UNIT 3 TOTAL QUALITY MANAGEMENT

Structure

3.0 OBJECTIVES

After studying this unit, we shall be able to:

- enumerate different aspects of Total Quality Management;
- state the need for Safety and Health Management;
- know the approach towards safety;
- understand the system approach to management of safety and health;
- understand the guiding principles of ISO 9000;
- general occupational health problems; and
- state how to control of health risks in industries.

3.1 INTRODUCTION

Total Quality Management (TQM) has become a buzzword in the business management field all over the world. Its philosophy and approach seem to have caught the imagination of organizational managers who find themselves in the midst of intense competition and are thus concerned with their survival. The concept, however, has not appeared overnight but has evolved over a period of time.

In this unit, we address ourselves to several issues related to the philosophy and approach of TQM. First, we attempt an answer to the basic question as to why there is a need for quality management, and why organisations all over the world find it essential to look to this approach as a panacea to their problems?

After getting convinced about the need for adopting a strategic approach in the form of TQM, we then proceed to understand the basic concepts on which the TQM approach is based. You will also learn the necessary vocabulary so that you can communicate in the language of TQM.

Equipped with this basic knowledge, we will finally discuss the important ingredients of the TQM philosophy, its approach and it's principles.

The significance of Safety and Health in business can be perceived from the following statement of Peter Drucker.

The first duty of business is to survive and the guiding principles of business economics is not the maximization of profits, it is the avoidance of loss.

Any accident can lead to the loss of three Ps i.e. People, Property and Process, which affect the bottom line of a business.

Safety and Health Management deals with the avoidance of such accidents and thus prevents occurrence of losses.

A systems approach to management of safety and health is very important for an organisation attempting to imbibe a TQM culture. You are all aware that the overall success of a business enterprise depends on:

- The people;

- The process; and
- The customers

A) **People:** TQM requires involvement of all the people in the organisation. The business activities are perceived, processed and delivered by the people. Commitment and contribution of people are achieved through various pro-active measures like empowering them, providing training to enhance their capabilities; and above all recognizing their excellent performance.

   Performance of the people can be achieved provided management takes care of their safety and health at the work place.

B) **Process:** The business inputs (raw materials) need to be processed to convert them into value added products. The conversion process may involve use of machinery and equipment. Safety, health and environment are therefore essential elements to be considered in order that the processes become effective and efficient. The processes directly affects the productivity of the organisation. Suppose there is an accident in a machine shop, the immediate effect will be loss of production due to downtime of the machine, operators' injury and curiosity amongst co-workers.

   Some chemical processes generate obnoxious fumes in the plant which are a health hazard. Unless the hazard is removed the people cannot work in the plant continuously. Productivity and quality will be affected.

C) **Customers:** In the present scenario, customers are becoming more and more aware about the safety and health problems regarding the products and services they buy from the suppliers. This is not only true for western customers but also for Indian customers as well. You will recall, recently a number of chemical industries like galvanizing plants have been ordered to be shifted out of the capital (Delhi) for health reasons.

The importance of safety and health in relation to TQM can be better understood by looking at Malcolm Baldrige Criteria (National Quality award of USA) for business excellence. One of the criteria of the Malcolm Baldrige award scheme is Employee well being and satisfaction. This requires examining how the company includes employees' well being factors such as health and safety into its quality improvement activities.

This requires us to understand how the company determines the root causes of employee accidents and work place hazards and how these hazards are eliminated.

We will study more in this unit about managing safety and quality in systematic way.

3.2 WHY QUALITY MANAGEMENT?

Total Quality Management (TQM) in its various forms appears to dominate business life now-a-days. In the earlier days, before the emergence of the industrial Revolution, quality did not pose any problem as the emphasis was on individual craftsmanship, workmanship and skills. The era of mass production initiated the industrial revolution and quality started getting attention, from then on, quality has been a problem addressed for a long time and has progressed from stages of playing a purely reactive role (inspection) to its present prominence in shaping the competitive strategy of business. Fig.3.1 depicts this evolution. The development of quality management through phases

involved the work of pioneers such as Juran, Feingenbaum, Deming, Crosby, Ishikawa and many others. The quality movement has thus progressed until the present day when quality has taken a central place in determining the organizational objectives and competitive positives.

It seems that, besides the Japanese, the rest of the world has suddenly woken up from a long sleep with eagerness and a sense of urgency to be updated on all the potential benefits of quality which is being adopted as a way of conducting business. Let us now look briefly at some of the important factors, which caused this realization. They are:

3.2.1 Question of Survival in an Intense Competitive Environment

The industrial development in any society/country takes place in phases. In the initial phase, subsequent to identifying a need, one or few suppliers emerge to provide the product/service to satisfy the need of customers. This near-monopoly situation dominated by the suppliers creates a seller's market enabling the suppliers to provide a product/service of the quality they are capable of providing without bothering whether their products satisfy the need or not. However, soon in the later phase, more and more suppliers looking for business opportunities emerge on the scene creating a buyer's market enabling the customers to choose a supplier. As you must have observed, over the last 10 years or so, phenomenal changes have taken place in the economic scenario all over the world. By now, we are sure, you are familiar with the terms "globalization" and "liberalization". Economic barriers, which existed in many world economies, have broken down and the whole world, economy-wise, has shrunk as one big market allowing almost free exchange of goods and services. Suppliers now not only face competition from domestic suppliers but also from the international ones. All the suppliers try their best to retain and possibly increase their market share. We are in the era of intense competition, and for suppliers all over the world it has become a question of survival. Just conforming to specifications and satisfying the needs of the customer is no more enough. The emphasis now is on delighting and winning over customers. The earlier concepts of quality management have been found inadequate to meet this objective, giving rise to the present concept of **Total Quality Management**.

3.2.2 Increasing Customer Consciousness

Customers all over the world are becoming increasingly conscious about getting more than just value for the money paid for products and services they buy. Backed by government laws and regulations, a number of agencies (governmental and non-governmental) have emerged which are working for protection of consumer's interests. The needs of the customers also keep on changing fast. Unless the suppliers are fast enough and are capable of satisfying the changed needs, they just lose the customers, ultimately resulting in a reduction in their market share.

3.2.3 Need for Earning Profit instead of Making Profit

All business organisations have to be profit-oriented as profits are essential for the very survival of the organisation and are also needed for its growth. In the earlier economic situation of seller's market, organisations used to make profit through the age-old equation of cost price (CP) + Profit (P) = Sales price (SP). The selling price used to be fixed in such a way that it automatically ensured making of as much profit

as desired by the supplier organisation. In the present prevailing competitive buyer-dominated situation, this equation is no more valid as the market forces now determine the selling price. Therefore, if the supplier organisation has to achieve the profit objective, it has now to earn profit by controlling the cost price. As you are aware, some of the major components which make up cost price are costs of material, energy and human resources. You are also aware how all the three costs keep on rising and the supplier organisation has no control on the cost of these inputs. So, for controlling the cost price, the only major way in the hands of the supplier is to reduce what is known as 'quality cost' i.e. cost incurred by an organisation for making nonconforming products from a big chunk of the total sales turnover – as much as 20 to 30 % as revealed by way of case studies. You will learn more about quality cost as you go along. To reduce the quality cost, the objective of the supplier should, therefore, be to make things right first time and every time – a TQM approach.

3.2.4 Organizational Issues Pointing to the need to Focus on TQM

- That Leadership plays a very crucial role in the total business performance of the organisation has now been realized. The quality of an organisation is largely influenced by the quality of its leader. And, therefore, it has to be a major ingredient of quality management.
- Human resource management is one issue that is receiving increasing attention in organisation all over the world. In fact, it has been a major factor for many Japanese organisations to become world leaders. Though not considered important enough earlier, it now forms another major component of quality management.
- The advent of revolution in information technology:

  This has an impact on the total quality performance of the organisation in following ways:

  i) It intensifies the need for everyone in the organisation to be computer literate.

  ii) The distribution of power relating to technical, problems solving, and decision-making abilities in the organisation through computer networks.

  iii) The speed, directness and immediacy of information exchange, both within the organisation at all levels and between organisations and key external stakeholders (suppliers and customers), is redefining business relationship and responsibilities.

If you appreciate the factors listed above, you will realize the inadequacy of the earlier static approach to quality management and the need for some dynamic approach. This is provided by what has come to be known as Total Quality Management approach (TQM). As per definition provided by the International Organisation for Standardization (ISO), TQM is a "management approach of an organisation, centered on quality, based on the participation of all its members and aiming at long-term success through customer satisfaction and benefits to all members of the organisation and to society".

Before we discuss and understand the philosophy and approach of TQM and its implications, let us get acquainted with some of the basic concepts on which TQM approach is based and clear understanding of basic concepts is very essential.

