INTERIOR DESIGN PRACTICE

AND

OFFICE MANAGEMENT - II

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2 .1 MEASURES

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We define objects and happenings primarily with measures. **Measures** define things in terms of lengths, areas, volumes or weights. Other perceptual aspects are also scaled through measures. Measures when combined with **Time** show the changes that occur in things. We measure events or happenings, for their start, the rate at which these actualize, duration and termination. Measures are very important in **recording and recreating objects and happenings**.

> Measurement is finding size or amount of some quantity, and expressing it as a number of defined units. All measurements are based on comparisons. A thing to be measured is compared with something similar, or with a thing that has already been calibrated -measured against a known reference.

Measures are **comparative facts**. There was a time, when things were measured in terms of **body sizes and body's capacities**. Long **Distances** were measured for the travel time required, like in lunch breaks or night halts. Short distances or **Lengths** were measured in arm lengths or foot steps. Smaller sizes were measured with the palm, length of a finger or width of a thumb. Finer widths were measured in terms barley grain. **Volumes** were measured as the holding capacity of limbs like pinch or palm. **Weight**s were measured in terms of carrying or displacement capacity of a person or animal, such as head load, cart loads, horsepower.

Measures based on body sizes or capacities have many **racial and regional variations**. It is possible to equate out such differences in a barter trade between neighbours. But, the same proved to be very difficult for trade with far-off regions. Intermediaries like, brokers, caravan masters and shippers facilitated trade with other regions and also made large profits through **Conversion of measures**. This required some common measure system. The inconsistencies of the measure conversions were solved partly, when **monetary pricing** replaced the bartered trading. Trading blocks had to concur to a common set of **Nominal measurements**.

All measure systems such as weights, lengths, volumes were **mutually incompatible**, as each had a different scale of sub fractioning. The problem multiplied when equated with equally **varied units and sub fractions** of monetary units. This was sought to be solved during the French Revolution.

> Over a period of time many units for measuring length came into practice in different societies. Lengths were measured in Angula, Danda, Goruta or Korsa, Dhanush, Inches, Cubit, Digit, Thumb, Hand, Arm, Feet, Yojan or Jojan, Yard, Chain, Link, Fathom, Rod, Furlong, Miles, Nautical miles, League, Stadia. Early metric system had several units @ 10^X such as Millimetre, Centimetre, Decimeter, Metre, Dekametre, Hectometre, Kilometre. To these were added micro measures like nanometre, micron and Angstrom.
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> Roman pes or foot was divided in 12 parts called unciae, from which the words **inch and ounce** have derived. Similarly **yard** (gird) can be traced back to early Saxon kings who wore a sash or girdle around the waist which was removed and used to measure lengths. Later King Henry decreed that a yard should be the distance from the tip of his nose to the end of his outstretched thumb.

During the **French Revolution** (1870) the National Assembly of France asked French Academy of Sciences to formulate a **scientific and rational measure system**. Such a system was expected to be:

1 neutral and universal,

2 replicable anytime and anywhere,

3 to have decimal multiples,

4 to follow common prefixes and

5 be practical and simple to use.

The rationale for such a system forced many countries of Europe to think on similar strategies.

Industrial Revolution period saw faster means of transport and better communication systems. It fostered trade between far off regions and different political domains. The producer and the consumer were very distanced. British, Spanish, French and Dutch empires established trading outposts and their colonies controlled major part of the international trade. These colonial nations maintained their own measurement system. Yet for inter-empire trade there was an acute need for a common, logical, definable, replicable and comparable system of measurements. As nations became free of Colonial controls (such as USA) the International trade needed a fair measurement policy.

> **Foot & Pound system** was widely used in British colonies and their trading outposts besides USA and parts of Canada. Foot & Pound system was a well developed but not very coherent as relationships between measures were illogical. **Metric System** on the other hand was

mathematical but had too many sub fractions. Different nations, regions, and trade groups favoured different sub fractions, creating confusion. This was perhaps the major deterrent for other countries (chiefly those following the FP system), desiring a change over to the Metric System. Historically Metric system has seen many versions: **CGS** or the Centimetre-gram-second system, **MKS** or the Metre-kilogram-second system, **MTS** or the Metre-tonne-second system.

First International effort to develop a worldwide policy for weights and measures was made during May 1875. Some 17 countries signed a **Metre Convention or Convention du Mètre,** an international treaty to create a 'permanent mechanism to recommend and adopt further refinements in the metric system'. This was directed towards defining what constitutes a **standard measure unit** and means to replicate it in **great accuracy anywhere and anytime** and towards defining sub units for the main measures.

The metric convention was held at the time of heightened Industrial activity during the Industrial Revolution period across Europe and USA. Signatories of Treaty of Metric were: USA, Germany, Hungary, Belgium, Brazil, Argentina, Denmark, Spain, France, Italy, Peru, Portugal, Russia, Sweden, Norway, Switzerland, Turkey, Venezuela.

After the **Convention du Mètre** in France in 1875 a General Conference on weights and measures or **Confèence gènvrale des poids et mesures CGPM** was organised in 1889. Eight CGPM, at rough intervals of 4 years, were held till 1933, followed by an inactive period due to world war II. These meetings gradually evolved a worldwide policy on the advice of scientists and metrologists (Metrology is science of measurements).

Conférence générale des poids et mesures (CGPM), an intergovernmental conference of official delegates of member nations and the supreme authority for all actions. It continued the deliberations of **Convention du Mètre**.

Comité international des poids et mesures (CIPM), consisting of selected scientists and metrologists, which prepares and executes the decisions of the CGPM and is responsible for the supervision of the International Bureau of Weights and Measures.

Bureau international des poids et mesures (BIPM), a permanent laboratory and world centre of scientific metrology, the activities of which include the establishment of the basic standards and scales of the principal physical quantities and maintenance of the international prototype standards.

Hectic reconstruction activities began everywhere in the post world war II (1945) period. Major impediments to this effort were the differing **National Standards**. To allow free flow of raw materials, equipments and technology a platform of **common Standards and Specifications** was required. In 1946, delegates from

25 countries met in London to create a new organization, to facilitate the international coordination and unification of industrial standards. The new organization, Organisation internationale de normalisation, **ISO**, officially began operations on 23 February 1947, in Geneva, Switzerland.

The word ISO was selected to represent the organization in all languages, because it is derived from the Greek isos, meaning equal. (More about ISO in later chapters.)

9th CGPM in 1948, meeting after 15 years gap due to WW II formally adopted a recommendation for writing and printing of measure unit symbols and numbers. The name **Systeme International d'Unites** (International System of Units), with the international abbreviation **SI**, was adopted for this **New Metric System**.

In 1960, the CGPM revised and simplified the measure system. Seven **Base Units** such as: **meter** (Length), **kilogram** (Mass), **second** (Time), **ampere** (Electric current), **kelvin** (Temperature), **mole** (Substance), and **candela** (Luminous intensity), were established.

Acceptance of SI has been varied. For French and other European countries including their colonies, already using MKS system, adopting the new system (SI) was very easy. In 1965 Britain started using it. Canada, Australia, New Zealand, and South Africa quickly followed and soon exceeded the speed of change in Britain. In 1975, USA officially accepted the Metric system (in the form of SI system), but no specific schedule was set for the change over.

SI MEASUREMENTS: As a designer, we are concerned with formulating or creating new entities, and also using ready parts and components. For both the purposes, we need to specify the Measures. ISO has formulated rules for Writing and Specifying Measures in drawings, documents, specifications and other forms of communication. This is done to avoid any ambiguities in interpretation of information. Some of these practices are mentioned here:

WRITING AND SPECIFYING MEASURES:

- All decimal numbers must be preceded by a zero if no other digit exists. e.g. 0.121 (and not as .121)
- No thousand or hundred markers are to be used, e.g. 1000 (and not

1,000), but where large number of digits are involved a blank or space (equal to 1 digit or not less than ½ digit in width) may be used as a separator, in place of a marker. However, where only four digits are used no space as a separator need be provided. e.g. 100 000, 10 000 or 1000 (but not 1 00 000 or 1 000)

■ For length units km / m / mm, all must be in small letters (Unit indicators may be used, but only when necessary. For example architectural plans have nearly all measures in mm, so the mention of mm should be avoided. However, in the same drawing if weight or volume or such other measures are to be indicated then identifiers for such units may be indicated).

Architectural drawings nominally have 5 digits for dimensions (unless a detail requires indicating a fraction of a millimetre) signifying measures up to 99999 mm or 99.999 mts (-but unit identifiers are not to be used). Plans larger then 99mts sizes are considered of Map category.

■ Full names of units even when these are named after a person, are written in small letters: ampere, volt etc., with the exception W for watt and J for joule.

■ For liquid measure however lt may be written as Lt (to differentiate between 1 and l).

■ Plurals need not be used. (kms, mts, kgs).

■ Point or Full stop for abbreviation may not be used, for example as in m.m. or mm.

■ Where cubic or square measures are to be shown: 3m3 = will mean three cubic metres and not 3^3 i.e. 3 x 3 x 3 = 27cmt.

■ Following common units are acceptable
Length mm m km (all 1000 factored)
Weight gm kg mt or t (all 1000 factored)
Liquid mlt Lt klt (all 1000 factored).

■ Where traditionally only one unit is accepted, and if there are no chances of ambiguity, the measure nomenclature (mm, km, gm etc.) may not be mentioned. (E.g. cloth width = 1.200). If in one sheet of drawing (or a document) only one scale and one mode of measure are used, the nomenclature may be mentioned as a general instruction for the drawing.

■Where drawings or details are likely to be reduced or enlarged in processing / copying, a graphical scale preferably showing 100 mm bar may be shown. If 100 mm size is not suitable due to micro reduction or macro enlargement, suitable multiples of 100 mm for upwards scaling and 10x fractions of 100 mm for downwards scaling maybe used.

MEASUREMENTS ON DRAWINGS

When both mt & mm are used on drawings, it will be less confusing if the dimension is always written to three places of decimals, i.e. 3.450. No unit symbol need be shown unless a lesser number of decimal places are used; i.e. 3.450 or 3.45 m and under some circumstances 3.5 m, are all correct. Of the options, 3450 and 3.450 both are preferred. Where no ambiguity can arise, symbols may be discarded, according to following rules:

- Whole numbers indicate mm
- Decimated fractions to three palaces of decimals indicate m (and also by implication, mm)
- All other dimensions must be followed by the unit symbol.
- Where dimensions refer to different types of measures (lengths, weights, temperature etc.), preferably all units should be indicated or all units other than the major one should be indicated.
- Main dimensions and the tolerance (fitments, limits, margins etc.) etc. should be in the same unit system.
- Where main dimensions are accompanied by + or - range, both should be in the same unit.

2 . 2 MEASURES AND MODULATION

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Measures and Dimensional referencing: We perceive objects for their Sizes. The Sizes take on **meaningful dimensions** like Length, Height and Width through the referencing. Primary reference is by comparison with our body that tells if the measure is large or small. Other references are mainly through Gravity (horizontal vs vertical or up vs down), Sun (east vs west), Magnetism (north vs south).

The Dimensions (L x H x W) create a **3D matrix**, a referencing system now universally accepted as the X-Y-Z system. We experience the **Spatial Configurations** through such 3 way references. The Time is considered as the 4th facet of reality that defines an Event or Happening. 'All such context references, and calibrations, however, accurate, encompassing and well presented, cannot recreate the entity like the original'.

SENSING OBJECTS BEYOND THEIR SIZE MEASURES:

Dealing with Real Sizes and Scaled Forms: Our **Faculties of Perceptions** have inherent limitations. We see up to a certain fineness and distance. Beyond such a range we need to **scale the effect** for clearer comprehension. A site plan drawn at a smaller scale allows us to see the neighbourhood, or an enlarged detail allows greater manipulation. We scale measurements to avoid or enhance certain details also to exploit the space available for recording on media. We deal with entities at one level, as they really exist in **original measures** or all conditions of enactments, and at another level, in their **scaled representations**. Designers are trained to manipulate, arrange, or compose scaled representations, and generally achieve results equal to their **real size forms**.

We also experience objects through the **sensory affectations** like light, colour, sound, temperature, smell, pressure, etc., as caused to our body. But such affectations are very subjective, and not easily accountable to any universal system of measurements. However, we can emulate the changes (as equivalent physio-chemical-electrical changes in our body) elsewhere and measure the sensory affectations. For example, we measure the temperature as it affects the mass of mercury or a metal sensor. This allows measurement of range beyond body's nominal capacity. Similarly inaudible sounds like ultra or infra sounds can also be measured.

Surrogate, Metaphoric and Symbolic Representations: We also deal with complex entities by translating them into **Surrogate, Metaphoric and Symbolic representations**. Designers work with such representations to achieve their design objectives.

Graphical Representations: Temperature or heartbeats as represented in a graph chart like a Thermal-gram or a Cardiogram, do not convey anything to a lay person. A written musical scale or stenographer's phonetic language notes do not recreate the original sound, yet convey the meaning. A graphical representation stands for the original in a restricted sense. Nominally graphical representations are difficult to read, but with frequent exposure, one gains the proficiency to automatically interpret the conveyed information, as if it is the real happening. Such proficiencies are circumstance and person specific, and cannot be replicated everywhere or by everyone. Graphical representations, often create an 'artistic', proportionate, or an 'aesthetic composition' on their own.

In some situations a Designer deals with a secondary graphical or scaled formation that represents another graphical or scaled entity. Designers, who deal with a variety of representations, scaled, graphical or metaphoric, are often not aware of the **levels of conversions that distance the original**. They are also oblivious of the transition from one form of representation to another. It becomes a 'second nature' for them. It is only when the desired objectives are not achieved, or when some unusual phenomena are discovered, that a designer begins to re-search the process.

SYSTEM OF MODULATION AND PROPORTIONS

It has been seen that certain **Compositional Values or Patterns** persist even through the scaling (reductions or enlargements). These compositional values, whatever scales or measures they may relate, are of pure numbers. **Compositions of pure numbers** have a **degree of order**, called the **System of**

Proportions. When the order occurs as a pervasive system, whole to the parts or parts to the whole, a System of Modulation occurs.

A **System of Modulation** inherently will have some kind of System of Proportion, but a System of Proportion may not have any apparent System of Modulation. A System of Modulation is an intellectual contribution to the composition, whereas most of the Proportion Systems defy such definition, and so seem intuitive.

According to the arithmetical definition, a **Proportion is the equality of Ratios**. A **Proportionate Ratio** manifests with numbers that have some contextual relationship, such as adjacent numbers in sequence, in a matrix or in multi lateral composition (between length, width and height). A proportion is an ideal relationship between two numbers, defined as the division of one number by the other.

Golden Section and other Systems of Proportions: Historically many Systems of Proportions and Systems of Modulation have been attempted.

