

KV INSTITUTE OF MANAGEMENT AND INFORMATION STUDIES
BA 5107 - TOTAL QUALITY MANAGEMENT

UNIT II - PRINCIPLES AND PHILOSOPHIES OF QUALITY MANAGEMENT

Over view of the contributions of Deming, Juran, Crosby, Masaaki Imai, Feigenbaum, Ishikawa, Taguchi techniques-introduction, loss function, Parameter and tolerance design, Signal to noise ratio. Concepts of quality circles, Japanese 5S and 8D methodology

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Introduction

A Guru is a spiritual guide who is considered to have attained complete insight. “A guru, by definition, is a good person, a wise person and teacher.

A quality guru should be all of these, plus have a *concept and approach to quality* within business that has made a major and lasting impact.

Three groups of gurus

Early 1950's Americans who took the messages of quality to Japan



Late 1950's Japanese who developed new concepts in response to the Americans



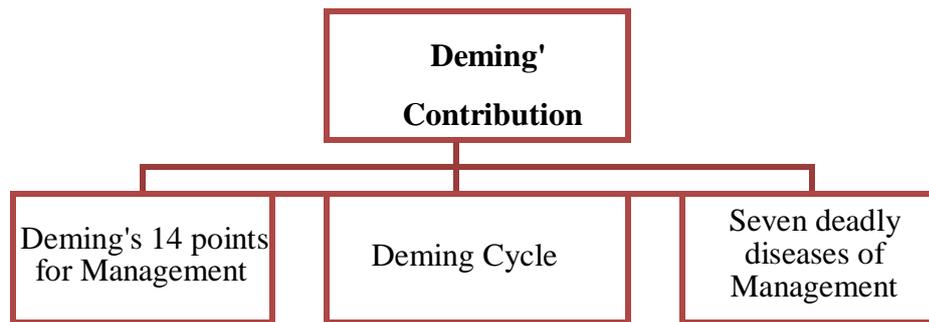
1970's-1980's Western gurus who followed the Japanese industrial success

Overview of the Deming's Contribution

William Edwards Deming (October 14, 1900–December 20, 1993) was an American statistician, college professor, author, lecturer, and consultant. Deming is widely credited with improving production in the United States during World War II, although he is perhaps best known for his work in Japan.

Deming was a prominent consultant, teacher, and author on the subject of quality. He has published more than 200 works, including well-known books 'quality', 'productivity and competitive position', and 'out of the crisis'. He awarded as the senior quality guru in 1928.

- Dr. W. Edwards Deming is known as the father of the Japanese post-war industrial revival and was regarded by many as the leading quality guru in the United States. He passed on in 1993.
- Trained as a statistician, his expertise was used during World War II to assist the United States in its effort to improve the quality of war materials.
- W. Edwards Deming is best known for his management philosophy establishing quality, productivity, and competitive position.



Deming 14 Points for Management

- I. **Constancy of purpose:** - Create constancy of purpose for continual improvement of products and service, and allocate resource to cater to long term needs rather than short term profitability with a plan to become competitive, stay in business and provide jobs.

An organization must define its values, mission and vision of the future to provide long-term direction for its management and employees. Deming believed that businesses are social entities whose basic purpose is to serve their customers and employees. To do this, they must take a long-term view and invest in innovation, training and research

- II. **The new philosophy:** - Adopt the new philosophy for one can no longer accept delays, mistakes and defective workmanship. Transformation of the western management style is necessary to halt the continued decline in the industry.

Companies cannot survive if products of poor quality of conformance or poor fitness for use leave their customers dissatisfied. Instead, companies must take a customer driven approach based on mutual co-operation between labor and management and a never-ending cycle of improvement. Everyone, from CEO to the lowest level employee of the organization must recognize the need for a new philosophy to keep the firm and its functions alive and growing in today's competitive environment and must learn the new philosophy

- III. **Cease dependence on inspection:**-Eliminate the need for mass inspection as a way to achieve quality by building quality into the product in first place. Demand statistical evidence of built in quality in both manufacturing and purchasing function.

“Routine inspection acknowledges that defects are present, but does not add value to the product. Defects are inherent to any product or process, and we can hope to prevent those defects from reaching customers only by inspecting them”

Deming contradicted the above view, since inspections increase costs rather than reduce them and create more problems than they solve. The rework of defective products decreases productivity and in service industries, rework cannot be

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performed. Workers must take responsibility for their work rather than leave the problems for the inspectors.

- IV. **End lowest tender contracts:** - End the practice of awarding business contracts solely on the basis of price tags. Instead, go for meaning full measures of quality along with price. Reduce the number of suppliers for the same item by eliminating those that do not qualify against the statistical yardstick of quality. The aim is to minimize total cost, not merely the initial cost.

Purchase departments have long been driven by cost minimization, without regard to quality. Low prices are often associated with low quality, which can actually raise overall costs through increased expenses for inspection, scrap and rework, inventory to replace defective items and employee frustration. Managers must identify and assess all of the effects and costs created by every purchase and buy from the supplier that offers the lowest total cost.

- V. **Improve every process:** - Constantly improve every process involved in the stage of planning, production and service. Search continually for problems in order to improve every activity in the company because better quality leads to increased productivity and decreased costs. It is the management's job to continually work on all aspects of the system.

Whereas Western management has viewed improvement in the context of large, expensive technological innovations such as robotics and computer-integrated manufacturing, Japanese manufacturer's success is primarily due to incremental improvements.

Improvements are necessary in both design and production. Improved design comes from understanding customer needs through continual market surveys and other sources of feedback. Also, understanding the manufacturing process and developing designs having productivity are essential to achieve improved design. Improved production is achieved by reducing the causes of variation and establishing stable, predictable processes.

- VI. **Institute training on the job:** - Institute modern methods of training on the job, including management to make maximum use of all employees. New skills are required to keep up with changes in material, methods, product design, machinery, techniques and service.
- VII. **Institute leadership:** - Adopt and institute leadership, which is aimed at helping people do a better job. The responsibilities of managers and supervisors must be changed to emphasize on quality rather than quantity. This will automatically improve

productivity. The management must ensure that immediate action is taken on reports of inherited defects, maintenance requirements, poor tools, fussy operational definitions and other conditions detrimental to quality.

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However, most firms view training as a requirement of newly hired employees only. Later, they implicitly and wrongly assume that the employees no longer need any training. The critical need to learn never ends. All employees should be trained in statistical tools for solving quality problems. Not only does training result in improvement in quality and productivity, but it adds to worker's morale. In addition, training removes barriers between workers and supervisors, giving both more incentives to improve further

- VIII. **Drive out fear:-**Encourage effective two way communication and other means to drive out fear throughout the organization so that all employees are able to work effectively and ensure greater productivity for the company.

