الهيئة السعودية للمقيّمين المعتمدين
Saudi Authority for Accredited Valuers

تقييم
TAQEEM

UNDERSTANDING MACHINE SHOPS AND VALUATION PROCEDURES

ME402

Objective

These notes are for reference only by TAQEEM trainees. The objective of this publication is to provide knowledge on fundamentals of machine shops, data collection and management systems and referencing and basic reporting.

Disclaimer

For further information, please contact:

Saudi Authority for Accredited Valuers (TAQEEM)

Al-Sahafa district, Alamani center, Floor 3

13321 Riyadh, Saudi Arabia

www.taqeem.gov.sa

UNDERSTANDING MACHINE SHOPS & VALUATION PROCEDURES

402

Contents:

- **Session I:** Fundamentals of Machine Shops
- **Session II:** Data Collection and Management Systems
- **Session III:** Referencing & Basic Reporting

TABLE OF CONTENTS **PAGE**

REPORTING FORMAT

Session I

FUNDAMENTALS OF MACHINE SHOPS

- Introduction to Machinery and Equipment
- Main and Support Machines for Machine Shops
- Introduction to Vehicles

1.0 MACHINE SHOPS

1.1. Definition

In Machinery and Equipment (ME), the term machine shop describes the place or business where machining, a form of subtractive manufacturing, is done. In a machine shop, machinists use machine tools and cutting tools to make parts, usually of metal or plastic (but sometimes of other materials such as glass or wood).[1]

Machine shops are established in different forms:

a) A room where machine tools are placed and used to provide technical support such as machining, repairs and maintenance of production machinery and equipment of a particular factory;
b) A section or part of factory building dedicated for placing machine tools to provide technical support to the production machinery and equipment;
c) A building which houses machine tools within a factory premises to provide technical and engineering services to the production machinery and equipment.
d) A business established to provide mechanical engineering support service to the local industry such as machining, manufacturing and repairs of various machinery and equipment.

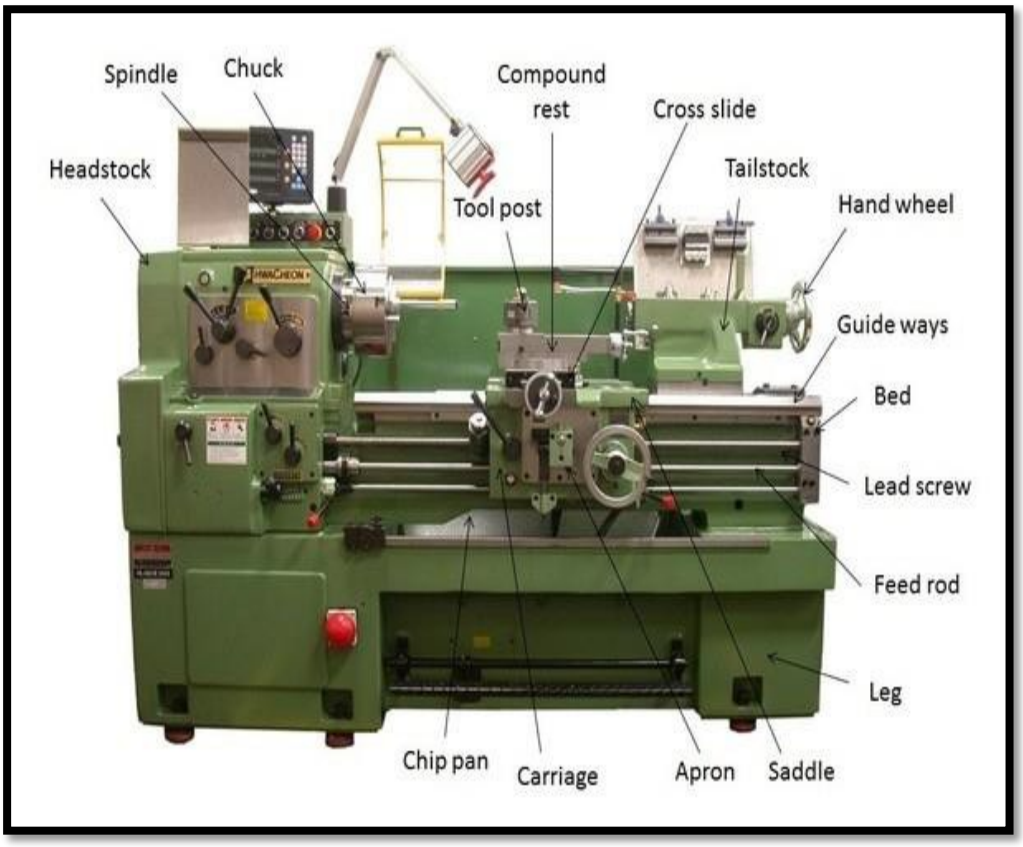
Machine tools refers to *standalone machine* which usually performs a specific task, independent of other machines. In terms of functionality, machine tools do not require linkage to other machines, but it may be used to manufacture parts that will be used for end product manufacturing. Machine tools typically include metal lathes, milling machines, machining centers, multi-tasking machines, drill presses or grinding machines. Some of these machines are controlled by Computer Numerical Control (CNC).

1.2. Examples and Function of Machine Shop Tools

There are many types and examples of machine tools such as:

[1] https://en.wikipedia.org/wiki/Machine_shop

Figure 1: Engine Lathe



1.2.1. Lathe

A lathe is a machine tool which spins the workpiece to perform various operations such as cutting, sanding, knurling, drilling or deformation with tools that are applied to the workpiece to create an object which has symmetry about an axis of rotation. Lathes perform the machining operation known as "turning". While turning, material is removed from a workpiece by rotating it against a tool. Turning is a central production operation in the manufacture of many metal, plastic and wood parts. Lathes can be either manually operated or computer controlled (CNC). Lathes can have many different features and accessories to facilitate a wide range of jobs.

The Turning Process

The turning process removes metal by means of rotating the item to be worked upon against a cutting tool that is fed longitudinally or radially to the work piece's axis. The work revolves, not the tool. The work is a speed function and the tool is a feed function.

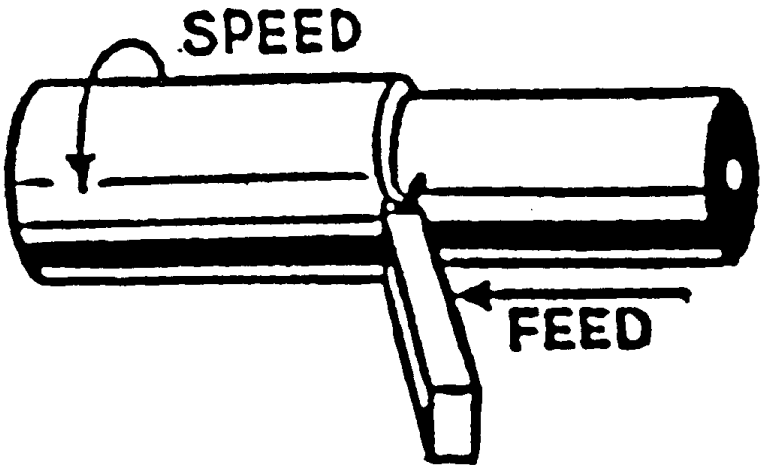


Figure 2: Turning Process

Common types of lathe are:

1.2.1.1. Wood Lathe

The simplest lathe type is the wood lathe. It is designed for turning wood. Wood lathes are small machines consisting of a bed, headstock, tailstock and tool rest. Unlike with what is found on a metal-working machine, there are no precision ways since the cutting tools are moved by hand and not by machine power. A worker with high skills is needed to control the cutting tool. The spindle is driven by a belt connected to a motor, and speed differentiations are made by manually moving the belt to one of many pulleys mounted to the back of the spindle. Lathe tools are held by hand against the work, with the support of the tool rest. The tool rest is adjustable and is clamped to the bed at a position that best suits the operation at hand.

1.2.1.2. Engine Lathe

Engine lathe is a type of machinery, shaped horizontally and it is often used to cut metal. The metal is turned, and the machine uses special cutting tools to create the desired shape They come in different sizes and are flexible to working virtually on any material. These machines have a longitudinal bed to which is mounted a headstock and tailstock. As in the wood lathe, the headstock contains the spindle. The spindle drive is more complex, including variable speed capacity or selectable gearing to provide a broader range of speeds. A carriage moves back forth on

bed ways for longitudinal turning. A cross-slide and compound rest are mounted to the top of the carriage to provide cross and angled cutting capability. The lathe cutting tools are moved against the work manually using hand wheels or mechanically under the power of a lead screw that is driven by gears in the headstock.

1.2.1.3. Tool Room Lathe

A tool room lathe is a lathe optimized for tool room work. It is essentially just a top-of-the-line centre lathe, with all the best optional features that may be missed from less expensive models, such as a collet closer, taper attachment, and others. The bed of a tool room lathe is generally wider than that of a standard centre lathe. Through years of selective assembly and extra fitting, great care have been taken to develop the best tool room lathe that is excellent in smooth running and more accurate.

1.2.1.4. Turret Lathe

Turret lathes are used in production machine shops where several sequential operations are needed on single workpiece. It is expensive and time consuming to remove a workpiece from one machine and hold it in another. Removing and resetting a workpiece also cause errors in work alignment and machining accuracy. The turret lathe has a rotating turret mounted to the carriage which is after an operation with one tool is completed, the turret will automatically bring another tool into working position. The part is then machined again without having to remove it from the chuck or collet. Eight (or more) different operations can be performed on a workpiece using this type of machine.

1.2.1.5. CNC Lathe

Computer numerically controlled (CNC) lathes have largely replaced engine lathes in production machining environments. CNC lathes offer benefits of greater powered axis drives, feedback control to watch and maintain tool positioning and fast repetition of complex machine motions. Once a program is established, an operation can be quickly set up again without the necessity for tedious manual adjustments. CNC lathes do extremely well at cutting curved contours without the need for specially formed tools. This is done by programmed modification of the speed of two motion axes and the spindle simultaneously - an operation that is very unlikely with an engine lathe.

Figure 3: Types of Lathes

1.2.2. Milling Machine

A milling machine is a machine tool that removes metal as the workpiece is fed against a rotating multipoint cutter. The milling cutter rotates at high speed and it removes metal at a very fast rate with the help of multiple cutting edges. One or more cutters can be mounted simultaneously on the arbour of milling machine. This is the reason that a milling machine finds wide range of applications in production work. Milling machine is used for machining flat surfaces, contoured surfaces, surfaces of revolution, external and internal threads, and helical surfaces of various cross- sections.

The Milling Process

Milling is the process of removing metal in which a rapidly rotating multi-toothed cutter (a speed function) removes chips from a work piece that is fed across the cutter. (a feed function).

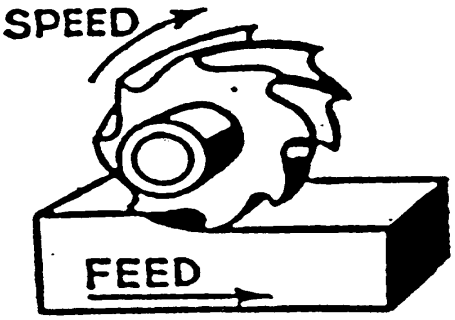


Figure 4: Milling Process

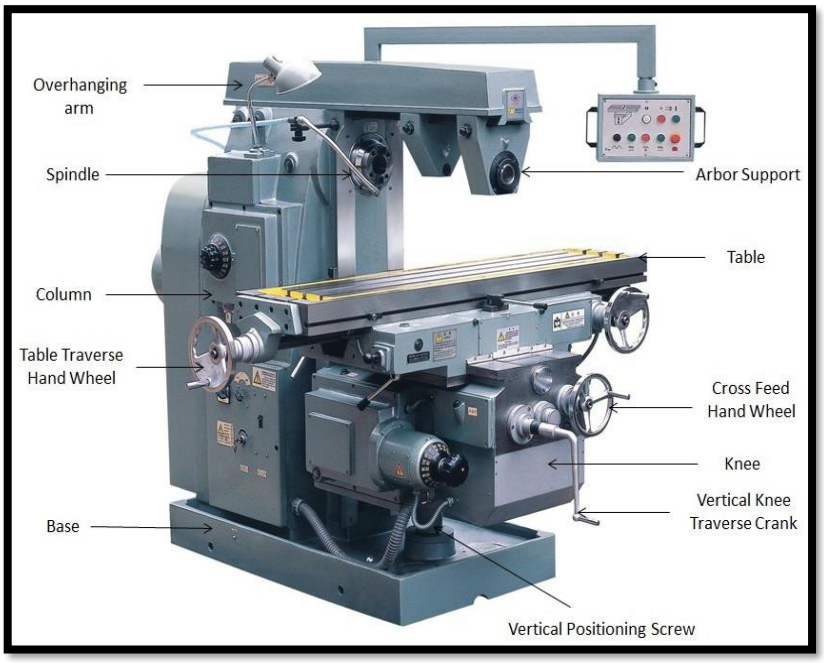


Figure 5: Milling Machine

Types of milling machines are:

1.2.2.1. Column and knee type milling machine:

In this machine, a vertical column is attached to the bed which consist of gear drives which rotate the knee and saddle. A knee is situated on the base which can provide vertical motion to the work piece or which can move up and down. A saddle is attached to the upper section of the knee which can move in transverse direction. The table is placed over the object which can hold the work piece by use of climbing bolts.

i. Vertical milling machine

It is one of the types of knee and column milling machine. The spindle of this machine is in vertical position. No arbour is required in this machine. The cutter tool has cylindrical shape and the cutting edges are situated at the circumference of the cylindrical face.

ii. Horizontal milling machine:

As the name implies the spindle is positioned horizontally. The spindle rotates horizontally. An arbour is attached to the machine which holds the cylindrical disk shape cutter which cuts the metal work piece.

iii. Universal milling machine:

The universal milling machine is same as horizontal milling machine except there is an arrangement of swing up the table to 45 degrees in either direction

Figure 6: Milling Machine – Column and Knee Type

1.2.2.2 Fixed bed milling machine:

In this milling machine the bed of the machine is fixed to the machine. There is no arrangement of knee and saddle which can move vertically and transversally. The worktable is direct situated at the fixed bed. The spindle of this machine is mountain on a movable spindle head. It can move in vertical and horizontal direction and perform the cutting operation.

i. Simplex milling machine:

In the simplex machine spindle head or the spindle can travel only in one direction. Mostly it travels in vertical direction.

ii. Duplex milling machine:

In this machine the spindle can travel both in vertical and horizontal direction.

iii. Triplex milling machine:

In triplex machine spindle can move in all three directions along.

iv. XYZ axis (Three Axis) Milling Machine:

In this machine the spindle can move also in three directions

along three Axis.

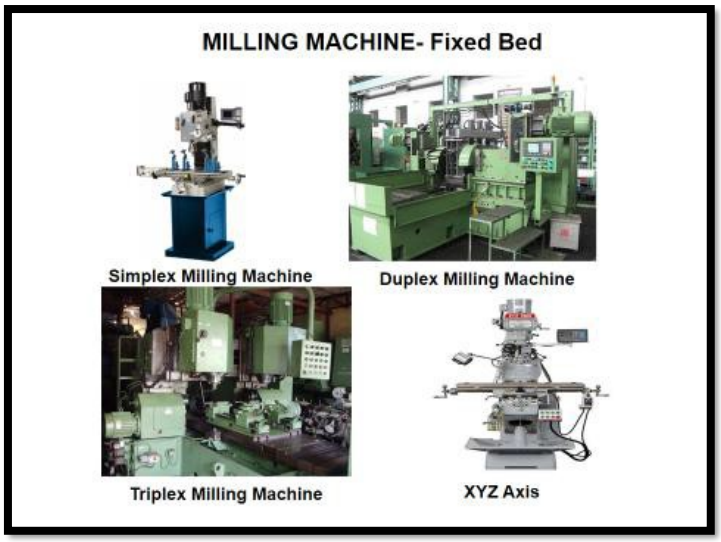


Figure 7: Milling Machine – Fixed Bed

a) Planer milling machine

Planer milling machine is mostly used for facing operation in mass production. These machines are similar to the bed type milling machine except that it can mounted with various cutters and spindle heads to the machine. These cutters can perform the facing operations simultaneously.

Figure 8: Planer Milling Machine

b) Special milling machine:

These machines are modern milling machines which are developed to ease the milling operations according to the

jobs.

i. Tracer milling machine:

Tracer machine can perform all difficult die making job by synchronizing the tracing unit. It can handle any difficult shape. It is mostly used in automobile and aerospace industries.

ii. CNC milling machine:

CNC milling machine is most versatile machine which is controlled by a computer. It is the upgrade version of bed type milling machine in which the spindle can move in all three directions and the table can rotate 360 degrees. All movements are hydraulically controlled and commanded by a computer. Any difficult geometry can be handled by these machines. A sketch of the work piece is loaded to the computer which is automatically being transferred to the machine.

Figure 9: Special Milling Machine

1.2.3 Shaping Machine

Shaping is a process of machining a flat surface which may be horizontal, vertical, inclined, concave or convex using a reciprocating single point tool. The workpiece is held firmly on the table and the ram is allowed to reciprocate over it. A single point cutting tool is attached to the ram. When the ram moves horizontally in the forward direction, the tool removes metal from the workpiece. On the return stroke, metal is not removed. The ram moves at a slow speed during forward stroke. But during return stroke, the ram moves at a faster speed. Though the

distances of ram movement during the forward and return stroke remain the same, the time taken by the return stroke is less as it is faster. It is possible by 'Quick return mechanism'. In a shaping machine, a flat horizontal surface is machined by moving the work mounted on the table in a cross direction to the tool movement. When vertical surfaces are machined, the feed is given to the tool. When an inclined surface is machined, the vertical slide of the tool head is swivelled to the required angle and the feed is given to the tool by rotating the down feed hand wheel.

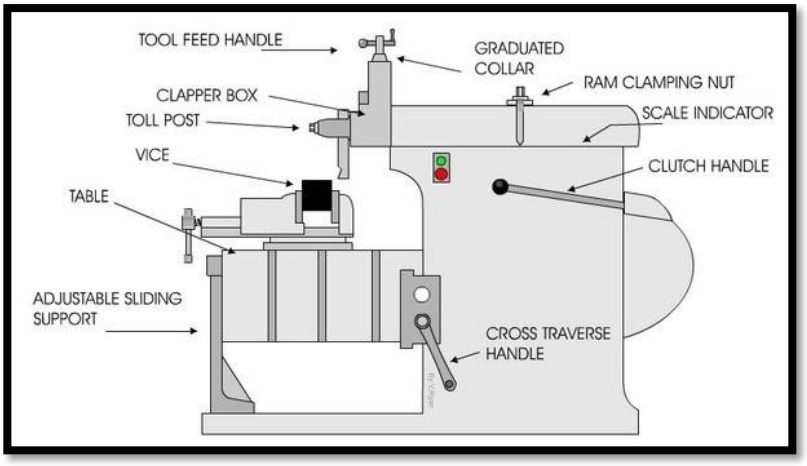


Figure 10: Shaping Machine

The Shaping Process

The cutting tool is operated in a straight line and reciprocating motion, either horizontally or vertically (a speed function) against the work piece that is fed sidewise (a feed function) by an amount equal to the width of the cut strip.

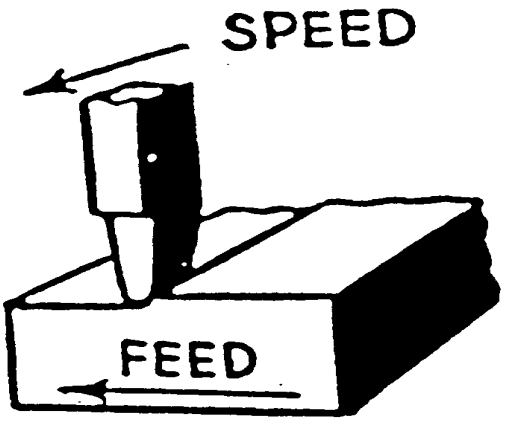


Figure 11: Shaping Process

Types of shaper such as:

i. **Crank shaper**

In these shapers the reciprocating ram is driven by crank mechanism and a single point cutting tool is employed to do the operation. A crank is connected to the ram and the bull gear to which the power is given through an individual motor. These are most common type of shapers being used. The reciprocating ram length will always be equal to the length of stroke to cutting the tool.

ii. Hydraulic shaper

These shapers run on hydraulic power. The end of the ram is connected to a piston fitted in to a cylinder. Hydraulic oil is fed in to the cylinder which moves the cylinder on the ram in one direction. A varying pressure is applied on the oil to obtain the reciprocating motion of the ram. One of the main advantages of this shaper is a constant speed can be obtained from the starting of the machining operation. There will be no fluctuations in the cutting speed and stroke of the ram. Another important advantage of this shaper is no sound will be produced hence a noise free environment can be obtained.

iii. Universal shaper

Besides two movements done by the standard shaper, this shaper can perform two more directions or tasks.

