



**Multidisciplinary Reference and Guide for Executives
(MIRAGE)**

*Definitions, Meanings and Clarifications of Industry &
Management Terms*

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DEFINITION OF UPSTREAM E&P ACTIVITIES

Upstream E&P Activities include :-

1. The search for crude oil, including condensate and natural gas liquids, or natural gas ("oil and gas") in their natural states and original locations.
2. The acquisition of property rights or properties for the purpose of further exploration and/or for the purpose of removing the oil or gas from existing reservoirs on those properties.
3. The construction, drilling and production activities necessary to retrieve oil and gas from its natural reservoirs, and the acquisition, construction, installation, and maintenance of field gathering and storage systems including lifting the oil and gas to the surface and gathering, treating, field processing (as in the case of processing gas to extract liquid hydrocarbons) and field storage.
4. The oil and gas production function is normally regarded as terminating at the outlet valve on the lease or field storage tank; if unusual physical or operational circumstances exist, it may be appropriate to regard the production function as terminating at the first point at which oil, gas, or gas liquids are delivered to a main pipeline, a common carrier, a refinery, or a marine terminal.

Functionally Related Activities include :

1. Extraction of hydrocarbons from shale, tar sands, coal, gas hydrates etc. (unconventional hydrocarbon reserves).
2. Underground coal gasification.
3. Production of geothermal steam or extraction of hydrocarbons as a by-product of the production of geothermal steam.

Value Linkage Activities include :

1. Processing of natural gas & condensate for higher value products.
2. Refining of crude oil and chemical conversion of natural gas products.
3. Transportation & marketing of oil, gas and their products.
4. Gas based power generation.

Note : Downstream R&M (Refinery & Marketing) activities are those which take place between the loading of crude oil at the export terminal and use of products by the end user. This encompasses the transportation of crude oil, supply, trading, refining and the distribution and marketing of the oil products.

SEISMIC SURVEY TO SERVICE STATION : STAGES

The stages in the oil and gas industry :-

1. Seismic surveys
2. Identification and mapping of prospect
3. Exploratory drilling on prospect
4. Appraisal of prospect (drilling of appraisal wells and delineation)
5. Development of field (development wells & production facilities)
6. Production - flow of oil & gas
7. Separation & treatment (oil, gas, water)
8. Storage & stabilisation (crude)
9. Transportation (crude oil - pipelines, tankers)
10. Marketing and distribution - to Refineries
11. Storage - crude oil (Refinery)
12. Refining and processing - fractionation, cracking, reforming etc.
13. Storage - refined products (Refinery)
14. Transportation (refined products - pipelines, tankers)
15. Marketing & distribution (to retail outlets, petrochemical plants)
16. Storage - regional, area depots
17. Service station

Natural Gas (branching from 7 above)

8. Dehydration & compression
9. Transport (pipeline)
10. Marketing & distribution
11. Consumption - fuel, feedstock
12. Petrochemicals, fertilisers (from feedstock)
13. Transport of finished products
14. Marketing and distribution
15. Retail outlets

ORGANISATION OF PETROLEUM BEARING AREAS

Province	A large area of downwarping associated with a regional tectonic element and characterised by definite structural features and geological history and to which one or more plays are confined.
Play	A group of prospects with geologically similar source, reservoir and trap control on oil and gas occurrence. It may include the entire geologic section from grassroots to basement within certain geography or only a limited stratigraphic horizon or horizons.
Prospect	An area defined by particular geography and geology that is limited usually to a set of pools stacked vertically.
Pool	A single oil or gas accumulation in a natural reservoir confined on all sides.

GRADES OF HYDROCARBON ASSETS

Resources (R0)	Prognosticated : An estimated accumulation or concentration of hydrocarbons in a given area that is currently extractable or its extraction may become feasible in the future. A measure of the total potential of the area studied, based on current knowledge.
Reserves (R1)	Initially Inplace : That portion of the resources whose location, rank, quality and quantity are identified by drilling and known from geological evidence and engineering studies.
Recoverables (R2)	Ultimate : That portion of the reserves that is available now for production by being economically recoverable under existing technological conditions and prices.
Production	Cumulative : That portion of recoverables that is already produced at the time of accounting.