Deming identified fear as major obstacle to improve efficiency and effectiveness and a major barrier to change and survival. Fear is manifested in many ways: Fear of reprisal, fear of failure, fear of the unknown, fear of losing control and fear of change. Fear affects an operating system in many ways. Some people are afraid to ask questions and reveal weaknesses in their knowledge, fear of the perceived cost of failure, such as poor performance reviews or even termination, prevents some people from challenging current practices or trying new techniques. Many people simply fear change because it forces them to deal with new and unfamiliar methods in place of known and familiar, though inefficient methods

- IX. **Break down barriers :-** Break down barriers between people in different divisions of the organization such as R&D, sales, Administration and production. They must work in teams to tackle problems that may be encountered.
- X. **Eliminate exhortations:-** Eliminate use of slogans, posters and exhortations demanding zero defects and new level of productivity from the workforce, without providing commensurate methods. Such exhortations only create adversarial relationships; the bulk of the cases of low quality and low productivity belong to the system and; thus, lie beyond the power of workforce.
- XI. **Eliminate arbitrary numerical targets:-** Eliminate work standard that prescribes numerical quotas for the work force and numerical goals for people in the management. Substitute these with aids and helpful supervision and use statistical methods for continual improvement of quality and productivity.
- XII. **Permit pride of workmanship:-** Remove the barriers that robe hourly workers and people in the management of their rights to pride of workmanship. This implies the abolition of the annual merit rating (appraisal of performance) and management by objectives. Again, the responsibility of managers, supervisors and foremen must be changed from sheer numbers to quality.
- XIII. **Encourage education:-** Institute a vigorous programme of education and encourage self improvement. What an organization need is not just good people; It needs people who improve education. A workforce routed in knowledge will always enable an organization to be competitive.
- XIV. **Top management's commitment:-** A clearly defined commitment by the top management to constantly improve quality and productivity and reinforcement of

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obligations to implement all these principles is always beneficial to the workforce and the organization. Create structure in the top management whose main task will be to push these 13 points constantly and take action in order to accomplish the transformation.

Deming’s cycle

The ‘Deming wheel’ or ‘Deming cycle’ which is also known as the PDCA cycle (Plan-Do-Check-Act) is a problems solving process adopted by firms engaged in continuous improvement (CI).

The PDCA cycle, or the PDSA (Plan, Do, Study, Act) cycle is a model for continuous improvement of quality. It consists of a logical sequence of four repetitive steps for continuous improvement and learning: Plan, Do, Check (study), and Act. The PDCA cycle is also known as Deming cycle or as the Deming wheel or as the continuous improvement spiral. It originated in the 1920s with the eminent statistics expert. Mr. Walter A. Shewhart, who introduced the concept of Plan, Do and see. Deming modified the cycle of Shewart towards: Plan, Do, Study and Act. The Deming cycle is related to Kaizen thinking and just-in-time manufacturing

Under Deming’s approach, quality is maintained and improved when leaders, managers and the workforce understand and commit to constant customer satisfaction through continuous quality improvement. Applications of the PDCA cycle are

It is used to satisfy the quality requirements of the customer. It may be used for the development of a new product based on the quality requirement of the customer. It develops teamwork between the company’s various functions and aids in product design and development, production, sales and market research.

Demings cycle



Plan what is needed

Do it

Check that it works

Act to correct any problems or improve performance

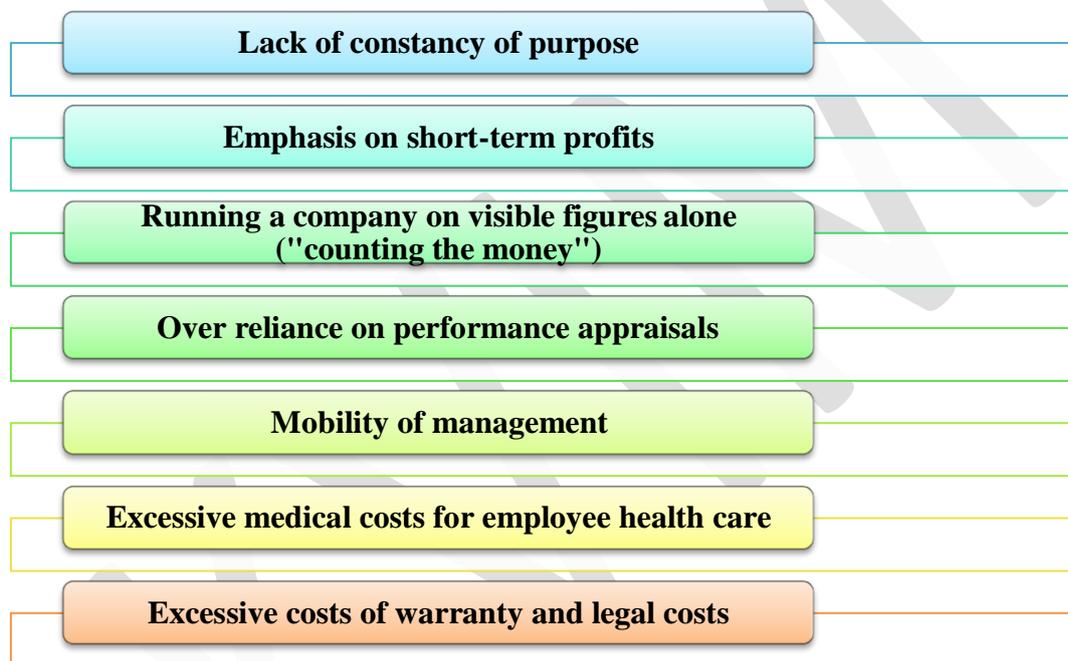
Design	Plan	When problem is detected in product design and development, find the cause of problem
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Production	Do	A pilot project is done
Sales	Check	The result of the effort are observed and analysed against the plan.
Research	Action	At this stage, the cycle starts again with planning an improvement

The Deming chain reaction (Seven deadly diseases of management)

The Deming chain reaction was first presented in 1950 in Japan after Second World War. It illustrated Shewart's concept that productivity and quality improved as variation reduced. His book out of the crisis (1989) is considered a quality classic. Deming identified seven deadly sins affecting quality:



Deming's Seven Deadly Diseases

1. Lack of constancy of purpose:

Many companies have only short-term quality programs. They do not look towards the long-term. For example: at one small plant, the plant manager stated vehemently that no one should ever compromise on quality. After sometime, a customer called for a rush order to meet his urgent needs and willing to take any product that the plant could ship irrespective of quality.

2. Emphasis on short term profits:

A process that focuses on short-term profits encourages short-term thinking and short-term actions. Managers may cut costs in the short-term while sacrificing the long-term planning that TQM demands and raising costs overall.