1) By swivel the table about an axis ram way.
2) The table can be tilted about an axis perpendicular to the first one. So due to these two features any operation at any angle can be performed very easily. Because of these features the shaper is termed as a universal shaper.

iv. Standard shaper

On these shapers the table has only two movements i.e. vertical and horizontal. The table may or may not be supported on the other end.

v. Draw-cut shaper

Draw cut shaper is similar to a standard shaper in construction except that it is moderately heavier. The major difference is that a standard shaper peels off metal chips through backward stroke while a draw-cut shaper does so

through forward stroke.

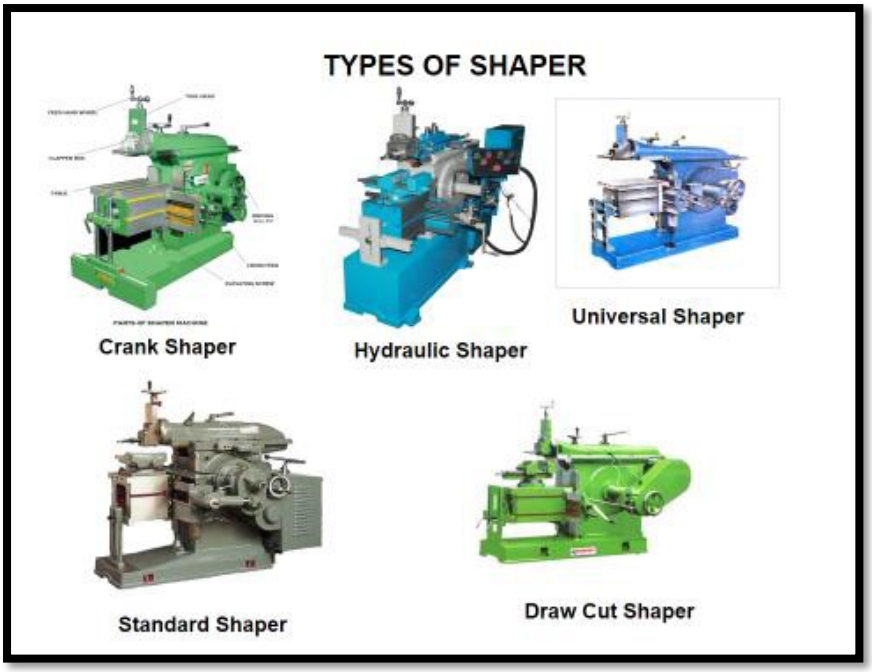


Figure 12: Types of Shapers

vi. Horizontal shaper

As the name indicates these shapers have the motion of ram along the horizontal axis. This type of shapers is generally used to generate fine and flat surfaces.

vii. Vertical shaper

On these shapers the tool containing ram has its motion in vertical direction. In some of the shapers a provision of 100 rotation of the ram is also provided. The ram of vertical shaper may be driven by either crank drive, screw drive, gear drive, or by hydraulic power. Vertical shaping machines have many applications such as deep hole boring, machining internal surfaces, keyways, grooves etc. Vertical shaper has a very robust table which can have cross, longitudinal, and rotational movement. The tool used on a vertical shaper is totally different from that of the normal tool used on a horizontal shaper.

viii. Geared Shaper

These are rarely used shapers. these shapers a rack and pinion are used. The rack is attached to the lower part of the ram on which the pinion moves. The power is transmitted by the bull gear.

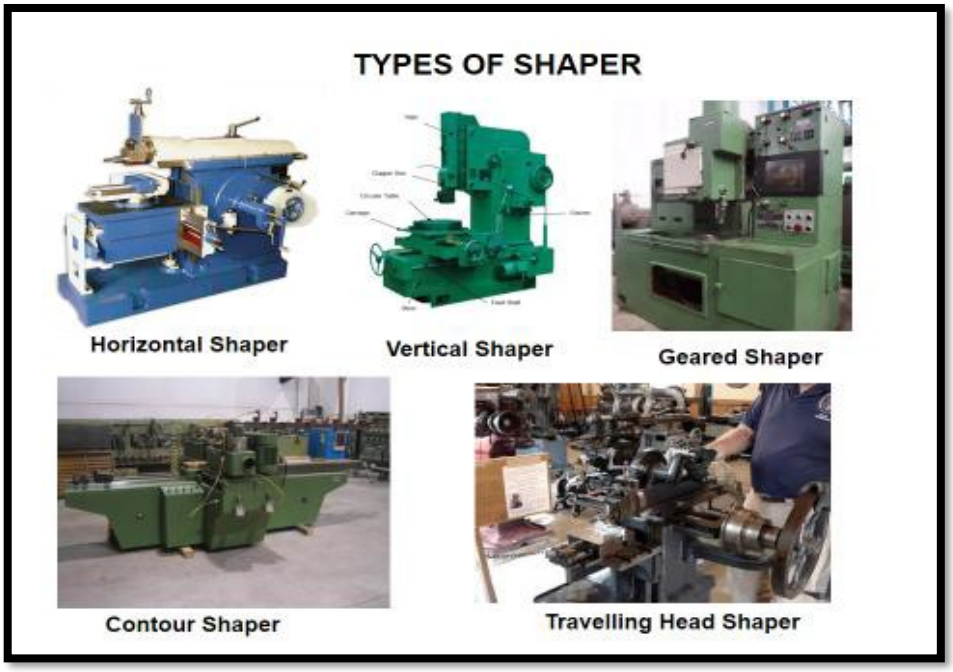
ix. Contour shaper

Contour shaper is a standard shaper fixed by an additional tracer mechanism. This shaper has a pattern and is used to make contour like shapes based on the template.

x. Travelling head shaper

This type of shaper is generally used for machining very large objects that cannot be mounted on the table of the machine and cannot be moved. On this machine the ram having reciprocating movement also provides crosswise movement simultaneously such that the tool can cut the required shape on the work piece.

Figure 13: Types of Shapers



1.2.4 Drilling Machine

A metal removing process where the work is held stationary and the cutting tool (drill) rotates as it is fed into the work (a combination speed and feed function).

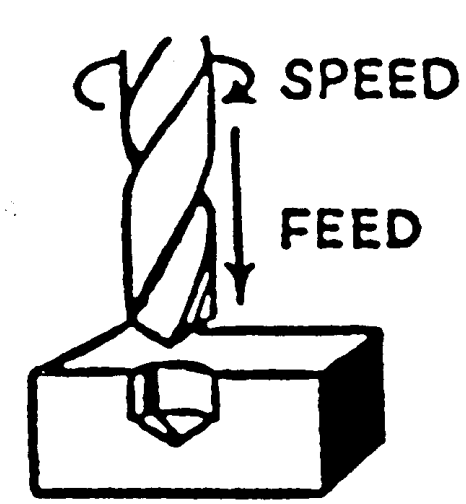


Figure 14: Drilling Process

Figure 15: Radial Drill Press

Types of Drills

i. Upright Drill

Designed for handling medium sized workpieces. Holes of up to 50mm can be made with this type of machine. For drilling different types of work, the machine is equipped with a number of spindle speeds and feed.

ii. Multiple Spindle Drill

This machine is used for drilling a number of holes in a workpiece simultaneously and for reproducing the same pattern of holes in a number of identical pieces. It has several spindles driven by a single motor and a set of gears. All spindles are fed into the work at the same time.

iii. Radial Drill

Intended for medium to large and heavy workpieces, the radial drill has a heavy round column supporting a radial arm that can be raised or lowered to enable the table to accommodate workpieces of different heights. The arm, which has the drill head on it, can be swung around to any position

iv. Deep Hole Drill

There are two types of deep hole drills, vertical and horizontal. They are designed to drill deeper holes into spindles, connecting rods and barrels. High cutting speeds and less feed are necessary to drill deep holes. A non-rotating drill is fed slowly into the rotating stock.

1.2.5 Grinding Machine

Grinding machine is a type of tool that is utilised for grinding work pieces. It basically uses an abrasive wheel as the cutting tool. The rough surface of the abrasive wheel shreds off small portions of the work piece as required.

A grinder is generally used to precisely shape and finish the given materials with low surface roughness and high surface quality. It is primarily a finishing operation that removes relatively small quantities of metal, to deliver highly accurate products. However, certain grinding applications also involve swiftly eliminating high volumes of metal.

The Grinding Process

Grinding operations vary the speed function between the work and the wheel, while the feed function can apply to either work or wheel.

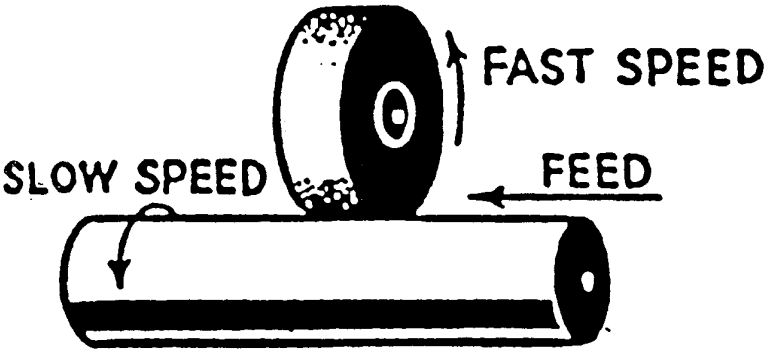


Figure 16: Grinding Process

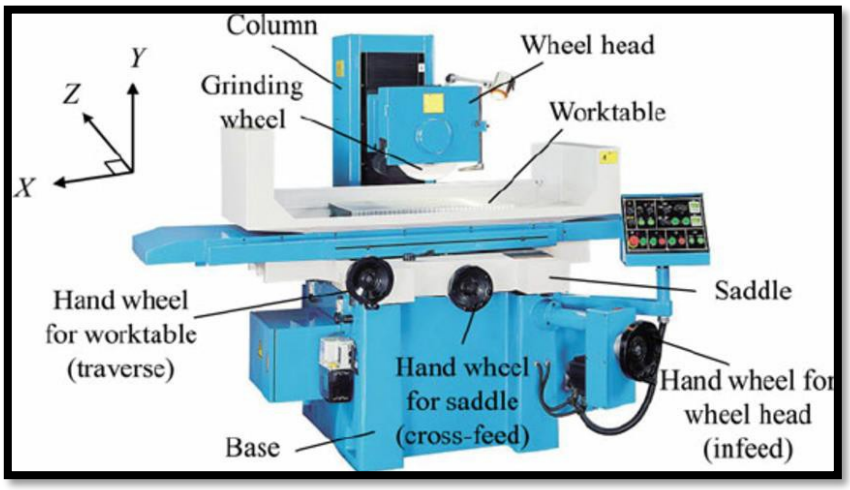


Figure 17: Grinding Machine

Types of grinder are as follows:

- *Bench grinder* is manually operated and normally has two wheels of different grain sizes that are fixed on a floor stand or work bench; to perform roughing and finishing operations. It is mainly used to shape tool bits; and repair or make various tools.

- *Belt grinder* includes a machining process to grind metals and other materials, with the help of coated abrasives. Belt grinding is a versatile process that involves several kinds of applications such as stock removal and finishing.

- *Jig grinder* is used for finishing jigs, dies, and fixtures. It grinds holes and can be used for complicated surface grinding and finishing work.

- *Gear grinder* is used to remove the last few inches of material while manufacturing high precision gears.

Figure 18: Types of Grinders

- *Cylindrical grinder* is a type of grinding machine used for shaping the outside of an object. A cylindrical grinder may have multiple grinding wheels to work on a variety of shapes, however the object must have a central axis of rotation. This includes but is not limited to such shapes as a cylinder, an ellipse, a cam or a crankshaft. It is used to make precision rods, tubes, bearing races, bushings and many other parts.

- *Die grinder* which is a high-speed hand-held power tools used for grinding, sanding, honing, polishing or machining material. They are typically air driven (using compressed air) but can be driven with a small electric motor directly or via a flexible shaft.

- *Tool and Cutter grinder* usually perform the minor function of the drill bit grinder, or other specialist tool room grinding operations

- *Surface grinding* is used to produce a smooth finish on flat surfaces. It is a widely used abrasive machining process in which a spinning wheel covered in rough particles grinding wheel cuts chips of metallic or non-metallic substance from a work piece, making a face of it flat or smooth.

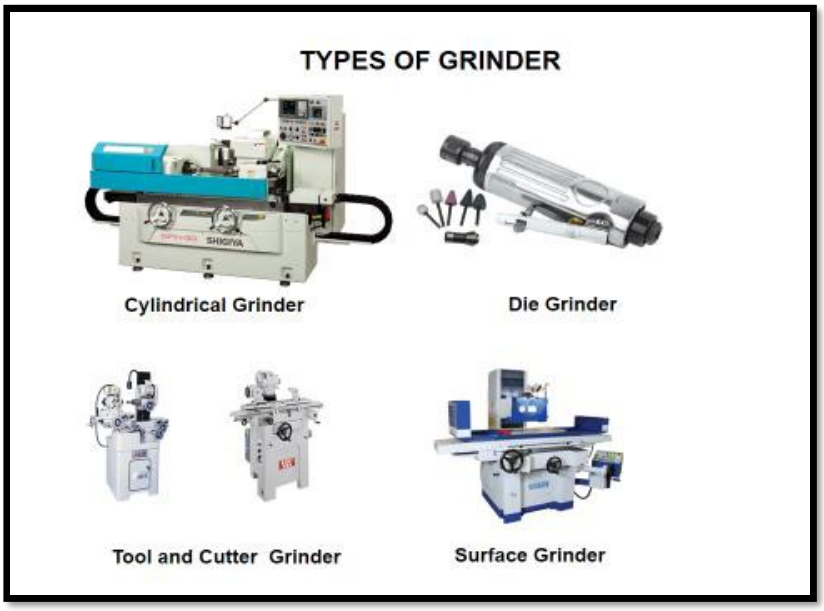


Figure 19: Types of Grinders

1.2.6 Slotting Machine

The slotter or slotting machine is also a reciprocating type of machine tool similar to a shaper. It may be considered as a vertical shaper. The machine operates in a manner similar to the shaper, however, the tool moves vertically rather than in a horizontal direction. The job is held stationary. The slotter has a vertical ram and a hand or power operated rotary table.

The Slotting Process

The slotting machine is operated in a straight line and reciprocating motion, either horizontally or vertically (a speed function) against the work piece that is fed sidewise (a feed function) by an amount equal to the width of the cut strip.

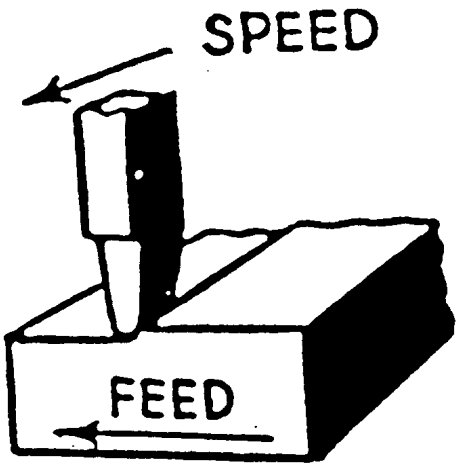


Figure 20: Slotting Process

Figure 21: Slotting Machine

Common types of slotting machine are:

a) Puncher Slotting machine

The puncher slotter is a heavy, rigid machine designed for removal of large amount of metal from large forgings or castings. The length of stroke of a puncher slotter is sufficiently large. It can remove 1.5 Kg to 2.5 Kg of material in one minute. Locomotive crank webs can be slotted from the rectangular shapes to exact size in less time than by any other method.

b) Precision Tool Room Slotting Machine

The slotter operates at high speeds and is designed to take light cuts to produce accurate finish. In the larger machines, all the table and hand control are conveniently grouped together to perform profiling operation, where two feeds are to be used simultaneously.

c) Key Seater Slotting Machine

The key seater slotter are specialized machines designed to cut keyways. They are very similar to vertical shapers. the difference is that the cutting tool on a key seater enters the workpiece from the bottom and cuts on the down-stroke, while the tool on a shaper enters the workpiece from the top and cuts downward. Another difference is a key seater has a guiding system above the workpiece to minimize deflection, which results in a closer tolerance cut

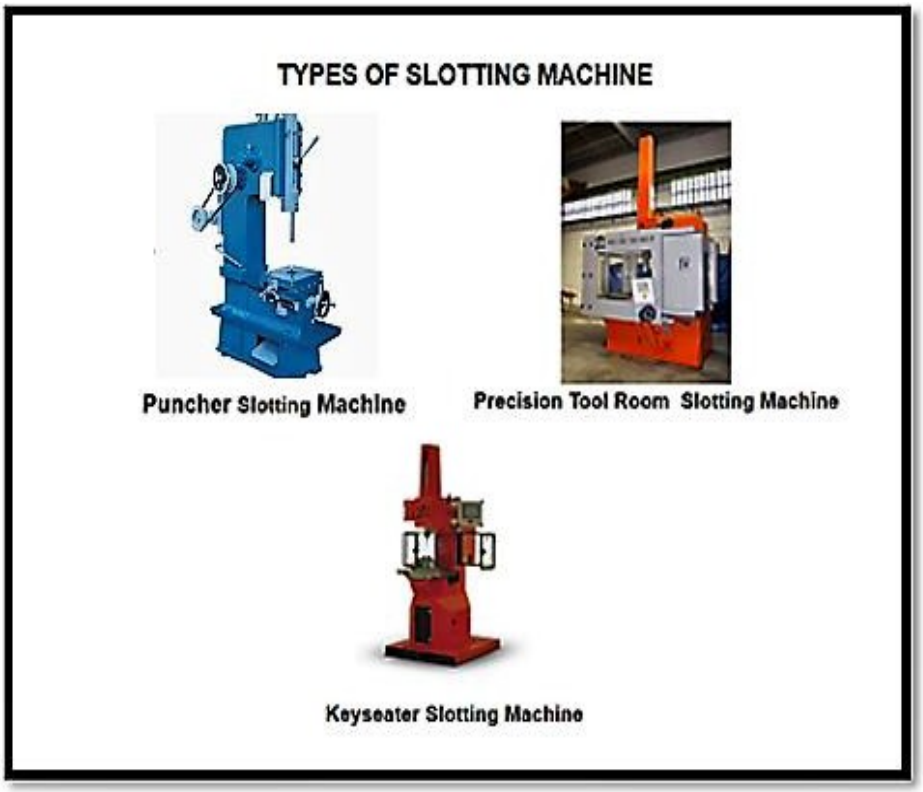


Figure 22: Types of Slotting Machines

1.2.7 Planer

Planer is used primarily to produce horizontal, vertical or inclined flat surfaces by a single point cutting tool. And it is used for machining large and heavy work pieces that cannot be accommodated on the table of a shaper. In addition to machining large work, the planer is frequently used to machine multiple small parts held in line on the platen. Planer is mainly of two types namely open housing planer and double housing planer.

The Planing Machine

The work is operated in a straight line and horizontal reciprocating motion (a speed function) against a cutting tool, which is fed sideways or vertically in incremental amounts as the work progresses (a feed function).

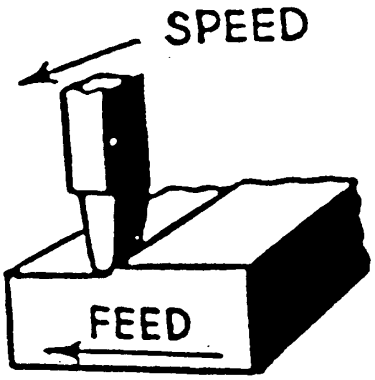


Figure 23: Planing Machine

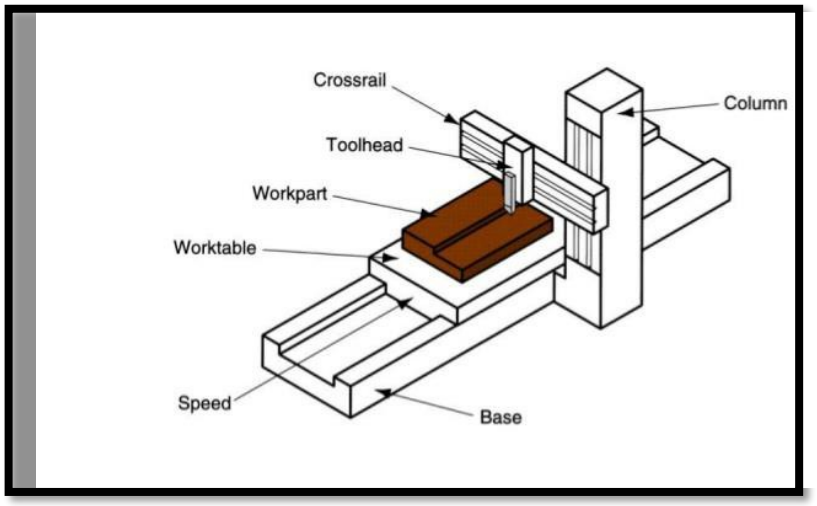


Figure 24: Planer

Following are the common types of planers:

i. Double housing planer

This is a common type of planer. It consists of mainly massive bed on which the worktable reciprocates and two vertical columns or housing, one on each side of the bed. Each column carries a tool head that can be slide up and down on the column.

ii. Open side planer

The only difference with this type is that only one vertical column is provided on one side of the bed and other side

is left free. So, large and heavier jobs can be mounted on the table. The construction and working principle are same as that of a double housing planer.

iii. Pit Planer

The working principle of this planer is same as that of other types of planer. But the table of the planner is kept in a pit as the floor coincides with the top surface of the table. So heavy and large work can be held and machined easily.

iv. Edge or Plate Type Planer

On this type of edge planer, the bed and table are stationary, and the tool head is mounted on a carriage. The carriage can be moved longitudinally on guide ways. A platform is provided to stand and travel along with it while machining. It is mainly used for machining the edges of steel plates.

v. Divided Table Planer

The working principle is similar to that of a standard planer. But it has two reciprocating tables. Generally, more time is required set the work on the planer. To reduce the setting time of work, the two same machining are combined by using two tables.

