt it was necessary.

**Step 5.** Rank the 3 most probable causes in order of importance. The team should vote on the importance of these causes. If there are any small groups of causes under a major cause, these small causes should also be ranked by importance.

**Step 6.** Try to verify or confirm that the #1 cause really is a cause of the problem. The team can do this by discussion, brainstorming, or gathering some data. We also want to verify that causes #2 and #3 are part of the problem.

**Step 7.** Brainstorm about all the possible ways to correct the problem. To help us consider all solutions, we should think about two things:

a. What can we do to get rid of or change the cause?

b. What are the effects or results if the problem is gone?

**Step 8.** Choose the best solution and recommend it to management. The best way to choose the solution is by team discussion and voting. The team is the expert. By discussing the solutions, the team can find the best one. Teams can also use Decision Analysis to decide which solution solves the problem the best. To keep the solution from getting lost, it should be recommended to management in writing.
EXAMPLE

During our Pareto Analysis, our PAL team identified the large number of rejects for part number 42059 as the number one problem. This is the problem we will analyze and look at in more detail. We will use a large piece of paper to write down what we do at each step.

Step 1. The problem is:

Part Number 42059 has too many rejects.

Step 2. The groups we decided to use are the 4 M’s: Machines, Methods, Manpower and Materials.

Step 3. The team brainstorms and lists all the possible causes anyone can think of. This is what their paper looks like:

***Place Brainstorming For Causes on overhead.***

### BRAINSTORMING FOR CAUSES

The Problem: Part Number 42059 has too many rejects.

<table>
<thead>
<tr>
<th>Major Groupings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Machines</strong></td>
</tr>
<tr>
<td>Milling Machine</td>
</tr>
<tr>
<td>Alignment</td>
</tr>
<tr>
<td>Dull Edge</td>
</tr>
<tr>
<td>Stability</td>
</tr>
<tr>
<td>Lathe (3)</td>
</tr>
<tr>
<td>2. Cutting Edge</td>
</tr>
<tr>
<td>1. Alignment</td>
</tr>
<tr>
<td>3. Machine Age</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Notice that the team left lots of space between each big possible cause to list all the small things which might contribute or add to it.

Step 4. The team voted the three numbered causes as the most probable ones. These are the causes with a circled number beside them.

Step 5. The team discussed the importance of the three causes and ranked them. They also ranked the smaller causes listed under each of the three major causes.

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Step 6. During the team discussion, members noted that this part number was only made once a month. The rest of the month was spent on other parts. Someone else suggested that less experienced machine operators were having to relearn how to make that part every month. The team members continued their discussion and verified from their own knowledge and experience that these were indeed three very possible causes.

Step 7. Team members wanted a solution that resulted in less rejects for part number 42059. They brainstormed for possible solutions and changes they could make to get less rejects.

Here are their ideas.

***Place Solutions Brainstorming on overhead.***

<table>
<thead>
<tr>
<th>Solution Brainstorming</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency</strong></td>
</tr>
<tr>
<td>1. Schedule part to be made more often.</td>
</tr>
<tr>
<td>2. Make the part in very large lot sizes only twice a year.</td>
</tr>
<tr>
<td><strong>Machine Operator</strong></td>
</tr>
<tr>
<td>1. Provide more training to operators.</td>
</tr>
<tr>
<td>2. Provide refresher training just before that part lot is going to be made.</td>
</tr>
<tr>
<td>3. Assign certain operators to always make that part number.</td>
</tr>
<tr>
<td><strong>Lathe</strong></td>
</tr>
<tr>
<td>1. Check machine alignment more often.</td>
</tr>
<tr>
<td>2. Make sure machine is securely attached to the floor.</td>
</tr>
<tr>
<td>3. Change cutting edge more often.</td>
</tr>
<tr>
<td>4. Try a new cutting edge material.</td>
</tr>
<tr>
<td>5. Check machine for age and wear.</td>
</tr>
<tr>
<td>6. Replace machine.</td>
</tr>
</tbody>
</table>

***Ask team members if they think there are any other possible solutions.***

Step 8. Team members discussed all of their solution ideas. They spent later sessions finding out the possible results of the best solutions. Then they used Decision Analysis to decide which solution was best. This is the solution that was written up and recommended to management.

***Let team members know that Decision Analysis will be covered in Session Eight.***

***Have team members complete the written review questions.***
**REVIEW EXERCISE**

Problem analysis helps us to find the true causes of a problem. The problem that we want to analyze is how to get better gas mileage from our cars. Go through all the steps as follows:

1. **State the problem as precisely as you can.** Do we want better gas mileage in town, on the freeway, or all the time? Is the season of the year important? Use your imagination and be precise.

2. **Identify the major groupings of the causes.** We can use the 4 M's, the five W's and an H (when, where, what, why, who, and how), or anything else that fits.

3. **Brainstorm and identify possible causes.** This is a good place to use your imagination.

4. **Identify the most likely causes by discussion and voting.** Circle the causes getting the most votes.

5. **Discuss the importance of each cause and vote on what priority or rank each one is.**

6. **Verification.** The whole team should get involved to find a good test to see if we can verify that the number one cause is really responsible for the problem.

7. **Solution.** Briefly describe what we should do to correct the problem.

---

**The Problem**

**Causes**

---

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The Number One Cause

Verification Test

Possible Solutions

The Best Solution

NEXT SESSION

We will begin to analyze our number one problem by taking it apart and looking at its causes. We will also review Problem Analysis by answering any questions you have about it.

***Before the next session, have the Team identify a problem they want to work on.***

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REVIEW QUESTIONS

1. When we identify important causes in Step 4, how many causes can be circled?
   a. One
   b. Three
   c. No limit

2. The technique that usually comes just before Problem Analysis is:
   a. Making a check sheet
   b. Pareto Analysis
   c. Brainstorming

3. Verifying the cause in Step 6 is:
   a. Mandatory
   b. Recommended
   c. Never used
4. The purpose of Problem Analysis is to consider as many causes of the problem as possible.

True_______ False_______

5. The problem to be analyzed should be stated very generally to encourage members to suggest a wide range of causes.

True_______ False_______

6. Before the brainstorming step, members should review the rules of brainstorming only if new members or visitors are present.

True_______ False_______

7. When we look for causes, it helps to consider: (Several answers apply.)

a. Changes
b. Similarities
c. Repeating patterns
d. Causes suggested by visitors to the group
e. Causes that start the most discussion

8. In order of preference, the Problem Analysis should be done on a:

a. _______ Blackboard
b. _______ Note pad
c. _______ Large sheet of paper
d. _______ Overhead projector

9. Discussion of all suggested causes takes place:

a. During brainstorming.
b. During voting to decide the most likely causes.
c. During the verification step.

10. Please name the 4 M's.

a. 

b. 

c. 

d. 

SESSION OVERVIEW

If we are to solve problems, we must have data. The most common forms of data are numbers and written down facts. The data we collect will help us at every step of problem solving. Today, we will look at 2 ways to collect data. One way is for number data and the other is for describing facts.

This session will describe:

1) WHY we collect data.
2) WHEN to collect data.
3) HOW to Ask/Look/Measure.
4) HOW to describe a process with a Flow Process Diagram.

After we look at these ideas, we will work a sample exercise together and answer some review questions.
DATA COLLECTION

Collecting useful data helps us to analyze our problems better. We want to collect data when we are trying to solve a problem or prevent one. We will learn 2 methods for collecting data. They are called Ask/Look/Measure and the Flow Process Diagram. The team can use brainstorming to go through the steps of each method.

The Ask/Look/Measure Method

The name Ask/Look/Measure tells us exactly how we can collect numerical data. Examples of numerical data are: The number of safety-related accidents a group of workers has and the number of rejects coming off of a certain machine. We can use this kind of data for our Pareto Charts. Here are three basic steps to the method.

***Put Ask/Look/Measure Data Collection Steps on the overhead.***

Ask/Look/Measure Steps

Step 1. **Ask** the question, "What exactly do we want to know?" We must decide what kind of data we want to collect. Then we need to draw up a simple checklist to collect this data on.

***Let members know that we will cover checksheets in Session Seven.***

Step 2. **Look** at the item or process we are collecting data on. We want to decide on the best way to collect the information we need. We can either collect data on every unit or process step or we can take a sample.

Collecting data can be expensive if we collect a lot of data or get the data from destructive testing. Usually, it is better to collect our data by sampling. It is very important that the sample represents the entire product lot or process. An example of this is when we have a blood sample taken. The hospital takes only a small sample which can tell them about all of your blood supply.

***Ask members if they can think of other times when we only take a sample to get data. (e.g. Sampling our cooking).***

To make sure that the sample represents the whole population, we try to take a random sample. A random sample is when each item in a group has the same chance of being picked to be measured and each item is chosen independent of any other item. A sample that is not random has bias in it. We do not want a biased sample. An example of choosing a random sample is when the bingo caller reaches into the container full of moving bingo balls or tokens to choose one to call next.
There is a famous example of a biased sample where a magazine wanted to predict the upcoming Presidential election winner. The magazine decided to take a survey and ask people who they were going to vote for. The survey interviewers randomly chose names from the phone book, called these people, and wrote down which candidate the person was voting for. As a result, the magazine predicted that the Republican candidate would win by a large margin. However, it was the Democratic candidate that won by a large margin. The reason that the sample did not let the magazine predict the real winner was that the people sampled were not chosen independently of each other. This is because, during the early 1930's, only wealthy people had telephones and most wealthy people then were Republicans. So, the people in the phone book tended to be more from the Republican party. Today, this is not true of people with telephones. When people are sampled these days, the interviewer is very careful to get a random sample that includes people of both sexes from all types of jobs and economic levels. This way, the sample represents everyone.