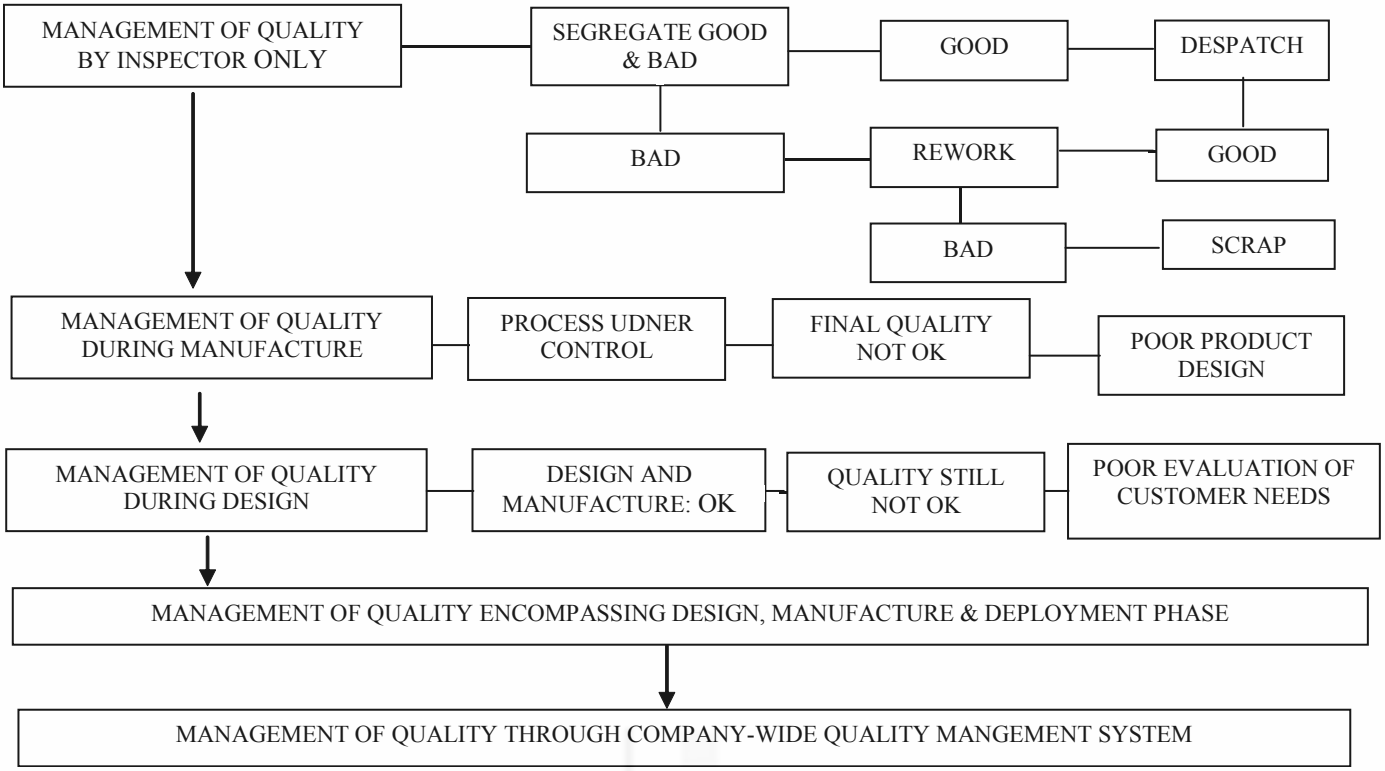

Fig. 3.1: Quality Management Concept

TQM is the application of quantitative methods and human resources to improve:

i) The material and services supplied,

ii) All the processes within the organisation, and

iii) Degree to which the needs of the customers are met

The TQM is a process and a journey and continuous; it is not a destination. It is a philosophy, culture and a way of doing business.

3.2.5 Basic Tenets of TQM

- Focus on customer satisfaction,
  - Internal customers
  - External customers
- Continuous improvements,
- Employee investment and empowerment,
- Measurement and documenting the work,
- Doing it right the first time,
- Effective communication, education and training,
- Leadership from top, and
- Providing everyone with the opportunity to do their job properly.

3.2.6 Benefits of TQM

- Improvements in leadership qualities and more visible leadership from executives and senior managers.
- Involving personnel in decision making process.

- Increased confidence of personnel in their ability to carry out their work and to achieve targets.
- Reduction of mistakes, increased pride in work, sense of achievement for workers.
- Opportunity for self-development and self-improvement of personnel through a pro-active involvement in work.
- Opportunity to engage in creative thinking to improve product quality and work environment.
- Increased co-operation, quality and work environment.
- Increased co-operation, improved teamwork and reduced conflict.

3.3 UNDERSTANDING SOME BASIC CONCEPTS

3.3.1 Definition of "Quality"

Quality of foods may be defined as the composite of those characteristics that differentiate individual units of product, these characteristics should have significance in determining the degree of acceptability of that unit by the buyer.

The word 'quality' is the most commonly used word by all of us. At the same time, it is one of the most difficult words to define properly. It is a perception of what you are looking for in a product or service and therefore varies from individual to individual. It is akin to another word 'beauty' about which it is said, "beauty lies in the beholder's eyes". In the context of quality management also, there are as many definitions of quality as there are books, authors and protagonists. Some of them, spelt out by very prominent Gurus and widely accepted, are as follows:

i) Quality is a predictable degree of uniformity and dependability, at low cost and suited to the market (Deming).

ii) Quality is fitness for use (Juran).

iii) Quality is conformance to requirements (Crosby).

iv) Quality is the (minimum) loss imparted by a product to society from the time of the product is shipped (Taguchi).

v) Quality is, in its essence, a way of managing the organisation (Feigenbaum).

vi) Quality is correcting and preventing loss, not living with loss (Hoshim).

Each of the above definitions (and several others by various authors) holds a strong but limited vision of quality. The universally accepted definition of 'quality', which is provided to us by ISO, is as follows:

Quality is the degree to which a set of inherent characteristics fulfils requirements **(ISO 9000:2005)**

This is sentence definition, though it appears simple enough, conveys a lot of meaning about requirements of quality. The second part of the sentence is crucial as it emphasizes the ability of the entity to satisfy stated and implied needs of a customer. An entity may be a process, a product or an organisation. Needs or requirements may be stated in the form of a specification by the customer or they may be unstated but implied either by convention, customers' expectations or by statutory requirements of society. The implied needs are expected to be identified by the supplier.

3.3.2 Definition of "Product"

It is important that we understand what the term 'product' in terms of quality management. A 'product' is the result of a process and includes service, hardware, software and processed materials. It can again be a tangible (e.g. assemblies or processed materials) or intangible (e.g knowledge or concepts) or a combination thereof.

3.3.3 Dimensions of Quality

Based on the stated and implied needs of the customer, the product to be provided by the supplier has to have certain characteristics and features and ultimately it is the customers who determine whether or not quality has been achieved. Standards have, therefore, to be established enabling the characteristics to be measured either by determinants or by subjective criteria or a combination of both. The various dimensions of quality, which the customers look for in a product in order to satisfy their needs, determine the characteristics of the product.

Dimensions of Quality

1) For Manufactured Product
   - **Performance:** Product's primary operating characteristics.
   - **Features:** Secondary characteristics that supplement the product's basic functioning.
   - **Reliability:** The probability of a product's surviving over a specified period of time under stated conditions of use.
   - **Conformity:** The degree to which physical and performance characteristics of a product match pre-established standards.
   - **Durability:** The amount of use one gets from a product before it physically deteriorates or until replacement is preferable.
   - **Serviceability:** The ability to repair a product quickly and easily.
   - **Aesthetics:** How a product looks, feels, tastes or smells.
   - **Perceived Quality:** Subjective assessment resulting image, advertising or brand name.
2) For a service
   - **Time:** How much time must a customer wait?
   - **Timeliness:** Will a service be performed when promised?
   - **Completeness:** Are all items in the order included?
   - **Courtesy:** Do front-line employees greet each customer cheerfully and politely?
   - **Consistency:** Are services delivered in the same fashion for every customer and every time for the same customer?
   - **Accessibility and Convenience:** Is the service easy to obtain?
   - **Accuracy:** Are the services performed right the first time?
   - **Responsiveness:** Can the service personnel react quickly and resolve unexpected problems?

3.3.4 Facets of Quality

For the supplier, the following are the four facets of quality, which cover most of the quality dimensions that are key contributors to product quality:

i) **Quality due to definition of needs for the product:** The first facet of quality is due to the extent and completeness of defining and updating the product needs to meet market places requirements and opportunities.

ii) **Quality due to product design:** The second facet of quality is due to designing into the product the characteristics (based on quality dimensions) that enable it to meet marketplace requirements and opportunities, and to provide value to customers and other stakeholders.

iii) **Quality due to conformity to product design:** The third facet of quality is due to maintaining day-to-day consistency in conforming to product design and in providing the designed characteristics and values for customers and other stakeholders.

iv) **Quality due to product support:** The fourth facet is quality due to furnishing product support throughout its life cycle, as needed, to provide the designed characteristics and values for customers and other stakeholders.

3.3.5 Concept of a Process and its Networking

In any organisation, all work is accomplished by a process. According to the definition provided by ISO "a process is a set of inter-related or interacting activities which transform inputs into outputs" (ISO 9000:2005). The resources may include personnel, finance, facilities equipment, techniques and methods. Every process, therefore, has to have inputs and, after value addition, results into outputs. The output of a process, for example, may be an invoice, computing software, liquid fuel, a clinical device, a banking service or an intermediate food product.

The absence of a clearly defined process makes the activity subject to an arbitrary mode of execution and its outcome or output subject to unpredictable performance. In order to "do it right the first time" and "do the right things right", processes must be effectively managed. When processes are not adequately managed, quality may regress to mediocrity.