3. Over reliance on performance appraisals:

A performance appraisal system can hinder the implementation of TQM by encouraging rivalry, fear and short-term thinking. It can also destroy teamwork and mutual respect.

4. Mobility of management:-

Managers who continually job-hop fail to understand the companies, for which they work, focus on the short-term and are unable to implement the long-term changes necessary for lasting quality improvement. Even though it may be argued that job hopping exposes managers to a beneficial diversity of experiences, excessive job hopping encourages short-term thinking and inhibits the ability of the manager to understand the long-term implications of actions.

5. Overemphasis on visible figures:-

Managers tend to evaluate performance by looking only at measures that they can easily capture. But most important figures may be unknown or often unknowable, such as the effect of a satisfied customer. TQM requires the managers to evaluate the total effect of any action by reviewing both quantitative information like the number of defects and qualitative data like expressions of customer satisfaction or employee perception about the firm.

6. Excessive medical costs for employee health care:-

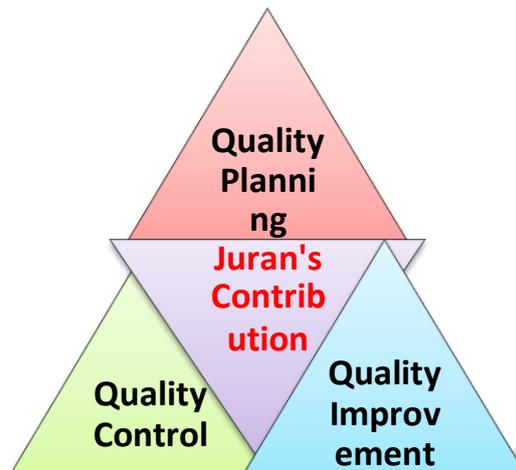
Healthcare costs and rate of absenteeism due to illness have increased at a phenomenal rate over the years.

7. Excessive costs of warranty and legal costs:-

\Due to proliferation of law suits and multi-million-dollar judgments concerned with compensation to be paid to the patients, the medical professionals in US spend lot of money for paying insurance premium to cover the risk in practising their medical profession.

Contributions of Juran

Joseph Juran is an internationally acclaimed quality guru, similar to [Edwards Deming](#), strongly influencing Japanese manufacturing practices. Joseph Juran's belief that "*quality does not happen by accident*" gave rise to the quality trilogy:



Juran's Trilogy

In the 1980's Joseph Juran recognized that the **common approach** to total quality management...believes quality must start at the top.

The key steps in **implementing company-wide strategic goals** are: **Identify customers** and their needs – both internal and external – and work to meet those needs.

Create measures of quality, establish optimal quality goals and organize to meet them

Create processes capable of meeting quality goals in “real” operating conditions

Juran's formula

- Build an awareness regarding the need and offer an opportunity for improvement
- Set goals for improvement
- Organize paths to reach the goals (Establish a quality council, identify problems, select projects, appoint teams, designate facilitators, etc)
- Provide training
- Carry out projects to solve the problem
- Report progress
- Give recognitions
- Communicate results
- Keep score
- Maintain momentum by making annual improvements part of the regular systems and process of the company.

Overview of the contributions of Crosby:-

Philip Crosby (1926-2001) is another of the American quality gurus who rose to international fame mainly thanks to his teachings on quality management. He is best known for the concepts of ‘zero defects’ He has authored many books, including “quality is free”, “quality without tears”, and “let's talk quality and leading: the art of becoming an executive”.



Four absolutes of quality:-

1. **Definition of quality is conformance to requirement:-** Quality is conformance to requirements, not goodness.
2. **The system:-**Prevention not appraisal
3. **The performance standard:** Zero defects
4. **The measurement:-** The price of non conformance to requirements, not quality indices. Based on these premises, he developed a 14 step methodology.

Fourteen steps to quality management:-

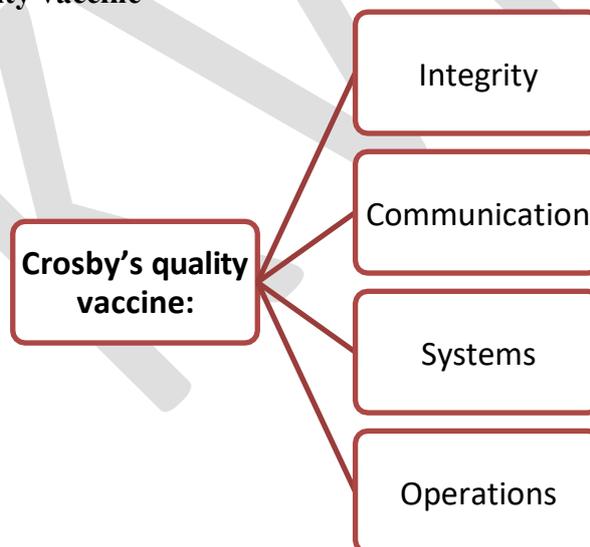
- (i) **Management commitment:** To clarify the management's stand on quality
- (ii) **Quality improvement team:** To run the quality improvement programme
- (iii) **Quality measurement:** To display current and potential non-conformance problems in the manner that permits objective evaluation and corrective action
- (iv) **Cost of quality:** To define the ingredients of the cost of quality, and explain its use as a management tool
- (v) **Quality awareness:** To provide a method of raising personal concern among the personnel in the company towards the conformance of the product and service, and the reputation of the company on the issue of quality.
- (vi) **Corrective action:** To provide a systematic method of resolving the problem identified through actions taken previously

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- (vii) **Zero defects planning:** To examine the various activities that must be conducted in preparation for formally launching the zero defects programme
- (viii) **Supervisor training:** To define the type of training that supervisor need in order to actively carry out their roles with regard to the quality improvement programme.
- (ix) **Zero defects day:** to create an event that will let all employees realise, through a personal experience, that there has been a change.
 - (x) **Goal setting:** to turn pledges and commitments into action by encouraging individuals to establish improvement goals for themselves and their groups.
 - (xi) **Error cause removal:** to give individual employees a method of communicating to the management, the situations that make it difficult for employees to meet the plledge to improve.
 - (xii) **Recognition:** To appreciate those who participate
- (xiii) **Quality councils:-**To bring together professionals in the domain of quality for planned communication on a regular basis with the workforce and management alike.
- (xiv) **Do it over again:** to emphasize that the quality improvement programme never ends.

Crosby's quality vaccine



Overview of the contributions of Masaaki Imai:

Imai was a Japanese quality guru. 1962-he founded the Cambridge corporation, an international management consultancy and executive recruiting firm, based in Tokyo From 1976 to 1986- he served as president of the Japan Federation of Recruiting and Employment Agency

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Associations 1986-he established the Kaizen Institute to help western companies introduce kaizen concepts, systems and tools

As a consultant, Imai assisted more than 200 foreign and joint venture companies in Japan in fields including recruiting, executive development, personnel management and organizational studies. He also published his book on Japanese management, “Kaizen: The key to Japan’s Competitive Success”.