DEFINING CHARACTERISTICS OF A PETROLEUM PROVINCE

A petroleum province is defined by three parameters - sedimentary volume, hydrocarbon potential and distribution pattern (habitat).

Sedimentary Volume	Product of geographical area and average thickness of sedimentary column. Prospective provinces are usually larger than 10,000 sq. km. with a minimum sedimentary thickness of 2000 m.
Hydrocarbon Potential	Hydrocarbon density or potential wealth defined as the quantum of hydrocarbons per unit area i. Rich province $> 10,000 \text{ tons/Km}^2$ ii. Average province $1000-10,000 \text{ tons/Km}^2$ iii. Poor province $< 1000 \text{ tons/Km}^2$
Distribution Pattern	Hydrocarbons are not ubiquitous, that is, they are not uniformly distributed over the entire province but instead accumulate as discrete pools. Habitat is the spatial distribution of the pools in the province. Generally number of pools vary inversely with size. $G_n/G_{n-1} = n(n-1) \times K$ Zipf's Law G is the dimension (size) of a field of rank n. In a log - normal distribution, the constant K=1. i. Dispersed habitat : K = 0.5 to 1.0; the largest field contains only 5 to 10% of the total reserves in the province. ii. Concentrated habitat : K = 1.0 to 2.0; the largest field may contain 25 to 30% of the total reserves in the province.

These characteristics are the combined effect of a number of interrelated causes - scale of tectonic activity, depositional environment, subsidence rates, duration of sedimentary processes and magnitude of deformational forces.

TYPES OF HYDROCARBON BEARING FORMATIONS

Clastic	Account for nearly 60% of world reserves; consists mainly of sandstones; exhibit fairly uniform porosity and permeability. Primary porosity of intergranular type. Relationship between porosity and permeability generally good; secondary porosity relatively unimportant. Most of these formations cover a limited area; generally elongated or lens shaped.
Carbonate	Account for about 40% of world reserves; consists mainly of limestones and dolomites; characterised by a broad range of porosities and permeabilities. Primary porosity mainly of intergranular type. Relationship between porosity and permeability generally not clear; secondary porosity important. Most of these formations often occur as sheets covering large areas.
Crystalline	Account for less than 1% of world reserves; consists mainly of igneous and metamorphised rocks; primary porosity negligible or nil. Porosity and permeability due to development of fissures and fractures. Reservoirs in these formations are usually small, with limited areal extent.

Note : A formation is a vertically definable sedimentary layer of rock.

TYPES OF PETROLEUM TRAPS

Structural	Trap formed as a result of the structural deformation of rock formations. The most common types are folds and faults. Majority of petroleum deposits, especially the large & giant category are of the structural type.
Subtle	Trap defined as one in which a variation in stratigraphy or lithology (depositional process) is the chief confining element in the reservoir e.g. pinchout, facies change, unconformity.
Combination	Complex traps formed through a combination of depositional and deformational processes.

Note : A trap is a porous sedimentary rock volume which can confine and hold petroleum fluid so as to become a reservoir.

CONVENTIONAL & CONTINUOUS GAS RESOURCES

- A. Conventional Type** These are natural gas resources commonly found in limestone or sandstone reservoirs and can be geographically defined as fields or discrete units. The gas occurs either in a free state, cap gas above an oil zone or as dissolved gas in the crude oil. Very high rates of production from a single reservoir are possible based on the reserves size and pressure.
- B. Continuous Type** These are the unconventional resources of gas. Continuous type plays are geologically diverse and include coal-bed methane, fractured shale gas and gas hydrates. They are large, potentially productive areas that cannot be defined as fields or discrete units with down-dip hydrocarbon and water contacts.
- i. Gas Hydrates Naturally occurring clathrate substances in which a solid water lattice accommodates gas molecules. Gas hydrates form in places where the temperature is below the freezing point of water i.e. in the permafrost regions and the deep sea areas deeper than 500 m isobath. Gas hydrates are predominantly methane and the reservoirs are generally shallow to medium in depth. The thickness of the gas hydrate zone depends on the geothermal gradient.
- ii. Coal Bed Methane (CBM) Methane generated from the organic matter gets adsorbed in the molecular structure of the coal which acts as a reservoir. Production rates from individual wells are generally small and large quantities of water present in the fissure & cracks in the coal have to be removed for gas production.
- iii. Fractured Shale Gas (FSG) Gas generated from the organic matter in the shale collects in the fissures and fractures. The shale formation thus serves as a reservoir. Fractured shale gas is predominantly methane.