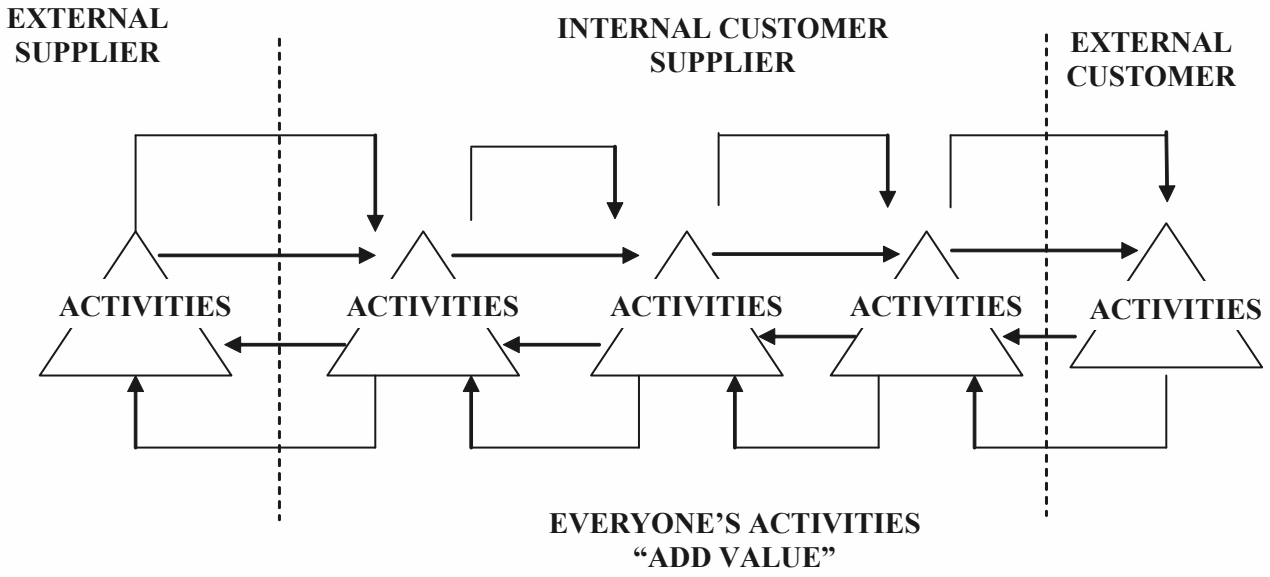

Fig. 3.2: Customer – Supplier chains and value additions

Every organisation exists to accomplish value-addition work. The work is accomplished through a network of processes and sub-processes. An external customer is affected by any one or more processes at any given time. Every process has internal customers (those who depend on it or affected by it) and internal suppliers (those who provide the necessary input for that process). Consequently, everyone in the organisation serves a customer or serves someone who is serving a customer. This supplier-customer chain is formed by all the processes/subprocesses and persons operating them right upto the time the external customer receives the product or/and service. The quality of the work of a person or a process, which servers as a link in the chain decides the quality of the product provided to the customer as per the saying "The strength of the chain is determined by its weakest link." Fig. 3.2 describes the value addition in the process network.

3.3.6 Stakeholders and their Expectations

Stakeholder(s) is an individual or group of individuals with a common interest in the performance of the supplier organisation and the environment in which it operates. Every organisation as a supplier has five principal groups of stakeholders. The supplier should meet the expectations and needs of all its stakeholders. See Table 3.1 for details.

Table 3.1: Stakeholders and their Expectation

	Suppliers Stakeholders	Typical Expectations or Needs
1.	Customers	Product quality
2.	Employees	Career/work satisfaction
3.	Owners	Investment performance
4.	Sub-suppliers	Continuing business opportunities
5.	Society	Responsible Stewardship

3.3.7 Quality Control and Quality Assurance

a) **Quality Control:** As per the definition provided by ISO **"**part of **quality management** focused on fulfilling quality requirements (ISO 9000:2005)". The activities and the techniques used, therefore, have the following objectives:

i) to ensure true expression/correct translation of stated and implied needs of the customer (both internal and external) in the form of standards specifying quantitative and qualitative measurable characteristics;

ii) to monitor the process for realization of the product at various stages of its operation and eliminating causes of unsatisfactory performance at all stages of quality loop in order to achieve economic effectiveness;

iii) inspection of the product/service package to determine conformance to customer needs;

iv) to provide a feedback of data for bringing about improvements wherever possible.

b) **Quality Assurance:** As per the definition provided by ISO, Quality assurance means "part of **quality management** focused on providing confidence that quality requirements will be fulfilled" ISO 9000:2005. In other words, it means all the planned and systematic activities, implemented within the organisation for

quality management, to provide adequate confidence that a product or service will satisfy given requirements for quality.

Essentially, quality assurance is a preventive activity and is, therefore, required to be systematically planned in advance. The activity includes identification and planning of the checks, inspection and control of process as a part of quality control. Quality assurance also means establishment of a quality system which can demonstrate. If required, the capability of the organisation to satisfy the requirements of the customer. Quality assurance provides confidence internally to the management and externally to the customer.

3.3.8 Standardisation

a) The concept and its evolution

The concept of standardization is as old as nature itself. In its broader sense, the standardization has furnished the base on which nature has created the universe. The various natural phenomena which furnished the base on which have been taking place for millions of years like the movements of planets, changing seasons on the earth, living beings reproducing themselves and maintaining their features, all reflect a definitive pattern of things.

Perhaps the most striking example of standardization in the early history of human civilization to establish language as a means of communication enabling the early humans to convey their thoughts, feelings and messages to each other. Another example of standards consciously and deliberately developed by the ancients is that of weights and measures which formed the basis of all measurements.

With the onset of industrial revolution caused by the concept of mass production, through interchangeability of parts, necessitated the development of modern standardization. By the time, the First World War broke out, standardization had been well recognized as an industrial process capable of ensuring productivity through interchangeability, not only within a given factory but also from one factory to another, and the importance of creating industry-wise standards and national standards slowly began to be realized. Where the experience of the First World War revealed the potentialities of standardisation, it was the Second World War, which brought even more pointed urgency for national and international standardization. The supply and maintenance facilities of the Allies were severely strained because of differences in standards, which prevented interchangeable use of tools and even of common engineering items like bolts, nuts and screws. Supply management during the War also re-emphasized the importance of standardization and reduction in variety of materials and products, and brought about evolution of many new techniques, including operational resource, value analysis linear programming, statistical quality control and so on. Another factor, which gave a spirit to the standardistion movement after the Second World War, was the creation of United Nations Standards Co-ordinating Committee for bringing together the existing national standards bodies into an international forum. Standardistion now is recognized as a vital ingredient of industrial efficiency and a pre-requisite for quality management systems. It is firmly believed that efficient and effective standardization techniques, correctly interpreted and properly applied in almost all functional areas of the organisation, form the essential requirement of successful quality management systems. Standardization and quality management go hand-in-hand.

b) Definition of Terms

Standardisation: According to the ISO definition "Standardisation is an activity of establishing, with regard to actual or potential problems, **provisions** for common and repeated use, aimed at the achievement of the optimum degree of order in a given context". ISO Guide 2:2004

Notes

i) The definition implies that the process is for both formulating the standard and its implementation.

ii) The emphasis is on cooperation of all concerned and on achieving consensus (agreement).

iii) The standardization process is dynamic as it keeps pace with progress.

iv) The process of standardistion, as the definition requires, is quite an involved process. It calls for pooling together of all knowledge, expertise and experience of all those who are concerned. The approach, therefore, involves setting up groups well represented by the major players in the activity like the supplier, the customer, the statutory authorities etc. The process tries to achieve maximum consensus through circulation of draft standards.

v) Some particular applications of standardisation are:

- Units of measurement
- Terminology and symbolic representations
- Products and Procedures
- Safety of person and goods

c) Standard

According to the ISO definition, "standard is a document, established by **consensus** and approved by a recognized **body**, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context" ISO Guide 2:2004. It may take the form of:

- a document containing a set of conditions to be fulfilled;
- a fundamental unit or physical constant (example : absolute zero); and
- an object for physical comparison (example : metre).

It may be noted that –

i) As the standard is the result of standardistion, it is established with the cooperation of all concerned.

ii) It is a living dynamic document liable to continual change through amendments/ revisions due to the following:

- Technology upgradation;
- Change in the needs of consumers;
- Improved methods of quality evaluation; and
- Change/upgradation of materials used.

iii) As a standard has to be approved by a recognized authority, following categories of standards are prevalent (See Fig. 3.3)

- International standard – Standard that is adopted by an international organisation. (example: ISO 9000 Standards)
- Regional Standard – Standard that is adopted by a regional organisation; (example: EN standard adopted by European Committee for Standardistion).
- National Standard – Standard adopted by a National Standards organisation; (example: Standard of Bureau of Indian Standards).
- Company Standard: Standard adopted by an organisation for its own use only.

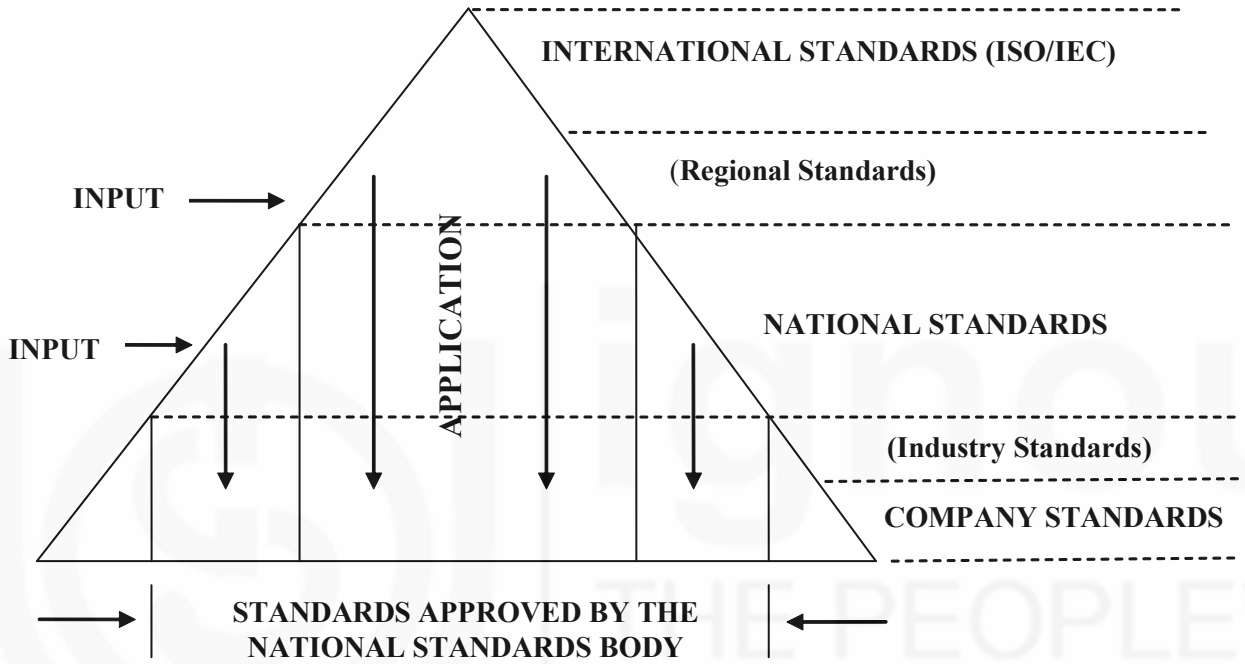

Fig. 3.3: Standards at various levels

*(**Source:** Institute of Standards Engineers, Mumbai, Monograph on Standardisation; 1986)*

iv) Depending on the contents of the document, a standard could be broadly categorized as follows:

- **Basic Standard:** Standard that has a wide-ranging coverage or contains general provisions for one particular field (example: IS 626 – Code for Engg. Drawings).
- **Terminology/Vocabulary Standard:** Standard that is concerned with terms, usually accompanied by their definitions and sometimes, by explanatory notes, illustrations, examples etc.
- **Testing Standard:** Standard that is concerned with test methods, sometimes supplemented with other provisions related to testing, such as sampling, use of statistical methods, sequence of test etc.
- **Product Standard:** Standard that specifies requirements to be fulfilled by a product or a group of products, to establish its fitness for purpose.
- **Process Standard:** Standard that specifies requirements to be fulfilled by a process, to establish fitness for purpose.
- **Service Standard:** Standard that specifies requirements to be fulfilled by a service to establish its fitness for purpose.

3.4 NEED FOR SAFETY AND HEALTH IN INDUSTRY

In the introduction we talked about the significance of safety and health in Total Quality Management. You may still be intrigued with the question "Why safety and health are so important?"

The answer is apparent from the following Fig. 3.4.

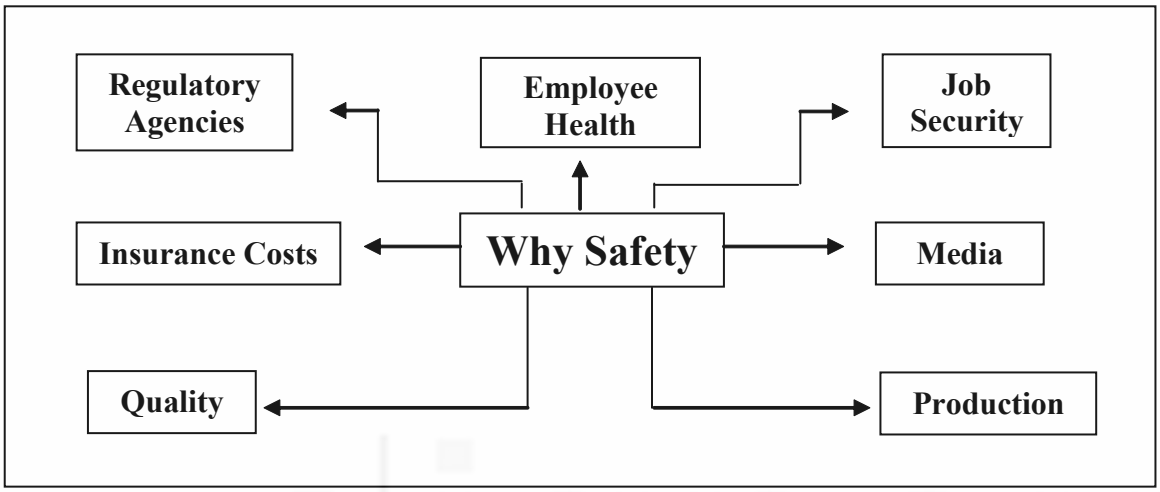

Fig. 3.4 : Why Safety

The first and foremost concern for safety is employee health. Good health is a pre-requisite for commitment to quality work and growth. We need to earn our livelihood on a continuous basis which again depends on maintenance of good health. *Job security* is influenced by ill-health, be it due to occupational hazards or otherwise. Efforts are required to maintain general health and keep off occupational hazards so that we do not fall ill and are thus unable to attend to our jobs. Poor performance on safety may lead to adverse opinion in the publicity. **"Media"** which ultimately may affect market share. Accidents sometimes cause downtime of machinery and loss of available man-days which in turn affect *production* and profitability of an organisation. Poor working conditions and unsafe acts are also the contributing factors for '*Poor Quality*'. Frequent accidents in an industrial plant lead to more spending on worker compensation. Insurance company may tend to increase the premium for such industries. Accidents/ fatalities also call for investigation by "*regulatory agencies*" like the police, factories inspector, Pollution Control Board representative etc. This causes avoidable wastage of man-hours. The urge to prevent loss of people, property and process leads to the implementation of Safety and Health Management in industry.

The losses due to accidents can be classified into the following two major categories of cost (examples are given):

Direct Cost

- Emergency medical care.
- Replacement / Repair of damaged equipment.
- Payment of compensation to the victims / their families.

Indirect Cost

- Loss of production.
- Loss of productivity due to follow-up care.

- Loss of productivity after resumption of work.
- Fellow workers assisting the injured colleague.
- Loss of productivity due to inspection / investigation.
- Fellow workers watching events and discussing accident, thus leading to loss of productivity.
- Cost of training the replacement worker.
- Supervisor's time spent in investigation and preparation of reports.
- Time spent with regulatory authorities.

All the above elements of cost influence the bottom line of business. More particularly accident-prone industries do not enjoy reputation as good employers and find it difficult to engage people.

All these factors make it a must to go in for proper management of safety and health.

Let us look at the following cases to appreciate the need for safety in industry.

i) Suppose in a building construction activity masons are to work at a height of 10ft from the ground. As an employer we should provide them with a safe place to work. This means we should make arrangement for proper acaffolding and a comfortable platform to work at that height. But these alone are not sufficient to prevent an accident due to a fall. In addition to this we have to force the contractor to provide necessary personal protective equipment (PPE) to the workers, like full body harness and tie it to a life line (firm support) so that the mason can be protected from a fall hazard.

ii) Let us consider two welders who are to work inside a confined space (closed tank). How do we ensure that they do not get harmed due to suffocation? This can be done by using an oxygen analyzer to establish the availability of oxygen inside the confined space. While welding is going on (inside), we should arrange for forced ventilation to ensure supply of oxygen. One person should be outside the confined space to be able to rescue the person working inside in case of an emergency.

Both the cases highlight examples of situations warranting safety.

3.5 THE APPROACH TOWARDS SAFETY

From the standpoint of safety management three distinct management styles can be observed (Pascal Dennis Quality, Safety and Environment – Synergy in the 21st century; ASQC Quality Press, Milwaukee, Wisconsin, pp-60 as follows:

SWAMP – Safety Without Any Management Process (16% of all companies).

NORM - The Naturally Occurring Reactive Management (77% of all companies). Also known as Reluctant Compliers.

World class – Leaders amongst industries where most are today (7% of all companies).

What differentiates the three types?

During the 70s a study was carried out by the National Institute of Occupational Safety and Health (NIOSH) of U.S.A to understand what made the difference in the three types of styles described above. It was found that the conventional safety practices

like establishment of a safety committee, adhering to safety rules, promotion of safety, accident investigation and reporting were present in all the companies of three different styles with little degree of variance. The factors responsible for improved safety performance were:

- Management commitment and ownership; and
- Planning, interpersonal relations and peoples involvement.

Thus the Core Management Group need to define the role of safety management. The approach to world class safety management style is possible if there is a sincere desire on the part of management, as expressed by W.E. deming:

Table 3.2: Analysis of Characteristics for the Three Types of Styles

Sl	Characteristic	The SWAMP Style	The NORMS Style	World Class
1.	Safety Responsibility	Not recognized or rejected	Not understood or defined	Line Management owned/ drive
2.	How it is perceived	As a burden	As a cost	Good business investment
3.	Management practices	• Accidents to happen • Autocratic style Safety next to production • Planning minimal, short time • Communication one way (down the line) • Solution-make do/ make fit approach • Minimal employee involvement • Adversarial climate	• Accident are excused away • Recognises problem (unwilling/unable to solve) • Willing to go half way • High visibility (many labels, little result) • Significant line/staff authority conflict • Programs/campaign short lived • "Line accountability" lacking	• Accidents are intolerable Safety is an element of management effectiveness • Responsibilies and expectations are clearly defined • Employees are empowered and rewarded • Communication informal, open • Efforts closely measured and responded to

"Management must feel pain and dissatisfaction with past performance and must have the courage to change. They must break out of line, even to the point of exile among their peers. There must be a burning desire to transform their style of management".

3.6 SAFETY MANAGEMENT

General concept

Management of safety depends heavily on the **root cause analysis**. You will remember the saying *Accidents do not happen,* ***they are caused.***

What causes an accident?

Predominantly, two factors either individually or in combination lead to an accident. They are:

i) Unsafe act, and

ii) Unsafe condition.

Unsafe act is attributable to an individual. This may be due to lack of understanding of the hazard facing the task being performed or the negligent act.

Unsafe condition like slippery floor, lack of ventilation, inadequate lighting may be the cause of an accident. Unsafe condition is attributable to management responsibility.

From the above discussion you will appreciate that management of safety involves a two-pronged approach, *viz*. prevention of the unsafe act and providing a safe work place (i.e. elimination of unsafe condition). This is the fundamental principle of any Safety Management.

As is evident from the above we must endeavour to identify the hazard/risk associated with the accomplishment of a task and then adopt suitable measures for corrective and preventative action through systems approach in the context of safety management.

Let us now see how this principle can be applied to practice.

3.6.1 Risk Assessment through Hazard Identification and Job Safety Analysis

In safety parlance very often we come across the term 'hazard' and 'risk'. It is necessary to clearly understand what these terms actually mean.

'Hazard" is something that has a potential for harm.