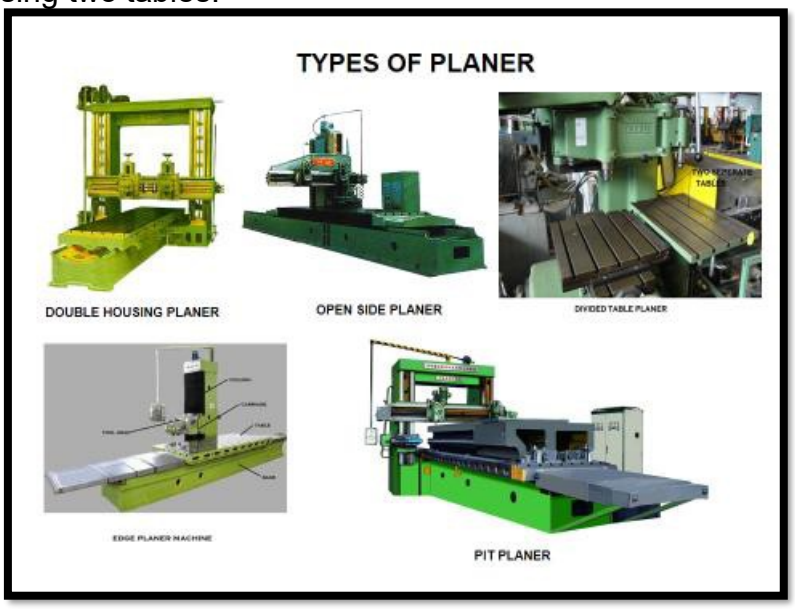


Figure 25: Types of Planers

2.0 MAIN AND SUPPORT MACHINES

2.1 Main Machine

Main Machine is constructed by one or more parts which are needed to achieve a particular goal or products. In general, the focus is given to the processing and production plants because it has the largest number of plant and machinery components.

For example, oil refinery. Equipment and parts of plants other than major equipment is considered as ancillary equipment and help to complete the entire factory. Another example, electrical power control equipment is an accessory device, but without an overall electric power plant it cannot function on its own.

Therefore, it is important to understand the whole process of manufacturing to distinguish the roles and functions of each piece of equipment to be valued.

2.2 Support Machine

Support Machine is:

a. Machine that can be used with the main machine
b. Machine that can help complete the main machine/plant (e.g. Motor Control Centre (MCC) and Constant Current Regulator (CCR).
c. Machine that can increase production capacity and generate a better product (e.g. Lathe)

Type of Support Machine

a) Motor Control Centre (MCC)

Motor Control Centre or MCC is an important component in the supply of electricity. The main source of electrical substation station (substation) is routed through the transformer located outside the building. It works by changing (downgrading) the flow of electricity from the main line to a lower power levels depending on local needs.

Typically, MCCs will be located in each area of supply of electricity for the part, but there are times when it's just a hand and used to control the entire plant. MCC can be found in many forms. There has a form fitting to the wall for switch control to control the supply of major special feature with its own air conditioning system.

The size of the electrical equipment is via alternating current (AC) or direct current (DC). Most of the existing measures in the industrial sector is using AC, with cycles of 50 or 60 hertz, depending on local industrial requirement (refer list of Worldwide AC Voltages and Frequencies). The engine is measured by horsepower (hp) or kilowatt (kW). Electric flow was measured as amperes (Amps). In industrial environment is normally used three-phase electricity system.

The importance of the MCC is especially relevant when the assessment is carried out on plant and machinery as a whole or to assess plant and machinery available for use. MCC is not recognized if the plant and machinery was moved to another place.

Figure 26: Motor Control Centre (MCC)

b) Programmable Logic Control (PLC) is a specialized device used to provide high-speed, low-level control of a process. It is programmed using Ladder Logic/ Ladder Diagram (LD) or some form of structured language, so that engineers can program it. PLC hardware typically costs a lot of money, and often has very good redundancy and fail-over capabilities. PLC controller is a digital computer used for automation of typically industrial electromechanical processes, such as control of machinery on factory assembly lines, amusement rides, or light fixtures. PLC controller is a digital computer used for automation of typically industrial electromechanical processes, such as control of machinery on factory assembly lines, amusement rides, or light fixtures.

Figure 27: Programmable Logic Control (PLC)

c) **Control Panel** is a flat, typically vertical, area where control or monitoring instruments are displayed. They are typically found in complex pieces of engineering, such as nuclear power plants, ships, aircraft, etc.

Figure 28: Control Panel

d) **Switch Board** one or more panels accommodating control switches, indicators, and other apparatus for operating electric circuits.

Figure 29: Switch Board

e) **Distributed Communications System (DCS)** is a network that allows multiple switches in the same or remote locations to work together as one switch.

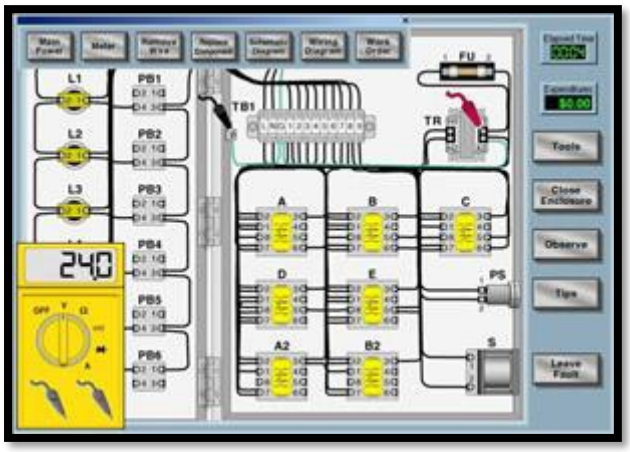


Figure 30: Distributed Communications System (DCS)

f) Power Wiring

Electrical wiring is routed from the MCC to all machinery and equipment in the factory. Wiring systems, control boxes and switches are an extension of the electricity supply to the plant. Details to be observed include the following:

- Electrical wiring
- Size wiring
- Distance online and conduits
- Total number of motors
- MCC

The plant power wiring connects the plant equipment to MCC. The equipment is strung together with wiring, controls, switches etc.

g) Piping Reticulation

Most plant and machinery require air compression systems, water supply, condensation, drainage, gas, liquid flow systems for the processing of heating or cooling.

For example, dairy factory processing plants require a lot of piping and involve various stages of processing. The factory is equipped with various types of pipes, valves, fittings, gauges, pumps, process control etc. This is particularly important when assessing the PME primarily for insurance purposes and to determine the market price for existing use. However, this will become less important when valuing for the purpose of insolvency (or liquidation).

h) Structural Support and Foundation

Some PME require structural support and foundation to get sufficient mass and stiffness to permit the machine to operate in a near state of equilibrium. Lack of mass/ stiffness causes normal operating forces to generate abnormal vibration levels that reduce useful life and increase frequency of maintenance.

Proper machine installation is critical in maximising reliability and minimising life cycle costs. Conversely, improper installation is a chronic source of downtime, poor product quality, reduced capacity and high operating cost.

Examples of structural supports in PME include the following:

i) Foundation

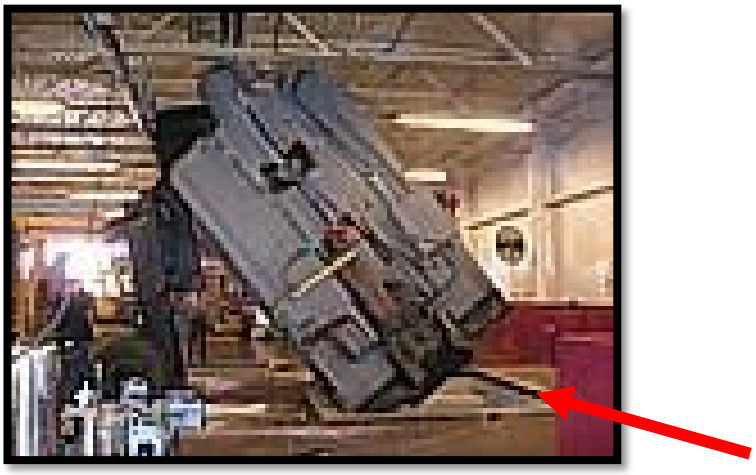


Figure 31: Foundation

Figure 32: Foundation

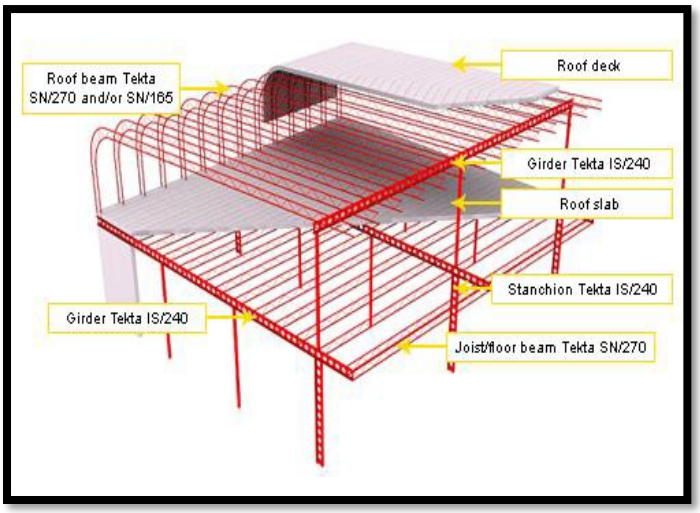


Figure 33: Structural Steel

ii) Catwalk

Figure 34: Catwalks

iii) Ladder

Figure 35: Ladder

iv) Platform

Figure 36: Platforms

i) Material Handling and Storage Equipment

Processing plants require handling equipment to load/ unload processing materials or to send them from one place to another. For instance, raw materials received need to be transported to the processing area, then transported back to the storage after processing. All of this requires the following handling equipment such as:

- Forklifts
- Loaders
- Conveyors
- Overhead Travel Cranes
- Hoists
- Pallet movers
- Baggage handling (at airports)

Figure 37: Material Handling and Storage Equipment

j) General Plant Equipment

This usually involve small-sized equipment needed by the industry such as:

- Industrial furniture and fittings
- Fit-outs i.e. partitions, carpeting, advertisement board
- Benches
- Racks
- Shelves
- Lockers
- Measurement equipment
- Communication devices i.e. telephone, walkie-talkie
- Time recorders
- Fire extinguishers

k) Transportation

Transportation equipment includes any systems on land, air and water. In a PME environment, vehicles may be categorised based on the following situations:

a. For internal (inside plant area) use
Autonomous trucks, forklifts, cranes, tractors and mobile equipment. These are usually not licensed for over the road use.

b. For external use (road vehicles)
Automobiles, trucks, tractors, trailers and other vehicles licensed for road use, cargo haulers, aircraft and, container vessel etc.

l) Laboratory and Test Equipment

Laboratory and test equipment are mainly found in Research and Development (R & D) facilities and in industries that require quality control and production quality. Examples of laboratory and test equipment include:

- Industrial Ovens
- Microscope
- Smoke inhaler
- Test tube
- Spectrograph
- Oven
- Glassware

m) Office Furniture, Fixtures and Equipment

Office furniture equipment includes:

- Chair
- Desk
- Filing cabinets
- Calculator
- Copiers
- Fax machine

n) Computer Equipment

Classification of computer equipment involve the entire personal computing hardware equipment, networks and network key, screen display, printers, scanners, plotters, servers, modems and other equipment. It includes all designs created with the help of computers.

This class includes if they are not included in “office furniture, fixtures and equipment.

o) Tools

Divided into 2 subclasses:

a. Permanent Tools
    - Portable electric and air tools, anvils, vice, gauges, drills, chuck and similar items
b. Perishable Tools
    - Drill bits, chisel, reamers, taps and similar item.

3.0 INTRODUCTION TO VEHICLES

Motor vehicle is a mobile machine used for transporting people, goods and services. Motor vehicle is one of the assets that are around everywhere in the world, second only to real estate. There is hardly any valuation assignment that does not involve motor vehicle. It is therefore very important for a valuer to know the principles of motor vehicle valuation.

3.1 Definition of Motor Vehicle

A motor vehicle is a self-propelled vehicle, commonly wheeled, that does not operate on rails, such as trains or trams and used for the transportation of passengers, or passengers and property.

The vehicle propulsion is provided by an engine or motor, usually by an internal combustion engine, or an electric motor, or some combination of the two, such as hybrid electric vehicles and plug-in hybrids. For legal purposes motor vehicles are often identified within a number of vehicle classes including cars, buses, motorcycles, off-road vehicles, light trucks and regular trucks.

3.2 What is Motor Vehicle Valuation?

- The process of estimating the worth of a motor vehicle
- The act of estimating or setting the value of motor vehicle

3.3 Factors Affecting Value of Motor Vehicles

3.3.1 Economy

The law of supply and demand is something many of us learned in basic business or economics classes in school. It applies to pretty much anything that can be bought and sold, and that includes cars.

When the economy is down, used cars becomes more attractive to buyers, who are now more interested in getting a good deal than having the latest model. This increased demand for used cars naturally causes their value to go up. As fuel prices rise,

demand for fuel-efficient vehicles increases. When vehicle loans are restrictive, sales of both new and used vehicles are affected

3.3.2 Brand Reputation

The brand of the vehicle could have significant impact on used vehicle resale value, regardless of the quality or condition of the vehicle. Some vehicles are known for rapidly depreciating in value as soon as you drive off the lot. In Saudi Arabia Malaysian market Toyota, Hyundai, Ford and Chevrolet rank at the top in the mass-market for retaining higher resale values while Lexus, Acura, Infiniti, Mercedes, and Audi fare best in terms of luxury brands. Values vary, but these brands can retain anywhere from 45-60% of their value in the first three years of ownership compared to only 35% for other brands in the same amount of time.

3.3.3 Age

Age is one of the primary factors that determine the value. New vehicle loose about 20% of its value the moment it is registered for use or driven off the lot. Subsequently it could losses 15 - 20% of its value each year.

3.3.4 Mileage

Lower mileage typically translates to higher resale values. The age of a vehicle is important, but if it comes down to a five-year-old vehicle with 85,000 miles versus a six-year-old vehicle of the same make, model, trim, colour with 45,000 miles, the six-year-old vehicle will bring better value. Higher mileage contributes to the wear and tear of a vehicle. The mechanical parts of the vehicle slowly wear as the mileage increase and affect the resale value of a vehicle. Also, warranty effects value.

3.3.5 Physical Condition

The most obvious factor which affects vehicle value is the condition of the vehicle. This includes exterior and interior condition. The amount of wear and tear the vehicle has, as well as actual damage and previous repairs will reduce the value.

3.3.6 Maintenance

The most expensive mechanical parts of maintenance a vehicle are the engine and the transmission system. A well-maintained vehicle should be in good working condition. There should be no damage, leakage or evidence of excessive wear. The transmission system needs to be free from any leakages, without major repairs.

Regular service and periodic maintenance keep the vehicle in great running shape. Having a full-service history can be advantageous to attract potential buyers. The buyer will be more likely to pay more for the vehicle has been well maintained.

3.3.7 Modifications

Modifications made to the vehicle are likely to have an impact on the value. Unmodified vehicles are generally more preferred than modified vehicles as they are easier to insure and more marketable.

Modified vehicles are considered as riskier to purchase as it may not comply with road and transportation regulations and requirements. This may subsequently cause problems to have the vehicles financed, insured and maintained.

3.3.8 Sales Arrangement

a. Direct sale
b. Via agent (dealership)
c. Trade-in
d. Auction (repossession)
e. Online

One of the largest determinants of value is the sales venue. The highest prices are almost always achieved through private party sales, but the downside of selling the vehicle this way is that it involves a longer wait and much more work advertising and meeting buyers. Other methods such as selling to a dealership or through auction are quicker, but the valuation will be lower (Trade-In).

3.4 Categories of Motor Vehicles Condition

The condition of a motor vehicle may be categorised as follows:

a. Excellent

The used vehicle is in perfect mechanical condition. The exterior is in “showroom condition”, meaning it is free of dents and body damage. The interior carpets and upholstery are clean from any stain or burn marks. The tyres should still have significant treads (low wear and tear) with low mileage count.

b. Good

The used vehicle may have minor mechanical or electrical problems. The exterior is clean with only minor door dents and scratches from routine wear-and-tear. The interior carpets and upholstery will show minor wear with slight staining on the carpets. The tyres will match but their remaining tread life will be short (most vehicle less than five years old fall under this category).

c. Fair

The used vehicle will have several mechanical and electrical problems, but still drivable. The exterior will have visible dings, scratches and dent, with rust on some body panels. The tyres may look worn and due for replacement.

d. Poor

The used vehicle will have severe mechanical problems and may not run properly. The exterior is usually damaged and there will be extensive rust, with worn out tyres in need of replacement. Vehicles in poor condition will have high mileage count and high maintenance cost.

4.0 MACHINE SHOP AND VEHICLES VALUATION

Normally, there are two methods of valuation to carry out the valuation of machine shop and vehicles. The method chosen depends on the purpose of valuation, available information and reliable data.

4.1 Comparison Method

The comparison method of valuation holds a principle of substitution whereby there is no prudent purchaser will pay more than what will cost him to purchase a comparable alternative property that he can obtain elsewhere. The cost of acquisition is the price which must be paid for an already existing substitute. Evidence of sales of other similar (make, model, age and capacity) must be gathered before it can be used.

Example of Comparison Method in Practice

Valuation of Motor Vehicle:

Information: Chevrolet Malibu, 2016 year built, 45,000 kilometre odometer:

Specifications		Comparable 1	Comparable 2	Comparable 3
Year	**2016**	**2016**	**2015**	**2014**
Price		SAR40,000	SAR35,000	SAR32,000
Odometer Reading	45,000	50,000	60,000	45,000
Asking Price		-5%	-5%	-5%
Age		-	5%	10%
Condition		-10%	-5%	5%
Odometer		5%	10%	-
Total Adjustment		**-10%**	**5%**	**10%**
Adjusted MV		**SAR36,000**	**SAR36,750**	**SAR35,200**
Opinion of Value		**SAR36,000**		

4.1.1 Determine the Market Value based on Reinstatement Value for Machine Shop Tool

Current price (new)		**SAR a**
(+)	Transport	SAR b
(+)	Installation	SAR c
(+)	Commissioning	SAR d
(+)	Freight charges	SAR e
(+)	Insurance	SAR f
(+)	Duties/Tax	SAR g
Replacement cost new		**SAR h**
(+)	Debris	
	? % of SAR h	SAR i
(+)	Inflation	
	? Years @? % pa of (SAR h+i)	SAR h
Reinstatement Value		**SAR k**

4.1.2 Determine the Market Value based on Indemnity Value for Machine Shop Tool.

Price of similar second-hand machine		SAR a
(+)	Transport	SAR b
(+)	Installation	SAR c
(+)	Commissioning	SAR d
(+)	Consultant	SAR e
Indemnity Value		**SAR f**

4.2 Depreciated Replacement Cost (DRC) for Machine Shop Tool

The basic principle of this method is based on the principle of alternatives i.e., the theory that a person should not pay more for a property than it would cost him to purchase a site and rebuilt a building of similar utility. DRC method is the current cost of reproduction or replacement of an asset less deductions for physical deterioration and all relevant forms of obsolescence and optimization.