FIELD, RESERVOIR, TRAP, PROSPECT, STRUCTURE

Field	An area consisting of a single reservoir or multiple reservoirs all grouped on or related to the same individual geological structural feature and/or stratigraphic condition. There may be two or more reservoirs in a field that are separated vertically by intervening impervious strata, or laterally by local geologic barriers, or by both. Reservoirs that are associated by being in overlapping or adjacent fields may be treated as a single or common operational field. The geological terms "structural feature" and "stratigraphic trap" are intended to identify localized geological features as opposed to the broader terms of basins, provinces, plays etc.
Reservoir	A porous and permeable underground formation containing a natural accumulation of producible oil and /or gas that is confined by impermeable rock or water barriers and is individual and separate from other reservoirs. There may be more than one reservoir in a field.
Trap	A trap is a porous and permeable volume of rock that has a closure and seal on the upper surface into which oil & gas moving upwards can accumulate and form a reservoir.
Prospect	A potential field or geological feature attractive from hydrocarbon exploration point of view.
Structure	More correctly a structural feature e.g. fold, fault which may or may not be a prospect.
Formation	A rock layer or stratigraphic subdivision with defined upper and lower boundaries. The formation may be hydrocarbon bearing in areas where reservoir and trap conditions are developed.
Acreage	Area covered by a lease granted for oil & gas exploration and for possible future production.

PARAMETERS IN VOLUMETRIC ESTIMATION OF RESERVES

The recoverable reserves of oil & gas are estimated by multiplying the initially in-place volume (N_p) by the recovery factor (RF).

Parameters used in the estimation of N_p

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|------------------|--|
| 1. Area | the area enclosed by the lowermost continuous encircling structure contour. A structure contour is a line connecting points of equal depth below mean sea level on the prospect. |
| 2. Closure | determines the maximum possible area over which the fluid can be contained by the structure. Simply defined as the vertical distance between the topmost part of the prospect and the lowermost continuous encircling contour. |
| 3. Fill | determines the actual area over which hydrocarbons are contained. It is the vertical distance between top of prospect and the watertable or lowest depth of hydrocarbon occurrence. |
| 4. Porosity | fluids are contained in the pore spaces in the rock. Porosity is the ratio of the total volume of pore spaces to the total rock volume. Porosity therefore is a measure of the volume capacity of the rock to hold fluids. |
| 5. Saturation | the extent or portion of the pore volume which is occupied by hydrocarbons. The rest of the pore volume contains water. |
| 6. Volume Factor | correction factor to determine fluid volume at surface conditions as distinct from reservoir conditions. Reserves are always quoted at surface conditions. |

Parameters considered in the estimation of RF

- | | |
|------------------|---|
| 1. Permeability | a measure of the ease with which fluids can flow through a porous rock i.e. the fluid conductivity of the porous medium. |
| 2. Drive | the natural energy or drive available in the reservoir which causes the fluids to flow out of the pore spaces into the well bore. |
| 3. Fluids | fluid properties, particularly viscosity of crude oil and compressibility of gas. |
| 4. Heterogeneity | the spatial variation in pore connectivity/ conductivity and pressure diffusivity of the reservoir. |
| 5. Pressure | the initial and abandonment pressures in the reservoir. |