'Risk' is the likelihood of the harm happening, and the consequences in case it happens.

Approach

The assessment of risk is carried out through **Job Safety Analysis** (JSA). Safety implies freedom from risk, danger and harm. Job Safety Analysis therefore helps us to:

- Identify the risks/hazards,
- Protect from danger, and
- Eliminate the potential to harm.

The JSA approach, involves the following basic steps:

- Identification and selection of task.
- Breaking it down into steps.
- Identification of potential hazards.
- Assessment and elimination of risks.
- Recommendation of safe work procedure.

3.6.2 Selection of Task

From the safety point of view and for effective management of safety, each job needs to be analysed prior to its starting. The operators should be briefed about the risks involved in the performance of a job and the procedures and precautions to be followed for safe performance of the tasks. While more than one job needs to be analysed, the priorities can be decided based on the following criteria:

- High frequency of accidents or near misses.
- History of serious accidents or fatalities.

- Potential for serious harm.
- New jobs.

3.6.3 Breaking Down the Task into Various Steps

A complex task may involve various risks at different steps. A comprehensive study of the various steps is essential to evaluate the risks associated.

Job Safety Analysis starts with:

- A discussion of how the job is performed. Once the process familiarity is obtained, the job can be divided into steps.
- Watching out an operator performing the task completely.
- Noting down the crucial steps as the job progresses.

Now corresponding to each step we can identify the existing hazards. An example of steps involved in replacing of a flat tyre are identified in Box.

Identify Basis Job Steps: Replacing a Flat Tyre

While proceeding to your work, you discover that your car has a flat tyre. The car is parked on a level ground and the parking brake is already set. The bumper jack and the car tyre are both in good condition and kept in the car's trunk. The steps involved in replacing the flat tyre are:

1) Remove jack, spare tyre and lug wrench from trunk
2) Loosen lug nuts
3) Raise the jack
4) Remove flat tyre
5) Install spare tyre
6) Lower jack
7) Tighten lug nuts
8) Place flat tyre, jack and lug wrench in the trunk

The five major factors listed below will help ascertaining risks associated with any step:

a) Physical Actions
b) Materials
c) Equipment
d) Conditions
e) "What if" question

Identification of Hazards

The basis tool used to identify a hazard is through Inspection. Inspection provides a reliable way to identify and eliminate conditions that could lead to an accident, illness or environmental damage. In order to conduct an inspection it is important to know what is to be looked for in a specific area. A checklist of potential hazards is prepared to carry out the inspection.

Creating a checklist involves the following four steps:

i) Write down every potential hazard within the category that exists in your work area

ii) Check availability of written resources

iii) Examine the work area

iv) Have the employees review the list

The sources of information to develop a check list are:

- Job hazard analyses or process reviews
- Maintenance records
- Material safety data sheets (MSDS)
- Accident investigation reports
- Work environment studies

3.7 ASSESSMENT AND ELIMINATION OF RISKS

Once the hazards are identified it is an obvious expectation to have the risks eliminated from the job sites. Many times a situation encompasses a number and variety of risks.

The following techniques can be helpful in assessing the risk factor and in classifying the various hazards according to the seriousness of impact and priority for remedy.

Methodology

Complete the Risk Assessment format (as given in Fig.3.5) and proceed with the determination of risk factors as follows:

Job Site:
Date: Location :
Supervisor Responsible :
Contractor's Name :
Name of Safety Personnel :

Sl. No	Identification of Hazard	Severity Level			Likelihood of Occurrence			Population Affected			Risk Factor
		Low	Med	High	Low	Med	High	Low	Med	High	

Fig. 3.5: Risk Assessment

Severity level

Low = Effect of risk is minimum (not serious)

Med = Moderate effect tending to become serious

High = Dangerous to life

Likelihood of Occurrence

Low = Very less probability

Med = May take place often

High = Very frequent changes of happening

Population Affected

Low = Upto 5 persons

Med = 5 to 15 persons

High = More than 15 per persons

RISKS FACTOR = Severity Level × Likelihood of Occurrence × Population Affected.

Based on the assessment of **Risk Factors** we go on to tabulate the risks in order of their diminishing severity. This helps in developing a corrective action plan.

The format (Fig. 3.6) can be used for this purpose.

Sl. No	Risks in order of Severity Levels	Control Measures recommended	Remarks Action Taken/ Action by (Person & Date)

Fig. 3.6: Prioritization of risks to be Eliminated / Minimised

Recommendations of Safe Work Procedures

The final phase of Job Safety Analysis process involves recommending ways to control the hazards associated with each of the job steps. The following aspects shall be recognized while making recommendations:

- Recommendations should be developed at the job site whenever possible.
- Recommendations should be in sequence, beginning with the first hazard (so that not a single hazard is missed).
- Recommendations must be specific.
- As many solutions as are possible should be listed.

The preparation of recommendations needs expertise and knowledge on the part of the JSA team. However, the following documents may be helpful a great deal in formulating Corrective Action Plans/ Safe Work Procedures:

- Utilise company's Accident Prevention Manual while developing safety procedures on site.
- Refer to earlier recommendation validated with successful observations for a similar problem.
- Statutory regulations prevailing in the work areas.

Safety Task Assignment (STA)

Many a time recommendations indicate instruction/direction for Safety Task Assignment. This STA is not as formal as a JSA. The JSA involves:

a) Reviewing the safety issued of any new tasks;

b) Appraising the task performance about the risks involved in carrying out the task;

c) Procedures to be followed for performing the task; and

d) Personnel Protective Equipment to be used.

STA has the following advantages:

- It raises safety awareness within each crew and is a reminder that hazards to exist.
- Assigns each member of the team a safety responsibility
- Demonstrates management's commitment to safety

A typical JSA for changing a flat Tyre is given in Fig.3.7

JSA – Changing a Flat Tyre

Date: Job: Change Flat Tyre

Title of Person performing job Supervisor Analysis by:

Sl. No.	Sequence of Basic Job Step	Potential Accident or Hazards	Recommended Safe Procedures
1.	Remove jack, spare tyre and lug wrench	a) Lifting strain b) Trip hazard	a) Proper lifting technique b) Material out of working area
2.	Loosen lug nuts	a) Arm & wrist strains Pinch paints	a) Good body positioning b) Use gloves
3.	Jack up car	a) Car tripping b) Strains to back and lower body	a) Jack level & positioned properly b) Back Straight
4.	Remove lug nuts	a) Car tripping b) Strains to upper extremities	a) Remove under control b) Good body positioning
5.	Remove tyre	a) Car tripping b) Lower back strains	a) Remove under control b) Put back tyre with straight legs
6.	Replace tyre	a) Lower back strains b) Pinch paints c) Car tripping	a) Lift with legs & back b) Gloves c) Replace under control
7.	Tighten lug nuts	a) Arm & wrist pain b) Pinch paints	a) Use all of body b) Gloves
8.	Lower Car	Car Tripping	Lower Slowly

Fig. 3.7: A typical JSA for changing a flat tyre

Risk assessment is the first step in establishing a safety program to achieve the goal of safety excellence i.e. "Zero Accident"

Safety Implementation – The Systems Approach

Safety means freedom from risk, harm and danger. Implementation of a safety program helps us avoid unnecessary costs from any accident/injury and loss of production. Enlightened management sets a target of "zero" injury to attain excellence. This is a journey towards continuous performance improvement, an essential element of **Total Quality Management.**

Systems approach to safety management rests on :

i) setting targets / goals to be achieved during project execution;

ii) continuous monitoring of the goals to effect corrective action; and

iii) providing resources and training for successful implementation of the program.

The elements of a Safety Programme

The basic elements of a safety programme include the three :

- Engineering
- Education
- Enforcement

In the Engineering phase attention is given for the planning and development of an affective Safety Program. While developing the program emphasis is given to the particular type of industry and its associated hazards.

Hazard Identification and Job Safety Analysis (JSA) are important techniques involved in the development of a suitable safety plan.

Hazard identification involves a basic knowledge about the project activities and their potential hazards. Past experience, thorough inspection and checklists can be useful in the process of hazard identification.

Job safety analysis is a technique which involves a study of tasks to know their associated hazards and practical recommendations of provide for corrective actions. JSA involves the following five essential steps:

i) Selection of the task.

ii) Breaking down the task into component steps (sub-tasks).

iii) Identifying the hazards associated with each of the steps (sub-tasks).

iv) Assessment of Risk (quantification) for prioritization of the corrective action.

v) Providing recommendations for elimination of the hazards.

With the knowledge of the outcome of Job Safety Analysis a comprehensive Safety Plan is developed so as to attain the goal of Zero-Injury.

The Second phase of an effective Safety Program is the education of all the people (contractor's people included) as associated with the project execution. Like any weak unit of a chain the total strength make the Safety Program weak and thus may be susceptible to work related injuries/accidents. Education is therefore a very important aspect of a Safety Program. Education can be imparted through.

- Training and orientation programme.
- Display of poster/banners.
- Use of sign age's (cautionary, preventive, warning).
- Safety Task Assignments (STA).

Management System for TQM

Having developed a Safety program and having provided education to the employees, concerned, the next important activity that brings in success to the program is its' enforcement'. However good a Safety Plan is, or however excellent the education given to the workers, the ultimate result depends on enforcement.

Enforcement requires a strong will and determination on the part of management. Management commitment is expressed through safety promotional measures like.

- Reward for better safety performance.
- Safety Competition (slogan, cartoon, essay, etc).
- Operating safety related disciplinary programs, i.e. punishment commensurate with extent/ nature of safety violation.
- Carrying our Accident/ Incident investigation for ascertaining corrective and preventive actions.

3.8 STATISTICAL QUALITY CONTROL

The concept of TQM is basically very simple. Each part of the organisation has customers, some external and many internal. Identifying what the customer requirements are and setting about to meet them is the core of a total quality approach. This requires a good management system, methods including *statistical quality control* (SQC), and teamwork.