To make sure that each item has the same chance to be picked for measuring, we can use a sampling table or invite outside personnel to aid us. Using other personnel, who are more skilled in this area, will save us time and make sure our sample really represents the true situation.

Step 3. Measure each item for the data we want to know. For example, we could count the number of scratches on each instrument cabinet or count the number of resistors that have the wrong resistance wound on them. Record the data collected on the checksheet. Make sure your checksheet has a title, date, location, and collector's name on it.

**Ask/Look/Measure Example**

Our company makes breakfast cereals. We have been getting a lot of complaints about our boxes being only half full when the customers open them for the first time. We want to find out if this is really happening at our plant.

The Problem: Cereal boxes are being filled only half full.

Step 1. What do we need to know? Our team would like to know how many boxes of each cereal, during one week, are only filled half full. The team designed the following checksheet to collect the data on.
Step 2. Look at the box filling process. How do we want to collect the data? Since we can’t sell the boxes we open to check, we decide to sample. We ask someone in Quality Control to help us design a way to sample the cereal boxes over the week. This way, we will get a random sample that represents all the cereal boxes filled during the week.

Step 3. We collect our sample of boxes each day. Then, we open each box and see if it is full or half-full. If it is only half-full, then we mark it down on our data sheet. Later, we can use this data in a Pareto Chart to see if we really have a problem.

### The Flow Process Diagram

The Flow Process Diagram is entirely different from Ask/Look/Measure. Flow Process Diagrams allow us to collect data on a process by using words and pictures to show each small step of the process. This way we can show how the work moves or flows through the work area. These diagrams and written descriptions let us ask questions like:

a. Is any particular step causing the most problems?
b. Can we combine or eliminate any of these steps?
c. Is there a better order we could do the steps in?
d. Is there a better place or person to do some of the steps?

The two methods we will look at can help us save work space, get rid of unnecessary work and walking around, and save time. Here are 2 ways to draw the Flow Process Diagram.

### Map Method

One way is known as the Map Method. This method uses a drawing or map of the work area, with numbered arrows on the map, to show the path of the product or
process. Next to this drawing, we can describe each step of the process in more detail.

Step 1. Make a drawing or map of the area where the process takes place.

Step 2. Draw arrows on the diagram to show the path that the process follows. Number the arrows in the order they happen.

Step 3. Next to the drawing, write down the number of each arrow and what is happening at that step.

Map Method Example

The Problem: We get thirsty watching the T.V.

The Process: Getting a soda or beer from the refrigerator.

1. Go to cabinet for bottle opener.
2. Get bottle from refrigerator.
3. Open bottle over sink.
4. Throw bottle cap away.
5. Take bottle and return to sofa.

Box Chain Method

The second way is the Box Chain Method. In this method, we write each step of the process, in the order it happens, in a horizontal line of boxes. Each box is connected to the next by an arrow. We usually put the first step in the far left box and end with the final step in the far right box.

Step 1. Draw a group of boxes in a horizontal line and connect each box to the next with an arrow.

Step 2. Put each step of the process in a box, in the order it happens. Start by putting the first step in the far left box.
Box Chain Method Example

The Problem: We are out of food at home.

The Process: Going grocery shopping.

1. Get Money
2. Make Shopping List
3. Drive to Store
4. Shop for Groceries

***Have team members complete the written review questions.***

***Let team members know that they can work together on the Review Exercises.***

REVIEW EXERCISES

Ask/Look/Measure

Our beer company is losing sales. Unhappy customers are complaining the beer is flat when they buy it. We know that beer goes flat when it gets too much air next to the surface. This can happen when our bottles have loose caps or the bottle only gets partly filled.

The Problem: Flat beer.

Step 1. What do we need to know about our bottles of beer?

We need to know how many of our bottles of beer are flat.

Step 2. Should we sample certain bottles or check every bottle of beer we make.

The best idea is to sample. We can't sell the bottles we check.

Step 3. Specifically, what should we measure? Please write down what kinds of things we should count.

Count the number of loose bottle caps. Count the number of half-filled bottles. Taste the beer in our sample and count the ones that taste flat.
Flow Process Diagrams

Map Method

Using arrows, show the steps needed to get to work on time. Write these steps down. Use as many steps as you need.

The Problem: Getting to work on time.

The Process: Getting to work.

1. Get up.
2. Shower/Shave
3. Dress.
4. Eat.
5. Start and drive car.
6. Get to work on time.

Box Chain Method

Fill in the blocks with the steps that you believe should go there. Use as many boxes as you need.

The Problem: Getting to work on time.

The Process: Getting to work.

NEXT SESSION

During the next session, we will use these methods, to decide what data we need to gather, to help solve our chosen problem. We will also review these methods and answer any questions.

DH
3/31
DATA COLLECTION

REVIEW QUESTIONS

1. We collect data to prevent or solve a problem.
   True_______    False_______

2. A random sample helps to assure that the sample represents the whole lot or process.
   True_______    False_______

3. We can use the data we gather to draw a Pareto Chart.
   True_______    False_______

4. The reason we use sampling is to save time, effort, and money.
   True_______    False_______

5. Flow Process Diagrams are used to show the individual steps in a process.
   True_______    False_______

DH
3/81
6. Flow Process Diagrams help us by: (several answers apply)
   a. Suggesting a better order for the steps to save time.
   b. Showing where we could save extra walking around.
   c. Showing where we could save work space by rearranging our work area.
   d. By identifying our biggest problem.

7. The boxes of steps in the "Box Chain" Flow Process Diagram can be arranged in any order.
   True_____    False_____  

8. What parts can be seen on the "Map Method" Flow Process Diagram? (several answers apply)
   a. Numbered arrows.
   b. A diagram or map.
   c. Written down steps.
   d. Several boxes, in a row, connected by single arrows.

9. It is very helpful to collect our numerical data on some kind of checksheet.
   True_____    False_____  

10. If we do not choose a sample randomly, our sample and our data will:
    a. Be biased.
    b. Represent the whole group that it was taken from.
SESSION OVERVIEW

Decision Analysis helps us to choose the best solution to a problem. We can use Decision Analysis after we have collected data and carefully analyzed our problem using Problem Analysis. Often, we will use Decision Analysis to choose between similar types of solutions, such as choosing which brand or model of an item to buy.

This session will cover:

1) The PURPOSE of Decision Analysis.
2) WHEN TO USE Decision Analysis.
3) HOW to analyze our possible decisions and pick the best solution.

We will answer some written review questions and work through a sample exercise after we cover this material.

DECISION ANALYSIS

The purposes of Decision Analysis are:

1) To help us look at how we make a decision.
2) To help us make an objective decision, based on facts, so that we get the best solution to our problem.

An objective decision is one which is made using facts, instead of personal prejudice or emotion.
We want to use Decision Analysis when we have to choose between several possible problem solutions. Often, when we have several conditions that a "best" solution must or should meet, we have to make trade-offs to get a "good" solution.

As we go through the steps of Decision Analysis, we will use the brainstorming techniques that we have learned. Remember to use a large sheet of paper to write down what the team does at each step. When we title and date this paper, it will become a highly visible, permanent record of what the team has done and decided.

*** Remind team members of the rules of brainstorming. Go through each of them quickly. ***

DECISION ANALYSIS STEPS

Step 1. Decide on a decision statement. Make it as specific as possible. The team should discuss how to word the statement and then vote to decide on the best decision statement.

Step 2. List all the factors a solution must include for us to make a decision about it. We must be able to state these "must factors" in words and measure them by numbers. The team should decide on these "must factors" by discussion and voting.

Step 3. List all the factors that we want a solution to have. We can brainstorm as a team to get this list and then narrow it down by team discussion and voting.

Step 4. Rank all "must" and "want" factors according to their importance. This means that we assign a number to each factor to show how important it is to us. A 10 is the highest importance and a 1 is the lowest. All of the factors can be given any number from 1 to 10.

Step 5. Decide on the possible solutions that we want to evaluate and choose between. Very often, the possible solutions are the different brands and models of a particular machine or item we need to solve our problem.

Step 6. Collect data on each solution to find out how well each one meets our "musts" and "wants." We can collect our data on a chart like this one.

*** Each step of Decision Analysis is done by discussion and voting by the team members. ***
**DECISION ANALYSIS TABLE**

**Decision Statement:**

<table>
<thead>
<tr>
<th>Factors</th>
<th>Possible Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Alternative #1</td>
</tr>
<tr>
<td></td>
<td>Impt. Rank</td>
</tr>
<tr>
<td>Musts</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Wants</td>
<td></td>
</tr>
</tbody>
</table>

*** The team members can draw a larger table that has space for several more alternatives, if it is needed. ***

**Step 7.** Check to see if each alternative meets each "must" factor. If it does, mark a G for Go, in the G/NG column. If an alternative does not meet a "must", mark NG for No Go, in that same column. If an alternative has any No Go's, we get rid of it as a possible solution and cross it out on our chart.