Imai’s contributions:-

- Imai has brought the management philosophies, theories and tools as a single concept known as kaizen. Kaizen is a Japanese word which means continuous improvement or improvement over improvement. It is process of continuous improvements in small increments that make the process more efficient, effective, controllable, and adequate
- Kaizen begins with the notion than an organisation can assure its long-term survival and success only when every member in the operating system and throughout the firm, actively pursues opportunities to identify and implement improvements every day. Kaizen incremental improvements by understanding the functions of the current system and its weaknesses or relative inefficiencies. Furthermore, small improvements gain returns the firm without the need for large, initial investments to fund major innovations like a new, automated assembly line. The quality improvement perspective of kaizen is best described by an old saying, “Everyday and in every way, we are getting better and better”.

The aim of Kaizen is to ensure that everyone in an organization is of the frame of mind to pursue naturally continuous improvement in whatever they do. It also encourages people to accept continuing change at the place where action takes place. The concept has a number of basic principles such as:

- 1) Continuous focus on improvement
- 2) Everyone in the company should be involved
- 3) Delighting the customer
- 4) Everything should be considered from a total system stand point

The key elements of Kaizen:

- 1) Adaptability of both people and equipment
- 2) Use of existing technology to optimize capacity
- 3) Creative involvement of all employees and
- 4) ‘Make it a little better each day’ attitude

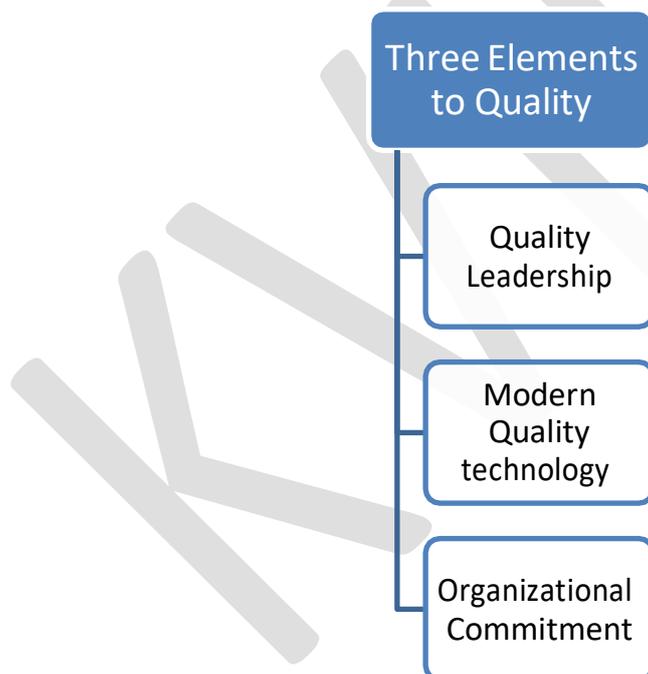
Overview of the contributions of Feigenbaum:

He was the founder and president of General Systems Company Inc., an international engineering company that designs and implements total quality systems. He originated the concept of total quality control in his book “Total Quality Control”, which was published in 1951 and also he was a holder of the Edwards Medal and Lancaster Award for international contributions to quality and productivity.

- Feigenbaum defined total Quality control as an effective system for integrating the quality development, quality maintenance, and quality improvement efforts of the various groups in an organization so as to enable production and service at the most economical levels which allow full customer satisfaction

Armand is also know for his concept of the "**hidden**" **plant** the idea that so much extra work is performed in **correcting mistakes** that there is effectively a hidden plant within any factory.

Three Elements to quality



1. Industry cycle:-

Feigenbaum stated that the industrial cycle was an ongoing sequence to bring products or services to the customer. These activities include marketing, purchasing, design, engineering, manufacturing, production, inspection, packaging, delivery, installation and service. He also maintained that “quality is everybody’s job”.

At the heart of Feigenbaum’s concept was a belief that the cycle begins and ends with the customer and in between were a multitude of different requirements to be

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defined and communicated, in this he saw the prime role of the quality professional to coordinate it. Warning of the consequences of communication breakdowns resulting in directions other than the design actually being developed, it was pointed out that the total cost of quality accumulated throughout the whole process and it was essential to manage quality throughout lower the overall cost. The two fundamental concepts:

- “Quality is everybody’s job” management and operators cannot totally delegate authority and responsibility and still expect a satisfactory product
- “Because quality is everybody’s job in a business, it may become nobody’s job”

2. Hidden plant:-

One of the more well known concepts developed by feigenbaum was that of the “hidden plant”. He maintained that within every company or factory a proportion of its capacity was wasted by not getting it right first time. He noted a figure of up to 40% of the capacity of the plant being wasted.

3. Quality control:-

Emphasizing that human relation was a basic issue in quality control activities, and such things as statistics and preventive measures were only a part of the whole equation. “Quality” is what suits the customer at the right price for both the provider and customer and a common sense approach to quality standards, conformance, corrective actions and planning for improvement is the control required to gain that quality.

By stimulating and encouraging everyone in an organization to realize their responsibilities and potential effects on the quality of a product or service. Feigenbaum emphasized that success needs quality-thought at all levels with complete top management support. To encourage the right growth environment, quality issues should be widely communicated and commitment should be demonstrated by recognition that this is not an overnight or temporary cost-cutting exercise.

He also pointed out the recent change in customer perceptions of quality and the increased awareness of variation between products of the same country and its competition. Pointing out that the predictability of a controlled process is essential to achieve a product with a specific reliability is the most important driver for companies wanting to succeed and grow

4. Crucial elements of total quality:-

- 1) Quality is the customers perception of what quality is, not what a company thinks it is.
- 2) Quality and cost are the same, not different
- 3) Quality is an individual and team commitment

- 4) Quality and innovation are interrelated and mutually beneficial
- 5) Managing quality is managing the business
- 6) Quality is a principal
- 7) Quality is not a temporary or quick fix but a continuous process of improvement

Overview of the contributions of Ishikawa

Professor Kaoru Ishikawa(1915-1989) is known as the” father of quality circles” for his role in launching Japan’s quality movement in 1960’s.Ishikava advocated the following principles:

Quality is a companywide issue and must wield an all-pervasive influence on the way every issue of business is conducted

Seven simplified tools of quality control need to be used by all the people in the organization
Quality circles

Kaoru Ishikawa is credited with developing the idea of companywide quality control in Japan .He pioneered the use of quality circles and championed the use of quality tools to understand the root cause of the problems. He developed one of those tools, the cause and effect diagram, which is also referred to as the Ishikawa diagram or the fishbone diagram, In his book *what is total quality control?* Ishikawa said that seven basic tools were “indispensable for quality control.”