> **Golden Section**, is an order of a **Geometric Proportion** based on a specific ratio in which the Whole relates to the Larger Part, just as the Larger Part relates to the Smaller Part. For example a line AC (whole) is divided into two unequal parts, AB (larger part) and BC (smaller part). The ratio of AC / AB (whole / larger part) is same as the ratio of AB / BC (lager part / smaller part). Mathematical this reads as AC/AB = AB/BC or inversely as AB/AC = BC/AB.
>
> This ratio is known as the **Divine Proportion**. The Golden Rectangle, whose length and width are the segments of a line divided according to the Golden Section, occupies an important position in paintings, sculpture, and architecture, because its proportions have long been considered the most attractive to the eye.
>
> Another Proportioning System is the Ratio of $\sqrt{2} : 1$ = 1.4142 : 1 The simplicity of this derivation (a square root of 2 is the diagonal, in a square of side length 1) is parallelled by the ease of maintaining the proportion through division or multiplication of the proportioned rectangles.

Measurements as Pure Numbers and Numeric Orders: Measurements without any context (feet, inches, metres, or height, width, etc.) are Pure Numbers. Creative persons, over the ages have tried, and are still trying to discover a perfect order for composition of pure numbers. Many complex **Numeric Orders** have been devised and tried, but none has yet proved to be a universal system. The most common are the various **Arithmetic Orders**, in which through a specific formula (equation) the numbers are sequenced to form a **Logical Series**. The

Fibonacci Series is an arithmetic order (1,2,3,5,8,13,21,34,55...) That has been shown to have an Order of Proportion between adjoining two numbers (3/5, 5/8, 8/13, 13/21, 21/34...).

There is an on going search for an order or Modulation System that coordinates various limb sizes (anthropometric measures), of not only an average or a perfect human being, but people of different races (different stature). Le Corbusier has attempted to develop a '**Modulor System**' that coordinates human limb sizes. He also believed that such a system on its own generates a System of Proportions. Possibly in his own work he did achieve a System of Proportion, but looking back in a historical perspective it was not fully accepted by other designers.

> The 'Modulor System' was essentially a linear system. Human perception of solid - 3D forms are conditioned by the perspective or converging view. The perspective view depends on the distance and angle of vision of the object. From every point in space one gets a different perspective, and so our perceptions of objects' measures are ever changing.

No definite system that truly works for such a dynamic situation has yet been devised. A Modular Measure System based on the Ergonomics (usage through human limbs), may not work, for the visual and other sensorial (aesthetic) needs.

For **ISO Modular preferences** refer to next Chapter

2 . 3 MODULAR COORDINATION

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MODULATION WITH BODY-BASED MEASURE SYSTEMS:

Ancient measure systems were based on the human limb sizes and body's capacities. These were **function-related measures** such as: foot size and walking, thumb and width, fingers and numbers, palm and holding capacity, head load or horse power and carrying capacity, etc.

> In Indian context a weights series had a Maund made of 40 seers and each seer had 16 chhatanks, Monetary series had 1 Rupee consisting of 16 Annas and each anna had value of 4 paise, whereas the length series a Gaz was of 2 Hath and each Hath was of 8 Girah or 24 Anguls. For example a 5 Gaz cloth was valued 12 rupees, it would be difficult to calculate 1 Hath length piece. A Foot was divisible to 12 inches, but the weight unit Pound (avoirdupois) was divisible to 16 ounces.

In a series of measure units, the sub units, though body related, were nearly independent. The interrelationships between sub units were simple but enforced. Various **measures' series** were **mutually incomparable** and to an extent **incompatible**.

Across the world there were innumerable measure systems, but the **Foot-Pound system** became dominant due to extensive colonization by the British Empire.

The **Metric System** (created in France post Revolution period) was an abstract system with a **Mathematical Order**. It had the advantage of **Logical Fractions**. All measure units were divisible to 10^x. But (early) Metric system had several sub units, many of which had no effective use. For some people the rationale of Metric system was too contrived as its scale did not relate to human body and its parts-whole-parts relationship.

NEED FOR A COORDINATED MEASURE SYSTEM:

'Raw materials or Finished product's are transient terms for goods. A finished product is a raw material for some other process. Raw materials procured in a linear, square, volumetric, weight or liquid measures get processed into a different 'measure' entity. For products transiting from **one measure phase to another**, a

persistent dimensioning system is very advantageous. **Consistency of dimensions** allows use of standard tools, equipments, plants and technologies. The dimensional consistency, if properly recognized and supported, can rationalize the conversion processes, storage, handling, and waste management.

> For example metal ore is mined in volumetric measure, transported by its weight measure, bought for its yield rate value, refined into ingots for weight measures, rolled into metal sections to be used for their strength aspect.

In the 'Post Industrial Revolution' period, trade and industry all over the world recognized the need for a **Universal Dimensioning Discipline.** At that time better coordination was also required for conversion and transmission from old measurement systems to the new SI system of measurements. First worldwide understanding emerged in the adoption of SI as the **Universal Measure System**.

> Organisation internationale de normalisation or International Organization for Standardization would have different acronyms in different languages. Its founders decided to give it a short, all-purpose name. They chose ISO derived from the Greek isos, meaning equal. ISO is a voluntary, democratic and non governmental organization for International Cooperation for Standardization. SI = Systeme Internationale stand for Universal Measure System and it is now accepted by nearly all countries of the world. ....More on ISO in later chapters

SI Recognized Measures: The SI system recognizes three sets of measures in each of the major categories. There is a 1000-factored gradation.

The ISO Recognised Measures are:

Length:	mm	mt	km
Weight:	mg	kg	T
Volume	ml	Lt	kl

ISO MODULAR PREFERENCES:

The SI also recognized that, measures as above are either too large or small for nominal use. Such a widely spaced (1000 factored) measurement system was not amenable to **unit formation** for processes like planning, design, production, transportation, fabrication or execution, etc. ISO (International Standards Organization) as a result devised a practical modular system of dimensions known as **ISO Modular Preferences**. Most National Standards (including Indian

Standards) are recommending and enforcing the same for various products and processes.

The ISO Modular Preferences help in both, dividing a whole into logical parts and combining parts into a rational whole. It also accommodates traditional modular systems, such as foot-Inch and earlier versions of the metric systems. Typically, the Foot (12"), the most popular measure of FPS has been accommodated (but not the 1/4 or 1/5 part of the Meter such as 20 or 25 cm or 200 or 250 mm). This was done for wider acceptance and to achieve a gradual changeover.

ISO's Four Preferences for Modular Coordination:

First Preference	30 cm or 300 mm = 12"
Second Preference	10 cm or 100 mm = 4"
Third Preference	5 cm or 50 mm = 2"
Fourth Preference	2.5 cm or 25 mm = 1"

- **First Preference** is favoured by the building materials' industry. Plywoods and other wood products are available in modules of 300 such as 600, 900, 1200, 1800, 2400 etc. Large buildings are designed with 300 as the modular measure. But, for smaller spaces such as Bedrooms, toilets, second preference of 100 is used as a module.

- **Second Preference** is considered to be the most appropriate one for Building components and Planning. Glazed Tiles are available in multiples of 100 mm, with sizes like 100 x 200, 200 x 200, 200 x 300 etc., and also in sizes such as 150 x 150, 150 x 200 etc. as a carry over from the old system. Fabrics have widths of 600, 900, 1000, 1200, 1800 etc. When we order Windows or Doors the width x height are measured in 100 mm increments.

- **Third and Fourth Preferences** are more preferred for objects smaller then 300 sizes. These preferences are not to be used for basic object sizes of more than 300, unless there are strong economic or functional reasons for doing differently.

IMPLICATIONS OF THE MODULAR COORDINATION OF DIMENSIONS:

There are many products where **smaller modulation or variations** are desirable such as Garments and Shoes. ISO Modular Preferences, do not consider the variations in naturally available materials. Furniture, fittings and fixtures designed with **ergonomic profile or serving anthropometric, inconsistencies** have no specific accommodation in this system.

ISO is a modular system to form a **grid or matrix for macro planning** and in that sense takes a superior position. Components and parts are expected to fit in the system. As a result, work-sizes of components and assemblies should be determined by taking account of **space for joint** and **allowance for tolerances**.

The ISO modular system is based on SI system (a derivative of the metric system) which originally was rational and contrived, and continues to be so. This type of **Modular Coordination of Dimensions**, is unnatural and does not exactly relate to human body. Its implications to our senses are extremely limited. It creates an '**order that lacks beauty**'. The system does not harmonize the variable tolerances' requirements, and differences in fitment sizes.

ISO Modular system has very simple and predictable progression-digression, unlike many mathematical orders and systems like Corbusier's Modulor system.

ISO Modular Preferences, as a universally agreed system of preferred measures, disciplines design, procurement, production, conveyance, handling, storage, distribution, usage, wastage and reuse or recycling of materials. The system has provided a level ground to compare standards of various countries, and evolve world standards (ISO) for various products, services and work or operational procedures. It has made the writing of specification lucid and logical. It simplifies taxation procedures, costing, estimating, and valuation. It also rationalizes deployment of human and energy resources. It has made quality control procedures very objective.

At any cross section of time, there are many creative people, who feel stifled by such an **Abstract Dimension Modulating System**. But one must also concede that by its universal acceptance (through ISO), a logical dimensioning tool has been made available to a vast majority of people. The **Dimensioning Tool** defies all localized traditions, cultural variations, anthropometric distinctions, racial biases and geographical peculiarities. The system is unaffected by time or space.

2 . 4 MEASUREMENT : MODULES - MODES

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MODULES OF MEASUREMENTS:

SI is a derived set of Measurement Units factored by x1000. **ISO's Modulor Preferences** are **prescribed sets of Measurements** in consideration of the **traditional choices, commercial practices and rational applicability**. ISO modular preferences in spite of the universal acceptance do not fully resolve all the anomalies of the world's commercial processes.

In traditional commercial activities, **Jobs or Tasks** are conceived, assigned, monitored, delivered and valued in **practical lots of work**. Such lot-Based identifications have prevailed for their realism.

PRACTICAL WORK LOTS AS OPTIMUM QUANTUM OF WORK:

For a supplier, manufacturer or a contractor, job-orders need to have an optimum quantum of work. Any **work-lot** below the optimum quantity affects the **Economics of Scale and Profit**. Larger work-lots must be accounted in **Multiple Units of the Optimum Quantity**, so that inputs, overheads, profits etc. can be judged in terms of batches or lots. Such practical lots or batch-based modules provide a practicable unit upon which quotation, valuation or comparisons can be made. Such practical work-lot-based systems have their own efficiency of naturalness.

TRADITIONAL MODULES OF MEASUREMENTS:

Practical work-lots of work are derived on the basis of many complex factors such as:

1 Traditions and customs prevailing in the field.
2 Trends set by major work agencies in the field such as the Public Works Departments / Indian Railways.
3 Government labour laws: Truck load limits, head load carriage conditions.
4 Productivity: output per labourer, tool, equipment, machine, plant on per

hour, day, shift, batch, week, month basis.

5 Compensation: wages or salary schedules hours, shift, day, week, fortnight, month, season, annual.

6 Anthropometric aspects of work conditions (e.g. depth of foundation in multiples of 1.50 mts).

7 Accuracy of measures, measuring tools, availability of measurement devices on site-location, Competence of staff taking the measurements.

8 Affinity of measuring means and methods: grouping of items with similar constitution, nature, function, style, pattern, design, execution methodology, installation system, energy input.

9 Permissible tolerances, margins of allowances.

10 Permissible accounting rounding off.

11 Number of repeatable units (measurements in pure numbers).

12 Monetary value (relative) and cost (absolute) of the item.

13 Sizes and measures of raw materials as delivered (lots, batches packing).

14 Contract documents / specifications etc. that define whether the item is to be considered as a whole, or in separate lots.

15 The difference between smallest, and the largest size within an item lot.

16 Wastage, breakage, residuals, left over etc. to be taken care of.

Modules of measurements include Linear or Length-1D, Square or Area-2D, and Cube or Volume-3D measures in addition to Weight (mass). But many items are accounted for in **Pure Numbers**. Here a typical item is specified in nominal measurements or its details are commonly known. Units like Dozen (12), Kodi (20), Panja (5), Gha (24), or Rim (480), are all practical lots, denoting **modules of pure numbers**.

Brass: Brass was a simple and once popular measure unit. It was easy to measure and deal with. As for example Surface Works (painting, plastering, flooring) were measured in terms of **Brass** =100 sq. ft. A unit smaller than this was economically (daily out put and wages) not appropriate. Earthworks on small sites were measured in terms of Cubic Brass =100 cft. (a pair of workers can excavate approximately 2 brass of soft soil in a day). Though on very large sites like dams, these were in terms of 100 brass or acre-feet (as machine output is much larger than human work). Brass as a unit due to its familiarity was considered almost like a **pure number** entity.

Factors that format the Modules of Measurements:

- Module of Measurement, as far as possible match the Natural or custom lots of the item.
- Items should be so placed (in both, time and space) that it is possible to take an account of them in their obvious lots or modules.

- Items are supplied / created in lots, and even after value addition processing, may not lose the basic personality of their lot-based accountability, so a consistent module of measurement is preferable.
- Module of Measurements must override the minor Quantitative and Qualitative variations within a lot.
- It is preferable to have one Module of Measurements for all items dealt by a trade / agency.
- A new Module of Measurement must confirm SI measure system and ISO Modular Preferences, and must respect the traditional practices of the trade and geographic region.

MODES OF MEASUREMENTS

Mode of Measurement is a style, manner or a methodology of taking measurements of an item. On a **Work Site** and in **Permanent Production Areas** such as factories, industrial plants, etc. a definite **methodology of measurements taking** is followed. **Measure Units** used, are as per the SI, and modules perhaps as per the ISO Modular Preferences, but the **Modes of Measurements** are governed by the 'optimum or practical lots of work'.

The Modes of Measurements help in Quantity and Quality checking by reducing the number (types) of items for procedures like estimating, specification writing, tendering the quotations, task supervision (productivity of human and machine resources), billing, etc.

Major job agencies like Public Works Departments, Railways, etc. dictate the job market, and evolve their own 'Game Rules' for measuring and paying for the works. The rules are very practical, as have evolved through years of experience. The rules may vary in minor details from one agency to another, and one geographical region to another. Over the years, however, a common **System of Taking Measurements** comes into being.

SOME CONSIDERATIONS FOR MODE OF MEASUREMENTS:

- **Use of Appropriate Technology:** Measurement taking must occur with the appropriate technology on hand. E.g. a steel fabrication job ideally needs to be paid by Weight, but it is not possible to weigh a complex fabricated object on the site. Earthworks on contoured terrain can only be measured in terms of truckloads of soil moved or hours an excavator operates at a site. Intricately shaped and massive concrete structure can be paid in terms of concrete poured in. Painting work on a complex steel structure cannot be measured in surface area, so is paid per volume of paint applied. Earthworks on a small and remote location are measured in multiple lengths of the pick axe handles (approx. 750 mm), rather than using measure tapes or automatic measuring devices.

- **Commercial Value and Frequency of item:** The effort expended in measuring an item also depends on the **commercial value and frequency of its occurrence**. Items of **low commercial value** are measured in **larger measure modules**. An item is considered costly if its labour, material or techniques of installation are rare, or difficult to procure. An item is also costly, if it forms a large component of the total cost of the scheme. Frequently occurring item is measured thoroughly once, and its product is used as a basis.