The model of DRC as follow:

	Current price new (FOB)	SAR a
(+)	Freight charges	SAR b
(+)	Insurance	SAR c
(+)	Duties/Tax	SAR d
(+)	Transport	SAR e
(+)	Installation	SAR f
(+)	Commissioning	SAR g
	Replacement cost new	**SAR h**
	Depreciation	x?
	Depreciated replacement cost	**SAR i**

Example

A Horizontal Extruder machine made in United States of America installed 5 years ago at a cost of SAR14,000. Information that reveals the cost of extruder machine to the same model now involves the cost of purchase of SAR30,000. Other costs involved are:

- Transportation cost: SAR 1,000
- Insurance: SAR 200
- Installation cost: SAR 750
- Commissioning cost: SAR 750
- Consultants fees: SAR 750
- Imports duties/taxes: SAR 1,500

a) Indemnity Value

If the machine has assumed economic life span of 15 years and 5 years old, cost is as follows:

Replacement Cost New	SAR 34,950
Less	
Depreciation (30%)	x 0.70 (*)
Indemnity Value	SAR 24,465

Note: (*) Refer Rushton Table – top figure

b) Market Value In-Situ

Replacement Cost New	SAR 34,950
Depreciation	x 0.47 (*)
Market Value	SAR 16,427

Note: (*) Refer Rushton Table – bottom figure

5.0 Advanced Cost Approach Techniques

5.1 Cost to Capacity Relationship

Cost engineers have determined that many times known relationships exist between the cost and capacity of certain process-related machinery. They also have determined that in most instances the relationships between costs and capacities are not linear. That is, “economies of scale” probably exist as process-related machinery increases in capacity. These economies of scale tend to increase until such time as heavier construction materials are required as capacity increases

a) Cost to Capacity Equation

The relationship developed by the cost engineers is best reflected in the following equation.

$$\frac{Cost\ A}{Cost\ B} = \left(\frac{Capacity\ A}{Capacity\ B}\right)^{x}$$

x ranges from 0.4 to >1.0

b) Cost to Capacity Substitution

Moving Cost B to the right side of the equation, the formula is restated as follows:

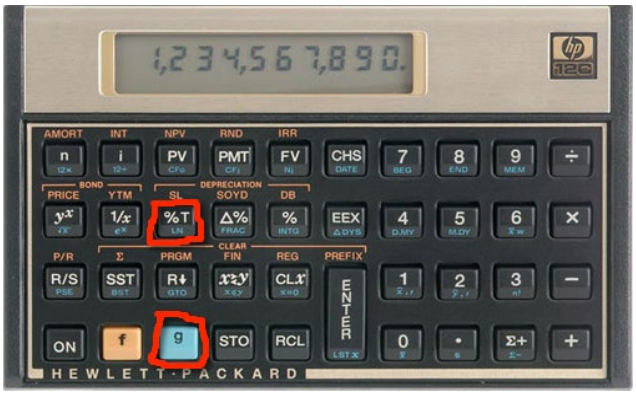
$$Cost\ A = Cost\ B\ \times \left(\frac{40{,}000}{20{,}000}\right)^{0.9}$$

$$Cost\ A = Cost\ B\ \times (2)^{0.9}$$

$$Cost\ A = Cost\ B\ \times (1.87)$$

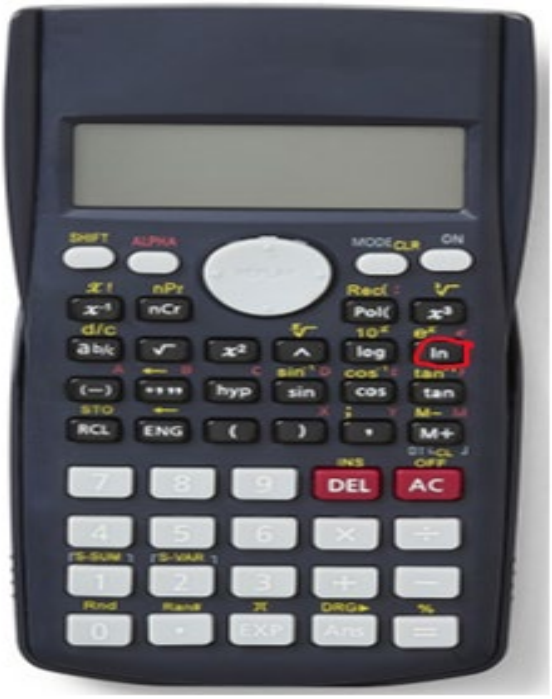
c) Calculating the Exponent in the Cost to Capacity Equation

Calculating the Exponent in the Cost to Capacity equation involves the use of Natural Logarithms. Logarithms were introduced in 1614 to simplify calculations. They were rapidly adopted by navigators, scientists, engineers, surveyors and others to perform high-accuracy computations more easily. Two types of logarithms are the Common Logarithms and Natural Logarithms. Natural Logarithms are widespread in mathematics and physics.



To calculate Natural Logarithms using a financial calculator such as a HP 12c, you would use the following keystrokes:

Pressing [g] [LN] calculates the natural logarithm of the number in the display. For example, to calculate the natural logarithm of 25: 25 [ENTER] [g] [LN] returns the natural logarithm of 25 or 3.2189



To calculate Natural Logarithms using a scientific calculator such as a CASIO, you would use the following keystrokes:

Pressing [ln], pressing number to calculate and the natural logarithm of the number in the display. For example, to calculate the natural logarithm of 25:
Pressing [ln], pressing number 25 and returns the natural logarithm of 25 or 3.2189

Centrifugal Air Compressor

A	B
5,000 CFM 1,000 horsepower SAR171,000	3,000 CFM 700 horsepower SAR119,000

$$\frac{Cost\ A}{Cost\ B} = \left(\frac{Capacity\ A}{Capacity\ B}\right)^{x}$$

$$\frac{171{,}000}{119{,}000} = \left(\frac{5{,}000}{3{,}000}\right)^{x}$$

$$1.44 = (1.67)^{x}$$

Solution

Cost ratio 1.44 LN = 0.36
Cap ratio 1.67 LN = 0.51
Divide 0.36 by 0.51 = 0.71
0.71 = x

Remember which way to divide:
Divide the capacity log into the cost log
Note: LN - Natural Logarithm

d) Sphere Exercise

The following information pertains to The American Society of Mechanical Engineers (ASME) spheres of A-515 pressure vessel quality grade 70 steel plate. Current prices reflect field erection.

Diameter	30 meters	50 meters
Volume	14,137 cubic meters	65,450 cubic meters
Wall Thickness	0.75 centimeters	0.75 centimeters
Weight	96,690 kilograms	256,670 kilograms
Current Cost	SAR129,000	SAR290,000

Estimate the current cost of a sphere with a 60 meters diameter and 0.75-centimeter thickness. Total volume is 113,097 cubic meter, and total erected weight is 365,190 kilograms.

Solution to Sphere Exercise

Cubic Meters

Solve for X: $\frac{Cost\ A}{Cost\ B} = \left(\frac{Volume\ A}{Volume\ B}\right)^{x}$

$\frac{290{,}000}{129{,}00} = \left(\frac{65{,}450}{14{,}137}\right)^{\mathbf{x}}$

$2.248 = (4.630)^{\mathbf{x}}$

2.248 LN 4.630 LN **divide right to left**

$\frac{0.81}{1.53} = 0.53$

X= 0.5294, say 0.53

$\frac{Cost\ A}{290{,}000} = \left(\frac{113{,}097}{65{,}450}\right)^{0.53}$

Cost A = 290,000 x $(1.728)^{0.53}$

SAR290,000 x 1.336 = SAR387,440

Weight

Solve for X: $\frac{Cost\ A}{Cost\ B} = \left(\frac{Weight\ A}{Weight\ B}\right)^{x}$

$\frac{290{,}000}{129{,}00} = \left(\frac{256{,}670}{96{,}690}\right)^{\mathbf{x}}$

$2.248 = (2.657)^{\mathbf{x}}$

2.248 LN 2.657 LN

$\frac{0.81}{0.98} = 0.83$

X= 0.8289, say 0.83

$\frac{Cost\ A}{290{,}000} = \left(\frac{365{,}190}{256{,}670}\right)^{0.83}$

Cost A = 290,000 x $(1.4228)^{0.83}$

SAR290,000 x 1.34 = SAR388,600

Round to SAR390,000

e) Inutility Formula

The Inutility Formula can be used to measure a form of economic obsolescence such as reduced demand for a product due to external factors. However, it is limited to the design and physical output of fixed assets. This manifest itself as a reduction in value to the fixed assets for the unneeded capacity, when the asset is overbuilt (some appraisers may also characterize this as a form of functional obsolescence). It does not address the broader elements of Economic Obsolescence that affect the business such as the economics of the industry.

Inutility Formula

Economic obsolescence = $\left[1 - \left(\frac{Capacity\ B}{Capacity\ A}\right)^{X}\right] x\ 100$

Example: Suppose you have a pump and need to create an exponent based on information from two other pumps. The calculations are as follows:

$$\left[\left(\frac{A\ known=SAR150}{A\ known=SAR200}\right) - \left(\frac{A=50\ LMP}{B=75\ LMP}\right)^{X}\right] = Results = 0.71\ as\ an\ exponent$$

Then replace the unknown, using the 0.71 as am exponent

Inutility Exercise

i. Rated capacity = 10,000 units/day
ii. Current operation = 5,000 units/day
iii. (This should be determined for each case.)
iv. Assumed exponent = 0.6
v. Economic obsolescence =

Formula is $\left[1 - \left(\frac{Capacity\ B}{Capacity\ A}\right)^{X}\right] x\ 100$

What is the percentage of economic obsolescence?
Solution

vi. Assign 10,000 units to capacity A and 5,000 units to capacity B, then reverse the calculation to get the amount to decrease. Then, 34% is the penalty and it should apply to the line after the previous calculations to get percentage of economic obsolescence.
vii. The substitutions would be as follows $\left[1 - \left(\frac{5{,}000}{10{,}000}\right)^{0.6}\right] x\ 100$
(Multiplying by 100 gives a percentage.)

$$[1 - 0.66]\ x\ 100 = 34\%$$

f) Economic Obsolescence Problem

- A subject plant is capable of producing one million units. However, due to decreased demand for the product, it is estimated that there will be a 40% reduction in production as long as the plant continues to operate.
- Given: Exponent of 0.8
- Question: What is the economic impact percentage due to inutility?

Solution

Restate formula $\left[1 - \left(\frac{Capacity\ B}{Capacity\ A}\right)^{X}\right] x\ 100$

Or $\left[1 - \left(\frac{Actual\ capacity}{Design\ capacity}\right)^{X}\right] x\ 100$

Substituting $\left[1 - \left(\frac{600{,}000}{1{,}000{,}000}\right)^{0.8}\right] x\ 100$

Calculations $[1 - (0.6)^{0.8}]\ x\ 100$

$$[1 - 0.665]\ x\ 100 = 33.5\%$$

g) Economic Obsolescence Problem 2

- A plant that has a design production capacity of 500,000 units per day.
- The actual production is only 300,000 units per day due to the loss of market share to new competitor opening a plant nearby.
- A new plant that produces 150,000 units per day would cost about SAR3,000,000.
- A new 250,000 unit per day plant would cost SAR4,700,000.

What is the amount of economic obsolescence that exists at subject plant due to inutility?

Solution

Using the cost to capacity formula, determine the exponent.

- Cost B divided by Cost A = Capacity B divided by Capacity A.

Formula with substitutes = $\left[\frac{SAR3{,}000{,}000}{SAR4{,}700{,}000}\right] = \left[\frac{150{,}000}{250{,}000}\right]$

.64 = .60

To natural log LN .64 = .45 LN .60 = .51

.45 divided by .51 = .88

Exponent .88

$\left[1 - \left(\frac{Capacity\ B}{Capacity\ A}\right)^{X}\right] x\ 100$ or $\left[1 - \left(\frac{300{,}000}{500{,}000}\right)^{.88}\right] x\ 100$

Then 300,000 divided by 500,000 = .60 to the .88 power = .64

1 – .64 = .36 × 100 = 36%

36% Economic obsolescence due to inutility

h) Fuel Tank Exercise

- One steel tank purchased and installed 12 years ago for SAR 251,250 placed on existing slab.
- A second tank acquired 9 years ago for SAR 279,375 placed on existing slab.
- Slabs under each tank are 2 metres thick and 26 meters in diameter
- Slab current cost = SAR 22.24 per cubic meter including reinforcing and labor
- Each tank is 24 meters diameter and is 45 meters high with dome shaped roof and weighs 64,180 kilograms.

Past Tank Costs

Tank Size	Capacity	Weight	Price	Date
22.66m Dia x 42.53m High	107,895 barrels	54,080 kg.	SAR 251,000	5 years ago
22.66m Dia x 42.53m High	107,895 barrels	54,080 kg.	SAR 272,000	3 years ago
22.66m Dia x 42.53m High	107,895 barrels	54,080 kg.	SAR 289,000	6 months ago
27.44m Dia x 43.89m High	163,253 barrels	81,8279 kg.	SAR 401,000	6 months ago

All above dome shaped rood and a barrel of product contains 159 liters

Additional Information

i. A tank twelve years ago installation cost was SAR 37,500 for 500-man hours, current labor rate is SAR 112.50
ii. Scrap dealers offering to buy any unused steel tanks for SAR 0.56 per kg, in place
iii. Freight is based upon SAR 0.56 per kg
iv. Insurance policy is depreciated replacement cost but excludes the foundations
v. Remaining useful of the tanks is 15 years (Notes taken on site)
vi. NUL = 30 years
vii. Dealer recently paid SAR 80,625 for 119,100 barrels tank intended for re-sell
viii. Bankruptcy auction, a 119,100 barrels tank went for SAR 60,000. Several other auctions in the area resulted in SAR 73,125 for a 148,800 barrels tank; SAR105,000 for a 223,200 barrels tank; and SAR128,250 for a 282,800 barrels tank
ix. Market information indicates no functional or economic obsolescence
x. Given: Exponent of 0.6.

Auction Comparables

Auction sales with less than 30 days exposure from the last 6 months

Capacity BBLs	Sales Price	Sale Location	Sale Condition	Age
148,800	SAR 37,500	Dhahran	Average	12 years
223,200	SAR 60,000	Shaybah	Average	12 years
297,600	SAR 75,000	Jubail	Average	14 years
446,500	SAR 105,000	Qatif	Average	10 years

Formula for Concrete Bases

$\pi r^2 h$

π (Pi) = 3.1416
h (height) = 2 meters
r (radius) = 13 meters

3.1416 X 13^2 = 530.93 square meters
X 2 meters = 1,061.86 cubic meters

1,061.86 X SAR 22.25 = SAR 23,627

Round to SAR 23,630 per base

Reproduction Cost

- **A 1st tank, latest price list available**

Current Cost (derived from Cost-to-Capacity calculation)	SAR 320,000
Slab	SAR 23,626
Trended Cost Now	**SAR 343,626**

• Estimation of Current Cost by Cost-to-Capacity method of new identical tank
(Cost A)/(289,000)= ((128,045)/(107,895))^0.6
289,000 x 1.187^0.6
289,000 x 1.1083 = **SAR 320,000** (rounded off)

• **2nd tank (same as first tank)**	SAR 343,626
• Total reproduction cost new, installed (both tanks)	SAR 687,253
Rounded to	**SAR 687,300**

Replacement Cost

- (Same as reproduction cost) SAR 687,300 (rounded)
- Tanks are usually reproduced but there are times when the replacement can be found.
- No information was given in this case.
- There are cases when one tank can take the place of two and then the replacement cost would be different due to demand or use.

Depreciated Replacement Cost

• First tank (12 years ago)		SAR 320,000
- Less physical deterioration*	-	SAR 128,000
- Depreciated RCN of first tank		SAR 192,000
• Second tank (9 years ago)		SAR 320,000
- Less physical deterioration**	-	SAR 96,000
- Depreciated RCN of second tank		SAR 224,000
• Summary		
- First tank		SAR 192,000
- Second tank	+	SAR 224,000
• Total depreciated replacement cost new		SAR 416,000

Both Tanks **SAR 416,000**

*** Age/Life (12 years ÷ 30 NUL = 40% depreciation)**
****Age/Life (9 years ÷ 30 NUL = 30% depreciation)**

Depreciated Replacement Cost Using Observation

- RUL = 15 years
- NUL = 30 years

$$\frac{15}{30} = 50\%$$

- Replacement Cost SAR 687,300

X .50

Total depreciated replacement cost = SAR 343,650

Tank Sales Comparison Approach

- No sales on 128,045 bbl. Tanks
- 119,100 bbls sold for SAR 80,625
- 7.5% larger than the comparable
- 128,045 ÷ 119,100 = 1.075 or 7.5%
- SAR 80,625 ÷ 1.075 = SAR 86,672 or say SAR 86,630
- 2 tanks at SAR 86,670 each = SAR 173,340
- Freight (64,180 kg. X SAR 0.56 x 2 x 50% = SAR 35,940
- Foundation SAR 23,630 x 2 x 50% = SAR 23,630
- Erection 500 hours x SAR 112.50 x 2 x 50% = SAR 56,250
- Total **SAR 289,160**

Or say SAR 289,000

Correlation

- By the Cost Approach SAR 416,000
- Alternate by Cost (observation) SAR 343,650
- By the Sales Comparison Approach SAR 289,000
- By the Income Approach Not Used
- Concluded Fair Market Value in Continued Use SAR 416,000

Session II

DATA COLLECTION AND MANAGEMENT SYSTEMS

- Introduction to Data Collection & Analysis

- Introduction to Data Management

DATA COLLECTION AND MANAGEMENT SYSTEM

1.0 INTRODUCTION

Data collection can generally be defined as the process of gathering and measuring information on variables of interest, in an established systematic fashion that enables one to answer stated research questions, test hypotheses and evaluate outcomes.

In ME valuation, data collection is defined as the process to obtain data to be analysed and used in support of the determination of ME value.

Data collection is one of the most important steps in the valuation process. This stage involves the process of gathering information about the ME to be valued as well as observations about its surroundings, condition and other support information that may have direct and/or indirective impact on its value.

Additionally, the data collection process also covers the research to find data of ME comparable evidence for comparison purposes. Subsequently, the data acquired may also be indexed into a ME catalogue or inventory database for future reference.

The data collection process should not be taken lightly. Consequences of poor data collection include:

- Inaccurate descriptions and understanding of the ME (i.e.: vague details on machine specification, serial numbers, data plate information and inaccurate production capacity information etc.);
- Inadequate ME information to perform value analyses (i.e.: when comparing machine productivity but ME data is insufficient);
- Wasted resources (i.e.: time and cost to re-inspect ME); and
- Subsequently resulting in inaccurate valuation.

Therefore, systematically managed data has a huge role in supporting the integrity of the ME valuation.

The data collection process for ME is generally quite similar to the data collection process for conventional real estate, however the information that needs to be collected is quite different and the data sources are more challenging to handle due to the varied ways machine information is published.

2.0 TYPES OF DATA

Data can generally be divided into two different types:

2.1 Quantitative Data

This type of data consists of data in numerical forms. Quantitative data is usually well structured and easy to analyse statistically. Examples of quantitative data include machine dimensions, production capacity, energy consumption, acquisition costs, depreciation etc.

2.2 Qualitative Data

Qualitative data is in the form of words, string texts or sentences that are not numerical (quantified) in description. This type of data is generally unstructured and non-statistical. Examples of qualified data include observation notes on a machine's physical characteristics, ME process flow description and machine functionalities.

For purposes of analyses, qualitative data are usually transformed into quantitative data using a pre-determined set of scale before statistical technique could be applied on them. For instance, to measure the physical condition of a machine, a valuer may index according to a 1- to-5 scale (where 1 is bad condition and 5 is excellent condition) based on a set of rules.

3.0 CATEGORIES OF DATA

Data are typically divided into two categories according to the data sources:

3.1 Primary Data

Primary data consists of data observed or collected directly from first-hand experience using tools such as interviews, observations and case studies.

Within the context of ME valuation, primary data includes information collected during ME inspection, interviews with ME operators, operation manuals and internal plant production logs.

3.2 Secondary Data

Published data that was collected, processed, analysed and reported by other persons or organisations is termed as secondary data. It may also be defined as data already in existence and which has been collected for some other purposes. Secondary data may be extracted from existing records, published sources or unpublished sources.

Secondary data include official economy report from government agencies such as the Central Bank, Ministry of Finance and Department of Statistics. It also includes industrial/ academic researches on the industry, textbooks and conference papers.

For ME, secondary data include other (including previous) ME valuation report for reference, plant production reports and company accounts. This data might be considered as indexes if it is properly catalogued.

4.0 SOURCES OF DATA

ME data comes from an array of sources. For example, some information is provided by the ME itself such as the specification plate/ machine tags, serial numbers, and operation manuals. Sometimes, the information is supplied by the client such as maintenance records and production logs.

Listed below are some of the sources of ME data:

- Manufacturers, suppliers and dealers (new and used)
- Published price guides and catalogues (Indexes) (subscription services)
- Plant/ factory accounts, receipts and invoices
- Stock keeping unit (SKU) and inventories
- Trade shows and exhibitions
- Auctioneers (published auction results)
- Classified sections in newspapers
- Magazines and articles
- Internet (Today most data is tracked through the internet)

The relation between data types, categories and sources is best describe in Figure 1 below:

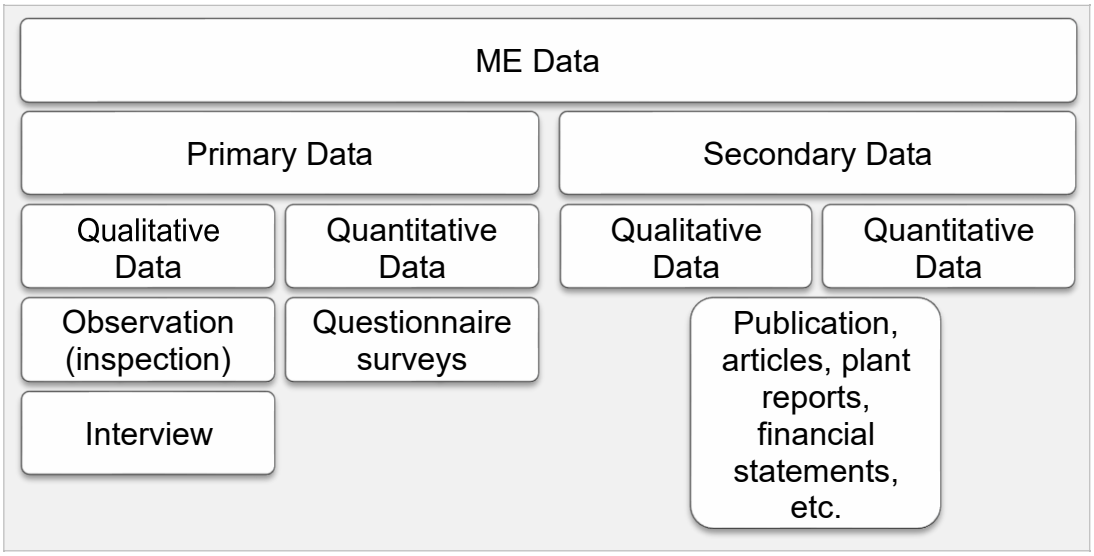


Figure 1: Relationship Between Data Types, Categories and Sources

5.0 METHODOLOGIES FOR ME DATA COLLECTION

There are many methods that can be used to gather data for ME valuation. The most common methods in practice are as follows:

5.1 Site Inspection/ Fieldwork/ Observation

Data from the site inspection/ fieldwork/ observation is the primary data especially regarding the capacity, specification and the physical condition of the machinery and equipment.