These are pareto analysis, fish bone diagrams, stratification, tally charts, histograms, scatter diagrams and control charts. Ishikawa argued that with these tools, managers and staff could tackle and solve the quality problems facing them. Ishikawa was the first quality guru to emphasize the importance of the “internal customer”, the next person in the production process.

Ishikawa emphasized on quality as a way of management. He influenced the development of participative, bottom-up view of quality, which became the trademark of Japanese approach to quality management. Some of the key elements of his philosophies are :

Quality begins with education and ends with education

- a. The first step in quality is to know the customer’s requirements
- b. The ideal state of quality control occurs when inspection is no longer necessary
- c. Remove the root cause, not the symptoms
- d. Quality control is the responsibility of all workers and divisions

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- e. Do not confuse means with objectives
- f. Put quality first and set your sights on long term-profits
- g. Market is the entrance and exit of quality
- h. Top management must not show anger when facts are presented by subordinates
- i. Ninety-five per cent of problems in a company can be solved with simple tools for analysis and problem solving.
- j. Data without dispersion information (variability) are false data.

Taguchi Technique

A product can fail because it was manufactured wrong in the factory (quality of conformance) or because it was designed incorrectly (quality of design). Quality control techniques such as statistical process control (SPC) concentrate on quality of conformance. Genichi Taguchi, a Japanese consultant and statistician, suggests that product-failure is primarily, a function of design quality.

A product should be designed to withstand variations in environments and operating conditions, is said to be robust or possess robust quality. Taguchi believes that superior quality is derived from products that are most robust and that robustness comes from robust design.

The conditions that cause a product to operate poorly can be separated into controllable and uncontrollable factors are design parameters such as materials used, dimensions, and form of processing. Uncontrollable factors are under the user's control (length of use, maintenance, settings, and so on) or occur in the user's environment (heat, humidity, excess demand and so on). The designer's job is to choose value from the controllable variables that react in a robust fashion to the possible occurrences of uncontrollable factors.

As part of the process, design-engineers must also specify certain tolerances or allowable ranges of variations in the dimension of a part. It is assumed that producing parts within those tolerance-limits will result in a quality product. Taguchi, however, suggests that consistency is more important to quality than being within tolerance.

Taguchi loss function

- Taguchi defines quality as "the loss imparted by the product to society from the time the product is shipped".
- This loss includes costs to operate, failure to function, maintenance and repair costs, customer dissatisfaction, injuries caused by poor design, and similar costs.

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- Defective products / parts that are detected, repaired, reworked, or scrapped before shipment are not considered part of this loss.
- The essence of the loss function concept is that whenever a product deviates from its target performance, it generates a loss to society. This loss is minimum when performance is right on target, but it grows gradually as one deviates from the target.
- Therefore the loss function philosophy says that for a manufacturer, the best strategy is to produce products as close to the target as possible, rather than aiming at “being within specifications”.

Taguchi’s approach Vs traditional approach

- Consider two products and one is within the specified limits and the other is just outside of the specified limits. In the traditional approach, the product within the limits is considered as a good product while the outside one is considered as bad product.
- Taguchi disagrees with this traditional approach. He believes that when a product moves from its target value, that move causes a loss no matter if the move falls inside or outside the specified limits.

Explanation of the taguchi method

Suppose the manufacturing specifications for a widget is 20 (plus or minus) 3 mm. Under the traditional manufacturing perspective, if the widget actually produced is less than 17 mm or greater than 23 mm, then it must be discarded. For any widget within the 17mm to 23mm range, the traditional manufacturing perspective recognizes no quality loss cost.

Under the Taguchi perspective, a quality cost is incurred whenever the actual weight does not reach the exact target value 20mm. Variations from this target value (even 19mm or 21mm value) will produce the quality loss cost.

The assembly of two parts that are near opposite tolerance-limits may result in tolerance stack-ups and poor quality. For example, a button diameter, that is small (near to the lower tolerance-limit), combined with a buttonhole, that is large (near to its upper tolerance-limit) results in a button that won’t stay fastened. Although it isn’t beyond the scope of this text, Taguchi advises how to set tolerance-limits so that tolerance stack-ups can be avoided.

Manufacturing tolerances define what acceptable or unacceptable quality is. Parts or products, measured outside tolerance-limits are considered defective and are either reworked or discarded. Parts or products within the limits, are considered “good”.

Taguchi asserts that although all the parts or products within tolerance may be acceptable, they are not all of the 60 in a course. He or she will pass, whereas a student who earns an average grade of 59 will fail. A student with a 95 average will also pass a course.

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Taguchi would claim that there is negligible difference between the quality of the students with averages of 59 and 60, even though one was “rejected” and the other was not. There is however, a great deal of difference in the quality of the student with an average of 60 and the student with an average of 95.

Formula to find Taguchi’s Loss Function

Taguchi uses Quadratic Equation to determine loss Curve

$$L(x) = k(x-N)^2$$

Where $L(x)$ = Loss Function,

$k = C/d^2$ = Constant of proportionality,

where C – Loss associated with sp limit

d - Deviation of specification from target value

x = Quality Features of selected product,

N = Nominal Value of the product and

$(x-N)$ = Tolerance

3. System design , Parameter design , Tolerance design

The implementation of Taguchi methods consists of three phases (1) System design (2) Parameter design (3) Tolerance design

(1) **System design:-**This phase involves investigating process ,procedures and product factors that may cause variation in the final products. These factors might include strength of the material (product factor) and heat treatment processes(process factor).These system variables that contribute to variation are viewed in the Taguchi analysis as parameter that design a product’s quality.

(2) **Parameter design:-**This phase involves experimental research on the parameters that were determined in phase 1 to define a product’s quality. The purpose of the research is to determine how important each parameter is in determining product quality.

Considerable statistical experimental design (design of experiments) and analysis are conducted in this phase. Also, cost information brought into the analysis for consideration in recommending were cost-justified changes in the production process are permissible.

(3) **Tolerance design:** this phase involves determining product tolerance for each parameter that was found in phase 2 to be a substantial factor in generating

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production variation. This phase is also marked by a continual and dynamic tightening of tolerances as product variation improvements are suggested and implemented to improve quality over an extended period of time.

Signal to Noise Ratios

In the parameter design stage Taguchi makes use of designed experiments and signal to noise ratios to determine the optimal parameter settings. The signal to noise ratios are derived from the Taguchi loss function. While Taguchi has proposed a large number of signal to noise ratios three are the most widely used.