- **Identity in time and Space:** An item forms a distinct identity depending on the nature and time of execution. Frames for doors and windows are fitted in masonry, before the plaster work begins, the shutters are installed after the plaster and flooring work, whereas fittings-fixtures hardware, are fixed after painting and polishing work. Here the item is same, but likely to be paid in parts at different time schedules.

- **Multiple modes of measurements:** Some items require **multiple modes of measurements**. A design office, supplier, manufacturing workshop, and the site supervisor, all have distinctly different ways of dealing with the same item. For example a flat coiled-spring used in a sofa can be readily measured in a linear measure, but real cost can only be estimated in a weight measure, (by which it is purchased). Similarly furnishing fabric may be estimated in square measures (area) but must be resolved into lengths (of woven fabric widths) for purchase. Leather may be estimated in square measure (area), but can be purchased in weight measures only. A designer tends to estimate the item in the form represented in the drawing, whereas the site-in-charge person would estimate the item in terms of its market form.

- **Applying same Mode of Measurement:** Some work items are reclassified so that can be measured using the same mode of measurement. RCC slabs are paid in square measures (area), the beams and columns in linear measures, and other massive works like foundations in cubic measures. Such **multiplicity of measures** can be avoided by awarding all RCC items in volumetric quantity and by awarding the form work and casting labour separately.

- **Newer Modes of Measurements:** Traditional markets do not readily accommodate the changes in tools, technology, or labour inputs that happen over a period. Yet, newer modes of measurements do come up, for example, marble flooring was once made mostly from factory cut pieces. On-site cutting was rare, as it required cutting with a chisel and manual edge-dressing (old technique). Each splitting (cutting with a chisel also required post dressing of two edges) was charged in double lengths. But with small rotary cutting machines (now widely available) both split edges get a clean (polished) cut in a single effort. Earlier practice of charging marble floor fixing by square measures, and splitting + edge dressing by length was not commercially valid or viable any longer. So, now the marble flooring work is charged through one all-inclusive rate. Often this rate (square measure) also includes providing and laying the substrate as well as polishing the floor. And, in many instances to save the labour of billing etc. a certain percentage for skirting work (which earlier was a linear measure) is added to the floor work (square measure).

- **New work items:** New work items require a very different attitude for mode of measurement. Cleaning a site (installations, furniture, furnishings) after the work is over, is a problem, for which no organized labour contractor is available. For this work no traditional mode of measurement practice exists. So a lump sum amount, or a % amount over the cost of painting is charged for the job of final cleaning of the site. This is a non-traditional item, but depending on the relevance, a logical solution has been achieved.

- **Mode of measurement and billing:** These two are intimately linked. When all sub items within a bill are dealt in one mode of measurement, and priced by a single or similar rates, the updating, revision or scrutiny becomes easier.

- **Abstracting the modes of measurements:** Mode of measurement of one type is generally transferable into another type (linear to square to cubic) (volume to the mass) (speed to distance and time). e.g. RCC slabs can be paid in square or cubic measure. A taxi driver may charge you on per kilometre basis, or on per day travel basis (that may include the cost of waiting). Where, for any reason, such transfers are not possible, permissible or illogical, the mode can be generalized into a **neutral denominator** like **Monetary Value**. Such **abstracted modes** are absolute in nature and provide a common ground for **evaluation of many dissimilar entities**.

- **Usefulness of Mode of Measurement:** Mode of measurement is a very critical tool for efficient use of resources. Saving (in monetary terms) of 7.5 to 12 % can be achieved by efficient mode of measuring and related accounting methods. An efficient and logical measurement practice can reduce the labour and time involved in estimating and billing a job. Reduce the total number (types) of items and number of different rates for them, (by suitable accommodation of minor variations and acceptable methods of generalizations). Eliminate chances of disputes at all levels. In many instances extra items are eliminated, and where such items do appear, a clear basis for their identity is available.

CURRENT DAY MODULES AND MODES OF MEASUREMENTS:

As a continuously evolving process the modules and modes of measurements keep up their relevance. With the advent of SI, and easy availability of digital calculating equipments, the need for Modules of Measurements is not acutely felt, except for the work procedures.

Similarly Modes of Measurements can also be made redundant to a large extent, if the work-Items are designed and requested as a whole (in a ready-to-install or use condition), in numbers. Nowadays, National and International agencies like ISI, ISO, etc. promote **Performance Specifications**. These completely replace the need for the **quantity definitions** with the **quality requirements**, making the modes of measurements irrelevant. Though as an in-house activity (within the design office, site, factory, plant, etc.) it will have continued relevance.

2 . 5 SPECIFICATIONS

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Our experience about things around us is a continuously **evolving process**. The more we become familiar with a situation, greater revelations come to us. By remembering or recording the experiences, we hope to have greater understanding. **Records of the experience** help in recollection or re-enactment of the happening of the past. To record the experience we detail or specify it. **Specifying our experiences** is a process of **continuous improvisation and rationalization**. A specification is the 'best possible definition or explanation at a given time, for a given situation'.

Specification at a very basic level could be a **description** of a thing or happening. The **description of a thing** lists the physical qualities such as size, weight, shape, colour, feel, etc. Whereas the **description of a happening** includes the changes occurring in the thing itself, as well its surroundings, both, of which are profiled or sequenced in 'constant time' (same time sections).

A description alone may not prove sufficient for reproducing a thing or happening. One needs to discover and define **the process for occurrence**. When a description consists of both, the **physical characteristics and the processes**, sequenced in time, it becomes a **Specification**.

A specification that has been tried for recollection or re-enactment, and with reasonable success for every attempt, becomes a **standard specification**. A standardised specification provides a satisfactory or **assured result**.

NATURE OF SPECIFICATIONS:

Fear about a thing unknown or less known, makes a person prudent, so specifications of novel creations or new experiences, tend to be minimal and negative. Gradually, with realization of all causes and effects, the initial Negative Specification becomes elaborate and affirmative statement or Positive Specifications.

Though for many neither of the processes is effective, as negative specifications are too thin and positive specifications too elaborate and technically complex. A reliable and secure way out of such a dilemma is to look for a Comparative Condition somewhere, and relate to it.

CLASSES OF SPECIFICATIONS:

Negative
Affirmative or positive
Comparative.

Negative specifications: When goods and materials are comparatively new and their effects are not fully known, ignorance and fear dominate. Negative specifications, therefore mention, undesirable aspects that must be avoided. Negative specifications relate to things that are harmful, unpredictable and debilitative for life. All specifications initially tend to be Negative, but gradually become Affirmative. Negative specification may, however, remain an 'independent statement with insufficient corroboration'. Negative specifications are eliminating, and so allow a vast degree of openness. Results or creations, through negative specifications may prove to be unexpected and even detrimental.

Affirmative or Positive specifications: Affirmative Specifications come into being, when things are fairly well known, and their affective aspects are well documented. Affirmative specifications list out the desirable aspects that goods or materials are endowed with. Affirmative specifications also come into being when objects are beneficial and supportive of life. A specification becomes affirmative on being corroborated through detailing of all sub aspects or parts. Affirmative specifications gain their clarity through **cross references** or **dependency on similar other specifications**. Affirmative specifications are very strict, rigid, complete and positive, so allow little variations, alterations or improvisations. As a result these do not seem very innovative. However, results are better guaranteed in known situations.

Comparative specifications: Comparative Specifications are **dependent specifications**. An item is imitated or referenced because an assurance is available. Here the object is perceived to be like the original. People who are technically incompetent to define a problem or its context (a lay person trying to procure a technologically complex system, without any help), follow such a strategy. People tend to buy a branded or its equivalent thing, because there is an assurance of it being fail-safe. An original may be perfect in its own, but the same in a different context or environment may precipitate unseen problems. It is very difficult to search for a root cause of a fault, or a deficiency through such specifications. Comparative specifications are usually not innovative or creative.

FORMS OF SPECIFICATIONS

Specifications have many different forms. **Oral instructions or messages** are the simplest way of conveying details. These are **ordered or delivered** in **chronological order**, or at least have some **cause-effect arrangement**, and so seem **action-oriented**. Substantial amounts of specifications occur as **written or recorded documents**. Where documents are complex and bulky, these include **methods for access, reference, and interpretation**.

Primary way of specifying a thing is through its **sizes**. Beyond these come the **sensorial aspects and physical qualities** of the object. The definition of **constituents and production processes** form the substantial section of **Traditional Specifications**.

For specifying a happening, time definitions such as, **rate and quantum of change** are required. Items flourishing for their **Performance** (output-input, yield rate, productivity, etc.) require **checks and evaluation processes** and **operational assurances** through **guarantees and warrantees**.

Specifications of Technical Nature: Specifications of technical nature depend on **drawings and flow charts** (scaled representations and also surrogate representations using symbols, metaphors, etc.). Drawings show size, shape, scale and such other physical details, but cannot show the **sensorial aspects** like weight, speed, odour, warmth, etc. Drawings, therefore require a **written backup**. Specifications are sometimes delivered as **scaled models** (art cartoons, mockups, dummies, samples, pilots, etc.), or **full-size replicas**. Like technical drawings, models show only physical details, but require backup with written explanations, regarding the materials' and other aspects.

SPECIFICATIONS FORMATS

Brand-name Specifications: These are restrictive kind of specification limiting the bidding to a single product. The only competition will be between various suppliers of the same product.

Brand-name or its Equivalent Specifications: These specifications cite one or more brand-names, model identity or other details to identify certain category of products. The vendor is asked to supply the product mentioned or show that offered product is indeed identical. The procuring agency reserves the right to determine equivalency. Brand-name or its equivalents have perhaps a legitimate ground but very limited place in public affairs.

List of Qualified Products (QPL): Such lists are produced by Government's agencies for purchase of commonly used items by various departments. Such lists are periodically updated and often have standard price tags. Vendors quote for such an approved item as + or - the standard price tag. The criteria and the methods for establishing and maintaining a QPL is usually in public domains.

In India, The Central Purchase Organization **DGS&D** (Directorate General of Supplies & Disposals) typically creates manuals of such goods with approved rates. The term goods used in this manual apply generally to all articles, material, commodities, livestock, furniture, fixtures, raw material, spares, instruments, machinery, equipment, industrial plant etc. purchased or otherwise acquired for the use of Government but excluding books, publications, periodicals, etc. for a library.

Design Specifications: Design specifications mention dimensional and other physical requirements of the item. Design here means a method or scheme of creating or putting together an item. It is the most traditional kind of specification. Design specifications are prescription of what an entity should be in its completed form. These are also called **Item Specifications**, as the design details are itemised in terms of the **execution, material's technology or mode of execution**. Design specifications show how the item must be created, and often with the additional information (but, usually less effectively) what the final product is intended to be (goal, dreams, perception). Here the problems arise, because a manufacturer or supplier is emphatically told **what and how to produce or deliver**. In most cases this means a demand for a very customised Item. It leaves no chance for the manufacturer or supplier to offer, technologically or economically superior item, or even one from their own standard range.

Performance Specifications: Performance specifications list the expectations how an entity should **function** or what it **must deliver**. Here the user communicates the requirements as to What will be an acceptable product, and How the adequacy of the product will be judged. The performance specification is more related to how a product performs or functions and at what cost, and less related to its dimensions, materials or configuration. The vendor gets substantial freedom in offering the most appropriate technology. For such specifications it is mandatory to explain in detail the **results required and how these will be checked**. All performance requirements must be matched with tests for adequacy. There is a tendency to demand performance requirements that are very high in comparison to actual projections, which leads to cost escalation.

Problems arise when **test methods** for judging adequacy of a product could require a 'Destructive Testing' or a 'Laboratory or Plant-based facility'. Full activation or critical testing of an atomic reactor may not be feasible, or a long term performance of material cannot be checked in any setup. The provision of assurance by the supplier becomes very important.

Operational specifications: Operational specifications have lesser bearing on how an item is created or procured, but relate to the working of a system. These relate to the functioning of the item, and for that reason product formation, delivery, installation processes must have built in strategy for operation or conduction with optimum efficiency. Operational specifications are not performance specifications but details about **mitigating risks arising out of operation of a system**.

PURPOSES SPECIFICATIONS SERVE

Specifications are required for following purposes:

to create objects
to procure entities
to provide services
to verify the fulfilment of a purpose,

to operate a system, and also
to structure a set of specifications.

Specifications serve one or more of the following conditions.

1 If the needed object is available in the **Market or Nature**, one can define the **conditions of procurement**, including terms of purchase, delivery, quality parameters, etc.

2 A **Routine object** can be produced by prescribing the **constituents** and a **process for production** or **fabrication**. The process details, may exclude (for brevity) the particulars of the **quality of raw materials** (commonly known or available), and **characteristics of the resultant product or service**.

3 A **Custom designed object** will be produced with specific quality of raw materials, through set procedures. And the resultant product is expected to have the **peculiar sensorial qualities and functionality**.

4 A **product or service** to be delivered / procured with the **assurance of quality** (guarantee / warrantee) may have only **performance parameters** prescribed. The quality of raw materials and process become less relevant.

5 **Operation of large and complex systems** is an undertaking by itself. Here the specifications are **operational strategies** defining the duties of different system operators (traffic, risks management, emergencies, security, etc.). The scheme exploits the built-in capabilities, and is also sustained by **planned external interventions**.

6 **Composite systems** that have very dependent sub systems flourish only under **Specific Environment**. Specifications here detail the **contextual conditions** for the subsystem to flourish effectively.

7 **Critical and Hazardous systems** cannot come into being unless **appropriate routines for handling, storage, disposal, demolition**, etc. are predefined.

STRUCTURE OF SPECIFICATIONS

1 Dependent and independent specifications: To specify, an object is conceived as consisting of components and parts, which in turn consist of elemental units. Similarly a job is handled through a series of tasks, and the required materials, tools, machines and power. Such **Objects and Jobs** have a **web of dependancies**. Their specifications cannot be changed without any consequent repercussions. Though, rationalization of a sub-aspect helps in rationalization of the larger object or job. Otherwise many other objects and jobs or their parts and tasks are perceived as fairly **independent**. A change in their specification may not cause any remarkable change elsewhere.

2 Specifications for Open-ended and Closed-ended Products: Specification writers such as designers, aspire to conceive parts and tasks which are independent, or at least have a **designed or controlled interdependency**. Plug in micro chips of modern electronics and other **add-on systems** are examples of such **purposive design**. Some creators wish to protect their creations from marauders, so intentionally design an inaccessible or **closed system**. Such **closed ended products** or 'close ended architecture' lose the favour when equivalent **open-ended objects** are available. Products with public (domain) specifications are 'open-ended Architecture', and are always preferred by the users. Such products allow greater degree of customization.

3 Design Specifications deal with some trade branch, and so relate to specific tools, equipments and plants and human skills. Design specifications are presented as drawings, images, models, prototypes or text. Design specifications are aimed at creating or procuring an entity, or putting together several of them to form an **invoice-able item**. The invoice-able items are substantially whole, and similarly identified in the Estimate schedules. Design specifications also reappear in estimates schedules often as '**brief description**' often causing contradictions.