5.2 Content Extraction from Documents

PME data may be extracted from relevant documents provided by the client and other sources. For example, function and capacity of certain machines are described in the manufacturer's brochures and original equipment invoices. Price data can be found from internet searches and relevant websites. Some institutions and their corresponding journals also provide consumer price indices for ME.

5.3 Interview

Respondent such as manufacturer, plant manager or supplier customer service personnel can be interviewed to obtain data and information pertaining to the plant, machinery and equipment. Interviews could be structured, unstructured or semi-structured, and conducted either face to face or by telephone or online.

6.0 ME IDENTIFICATION

Valuers need comprehensive ME data not only to perform value analysis, but also to clearly describe the ME in the valuation report. For this purpose, it is vital for valuers to understand how to narrate the functions and set up of the ME. In order to systematically describe ME, valuers are recommended to divide the descriptions in the following sections:

6.1 Macro Identification

Macro identification can be defined as describing the overall functions and roles of the ME. For plants, it includes description of the main components that contribute to the design and capabilities of the plant from receiving the input raw materials until it can produce an output.

6.1.1 General Description of the ME

The general macro Identification of the ME would include the following:

- What the plant manufactures or produces
- The process used to produce the plant's output
- Plant production capacity (maximum and optimum)
- Overview of components and assemblages used in the processing stages

6.1.2 Contents of Macro Description

A list of information to be considered when gathering the data for macro identification of machinery and equipment is as follows:

a. Date of valuation (Report Date and effective date of the valuation report)

b. Intended Use and Intended Users of the Valuation Report

c. Purpose of valuation

d. Name and address of plant to be valued

e. Details of the company that operates the plant

f. Business/organisation background information

g. General explanation of ME
    i. Overview of ME sections and components
    ii. Original date of ME construction and expansion(s)
    iii. Proximity to resources, feedstock, transportation network etc.
    iv. Overall power consumption (electricity/ fuel)
    v. Overall plant capabilities - design capacity
    vi. Actual working capacity - at current moment and date of inspection
    vii. Age: chronological and effective life
    viii. General physical and operational condition
    ix. General overview of the maintenance schedule
    x. Pollution control equipment in place
    xi. Fixed Asset Register along with high price invoices.

h. ME sections/components
    i. Overview of ME sections/ components
    ii. Support facilities
    iii. Construction/installation date of ME section/ component/ support facilities and expansion(s)
    iv. Type of control system and if the control is centralized – fully automated/ semi- auto/ programmable system etc.
    v. Operation staff per unit (section)
    vi. Which equipment requires more than routine maintenance and why
    vii. How the maintenance program is conducted: regular, preventive or corrective

i. Plant process
    i. The production process – general workflow from raw materials to end product
    ii. Operating mode (day, month) if not identified in capacity, for example, sugar beet plant that run their "campaign only certain times of the years"
    iii. Plant layout flow: considered adequate, manageable, etc.
    iv. Available historical operational data over three to five years

j. Business/organisation background information
    i. Financial statements for the last 3 years
    ii. Yield or loses, reason for losses
    iii. Estimated maintenance budgets over last three to five years and projected upcoming budget if plant is operational
    iv. Market demand for end product

k. Industrial safety and quality control standards. If safety and environmental standards are good (if not, can it be upgraded and at what cost)

l. Compliance with local authority/ enforcement requirements

6.2 Micro Identification

Micro identification can be defined as the process of finding the individual characteristics of the machine and equipment. Micro Identification concerns the listing of a single machine.

Items that should be included in ME micro description are as the following:

a. Brand

b. Model

c. Type

d. Capacity

e. Size

f. Serial number

g. The name of the manufacturer or manufacturers of machinery

h. Supplier name

i. Description of the machine
    i. Original/main machine
    ii. Accessories or additions to the original machine (support machines)

j. If there is a special site for the machine as well as any special connections such as electrical controls, piping and the like.

6.3 Examples of Data

An example of the kind of information that is taken from the individual machine is shown in Figure 2

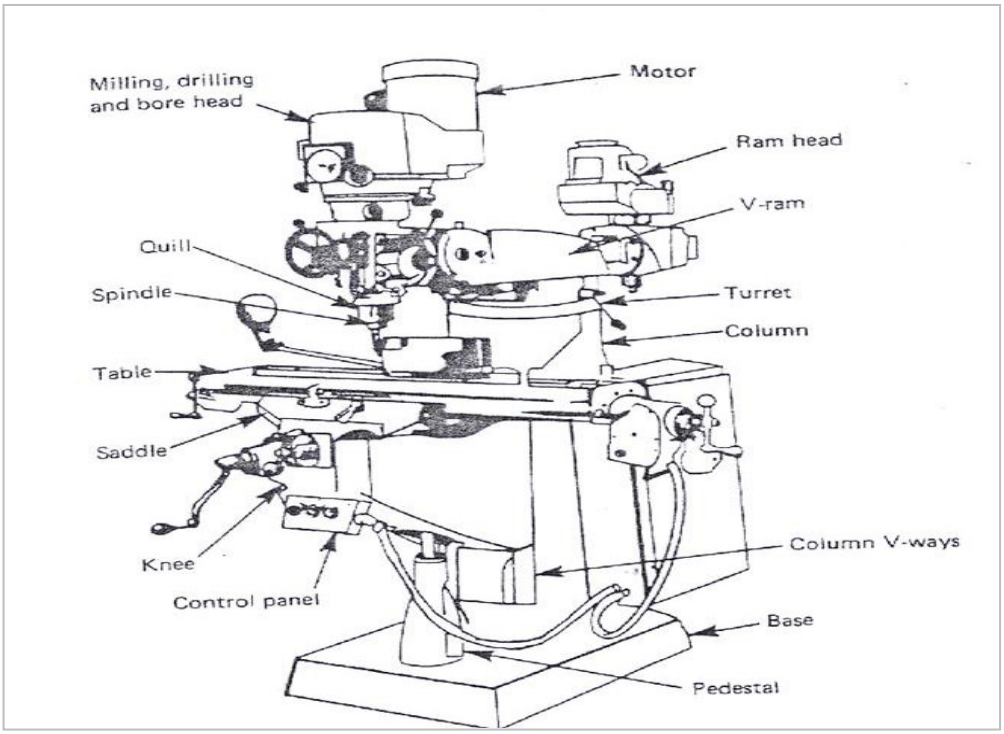


Figure 2 : Micro identification – Vertical Milling Machine

Information to collect:

- Brand name
- Model number and/or size
- Table size and axis (if more than two axes machine)
- Special controls, readouts, programming devices
- Type of milling head and motor horsepower
- Accessory head, vice, tooling
- Apparent conditions

Another example of micro detail is the industrial fork truck demonstrated in Figure 3

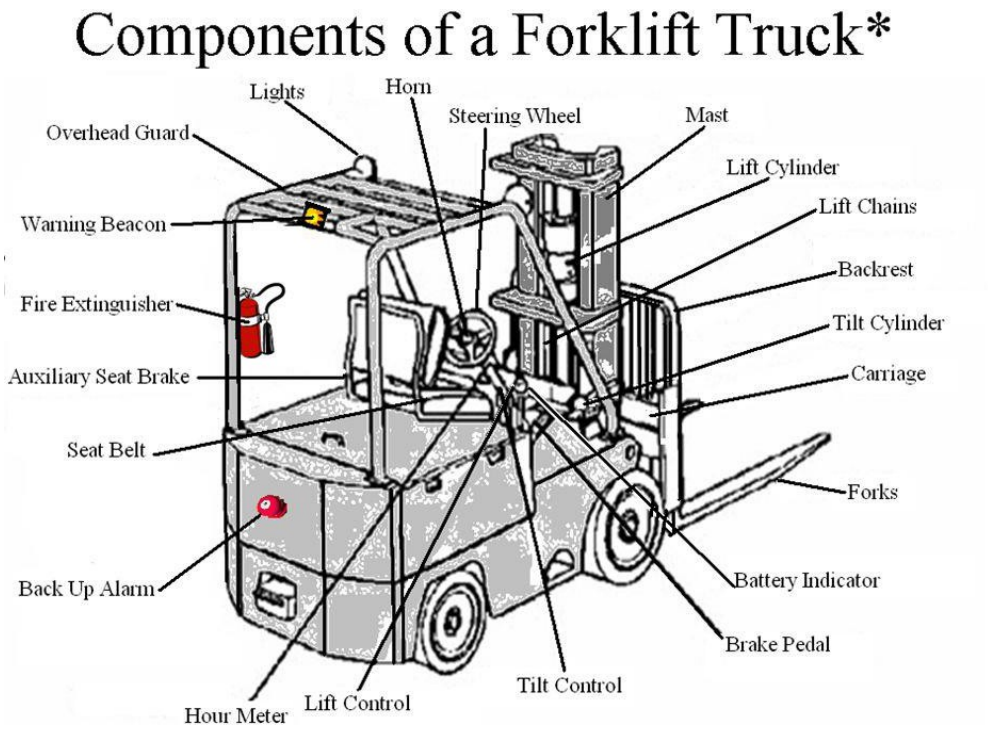
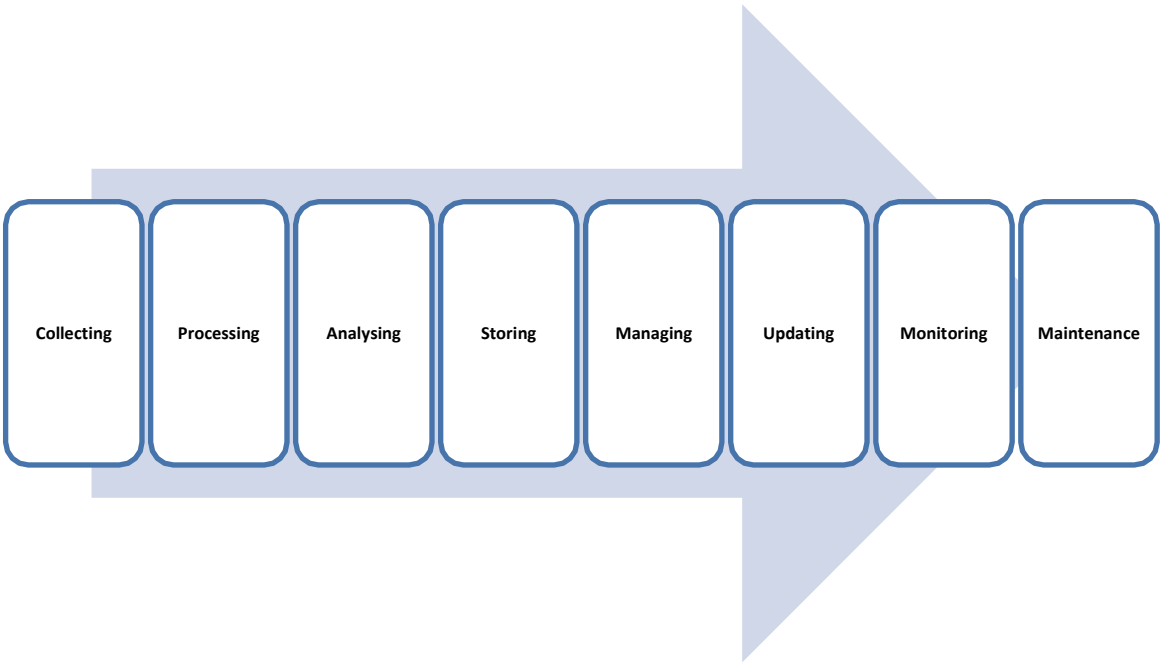


Figure 3: Microidentification – The Principal parts of a fork truck

Information to collect:

- Brand name and capacity
- Model number
- serial number
- Type of tires (pneumatic, solid)
- Type of truck (warehouse, rough terrain, yard)
- Type of fuel (diesel, gas, propane)
- If battery powered, the charger
- Lift height, double mast, tri-mast
- Extended fork height, tilt
- Accessories: side shifter, barrel attachment, slip sheet attachment
- General condition

7.0 DATA MANAGEMENT



Data management refers to the actions of collecting, processing, analysing, storing, managing, updating, monitoring and maintenance of information to be used to determine the value of plant, machinery and equipment.

Data management is vital to ensure efficient management of ME data and records. Systematic data management will also ease data retrieval process when handling future ME valuation.

Information and inquiries from all previous ME cases is gathered and indexed according to categories and group of common usage. Suitable parameters are identified for easy retrieval when ME data is uploaded into a database.

a) ***Data collection*** is the operation of gathering and measuring information on variables of interest, in an established systematic listing of machine and equipment. This information can then be used to evaluate and value the equipment

b) ***Data processing*** is simply the conversion of raw data to meaningful information through a process. Data is manipulated to produce results that lead to a resolution of a problem or improvement of an existing situation. Similar to a production process, it follows a cycle where raw data are fed to a process to produce output (information). The process includes activities like data entry, summary, calculation, storage, etc.

c) ***Data analysis*** is a process of inspecting, cleaning, transforming and modelling data with the goal of discovering useful information, suggestion conclusions, supporting decision-making. Data analysis has multiple facets and approaches, encompassing diverse techniques.

d) ***Data storing*** is the recording (storing) of information (data) in a storage system.

e) ***Data managing*** is the practice of organizing and maintaining data processes, to meet on going information lifecycle needs.

f) ***Data updating*** is the processes involving adding, modifying, or deleting data to bring a file or database up to-date.

g) ***Data monitoring*** in which data is routinely checked against quality control rules to make sure it is always of high quality and meet previously established standards for formatting and consistency.

h) ***Data maintenance*** is the process to improve database. These are routines meant to help performance, free up disk space, check for data errors, check for hardware, update internal data machine and equipment and many other obscure (but important) things.

7.1 Data Classification/Indexing

Data classification is the process of organising data into categories for its most effective and efficient use. A well-planned data classification system makes essential data easy to find and retrieve.

Therefore, it is becoming increasingly important to utilise the right tools and techniques to capture and organise a wide variety of data types from different sources and to be able to easily analyse.

There are three methods of filing the data:

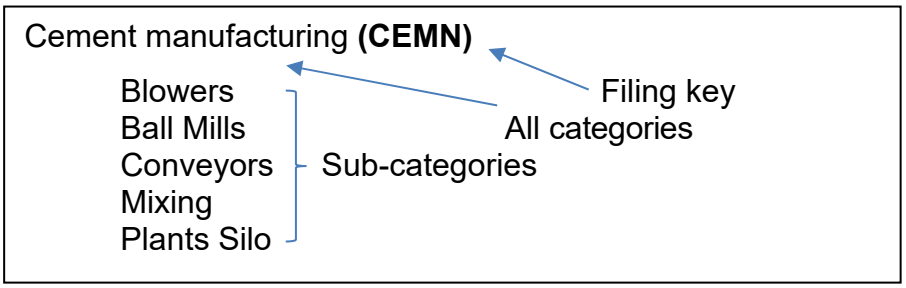
- Filing by Subject/Category
- Filing in Alphabetical order
- Filling by Numbers/Numerical order

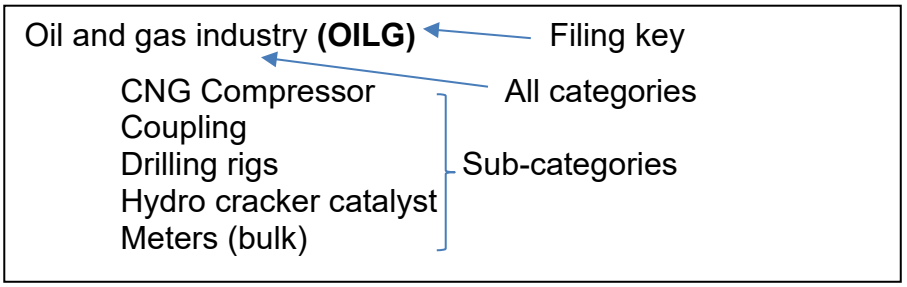
These methods of filing are called classification which provides a means organising things that are alike together. However, we can combine all or some of these methods for filing purposes. For example, main files are kept together according to subject/category but inside each file the documents could be arranged according to alphabetical order.

Example: Category: Industry
Category: Asset

If data is arranged by categories, it should be filed in a logical way; we don't put them together just because they start with the same letter. Once categories have been decided, create filing index for easy reference to user. This index is called a filing key.

Write up a filing key by listing all the categories and sub-categories in the order they are filed in. Examples of the categories and sub-categories shown below:





7.2 Master Control File/Database

One copy of parent/master list for all categories file should be established. One small list (Sub-categories) also should be established.

Under Sub-categories, this information is required:

- Brand
- Model
- Type
- Capacity
- Size
- Serial number
- Price/Value
- Date of manufacturing
- Date of valuation/Date of data
- Description of the machine
- Transportation costs

When the prices of machine do not include transport costs, these costs should be estimated by countries. They would determine the average distance over which the items are transported from the plant where they are made or, for imports from the port of entry.

- Installation costs

  Costs are usually associated with the installation of fixed equipment. Installation charges include not only those paid by the purchaser for physical installation of an item at a factory or other site but also any charges for testing or calibrating the equipment. In the case of transport or mobile equipment, there are usually no installation costs.

- Product taxes

  The value should only include non-deductible product taxes. Countries that levy a value added tax (VAT) normally allow purchasers to deduct the full amount of the tax on capital goods. Sales and other product taxes, and sometimes import duties, may also be fully or partly deductible on capital goods.

- Discounts

  The value should refer to the purchase of a single item so that it is not affected by discounts that may be available for large orders. The price of the single item should be reported after deducting any discount that is customarily available to most purchasers and that is available for most of the year.

7.3 Data Storage System

7.3.1 Definition of Hard Copy (Printed Copy)

A hard copy is a printed document. It may be a text file, photograph, drawing, or any other type of printable file. For example, instead of e-mailing a business memo, it may be sent out as a hard copy, or an actual physical paper containing the memo.

Hard copy can be defined as a document that has physical presence. It is touchable, tangible and physical. It can either be a hand-written format or computer printed. A hard copy bulky to carry, take up more spaces and difficult to make changes. Before the existence of computing machine, they were the only source of documentation. Transportation of such document to other cities or places takes a longer time, and sometime document may not last long.

Hard copy includes various items such as magazines, newspapers, records and bills of fare. One of the benefits of hard copy document is that they can be easily accessed and not tampered with as compared to a document on the internet.

7.3.2 Definition of Soft copy

A soft copy is a document saved on a computer. It is the electronic version of a document, which can be opened and edited using a software program.

The term "soft copy" is most often used in contrast to hard copy, which is the printed version of a document. Soft copies can be sent via e-mail or over a network connection, which makes them a more efficient and cost-effective option than using hard copies for communications. The downside to using soft copies is that they require a computer and software to open and can be accidentally deleted. Of course, some people have so many papers on their desks, that a soft copy may be less likely to disappear.

Session III

REFERENCING & BASIC REPORTING

- Specification Writing
- Inspection Procedures
- Reporting Format

REFERENCING: SPECIFICATION WRITING

1.0 INTRODUCTION

This session is an introduction to the procedures to be adhered to in preparing detailed inventory of Machinery and Equipment (ME). The task of identifying vital ME information and compiling the inventory list are the main items in preparing specification writing. The inventory list is for purposes of verifying ME with plant's records (if available fixed asset registers) as well as for valuation analysis purposes. Generally, all processes and equipment have common traits of identification. Therefore, the method of listing is not explicit to specific industry. At the end of this session participants will gain knowledge regarding direct and indirect ME information to be extracted for specification writing.

As in the field of real estate, ME valuation requires both on-site and desktop data gathering. In general, there are five valuation processes that include:

a. Identifying the ownership of assets in the inventories
b. Referencing or field inspection and verification of assets and equipment involved
c. Explaining the scope of valuation or scope of work
d. Describing the approach taken in the valuation exercise; and
e. Value conclusion and recommendation.

The former two processes relate to data gathering (on-site process) while the later three processes involve research process (desktop process).

Referencing or field inspection processes include an on-the-site examination of each machine and each item of the equipment (that are material in nature). The information collected will then be compiled as an inventory of the plant and other items – the foundation of the entire valuation.