**Step 8.** Rate the remaining alternatives on how well they meet each "must" or "want". Use a 1 to 10 scale, where 1 is worst and 10 is best.

**Step 9.** Multiply the "importance number" of each factor times its rating for each of the possible solutions. This will give us a score for each factor.

**Step 10.** Sum up the scores for each possible solution or alternative. This will give us a total score for each alternative.

**Step 11.** Compare the total scores of the possible solutions to see how well they each meet our "musts" and "wants". Decide on the best solution.

**Note:** We do not always want to pick the solution with the highest score. There could be some bad effects from choosing some solutions, even if they meet all of our factors. We need to look carefully at what the effect will be of choosing each solution before we make a final decision.

DH
3/81
EXAMPLE

We decide our old family car is on its last legs (or tires) and we are going to replace it with a new car.

**Step 1.** The decision statement is: Choose a new family car to buy to replace the old one.

**Step 2.** We decide on all the items or qualities a new car must have.

**Musts**
1. Gets at least 26 mpg in the city and 37 mpg on the highway.
2. Has a heater.
3. Has front wheel disk brakes.
4. Has electronic ignition.
5. Has power assist brakes/steering.
6. Costs less than $6,000.

**Step 3.** We decide on what things we want the car to have.

**Wants**
1. Can seat 4 or more passengers.
2. Has rear window defroster.
3. Has 4-wheel drive.
4. Has radial tires.
5. Has tape deck/AM-FM radio.
6. Has variable speed windshield wipers.

**Step 4.** We rank our "must" and "want" factors according to their importance. (See Impt. Rank column on the Decision Analysis Table.)

**Step 5.** Since we have had good experiences in the past with both DORF and ATOTAT company cars, we will look at their 1981 compact cars as possible solutions.

DH
3/81
Step 6. We collect the data for the two different cars on the Decision Analysis Table.

**DECISION ANALYSIS TABLE**

**Decision Statement:** Choose a new family car to buy to replace the old one.

<table>
<thead>
<tr>
<th>Factors</th>
<th>Alt.#1 DORF Horsey</th>
<th>Alt.#2 ATOVAT Spider</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Impt. Rank</td>
<td>Information</td>
</tr>
<tr>
<td>26 mpg. city/ 37 mpg highway</td>
<td>10</td>
<td>35 city/ 42 highway</td>
</tr>
<tr>
<td>Heater</td>
<td>10</td>
<td>Yes - very warm</td>
</tr>
<tr>
<td>Front Wh. disk brakes</td>
<td>10</td>
<td>Yes - front only</td>
</tr>
<tr>
<td>Electronic Ignition</td>
<td>9</td>
<td>Yes</td>
</tr>
<tr>
<td>Power assist brakes/ steering</td>
<td>9</td>
<td>Yes</td>
</tr>
<tr>
<td>Costs less than $6000</td>
<td>10</td>
<td>Yes - $5100</td>
</tr>
<tr>
<td>Wants</td>
<td>Impt. Rank</td>
<td>Information</td>
</tr>
<tr>
<td>Carries 4 people</td>
<td>10</td>
<td>Carries 5 people</td>
</tr>
<tr>
<td>Rear Window Def.</td>
<td>7</td>
<td>No - optional</td>
</tr>
<tr>
<td>4-wheel drive</td>
<td>4</td>
<td>No</td>
</tr>
<tr>
<td>Radial tires</td>
<td>9</td>
<td>Yes - good brand</td>
</tr>
<tr>
<td>Tape deck/ AM-FM radio</td>
<td>6</td>
<td>No - optional</td>
</tr>
<tr>
<td>Variable speed wipers</td>
<td>7</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Total Score</strong></td>
<td>701</td>
<td></td>
</tr>
</tbody>
</table>
Step 7. We check to make sure each alternative meets all “must” factors. Since ours do, we do not have to eliminate either of them.

Step 8. We rate the alternative cars on how well they meet each “must” and “want.” This can be seen in the chart in Step 6.

Step 9. We multiply the importance number times the rating (the R column) for each factor to get a score which we list under the S column.

Step 10. We then sum up the scores, the S column, for each possible solution to get a total score for each one.

Step 11. Now we can compare the cars and how well they meet our factors. Using this method we can keep from being influenced by a fast-talking salesman, a pretty paint color, or a lot of shiny chrome.

REVIEW EXERCISE

Decision Analysis helps us compare solutions so we can make an objective decision. We want to decide which brand of coffee to buy. Use the 11 steps and the table to evaluate 2 different brands of coffee we could buy.

*** Have team members pick two common brands of coffee to use for examples. ***

Step 1. Write the decision statement.

Step 2. List all “musts.”

Step 3. List all “wants.”

Step 4. Rank the “must” and “want” factors by their importance.

Step 5. Decide on the possible solutions we will evaluate.

Step 6. Collect data on the possible solutions.

Step 7. Check to see that each alternative meets all of our “musts”. If any do not, cross them off the table.

Step 8. Rate each remaining solution on the way it fulfills our “musts” and “wants.”

Step 9. Multiply the importance rankings times the ratings to get a score for each factor.

Step 10. Sum up the scores for each alternative to get a total score for each solution.

Step 11. Compare the total scores for each alternative. Decide on the best solution.

*** The table on page 8-7 is an example of how the exercise might turn out.***
**DEcision Analysis Table**

**Decision Statement:** Decide which coffee to buy for the office.

<table>
<thead>
<tr>
<th>Factors</th>
<th>Possible Solutions</th>
<th>Alternative #1 - Folger's</th>
<th>Alternative #2 - Hill Bros</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Musts</strong></td>
<td>Impt. Rank</td>
<td>Information</td>
<td>G/NG</td>
</tr>
<tr>
<td>Costs less than $3.50 a pound.</td>
<td>10</td>
<td>Costs $3.00 per pound.</td>
<td>G</td>
</tr>
<tr>
<td>Available in different grinds</td>
<td>9</td>
<td>Ground for regular, drip, and electric.</td>
<td>G</td>
</tr>
<tr>
<td><strong>Wants</strong></td>
<td>Impt. Rank</td>
<td>Information</td>
<td>R</td>
</tr>
<tr>
<td>Good taste</td>
<td>10</td>
<td>Tasted good to team</td>
<td>9</td>
</tr>
<tr>
<td>Good Ads.</td>
<td>6</td>
<td>&quot;Mountain Grown&quot;</td>
<td>5</td>
</tr>
</tbody>
</table>

**Total Score**
- Alternative #1: 310
- Alternative #2: 258

**Next Session**

We will apply this technique to one of the problems we are solving. We will also review Decision Analysis by answering any questions you might have.
1. Decision Analysis helps us to evaluate and rate alternative solutions.
   True ____     False ____

2. We assign weighting numbers to each "want" and "must" to show its importance.
   True ____     False ____

3. The alternative or solution with the highest total score is always the best one to choose.
   True ____     False ____

4. When we rate the way each solution fulfills our "musts" and "wants," we use 1 as the lowest score and 10 as the highest.
   True ____     False ____
5. How many "musts" can we have?
   a. 3
   b. 5
   c. 10
   d. no limit

6. How many "wants" can we have?
   a. 4
   b. 6
   c. 12
   d. no limit

7. How many alternative solutions can we analyze?
   a. 2
   b. 3
   c. 7
   d. no limit

8. Only one "want" or "must" can be weighted with the top value of 10.
   True ____    False ____
SESSION OVERVIEW

The management presentation is an important part of our team activities. It is a rewarding experience for everyone involved. The team can present what they have been doing and management can keep informed of team progress in problem identification, analysis and solution.

This session will cover:

1) The PURPOSE of the management presentation.
2) WHO to have at the presentation.
3) WHEN to have a management presentation.
4) WHAT to cover at the presentation.
5) HOW to make a management presentation.

The review questions and exercises at the end of the session will help us understand the key points of making a management presentation.

THE MANAGEMENT PRESENTATION

The primary purpose of the management presentation is COMMUNICATION. This communication allows us to:

1. Have a two-way conversation to ensure understanding.
2. Inform others of team activities.
3. Seek approval for a team recommendation.
4. Give recognition to contributing team members.
5. Generate enthusiasm for team activities.
The management presentation is a team effort where all team members will participate in one way or another. The main focus of the presentation is to inform those present on how the problem was identified and analyzed and to recommend a solution. In other words, we want to explain:

1. What the problem was and why.
2. What we have done to analyze the problem.
3. What solution we are recommending.
4. The benefits of our solution and what impact it will have on saving time, money, or materials.

We can use a management presentation to report on problems that we failed to solve and what the team learned from the experience, as well as reporting on the status of our next project. Also, we can use the presentation to report on completed projects that needed no approval.

The management presentation is usually made to the manager to whom the team leader reports and to guests that the team members and manager feel should be present. We do this because the leader's manager is usually qualified to evaluate and approve the team recommendation and because we should use normal reporting channels. The presentation should not be used to get around the normal chain of command and force a favorable response by appealing to the manager's boss. That is not a win-win method and will cause problems with the manager in the future.

The team should try to have a management presentation about every 3 months, although they can be held as often as necessary. Sometimes the team will want to cover more than one project or idea at a presentation. The presentation should be under one hour in length.

***Ask team members what projects they would like to cover at a management presentation.***

The HOW of making a management presentation covers the four basic areas of preparations, method, visual aids, and style.