CLASSIFICATION OF RESERVES

Proved (P1)	Estimated quantities on a specific date, with a reasonable certainty to be recoverable in the future from known reservoirs under existing economic & technological conditions through application of established recovery techniques. Area of reservoir considered proved includes that portion delineated by drilling and defined by fluid contacts and immediately adjoining portions not yet drilled but can reasonably be judged to be economically productive on the basis of available geological and engineering data. Reserves which can be produced economically through application of improved recovery techniques are included in proved classification after successful pilot testing.
Probable (P2)	Estimated on the basis of engineering and geological data similar to those used for proved reserves but lack the certainty of proved reserves. Include reserves of extensions of reservoirs already established to be productive, reservoirs that appear to be prospective on logs but no test data is available, reserves obtained through contemplated improved recovery methods and those established through workover operations.
Possible (P3)	Estimated on the basis of geological data that are less conclusive and less complete than the data used in estimating probable reserves. Include those reserves likely to be present in new structural/ stratigraphic traps in known prospects or undrilled prospects in productive plays and also reserves that might be accrued due to planned improved recovery programmes.

Note : Proved reserves are further subdivided into proved developed and proved undeveloped.

PROVED DEVELOPED & UNDEVELOPED RESERVES

Proved Reserves	Proved oil and gas reserves are the estimated quantities of crude oil, natural gas, and natural gas liquids which geological and engineering data demonstrate with reasonable certainty to be recoverable in future years from known reservoirs under existing economic and operating conditions i.e. prices and costs as on the date the estimate is made. Proved reserves are subclassified into proved developed and proved undeveloped.
Proved Developed Reserves	Proved developed oil and gas reserves are reserves that can be expected to be recovered through existing wells with existing equipment and operating methods. Additional oil and gas expected to be obtained through the application of fluid injection or other improved recovery techniques for supplementing the natural forces and mechanisms of primary recovery should be included as "proved developed reserves" only after testing by a pilot project or after the operation of an installed program has confirmed through production response that increased recovery will be achieved.
Proved Undeveloped Reserves	Proved undeveloped oil and gas reserves are reserves that are expected to be recovered from new wells on undrilled acreage, or from existing wells where a relatively major expenditure is required for recompletion. Reserves on undrilled acreage shall be limited to those drilling units offsetting productive units that are reasonably certain of production when drilled. Proved reserves for other undrilled units can be claimed only where it can be demonstrated with certainty that there is continuity of production from the existing productive formation. Estimates for proved undeveloped reserves should not be attributed to any acreage for which a fluid injection or other improved recovery technique is contemplated, unless such techniques have been proved effective by actual tests in the area and in the same reservoir.

BASIC GEOLOGIC-ENGINEERING RESERVOIR MODELS

Hotelling	An ideal, geologically homogenous reservoir covering a relatively small area. Excellent fluid flow over reservoir distance. Recoverable reserves are not influenced by depletion strategy and are constant at initial investment level i.e. recovery is unrelated to the rate at which the reservoir has produced.
Base-case	An intermediate type reservoir. Depending on depth, the degree of homogeneity in geological and reservoir technical parameters and possibility of communication over long distances, the technically recoverable reserves will increase more or less, but at a declining rate, with the number of production and injection projects deployed.
Geosensitive	Reservoir is shallow, covers a large geographical area and is characterised by inhomogeneity in reservoir geological parameters and poor conditions for fluid flow over long distances. Recoverable reserves are very sensitive to the geographical distribution of the production equipment and increase almost linearly with investment. Successive incremental projects are assumed to be executed optimally from an engineering point of view given the characteristics of the reservoir.

PRIMARY ENGINEERING-ECONOMIC PRODUCTION STRATEGIES

Current Income Maximisation	Producing at the greatest economic rate possible so that current revenue income is maximised.
Ultimate Recovery Maximisation	Producing at the maximum efficient rate so that ultimate recovery is maximised.
Present Worth Maximisation	Combining improved rate and greater recovery to lead to the accumulation of maximum present worth.

RESERVOIR DRIVE MECHANISMS

Depletion Drive	Energy of reservoir derived from expansion of unsaturated oil above bubble point and subsequently by expansion of gas released from solution in the oil below the bubble point. Drive efficiency is the least and primary recovery factor is lowest, averaging about 15%.
Gas Cap Drive	In the presence of a large gas cap above the oil, the natural energy available to produce the oil comes from two sources - the expansion of the gas cap gas and the expansion of the dissolved gas as it is liberated from the oil. Drive efficiency quite good and expected primary oil recovery averages about 30%.
Water Drive	Water drive reservoirs are geologically open systems where the energy to produce the oil is supplied by water influx from adjoining aquifer. Drive efficiency highest and primary recovery averages about 45%.