The inventory list prepared by ME valuers should provide technical specifications as well as detailed descriptions of the ME to be valued. Hence, the task is termed as specification writing. Main items in the specification writing include machine name, manufacturer's name, model, serial number, list of attachments, motor capacity and electrical wiring, mechanical piping and structural foundation. (listing cadence should stay the same order for each item)

This inventory is compiled in an orderly manner, generally listed according to departments in the manufacturing process and building number. The inventory list could be prepared before inspection based on information provided by client and more details are to be completed and verified during inspection process. During inspection, inquiry is made into physical condition, age, hours of use, maintenance history and functional obsolescence, and rated capacity in comparison to a new or substitute modern machine with similar function (you may request original equipment invoices on high priced assets).

2.0 SPECIFICATION WRITING AND ITS IMPORTANCE

The word “specification” is defined as "to state explicitly or in detail" or "to be specific". A specification may refer to a type of technical standard of a product or service. In this context, specification writing means to compile details of a machinery based on the information found on the machine and as well as from other sources such as plant registers, brochures, maintenance records, original equipment invoices and procurement documents.

When instructions are received to carry out open market or forced sale valuations, there will usually be a requirement for a Plant Register or detailed inventory. There is undoubtedly advantage in this from the valuer’s point of view, since the Plant Register will make the precise contents of the valuation quite clear and undisputable.

Valuation of ME requires the preparation of an inventory in the form of a schedule. The extent of details to be included in such a schedule is a matter dependent upon the valuer’s judgement after due consideration of client’s instruction.

The description should be so precise that the reader of valuation report can properly identify or can find the machine. Information collected based on micro identification in this session are relevant in the preparation of the inventory.

Proper identification and comprehensive description of the ME will enable valuer to make a well informed and reasonable decision on the value since all necessary facts are considered.

The inventory list or plant registers maintained by the client would be a good starting point but should only be treated as a source of secondary reference. ME Valuer should make cross reference with physical inspection as well as other records such as procurement records, installation records and maintenance records. The valuer should also request for a list of disposals or scrapped items. It must remain a first principle that the inventory which forms the foundation of valuation should be compiled by the valuer based on his personal inspection of the assets.

3.0 IDENTIFICATION OF MACHINERY AND EQUIPMENT

Most authors agreed that there are two major procedures involved in the identification of assets in machinery and equipment valuation (Maninggo, 2010; Abdul Rahman, 2010; Derry, 2008; Mohd Khairudin, 2008 and Budhbhatti, 1999). Identification of ME can be classified into the following two categories:

3.1 Macro Identification

In this method, the entire manufacturing process is studied by identifying the major components contributing to the design capacity of the plant. Macro identification considers the market of identical asset, as well as the similar comparability in the market. Valuer uses this method to identify the following:

- What the plant manufactures or produces?
- How the product is manufactured?
- What is the capacity of the plant?

A prime example is an oil rig, illustrated in **Figure 1**. Quite often we refer to an oil rig as if it is one piece of equipment. A rotary oil rig is an entire plant made up of components. Some components are entire plants made from a composite of items designed to work together. Components can be sold from the rig or replaced when they wear out. However, the oil rig is not considered complete without its complement of mast, substructure, rotary table, power source, pumps and tools.

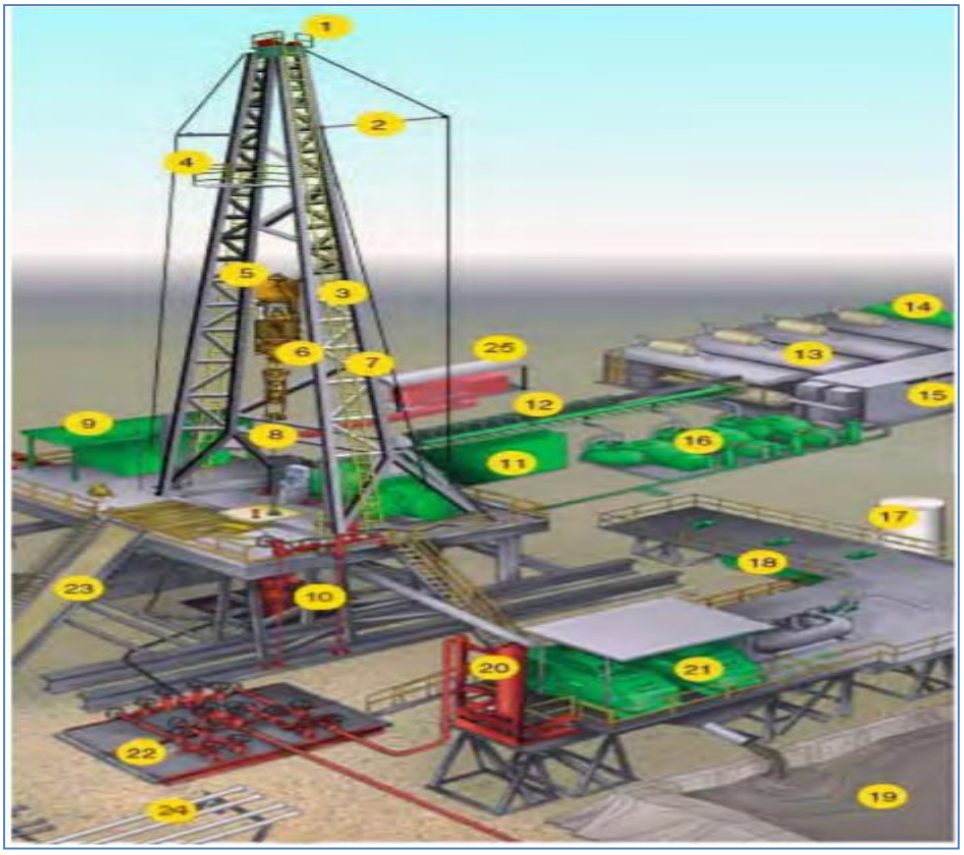


Figure 1: Macro identification – an oil rig

Note: Drilling Rig Components

[1] Crown Block and Water Table
[2] Catline Boom and Hoist Line
[3] Drilling Line
[4] Monkey Board
[5] Travelling Block
[6] Top Drive
[7] Mast
[8] Drill Pipe
[9] Doghouse
[10] Blowout Preventer
[11] Water Tank
[12] Electric Cable Tray
[13] Engine Generator Sets
[14] Fuel Tank
[15] Electrical Control House
[16] Mud Pumps
[17] Bulk Mud Component Tanks
[18] Mud Tanks (Pits)

3.2 Micro Identification

Micro identification is the process of finding the individual characteristics of the machinery or equipment. The method concerns the listing of a single machine. Identification includes the generic item. The brand name, model number, serial number, type of power and dimension is the prime importance in the micro identification. An example of the kind of information that is taken from the individual machine is shown in **Figure 2**.

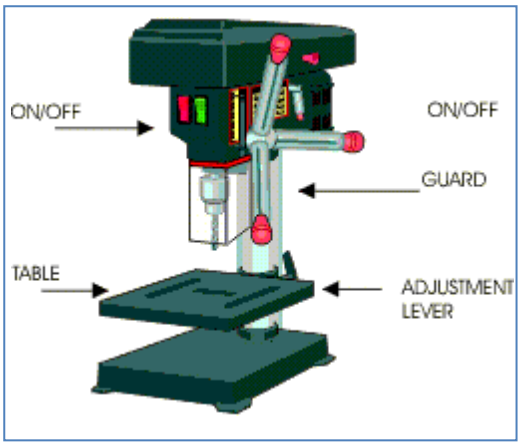


Figure 2: Drilling Machine (Bench Type)

Note: Information on drilling machine bench type

[1] Belt driven with 4-speed spindle.
[2] Drilling table can be raised and lowered and can be set at an angle of 0° until 45° and can be swung sideways
[3] Bench dimensions
-Length minimum 450 mm, Width minimum 150 mm
[4] Distance from spindle to base is minimum 600mm
[5] Drilling capacity is minimum 13 mm
[6] Motor power minimum 0.300 HP
[7] With chuck and key chuck
[8] Complete with 1 set of drill bits 7 pcs
[9] With vice 1 set

4.0 INFORMATION NEEDED FOR SPECIFICATION WRITING

To accomplish the task of specification writing, it is necessary to adopt standard procedure having the following descriptive characteristics:

a. Customer Reference Number/ Client's Asset Number/ Identification Number (if available)
This information could be sourced from client's plant register and/or identification mark on the machine (if available). (Client or Plant may have their own system of tagging assets.)

b. Make/ Brand Name
Normally it is the brand name of the manufacturer which is printed or stamped on the machine or machine tag i.e. Caterpillar is a brand name for heavy construction vehicles.

c. Description/Machine Type (Generic Name)

- General category
  What is it? Use common name of machine used in the industry such as compressor, milling machine etc. ME Valuer must get the correct description of machine from catalogue or other technical books. (Also ask the head of operations if you do not know the item or function. Also reference and invoice if needed)
- Specific type
  Further classification of category i.e. drilling machine bench type, engine lathe or centre lathe, automatic lathe and CNC lathe.
- Other general identifying characteristics for a special machinery are: construction equipment, restaurant equipment, automotive equipment, computers etc.
- Status of machine
  Whether new or used. Followed by a condition code.

d. Model
There could be many versions of the same machine. Therefore, machine can be identified by the model number for easy reference and parts number i.e. “Fu Sheng” Compressor Model ‘CNS C4088’.

e. Serial Number
This number is found on every machine for easy reference on details of manufacture and parts replacement.

f. Supplier (if available)
Most of the machine will have the name of supplier in the machine tag to enable client to contact the supplier for any enquiries for parts replacement, maintenance or servicing.

g. Size and Capacity
Measure important item of the machine based on measurement stated in the catalogue or plant register. Where possible metric units must be used.

h. Manufacturing date (if known)
If not stated on machine tag or name plate, it can be sourced from client’s plant register or procurement documents. This will enable the computation of economic life of machine as well as depreciation rate. Also, when providing the serial number to the manufacturer you can obtain the exact date of manufacture.

i. Special support/ structure for base (if available)
Reference to special foundations, platform, servicing connections i.e. wiring controls, plumbing/piping installation, other excessive installation cost (if known or relevant).

j. Addition/modification made to the original machine
ME Valuer must gather knowledge and information on the original machine and measurements so as to identify additional accessories on ME. Usually procurement documents and maintenance record will have details of extra accessories.

k. Details of original attachments, accessories and components; i.e. chucks, collets, tooling etc. for the machine

l. Source of energy and prime mover: electric motor, engine driven or hydraulic.

- If electric motor driven:
    - brand name, horse power, phase, voltage, amperage and revolutions per minute
    - type of enclosure: open drip proof, totally enclosed fan cooled, enclosed non-ventilated etc.
    - determine if the motor is directly connected integral to the unit (flange mounted) or connected via the drive or coupling.

- If engine driven:
  - manufacturer, model, horsepower, diesel or petrol.
  - If diesel engine; presence of an hour meter and a scrubber for fume, brake horsepower, number of revolutions per minute, type of clutch, torque converter, skid mounted, trailer mounted, permanent installation etc.,
  - size and type of radiator (if noted on plate)

- If hydraulic:
  - pump name plate (if available), type of power, size of unit and accumulator, brand name, model and serial number.

m. Present usage/production:
Briefly describe the machine current usage and production capacity (if any) whether full capacity or below capacity. You might gather this information from the head of plant operations

n. Maintenance record
Maintenance record will have information on the general condition, standard of maintenance, workload of asset and replacement of components parts since new installed.

o. Purchase price/installation cost
Information on the original purchase price and installation costs could be sourced from the client's procurement documents or original equipment invoices.

p. Type of driver and details of drive: chain drive/V belt drive, gear drive, chain to gear, reducer drive etc
This information can be sourced from plant register and catalogue since PME Valuer would not be able to open a machine to see the anatomy of machinery.

q. Controls
Take note of special control not normally furnished by the equipment manufacturer, amperage, voltages, phases, type of enclosures. If process equipment, presence of temperature recorder or other instrument relative to the equipment.

r. Starting equipment, transformers, heavy duty wiring
It is likely that all the description mentioned may not be applicable to certain machines and should not be included in the specification writing.

Figure 3: Example of information available on the machine

"Fu Sheng" 'CNS C4088' Triple Head Receiver Mounted Compressor, S/N 37B0600014, 1994, Taiwan, driven by "Teco" S/N 47121092, 5.5HP/4 Kw 3 Phase Induction Motor Air Compressor

Figure 4: Example of machine tag or name plate

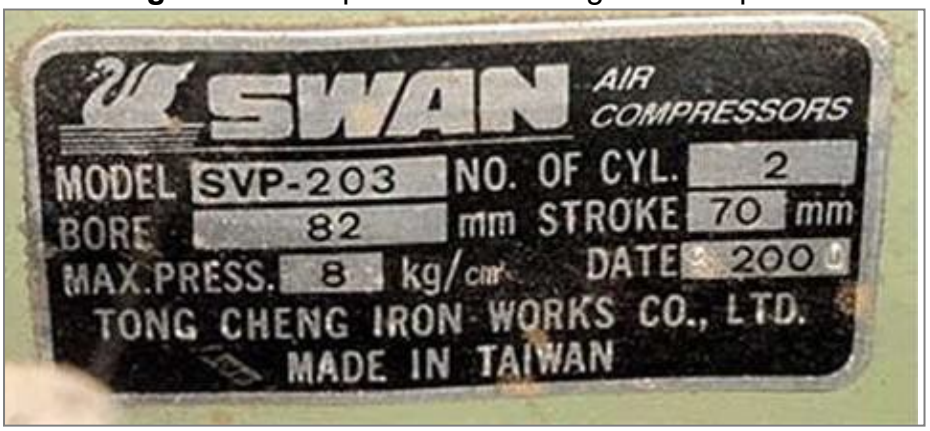


Figure 5: Example of Welder and generator

"Airman" 'PDW280SBL' Brushless Welder & Generator, Capacity 280 for welding, Single Phase 220V/50Hz Electricity Output

5.0 VERIFICATION OF INFORMATION

5.1 Physical Verification

Physical verification of ME by the valuer is prerequisite to valuation unless the valuation is a desktop valuation sight unseen. Inventory of ME installed in various sections complete in detail like technical specification, make, model, capacity, machinery if unused etc. shall have to be verified with accounting and technical records of the company. It is essential to identify the discrepancies, if any, detected on actual physical verification.

5.2 Reference to Company Record

Comparison of inventory with company's record shall be made for preparation of lists on the following basic consideration:

a. ME physically existing on site, but account reference not available, due to omissions arising out of:
   - ME having been manufacture in the company's own premises utilizing its own material and labour
   - Large tank being converted into several small tanks or alike units
   - Cost of ME treated as revenue expenses
   - ME taken on lease, or otherwise (including those belonging to sister company) put into use.

b. ME existing in account but physically not available due to factors such as:
   - ME already scrapped/ not in use/lying outside factory premises for repairs etc.
   - ME already sold and money realized shown as miscellaneous receipts, but effects not given in the fixed asset/plant register
   - Items of revenue nature capitalized
   - ME given on lease or lying in sub contractor's premises

Any discrepancies noticed on such verification shall be noted in the inventory list.

5.3 Maintenance Record

Technical specifications shall be verified in the following manner:

- Reference to the purchase orders with the Purchase/Account department. This is to enable the valuer to ascertain the acquisition cost including the installation cost.
- Consulting the technical literature from technical personnel using and/ or maintaining ME.

- Thorough discussion with technical personnel after evolving a formal discussion based on familiarity with the process, background of experience and consultation with other experts in the field.
- It is essential to scrutinize the purchase order as it gives a reasonably complete detail of a main machine, its accessories and other salient features of relevance. While taking inventory, a valuer shall not miss those accessories which have the potential to contribute to the process of manufacturing but not actually pressed into service.

6.0 EXAMPLES OF SPECIFICATION WRITING

The following are some examples of how machine specification is written:

Example 1: Triple head receiver mounted compressor

Figure 6

“Fu Sheng” ‘CNS C4088’ Triple Head Receiver Mounted Compressor, S/N 37B0600014, Year 1994, Made in Taiwan, driven by “Teco” S/N 47121092, 5.5HP/4 Kw 3 Phase Induction Motor

Example 2: Twin head receiver mounted air compressor

The Bebicon oil-less Air Compressor:

Air Products is powered by twin 1.5 HP, 4-cylinder oil-less Compressor heads. These twin heads pump up to 6 simultaneous users. The 30-gallon air storage tank provides a large supply of reserve air pressure for the office air system.

Information on the machine plate
"Bebicon" ‘TC 100’, 1.5 HP, driven by "Wayne" 'Y 132M-4', SN 708007 10 HP motor, piping.

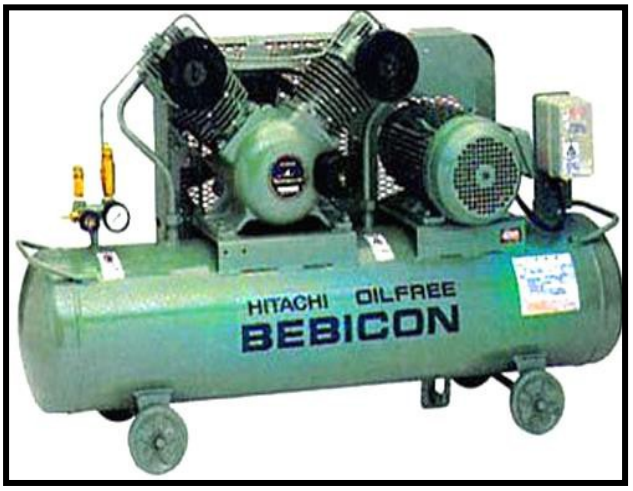


Figure 7: **Bebicon twin head air compressor**

Figure 8: **A steam boiler**

Figure 9: **Machine plate of boiler**

Example of machine specification recorded in the ME Inventory list:

TAQEEM/P&M/1 Location: Workshop Block A					
No.	**Brand/ Model/Type (function)/Capacity/ Serial number/ Capacity particulars/ Measurement/ Accessories/ Manufacturer/Year of manufacture/Country of origin/condition**	**Initial cost**	**Reinstatement Value**	**Market Value**	**Condition code**
1	*"Fu Sheng" 'CNS C4088' Triple Head Receiver Mounted Compressor, S/N 37B0600014, 1994, Taiwan, driven by "Teco' S/N 47121092, 5.5HP/4 Kw 3 Phase Induction Motor Air Compressor*				
2	*"Bebicon" 'TC 100', Twin head receiver mounted compressor, S/N 708007 ,1.5 HP, with piping, driven by "Wayne" 'Y 132M-4', 10 HP motor, Mitsubishi.*				

7.0 PHYSICAL CONDITION AND OBSOLESCENCE

In the process of ME valuation, the depreciation and obsolescence factor are very relevant. In view of technological development, it is necessary to understand the clear distinction of the meaning of depreciation as different from obsolescence.

Depreciation/Deterioration is a universal phenomenon. It is an attribute of all physical objects that they are subject to wear and tear, whether in use or not in use. Therefore, depreciation is in the sense that decay cannot be avoided.

Obsolescence, on the other hand is stimulated by external factor, be it technological, functional or economic. The effect is depreciation in value, but it is not the depreciation itself. Obsolescence and physical deterioration are both form of depreciation.

7.1 Depreciation

Depreciation may be defined as the usual wear and tear caused by the normal working of any asset despite the maintenance and preservation work being done on the machine. A valuer must make observation about the condition whether it is actual or perceived. For example, a machine is recently painted, it appears new, but it may be an old machine.

A Valuer must consider 3 major factors to arrive at the condition of the ME:

a. **Environment**
   What is the state of surrounding area housing the equipment? Is it sufficient to protect the Machinery and Equipment? Surrounding weather condition also contribute to balance life cycle and performance of machinery. Items such as salt water near the sea or sand near the desert may have impact on equipment.

b. **Usage**
   Is the machinery used strictly as per manufacturer's recommendation capacity? Get details from the record usage of the machinery.

c. **Maintenance**
   What is the system of maintenance? Is it routine breakdown maintenance or preventive maintenance? Has the company adopted maintenance audit procedures? These are pertinent question within the scope of maintenance.

Answer to all the above question will lead to a determination of whether the machinery is under the normal wear and tear or abnormal wear and tear.

7.2 Obsolescence

Obsolescence is a factor included in depreciation to cover decline in value of assets due to invention of new or better processes of machines, changes in demand, in design or in the other technical or legal changes but not to cover physical deterioration.

There are three types of obsolescence:

a. **Technological**
   Technological obsolescence is due to change in design and materials of construction of the ME. Latest machinery with better efficiency or uses less energy are common in ME.

b. Functional

Functional obsolescence arises when a machine in use loses its optimum capacity owing to a decline in cooperation from its operating counterpart. The company may have been compelled to commission a new high rated machine because a low rated one is not available, and the existing machine is not designed to give the high rated machinery the opportunity for optimum output.

c. Economic

This is due to factors external to the ME itself. This could be due to change in demand, shrinkage in supply of raw materials and labour, legislation affecting taxes or duty, environmental or zoning control etc.

This chapter is only a brief explanation on depreciation and obsolescence. Refer notes on how to calculate depreciation in earlier module.