**Preparations**

There are several preparations the team members can make to ensure a smooth presentation.

1. Make sure the meeting area is free of distractions.
2. Set up the room in advance.
3. Use a checklist to make sure no necessary equipment is forgotten, such as an overhead projector, extension cord, pointer, or magic markers.
4. Make name cards for everyone attending the presentation.
5. Make visual aids well before the meeting.
6. Involve as many team members as possible.
7. Have an agenda of what the presentation will cover. Make sure everyone gets a copy.

***Ask team members if they can think of other preparations that should be made. Stress that everyone should share in some manner in putting on the presentation.***

D. HANLEN
4/81
Method

The KISS, Keep It Sweet and Simple, method should be used at every management presentation. Stick to the agenda and use very specific words to get your meaning across. General words can lead to confusion since some words mean different things to different people. If it is possible, bring an example of the actual hardware or paper into the presentation and introduce it at the appropriate time.

It is very important to express the team achievements in the manager's language, such as showing how the solution impacts cost, scheduling, quality, and safety. Stress team successes and show pride in your achievements. Do mention failures and what you gained from them. Thomas Edison performed more than 3,000 experiments to get a workable light bulb. He said that he had 3,000 victories that brought him closer to success, rather than 3,000 failures.

Start the meeting on time. If someone is missing, place a phone call to locate them, before starting. Introducing all of the team members at the start of the meeting and introducing each individual before their talk will help to keep communications open and friendly and gives the team members some recognition. If possible, take everyone to the work area to see first-hand how changes or proposed changes will affect it. If this is not possible, then photos or slides could help to do this. Handouts are another way of communicating during the presentation. However, do not make the handout so detailed that those present are reading it and not listening to the presentation. As the presentation is made, make sure to thank those people who helped you. This makes both them and you look good and establishes trust for a continued win-win situation. If we don't recognize their help, they may not be so helpful next time.

***Discuss with team members the difficulties we all seem to have in giving out praise instead of blame and criticism.***

Visual Aids

Visual aids can really help in a management presentation. Pictures and charts are often better than words for expressing your ideas.

One good idea is to use the charts, tables and graphs that the team developed when it was analyzing the problem. These are more believable when they are used as is and are not cleaned up for the presentation. Other charts we can use are the:

1. Pareto chart.
2. Bar charts.
3. Line graph.
4. Pie chart.
5. Decision Analysis table.
8. Milestone chart.

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We want to make sure that all of our visual aids are readable. This means making sure they are big and clear so everyone can see them. The visual aids can be presented in different ways. We can use:

1. The blackboard.
2. Flip charts.
3. Transparencies and an overhead projector.
4. Slides and a slide projector.

***Ask team members for other ideas on how they could present information.***

**Style**

Each team member will have their own unique speaking style. But, there are several things we can do to help the presentation go well.

To become comfortable speaking in front of a group, practice is very helpful. The team members can also practice their talks in front of the rest of the team to become more at ease. The entire team should go through a "dry run" of the presentation the first few times they give them.

Using cue cards with key words on them or writing down an outline of your talk can keep you from losing your place during the presentation.

Your listeners will be more attentive if they feel comfortable with you and understand what the talk is about. You can help them by smiling and showing your enthusiasm for the job your team has done. Good eye-contact and using gestures during the presentation will help communication. Try to encourage questions to assure that there is clear understanding. This way the manager and the team will agree on exactly what is being recommended and approved. If you are uncomfortable by yourself in front of a group, consider working in a pair with another team member.

All these actions and gestures can be part of your own personal style and will help your presentation go smoothly.
EXERCISES

1. Our team is planning a management presentation. We want to write down an agenda of what will be covered at the presentation and give a copy to everyone who attends.

   Use your imagination and construct a possible agenda.

   **Agenda**

   1. Introduction - Joe Smith
   2. The Problem Description - Sally Bagel
   3. The Analysis - Diane Thoughtful
   4. The Solution - Mike Answerer

2. Both the team members, and the manager to whom the presentation is made, will want others to attend.

   List those people who **should** attend, and those who might be **interested**. Indicate **why** for each person.

   - Team members - They are making the presentation.
   - Team Leader's Manager - She/He needs to approve the recommended solution.
   - Guests - Resource people who have helped us work on the problem and higher level management.

3. Sometimes there is a surprise question at a management presentation. Everyone is shocked when a manager (an invited guest) interrupts your talk and says, "Our department recommended that solution over a year ago. What makes it so new and novel now?"

   What would you respond?

   We weren't aware that his department had recommended the solution. It has been well thought out by the team and analyzed, and they are eager to implement the solution at this time.
THE MANAGEMENT PRESENTATION

REVIEW QUESTIONS

1. Management presentations should be done by:
   a. The team leader.
   b. The team leader and one assisting member.
   c. All of the team members.

2. One reason for a presentation is to make recommendations to management. Other reasons are:
   a. 
   b. 

3. Name four kinds of charts and graphs that would be helpful to use.
   a. 
   b. 
   c. 
   d. 

4. The charts used in a presentation should be professionally prepared.
   True_____ False_____

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5. How long should a presentation last?
   a. 60 minutes.
   b. 30 minutes.
   c. As long as necessary.

6. A management presentation should begin on time. One possible exception could be:

   __________________________

   __________________________

7. Who should introduce each speaker?
   a. The team leader.
   b. The previous speaker.
   c. It is optional.

8. Management presentations can be used to show improvements in several general areas. Name 3 of these areas.
   a. ________________________
   b. ________________________
   c. ________________________

9. Name two types of visual aid equipment that could help make your presentation more clear.
   a. ________________________
   b. ________________________

10. The chairperson for a management presentation is always the team leader.
    True_______  False_______

11. One benefit of a management presentation is that we can invite higher level management and get around our manager by appealing to them for a favorable decision.
    True_______  False_______

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SESSION OVERVIEW

In the past twelve training packages, we have covered many ways of analyzing problems in our team meetings.

This session will review:

1) The PURPOSE of having a team.
2) The PURPOSE of the training packages.
3) WHO uses the training packages.
4) WHAT topics/tools were explained in the packages.
5) HOW we have or should have worked, as a team, to solve problems.

The discussion questions at the end of the session will help us to look at the process we have been part of and to decide what, if any, changes need to be made.

OUR REVIEW

The purpose of having a team is to allow a group of employees in one department to participate in resolving their job related problems. These people can contribute their ideas to help improve their jobs.

The purpose of the training packages is to teach new skills in analyzing problems and in working together as a TEAM.

The training packages are used by the team members, as they are needed, to aid in analyzing problems. Not every tool or technique will be used on every problem. But, there are a wide variety of tools available to the team now to use in analyzing and solving problems.
The topics covered in the training packages are:

1) An Introduction to Teams.
2) Small Group Operations.
3) Creativity - Brainstorming.
4) Problem Selection - Pareto Analysis.
5) Problem Analysis.
6) Data Collection.
7) Data Formation.
8) Decision Analysis.
9) Economic Factors.
10) Group Productivity Measures.
12) Implementation and Planning.

Other topics which will be available to the teams are:

1) Basic Statistics.
2) Cause and Effect Diagrams.
3) Human Engineering.

The HOW of working as a team is the most important link in our chain of learned skills. It is the key to effective problem solving both now and in the future. Remember back to the sessions which introduced the team idea and talked about small group operations. There were several key points on how a team can best operate. They included the following:

1. The team is "owned" by all of the members, including the leader. Everyone participates in making the team meetings effective.

2. The team is responsible for making sure that any solution reached is due to the participation of all members and is a product of all. This means that "majority rule" is not used to get around other team members. We want discussion, sharing, and consensus.

   Consensus is not voting and reaching a majority decision. But, consensus does mean that everyone is heard and that the final decision is agreed on by all team members. We will not always agree totally with each other, but the team should work on the decision or topic until all of the team members can buy into it or "own it" as theirs.

3. Emotions, feelings, and conflicts are real facts that will often have to be dealt with at a team meeting. The team shares the leadership responsibility of bringing these issues out in the open and working them out in a non-attacking manner. It is up to the team to handle disruptive, impatient, or apathetic members.
4. The members share the responsibility for team actions, assignment of tasks, methods of working, and planning the available meeting time.

5. Team work is an "Everybody Wins" situation. Respecting each other's opinions (no one is an expert on everything), really listening to each other, and working for a best solution instead of a my solution, all help the team to win and ensure open communication links.

6. The team members use care and concern and deal with each other as unique, individual people rather than stereotyped molds.

These are some of the key points of how a team will function well together. Now, we want to look at the discussion questions, think about them, and discuss as a team, how our team has been operating and what, if any, changes we would like to make.

***Ask team members to take 10 minutes to read and think about the discussion questions. You can then open up discussion about the questions and team member responses.***

DISCUSSION QUESTIONS

1. How has the team organized to work on problems? What kind of ground rules or charter did we use? How was information treated? How were decisions made?

2. How did team members influence the development of the team? What kind of team-building behaviors did we use? (Bringing silent members into discussion, working out conflicts, etc.)
3. What kind of anti-group behaviors hindered the team's working on problems? (e.g. dominating, arguing, interrupting, withdrawing, attacking personalities instead of logic, etc.)