4 Performance Specifications are holistic, and so, have fewer or single item of work. Design if any relates to the exterior (such as fitment, size and shape parameters, etc.) rather then its interior (its constituents, method of working, etc.). But the set of specifications are distinctly tired.

Tiers of performance specifications:

Level : 1 This Level discusses the scope and background information of the project. No requirements are stated here, and even if implied, are not binding.

Level : 2 This lists all the documents that form the set.

Level : 3	**Performance requirements** are stated here, and these are binding.
Level : 4	**Testing and Verification** requirements are stated here and matched to the performance requirements.
Level : 5	This section lists all peripheral aspects of work, such as handling, packaging, shipping, delivery, precautions, etc.
Level : 6	This section contains information (such as method of submission, bid evaluation, etc.) and other data.
Level 3 & 4	are important as these state, the Requirements and Verification, respectively.

5 Statement of Work (SOW): Specifications do state the work, but a Statement of Work (SOW) is unique to each acquisition or proposition document. It protects both the Client and the Contractor, by identifying and documenting the details of the work to be performed. A Statement of Work consists of first three tiers (see above) only. A Specifier (Designer) must prepare, or alternatively seek a Statement of Work from the bidders, for all Services, and where feasible, also for the Goods. There are 3 types of SOW – **Function based, Performance based, and a combination of the two**. Selecting the type of SOW is dependent on how much the User wants to govern Specific Contract Requirements.

6 Citing Specifications and Standards: It is necessary to cite Published Specifications and Standards in a document. Such references from reliable sources make the document very compact, extremely reliable, and automatically updating. On the wrong side, citing an incompatible or a cancelled version is unprofessional.

When a Specification or Standard is cited, one may actually be citing a lengthy and voluminous chain of documents, many sections of which may not be relevant or impossible to understand. Some of the cited documents could be obsolete or cancelled. There may be requirements in the standards that may not have a bearing on the project. This could cause Impossibility of Performance.

2.6 CATEGORIES OF SPECIFICATIONS

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Specifications are required for **acquisition of Products**, **provision of Services and for operation of Systems**. The differences are in the **approach and intentions**, format of presentation and in many cases the nature of results to be achieved, (reflecting lessons learnt from the past experiences).

Recipes or process prescriptions are very instinctive, simple, but good for 'singular' entities. There are complex situations where attention to 'things to do and not to do' is necessary.

Such situations are of following types:

- New installation, entire system provided by one vendor: simple & singular entity
- New installation, system provided by many suppliers: multilateral systems
- Alterations and Expansion of existing installation: complex systems

Specification's formation process has many different facets. For a designer every project or product is **routine**, and **unique** only in terms of its **location** (siting conditions) and the **client**. But in reality design process is conducted selectively that is every project or product is intrinsically **unique proposition** and other conditions such as **site + client are presumed to be nominal**. This attitude is often reflected in the **formation of specifications**.

Frequently produced or procured products have **consistent specifications** which can be reused and frequently improvised, if only situation or occasion specific components like services are separated. **Products with accompanying Services** are jobs related, and their specifications have to be reset for every client or project. So separating the Services from the goods is a sensible move for **specification formation**.

TYPES OF SPECIFICATIONS:

There are 3 broad **categories of specifications**:

1.0 **ITEM OR DESIGN SPECIFICATIONS**

1.1 CONSTITUENTS -qualitative aspects

1.2 PROCEDURES -manufacture or assembly

1.3 CONDITIONS OF ORIGIN -care, handling, installation

2.0 **PERFORMANCE SPECIFICATIONS**

2.1 FOR READY TO USE OR OFF THE MARKET ITEMS

2.2 FOR DESIGNER PERCEIVED ITEMS

2.3 FOR PROCURING SERVICES

3.0 **OPERATIONS SPECIFICATIONS**

3.1 GUARANTEES, WARRANTIES

3.2 LIABILITIES

3.3 MAINTENANCE.

1.0 ITEM OR DESIGN SPECIFICATIONS:

GENERAL:

These specifications are very traditional, used for execution, manufacturing, fabricating, erecting, for procuring ready-made objects, and also for effecting various services. The term **Design** here means any **scheme**, as such orally conveyed, written, drawn, or otherwise implied. Design or scheme specifies constituents, processes of combining, synthesizing a coherent entity or system, method of care and handling the men, materials, machines, and the entity itself as it is being created.

> Primary instinct for a human effort is to create a **Recipe or Process**. We think or enact the thing we desire, and then project the intentions as: 1 **list of physical inputs** (ingredients), 2 **step by step method** (time sequence), 3 **list of things to do and not to do** (human intervention). A fair mix of first two (aspects) can provide an object, but not a deliverable entity. It is the last aspect that helps create an occasion or situation specific working entity and with definite level of efficiency.

A recipe is a perfect example of a design specification. When a design (recipe) is specified for a product and once readied (with reasonable sincerity), a client has to pay for it even if it fails on acceptability count. As a result, writing **Item or Design Requirements** is never advisable, unless the specifiers have had recent experience, at designing a nearly Identical Item, and fully comprehend all aspects of the design problem.

Specifications for a Designed Object: A Designer prepares the Item or design specifications, (materials, procedures and conditions of origin), so that contractor or vendor can provide the stated item. In this method a contractor or vendor gets no freedom to use alternative materials or execute it differently. If there is an **uncommon item**, the contractor will invariably charge more for the **extraordinary effort or customization**. This process does not assure that in spite of a sincere execution and diligent supervision a functional product will be delivered. The **Item specifications** specify 'physical adequacy of the item while seeking a hypothetical performance'.

Specifications for Sourcing a Ready-made Object: Item specification for acquiring a ready-made object by a designer tends to be even more **restrictive**. The specifications either have to match the **standards** followed by the Industry or match some 'super' **supplier's specifications**. Failing either of the conditions, one has to pay the extra **cost of customizing** a regular or standard item. In the later case the **assurance** nominally available for the regular or standard item are unlikely to be offered for the **altered form**.

1.1 **CONSTITUENTS** -qualitative aspects

Quality standards for raw materials or constituents were once set by major consumers like government departments and large industrial units. Their substantial needs were preferentially satisfied by the suppliers. Major consumers were well organised and had the means and methods to check the quality, and so enforced a **quality related discipline** in the supply market. Today this is done by the Government recognised or sponsored **standardization programmes and quality control agencies**.

Natural or Partially Processed Materials require controlled procurement procedures. These procedures establish quality equalization parameters, like permissible variations in size, patterns, colour, texture, weight, mass, moisture content physical and chemical properties and other factors of consistency (including irregularities, impurities), etc. **Manufactured (man-made) Materials** have an assured quality, achieved through **controlled raw materials acquisition** and defined set of **production procedures**.

Raw material manufacturers prefer to follow certain **qualitative goals**, often **surpassing the compulsory or legal requirements**. Such qualitative goals are framed for a set of common end-uses of the raw material. A producer or supplier cannot immediately perceive the continuously evolving new applications of the raw materials. For **radically different usage of raw materials**, an assurance beyond the **Nominal Quality Specifications** is required. Raw materials, as a result, are now offered with details of the entire setup (process), as to how the **declared quality goals** are being achieved. A concerned person (radical user), through such public domains documents may conclude suitable **Quality Parameters**.

Specifications for Qualitative Aspects of raw materials consist of **Testing (verification) Processes**. These processes, if documented for public use, and accepted as a standard, by the trade, industry or Government, are indicated by their **access code-source**.

1.2 **PROCEDURES** -Manufacture, Assembly, Purchase

Common objects are produced from **familiar raw materials** procured from their **traditional-local sources**, and as a result have a fairly **consistent and reliable quality**. **Conversion processes** are 'home breed' and simple, so require very little expert modifications to accommodate the occasional anomalies of raw materials. 'Quality products result from strict adherence to the traditions'. Such products are offered to the consumer on **personal assurance or faith**.

However, today commercial products are sold on the basis of their **Provable Quality**. A consumer often has no personal contact with the originator of the product. **Quality assurance** comes through the details on the label or from the accompanying literature. **Quality control and testing facilities** for irregular and one-time efforts or ventures are difficult to establish and maintain. For such circumstances it becomes advantageous to specify the exact **process of assembly or manufacture**.

Production procedures relate to sub processes or tasks managed through Men, Machines, and Programmes. As a result the process specifications greatly depend on human skills, machine capabilities, time scheduling, input-output rates, and sequences. Many production procedures are traditional and universal. Their just mention evokes certain work culture.

> Material Polishing process is universal, and applied to many different types of materials and work conditions. Wood, stone, and other materials have finishing processes with similar features. Bending, cutting, folding, polishing, welding, hammering, surface cleaning, etc. are many such traditional procedures.

Traditional procedures are so widely employed that their tools, equipments, machines are also well defined. Conventional tools have established efficiencies leading to automatic standardization. This helps utilities' manufacturers to offer standard equipments. Standardization of Materials, Means and Methods improves the work efficiency and economy.

Evolution of Procedure Specifications: It follows one or many of these paths:

1 Procurement procedures for natural resources are defined.

2 Quality parameters of naturally procured materials are standardized.

3 Tools and equipment used in not only procurement, but other **primary conversion processes** are standardized.

4 Plants, equipments used for **secondary processes like manufacturing**, are standardized. Their input, output, run rates, capacities, etc. are defined.

5 **Work procedures** that affect the productivity, like timings, schedules, intensities, speeds, frequencies, sequences, priorities, etc. are rationalized and clearly defined.

When products of **universal manufacturing procedures** are accepted in the market over a period of time, it is possible to define that product as a **Standard Item**.

ISO 9000 series of Specifications essentially require business and other bodies to define (specify) and document all their processes in detail. All consumables, equipments, other physical and non physical inputs, policies, decision making processes, work and other procedures, services, responsibilities, checks, controls must be defined to their conceivable sub levels. Where any of the above-mentioned aspects have been standardized at Industry, National or International level and adhered to, are mentioned in the document. This type of documentation helps in over all rationalization. It encourages transparent and responsible social behaviour. It also forms the basis for comparative evaluation of similar situations.

1.3 **CONDITIONS OF ORIGIN** -Care, Handling, Installation

Procedure Specifications relate to actions that yield a deliverable entity, or place a facility into a working order, often ignoring the **conditions of origin** required for an entity. Conditions of origin include care, handling and installation aspects. These take care of environmental protection, human safety and security matters. During the **conversion or fabrication, and immediately on completion**, the entity begins to **impact the surroundings**, and also **gets affected by the environment**. Many of the specifications relating to the Conditions of Origin category, are **universal** in nature, though some have exclusively **project specific identity**.

Conditions of Origin Specifications include:

Materials' handling routines: Storage methods (stacking, containerization, aeration, seasoning, access, unpacking, stock taking, leakage, pilferage, contamination), waste disposal techniques.

Cautions for assembly and fabrication: Designed loading techniques, premature and accidental loadings, nature of risks and hazards, safety measures, access to structure, delivery and carriage of components, time and sequence schedules, and management of human resources.

Planning and Scheduling: Conditions of origin closely relate to the resource allocation, over heads, cost over runs, delays, etc.

Systems Organization: Complex systems have location and occasion specific characteristics and come into being only when all required conditions are available. Such systems become ready on a site, by bringing in various parts or systems from many different places and vendors, at the appointed time. Many parts or components, going into such systems are identical, but acquire a unique personality on being installed. Most of the building, architectural or interior systems are elementally simple but take a very complex form on a site. Such systems have lots of features that are specific to the site. Such projects' specifications largely consist of custom installation procedures. It is the manner of installation that makes a system come into being.

Complex systems often begin to be live midway through the installation procedures, and must be dealt accordingly. For example, a stair way in a multi storey building becomes useful, floor by floor, as it is cast, for carriage of materials and men. Its safety aspects (railing etc.) become pertinent immediately.

2.0 PERFORMANCE SPECIFICATIONS

GENERAL:

Performance Specifications tell a manufacturer, vendor, supplier or provider: What is considered to be an acceptable product? And How will the product's acceptability be judged? In other words performance specifications state **requirements** in terms of the **results to be achieved** and provide **criteria for verifying the compliance**. Such specifications define the functional requirements for the product, the environment in which it must operate, and the interface and interchangeability requirements. Performance specifications, however, do not state means or methods for achieving the results. It allows the supplier with freedom to choose and improvise materials and methods.

> The preference for Performance Specifications over Design Specifications was introduced in USA by the Federal Acquisition Streamlining Act of 1994. Various agencies have adopted their own policies in compliance with the Act. The Act itself permits design specifications to be used in some cases by saying ". . .to the maximum practicable extent."

Systems specifier like a designer deals with a product or system only occasionally and do not get frequent feedback. Whereas, a system provider (such as the supplier, manufacturer, fabricator or installer) is consistently involved in supply field, and receives feedback from diverse sources. System suppliers as a result have better understanding and capacity to improvise the product. A system specifier may specify a **technologically adequate system**, but a system provider offers a **technologically superior and economically most appropriate item**.

A designer as a system specifier must work in close collaboration with the markets (represented as the supplier, manufacturer, fabricator or installer, etc.). To specify performance, ideally a system specifier and the parties capable of submitting the proposal or bid, both must have a consensus as to what the requirements are. But this type of neutral interaction is not possible or desirable in Government deals. So it is desired that requirements of performance are **specified quantitatively** rather than **qualitatively**. Qualitative data can provide varying interpretations and cause misunderstandings, but quantitative data is easily verifiable.

Performance and Verification: Any condition, characteristic, or capability that must be achieved, and is essential for item to perform in the perceived environment must be **plausible and verifiable**. For example, if a building is required to withstand certain measure of an earthquake, then methods how to verify this must be stated. Verification process is accompanied by definition of 'the extent of contractor or vendor's participation and their liability for providing corrective solution'. **Warranties** offered by the vendor can to some extent substitute the **performance and verification requirements**. However, very often warranties of the vendors are restricted to their own supplies. The warranties are also conceived like a risk management system for compensating a fault with something 'equivalent' or money, but not the for the affectations that occur in adjacent areas or systems.

In comparison to item or work specifications, performance specifications require fewer references, except for standard tests, interface drawings, etc. Due to the absence of procedures, performance specifications are less dependent.

Restrictions in Performance Specifications: Performance specifications must not limit a provider to specific materials, processes (including quality of man power or equipments), parts, etc. However, one can prohibit certain materials, processes, or parts when authorities have declared quality, reliability, or safety concerns such materials, technics or processes, as for example environmentally harmful technologies. Upper and/or lower performance characteristics can only be stated as requirements, but not as **goals or best efforts**.

Writing performance specifications: A System specification writer must know: Define and declare requirements that are absolute or threshold. Declare these: All constraints governing operations or use of systems within natural and induced environments, Interface requirements with other systems and Limitations for operators and maintenance persons.