8.0 CONCLUSION

This session will enable you to understand the process of ME identification, prepare an inventory and proceed into the next process in plant and machinery valuation. The inspection process and then the valuation process and finally preparing valuation report.

Information to be included in the inventory list depends on the valuer's judgement and purpose of valuation.

TASK AND DISCUSSION

Participants are required to work in small groups (2-3 people) and:

1. Write a comprehensive specification for a machine inside/around the classroom;

2. Use the flipchart to write specification of the machine.

3. Do a short presentation of their specification writing for comments and feedback from lecturer and other groups.

REFERENCING: INSPECTION PROCEDURE

1.0 INTRODUCTION

Referencing or onsite inspection is a comprehensive physical examination of all aspects of the Machinery and Equipment (ME) to supply information to the valuer to perform a valuation. Inspection must be carried out in line with provisions provided by the IVS, 2020 to ensure the accuracy and quality of ME inventory records. Therefore, all ME Valuers need to inspect the subject assets to ascertain the condition of the ME and to determine if the information provided to them is usable and related to the subject asset being valued.

The objective of this session is to discuss the procedures to be adopted in ME inspection. Similar to conventional real estate inspection, the assignment for ME valuation starts with a referencing or inspection. Proper inspection of ME is fundamental to ensure accuracy of background/ technical information of the valuation report.

2.0 DEFINITION OF REFERENCING

Referencing can be defined as “a detailed study into all aspects of a property or assets including particulars of identification, location, description, measurements and capabilities to enable a Valuer to carry out a proper valuation”. In simple words, referencing means “to schedule or reference all relevant and material details of a property which includes land and building, and other related records which will enable the valuer to compare one property with another in such a way as to express his valuation by a detailed standard”.

Similarly, the referencing process in ME valuation is a detailed physical verification of all aspects of ME. Identifying types of ME can often be difficult; therefore, inspection guidelines are important to assist participants in the process of ME inspection.

Valuers must adhere to standards or guidelines provided by the profession. For example, in Saudi Arabia, the Saudi Authority for Accredited Valuers (TAQEEM) provided the Saudi Machinery and Equipment Valuation Manual. The manual provides a clear guideline to guide ME valuers in conducting inspection and preparation of valuation report.

For small scaled ME, the whole of the inspection, including the referencing of the ME, may be carried out by one person. On the other hand, for large scale ME, formation of a team may be necessary as it may take longer time to complete.

3.0 CLARIFICATION OF TERM OF REFERENCE

Upon receiving valuation instruction/application, valuer needs to:

- Understand interest to be valued
- Clarify scope of valuation
- Request information needed to do valuation (i.e. client's inventory list, AutoCAD drawings, layout etc.)
- Additional details of ME by way of capital expenditure records (CAPEX)

4.0 OVERVIEW OF THE INSPECTION PROCESS

Inspection of ME can be divided into 4 stages as follows:

- Stage 1: Pre- Inspection Preparation (Requesting Information from the client prior to arrival)
- Stage 2: Preliminary Inspection
- Stage 3: During Inspection Process
- Stage 4: Post Inspection Process

4.1 Stage 1: Pre- Inspection Preparation

The valuer must gather as much information as possible, all the relevant basic information about the ME to be valued. Procedure at this stage would be:

a. Extract Information from Term of Reference

First and foremost, when a valuer receives instruction from client, he must get the Term of Reference (TOR) from the client. It is from the TOR that Valuer can extract initial information based on management tool such as 5W 1H analysis. (why, who, what, when, where, how)

i. WHY?

- Why is the valuation needed? Is it for insurance or financial purposes or market valuation? When the purpose has been established, basis of valuation may be determined, and the appropriate method of valuation will be identified.

ii. WHO?

- Who requires the valuation report? Is it the ME owner, business owner or partner or lessee or finance institution? Is it for buyer or seller or statutory body/bodies? Whose interest is to be valued? Is it the owner, proprietor or lessee or lessor?
- Based on this information, Valuer can determine the items that needed to be included in the valuation.

iii. WHAT?

- What is the scope of work/valuation? Does it involve the whole building, plant and machineries or part of the plant or building or loose items of machineries?
- Does it involve all machinery or only those bought by the company or those under lease?
- What type of ME? Machine shop or part of process plant. This is dependent on the client's need. These need to be identified because ME that provided services to the building is considered part of building. It will be valued as part of the building and known as building services.

iv. WHEN?

- When is the date of valuation? Every valuation must have a fixed date of valuation because value can change according to time factor due to economic effect or legal factor. Date of valuation could be determined based on the following fact:
  - Date of inspection
  - For statutory valuation, date of valuation as provided in the act or ordinance, or
  - other date required by the client
  - Effective Date and Report Date of the Valuation

v. WHERE?

- Where is the location of the ME? Is it in a building, industrial complex or stored in warehouse etc.
- Where can we get information or data on the ME? Is it from company record, accounting department or engineering department documentation?

vi. HOW?

- How do we gather information? Inspection or data from procurement record? How do we value the assets and using what method or approach?

b. Information Gathering

Every manufacturing process has their own needs of ME valuer. At times, Valuer will be required to value ME which they have yet to gain experience. In this case, he must gather as much information regarding the industry before he meets the client. Information could be sourced from:

- Reference books and flow charts
- Journals
- Magazines
- Brochures
- Catalogues
- Suppliers
- Advertisements
- Internet
- Equipment Dealers (new and used)

The ability to understand trade jargon, knowledge on ME to be valued and the industrial processes involved will help in convincing the client of the valuer's skill set.

c. Inspection Tools

Before inspection, a Valuer must have adequate tools for inspection. This includes:

- Pencil
- Torch light
- Measuring tape
- Camera
- Inspection notepad
- Safety equipment
- Safety boots
- Safety helmet
- Safety glasses
- Ear plug
- Dictation machine

4.2 Stage 2: Preliminary Inspection

At this stage, valuer will conduct a general observation of the ME as well as the surrounding areas. The valuer is expected to:

a. Arrange a meeting with client and have a briefing by the Plant Manager, on the workflow process of the ME as well as the security aspect. Verify the date of valuation, plant and company name and address, plant product, manufacturing process, plant

capacity, source of raw materials, product quality and duration of plant operation. (You might ask for a tour or walkaround).

b. Get the financial statement, production cost, income and overhead cost.

c. Get the plant layout plan, the manufacturing process flow plan or flow chart or schematic drawing both in hard and soft copies.

d. Understand the plant processes overview, initial process- where it starts, intermediate process- raw materials located, by- product of process and the final product located.

e. Identify the type of plant, plant manufacturing capacity, product from the plant and the plant process.

f. On the maintenance schedule, gather information on the level of maintenance, repair cost for the last 3 years, new machine or used machinery or latest design and compliance with the current law regarding environmental aspect, workers security and health hazard etc. (Ask about competing facilities nearby).

g. Get the inventory list of ME or plant register.

h. Prepare data collection procedure, identify source of data collection such as plant register, maintenance log book, contract document of machinery procurement, operation manuals, get photograph of machinery and historical value.

i. Estimate the time needed for the overall inspection.

j. Plan the proposed inspection in a systematic manner

4.3 Stage 3: During Inspection

Usually, access into plants is highly restricted. Therefore, before inspection, plant managers will hold a security briefing session before valuers are allowed to enter plant premises. During this briefing, make sure security clearance is obtained from plant manager to proceed with the physical inspection.

Valuers must also be aware of dangerous situation that they may face while working inside the operation area of a plant especially if the plant operation is maintained during the inspection. Examples Cold Storage for food processing, Special clothing

Inspection is carried out from building to building, room to room following the process flow to avoid any item being left out in the inspection. The Valuer might tag item such as fork lift that move around in the factory.

Procedure at this stage would involve security precaution before inspection, detail inspection, inspection (data collection) procedure and machine tag/ plate reading.

a. Security Precaution

- Wear appropriate clothing
- Wear security equipment such as goggles, ear plug, helmet and safety boots
- Ensure safe location at all times. Ensure that plant management is aware of your schedule on sight and when you are coming and going.
- Follow the safety procedure provided by the plant management
- Get escort for high risk areas such as generator room, boiler, moving machineries etc.
- Do not touch any machinery without permission
- Do not test any machinery without permission
- Do not remove any machinery without permission
- Do not switch on or touch or switch off electrical panel switch
- Do not switch off any machinery in operation
- Do not enter any room or section without permission
- Be careful of conveyor systems and hot item like ovens of any kind.

b. Inspection Procedure

The objective of inspection is to prepare an inventory list and data gathering. A good record and reference for each item is the most important aspect in valuation process of ME. Procedure at this stage are:

i. Preparation of Inventory
If any part of the ME is left out, the accuracy of valuation will be affected? The objective of inventory list is to record as much data as possible to enable Valuer to determine the value. Any extra information should be recorded to produce a good plant inventory list. Dictation might be an option

Inventory list from the client can be a guide as a secondary reference only. Sometime the information might not be up to date. Valuation must be based on the inventory list prepared by the Valuer.

ME recorded in the inventory list can be divided into:

- ME for processing and production
  - It is the most important ME in the list. Majority of the value of ME are made up of processing and production machinery. In term of size, it could be from the smallest bench tool to a big machinery. The cost of accessory that is fixed to precision machine tool could be double the value of a basic machinery.

- Ancillary ME and general tools
  - Ancillary ME might not be part of the process and production but it played an important role in contributing high value in the overall value of the plant i.e. maintenance plant and pilot plant.
  - General tools include furniture, small items such as micro miller, grinder, lathe and hand drill. Sometimes, the valuer can determine the value on the spot upon inspection.

ii. Office and laboratory
It might consist of multiple items but of low value. Record all the item and determine the value on the spot.

iii. Tools outside the building
Item could be:
- Fixed to the wall such as piping
- Tools at the roof such as dust extractor
- Internal transport such as forklift etc.
- ME not located on site of process or production line (Off-site assets).

c. Data collection

i. Client's Asset No./Identification No. (if available)
ii. Description/ Machine type: generic name
- General category – What is it?
- Specific type – further classification of category

iii. Name of Manufacturer
iv. Model
v. Type
vi. Serial number (if found) on the machine tag/plate
vii. Year of manufacturing (if known)
viii. Catalogue specifications (if relevant and available)
ix. Size and capacity (if measured or available)
x. New or used machine

xi. Details of attachments, accessories and components; i.e. chucks, collets, tooling etc. for the machine
xii. Materials of construction if process equipment or speciality item
xiii. Type of driver and details of drive: chain drive/V belt drive, gear drive, chain to gear, reducer drive, etc.
xiv. Prime mover, electric motor or engine driven
- If electric motor driven:
  - the name, horse power, phase, voltage, amperage and revolutions per minute
  - type of enclosure: open drip proof, totally enclosed fan cooled, enclosed non-ventilated etc.
  - determine if the motor is directly connected integral to the unit (flange mounted) or connected via the drive or coupling.
- If engine driven:
  - manufacturer, model, horsepower, diesel or petrol.
  - If diesel engine; presence of an hour meter and a scrubber for fume, brake horsepower, number of revolutions per minute, type of clutch, torque converter, skid mounted, trailer mounted, permanent installation etc.,
  - size and type of radiator (if noted on plate)
- If hydraulic: pump name plate (if available), type of power, size of unit and accumulator, brand name, model and serial number
- Presence of excessive leakage. Oil on the ground is a sign of poor maintenance which might alert the valuer that the company has financial problems and cannot afford to properly maintain the equipment.

xv. Controls: special control not normally furnished by the equipment manufacturer, amperage, voltages, phases, type of enclosures
- If process equipment: presence of temperature recorder or other instrument relative to the equipment.

xvi. Starting equipment, transformers, heavy duty wiring
xvii. Reference to special foundations, platform, servicing connections i.e. wiring controls, plumbing/piping installation, other excessive installation cost (if known or relevant).
xviii. Other general identifying characteristics for special machinery: construction equipment, restaurant equipment, automotive equipment, computers etc.
xix. Modifications or renovations to the standard machinery

d. Source of Inspection Data

i. ME

- Data collected from the machine tag/ plate are type of machine, make or brand name, model, serial number, manufacturer, capacity, country of origin, year of manufacture etc.

ii. Clients Record

- Data such as original cost, date of purchase and ancillary item attached to the basic machinery

iii. ME supervisor

- Data such as machine workload, repair and maintenance schedule etc.
- Source of inspection data

e. Inspection data

All inspection data should be recorded in an inspection form, note book or dictation. Condition codes should be recorded.

f. Photograph

Take photograph of machinery that is permitted by the plant manager. Note some equipment and setups are proprietary and permission of photo given prior to the start of an assignment. This is usually discussed with the company CEO, CFO or Operations manager.

g. ME description

Details of ME need to be described sufficiently to give a correct description of the machinery. There is no specific format but usually the record will be in the following sequence i.e. type of machine, make, model, serial number, capacity, year of manufacture, country of origin and the machine condition.

Inventory of ME installed in various locations complete with detail like technical specification, make, model, capacity present wear and tear, unusual maintenance requirements, energy consumption, machinery if unused etc., shall have to be verified with accounting and technical records of the company i.e. plant register.

It is essential to identify the discrepancies, if any, detected on actual physical verification. It is particularly necessary to notice whether year of manufacture in the account record and the year of manufacture of the machine installed in the plant differ due to the replacement of an original machine; and if the cost of replacement treated as revenue expenses.

Techniques to gather information from plate:

Rubbing method (tracing of model plate)	
Direct observation	
Snap shot and image search (internet)- hidden plate	
Mirror reflection – Hidden plate (Machine tag placed in unreachable location)	
Customer Records	Invoices, Purchase Orders, Maintenance Records

Sometimes there is a machine that cannot be seen on a variety of reasons such as position in the water, located high above the building which cannot get approval to site visit and etc. For assessment with reasonable assumptions relating to the existence and use of the machine and parts, the following methods can be used:

a. Machine is located so far from our location and very hard to enter can use the binoculars and camera Single-Lens-Reflects (CSLR).

b. Machine located in the water – can see the power connection and determine the position of the cable.

c. Cable, ducting and piping – can refer to technical drawing or AutoCAD.

4.4 Stage 4: Post Inspection

At this stage, when the inspection is completed, inspection notes must be checked to ensure no item is left out.

At the office, Valuer will start the data gathering process of each machinery to be valued. Information needed in this process could be sourced from:

a. Manufacturers
b. Suppliers of the machine
c. Trade exhibitions
d. Price catalogues
e. Customer's invoices
f. Advertisements in newspapers
g. Auctioneer (Auction Database)
h. ME database

i. Previous valuation reports
j. Clients' annual reports

Concurrently, valuers can start preparing drawings, photographs and other details that will be included in the valuation report as appendices. Company might provide drawings or site details.

BASIC REPORTING: REPORTING FORMAT

1.0 INTRODUCTION

This session will discuss the report format used in reporting the valuation to the client. It is the final part in the valuation process where the valuation is communicated to the Client in the form of a report. The Valuation Report can be acted upon by the client or certain third parties without any reference to the Valuer (unless a specific reservation or instruction has been made), it must therefore be clear and correct. Where applicable, the report should also detail intended users and intended use of the report and who can rely on the appraisal results.

The report must convey to the reader a clear understanding of the opinion expressed by the Valuer, provide sufficient information to permit those who read and rely upon the report to fully understand its data, reasoning and analyses the basis of the valuation used and conclusions. It must state the assumptions and information and limiting condition which the valuation is based. Great care should go into the report process explaining how the valuer/appraiser came to his or her conclusions.

Valuer must adhere to standards for reporting introduced by the respective bodies governing the valuation profession to ensure a quality valuation report.

2.0 REPORT FORMAT

There are 2 formats of valuation reports depending on the type of cases:

i) Letter or Certificate of Valuation (CV)
ii) Valuation Report

2.1 Certificate of Valuation

Valuer may report in the form of letter or certificate of valuation in two circumstances:

a) Letter of Valuation followed by valuation report

If this format is used, Valuer must:

- State specifically, a valuation report will be issued later
- Include all the assumption and conditions in the standards i.e. International Valuation Standards, 2020
- Must state value as contained in the valuation report.
- The date of the report was prepared, and the material date of valuation must be stated in the letter.

b) Certificate of Valuation

In this format, the letter or certificate of valuation must have at least the following items:

- Purpose of Valuation
- Date of Valuation
- Basis of Value
- Valuation
- Recommendation or relevant advice

If the client has put in writing, the terms & condition and assumption, these must be included in the letter or certificate of valuation.

If there is no written terms & conditions and assumption by the client, this must be stated in the letter or certificate.

This practice is important to protect the interest of Valuer and client to prevent any misunderstanding over the valuation report.

2.2 Valuation Report

The information in valuation report are different for each ME and the purpose of valuation. Generally, the content of a valuation report should contain the following:

2.2.1 Introduction

The report should clearly state:

i. The client, Intended User and instructions to value

ii. Interest to be valued - the interest should be carefully ascertained and clearly stated. Where interest is not found or stated in the document of title or relevant document, the Valuer shall state the interest clearly and include a copy of the document (s) that grant such interest. The report must also state that the user should enlist a legal practitioner to verify the ownership or interest in the property.

iii. Purpose of valuation - the purpose must be clearly stated either for financing (i.e. securitization or collateral), taxation, insurance (i.e. for indemnity or reinstatement new) or market valuation for sale, lease or litigation support etc.

iv. Treatment of item
Item to be valued must be identified such as
- on lease
- on hire purchase
- held in trust

2.2.2 Date of Valuation

The material date of valuation should be the date of inspection. However, where this is not applicable, the date of valuation must be clearly stated i.e. such date as required by the client. For statutory valuation purposes which involved legal requirement, the date of valuation should be specified in the law of the statutory document.

2.2.3 Date of Inspection

The date of inspection and details of person(s) involved in the procedure should be stated.

2.2.4 Definition of Machinery and Equipment

The definition should be based on standards set by the governing body of Valuers i.e. International Valuation Standards, 2020.

2.2.5 Location of Machinery and Equipment

Description of the property should cover such areas such as the neighbourhood, location, physical description of the property and its condition, available services etc.

Details of location such as in the building or sections of building must be stated clearly and identified on the site plan provided by the plant management or prepared by Valuer during inspection.

2.2.6 Description of Machine Tool

Description of machine specification.

2.2.7 Assumption

The report must clearly state all additional assumptions and special assumptions in bold and in capital letters.

2.2.8 Basis of Value

The basis of valuation must be clearly stated i.e. market value, reinstatement value and indemnity value.

2.2.9 Valuation Approach

Method of valuation used must be clearly stated and should comply with the valuation standards i.e. International Valuation Standards, 2020.

2.2.10 Information on Cost and Value

The report shall contain sources of information on cost and value.

2.2.11 Value Conclusion

This is the last part and reconciliation to the valuation report. The report shall contain a clear and unambiguous statement of value.

2.2.12 Valuer's Qualification

Valuer must sign the report and state his/her post in the firm or qualification.

2.2.13 Limiting Conditions

Valuer must state the limiting condition of the report such as the limit of Valuer's responsibility, limitation on reprinting in whatever manner etc.

2.2.14 Appendices

Depending on the requirement or purpose of valuation, appendices will contain the following items:

- Location plan
- Site plan
- Description of machinery/inventory
- Process plant diagram
- Photos of machinery, building etc
- Details of valuation for each plant and machineries

3.0 HOW TO PRODUCE A GOOD VALUATION REPORT

A good report should consider the following:

i. Statements must be paragraphed and follow appropriate flow
ii. Every sentence must be clear, concise and correct. Use simple sentences
iii. Sentences must be in correct grammar. Avoid sophisticated wording that is difficult to understand and repetition of words.
iv. Avoid wrong presentation of facts, missing important information and use of unverified evidence
v. Every heading and sub-heading must be numbered for easy reference by the reader
vi. Every report should have content page in the Front of the Report for easy reference by the reader
vii. Opinion expressed in the report must be reasonable, balanced view and supported by evidence.
viii. Report should have the appropriate plan and diagram
ix. Report should have photograph of the machine shop
x. Report should be signed by the Valuer, his/her designation, qualifications and certifications.
xi. The report including the appendices must be easily read from the same direction and need not be rotated to have the correct view
xii. Work files containing detailed records of investigation, research, analysis and conclusions should be maintained in the event of default or Client request in accordance with IVS General Standard 102 Investigations and Compliance, Section 30 – Valuation Record.

EXERCISE QUESTIONS
TAQEEM MACHINERY AND EQUIPMENT VALUATION
TRAINING PROGRAMME

MODULE	**:**	**INTERMEDIATE 1: UNDERSTANDING MACHINE SHOP AND VALUATION PROCEDURES (DATA COLLECTION, REFERENCING AND REPORTING)**
SUBJECT CODE	**:**	**402**
DATE	**:**	**2020**

1. All of the following content in the Certificate of Valuation can also be found in the Valuation Report **EXCEPT:**

   A. Purpose of valuation
   B. Appendices
   C. Basis of value.
   D. Valuation

2 The date of valuation in the valuation report could be one of the following dates **EXCEPT**.

   A. Date of inspection
   B. Date required by client
   C. Date of purchase/installation
   D. Date specified by law or statutory provision

Questions 3 & 4, Fill in the blank

Description of machine tool	Location of Machinery and Equipment	Definition of Machinery and Equipment
	Information on cost and value	

3. _____Description of property should cover areas such as the location, neighbourhood, physical description of the property and its condition, available services etc.