A well-operated, documented management system provides the necessary foundation for the successful application of SQC. Note, however, that SQC is not just a collection of techniques. It is strategy for reducing variability, the root cause of many quality problems. SQC refers to the use of statistical methods to improve or enhance quality for customer satisfaction. However, this task is seldom trivial because real world processes are affected by numerous uncontrolled factors. For instance, within every factory, conditions fluctuate with time. Variations occur in the incoming materials, in machine conditions, in the environment and in operator performance. A steel plant, for example, may purchase good quality ore from a mine, but the physical and chemical characteristics of ore coming from different locations in the mine may vary. Thus, everything isn't always "in control."

Many of these variations cannot be predicted with certainty, although sometimes it is possible to trace the unusual patterns of such variations to their root cause(s). If we have collected sufficient data from these variations, we can tell, in terms of probability, what is most likely to occur next if no action is taken. It we know what is likely to occur the next given certain conditions, we can take suitable actions to try to maintain or improve the acceptability of the output. This is the rationale of statistical quality control.

3.8.1 The Six Sigma Principle

The *six sigma* principle is Motorola's own rendering of what is known in the quality literature as the ***zero defects (ZD)*** program. Zero defects is a philosophical benchmark

or standard of excellence in quality proposed by Phillip Crosby. Crosby explained the mission and essence of ZD by the statement "What standard would you set on how many babies nurses are allowed to drop?" *ZD* is aimed at stimulating each employee to care about accuracy and completeness, to pay attention to detail, and to improve work habits. By adopting this mind-set, everyone assumes the responsibility toward reducing his or her own errors to zero.

For the typical Indian, a 10 hour train delay, an incorrect eye operation or drug administration, or no electricity or water half a day is no surprise; he/she routinely experiences even worse performance. Quantitatively, such performance is worse than two-sigma. Can this be called acceptable? One - or two-sigma performance is downright non-competitive.

Besides adopting TQM as the way to conduct business, many companies worldwide are now seriously looking at six-sigma benchmarks to assess where they stand. Six sigma not only reduces defects and raises customer acceptability, it has been now shown at Allied Signal Inc., Motorola, Raytheon, Bombardier Aerospace and Xerox that it can actually save money as well. Therefore, it is no surprise that Motorola aggressively set the following quality goal for itself in 1987 and then didn't want to stop till they achieved it.

Improved product and services quality ten times by 1989, and at least one hundred fold by 1991. Achieved six-sigma capability by 1992. With a deep sense of urgency, spread dedication to quality to every facet of the corporation, and achieve a culture of continual improvement to assure total customer satisfaction. There is only one goal: zero defect in everything we do.

3.8.2 The Steps to Six Sigma

The concept of six sigma quality is shrinking the inherent variation in a process to half of the spec range ($C_p = 2.0$) while allowing the mean to shift at most 1.5 sigma from the spec midpoint (the target quality) is explained by Fig. 3.8. The area under the shifted curves beyond the six sigma range (the tolerance limits) is only 0.0000034, or 3.4 parts per million. If the process mean can be controlled to within $\pm 1.5\ \sigma_x$ of the target, a maximum of 3.4 defects per million pieces produced can be expected. If the process mean is held exactly on target, only 2.0 defects per billion would be expected. This is why within its organisation Motorola defines six sigma as a state of the production or service unit that represents "almost perfect quality".

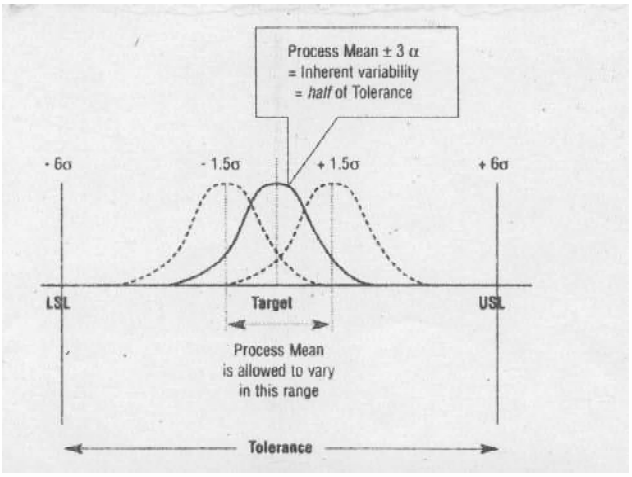

Fig. 3.8: The Six Sigma Process: USL = Mean + 3 sigma, LSL = Mean – 3 sigma

Motorola prescribes six steps to achieve the six-sigma state, as follows.

Step 1 : Identify the product you create or service you provide.

Step 2 : Identify the customer(s) for your product or service and determine what they consider important.

Step 3 : Identify your needs to provide the product or service that satisfies the customer.

Step 4 : Define the process for doing the work.

Step 5 : Mistake-proof the process and eliminate waste effort.

Step 6 : Ensure continuous improvement by measuring, analyzing and controlling the improved process.

Many companies have adopted the Measure-Analyze-Improve-Control cycle to step into six sigma. Typically they proceed as follows:

- Select critical-to-quality characteristics.
- Define performance standards (the targets to be achieved).
- Validate measurement systems (to ensure that the data is reliable).
- Establish Product Capability (how good are you now?).
- Define performance objectives.
- Identify sources of variation (seven tools etc.).
- Screen potential causes (correlation studies, etc.).
- Discover relationship between variables and causes or factors and the output (DOE).
- Establish operating tolerances for input factors and output variables.
- Validate the measurement system.
- Determine process capability (C_{pk}) (Can you deliver? What do you need to improve?).
- Implement process controls.

One must audit and review non-stop to ensure that one is moving along the charted path.

The aspect common between six sigma and ZD ("zero defects") is that both concepts require the maximum participation by the entire organisation. In other words, they require that unrelenting effort by management and the involvement of all employees. Companies such as General Motors have used a four-phase approach to seek six sigma:

1) **Measure:** Select critical quality characteristics through Pareto charts; determine the existing frequency of defects, define target performance standard, validate the measurements system and establish existing process capability.

2) **Analyze:** Understand when, where, and why defects occur by defining performance objectives and sources of variation.

3) **Improve:** Identify potential causes, discover cause-effect relationships, and establish operating tolerances.

4) **Control:** Maintain improvements by validating the measurement system, determining process capability and implementing process control system.

It is reported that in General Motors a new culture has been created. An individual or team devotes all its time and energy to solving one problem at a time, designs solutions with customers' assistance, and helps to minimize bureaucracy in supporting the six-sigma initiative.

3.8.3 Beyond TQM

The Japanese have recently evolved the "Bluebird Plan", which is a "third option" beyond SPC and TQM designed to achieve the four objectives of business excellence. These objectives include establishing corporate ethics, maintaining and boosting international competitiveness, ensuring stable employment and improving national quality of life.

The Bluebird Plan provides a forum for government, labour and management to discuss the actions which need to be taken. In Japan, the plan set out an action program for reform for the three years 1997-1999 which was noted to be a critical time that would determine the direction of Japan's future. Striking about the plan is the employers' acceptance that the relationship between labour and management is an imperative "stabilizing force in society". Thus it reaches beyond the tenets of TQM.

3.9 GENERAL OCCUPATIONAL HEALTH PROBLEMS

Industry contributes not only to physical hazards to workers like unguarded machines, poor housekeeping, falling of objects, flying particles which may cause injury. But certain processes, environment of conditions may affect the workers health as well. Let us have a look at what these hazards could be in relation to public health in general.

3.9.1 Public Health (General)

Some hazards encountered are discussed below:

1) **Tobacco:** It is widely used by workers. The forms include smoking, chewing, snuffing. This may cause lung and oral cancer, lung ailments etc.

2) **Drinking water:** The main source of water for industry is from river or from the ground. Leather industries and chemical industries let their effluent flow into a river or be absorbed in the ground thus polluting the soil and water (causing water pollution and soil pollution). The polluted water may cause lot of health problems like jaundice, liver and kidney failure, gastro-enteritis.

3) **Cancer:** Workers in chemical industries are exposed to chemicals like benzene, asbestos, nitrogen oxides, polyvinyl chlorides etc. These chemicals classified as carcinogens may cause cancer to the workers.

4) **Radiation:** Workers engaged in X-ray units and mines which contain radioactive materials may be affected due to radiation. This may cause cancer to the public.

5) **Drug abuse and alcoholism:** Drugs and alcoholism are very common public health hazards. They impair the sensory organs and due to inadequate judgment of the workers may cause accident.

6) **Unhygienic food:** Inadvertently supplied through canteen in the industry may cause diarrhoea, typhoid food poisoning, hepatitis etc. to the workers.

3.9.2 Cause of Health Hazards (Particular to Industry)

The general occupation health hazards may be due to:

(i) Heat (ii) Cold (iii) Light (iv) Noise (v) Chemicals (vii) Occupational Diseases.

i) **Heat:** Most of India is in the equator region and it is hot in summer months. Unlike western countries the employees get exhausted due to heat. Heat stroke is a common feature due to exhaustion during summer.

ii) **Cold:** Due to cold during winter the fingers may lose their sensation which may cause finger injuries. Loose items like mufflers/scarves may get entangled into running machines and cause injuries.

iii) **Light:** Adequate light is to be arranged in the work place. Vision is disturbed due to inadequate lighting, leading to the possibility of an accident.

iv) **Noise:** This creates a stressful situation, causing irritation, loss of hearing, rise in the blood pressure and increase in the heart beat.

v) **Radiation:** Workers engaged in NDT operation, X-ray laboratories and in atomic power industries are vulnerable to radiation which may cause cancer in the long run.

vi) **Chemicals:** Silica dust can enter the lungs and may cause silicosis. Asbestos may cause asbestosis. These are all lung ailments. Dye stuffs are used in dye industries mixed with water, any person drinking such water may suffer from liver/kidney disorders in course of time. Chemicals such as acids and corrosive alkalis may cause burns if they fall on the skin.