Performance Specifications for Structural, Architectural and Interior Design jobs: Such jobs consist mainly of industrially produced and standard components, but their composition (fabrication, installation or siting) is a unique phenomenon. Performance specifications at parts or components level are not very difficult to implement. However, adopting a performance specification strategy for large **complex systems, or whole projects** is a very difficult proposition. Design professionals can overcome this problem by consciously moving towards **self-sufficient systems** like **plug-in modules**, rather then **excessively customised products** that remain **one-time efforts**. Performance specifications at lower levels such as for **replaceable components and spares**, should include essentials for **interchangeability and interoperability**.

Strategies for Creating Performance Specifications: It is very difficult to conceive a **fresh set of exclusive performance specifications**. But one can gradually and consciously reformat the **traditional specifications** with inclusion of performance parameters for standard parts and components.

Resources for Performance Specifications: Many resources are available to form performance specifications: Government departments and large corporate groups which prepare **indexed descriptions of commercial items** for frequently or routinely required products. Performance oriented descriptions are also available in **public domain purchase bids**. Trade associations, commercial organizations, or technical societies often develop **coordinated standard specifications**, for the warranted performance of items produced by their members. Government Departments design and publish Model Specifications for use by their own sub departments and other agencies. Performance specifications of well-organised departments like defence, telecommunications, etc. can be used for further **understanding of the methodology**. Market analysis as available in technical journals can show the ranges of performance that are currently possible. Market analysis also show the technologies involved and available alternatives.

Standard Performance Specifications: Standard performance specifications are intended to facilitate **standardization and interchangeability of common equipment**. Standard performance specifications specify product characteristics, dimensions, matters relating to form, fit, and functions.

Performance specifications operate at three levels:

2.1 READY TO USE OR OFF THE MARKET ITEMS

Performance specifications, become immediately relevant, when entities are acquired **in ready to use state**, i.e. '**off the market**'. Many such products are **hermetically sealed-unopenable** or **'closed ended systems'**, allowing no customization (and often no repair or replacement of parts). Such components are sought only through the comparative analysis of **performance assurances**. The performance assurance is either through the product conformity with some standards, or through performance specifications of the vendor-manufacturer.

2.2 DESIGNER PERCEIVED ITEMS

Designer conceived, systems are likely to be completely original inventions or slightly to substantially customized. For performance specification method the designer is expected to specify the expectations or needs for the product in terms of its performance.

2.3 FOR PROCURING SERVICES

Services are procured for creating a real or hypothetical product. In the first instance the service is required ultimately to generate a product, then acquisition of the product must be aimed. In the later case the delivery is in the form of advice, design, etc. Since this is a product, its performance can be specified, though with little difficulty. If such a hypothetical product is to be provided by a recognised expert, such as doctor, chartered accountant or lawyer, then that condition can form part of guarantee-warrantee with the performance specifications. Services by professionals such as Designer, lawyer, doctor etc., depend on their professional attitude and behaviour, resulting in their earnestness. This is difficult to verify through any definitive criteria.

3.0 OPERATIONS' SPECIFICATIONS

GENERAL:

Simple and projects of routine nature are distinctly **delivered - handed** over to the **client or user**, according to a defined process and schedule. Then the client or user on own or through other agencies are expected to manage and operate the system.

However, in case of **complex projects** there are many subsystems which begin to be operative as soon as are installed. A contractor or vendor uses many subsystems (such as stairs, drainage & water supply system etc.) till the project is delivered. In cases like, **turnkey projects**, some of the subsystems must be operated for **trial and verification**.

Projects conceived through **Performance Specifications** invariably have many **built in provisions** for care of the main and subsystems during their **emergent phase**. For complex projects the job of operations and maintenance is handled through departmental facilities or out sourced to specialized agencies. In both cases a strategy is required for dealing with **probable conditions** and also for **less-predictable situations** (disasters, crisis). Designers of the system may provide such a strategy or specialist agencies are required to prepare the **operational specifications**.

Forms of Operations Specifications: The agency that evolves operational specifications, such as Owners, Designers, or Operators of the systems, each adopts a varied strategy to deal with the situation. Operations specifications become key instructions during crisis. So such specifications often are more graphical then written to make its access non technical, and free of language barriers. These specifications may not occur as a single comprehensive document but distributed across the estate. Many specifications are in the form of signage, instructions or warning signals. Repairs and maintenance work are scheduled with other plans of actions. Operations specifications also include methods of observance, supervision and feedback systems.

Conditions for Creating and Providing the Operations Specifications:

1 System Designer, System Provider (contractor, fabricator), and the System Operator, each ones roles should be clearly delineated.

2 A System Provider must distinctly (formally) handover (deliver) the System (whole or self-sufficient parts of it) to the Client or appointed System Operators, as provided in the contract.

3 A System Designer and System Provider, together evolve the Operations Specifications. Only one of them is made responsible for Formal Transfer of the Operations Specifications' Documents to the operative agency.

4 System Designer (or the client) must see that necessary guarantee as available from Vendors and Sub contractors, and as provided by the main System Contractor, are transmitted to the Client. Alternatively a third party agency is appointed to create them afresh, affect such a transmission of guarantees.

3.1 GUARANTEES, WARRANTIES

Transmission of Guarantees and Warranties: Concepts turn into Designs + Specifications, and ultimately into a **Product or Service** deliverable to a client. A Client (as user or owner-investor) is the person who has initialized the whole process with an expectation for a certain gain or compensation. If the product or service, is deficient then everyone concerned for its conception, design and production, is held responsible. But in reality this is very difficult, as there are many persons, materials, technologies etc. involved in the process, with very **indistinct and overlapping roles**. Often, the extent of **individual responsibilities** and **mode for verification** of their compliance, are not properly defined. In other instances' products and services come into being only as a conglomerate, where the individual share of responsibilities need not match with the physical scale of contribution. Congregated entities automatically do not offer a **comprehensive assurance**, which must be offered by an expert person or organization. So all **individual assurances** must be assimilated into a **comprehensive assurance** which then must be **transmitted** to the owner or operator of the project.

Creating - Providing own Guarantees: Dynamic Users employ raw materials (materials, parts, components) in forms and conditions beyond the **original manufacturers' provisions**. Guarantees provided by the original manufacturer for the **few definite end-uses** are rarely of any help for dynamic users. Even where materials are employed in the manner prescribed by the original manufacturer, the output process could make it impossible to relate a particular inadequacy to a certain material or procedure. People who assemble complex entities cannot hope to dilute their responsibilities even by involving people like suppliers of materials, etc., System creators must evolve their own guarantees.

Comprehensive Guarantees: In some jobs several vendors come together to a site, to create a System. Designers are not equipped to check or test run the system, or in such instances the system is not **completely verifiable**. Often there is no **Master Agency** to assure that the system so assembled will function according to the parameters set by Designers. Owners however, need a comprehensive guarantee to assign the operations and maintenance to agencies concerned with working of the whole entity, such as Insurance companies, Safety (fire, security) Engineers, System Operators, etc.

Processes required for Comprehensive Guarantee to materialize: Specifications for Turn-key Jobs invariably include ways and means for assimilating and interpolating individual guarantees into a composite form for the individual part buyers or users**.** Specifications are also provided for appointment of third party agencies to manage the guarantees and warranties for the life cycle of the entity. Such additional mechanisms provide an **uninterrupted cover** for all the **resultant liabilities** and an **operandi for the management of risks** thereof.

> Lloyds Register of shipping: Lloyds is one such organization that began in 1760 in London, It provides standards for construction and maintenance of merchant ships, and provides necessary technical help. Shipping agents, governments, bankers, insurance cos all depend on the certification provided by Lloyds.

3.2 LIABILITIES

Liabilities for projects result from **internal causes**, like inadequate performance, and also from **external conditions** like, disasters, calamities, political situations, changes in law, rules, perceptions, trends, fashions, etc.

Designer's Liabilities: A designer is liable for the inadequacies of conception resulting in poor definition of performance requirements, and for having inadequate process of verification for the offerings of the contractor or vendor.

Contractor or Vendor's Liabilities: A Contractor or Vendor's liabilities are always restricted, in spite of all-inclusive clauses that may have been integrated in the terms of contract. The liabilities of the contractor generally relate to **correcting the defects or complete replacement**. The liabilities may also include **making good the loss of profit and loss of opportunity** during the **period of inadequate working**. In some conditions it may include the **loss of life and damage to other properties**.

Operations Liabilities: Liabilities also arise from the operations of the building or system. Designers and Contractors usually preempt such situations with appropriate provisions in the contractual relationship with the client. Operations specifications, in recognition of such situations provide for setting up of appropriate **Risk Management Systems**. A risk management system recognises the role of regular maintenance. Guarantees and warranties help in diluting the level of apparent risks and thereby reduce the Cost of Risk-Management (insurance premium).

3.3 MAINTENANCE

Projects of physical nature (compared with services) require regular upkeep. Maintenance process consists of **observing the changes**, **predicting** if any of it could be harmful, and also **scheduling and implementing the corrective processes**. Maintenance Specifications define the modalities of surveillance, reportage, decision making and initiation of actions.

Feedback System synchronous to a Maintenance System: A Feedback System, if properly implemented as part of the operations phase, it can help in optimization of new projects. Feedback system is difficult to organize for **rare, first ever, or holistic projects**. Where owners themselves are responsible for organizing the project operations, they are able to utilize the feedback more effectively.

Conditions and Scale of Deterioration: Physical Projects deteriorate mainly through ageing, but also due to **misuse, under use, over use or even non use** conditions. Conditions and scale of deterioration are predictable, so remedial processes can be prescribed. **Project operations agencies** usually prepare maintenance schedules and specifications in consultations with the **project designers**.

Maintenance Specifications and Upgrading: Maintenance Specifications nominally relate to replacements of parts, components and subsystems with identical items. However, when all the fitment conditions and existing environmental situations are available as part of the maintenance specifications, replacements for enhanced performance, i.e. **item upgrading** becomes less restrictive. The **criteria for enhanced performance** here could be higher productivity, less energy consumption, micro sizing, lesser weights, simpler technology, greater control, etc.

COMPARATIVE EVALUATION

Design vs Performance Specifications: Item or Design specifications are process oriented with the belief that products can only be conceived through their **Recipes or Processes**. So Item or Design specifications result into **exclusive products**. Some products, requiring very exact cover of guarantees and warranties, need a **mix of Design and Performance specifications**. Just as Item or Design specifications offer **situation or occasion specific exclusive entities**, products based strongly on Performance Specifications, are likely to be **universal or procurable over and over again**.

Good specifications do not tell the provider how to deliver the service, but they describe what is to be delivered. This enables either the in-house team or an external provider to then prepare their strategy as to how the performance and quality standards will be achieved.

○ New installation, entire system provided by one vendor: A performance-based specification is preferred as allows the most economical solution to be applied for the entirely new system.

○ New installation, created from systems provided by many suppliers: In this case, the agency needs create a design specification appendage to ensure that the system as a whole will work.

○ Alterations and Expansion of an existing installation: A design specification is often unavoidable as the new equipment must connect and integrate with the existing system. This requires **site or occasion specific** parameters.

Performance Vs Operations Specifications: Engineering Design Specifications invariably have Operational Definitions. On the other hand Performance Specifications to be operational, must contain a Test Method Description for each Performance Requirement. The Test Method Descriptions communicate precise criteria for acceptance, more clearly than the **Statements of Requirements** do by themselves. Though a neat Performance-type specification remains a Design Specification, if ONE Design requirement is left in it.

2.07 PLACEMENT OF SPECIFICATIONS

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Specifications derive their **importance and relevance** on **How and Where** these are presented. Specifications in **Design Practice** are placed in many **different types of documents** with **peculiar formats** to serve very **exact intentions**. The **Document type**, **location** (Placement) and the **format of presentation,** are all determined mainly by the **nature of exposure** the specifications are to have.

Document types: Design documents are essentially of Four types: in-house, clients' eyes, for consultant's and for job award or execution. Other minor varieties of design documents include: for public presentation, for government authorities.

Location or Placement: Specifications are placed in sketches, drawings, as write-up accompanying drawings, as part of Job awards, brief memos, long reports, signage, as product or packing labels.

Format of Presentation: Specifications are literary or worded, drawn, orally communicated. Specifications could be sketchy, detailed, independent and intricately linked. Specifications could be drawn, printed, digital, audio-video, signs, signals, original, facsimiles.

Exposure: Very personal, i.e. **Author's-eyes only** (when access is restricted to its creator), **In-house** (available to office-staff only), **Clients' reference**, **Consultants' assignments**, Bids invitations or Job awards, Contract documents, Operating agencies.

Contents: The contents of specification documents are often defined to serve very specific purposes. The contents are re **validated** to see if, the information is **private vs. public**, Data is **freehold** (public domain) or **patent** (copyright, intellectual property), subject is **prosaic or engaging**, presentation is **brief or detailed**, language is **allegorical or straightforward**, etc.

SPECIFICATIONS IN A DESIGN OFFICE ARE PLACED:

Within a sketch or preliminary drawing: These drawings are prepared to initiate an idea. Sketch or preliminary drawings are too small in scale, lacking in details, and do not carry all the graphical views to convey the intentions. Similarly materials, components, procedures, and design parameters which have not yet been fully conceived, or not crystallized into a formal structure, are all placed as a write-up. Such write-ups are usually meant for the **designer's personal reference**, and very rarely for the client, so need not be a trade, technique or material specific. These write-ups may be just indicative or thin in content, as these are seedlings from which the total idea is to germinate.

Within a schematic drawing: At a **schematic drawing's stage**, the design has taken shape. Options regarding materials, finishes, techniques, are explored and indicated as write-up, in the drawing. Where parts / subsystems are yet to be conceived their design parameters are also indicted. More often than not a set (copy) of schematic drawings is submitted to the client. In such a case only the office copy (in-house set), carries the specifications' write-up. Schematic drawings are exploratory so may also carry optional specifications. However, whatever is shown or implied, will be construed by a client to be a promise.

Within a Layout Drawing: Layout drawings as the name indicates are used for specifying the whole work. These are also used in laying out the work on a site, and so contain specifications for establishing the scheme on the site. Since this is the main or **starter drawing** it **establishes links to other drawings and details**. It is used for conveying methods of interpretation for this and other linked drawings. Measures (dimensions, tolerances, fitments, margins, and measures like weights /mass /speed /time), which cannot be graphically indicated or linked to any particular graphical view are presented as a **common write-up or explanation**. Being the basic drawing, it provides a common ground to indicate, when and how a part or parts of drawing become execution worthy. Limitations and responsibilities of various agencies' work, time schedules and inter linkups for start and completion of various items, parts, etc., are all specified in the layout drawing.

Within a Detail Drawing: Detailed drawings are generally large scale presentations of complex parts. These drawings are often used by several trades' persons. Overlapping areas of several components are shown here. The detail drawing specifications include **legends** showing **graphical vocabulary** used for identifying various materials in sections and on their faces (elevations). It also includes **graphical symbols** to represent very small parts or standard components. The specifications on such drawings clearly indicate or establish relationships between the component and the concerned **trades branch**. Where several detailed drawing sheets are referred for a part or component, specifications need not be repeated on all sheets. However, if specifications are to be distributed over several sheets, a proper linkage must be established. These makes it easy to revise specifications or drawings, and convey such changes to the concerned parties, through other means of communications.