4. _____This information is related to the description of macro and micro identification of machineries. Each of the machinery and equipment to be valued should have detail description according to format in specification writing.

5. _____ is a printed output from a computer.
   A. Copy
   B. Paper
   C. Softcopy
   D. Hardcopy

6. The output shown on the computer monitor is called:
   A. Hardcopy
   B. Softcopy
   C. Screen copy
   D. Carbon copy

7. Machinery and Equipment data may be extracted from relevant documents provided by the client and other sources. For example, function and capacity of certain machines are described in the manufacturer's brochure, while price data can be found from internets searches and relevant websites.

   The statement above refers to sources of:

   A. secondary data
   B. primary data
   C. quantitative data
   D. none of the above

8. Which of the following is **NOT** a source of primary data?

A. Operation manual
B. Interview
C. Site Inspection
D. Observation

Questions 9 & 13, Fill in the blank

Processing	Storing	Hard copies	Soft copies	Monitoring

Data management refers to the action of collecting, _____, analysing, _____, managing, updating, _____and maintenance of information.

_____ do not depend on computers to be created or read, but _____are dependent on computers**.**

Questions 14 - 16, Match the correct answer from Group B against statement given in Group A

Micro identification – The Principal parts of a forklift truck:

	Column A		**Column B**
14.	Type of truck	i.	Diesel, gas, Electric
15.	Type of fuel	ii.	Pneumatic, solid
16.	Type of tires	iii.	Warehouse, rough terrain, yard

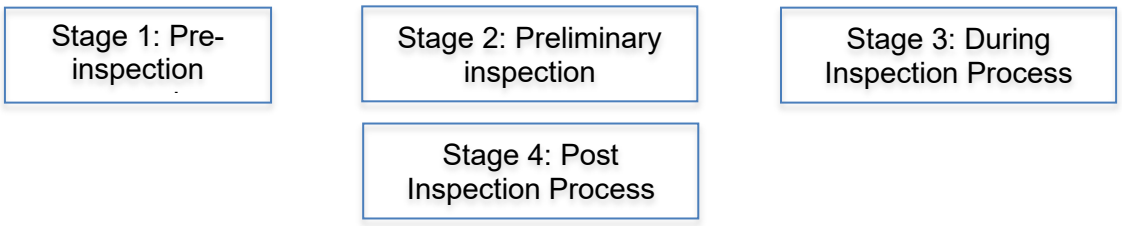
17. All of the following are sources of inspection data **EXCEPT:**

A. Data from clients record i.e.: date of purchase, original cost and ancillary item attached to the basic machinery
B. Data from plant and machinery database
C. Data from Plant and Machinery supervisor such as machine workload, repair and maintenance schedule etc.
D. Data collected from the machine plate are type of machine, make or brand name, model, serial number, manufacturer, capacity, country of origin, year of manufacturer etc.

18. All information could be sourced from the following **EXCEPT:**

A. Magazine
B. Reference books and flow chart
C. General Observation
D. Internet

Questions 19 & 20, Fill in the blank



19. _____ At this stage, valuer will conduct a general observation of the machinery and equipment as well as the surrounding areas. The valuer is expected to arrange a meeting with client and briefing of the plant by the Plant Manager on the work flow process of the machinery and equipment as well as the security aspect. Verify the date of valuation, plant and company name and address, plant product, manufacturing process, plant capacity, source of raw materials, product quality and duration of plant operation.

20. _____ At this stage, when the inspection is completed, inspection notes must be checked to ensue no item is left out. At the office, Valuer will start the data gathering process of each machinery and equipment to be valued. Information needed in this process could be sourced from manufacturers, suppliers of the machines, trade exhibitions, price catalogues, customer's invoices etc.

21. All the following are reliable sources of information for micro identification of machinery **EXCEPT:**

    A. Data from the machine tag/plate i.e. type of machine, make or brand name, model, serial number, manufacturer, capacity, country of origin, year of manufacturer etc.
    B. Data from plant and machinery database on the internet i.e., auction website, e-bay
    C. Information from Plant Supervisor such as machine workload, repair and maintenance schedule etc.
    D. Data from clients record i.e.: date of purchase, original cost and ancillary item attached to the basic machinery

22. Description of machinery and equipment in the specification writing are usually recorded in the following sequence:

    A. Brand, model, year of manufacture, measurement, type of machine, serial number, capacity, country of origin and machine condition
    B. Brand, model, year of manufacture, type of machine, measurement, serial number, capacity, country of origin and machine condition
    C. Brand, model, type of machine, capacity, serial number, measurement, year of manufacture, country of origin and machine condition
    D. Make, model, year of manufacture, type of machine, serial number, capacity, measurement, country of origin and machine condition

Questions 23 & 24, Fill in the blank.

Description/ type of machine	Model	Manufacturer	Make/ brand name

23. _____There could be various version of similar machine being manufactured. Therefore, machine can be identified by this information for easy reference and parts number.

24. _____Normally, this information is used by the manufacturer or printed on the machine or machine tag/plate. Some of brands are (IBM, Caterpillar) famous worldwide due to its high quality and well known in the industry.

25. Which of the following is **NOT** a perishable tool?

A. Drill bits
B. Drills
C. Taps
D. Reamers

26. Lathe, Milling Machine, Shaping Machine and Grinding Machine are examples of:

A. Machinery and Equipment Classes
B. Storage Equipment
C. Tools
D. Machine Tools

27. The types of milling machines are:

I. Column and knee type milling machine.
II. Fixed bed milling machine.
III. Planner milling machine.
IV. Special milling machine.

A. I & II
B. II & III
C. I, II & IV
D. All of the above

28. The types of slotting machines are:

I. Puncher slotting machine
II. Tool and cutter grinder.
III. Precision tool room slotting machine.
IV. Traveling head shaper.

A. I & II
B. II & III
C. I & III
D. All of the above

29. Which of the following is **NOT** an example of Permanent Tools?

A. Anvils
B. Chisel
C. Gauges
D. Drills

30. A term refers to a standalone machine which usually performs a specific task, independent of other machines

The statement above refers to:

A. Machine tools
B. Fire Extinguishers
C. Motor Control Centre
D. Support Equipment

31. Factors affecting motor vehicle value is:

A. Sales Arrangement
B. Modifications
C. Maintenance
D. All of the above

32. The examples of metal machine operations are as follows:

I. Turning
II. Drilling
III. Milling
IV. Grinding

A. I, II and III only
B. I, II and IV only
C. I, III and IV only
D. I, II, III and IV

33. New vehicles will have lost value by about _____ the moment they are driven off.

A. 10%
B. 20%
C. 30%
D. 40%

34. Which of the following is a potential sales arrangement?

I. Direct Sale
II. Via agent (dealership)
III. Trade-in
IV. Auction (repossession)

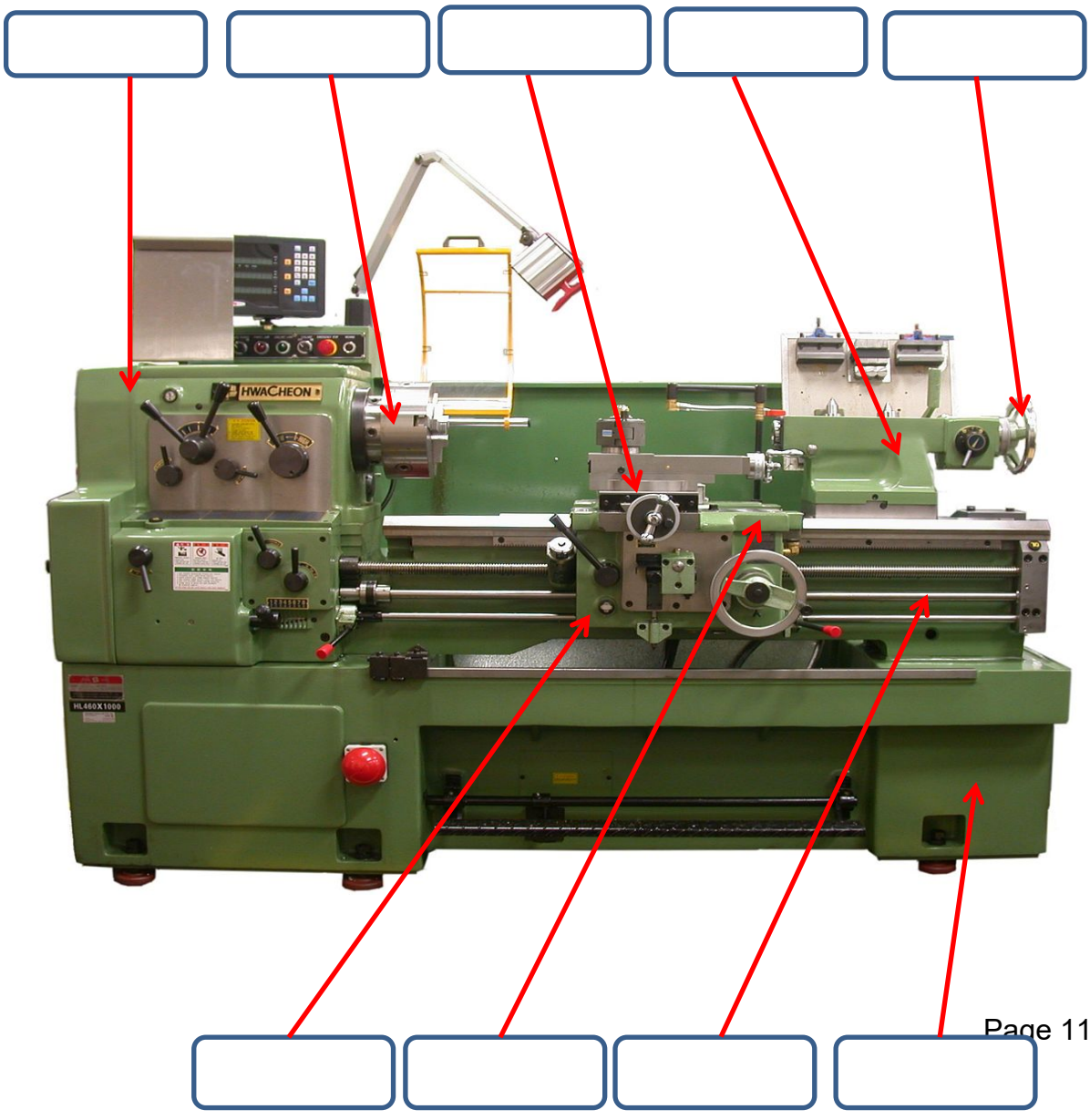
A. I, II and III only
B. I, II and IV only
C. I, III and IV only
D. I, II, III and IV

35. _____ a place or business where machinists use machine tools and cutting tools to make parts, usually of metal or plastic (but sometimes of other materials such as glass or wood).

A. Garage
B. Machine Tools
C. Production Machinery
D. Machine Shop

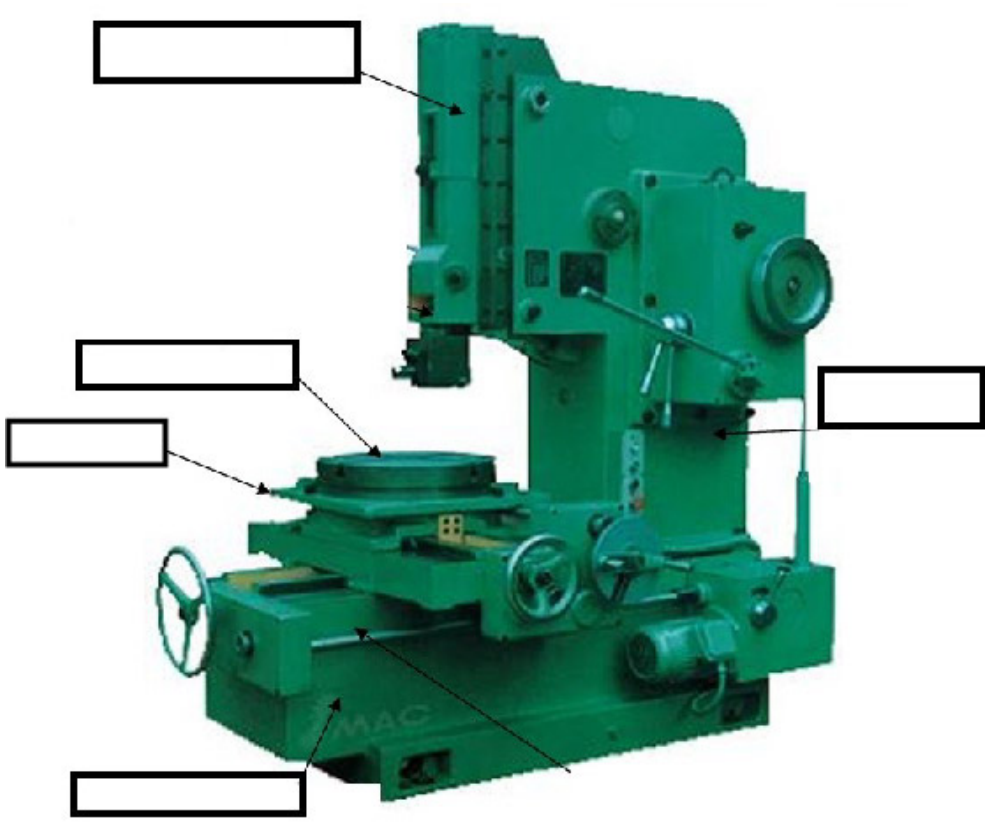
Fill in the blank.

Tailstock	Saddle	Chip pan	Hand wheel	Carriage
Compound rest	Feed rod	Spindle	Headstock	Leg



Fill in the blank.

Column	Ram	Carriage	Clapper Box
Feed Shaft	Base	Circular Table	



****

THIS IS THE END OF THE EXERCISE QUESTION PAPER

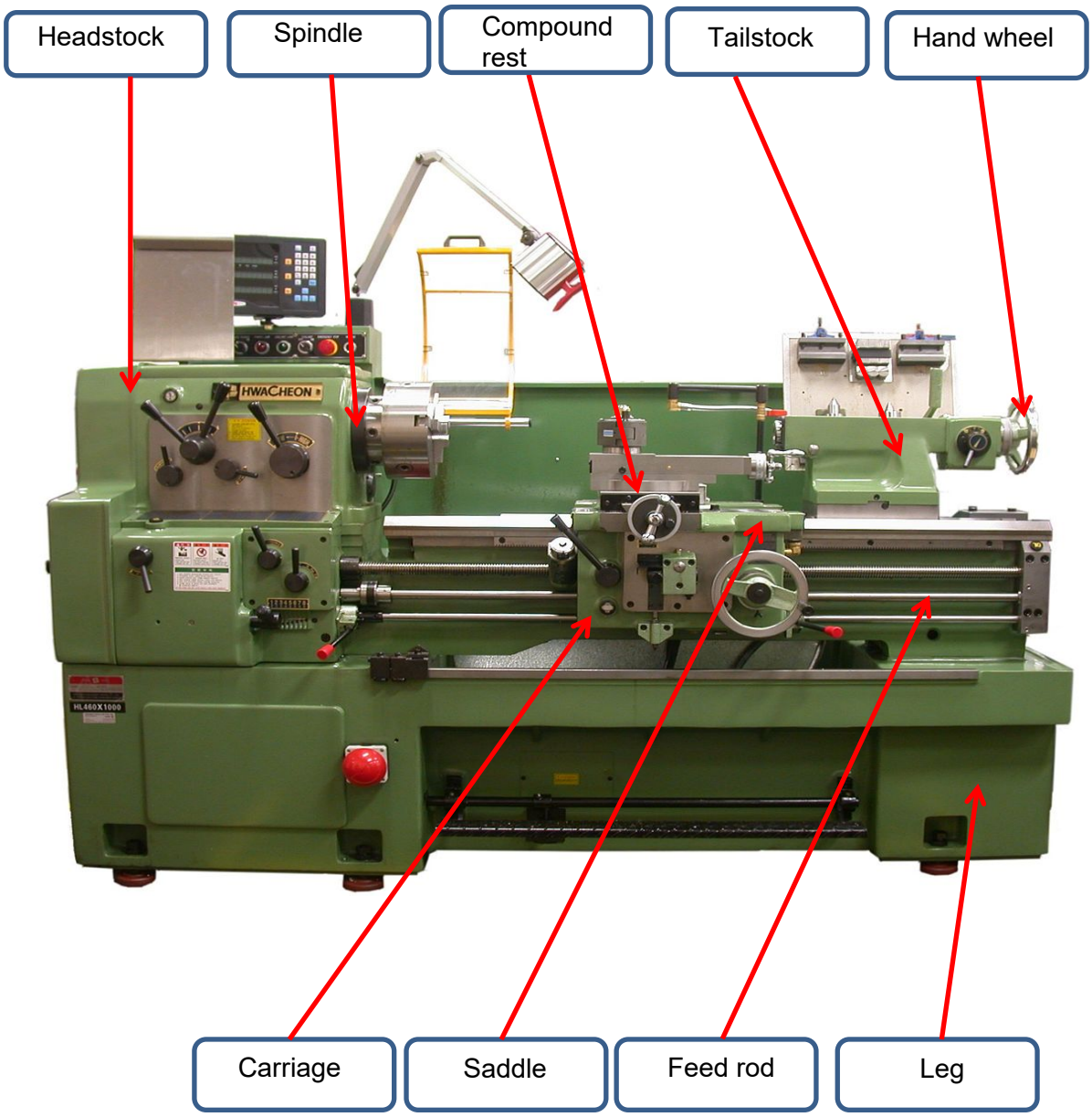
****

EXERCISE ANSWERS

1. B
2. C
3. Location of Machinery and Equipment
4. Description of machine shop
5. D
6. B
7. A
8. A
9. Processing
10. Storing
11. Monitoring
12. Hard copies
13. soft copies
14. Warehouse, rough terrain, yard
15. Diesel, gas, Electric
16. Pneumatic, solid
17. B
18. C
19. Stage 2: Preliminary inspection
20. Stage 4: Post Inspection Process
21. B
22. C
23. Model
24. Make/brand name
25. B
26. D
27. D
28. C
29. B
30. A
31. D
32. D
33. B
34. D
35. D

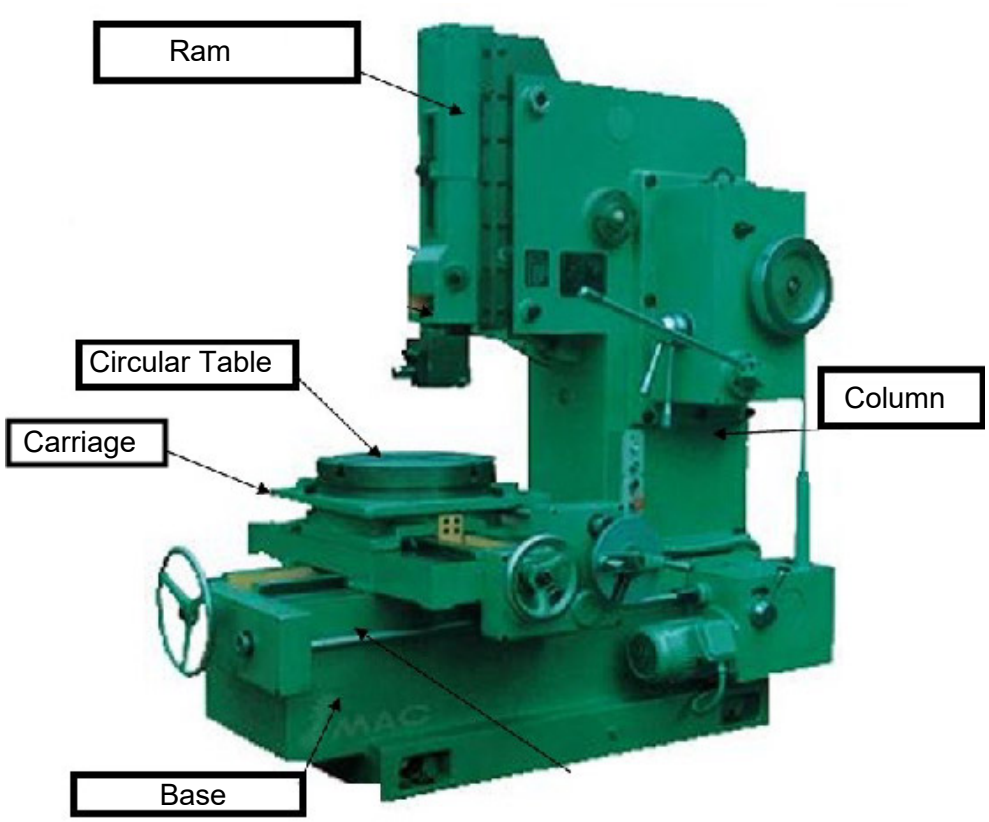
Fill in the blank.

Tailstock	Saddle	Chip pan	Hand wheel	Carriage
Compound rest	Feed rod	Spindle	Headstock	Leg



Fill in the blank.

Column	Ram	Carriage	Clapper Box
Feed Shaft	Base	Circular Table	



****

THIS IS THE END OF THE EXERCISE QUESTION PAPER

****