4. How did the team move from independent opinions to a collective decision? What kinds of behavior promoted agreement? What kinds of "false" consensus behavior showed up? (Such as "I'll go along with that," "me too," "majority rule.")

5. What kind of atmosphere did we have at our meetings? How did we deal with other's feelings? What kind of non-verbal behavior showed a change in the atmosphere? How did members' voices show the kind of feeling or atmosphere present at the meeting?
SESSION OVERVIEW

There are many times when we will want to describe something that is happening in our work area. Numbers often describe better than words, especially if we use the numbers to draw a graph or picture of the activity. Statistics are numerical descriptions of data, such as the unemployment rate, baseball batting averages, the Gallup Poll and the rate of inflation. We can use statistics to describe our average daily production and trends that happen in our work area, over time. Statistics are also used to help predict what may happen in the future.

***Ask team members for other examples of where statistics are used.***

This session will cover:

1) The PURPOSE of statistics.
2) The CONCEPTS of a mean (average) value, standard deviation, correlation, data plotting, and control charts.
3) HOW to use these concepts.

There will be review questions and exercises at the end of the session to help ensure that we understand and can use this information.

BASIC STATISTICS

Statistics are numerical descriptions of data that let us make a statement about a "population" or group of measurements we take. The statistics we will discuss are the mean, the standard deviation, and the correlation coefficient. We will then show how these statistics can be used, along with graphed data, to make statements about our data and the work activity it represents. This training package will combine the description of the concepts with examples, so that we can see exactly what is happening as we go along.

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Mean:

The "mean" is also known as the "average." It is equal to summing up all of our measurements and dividing by the number of measurements that we added up.

For example:

If there are 5 workers in our team and we want to know the average age of our team members, then we would ask each person their age, add up the ages and then divide by the number of ages we asked for and added together.

Say that the ages were:
19, 24, 36, 43, 28

We add the ages up:
19 + 24 + 36 + 43 + 28 = 150 years

Then, divide the sum by the number of ages we measured:
\[
\frac{150 \text{ years}}{5 \text{ workers}} = 30 \text{ years.}
\]

So, the average age in our team is 30 years.

In math symbols, we can say that:

\[ x = \text{any of the measurements (ages) in our collection.} \]
\[ n = \text{the number of measurements (# of ages) in the collection.} \]
\[ \bar{x} = \text{the mean (average) value of our collection of measurements.} \]
\[ \sum x = \text{the sum of all the measurements in our collection. The symbol } \sum \text{ means "add up all of the measurements you collected."} \]

So, we can see from these definitions that:

\[ \bar{x} = \frac{\sum x}{n} \]

Using our example:

\[ x_1 = 19, x_2 = 24, x_3 = 36, x_4 = 43, x_5 = 28 \]
\[ n = 5 \]
\[ \bar{x} = \frac{19 + 24 + 36 + 43 + 28}{5} = \frac{150}{5} = 30 \]
**Standard Deviation**

The standard deviation of a collection of measurements is a description of how much the measurements deviate, or vary, from the mean (average) value.

Let's plot our team ages to see how they vary from their mean. Remember $\bar{x} = 30$ and the ages were 19, 24, 36, 43, 28.

![Graph showing team ages with mean $\bar{x}$]

We want to know how much the difference between the mean and each measurement varies. We can't average the distances from $\bar{x}$ together since, the positive and negative values will cancel and the average distance would equal zero. One way around the problem of negative distances cancelling out positive distances is to square all of the values, then average them and take the square root of the numbers.

We will do this now, with our team ages, for an example.

First, take the difference between each age measurement and the average age. In math symbols, this means $(x - \bar{x})$.

$$
\begin{align*}
(x - \bar{x}) & = 19 - 30 = -11 \\
(x - \bar{x}) & = 24 - 30 = -6 \\
(x - \bar{x}) & = 36 - 30 = +6 \\
(x - \bar{x}) & = 43 - 30 = +13 \\
(x - \bar{x}) & = 28 - 30 = -2
\end{align*}
$$

Now, we want to square these results by multiplying them times themselves. In math symbols:

$$
(x - \bar{x})^2
$$

<table>
<thead>
<tr>
<th>$(x - \bar{x})$</th>
<th>$(x - \bar{x})^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>-11</td>
<td>121</td>
</tr>
<tr>
<td>-6</td>
<td>36</td>
</tr>
<tr>
<td>+6</td>
<td>36</td>
</tr>
<tr>
<td>+13</td>
<td>169</td>
</tr>
<tr>
<td>-2</td>
<td>4</td>
</tr>
</tbody>
</table>

Next, sum up the squared distances. In Math symbols this is: $\sum(x - \bar{x})^2$.

$$
\sum(x - \bar{x})^2 = 121 + 36 + 36 + 169 + 4 = 366.
$$

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Normally, to take an average, we divide by the number of items that we added together (n). But, for calculating a standard deviation or a variance, we divide by one less than that number (n-1). We will not go into the reasons why in this session. You need to accept the fact that dividing by n-1 gives us a better answer.

The variance is just the standard deviation squared. So, in math symbols:

\[ s^2 = \text{variance of our collection of measurements.} \]

\[ s = \text{standard deviation of our measurements.} \]

As we said earlier, the standard deviation is the average amount our measurements vary from their mean. In our math symbols:

\[ s = \sqrt{s^2} = \sqrt{\frac{\sum(x - \bar{x})^2}{n-1}} \]

For our example, the standard deviation is:

\[ s = \sqrt{s^2} = \sqrt{\frac{\sum(x - \bar{x})^2}{n-1}} = \sqrt{\frac{366}{4}} = \sqrt{91.5} = 9.57 \text{ years.} \]

This means that most of our team members' ages are between 30-9.57 = 20.43 years and 30+9.57 = 39.57.

We can use the standard deviation to tell us how similar our measurements are to each other or how much they vary.

**Correlation**

When we say that two different characteristics are somehow related, we say that they are correlated. When two characteristics are correlated, it does not mean that they cause each other. If two measurable characteristics are correlated, then we can sometimes use the value of one characteristic to predict the value of the other. Some examples of this are the beliefs that:

1. Number of cigarettes smoked is correlated to occurrence of lung cancer.
2. Population size is correlated to the number of crimes committed.
3. Women's skirt lengths are correlated to the national inflation rate.

The correlation coefficient tells us how much the two characteristics may be related.

To calculate the correlation coefficient, we must first measure both characteristics for each unit or item in our collection.

For example, we want to see if there is any correlation between the number of units each team member produces in a day and the number of years of experience they have at the job. Say that our team has 10 members, so n = 10. Then, on a typical day we measure the number of units they each made and also record their number of years of experience. Here is the data we measured and collected:

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n = 10
x = years of experience of the team member.
y = number of units produced by the team member.

<table>
<thead>
<tr>
<th>Team Member Number</th>
<th>Years of Experience (x)</th>
<th>Daily Units Produced (y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td>50</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>47</td>
</tr>
<tr>
<td>3</td>
<td>12</td>
<td>51</td>
</tr>
<tr>
<td>4</td>
<td>6</td>
<td>32</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>6</td>
<td>5</td>
<td>26</td>
</tr>
<tr>
<td>7</td>
<td>9</td>
<td>50</td>
</tr>
<tr>
<td>8</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>9</td>
<td>4</td>
<td>19</td>
</tr>
<tr>
<td>10</td>
<td>6</td>
<td>35</td>
</tr>
</tbody>
</table>

If we plot this data on a graph, we will have:

Notice that the points appear to be in the form of an upward line. This is what data does if it positively correlated. In other words, we can predict that if we increase a person's years of experience, they will probably have increased production. A negative correlation, a downward sloping line, means that as the value of one characteristic is decreased, the other characteristic increases. The correlation coefficient, r, has

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a value that is always between -1 and +1. The closer that r is to -1 or +1,
the stronger the correlation is. If r = 0 or is very close to zero, then
there is very little or no relationship between x and y, the two character-
istics.

The math formula for calculating the correlation coefficient, r, is:

\[
 r = \frac{SS_{xy}}{\sqrt{SS_{xx} \cdot SS_{yy}}} 
\]

where:

\[
 SS_{xy} = \sum xy - \left[ \frac{(\sum x)(\sum y)}{n} \right] 
\]
\[
 SS_{xx} = \sum x^2 - \left[ \frac{(\sum x)^2}{n} \right] 
\]
\[
 SS_{yy} = \sum y^2 - \left[ \frac{(\sum y)^2}{n} \right] 
\]

SS stands for "sum of squares." If we perform the above calculation on
our data, we will have:

<table>
<thead>
<tr>
<th>Team Member</th>
<th>x (yrs. exp.)</th>
<th>(x)^2</th>
<th>y (# Daily Units Produced)</th>
<th>y^2</th>
<th>xy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td>(10)^2 = 100</td>
<td>50</td>
<td>50^2 = 2500</td>
<td>10(50) = 500</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>(8)^2 = 64</td>
<td>47</td>
<td>47^2 = 2209</td>
<td>8(47) = 376</td>
</tr>
<tr>
<td>3</td>
<td>12</td>
<td>(12)^2 = 144</td>
<td>51</td>
<td>51^2 = 2601</td>
<td>12(51) = 612</td>
</tr>
<tr>
<td>4</td>
<td>6</td>
<td>(6)^2 = 36</td>
<td>32</td>
<td>32^2 = 1024</td>
<td>6(32) = 192</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>(2)^2 = 4</td>
<td>10</td>
<td>10^2 = 100</td>
<td>2(10) = 20</td>
</tr>
<tr>
<td>6</td>
<td>5</td>
<td>(5)^2 = 25</td>
<td>26</td>
<td>26^2 = 676</td>
<td>5(26) = 130</td>
</tr>
<tr>
<td>7</td>
<td>9</td>
<td>(9)^2 = 81</td>
<td>50</td>
<td>50^2 = 2500</td>
<td>9(50) = 450</td>
</tr>
<tr>
<td>8</td>
<td>3</td>
<td>(3)^2 = 9</td>
<td>15</td>
<td>15^2 = 225</td>
<td>3(15) = 45</td>
</tr>
<tr>
<td>9</td>
<td>4</td>
<td>(4)^2 = 16</td>
<td>19</td>
<td>19^2 = 361</td>
<td>4(19) = 76</td>
</tr>
<tr>
<td>10</td>
<td>6</td>
<td>(6)^2 = 36</td>
<td>35</td>
<td>35^2 = 1225</td>
<td>6(35) = 210</td>
</tr>
</tbody>
</table>

n = 10 \sum x = 65 \sum x^2 = 515 \sum y = 335 \sum y^2 = 13,421 \sum xy = 2,611

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Next, we calculate the "sums of squares" that we need.

\[ ss_{xy} = \sum xy - \left( \frac{\sum x \sum y}{n} \right) = 2611 - \left( \frac{65 \times 335}{10} \right) \]

\[ ss_{xy} = 2611 - 2177.5 = 433.5 \]

\[ ss_{xx} = \sum x^2 - \left( \frac{\sum x^2}{n} \right) = 515 - \left( \frac{65 \times 65}{10} \right) \]

\[ ss_{xx} = 515 - 422.5 = 92.5 \]

\[ ss_{yy} = \sum y^2 - \left( \frac{\sum y^2}{n} \right) = 13,421 - \left( \frac{335 \times 335}{10} \right) \]

\[ ss_{yy} = 13,421 - 11,222.5 = 2198.5 \]

The correlation coefficient is

\[ r = \frac{ss_{xy}}{\sqrt{ss_{xx}ss_{yy}}} = \frac{433.5}{\sqrt{92.5 \times 2198.5}} = \frac{433.5}{\sqrt{203,361.25}} \]

\[ r = \frac{433.5}{450.96} = + 0.96 \]

This means that the years of job experience, for our team members, has a high, positive correlation to the number of units each produces daily. We would predict that someone with many years of experience will usually outproduce someone with less experience. But, remember that we are not implying that years of experience causes high production rates.
There are several formats for plotting data. We covered many of these in Session Seven - Data Formats. The most common way to plot data for correlation purposes is to use a scattergram. When we take our measurements of two characteristics on each unit or item and plot them on a horizontal/vertical axis graph, we have a scattergram. The vertical line has measurement units for one characteristic and the horizontal line has the measurement units for the other characteristic. Then we plot the pairs of numbers. The graph we plotted in the Correlation section is an example of this.

Let's look at another example. If we were interested in car gas mileage, we might want to collect and plot data on car gas mileage and the weight of the car. We collected the data below.

<table>
<thead>
<tr>
<th>Car #</th>
<th>Car Weight (lbs.)</th>
<th>Car Gas Mileage (mpg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1500</td>
<td>30</td>
</tr>
<tr>
<td>2</td>
<td>2000</td>
<td>25</td>
</tr>
<tr>
<td>3</td>
<td>2700</td>
<td>11</td>
</tr>
<tr>
<td>4</td>
<td>1300</td>
<td>27</td>
</tr>
<tr>
<td>5</td>
<td>2500</td>
<td>18</td>
</tr>
<tr>
<td>6</td>
<td>2100</td>
<td>23</td>
</tr>
<tr>
<td>7</td>
<td>2700</td>
<td>17</td>
</tr>
<tr>
<td>8</td>
<td>2400</td>
<td>23</td>
</tr>
<tr>
<td>9</td>
<td>3100</td>
<td>11</td>
</tr>
<tr>
<td>10</td>
<td>3000</td>
<td>10</td>
</tr>
</tbody>
</table>

We can plot the data by the following steps.

1. Draw a vertical line on the left margin and a horizontal line across the bottom of our drawing area.
2. Divide the vertical line up into the units we measured for gas mileage.
3. Divide the horizontal line up into measurement units. In this case, we would use 100 pound (lb.) units.
4. Plot the pairs of points (weight, mileage) for each car.

(Graph on 14-9)
When we plot data, we can get a picture of what is happening and can often see trends that are occurring when we measure a characteristic and plot it against time.

**Control Charts**

Control charts help us to see how a process is behaving and if it is acting as expected. We will use what we have learned about the mean, the standard deviation and data plotting to develop the control chart. We plot data on a graph using units of time on the horizontal line and the measurement units of the process on the vertical line. The standard deviation and mean of the process are plotted as horizontal, dashed lines on the graph. These lines tell us where we expect future data points to fall. When some data points fall outside of the control boundaries, then we know that there is a problem present in the process that we need to look at. Usually, these boundaries are called the upper and lower control limits and are equal to the mean (average) value plus and minus 3 times the standard deviation.

In math symbols:

- \( UCL = \) upper control limit
- \( LCL = \) lower control limit
- \( UCL = \bar{x} + 3\sigma \)
- \( LCL = \bar{x} - 3\sigma \)

If we don't know the standard deviation, but we do know the boundaries we expect (from experience) or want, then we can use these values as our upper and lower control limits.

For example:

We expect our doughnut-maker machine to produce about the same number of doughnuts per day. But when the machine is getting very dirty or is in need of repair, it produces less doughnuts than average. From previously collected data, we find that the machine averages 1000 doughnuts/day and this average varies by 100 doughnuts/day. So, \( \bar{x} = 1000 \) and \( \sigma = 100 \). We collect and plot data on the number
of doughnuts made per day to see when the machine needs cleaning or repair. Here is our data and control chart.

\[
\bar{x} = 1000 \quad s = 100 \quad 3s = 300
\]

UCL = \bar{x} + 3s = 1300  \quad LCL = \bar{x} - 3s = 700

<table>
<thead>
<tr>
<th>Day #</th>
<th># Doughnuts Made</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1100</td>
</tr>
<tr>
<td>2</td>
<td>1000</td>
</tr>
<tr>
<td>3</td>
<td>900</td>
</tr>
<tr>
<td>4</td>
<td>1020</td>
</tr>
<tr>
<td>5</td>
<td>1200</td>
</tr>
<tr>
<td>6</td>
<td>1100</td>
</tr>
<tr>
<td>7</td>
<td>1000</td>
</tr>
<tr>
<td>8</td>
<td>1100</td>
</tr>
<tr>
<td>9</td>
<td>900</td>
</tr>
<tr>
<td>10</td>
<td>1000</td>
</tr>
<tr>
<td>11</td>
<td>950</td>
</tr>
<tr>
<td>12</td>
<td>800</td>
</tr>
<tr>
<td>13</td>
<td>700</td>
</tr>
<tr>
<td>14</td>
<td>600</td>
</tr>
<tr>
<td>15</td>
<td>400</td>
</tr>
</tbody>
</table>

From this control chart, we can see that we should check our doughnut machine immediately, to see if it needs cleaning or repair.

***Ask members if there is anything that they have questions on. If there are, go back over the material before going on to the Review Questions and Exercise.***

**SUMMARY**

Statistics can be useful numerical descriptions. We can use some statistics to predict future occurrences and to see trends in activities. There are many details about statistics and what they can tell us that are not explained in this session. If the team needs more detailed information or help, they should speak to someone with experience in statistics. People in Quality Control, Planning, or Engineering departments often have this knowledge and experience.

**EXERCISE**

Our team was interested in looking at their daily coffee drinking habits. We collected data for a week and it is given in the table below. Please fill in the rest of the chart. What is the average number of cups of coffee drank per
day by the team? What is the standard deviation of this data?

<table>
<thead>
<tr>
<th>Day #</th>
<th># Cups of Coffee</th>
<th>(x - $\bar{x}$)</th>
<th>$(x - \bar{x})^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30</td>
<td>30 - 26 = 4</td>
<td>(4)^2 = 16</td>
</tr>
<tr>
<td>2</td>
<td>21</td>
<td>21 - 26 = -5</td>
<td>(-5)^2 = 25</td>
</tr>
<tr>
<td>3</td>
<td>18</td>
<td>18 - 26 = -8</td>
<td>(-8)^2 = 64</td>
</tr>
<tr>
<td>4</td>
<td>23</td>
<td>23 - 26 = -3</td>
<td>(-3)^2 = 9</td>
</tr>
<tr>
<td>5</td>
<td>38</td>
<td>38 - 26 = 12</td>
<td>(12)^2 = 144</td>
</tr>
<tr>
<td>n = 5</td>
<td></td>
<td>$\sum x = 130$</td>
<td>$\sum (x-\bar{x})^2 = 258$</td>
</tr>
</tbody>
</table>

The mean $\bar{x} = \frac{\sum x}{n} = \frac{130}{5} = 26$

The standard deviation $s = \sqrt{\frac{\sum (x-\bar{x})^2}{n-1}} = \sqrt{\frac{258}{4}} = \sqrt{64.5} = 8.03$

The team decided to set up a control chart and plot the daily coffee consumption on it for three weeks. They want to see if there were any visible trends or patterns in their drinking habits or see if there were any particular days when the coffee consumption was unusually high or low. Use the data above to set up the control chart limits and then, plot the data given below, on the graph. Is there a pattern in our coffee drinking habits?