Note : A drive mechanism is the natural energy available within the reservoir to move fluids from the surrounding pore space into the well bore.

OIL RECOVERY MECHANISMS

Primary Recovery	Recovery techniques utilising natural energy of reservoir. In the later stages of field life, reservoir energy may be supplemented by artificial lift methods. However, no fluid is injected into reservoir and natural reservoir properties are not altered.
Secondary Recovery	Improved recovery obtained by injecting fluids like water or gas into reservoir, for pressure maintenance and/or flooding.
Enhanced Recovery	Enhanced recovery obtained by injecting fluids like steam, polymers, CO ₂ etc., which are not initially present in the reservoir or by carrying out processes like insitu combustion, all of which alter the natural properties of the reservoir.

Note : Though, by definition, infill drilling and horizontal wells are primary recovery techniques (no injection of fluids into reservoir), since these techniques usually result in significant improvement in recovery, they are generally considered as improved recovery techniques.

WATER INJECTION

Fluid injection programmes are designed not only to sustain reservoir pressures at levels which provide increased flowing life to wells but also to increase ultimate recovery from the reservoir.

Water Flooding A secondary recovery method by which water is injected into a reservoir to obtain additional oil recovery through movement of reservoir oil to a producing well after the reservoir has approached its economically productive limit by primary recovery methods.

Water Pressure Maintenance A process whereby water is injected into an oil producing reservoir to supplement the natural energy that is indigenous to the reservoir and to improve the oil producing characteristic of the field before the economically productive limits are reached. The water injection programme is operated like a natural water drive.

In a homogenous reservoir, maximum oil recovery can be expected if water pressure maintenance is begun at the precise time bubble point pressure is reached. This is because at P_b , R_s is maximum and oil viscosity is most favourable. In a heterogeneous reservoir the optimal time for water injection would be at a pressure lower than P_b .

Note : Reservoir pressure maintenance can also be done by gas injection. A gas injection programme is usually operated like a natural gas cap drive i.e. injection into structurally high wells to induce a gas cap.

TYPES OF RESERVOIR GEOMETRY

Layer Cake Reservoirs deposited by a single depositional mechanism that shows excellent correlation between wells.

Jigsaw Puzzle Different sand bodies fit together without major gaps but with occasional intervening low permeability zones.

Labyrinths These types represent more or less random arrangements of sands or carbonate stringers, usually discontinuous.

ENHANCED OIL RECOVERY

EOR is a term historically used to describe those processes for improved recovery of reserves beyond simple waterflooding. Basically it is recovery by injection of fluids not originally in the reservoir. Three major EOR methods are currently available; thermal (application of heat), miscible (mixing of oil with a solvent) and chemical (flooding with chemicals), each with several variants in application. Each EOR technique is tailored for a particular type of reservoir and there is no single cure-all unlike waterflooding which is effective in nearly all reservoirs. Because of the high costs involved, usually a pilot test of the proposed EOR process is first carried out to confirm anticipated performance before expensive, full scale implementation. Ideally the pilot is performed in an area that is geologically similar and statistically representative of the main field heterogeneity. EOR begins with a thorough geologic study followed by stringent economic analysis.

Thermal	thermal process most widely practiced (70% of EOR applications) having greatest certainty of success and highest recoveries at lowest costs. It is the main means of recovering heavy oils with gravity <20° API and viscosity in the range of 200-2000 centipoise. Increasing the oil's temperature dramatically reduces viscosity and improves mobility. The two methods are heating reservoir oil by injecting a fluid heated at the surface (steam injection/flooding) or production of heat directly within the reservoir by burning some of the oil in place by hot air injection (insitu combustion). A relative of the steam drive is the cyclic steam injection (huff & puff).
Miscible	fastest growing EOR process; uses a solvent that mixes fully with residual oil to overcome capillary forces and increase oil mobility. Different variants of the method are miscible slug, enriched gas and high pressure lean gas. In WAG (water alternate gas), waterflood and gas flood are alternated.
Chemical	injection of chemicals include polymers, surfactants and alkalis. Polymer flooding most commonly used.