In the construction industry, metal surface finishing work is done by sand blasting. This is due course of time causes silicosis. Chemicals such as paints, thinners, binders, fasteners may cause many health hazards to workers.

3.9.3 Control of Health Risk

Health risk may be controlled through the following measures:

i) **Engineering measures:** By devising good and safe engineering processes the risk to the health of workers can be reduced.

ii) **Legal Measures:** Government by notification asks the employers / industries to modify the process or control the hazard.

iii) **Medical Measures:** Medical measures include:

   a) **Medical Examinations:** All workers in the industry to be screened for occupational diseases.

   b) **Periodical Examination:** All workers working in highly hazardous chemicals must be periodically examined.

   c) **Health Care:** Health care to all employees be provided in chemical industry.

   d) **Health Education:** Workers should be educated for good and hygienic way of living.

e) **Records:** Records of all medical examination to be kept and maintained for review and prevention.

3.9.4 Maintaining of Healthy Environment

Managing a healthy environment involves the following activities:

i) Pre-employment medical examination

ii) Continuous education on health and hygiene

iii) Periodical inspection of the site

iv) Provision of proper personal protection equipment provided to employees

v) A good medical / clinic facility

3.9.5 Substance Abuse Prevention (Screening for Alcohol and Drugs)

Alcohol and drug use by workers may:

i) increase the accident rate;

ii) increase the medical expenses;

iii) increase absenteeism; and

iv) cause absenteeism and reduce the income to the family.

As per the Factories Act possession and use of alcohol and narcotics is not permitted inside the work premises.

Alcoholism and drugs abuse by workers can be dealt with by:

i) counselling to workers;

ii) strict vigil at workplace;

iii) surprise inspection at work place;

iv) medical test; and

v) termination from service (disciplinary action).

Personal Protection

Elimination of unsafe conditions should be the first priority. For additional protection to individuals, Personal Protection Equipment (PPE) should be provided. Depending on the nature of the job the PPE has to be selected and given.

3.9.6 Why is the PPE needed?

Statistics on accident investigation reveal that 60% of workers at the site sustaining head injuries do not wear helmets, and nearly 99% of workers suffering face injuries do not wear face protection. 77% of workers suffering from foot injuries do not wear safety shoes, and 60% of workers with eye injuries do not wear eye protection.

3.10 SAFETY AND HEALTH MANAGEMENT SYSTEM

You are all aware of the international system of Quality Management covered under the ISO 9000 series of standards. The International Organisation for Standardisation attempts to ensure consistency in the management approach. Though ISO 9000 Quality

System Standards are quite common in almost all countries, the safety system standardization is not yet complete. Efforts are on to develop an international standard for safety management (ISO 18000 series). At the moment various countries have their own practices of safety management based on their local legislation.

The most important of these legislation are:

i) OSHA (Occupation Safety and Health Administration) standards followed in the USA.

ii) HASAWA 74 (Health and Safety and Work Act) in UK.

iii) In India we have

- The Factories Act
- The Workmen Compensation Act
- The Indian Electricity Rules
- The Gas Cylinder Rules

and many more depending upon the nature of job.

The salient features of the above legislations are dealt with in Appendix 1.

3.11 CASE STUDIES

The following case studies illustrate the occurrence of accidents and remedial measured adopted to prevent their recurrence.

Case Study 1

3.11.1 Description of the Accident (Case Study 1)

Rahul was a worker associated with M/s XYZ construction company engaged in the civil works for a building project. He was doing chipping work on the concrete slabs. He was provided with a safety glass for eye protection and was wearing it in the morning. He wanted to finish his work quickly after lunch. He, therefore, finished his lunch early and started his work keeping his safety glass aside. All on a sudden a tiny piece hit his left eye. The piece directly hit the pupil and tore it. As it was lunch time the supervisor and safety steward both had gone for lunch and were not available at the spot.

The accident was immediately reported to the Safety supervisor by Rahul's colleague. The Safety Supervisor swung into action and the worker was taken to the First Aid centre. He was given first aid and thereafter he was referred to an eye hospital for surgery. In spite of timely and best treatment given, his left eye could not be saved. He lost his left eye sight.

a) Accident investigation

As per company's Safety manual the investigation was carried out by a team consisting of

- Safety Manager,
- Construction Supervisor, and
- Site In-charge (Contractors).

The following facts were observed during investigation by the team:

– The accident happened during lunch time.

– The same worker was wearing the safety glasses in the morning but not during the post lunch session.

– The supervisor and the safety steward were not present during the accident.

– The supervisor and safety steward had gone for lunch when the accident took place and were not available at site.

– The worker wanted to finish the work quickly.

– He was chipping the slab during lunch break without wearing the safety glass.

– There was no safety coverage during lunch time.

b) Root Cause of the Accident

The worker did the chipping work during the lunch break without wearing the safety glasses (Non adherence to safety procedure and an unsafe act)

c) Observations related to Safety Management at site prior to the Accident

– The particular contractor's worker were instructed about the safety requirements.

– All workers were given safety orientation.

– One trained supervisor was arranged at the work site.

– One safety steward was arranged by the contractor to look after safety implementation.

– Toolbox talks were conducted regularly.

– All tools and equipment were inspected periodically.

– Safety Incentives were given to the workers to adhere to safety procedures.

d) Corrective Action taken after the accident

– The contractor was called for a meeting to review the adequacy of the safety procedure.

– Training classes were organized for all the employees involved in this job and they were briefed as to what happened to their co-worker and why it happened to him and how to avoid such incidents in future.

– Special training was given to the supervisor and to the safety steward.

– The subject was discussed in the safety committee monthly meeting and superintendent's meeting.

e) Lesson learned

i) Management and control of work need better attention for safety of workers.

ii) Adherence to basic safety practices is must.

iii) Creating awareness on the part of workers through proper orientation and training is very important.

iv) Proper follow up is required for effective implementation of safety culture.

3.11.2 Description of the Accident (Case Study 2)

This accident happened at a site around Delhi on 25th January, 97 and this was a last time accident. Many female workers were engaged on the site to carry soil from one place to another with the head pan. There was a 2.5 feet wide × 3 feet deep trench excavated to lay down drain pipes. There was a crossover and mostly all of the workers were using the crossover to move from one side to the other. Some of the workers used to cross the trench by jumping from one side to the other. Ganga Devi (a worker engaged by M/s AZ Construction Co.) also wanted to jump across the trench. While jumping across the trench, she was unable to stretch her leg as she was wearing a saree, and fell into the trench and fractured her right forearm.

She was taken out of the trench and her hand was tied and kept straight with the help of a piece of wood and towel. She was taken to the site clinic for first aid and then referred to the hospital for further treatment.

a) Accident investigation

As per company's standard procedure the investigation was carried out by a team consisting of the:

- Safety Manager,
- Construction Superintendent, and
- Contractor's Site Manager.

The following facts were observed during investigation by the team:

- The accident happened in the morning around 9 a.m.
- There was a crossover on the trench.
- Some workers did not use the crossover. Instead they jumped to cross the trench.
- Ganga Devi tried to jump the trench and accidentally fell into it.
- She was unable to stretch her legs as she was wearing a saree.
- The supervisor in-charge was on the rounds there and he was informed about the accident. He informed the safety person on the site who immediately arranged for an ambulance to carry the person to the site clinic.
- She was given first aid in the clinic and then taken to the hospital for further treatment.
- In the hospital after preliminary investigation it was decided to perform an operation.
- She underwent an operation in the hospital and was in the hospital for approximately 23 days before being released.

b) Root Cause of the accident

- The female worker did not use the crossover. (did not follow the safety procedure, i.e. indulged in an unsafe act)
- She jumped the trench out of curiosity and her saree was an obstacle which did not allow her to stretch her legs.

c) Observations related to safety management at site prior to the accident

– The particular contractor was briefed about the safety requirements.

– All workers were not given safety orientation.

– One supervisor was arranged at the work site.

– One safety steward was arranged by the contractor to look after safety implementation.

– Toolbox talks were not conducted regularly.

d) Corrective Action taken after the accident

– The contractor was called for a meeting and it was insisted that strict safety procedures be implemented.

– Training classes were organized for all the employees and they were educated about the importance of safety. This accident victim was mentioned as an example to explain why it had happened to her, and how such incidents in future could be avoided.

– The contractor's safety officer and the supervisor were asked to conduct tool box meetings regularly.

– Since the severity of the accident was more the matter was discussed with the top executive of the contractor, in the safety committee meeting and in the superintendent's meeting to ensure better safety implementation.

e) Lesson learned

i) Contractors' half-hearted approach towards implementation of safety is apparent from the fact that orientation was not given to all workers and toolbox talks were not held regularly.

ii) Safety rules are required to be followed 24 hours a day, 7 days a week and 365 days a year.

Check Your Progress Exercise 1

Note: a) Use the space below for your answers.

b) Compare your answers with those given at the end of the unit.

1) What is Total Quality Management (TQM)?

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2) List the benefits of TQM?

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3) Define food quality?

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4) Why is quality and safety management needed in industries?

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3.12 LET US SUM UP

The Total Quality Management ensured avoidance of accidents in industries. It also improves the bottom line by reducing direct and indirect costs of accidents. The three distinctive management styles can be observed in regard to how safety is managed, *viz.* Safety Without Any Management Process, (SWAMP), Naturally Occurring Reactive Management (NORM), and World Class Management (WCM).

Implicit in the Quality Management is the belief that "accidents do not happen, they are caused". Accidents are caused by unsafe acts attributable to people and unsafe conditions attributable to management. The management of safety and quality therefore lies in the prevention of unsafe acts and in the provision of safe working conditions. This is the fundamental principle of safety and quality management.