$\bar{x} = 26$

UCL = 26 + 3(8.03) = 50.09 cups

LCL = 26 - 3(8.03) = 1.91 cups

---

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NEXT SESSION

During the next session, we will answer any questions you have about the material. We will also discuss different uses that we can think of for these statistical tools.
REVIEW QUESTIONS

1. Statistics are descriptions of numerical data.
   True_______  False_______

2. The mean is also known as the average.
   True_______  False_______

3. When we plot data, we can often: (Several answers apply.)
   a. See trends.
   b. Predict future occurrences.
   c. Make pretty, but useless graphs.

4. Correlation means:
   a. There is a relationship between two characteristics.
   b. That one characteristic causes another characteristic.
5. We can use correlation and scattergrams to predict the value of one characteristic, if we know the value of the other characteristic.

   True_______       False_______

6. The standard deviation tells us:
   a. The variability of our measurements.
   b. The average of our measurements.
   c. What the typical kook is like.

   True_______       False_______

7. Control charts use control limits to tell us when a process is acting normally (as expected) or unusually (unexpected).

   True_______       False_______

8. The control chart can show trends in a process.

   True_______       False_______

9. We can find the control limits for our control chart by using:
   (Several answers apply)
   a. The standard deviation and the mean.
   b. Our past experience.
   c. Looking in a fortune cookie.
SESSION OVERVIEW

The Cause & Effect diagram is another tool to help us analyze our problems better. This diagram is a very logical and organized tool. We will use it to take our problem apart and examine its causes and effects.

This session will cover:

1) The PURPOSE of Cause & Effect Diagrams.
2) WHEN to use the Cause & Effect Diagram.
3) HOW to use the Cause & Effect Diagram to analyze our problem.

After we cover these points, we will answer the Review Questions and then work through an exercise together.

CAUSE & EFFECT DIAGRAMS

The Cause & Effect diagram helps us to analyze our problem by organizing our ideas and giving a BIG picture of the problem causes and effects. We should use the Cause and Effect diagram when we want to make sure that we have looked at all possible parts of the problem. The diagram will reveal areas that we have not thought enough about and can also suggest new ideas to us. More importantly, the C & E (Cause & Effect) Diagram can be a recording device for ideas that our team generates. There are several steps to follow in making a C & E diagram of our problem. As we go through these steps, we will use the Rules of Brainstorming to make sure that we get everyone's ideas down on the paper. A large sheet of paper is the best way to record the team's ideas. When the team has finished the diagram, label and date it so that we have a permanent record of the analysis.

***Review the Rules of Brainstorming with the team members.***

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There are several important parts to a C & E diagram. They are:

1. An identified problem.
2. An ideal solution.
3. A milestone date. (The date when the solution should be in effect.)
4. Names of major areas that are contributing to the problem (causes) and units that we can use to measure their impact.
5. Names of major areas which would be impacted by a solution (effects) and measurement units to check on how they would be effected.

To analyze our problem with a C & E diagram, we will use the following steps:

Step 1. Identify the Problem: There are many important and trivial problems that the team could choose to attack. The team should pick out a problem that they feel can be solved. Then, the problem should be defined as precisely as possible, so that finding the causes and solutions is easier and takes less time. Write the problem statement at the top of the paper.

Step 2. State an Ideal Solution: By starting with the best possible solution we can imagine, we have room to compromise and can end up with a really good solution. This method works better than taking the time and energy to look at all possible solutions to the problem. (Looking at all possibilities could take forever!)

Visually display the ideal solution on the sheet of paper, like this:

```
      The Ideal Solution
```

Step 3. Specify a Milestone Date: This is the cut-off date, when the team wants to put the solution into effect or start the project that will solve the problem.
Place this date on a vertical line at the right end of the solution box, like this:

Step 4. Identify Major Cause Factors: These factors are ones that are causing the problem AND can contribute to the solution. The team should list all problem causes that can contribute to the ideal solution, even though we may not be able to take action in each area.

Choose 3-5 major cause categories and then brainstorm to generate a large number of specific causes in each of the general categories. For example, we can use the 2W's and 2P's and then creatively brainstorm in Step 6 to get more specific. When we identify causes, it helps to look for changes, similarities, and repeating patterns.
Step 5. Identify Major Effects: These effects are the areas we want to measure to make sure that the solution is working. These major areas are also listed on the diagram. Their particular names depend on the problem we are trying to solve, but we list them like this:

![Diagram showing the identification of major effects.]

Step 6. Brainstorm for Specific Causes: The team should brainstorm here to break each major cause down into all of its small parts that are adding to the problem. Next to each of these small contributors, write in parenthesis the units we can use to measure it. The specific causes should be drawn onto the major area arrow with a smaller arrow.

![Diagram showing the brainstorming of specific causes.]

Step 7. Identify the Specific Effects to Measure: The team should identify all the small, specific areas that the ideal solution will effect and state the units they want to use to measure the effects. A brainstorming session is a good way to do this. These smaller effects can be shown as smaller arrows...
coming off of the major areas effected.

**Material**: Process Temp. 

<table>
<thead>
<tr>
<th>QtY.(#)</th>
<th>EFFECT #1</th>
<th>EFFECT #2</th>
</tr>
</thead>
<tbody>
<tr>
<td>(#1)</td>
<td>(#1)</td>
<td>(#2)</td>
</tr>
<tr>
<td>(#3)</td>
<td>(#1)</td>
<td>(#2)</td>
</tr>
</tbody>
</table>

**Causes**

<table>
<thead>
<tr>
<th>Age (yrs)</th>
<th>Repair Rate</th>
<th>Experience (yrs)</th>
<th>Milestone Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>(#1)</td>
<td>(#1)</td>
<td>(#1)</td>
<td>(#1)</td>
</tr>
</tbody>
</table>

**Step 8. Identify a Feasible Solution**: The C & E Diagram should now show all of the factors that the team could imagine. Changing some of these factors will either have very little effect on the solution or they will not be financially, legally, or technically possible. But, acting on other factors can give a very good solution to the problem. These factors should be studied more closely to identify a solution. If any major arrow is not very detailed, then we may not have thought enough about it. The team should go back and brainstorm more on that area. Then, they can discuss all of the causes and identify a solution.

**Note**: When we identify factors of causes and effects, it helps to ask ourselves the questions: Who? What? When? Where? Why? and How?

**EXAMPLE**

Our team is having a hard time meeting its production schedule because we often run out of material. We would like to analyze this problem in detail to see if we can do anything about it. The team uses a large piece of paper to write down what they do at each step.

**Step 1.** The problem is: Our Team often has a Lack of Production Material.

**Step 2.** The ideal solution is to: Always Have Production Material Available.

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Step 3. The team discusses the time needed to solve the problem and decides to try and have a solution ready in 6 weeks.

Step 4. The team decides on 3 major areas that could be causing the problem. They are the RECEIVING DEPARTMENT, TRANSPORTATION, and WORKERS.

Step 5. The team discusses the problem and decides that, if it were solved, they would be able to see and measure its effects on the PRODUCTION SCHEDULE, SALES, and DELAYS.
Step 6. The team held a brainstorming session and came up with some very specific causes. These were listed under the major area that they belonged to.

- **Receiving Dept.**
  - Damaged Materials
  - Suppliers
  - Causes: A, B
  - Delivery Time: 5 days, 2 weeks

- **Production Schedule**
  - Effects

- **Workers**
  - Methods
  - Experience
  - Machines
  - Training Lead Time (hrs.)

- **Transportation**
  - Lead Time (hrs.)

Step 7. The specific effects to measure the solution on were brainstormed by the team and listed on the diagram.

- **Receiving Dept.**
  - Delivery Time: 5 days, 2 weeks
  - Suppliers
  - Causes: A, B

- **Production Schedule**
  - Effects

- **Workers**
  - Methods
  - Experience
  - Machines
  - Training Lead Time (hrs.)

- **Transportation**
  - Lead Time (hrs.)

Step 8. The team looked at the cause factors and decided that each area had been covered carefully, i.e. each arrow had the same amount of detail. They carefully considered all of the factors, collected some data and found that the material was ordered in plenty of time but that the suppliers were unreliable. The other factors were not as significant.

The team recommended that new suppliers be found that were more reliable in delivery of their materials to the company.

The solution was approved and implemented. The team followed up on this and measured the effects in terms of meeting the production schedule, production volume and amount of worker idle-time. They found that the solution had worked very well. This verified that the causes they worked on were the biggest part of the problem.
***Have the team answer the Review Questions. After going through the answers, have the team work on the Review Exercise together.***

REVIEW EXERCISE

The C & E diagram helps us to consider all of the problem causes and solution effects. We will look at the problem of our car's poor gas mileage. Go through the eight steps listed below and fill in the diagram.