RESERVES REPLENISHMENT

Present Reserves = Past Reserves + Additions - Production

Reserves can be added by

1. Discovery of new fields
2. Discovery of new pools in existing fields
3. Extending known reservoirs
4. Redefining reserves because of changes in economics of extraction
5. Redefining of reserves because of availability of new data
6. Acquisition of reserves

The above involves capabilities in three distinct areas :

Exploration	High risk ventures in frontier plays & provinces for relatively large additions to initially inplace reserves; essential for long term production growth; discontinuous process, generally cyclic.
Improved Recovery	Low to moderate risk efforts in discovered and producing fields; simultaneous growth in reserves & production; adds to reserves only, the initially inplace base remaining unchanged; continuous process.
Acquisition	No risk; adds simultaneously to initially inplace base and to production; may be costlier than exploration & improved recovery and requires well developed capabilities for asset evaluation/assessment.

Reserves Replenishment Ratio (RRR) : Hydrocarbons being depletable resources, it is crucial for E&P companies to maintain a minimum RRR=1 i.e. the annual production is fully replenished by additions/ accretions. To balance the risks & costs, companies generally include all three options i.e. exploration, improved recovery & acquisitions in their reserves replacement strategies.

Reserves to Production Ratio (R/P R) : This is the ratio of reserves to current annual production. Also sometimes given as reserves life index i.e. the number of years reserves would last at current rate of production. Generally a figure of R/P R = 10 is considered optimal for RRR=1; a low R/P ratio becomes a matter of concern if RRR>1. On the other hand, a high R/P ratio would indicate reserves are not being efficiently exploited.

PRODUCTION OPTIMISATION

For a given base of initially in place reserves, production optimisation is the step by step process of maximising oil production over the long term while minimising total production costs. Optimisation involves performance monitoring of individual well flow rates and total reservoir production rates.

I. Well Flow Rates	Well flow rates are compared with the reservoir quality in the drainage area covered by the well. Easiest and most useful parameter of reservoir quality is $\phi \times h \times S_o$ (product of porosity, effective thickness and saturation). Well flow rates can be restored or enhanced by workover operations.
i. Workover Operations	The production system consists of the surface equipment, completion string, well bore, completion surface and the well fluids. Workover refers to any operation performed on the well after its initial completion to remedy specific problems developed during the completion or production operations so as to restore and sometimes even to enhance well flow rates.
II. Reservoir Production Rates	In most reservoirs, the greater the number of wells, larger will be the ultimate recovery, provided the production rate does not exceed the maximum efficiency rate. The optimum number of wells to be drilled and their spacing would be determined by factors like heterogeneity, crude viscosity, depth of reservoir and total costs relative to the realisable value of the reserves. Reservoir production rates can be enhanced by improved recovery techniques.
ii. Improved Recovery	These are measures taken to remedy specific problems developed or likely to develop during the production life of the reservoir e.g. pressure depletion due to poor natural drive mechanism and bypassed pockets of crude oil due to poor displacement of the produced fluids.

Note : Reservoirs in which the ultimate recovery is related to production, there is a maximum efficiency rate (MER) above which there will be significant reduction in the ultimate recovery. In partial water drive, MER is the rate at which the voidage rates are in excess of the water influx. In a heterogeneous reservoir, the MER is the rate at which bypassing of oil in the less permeable layers becomes substantial.

FLOW STATUS OF PRODUCTION WELLS

A production well is one in which downhole production equipment is in place for flowing the well for earning revenue or deemed revenue. At any given point of time, production wells maybe flowing or non-flowing.