Within a Component Drawing: Components are conceived as self sufficient sub systems, and as a result their details consist of not only the **fitment conditions**, but **operative parameters** as well. Component specifications generally do not spread over to many drawings (Large/complex components will consist of sub assemblies, which can be detailed individually). Components, if presented with **siting specifications**, it will mean a **non standard placement** is proposed. Whereas for standard components, absence of siting specifications, will mean that standard conditions apply. Standardised components may also be indicated by referencing the **Standards' Documents**.

As a separate write-up but on the Drawing Sheet: Specifications as a separate write-up on drawings, generally relate to procedures and materials about several parts or whole of the object, e.g. siting of a building on land, preliminary-work to be carried out before the commencement of actual work, precautions regarding the start / continuation / completion of the work, etc. These are presented in a written format, because graphical formats are inadequate or inappropriate here. In situations where graphical presentations are likely to create **ambiguities in interpretation** (as in a court of law, or by lay people not conversant with graphical presentations, communication through inappropriate modes, etc.) details must be additionally specified in writing.

As a separate document accompanying Drawings: Where Specifications are not related to any particular drawing, and are describing common materials and procedures etc. that generally relate to the entire work, and when are very lengthy, are supplied on separate sheets of paper accompanying the drawing. If necessary, mention of such Sheets is made in the relevant drawings. Such sheets sometimes are bunched together as a catalogue of **Specifications of Works**.

As Memos and Short Messages: Site and Design Office have a continuous exchange of messages relating to inquiries, clarifications, confirmations, rejections, acceptance, corrections, reporting, etc. Some sections of such communications could have effect equal to a revision of a specification or initiation of a new specification. For this reason all messages, routed through whatever mode of communication must be **Dated and Numbered** with **Author and Receiver's Identity**. It is often more prudent to separate out Communications that could have **Consequential Effect**, and reconfirm them in the weekly or periodical reports. Communications relating to a specification, must mention the relevant part, component, subsystem or section of the project and exact location (drawing, communication, tender etc.) where it was earlier referred to.

As part of the Job Award Document like Tender: Specifications are very often linked to the **Quantities of various tasks or work items**, by actual mention or sheer **proximate placement**. The contractor is than asked to quote for the items. Such specifications are divided into two classes:

General Specifications: General Specifications as the name suggests, relate to the whole of work or several items. These are subdivided into categories such as (a) materials (b) techniques / procedures (c) precautions (d) time schedules (e) mode of measurements (f) billing procedures (g) completion of a part/s or whole.

Special Specifications: Special Specifications relate to an item and its materials, techniques / procedures, precautions, time schedules, etc. Such specifications are sometimes trade or supplier specific, and as a result, are restricted and technical in nature. Often the supplier is allowed to offer own improvised scheme within the frame work of specifications. Such specifications instead of describing, how and with what a part is to be made, a list of **Performance Parameters and Conditions of Fitments** are provided.

When specifications occur with any quantities for work or job, these are often perceived by the contractor or vendor, to be the **optimal quantity of work for cost calculation**. To avoid such a perception minimal quantity per **natural lot of work** (e.g. RCC or masonry work per day or stage) may need to be indicated.

As a Public Declaration: Public organizations are required to be transparent in their dealings and for that reason many details including specifications of work are placed in public domain such as internet. It could also be an internal publication for all the **stack holders** or one handed over to the **contractor of a project**. This could be a **legal requirement, tradition or a voluntary act**.

As a Traditional Statement of Work: This is a comprehensive statement listing all facts about the project for jobs to be handled through Design or Item specifications. It is meant to be public statement and is published with bids invitation. In this instance it includes all or few of the following details

(Statement of Work SOW for Performance Specifications discussed later-here)

1 Title of the project
2 Scope of the project
3 Nature and Sources of funding
4 Location of the site
5 Site-conditions
6 Ownership status of the site
7 Projection of work to be created or delivered
8 Status of approvals
9 Reportage requirements
10 Identification of documents that detail the project
11 Schedules

Statement of Work (SoW) for Performance Specifications: A Performance based SoW is very different from design or Item specification jobs. It describes what has to be accomplished without describing how the job must be done. As it leaves the 'how to do the job' to the contractor. Many of the works related conditions (as listed above) are not required. A Performance contract emphasizes acceptable results (output). However, some requirements relating to **functioning of site, safety and welfare of site entrants, and Government regulations** are stated. Many of these are legally evident but their mention here reinforces 'a sense of enforcement'.

As Description for Pro-forma Invoice: To avoid the technicality of specifications writing, many organizations, prefer **to acquire items that are familiar, standardized or commonly available in the market**. **Commercial descriptions** or simply the **Brand Names** are provided as a **Pro-forma Invoice** (an advanced bill / predefined bill). Such Pro-forma Invoices also include the conditions of delivery, installation, the quantity, sizes along with the tentative rates. Often the buyer indicates a tentative rate over which a supplier provides a quote which may be lower, equal or higher. Such a system obviates several office procedures. The **Pro-forma Invoice Specifications** in a way demand a particular product or its equivalent, with knowledgeable performance. Pro-forma specifications do not allow any **revision of specifications**.

Referencing Standards: Specification to be compact, reference **Published** (public domain) **Standards**. Most Standards for part or detail level clarity refer to many other standards. So when a standard publication is referenced only by its title and code (and by not quoting its text), intentionally the main standards document is attached, but unintentionally other linked standards also automatically get attached. A sub condition of a standard may be referenced, but it is very difficult to make it really effective bereft of its natural attachments.

2.08 SPECIFICATIONS FOR WHOM

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Just as the **Placement of Specifications**, determines the type of **Exposure** it will have, the type of Exposure also affects the **Format and Contents of Specifications**.

Author's-eyes only or personal: These documents are designers first sketches drawn impressionistically and often like a doodle, illegible. The orientation, language, signs, metaphors, symbols, etc., are very much subjective. These documents are very personal, un-interpretable or mis-interpretable, so must remain with the creator. These documents may have 'patent' or exclusivity value, so are not shown to anyone.

For Explanation of In-house Documents: These are created to understand and record various aspects of the project. In-House documents always remain within the office. Its language is very **technical and abbreviated** so only staff members who are conversant with it can read and interpret it. The contents are not binding to anyone so the composition is very casual. These types of specifications can be altered at any time without liability. However, some sort of standard format is required, to create documents that are **comparable and interpolating** with such documents within the organization.

For Clients' (Preliminary) Understanding: Clients are presented, or allowed to see some of the **preliminary design documents**. The specifications presented here are in simple form and language, so that a lay person like a client can understand. The only liability it can create, is that certain **language constructions** may be perceived as a **promise**, and which may convey guarantees and warranties. For these reasons such specifications should not be watertight, but rather open, allowing several **options and possibly interpretations**.

For other Consultants' Understanding: Designers have to consult other professionals for advice and action. At **advice or informal** level of consultation, alternative approaches are being sought. At **formal or action**

level, actual modalities for the execution of a decision are framed. In the first case the specifications should be self-sufficient. **Alternatives**, if any should be **self-evident**, and marked with an **order of preference**. For the second case specifications should be very definitive and complete. It must also unambiguously project the **consultant's responsibilities and liabilities**.

For Contract or Job Assignment: Contract Specifications are mainly used for causing a job or task. Even where the job is very simple, known or traditional, it must be **formally defined**. The vendor or the contractor is provided all the details / data necessary for the creation of an item through the specifications. These are always interlinked to other dependent specifications. So one must see that not only the main, but all other dependent specifications remain relevant, or there is a built-in automatic process of their up-gradation. Contract Specifications are also linked to the **considerations** (payments) the item will generate. Any short coming in providing the details / data, on part of a Designer, on one hand, and lack of effort, efficiency or misinterpretation on part of the vendor or contractor, can cause a defective or inadequate item. These types of specifications are very precise, and unambiguous.

Contract Specifications must incorporate **Time elements**, like schedule of start and end of not only the whole, but parts (in terms of execution, operation and occupation, transfer or discharge). **Compensation** should be linked not only to the **quality of performance or yield**, but also to the **scheduled completion** of the item. Contract Specifications must demand only plausible guarantees from the contractor or the vendor. Contract Specifications must not generate liabilities for client, designer or contractor that are not **time specific**.

Contract Specifications should as far as possible, be based on **Standards** established by authoritative agencies like BIS, ISO, WHO, ILO, etc. **Performance Parameters** should replace traditional **Materials & Methods type of Specifications**. Such provisions create a contract document that is **leaner in size**, **unambiguous in content** and **universally acceptable**.

For Operations of Systems: The **Operational Requirements** for a system are best determined by its designer. **Turnkey installations** are created with very **specific operational definitions**. These somehow need to be communicated to the client, the user, and their successors. Often **Crisis Handlers** like fire brigade, territorial army, police, security, army etc. need to take over the system. **Risk Managers** like insurance surveyors, maintenance persons, safety inspectors, environmental monitors also oversee the working of a system, and need to know the operational definitions.

Operations Specifications deal with following aspects:

- Details of structure of main and sub systems of the installation,
- Replaceable parts and their specifications,
- Schedules and modalities for repairs and maintenance,
- Required inputs and possible outputs for the operations,
- Operative instructions
- Hazards, risks, ways to make the system inoperative or safe,
- Dismantling and disposing the installation or its parts.

Such specifications are compiled as a **Manual, Chart or Booklet** that are easy to access with all types of cross referencing facilities. Often such manuals are **multi lingual or graphical** to obviate the language barrier. Operations specifications often contain systems to generate **feed-back data** reports.

2.09 WRITING SPECIFICATIONS

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Type of Specifications in a Design Practice: A Design Office generates a variety of Documents that contain some or the other forms of Specifications. Such **Specification related documents are of following categories:**

1. Drawings, Graphical representations
2. Literary explanations
3. References to other Graphical Representations and Literary explanations, Legends, Indexes, Lists.

Quality of Expression in Specification Writing: Writing Specifications is the most important way of **facilitating a product or service**. Specifications writing is an extended activity of contracting, so here too all the **contract fundamentals** are strictly followed. Such as a contract has to be enforceable, and whatever is specified must be doable. Specifications cover all valid and essential requirements of the job. A major danger in writing specifications is to include unnecessary information, choosing what to exclude is as important, as choosing what to include. Specifiers (Designers) must **eliminate any requirement that adds no value to the Product or Service being acquired**. The Specifier (Designer) must state clear conditions in a complete language, and yet remain brief.

Defects in Specifications and Liabilities: Very few specifications are totally free from defects. As a fundamental principle of law, a specifier (Designer) is responsible for the consequences of the specifications. Designers usually put in a **disclaimer** (in the contract with their client) for errors found in their work. The Insurance companies that cover the designers for **Professional Liability** (Professional Indemnity Insurance) insist upon it.

Most of the specification writers (Designers) incorrectly presume that their text of specifications is read and interpreted by **comrade technocrats** only, with whom they share **similar experience and mind-set**. Specifications, however, are more attended by **non technocrats** like the administrators, lawyers, jurors and judges. A contractor interprets the specifications, as long as the **interpretation is**

commercially reasonable (an earning proposition).

The Notion of Deconstructionism: A French philosopher, Jacques Derrida originated the Notions of Deconstructionism. It is a whim of finding alternate interpretations of text. He contended that the meaning of a text is dependent on the context in which it is interpreted. All writings in some degree can be interpreted differently from what was intended. Deconstructionism doctrines, from Jacques Derrida and his colleague Michel Foucault, were a rage in many universities during the 1980's. A quotation from Thoreau, 'The mass of men lead lives of quiet desperation' was attacked by a feminist deconstructionist in words like: '….. real intention was to say that most women lead lives of noisy elation.' Here the writer's unintentional gender-specific wording was interpreted differently.

Faulty Specifications and a Contractor's Attitude: A contractor works with **sheer sense of profit**, and so deals with **faulty specifications** in any one of these ways:

1 A contractor charges by doing the prescribed work according to the personal interpretation, then may

2 demand extra for undoing what was done, and also

3 charge for redoing the job according to the corrected interpretation.

In other direction…..

1 the Contractor may refuse to execute the work causing delay, or

2 take a legal recourse on the grounds of impossibility of performance or commercial impracticability.

Specifications and Enforcement: A neat contract is one where things are **delivered for consideration**, but strictly in a **one-way transaction**. However, contracts are very complex. Certain jobs require clients to provide information, materials, equipments, facilities or services to the contractor (as per the terms of a contract or job specifications), and **an obligation is incurred**. Even if such things are offered with or without a **return consideration**, the contracting parties get tied up in the **Reverse Transaction**. A client, failing to deliver as promised, takes the blame for missed schedules and cost overruns. Specifications causing such Reverse Transactions are prone to **enforcement difficulties**.

Accuracy and completeness of Contract Specifications: A Contract is in force the moment it is signed, or dated to be effective. Once a contract comes into force, any thing has been left-out, or not properly defined, can be only corrected through a **Negotiated Supplementary Agreement**. A Contract and Specifications must not leave out any aspect, as something to be agreed or determined later on (e.g. a clause like: plastic paint of x quality, but colour shade to be approved later).

Specification Writing is a **last moment compilation**, and as a result it is common to see specifications of items that do not exist, or have been eliminated from the project. Specifications of only **intended items and required quantities** of work should be provided to the contractor. Otherwise, the bids will reflect the necessity of being prepared to handle **Intended items and Quantified work**.

Holistic Products and Site Assembled Systems: Job assignments for Structures, Architecture, Interior Design, etc. consist of both, Holistic Products and Site Assembled Systems. It is often easier to handle **Holistic Products**, fully or substantially through **Performance Specifications**. However, **Site Assembled Systems** inevitably have some form of **Design Specifications**.

Specifications and Fair Trade Practices: Avoid specifying a particular product, agency, tool, equipment, or a patent process. Favouring one, to the exclusion of others would mean Unfair Trade Practice. It is a good business sense to encourage competition to achieve better prices and quality. Competition also provides optional and reliable sources of supply. Mentioning a particular product, provides an unintentional warranty of its suitability for the purpose. It is better to confine Specifications to Requirement Statements.

Property Disposal: When Writing Statements of Work, the Contractor must be told How to dispose of residual materials, garbage, sewage, emissions, etc. Such Disposal Procedures have to follow the local regulations, often at cost. The liabilities arising out of compliance and the cost operations need to be specified. If the residual materials are to be handed back to the client, then handling and storage must be specified. If disposal of such items is likely generate an income, who takes the money must be mentioned. The Tax liabilities of expenditure, income generated, or sales done for disposal, also requires clarification.

Valid Claims: A Designer and Client realize shortcomings of the work being executed, and request alterations or corrections. Such changes are not executed unless formally requested. The cost of such **constructive changes** is to be paid by the client and is considered a **Valid Claim**. Contractors also make mistakes. A contract specifies modalities for notifying mistakes and what is considered to be improper communication of information or reportage by the contractor. Contracts also list modalities for corrective action and settlement of costs.