Nominal is Best: $SN_N = 10 \log \frac{\bar{y}^2}{s^2}$

Larger is Better: $SN_L = 10 \log \frac{1}{\frac{1}{n} \sum_{i=1}^n y_i^2}$

Smaller is Better: $SN_S = 10 \log \frac{1}{\frac{1}{n} \sum_{i=1}^n y_i^2}$

QUALITY CIRCLES

A quality circle is a group of work-force members, usually from within same work area or doing similar works, who volunteer to meet weekly (on company time) to address quality problems that occur within their work area.

Quality circle is a small group of 6 to 12 employees doing similar work who voluntarily meet together on a regular basis to identify improvements in their respective work areas using proven techniques for analyzing and solving work related problems coming in the way of achieving and sustaining excellence leading to mutual upliftment of employees as well as the organization. It is "a way of capturing the creative and innovative power that lies within the work force".

Major Attributes of Quality Circle are:

- Quality Circle is a form of participation management.
- Quality Circle is a human resource development technique.
- Quality Circle is a problem solving technique.

Objectives of Quality Circle:

- To improve quality and productivity and thus contribute to the improvement and development of the enterprise.

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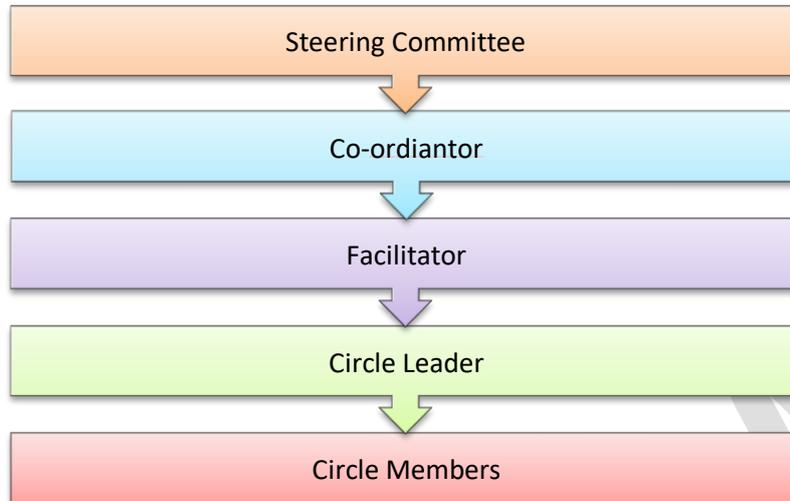
- To reduce the cost of products or services by waste reduction, safety, effective utilization of resources, avoiding unnecessary errors and defects.
- To identify and solve work related problems that interfere with production.
- To tap the creative intelligence of the persons working in the organization and to make full use of its human resources.
- To motivate employees to apply their knowledge and skill to complete a range of challenging tasks
- To improve communication within the organization
- To increase employee's loyalty and commitments to the organization and its goals.
- To respect humanity and build a happy bright workplace environment
- To enrich human capability, confidence, moral, attitude and relationships
- To satisfy the human needs of recognition, achievement and self-development

Characteristics of quality circles:-

The characteristics of quality circle as a management tool for improving quality are listed below:-

- 1) Quality circles are small primary groups of employees/workers with a group size ranging between 2 and 3
- 2) The membership in a quality circle is voluntary
- 3) The area supervisor leads each circle. They are normally coordinated centrally in an organization by a person who has been trained as a facilitator
- 4) The members meet regularly according to an agreed schedule
- 5) The circle members are specially trained in the techniques of problem solving and analysis in order to play their roles effectively.
- 6) The basic role of quality circles is to identify and solve work related problems for improving quality and productivity.
- 7) QCs enable their members to exercise their hidden talents, creative skills and competence for tackling challenging tasks and thus contribute to their self development.
- 8) It also promote the mutual development of members through cooperative participation.
- 9) The circle work is characterized by attributes such as high skill variety, task identity, task significance, autonomy, goal setting and feedback. These attributes contribute to job enrichment of the members.
- 10) Provide job satisfaction to employees.

Structure of quality circle



1. Steering committee:-

This is at the top of the structure. It is headed by a senior executive and includes representatives from the top management personnel and human resources development people. It establishes policy, plans and directs the program and meets usually once in a month.

2. Coordinator

He may be a Personnel or Administrative officer who co-ordinates and supervises the work of the facilitators and administers the programme.

3. Facilitator

He may be a senior supervisory officer. He coordinates the works of several quality circles through the Circle leaders. He is responsible for successful operation of the QC.

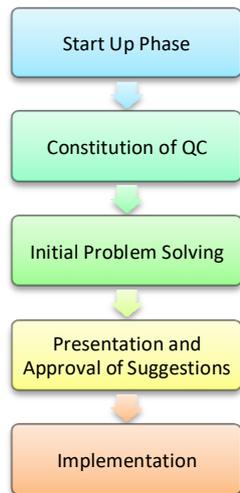
4. Circle leader

Leaders may be from lowest level workers or Supervisors. A Circle leader organizes and conducts Circle activities.

5. Circle members

They may be staff workers. Without circle members the program cannot exist. They are the lifeblood of quality circles. Member is one who voluntarily join other employees in same working area

Steps involved in developing quality circle:-



1. Start-up phase:-

QC requires an attempt just like an organizational change programme. An organizational change programme can be made successful when people are convinced about the utility of the change. Therefore, the first thing that should be done in developing QC is to publicize the concept of QC in the organization

2. Constitution of QC:-

QCs may be constituted at different workplaces in the organization. Members of a QC are from the same work area or doing similar type of work. They are drawn voluntarily. Once a QC is formed, they remain as permanent members of the circle unless they leave the work area. Besides QC at various workplaces, there may be steering committee, facilitator and coordinator.

3. Initial problem solving:-

Once people in the circle are trained and officially sanctioned, they turn to problem solving. This involves three stages: data collection, data analysis, and problem solving. Data collection is carried on through various ways like past records, contacting employees, and self-suggestions. Data analysis tries to establish the basic reasons for a particular problem or problems on hand. Problem-solving at the initial stage involves participation of various members of the QC on regular basis.

4. Presentation and approval of suggestions:-

When the QC members get ready to show their solution of a problem, they present it before the management. Presentation to management may be in the form of oral presentation by the members, preparation of the project report, or group assignments in project presentation. Presentation to management helps to improve the communication between management and workers, demonstrates management's involvement and interest to QC members, and good working relationship among all the people.

5. Implementation:-

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A final phase may be implementation of suggestions. For this purpose, relevant groups may be assigned activities depending on the nature of suggestion. If the suggestion involves only one workplace without affecting others, the implementation can be undertaken directly at that workplace.