Flowing : Self Flow	Well is flowing oil & gas as per expectation and using the natural energy of the reservoir to lift fluids to the surface.
Flowing: Artificial Lift	Artificial lift refers to use of external means to help lift the well fluids from the bottom to the surface. Usually implemented when reservoir energy is depleted resulting in reduced production or reduced well head pressure. Four types in commercial use - sucker rod pump (SRP), gas lift, electric submersible pump (ESP) and subsurface hydraulic pumping (SHP).
Sick Well	A well shut-in after initial completion for repair & rehabilitation as the well is assessed to be under performing with respect to reservoir quality due to specific problems developed during the completion or production operations. The well is worked over to restore or enhance flow rate.
Secluded Well *	A production well shut in for purposes other than repair and rehabilitation e.g. conservation of reservoir energy, construction work on production facilities etc. Such a well is temporarily out of production system.
Suspended Well	Completion category undecided. Well not yet put on initial flow due to low/ doubtful potential, logistics or technology.
Ceased Well	Well closed for abandonment either due to depleted reservoir or irreparable well damage.

* Term is not in common use. Used here for explanation purpose only.

ECONOMIC CATEGORISATION OF FIELDS

Stand alone	These are fields large enough to support development of infrastructure for production and export. The size of a field to be economically viable on a stand alone basis is determined by logistics and proximity to transport facilities or markets.
Marginal	These are borderline cases at current prices and technology. NPV could be positive but IRR lower than WACC. Possibility of marginal field becoming economical if some innovative concept can be implemented. Generally marginal fields are those with reserves in the range of 5 mmbbl for onshore fields and 50 mmbbl in offshore areas.
Satellite	These are small/marginal fields located in the vicinity of existing process/export facilities and whose development is dependent upon access to the existing infrastructure. For subsea completions, the limiting distance is about 30 Km to the nearest facility with current technology.
Isolated	Commercial discoveries located at a distance away from existing transport facilities or markets such that field development and transportation costs exceed the estimated value of production. The difference between isolated and marginal fields is that logistics is the major reason for non-development of the isolated field.
Non-commercial	Reserves too small for economic development. In practical terms, the value of sales is less than the cost of drilling and operating one production well.

CATEGORISATION OF FINDS

Discovery	Economic viability of development and production of hydrocarbons from a prospect established after delineation.
Strike	Production at stabilised rate and pressure and in commercial quantities obtained for the first time from a prospect. Though structural configuration of the prospect is known from geological/ seismic data, delineation by drilling is still to be done.
Indication	Flow of hydrocarbons noted for the first time in a new prospect during production testing but flow observed is at unstabilised rate and pressure and in non-commercial quantities.
Lead	Presence of hydrocarbons noticed for the first time in a new prospect during drilling of a well but flow through production testing still to be obtained.

CLASSIFICATION OF WELLS

Information	Drilled for obtaining stratigraphic information in a new sedimentary basin without any seismic subsurface control (key well) or drilled in new areas to enable correlation of seismic and other geological data and “proof of concept” (parametric well).
Exploratory	Well drilled on a prospect in a new play or on a new prospect in a productive play or for locating new pools in a producing field.
Appraisal	Drilling on a successful prospect for determining extent of pool size and delineation and full testing for upgradation of reserves.
Development	Drilling of oil/gas reservoirs where reserves are in Proved category and for which an accepted development scheme exists.
Production	A well brought on stream to produce oil & gas for earning revenue or deemed revenue.