Language: Contract language must be simple and for that reason sentences should be short. Long sentences do not provide any sensible meaning. Throughout the document for the sake consistency and even at the cost of creating dull and a simplistic writeup, use the same words, phrases (rather than exploiting a thesaurus). Use **category numbering** system and avoid **inter-document referencing** such as 'see xxx page, ref to yyy sub item, see above-below', etc. Avoid **acronyms**, If must, use the commercially known **abbreviations**, and provide a reference index with expanded meanings. Avoid ambiguous words, or phrases that reflect more than one meaning. Refrain from phrase constructions that due to their sequence of placement, context or grammatical relationship could be interpreted differently. **Conflicting Requirements** often result from using totality words (such as: all, always, never, every, and, none, etc.) in statements, when something else in another sentence makes an exception to the totality.

Writing in **Passive Voice** is always superior. The object of an action gets precedence and thereby the required special attention. In specifications the emphasis must rest on the product being described. It also removes the mention of the actor. Government servants favour passive voice because it does not require the mention of the actor, and thus avoid the responsibility. Avoid using **gender nominating words** like he, she, his, her, him, man, men, woman, women, etc.

Grammatical Errors: There are three levels of grammatical errors. At primary level such errors do not affect the meaning being conveyed. (X ate less apples than Y vs. X ate fewer apples then Y). At next level the grammatical mistake renders the sentence totally meaningless. Such errors can be corrected through meticulous proofreading. But the most dangerous **grammatical blunders** are those that alter the intended meaning of the expression, to something different. These get passed over by most literary proofreaders and software like word processors' grammar checks. Such mistakes can only be checked by an expert **Specification Writer**, or a **Seasoned Contractor**. The last level of errors are most exploited by a lawyer in case of a dispute.

2 .10 STANDARDS

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Standards emerge as the **most widely acceptable strategy**, set through specifications. Standards are conceived to generate a controlled response. Standards relate to specifications for making, maintaining, using and disposing objects, and mechanics of creation, handling, operations and management. Standards as the most widely acceptable strategy, could emerge from **empathy or as a strategic understanding between two or more persons**. Standards' formation is a raison d'etre for (reason for being) member of clan or society. Governments gain political power and patronage by administering standards. Regional blocks and International communities achieve efficiency by preventing conflict and duplication of effort through standards. Standards, very effectively and economically raise the levels of quality, safety, reliability, efficiency and commutability.

Levels of Relevance: Standards are expected to achieve predictable results, by **voluntary concurrence, obligation, or through enforcement**. Standards are very powerful means to cause a change or even maintain status quo. The nature of **Application of Standards** takes many different forms with varying levels of credibility. **Acceptance of standards** if voluntary ensues a social respect or some form of elite status. The enforcement also may occur with social boycott, penalty or punishment.

- **Compulsory and Legal:** Such as laws, rules
- **Obligatory and Quasi Legal:** Such as directives, policies
- **Obnoxious or Evil:** Such as decrees, mandates
- **Necessities:** Such as compulsions, obligations
- **Traditional and Esteemed** Such as customs, traditions, taboos
- **Provisions:** Such as, recommendations

TYPES OF STANDARDS:

Standards emerge at many different levels. At **basic level** these are very widely acceptable strategies. But at **higher level**, a person, an organization or a government department must strive for **greater universal participation**. Such an active role in the society occurs as a quest for quality for all aspects of being. The **quest for quality** is reflected through: desire to excel, readiness for improvisation, steadfastness to good practices, transparency in dealings, persistence for consistency, wider application.

Personal standards: Standards at a very primary level are compiled by a Person, as a 'collection of bests', 'most favoured or representative items' or 'my suggestion'. Since these are carefully picked out items, represent a **Quality Conscience of the Author**, and so are personal standards. Personal Standards are valued for the author's mastery over the subject, rather, then the absolute quality of the included material. Personal standards combined with personal norms for enforcement are often tyrannical. Specifications that establish personal standards describe entities' physical characteristics, but rarely provide the ways and means (processes) of achieving or even testing it.

Typical examples of personal standards are: Time saver standards for architecture and interior design, Furniture or item catalogues, Special issues of periodicals, etc.

Standards as a strategic understanding: Standards can be a strategic understanding, among the competitors or between the associates to manage a situation such as: reduce the rivalry, rationalise the methods of production, reduce the costs, enhance the image of the product, form a cartel to ward off the nonmembers etc. Such standards also emerge without any distinct effort, as 'followers of the same path', empathetically sustain similar actions. A **work-culture or faith comradery** develops among the practitioners.

Standards of clan or cast: Members of clan or cast can have a tacit or formal understanding for acting in unison. Such understandings are of usually negative dictates and are very restrictive. These understandings or standards sustain the livelihood by protecting the exclusive or patent knowhow, and by regulating the competition among the members. The standards are **more of the norms for behavioural and less of technological specifications**. Clans and casts flourish by acting in consonance with the Rulers or Government. Which, inturn enhances their governance by politically acknowledging such practices. Over a period of time the **divergent policies and directives** of the clans get rationalised as the **Code of Conduct**. Such Codes relate to personal behaviour, formation and conduct of commercial activities, use of resources including the environment, safety measures, risks management, manufacturing, handling and disposing of the materials, and trade practices relating to weights, measures, economic transactions, employment, etc.

Virtual standards: Some major Consumers, Government departments like defence, because of vast scales of their operations, are **prolific creators of specifications**, and their needs become virtual standards. These agencies can afford to operate testing facilities for the purchases, and have enough supervision expertise for rationalizing the work procedures.

In India, Railways and Public works departments are some of the agencies that dominate the realm of commercial activities. Whatever is consumed by them become the commercially the most viable item. In USA the Government (mainly in defence establishments) allows specifications to be only performance oriented. These are **Standards by Preference and Prevalence** and are, a commercial reality.

National standards: Specifications have strong indigenous origin, because materials and human skills, both have **strong local character and advantage**. The **Bureau of Indian Standards** (BIS) in India, and National Standards agencies in many countries of the world, operate as a **Standards Formulating, Licensing, and Enforcing-agency**. Whereas some governments like USA, act only as a **Facilitating agency**, encouraging the trade organizations and technical associations to take the lead in not only **developing standards, but for their enforcement**.

Governments during the later part of 20th century found it easier to frame laws that are parallel to standards. In many small countries, standards for only very urgent and acute requirements are prepared, as integral part of the legislation. '**Formulation of Standards' and Legislation** is considered to be the same.

International standards: National standards are very indigenous, designed to serve the national interests. The **national protectionist interests** are served by **restrictive or negative specifications**. National standards cover only the **exigent needs of the nation**, so do not serve the interests of **regional economic activities**. When materials and human resources are transected across nations, a need for a wider application of specifications makes Nations come together to create a **Charter of Regional or International Conduct**. A world level Organization was needed to coordinate the standards' activities of many Nations and Commercial Organizations. **International Standards Organization** (ISO -1947), International Electrotechnical Commission (IEC -1906) in 1906 and the International Federation of the National Standardizing Associations (ISA -1926-1942), are some such International agencies.

International Standards have no **Legislative Support or Enforcement** backing of a Government. International Standards work on **Voluntary Corroboration**. Such standards flourish on the realization that greater advantages are earned by following it, rather then not being part of it. Success of International Standards depends on the **Rational Confirmation and Wider Acceptance**.

PROCESS OF STANDARDIZATION:

Standardization is a process of identifying **common features** amongst various **Versions of Specifications** (personal, clan, trade, etc.) and assimilating them into a common and rational form. A standard emerges from equalization of divergent views, beliefs or concepts, as a consensus with intentions of efficiency and commercial advantage. 'A Standard is that level of performance or accomplishment which has been selected as an Ideal to which actions or objects may be equated'.

Standardization allows for clear communication between **User and Suppliers**, at a relatively low cost and with some degree of efficiency. Standards allow for interchangeable parts, replaceable systems and inter polarity of systems by encouraging concepts like: '**Open-Ended-Architecture**', '**Modulated Plug-in Systems**', '**Networking**', '**Shareware**', '**Systems thinking**'.

FORMS OF STANDARDS:

Standards may be written descriptions (or conveyed through other media), mathematical formulations, graphical presentations or drawings, all setting forth the important features of objects to be produced, services to be performed, or results to be achieved and verified.

Standards for industry may be **Qualitative Parameters for constituent raw materials**, which can provide a reasonable output. It could be **Capabilities of machines and other equipments**, which combined with specific human skills help efficient handling of tasks. Standards also specify **Tactics and Strategies** of securing assured results. It could be devices, instruments and methodologies to verify the performance. Standards could also include **mechanisms** to connect, operate, maintain and replace systems.

Standards invariably incorporate **Time as a disciplining factor**. Time management through scheduling, sequencing, acceleration, retardation, etc., regulates all events and happenings, and thereby forms the processes.

Standards that are applied in an Industrial setting include **Engineering Standards**, such as properties of materials, fits and tolerances, terminology, and drafting **practices. Product Standards** describe attributes and ingredients of manufactured items as embodied in drawings, formulas, material lists, descriptions, or models.

Updating the Standards: Specifications continuously evolve and so do the Standards. Standards cannot remain purposeful for very long, unless continuously improvised, and their domain enlarged. Some Commercial Standards, as for example, in the fields of Information Technology, Communication protocols and Data Processing are replaced by **emergent technologies** even before being implemented. ISO (International Standards Organization) and BIS (Bureau of Indian Standards) revise their standards, optimally **every five years**, but often more frequently. Improvisation updates the specifications included as standards, and enlarges the domain by including many more facets of human activities.

2.11 BUREAU OF INDIAN STANDARDS • BIS

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Work on standards formation in India began soon after independence in 1947 under the **Indian Standards Institution (ISI)**. It started a product certification scheme in 1955. The **Bureau of Indian Standards (BIS)** was set up by parliament in 1986, and has since then taken over the functions of Indian Standards Institution.

Bureau of Indian Standards Operations: BIS operates at two levels:

1 Formulating Indian Standards (IS) for the following sectors,

2 Product Certification activities.

Sectors for which BIS is operating:

Basic & Production Engineering
Chemicals
Civil Engineering
Electronics & Telecommunications
Electrotechnical
Food and Agriculture
Mechanical Engineering
Management and Systems
Medical Equipment and Hospital Planning
Metallurgical Engineering
Petroleum Coal and Related Products
Transport Engineering
Textile
Water Resources

Categories of Indian Standards:

Product Specifications,
Methods of tests,
Codes of practices,
Guidelines,
Terminologies,
Glossaries,
Basic standards.

Bureau of Indian Standards **(BIS) follows ISO** activities very closely

Its **coordination with ISO** takes on many different forms

> It provides technical advise on formation and revision of ISO Standards.
> It participates in various discussions on Standards related activities
> It revises its own existing standards to match the format and content style of International Standards of ISO
> It also provides equivalent ISO identifying numbers on its own standards. (Many BIS standards are now dual numbered standards, i.e. BIS & ISO)
> BIS operates Product Certification programmes as per the Guide lines of ISO
> It acts as a dissemination agency for various types of Quality Management related systems

The BIS Product Certification schemes are **Voluntary / Mandatory or Compulsory** in nature, and based on the International Standards Organization (ISO) **Guide 28.** The ISO guide provides general rules for determining conformity with product standards through initial testing, quality assessment, and sampling in the factories and in the open market. The Government of India has enforced **Mandatory Certification** of 135 products. Further under separate arrangements with statutory agencies, some products have been placed under **Special Certification Schemes** of lot or batch inspection, but carried out by BIS inspecting officers. For all other products, manufacturers are permitted to **Self Certify the Products** after ascertaining their conformity to the standard licensed for. It also **Subcontracts the activities of Surveillance and Certification** in specific areas, such as steel, rubber and electronic products.

All BIS Certifications (with ISI mark) are carried out on the basis of **Indian Standards** (BIS), which have been found amenable to product certification. A sizable number of Indian Standards however, have been framed according to ISO/IEC (International electrotechnical commission) standards, and some are, Dual Numbered as IS/ISO or IS/IEC standards. A large number of operational elements of the BIS product certification scheme correspond with the Requirements of ISO Guide 26 / 65.

The BIS product certification scheme is also open to manufacturers in other countries, though overseas certification is carried out after the signing of an agreement with the respective country. BIS standards are also used by National and State Governmental agencies as compulsory requirements for products, processes and services, through legislation. The enforcement (including verification of conformity) in such cases is not under BIS.

The broad areas of technologies now under **product certification** are:

Agriculture, food, beverages and tobaccos
Automotive components
Basic metals and fabricated metal products
Building materials
Cement and concrete products

Chemicals and Pesticides
Electrical, electronics and optical equipment
Leather products
Machinery and equipment
Paper and pulp products

Pumping, irrigation, drainage and sewage equipment
Rubber and Plastic products
Testing instruments
Textiles
Wood products.

Under the BIS product certification scheme, till to date more than 30,000 licences to manufacturers, covering a whole lot of industries, ranging from agriculture to textiles to electronics, have been granted. The certification entitles licensees to use the **ISI Mark**, which is considered the symbol of **Quality in India**.

Besides the normal Product Certification Scheme, BIS also grants licences to **Environment Friendly Products** under a special scheme and awards the **Eco Mark** to such products. These products have to conform to additional requirements specified in the relevant Indian standards.

> BIS is a **National Certifying Body** (issuing and recognizing) under the IEC System for conformity testing and **certification of electrical products** (IECEE). The Product categories for which BIS has IECEE acceptance are: Cables and Chords, Capacitors as components, Low voltage high power switching equipment, Installation protective equipment, Electronics and entertainment. BIS is the National authorised institution and the National Standards Organization under the **IEC system of Quality Assessment of electronic components** (IECQ).

BIS acts as the surveillance agency in India, for certifications granted by Canadian standards association (CSA) and South African Bureau of Standards.

BIS endeavours for improved adoption of Indian Standards by industry, large scale purchasing organizations, statutory bodies and universities. It lays emphasis on company standardization and association level standardization. It tries for effective implementation of standards through Sectoral Committees, such as those dealing with steel, food, textiles, information technology, automotive and power. State Level Committees on Standardization and Quality Systems also help for better implementation of Indian Standards. BIS also helps for use of Indian Standards in legislation definitions. BIS interacts with private sector undertakings for basing public purchases on Standards and Standardized Marked Products. BIS also tries for use of Standards in educational system.

Management Systems Certification Schemes: BIS is operating following management standards.

- ISO 9000 **Quality Management Systems (QMS)** Certification Scheme
- ISO 14000 **Environmental Management Systems (EMS)** Certification Scheme
- ISO 22000 **Food Safety Management Systems (HACCP) designated for Hazard Analysis and Critical Central Point**
- ISO 27001 **Information Security Management Systems (ISMS)**

other systems include

Social Responsibility ISO 26000

Risk Management ISO 31000

Services Management ISO 20000

Energy Management ISO 50000

Project Management ISO 21500

2.12 ISO : INTERNATIONAL STANDARDS ORGANIZATION

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Beginning of ISO: In 1946, delegates from 25 countries met in London and decided to create an **international standards organization**, to coordinate and unify industrial standards. The new organization, ISO, officially began operations on 23 February 1947, in Geneva, Switzerland.