Benefits of quality circles

- Quality circles effects on individuals characteristics
- Quality circles effects on individual relation with others
- Quality circles effects on workers and their attitudes toward the company

Limitations of quality circles

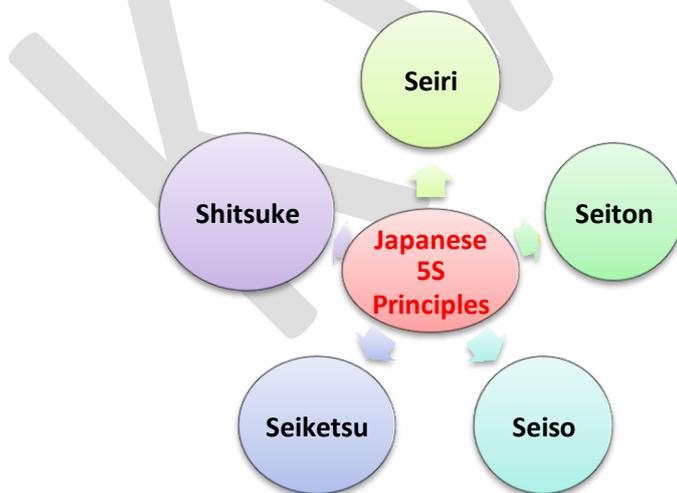
- Participation is not always voluntary in all cases
- Participation fades away if it lacks the top management's support
- No involvement of trade unions

Japanese 5S Principles

The 5S practice is a house keeping technique used to establish and maintain a productive and quality environment in an organisation.

A well-organized work place results in a safer, more efficient and more productive operation. It boosts the morale of the workers, promoting a sense of pride in their work and ownership of their responsibilities.

5S was invented in Japan. It stands for five Japanese words that start with the letter 'S' .



Lean Six Sigma: 5S

5S is a workplace organization technique composed for five primary phases:
Sort, Set In Order, Shine, Standardize, and Systematize.



SORT

Keep only necessary items in the workplace.



SET IN ORDER

Arrange items to promote efficient workflow.



SHINE

Clean the work area so it is neat and tidy.



STANDARDIZE

Set standards for a consistently organized workplace.

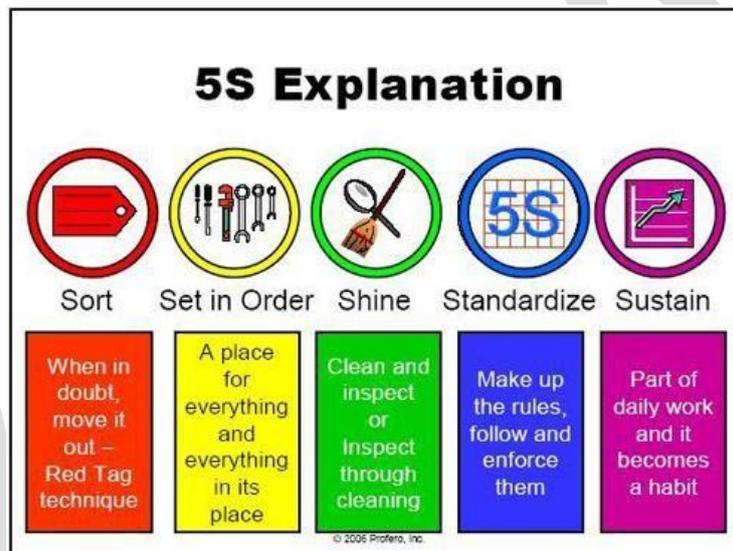


SYSTEMATIZE

Maintain and review standards.

GO LEANSIXSIGMA

www.GoLeanSixSigma.com



Objective of 5S

- To create a neat and clean work place
- To systemise day to day working
- To improve work efficiency
- To standardize work practices
- To improve work discipline

Details of 5S

1. SEIRI: clearing or sorting

SEIRI denotes action to identify and sort out all items into necessary and unnecessary items and discard all unnecessary items

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Examples of unwanted items:

- i) **At factory floor:** Machines to be scrapped; rejected materials; expired goods; broken tools, bins; old notices; etc.
- ii) **At office:** Broken pens; useless papers; old diaries; broken furniture; etc
- iii) **At home:** Broken toys; old clothes; broken suitcases; useless tins; etc.

How to practice SEIRI?

- Separate the wanted and the unwanted items. Classify everything by frequency of use
- Always repair the repairable items immediately. Don't let them lie around
- Throw away unwanted items. Do not keep them with a vague idea that may be needed. Defectives especially must be identified clearly and removed at fixed intervals.
- Develop a clear and well-understood policy of disposal of broken, unrepeatable or unwanted items.
- Make clear plans for getting rid of waste or dirt or leakages-either by action at the source to prevent its generation (E.g. oil leak from a machine) or by accumulating the waste conveniently

2. SEITON: Arranging

SEITON means to arrange everything in proper order so that it can be easily picked up for use. A place for everything and everything in its place.

Some examples of SEITON not in practice:

- i) **At factory floor:** unlabelled tool; clustered shelves, lockers; stores- on clear location system; things on the floor; etc.
- ii) **At office:** unlabelled file cabinet; clustered drawers, shelves, book-cases, tables; records and documents not arranged well; files and papers all over; etc.
- iii) **At home:** Cluster; no orderly arrangement –in drawing room or kitchen or anywhere

3. SEISO: Cleanliness

SEISO means to sweep the workplace thoroughly so that there is no dust, oil, etc.,anywhere

Some examples of poor SEISO:

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- i) **At factory floor:** Dirty machines; dust on products, parts, raw materials; dirty fixtures; dusty walls , roofs; etc
- ii) **At office:** Dusty table and furniture; dirty office equipment – typewriter, photo copier, computers
- iii) **At home:** Dirty furniture; dusty windows; doors; dirty book shelves, cupboards; dusty floor, fans; etc.

How to practice SEISO?

- Sweeping inside the lines is the responsibility of people working in that line. This includes cleaning of machines, tooling, bins etc.
- Packing bags, rejects, spilled powders, paper etc. must not be allowed to drop on the floor and then swept out of the lines and cleared later by sweeping staff
- Oil and other liquid spills should not take place but if they do they must be cleaned and the stains removed
- Inaccessible parts like roofs, high walls must be swept out
- Outside the built-up area, sweeping and washing must be kept up regularly
- Toilets should be kept clean and well supplied.

4. SEIKETSU : Standardization

SEIKETSU means maintaining a high standard of workplace organisation and house keeping at all times

Consequences of not practising SEIKETSU:

- Bad health and no safety are the results of not practising SEIKETSU
- Hazardous chemicals, dusty chemicals, etc., can make it a dangerous place to work in, unless controlled
- Working thoroughly cleans a place and makes the workplace pleasant. So an unwashed work place can become unpleasant
- Personal hygiene is also essential for a healthy work place.