**Step 1.** Identify the problem. Is the problem poor gas mileage in town, on the highway, or all the time. Be precise.

**Step 2.** State the ideal solution. Do we want to increase our gas mileage in town by 10 mpg? By 30 mpg?

**Step 3.** Specify a milestone date. By what date do you want to have solved the problem?

**Step 4.** Identify the major cause factors. Brainstorm, as a team, and try to cover all possibilities.

**Step 5.** Identify major effects. Brainstorm and use your imagination to find all the areas that will be affected by your actions to improve your gas mileage.

**Step 6.** Brainstorm for specific causes of poor gas mileage. List them under the major headings.

**Step 7.** Brainstorm for the specific effects of improving our gas mileage. Some of these effects will be results of our actions and won't be directly related to the amount of gas we are burning.

**Step 8.** Identify a feasible solution by recommending actions we can take to get rid of the major causes.

Follow through by seeing that the solution(s) are implemented and measuring the effects to see that we really did get rid of the major causes.

NOTE: Feel free to add or delete arrows from the diagram if you need to.

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The Problem:

During the next session, we will apply this technique to one of the problems the team is working on and answer any questions you might have.
CAUSE AND EFFECT DIAGRAMS

REVIEW QUESTIONS

1. The C & E diagram gives an organized picture of the problem causes and effects.
   True_______   False_______

2. Name the parts of a C & E diagram.
   a. 
   b. 
   c. 
   d. 
   e. 

3. Some clues to possible causes are: (Several answers apply.)
   _____ a. Changes.
   _____ b. Repeating patterns.
   _____ c. Similarities.
4. How many major causes can we put on the C & E diagram?
   
   a. 3
   b. 5
   c. No limit

5. The milestone date is the date the team drew the C & E diagram.
   True_______       False_______

6. The first step of drawing a C & E diagram is to:
   
   a. Identify the problem.
   b. List the problem causes.
   c. State the ideal solution.

7. The team should wait till all cause and effect brainstorming is finished to discuss the ideas.
   True_______       False_______

8. Name the 5 W's and H that we can use to think of causes and effects.
   
   a.   d.
   b.   e.
   c.   f.

9. Before the team starts, they should review the Rules of Brainstorming.
   True_______       False_______

10. The problem should be stated as precisely as possible to save time and effort.
    True_______       False_______
SESSION OVERVIEW

The concepts of human engineering are used to design safe and useable work areas and equipment. These ideas cover a large number of items, including work benches, chairs, lighting and ventilation. This is another way to work smarter, not harder.

The objectives of this session are to:

1) Define human engineering.
2) Explain the purpose of human engineering.
3) Explain some of the principles of human engineering.
4) Show areas that we can apply these principles to.

We will review the ideas presented by answering some written questions and working on an exercise at the end of the session.

HUMAN ENGINEERING

We define Human Engineering as designing tools, equipment, and work areas to aid a person in doing their job safely by accounting for the limitations of the human body. In other words, we want to:

1) Be able to get a specific task done.
2) Consider necessary safety areas.
3) Consider what the body is able to do.

The purpose of human engineering is to fit the task to the person, NOT the person to the task.
There are 4 basic principles of human engineering that we can apply to designing work areas, equipment, and tools.

1) Use knowledge about human physical and mental limitations in the design of the work area, equipment and tools for a specific task.

2) Make work benches, chairs, and necessary equipment adjustable.

3) Make work areas and equipment so that the large man fits with enough space and the small woman can easily reach all necessary objects.

4) Keep safety and safety regulations firmly in mind when designing work areas, tools, equipment and task procedures.

***Ask members if they can think of any other principles that would aid people in doing a job better and more safely.***

Let's go through each of these principles in more detail and give examples of areas or items that they can be applied to.

The first principle says that we want to use our knowledge of human physical and mental limitations when we are designing tools, equipment, and work areas to fit our specific task. Specialized equipment has the advantage of being more efficient at performing the task. The ability to perform better than general types of equipment means that we can save wasted time, motion, and energy. Examples of where we can apply this principle are:

1. Design the work area so that there is a logical flow of work from one work bench, or machine, to the next. This will help to prevent traffic snarls and accidents from occurring.

2. Design the work bench so that there is enough room available for doing the job, storing necessary parts and tools, and disposing of waste or scrap material. This enables the person to have necessary items available, instead of having to constantly go in search of them.

3. Tools made for specific tasks often help get the job done with less muscle fatigue, frustration, and time. For example, using needlenose pliers to reach into equipment is much easier than using standard pliers.

4. Write the task/job procedure so that the person performing the task has the chance to shift their body position and their concentration/attention every so often. This provides very necessary stimulation. We make less mistakes and cause fewer accidents if we aren't "sleepy".

5. Ensure that there is adequate ventilation and non-glare lighting. Using green plants in the work area can soften harsh lighting.

Using adjustable work benches, chairs, and equipment is our second principle. There is much less physical and even mental fatigue when the body is properly
supported. Since people come in various shapes and sizes, the one-size-fits-all attitude should not be used in designing or purchasing work tables, chairs and equipment. Adjustable equipment, when properly used, will support the body and reduce fatigue. Equipment and parts that should be adjustable include:

1. The work table height. This allows the user to do their work at the optimum level of 1 to 3 inches below the elbow.

2. The chair. The backrest, footrest, and seat height should all be adjustable to properly support many different sizes of people.

3. If only one worker is assigned to use a particular machine, it may be best to adjust the machine height to fit the person. Again, this helps to eliminate fatigue and accidents.

Designing, making or purchasing equipment that allows the large man to comfortably fit and the small woman to easily reach, means that a large part of the population can use the equipment. This 3rd principle ties into the last principle - safety. If a smaller person has to really stretch to reach a necessary object, they are often off-balance and can cause or become part of an accident. There is also resulting frustration from having to unnecessarily strain. When the large person can fit the equipment, the amount of their physical fatigue is reduced. A person who is cramped up or very restricted can also present safety problems. Some examples of where we can apply this principle are:

1. Locating the parts bins at the height that short people can reach into and large people won't have to stoop over for.

2. Buying a parts bin that large hands can get into and out of easily.

3. Having a work bench that the small person can reach across and the large person can get their knees under.

4. Locating racks of test equipment at a reasonable height for all workers.

***Ask members for other examples where we would want to consider body size as a factor.***

Safety is a very important consideration when designing or purchasing tools, equipment, and work areas. People often react, rather than act. They do before they think. This means that we often need to protect people from moving machine parts and other hazardous situations. Additionally, there are federal, state, and local safety regulations that must be followed. Using "common" (uncommon?) sense and reasonable precautions, we can incorporate safety into our work areas, tools, equipment and tasks. Safety precautions can include:

1. Stocking heavy parts on lower levels instead of being at heights
which need a ladder to be reached.

2. Having electrical cords banded together or run through conduit to prevent snarls, tangles and accidents.

3. Removing obstacles from foot traffic paths.

4. Having stable access to high storage areas.

5. Use of adequate lighting, especially in stairwells or crowded areas.

6. Labelling dangerous or hazardous fixtures, such as steam pipes, chemical bath tanks, and high voltages.

7. Use of asbestos material to guard work tables and floors from hot or molten materials.

8. Use of machine guards to prevent anything (hand, etc.) from being caught in moving machinery.

9. Color coding important materials or equipment.

***If the 9 items above don’t fit your work area, ask team members for other safety precaution examples that could be used for their work area.***

This seems to be very "common sense" to us. BUT, how many of us, at one time or another, have reacted instead of acted?

How many of us have:

1. "Made do" with ill-fitting tools and ended up with blisters?

2. Tripped over cords or objects lying in our path?

3. Banged our foot, elbow or knee in the dark because there was no light available or we didn't turn it on?

4. Stretched to get something, got off-balance, and dropped the item and/or hurt ourselves?

5. Started to use something in an unlabelled container, only to find it contained a different, more hazardous material?

So, when we design, make or purchase equipment, work areas and tools, we need to give very careful thought to what is really needed. Using these principles, we can prevent or correct problems in many areas of our work.

***Explain to team members that the exercise can be used to identify some of their work area problems.***

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EXERCISE

Using your knowledge of your work area, tools, equipment, and tasks, brainstorm for places where you can apply the 4 basic principles. Discuss these ideas afterwards, as a team.

Principle #1 - Design work areas, tools, tasks and equipment with human limitations in mind.

Principle #2 - Make work area equipment adjustable.

Principle #3 - Make work areas and equipment a reasonable size, so that it fits large men and small women.

Principle #4 - Design, make or purchase items or tasks with reasonable safety in mind.

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HUMAN

ENGINEERING

REVIEW QUESTIONS

1. We use the ideas of Human Engineering to design safe and useable work areas and equipment.

   True_______       False_______

2. The purpose of Human Engineering is to fit the person to the task.

   True_______       False_______

3. Why do we want to have adjustable equipment and furniture?

   ___________________________________________________
   ___________________________________________________
   ___________________________________________________

4. If we use specialized equipment, we can save wasted:

   a. ___________________________________________________
   b. ___________________________________________________

5. We should design our work areas and equipment so that the large man can reach and the small woman can fit.

   True_______       False_______
6. Safety means we try to prevent hazardous situations.
   True______  False______

7. Is "common" sense really common?
   Yes______  No______

8. Name some areas or aspects of your work or area that you can apply these principles to.
   a. 
   b. 
   c. 

9. How many basic principles did we discuss?
   a. 3 
   b. 4 
   c. 5