> ISO is not an abbreviation (of International Standards Organization). It is a word, derived from the Greek **isos**, meaning equal, thus avoiding the variety of abbreviations that would result from different languages. Whatever the language accepted short form of the organization's name is ISO.

ISO is a **voluntary, democratic and non governmental organization** for international cooperation. It is now a **Network of National Standards' Institutes** of 162 countries of the world. It is formed on the basis of one member per country. Some of the participants, delegated by their governments, are the most representative body for Standardization effort in their own country. Today, ISO is the world's largest developer of standards.

ISO is a non governmental organization and so cannot regulate or legislate. It has no legal authority to enforce its standards. It evolves standards by consensus. Every participating member, irrespective of strength of its political prestige or size of its economy, can influence the formation of standards. Some Standards, through bilateral and multi lateral agreements, have become an inevitable **International Trading Requirement** and important criteria for aid, loans, grants, etc.

ISO standards are developed by Technical Committees that comprise experts from industrial, technical and business sectors that follow these standards. In addition, these committees may also include representatives of government agencies, testing laboratories, consumer associations, non-governmental organizations and academic circles.

ISO has some 3000 Technical Groups (technical committees, subcommittees, working groups etc.) in which nearly 50000 experts participate annually to develop

ISO standards. The ISO has published more than 15000 International Standards.

Formation of Standards at ISO: When a need for a standard is felt by a Government, Industry or Business sector, the requirements are conveyed through one of the ISO's national members, to any of the three **General Policy Development Committees**. These committees are: **CASCO** (for conformity assessment), **COPOLCO** (for consumer policy), and **DEVCO** (for developing country matters). These committees provide strategic guidance for the standards' development work, and ensure that the specific technical work is aligned with the market requirements and consumer interests. The new proposal, if accepted, is assigned to a technical committee of experts from the industrial, technical and business sectors. These experts are joined by others with relevant knowledge, such as representatives of government agencies, consumer organizations, academia and testing laboratories.

The technical committees meet to discuss and debate, until reach a consensus on a **Draft Agreement**. The draft agreement is then circulated as a **Draft International Standard (DIS)** to all ISO's members, for comments and voting. Many countries hold public review procedures for wider evaluation of the DIS. The feedback helps formation of a **Final Draft International Standard (FDIS)**. If that is approved, then the document is published as the **International Standard (IS)**.

The process of approval through a consensus for a full International Standard (IS) is a time-consuming action, not acceptable for fast developing technologies and situations. For such eventualities ISO allows intermediate stage publications before a full consensus: 1 **Publicly Available Specification (PAS)**, 2 **Technical Specifications (TS)**, 3 **Technical Report (TR)**, 4 **International Workshop Agreement (IWA)**.

To ensure widespread applicability, ISO reviews its standards at least every five years to decide whether they should be maintained, updated or withdrawn.

Principal activity of ISO is the **Development of Technical Standards**. ISO standards have extensive economic and social relevance. ISO standards include agriculture, construction, mechanical engineering, medical devices and services, information technology including media, and communication fields. ISO helps develop an **International Consensus on Terminology** to make the transfer of technology, declarations, negotiations and communication hassle free. ISO standards serve industrial and business organizations, by providing them with an assured base for **development of efficient, safer and cleaner products and services**. The trade between countries becomes **easier, fairer and competitive**.

Standardized dimensions of packing, luggage and freight containers make transport and travel cheaper, faster and efficient. Communication protocols make telephone and other systems join seamlessly. Standardization frees access for the disabled persons to consumer products, public transport and buildings. Standardized symbols let one move across linguistic frontiers. A consensus on grades and varieties of various materials allows producers the economies of scale, and consumers with choices at lower costs. Standardization of performance or safety requirements of diverse equipment makes sure that users' needs are met while allowing individual manufacturers the freedom to design their own solution on how best to meet those needs. Standardization of connections and interfaces of all types ensures the compatibility of equipment of diverse origins and the interoperability of different technologies. Standardized protocols allow computers from different vendors to talk to each other. Standardized documents speed up the transit of goods, or identify sensitive or dangerous cargoes that may be handled by people speaking different languages.

Conformity Assessments: These are required to assess materials, products, systems and services for the Level of Compliance to relevant standards before these can be put on markets. Agreements on **Standard Test Procedures** provide a mode for evaluation of products. ISO itself does not carry out the conformity assessment. However, it has developed systems and norms as to how the Conformity Assessing Organizations operate.

ISO and Governments: The existence of divergent national or regional standards was creating **technical barriers to international trade**. Now governments and other regulatory bodies rely on International Standards of ISO for technological and scientific base while legislating their needs for health, safety and environment. For small and developing countries with scarce resources ISO represents a free reservoir of technology. ISO standards are the technical means by which **Trade Agreements** are negotiated.

ISO and Consumers: ISO Standards on air, water, food, and soil quality, on emissions of gases and radiation, protect the interest of world citizens. Conformity of products and services to International Standards provides assurance of quality, safety, reliability, wide choice, and worldwide compatibility of technologies.

ISO has during the last decade developed methods for an organization (including an individual person) to develop Quality Conscience. These serve not just the products, processes and services but universally everyone affected by it, as a consumer, producer or a being. The essence is on transparency of intent. One declares the intention of a creation or activity and all details about it. The intentions are codified as a policy which is continuously upgraded.

2.13 ISO 9000 and OTHER STANDARDS

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ISO began its work primarily with the formation of standards for measurements, such as: specifications for writing and coordinating measures. The **Standards for Measurements** offered a universal approach for measurement systems. Subsequently ISO began to evolve **International Standards for Products, Services, Processes**, etc. These were derived as a consensus based on many national standards. The international standards though universal in nature related to issues that were self contained within the product, service or process. The standards were upgraded and redefined every five years, and sometimes more frequently. Yet, to serve the user better, many individuals and organizations outperform the standards.

In all human endeavours, each **citizen** (or a being) is considered a **stack holder**. So one has to be conscious and conscientious of all our actions. It was accepted that for a consistent and all-inclusive care, an attitude at personal level, and a culture at organizational level is necessary. This can only be achieved if a person or the organization strives for continued excellence, and develop a synergetic system to achieve it. Many individuals and organizations have such ingrained mechanisms, but, often, these are not comparable in terms of their intentions or effectiveness.

It is very necessary to **institutionalize** the individual attitudes and organizational culture for 'good management' with support of right policies, procedures, records, technologies, resources, and structures. To achieve a **Quality System of consistency**, a **Quality Conscience** is required. In this direction ISO created a series of **Quality Management Standards (QMS)**, designated as **ISO 9000 series**. The Quality Management Systems created by ISO were meant to certify the processes and the system of an organization, not the product or service itself. ISO 9000 provisions how one conducts own work rather then the quality of the end product, because if the process is rational, it will naturally affect the end product. ISO 9000 series was to ensure that products not only meet just the customers' requirements but also satisfy all the 'stack holders'.

Quality conscience was once an individual quest of the producer or provider on one hand,

and buyer or acquirer on the other hand. Both evaluated the situation on their own, rarely requiring to interpolate their ideas. However, with greater industrial production, products became complex systems consisting of several interchangeable parts. Even within an organization a new system emerged as an improvisation over the existing one, where some of the subsystems and components continued to be used. This automatically led to standardization. The process of standardization also became a culture as everyone wanted to be part of the accepted scene. Across industry equalized (standardized) products began to emerge. Producers and suppliers began to compare what a competitor was offering, and what cost. Large variety of offers in the market for the same requirement also brought in sellers and choosy buyers who demanded lot more details about the offerings. Producers either had to provide the details on their own or were forced to confirm to local traditions and standards. But local standards however good had no relevance when goods were sent to other countries. EU was one such regional block that demanded certain details.

QMS or Quality Management Standards have their origin in the **Product Liability Directives of European Community (EC)** of July 1985, also known as the **single market directives**, which state that manufacturers exporting to the EC and, eventually, to the **European Free Trade Association**, would need to have a **well documented and implemented Quality Assurance System** for certain regulated products.

ISO realized the need to improve quality of products and services. The needs were factored like:

- to bring in transparency in the structure and working of organization associated with products and services.
- to use only standard products and follow standard service processes, and insist for such a conscience from all partners or participants.
- to provide assurance to customers, users and stack holders through a universal process
- to meet mandatory requirements for business with governments and for international transactions.

ISO 9000 series of Quality Management System (QMS) Standards are among the most widely known standards. Nearly Five lakh organizations in more than 150 countries are implementing ISO 9000. It is a specific family of standards which is referred to under this generic title for convenience. The family consists of **standards and guidelines** relating to Quality Management Systems, other supporting **standards on terminology** and **auditing tools**. The standards have been written in general terms, i.e. it may be applied within manufacturing industries or service organizations in any sector.

ISO itself does not certify quality of any product or service, or register a quality management compliant organization. However, its **certification bodies** (recognized agencies) certify an organization's conformity for QMS. ISO therefore maintains no official database of ISO 9000 certificate holders.

Some famous International Registrars:

ABS Quality Evaluations. Inc.
American Association for Laboratory Accreditation
AT & T Quality Registrar
British Standards Institution (BSI) Quality Assurance
Bureau Veritas Quality International (BVQI) #
Canadian General Standards Board
Det Norske Veritas Industry (DNV) # etc.

ISO 9000 in India: # BVQI and # DNV are operative auditors in India.

PREPARING FOR ISO 9000

QUALITY MANAGEMENT SYSTEM STANDARDS: QMS

An organization desiring to follow ISO 9000 system must carry out certain reforms within the organization before calling in a **recognized auditor for validation process**. The prime requirement is to frame the **goals of the organization**. Many times this are informal ideologies often with the top level of a management team. This must therefore be formally documented and every single participant (current and others joining in future) in the organization is made aware of it. The goals or the policy of the organization will cover:

- Nature of business being conducted
- Future changes as envisaged in business model
- Define clear roles and responsibilities for policy determination, implementation, preview and reporting
- Define **external 'clients'** who sustain the organization in return for the benefit gained or **beneficiaries of the offerings** of the organization for whom the entity functions
- Let each department define the **internal 'clients'** for products and services (such as intra-department demands)

- Define products, services and other inputs required to serve external and internal clients or designated beneficiaries. (Including validation of the providers, quality parameters for the offerings, compliance with 'accepted' standards and Governmental requirements)
- Define processes that occur within each of the departments and necessary conditions for them to flourish (including human resources, health & safety requirements, environmental concerns)
- Define likely scale of affectations to 'third parties' (non user beings) due to the endeavour
- Form and place where these data (as listed above) will be available, frequency of revision, and process of accepting feedback on it.

These exercises help define various processes operative in the organization and the nature of dependency amongst it. The organization is seen here as a large complex system consisting of several sub systems few of which are fairly independent, but most others are interpolating subsystems. The **structured perception of the organization** helps in developing a sharper quality control regime.

On completion of the ground work (as listed above) a request is made to any of the recognized registrar to specific requirements to be ISO compliance worthy. The requirements are defined in various standards of the series. One may also remain in compliance without being registered by an accredited Auditor, but cannot have the benefit of declaring itself to be an ISO 9000 accredited organization.

ISO 14000 ENVIRONMENTAL MANAGEMENT SYSTEMS STANDARDS: EMS

Rio Summit on the Environment held in 1992 was the main thrust for the development of this series. ISO 14000 is a generic management standard like the ISO 9000. It is focussed on environment issues. It helps implement a systematic approach for defining objectives and targets for environmental concerns and compliance with applicable legislative and other regulatory requirements. It does not specify levels of environmental performance, and as such is not designed to be specific to any particular set of activities. This helps in establishing a common ground for communicating about environmental concerns across organizations, their customers, regulators and other stakeholders. It helps organizations evolve EMS (Environmental Management System) to minimize harmful effects on the environment caused by commercial and other activities, and continually improve the environmental performance.

ISO 14000 series of standards have two distinct facets for reporting on Environmental Performance**. Internal objectives** are issues within the processes and activities and so substantially in control of the organization. The internal objectives are intended to assure all immediate stack holders including employees that the organization is an environmentally responsible entity. **External objectives** are larger issues between the organization and universe. The external objectives provide assurance on environmental issues, to external stakeholders such as customers, the community and regulatory agencies. It also provides for a system for inclusion of suppliers' declaration of their conformity to **ISO 14000**.

The EMS facilitates compliance with environmental regulations, supports the organization's claims about its own environmental policies, plans and actions. A certification of EMS conformity by an independent certification body furthers the work on QMS (ISO 9000). ISO 14001 compliance can improve the Environmental Management, and enable easy access to a growing '**Green-Market'**.

Benefits of ISO 14000 EMS: Improves operational efficiency, Cost savings, Energy conservation, Rational use of raw materials and other resource, Better recycling processes, Reduced waste generation and disposal costs, Pollution prevention. Minimize organization's impact on environment, Reduces environmental liability and risks, Improves community goodwill and societal images, compliance with legislative and regulatory requirements, Improved Industry Government relations, and provides Competitive advantage for `Green' products.

The EMS offers a range of approaches for **Environmental Labels and Declarations**, including self declared environmental claims, **Eco-labels** (seals of approval), and Quantified Environmental Information about Products and Services. It allows environmental aspects to be taken in account in the Design and Development of products. ISO has developed more than 350 Environment related International Standards for monitoring of such aspects as the Quality of Air, Water, Soil and Climate change, and Greenhouse Gas emissions.

OTHER MANAGEMENT STANDARDS

In the last two decades ISO has concerned itself with **Quality, Safety, Security, Environment, Food, Health**, etc. These standards refer to what an organization must do to manage its processes or activities. Some Management Standards have been formed and published for implementation, whereas a large number of them are in formative process and will appear soon.

> This is not a complete list of ISO management standards. The standards are listed in order of their number, which does not reflect their order of formation or year of publication.
>
> **ISO 18000** OHSMS Standard on Occupational Health & Safety Management Systems, **ISO 20000** IT Service Management, **ISO 22000** Food safety Standards, **ISO 24000** Security and Continuity Management Standards, **ISO 26000** Social Responsibility, **ISO 27000** Information Security, **ISO 31000** Risk Management Standard, **ISO 50000** series is for Energy Management Standards, **ISO 55000** Asset Management Standard.

ISO Management standards are broadly of two classes. **Generic Standards** mean that these can be applied to any organization such as business enterprise, public project, administration or government department, whatever the product or service may be. Other Management Standards are **Sector specific Standards**.

ISO Management standards can also be categorized as **Certifiable Standards** and **Requirement Standards**. An organization may get a conformity Certification by a recognized agency after an audit process as specified in such a series of standards. ISO 9000, ISO 14000, ISO 18000 and ISO 22000 are management standards that allow certification. There are several other Management Standards that have no certification process, and so-called Requirement Standards. The Requirements standards, only provide guidance for implementing a management system (such as ISO 26000 and ISO 31000).

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