5. SHITSUKE : Discipline

- SHITSUKE denotes self-discipline, especially with regard to safety rules and punctuality
- 5S means everything in its place. People must also be in their place, at the right time. It is management responsibility to train people to practice 5S with discipline, to acquire the habit and to keep it.

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How to practice SHITSUKE?

- All employees must be trained in all aspects of 5S. This must be done through class-room, actual practice and also by well illustrated instructions and displays.
- Supervisors must correct wrong practices everyday, on the spot
- If all members of an office or workshop are not present when they are supposed to be, it is poor 5S. Punctuality is the backbone of 5S
- Timeliness also applies to preparation of reports, filling out the charts, etc

3 Factors in implementing 5S

The following factors are required for any organisation to implement 5S concept successfully

Participation by all: 5S programme should be understood and practiced by all employees. Linkage with productivity, quality, cost, delivery, safety and customer satisfaction should be clear to everyone.

Top management commitment: The CEO along with senior management team needs personally committed practice and supervise the programme. Without their deep commitment, no 5S can be successful

Should be self sustaining: Banners, slogan posters, should be fully utilised to draw attention of everyone in the company. Basic in-house training and introduction to model companies would provide them the necessary skills

Review the programme: Every month, a group of people selected from different areas of responsibility should tour the plant, evaluate each zone according to certain criteria of house keeping principles.

Benefits in implementing 5S

The benefits in implementing 5S are as follows:

- Work place becomes clean and better organized. It becomes proud place to work.
- Results in good company image and generates more business
- Shop floor and office operations become easier and safer
- People become disciplined
- Contribute to productivity, quality and employee morale
- Better quality awareness

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Limitations of 5S housekeeping

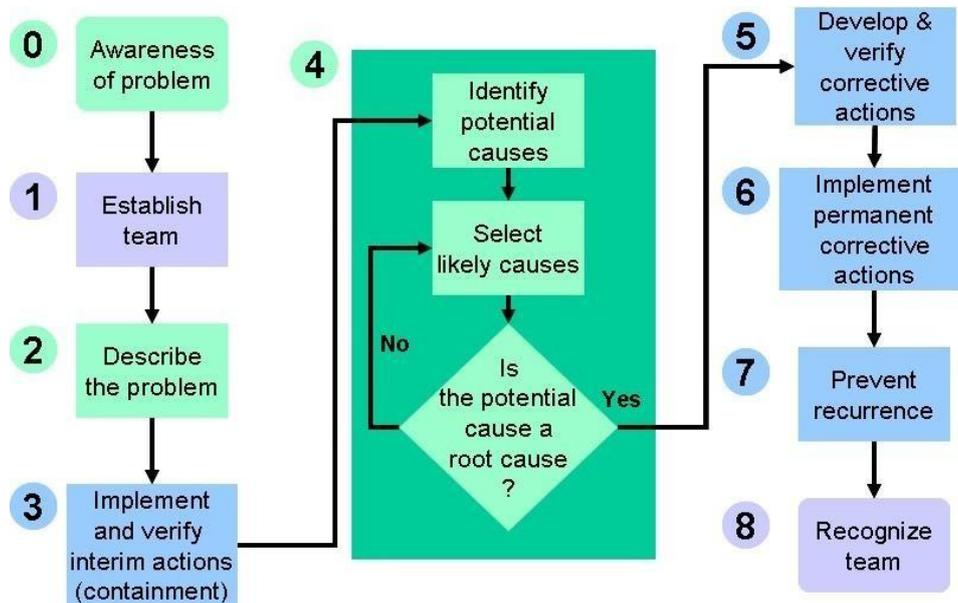
- People develop a comfort level for the way things are today, whether the methods are efficient or wasteful.
- Radically changing practices can be unsettling to people who live their lives within daily routines. People may resist giving-up their secret stashes of parts and tools.
- Cleaning – up a mess that took years to create takes time. An organization may need to clean-up the entire facility.
- The results of 5S fade away without management support to maintain the initiative.

8D methodology

- The Eight Disciplines (8D) comprise a method of resolving a problem when the cause of the problem is unknown
- The 8D methodology provides a framework to utilise the experience and expertise in an organisation to implement permanent solutions
- This problem solving methodology is powerful and can be easily applied to all levels of organisation and provide a documented history of improvements
- Nowadays, the 8D methodology is extensively used in manufacturing, service, and public sector.

Steps of 8-Disciplines problem solving methodology

- D1: Establish the team
- D2: Describe the problem
- D3: Implement and verify short-term corrective actions
- D4: Define and verify root causes
- D5: Verify corrective action
- D6: Implement permanent corrective actions
- D7: Prevent recurrence
- D8: Recognize team and individual contributions



D1: Establish the team:-

Establish a small group of people with the process/product knowledge, allocated time, authority, and skill in the required technical disciplines to solve the problem and implement corrective actions. The group must have a designated leader.

D2: Describe the problem:-

Describe the problem in measurable terms. Specify the internal or external customer problem by describing it in specific terms.

D3: Implement and verify short-term corrective actions:-

Define and implement those intermediate actions that will protect the customer from the problem until permanent corrective action is implemented. Verify with data the effectiveness of these actions.

D4: Define and verify root causes:-

Identify all potential causes which could explain why the problem occurred. Test each potential cause against the problem description and data. Identify alternative corrective actions to eliminate root cause

D5: Verify corrective actions:-

Confirm that the selected corrective actions will resolve the problem for the customer and will not cause undesirable side effects. Define other actions, if necessary, based on potential severity of problem.

D6: Implement corrective actions:-

Define and implement the permanent corrective actions needed. Choose ongoing controls to insure the root cause is eliminated. Once in production, monitor the long-term effects and implement additional controls are necessary.

D7: Prevent recurrence:-

Modify specifications; update training, practices, and procedures to prevent recurrence of these and any other similar problems

D8: Recognize team and individual contributions:-

Recognize the individual efforts and the collective efforts of the team and learn from what they did.

3. Benefits of 8D problem solving methodology

Some of the benefits of 8D problem solving methodology are given below:

- The 8D methodology provides systematic approach for analysing problems and identifying real root causes
- It enables effective containment actions and also implements permanent solutions to prevent recurrence of problem
- It emphasizes on teamwork
- It increases company competitiveness and customer satisfaction
- It helps to facilitate a timely resolution to the problem
- It provides a reporting format
- It establishes a standard practice.

Limitations of 8D methodology

- 8D training can be time consuming and difficult to develop.
- Requires training in the 8D problem-solving process as well as data collection and analysis tools such as Pareto diagrams, fishbone diagrams and flowcharts to name just a few.