To identify the risk involved, a powerful tool called Job Hazard Analysis or Job Safety Analysis (JSA) is used. This helps in unearthing the root causes. Necessary action can then be taken.

The three basic elements are vital parts of a good safety management. They are (i) good engineering standards, (ii) education, and (iii) enforcement. Based on these three elements safety is implemented in five steps.

Industries contribute to physical hazards and health problems. The nature of such problems depends upon the occupation, duration of work and hazards involved. The health problems in industries may be caused by the use of tobacco, carcinogens, heat, cold, light, noise, radiation, chemicals and substance abuse.

Personal protection is the last act to protect a worker (when all other control measures cannot ensure safety of a person at work). The right personal protection and standard equipment is to be selected and provided.

The important questions in safety management relate to finding the root cause of the safety/health problems, ways of correcting it and how we can save workers from health/physical hazards.

3.13 KEY WORDS

Job Safety Analysis (JSA)	:	A tool to assess the various types of risks associated with a job.
Norm	:	Naturally Occurring Reactive Management.
Safety	:	Freedom from risk, harm and danger.
Safety Task Assignment (STA)	:	Instructions related to the hazards minimization/ elimination involved in a job, e.g. the procedures to be followed and Personal Protective Equipment (PPE) to be used to perform the job safely.
SWAMP	:	Safety Without Any Management Process.
Standardization	:	Activity of establishing, with regard to actual or potential problems, provisions for common and repeated use, aimed at the achievement of the optimum degree of order in a given context

3.14 ANSWERS TO CHECK YOUR PROGRESS EXERCISE

Your answer should include the following points:

Check Your Progress Exercise 1

1) i) Characteristics differentiating individual units.

   ii) Degree of acceptability.

2) • Improvements in leadership qualities and more visible leadership from executives and senior managers.
   • Involving personnel in decision making process.
   • Increased confidence of personnel in their ability to carry out their work and to achieve targets.
   • Reduction of mistakes, increased pride in work, sense of achievement for workers.
   • Opportunity for self-development and self-improvement of personnel through a pro-active involvement in work.
   • Opportunity to engage in creative thinking to improve product quality and work environment.
   • Increased co-operation, quality and work environment.
   • Increased co-operation, improved teamwork and reduced conflict.

3) Quality of foods may be defined as the composite of those characteristics that differentiate individual units of product, these characteristics should have significance in determining the degree of acceptability of that unit by the buyer.

4) The first and foremost concern for safety is employee health. Good health is a pre-requisite for commitment to quality work and growth. We need to earn our livelihood on a continuous basis which again depends on maintenance of good health. *Job security* is influenced by ill-health, be it due to occupational hazards

or otherwise. Efforts are required to maintain general health and keep off occupational hazards so that we do not fall ill and are thus unable to attend to our jobs. Poor performance on safety may lead to adverse opinion in the publicity **"Media"** which ultimately may affect market share. Accidents sometimes cause downtime of machinery and loss of available man-days which in turn affect *production* and profitability of an organisation. Poor working conditions and unsafe acts are also the contributing factors for '*Poor Quality*' Frequent accidents in an industrial plant lead to more spending on worker compensation. Insurance company may tend to increase the premium for such industries. Accidents/fatalities also call for investigation by "*regulatory agencies*" like the police, factories inspector, Pollution Control Board representative etc. This causes avoidable wastage of man-hours. The urge to prevent loss of people, property and process leads to the implementation of Safety and Health Management in industry.

3.15 SUGGESTED READING

ISO 9001:2008 *Quality Managements Systems – Requirements,* International Organization for Stndardization ,Geneva.

Pascal Dennis; *Quality, Safety and Environment* – **Synergy in the 21st Century**, ASQC Quality Press, Milwaukee, Wisconsin, 1997.

Rao Killuru, Steven Barteu, Robin Pritblado, Scott stricoff; *Risk Assessment and Management Handbook for Environmental, Health and Safety Professionals*, McGraw Hill, 1996.

Features of Legislative Provision of Different Countries

A) Osha Standards – General Duty Safety Clause

Section 5 (a) requires each Employer:

i) Shall furnish to each of their employees – a place of employment which is free from recognized hazards that are causing or are likely to cause serious physical harm to their employees.

ii) Shall comply with occupational health standards promulgated under this act. Section : 5 (b) (1) requires each employee:

iii) Shall comply with Occupational Safety and Health Standards and all rules, regulations, and order issued pursuant to this Act which are applicable to their own actions or conduct.

For detailed requirements of various Occupational Safety aspects one may refer to (the "OSHA" standards).

B) Health and Safety at Work Act '74 (Haswa '74) – applicable in UK74

The purpose of this act is to provide the legislative framework to *promote, stimulate and encourage* high standards for Health and Safety at work.

The aim of the act is create safety awareness and provide the effective safety organisation and performance

The act is an enabling measure which replaces the existing HSE (Health and Safety Executive) Legislation.

The Act consists of four parts detailing out the various provisions as noted below.

Part I – Relating to Health, Safety and Welfare of employees at work place;

Part II – The employees Medical Advisory Service;

Part III – Amendments to Building Regulations; and

Part IV – To control emission of obnoxious gases or offensive substances to the atmosphere.

In addition, the HSE (Health and Safety Executive) Regulations, known as Six Pack Regulation guide the Safety and Health Management System in UK. These regulations include:

– Management of Health and Safety at Work Regulations.

– Work place Health and Safety Regulations.

– Provision and use of work regulations.

– Personnel Protective Equipment at work regulation.

– Manual Handling Operation regulations.

– Display Screen Equipment regulations.

C) The Position of India

i) The Factories Act, 1948

These Act forms the basis of the Safety & Health Management System required to be developed for industries.

In general safety aspects, specific to industries or usage of various materials are separately covered under diversified acts like:

– The Petroleum Act
– The Gas Cylinder Rules
– Indian Boiler Regulations
– Indian Electricity Act
– Indian Electricity Rules, etc.

The Factories Act specifies the general duties of the occupier (means the person who has ultimate control over the affairs of the factory) as:

1) Every occupier shall ensure, so far as is reasonably practicable, the health, safety and welfare of all workers while they are at work in the factory.

2) Without prejudice to the generality of the provisions of Sub-section (1) the matters to which such duty extends shall include:

   a) The provisions and maintenance of the plant and system of work in the factory that are safe and without risk to health;

   b) The arrangements in the factory for ensuring safety and absence of risks to health in connection with the use, handling, storage and transport of articles and substances;

   c) The provisions of such information, instructions, training and supervisions as are necessary to ensure the health and safety of all workers at work;

   d) The maintenance of all places of work in the factory, in a condition that is safe and without risk to the health and the provisions and maintenance of such means of access to, and egress from, such places as are safe and without such risks; and

   e) The provisions, maintenance and monitoring of such working environment in the factory for the workers, that is safe, without risk to health and adequate as regards facilities and arrangements for their welfare at work.

3) Except in such cases as may be prescribed, every occupier shall prepare, and, as often as may be appropriate, revise, a written statement of the general policy with respect to the health and safety of the workers at work and the organisations and arrangements for the time being in force for carrying out that policy, and to bring the statement and any revision thereof to the notice of all workers in such manner as may be prescribed."

The Factories Act has three major sections *viz.* Health, Safety and Welfare

Some of the important features described about Health are:

- Every factory shall be kept **clean** and free from effluvia arising from any drain and effective arrangements shall be made in every factory for the treatment of waste and effluents.

- Effective and suitable provision shall be made in every factory for securing and maintaining in every work room:

a) **Adequate ventilation** by circulation of fresh air.

b) Such a **temperature** as will secure to workers therein reasonable condition of comfort and prevent injury to health.

- In manufacturing processes where **dust or fume** or other impurity of such a nature and extent is given off, as is likely to be injurious to workers, effective measures shall be taken regarding its inhalation, and accumulation in any work room.
- In every part of a factory where workers are working or passing there shall be provided and maintained sufficient and suitable **lighting, natural** or **artificial** or **both**.
- In every factory effective arrangements shall be made to provide a sufficient supply of wholesome **drinking water** at suitable points conveniently situated for all workers.
- In every factory sufficient latrine and urinal accommodation of prescribed types shall be provided conveniently situated and accessible to workers at all times while they are at the factory.

The important features described about safety are:

- Every part of an electric generator, a motor or a rotary converter, transmission machinery and dangerous parts of any machinery shall be securely fenced by safeguards of a substantial construction (which shall be constantly maintained and kept in position) while the part of the machinery they are fencing in motion or in use.
- Women or young person shall not be allowed to clean, lubricate or adjust any part of a prime mover or of any transmission machinery while the prime mover or transmission machinery is in motion.
- Safety from – hoists and lifts:
  a) every hoist and lift shall be –
     i) of good mechanical construction, sound material and adequate strength; and
     ii) properly maintained, and shall be thoroughly examined by a competent person at least once in every six months, and a register shall be kept containing the prescribed particulars of every such examination.
- In every factory all floors, steps, stairs, passages and gangways shall be of sound construction, properly maintained and kept free from obstruction and substance likely to cause a person to slip, and where it is necessary to ensure safety, steps, stairs, passages and gangways shall be provided with substantial handrails.
- Every vessel, pump, tank, pit or opening in floor shall be securely covered or securely fenced.
- No person shall be employed in any factory to lift, carry or move any load so heavy as to be likely to cause him injury.
- In any manufacturing process which involves risk of injury to eyes, effective screen or suitable goggles shall be provided for protection.

- While working inside a chamber, tanks, vat, pipe, or other confined space, voltage of any electric lamp or other electric appliance, should not exceed twenty-four volts.
- All practicable measures shall be taken to prevent fire and to provide the necessary equipment for extinguishing fire.
- If a factory employs one thousand or more workers, if any risk injury or hazard to health is involved, the occupier shall, employ safety officers as applicable as per govt. notification.

For further details regarding legal requirements of Health and Safety you may please refer to the Acts/Regulation as applicable.