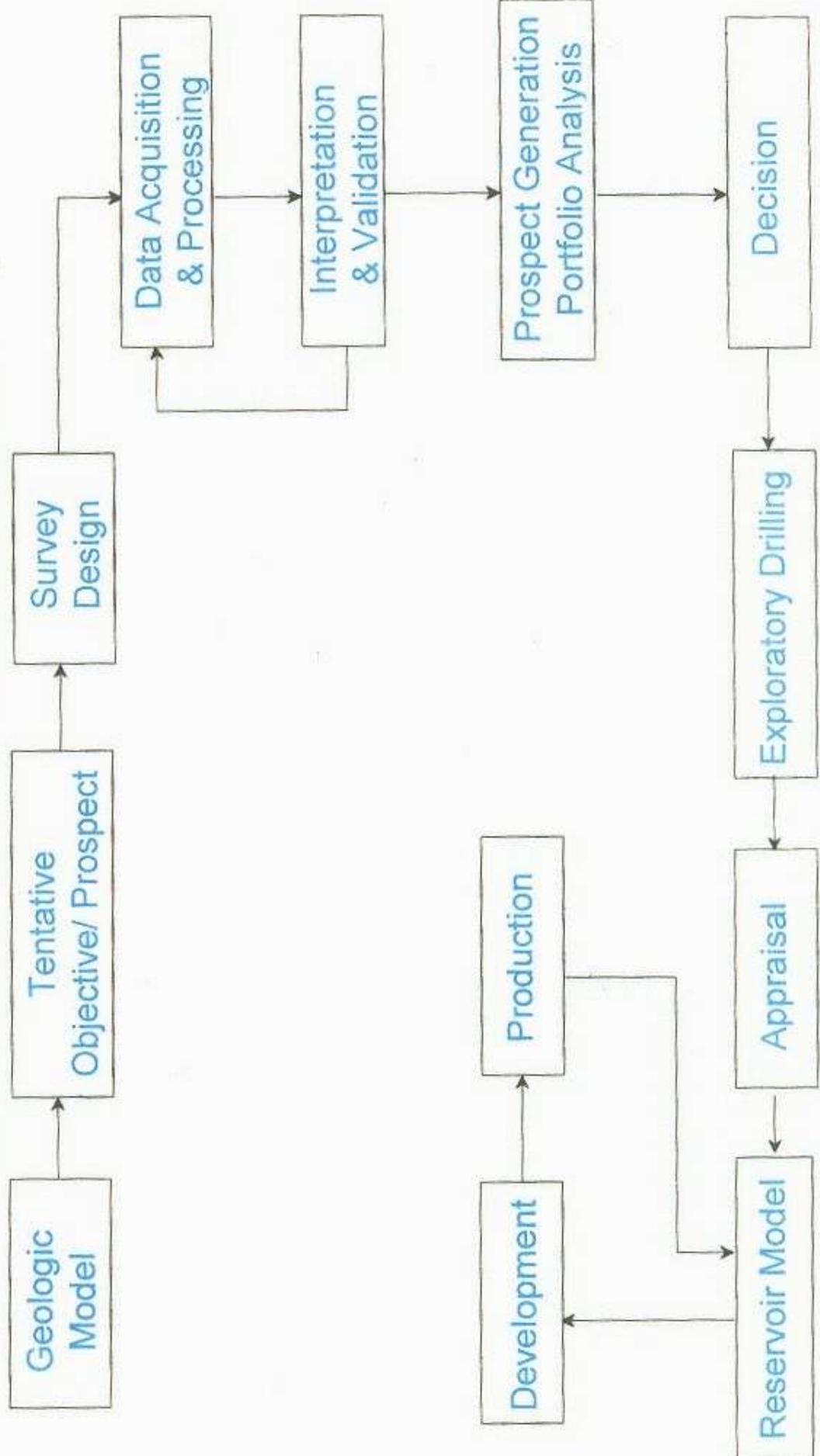
EXPLORATION EFFICIENCIES

Exploration Yield	Tons of hydrocarbons (O+OEG) discovered per exploratory well or per exploratory meter drilled.
Success Ratio	Ratio of number of successful exploratory wells to number of dry exploratory wells or Ratio of number of successful prospects to number of unsuccessful prospects.
Average Discovery	Average size of reserves in million tons of the successful prospects.

DRILLING EFFICIENCIES

Mechanical Speed	Expressed as meters/ hour and is obtained by total meterage drilled to total bit rotating hours.
Commercial Speed	Meterage drilled per rig month during the period the rig is under drilling operations. Rig operating period is counted from spud date till completion of hermetical testing or abandoning of well.
Cycle Speed	Expressed as meterage drilled per rig month but includes whole cycle of operations undertaken by a drilling rig i.e., time taken for rig building, drilling and production testing. The cycle starts on date of dismantling of previous well. If transportation is more than 100 kms or major repairs extend beyond 30 days, the time spent on derigging, transportation and rigging up is limited to "standard days" irrespective of actual days taken.

THE HYDROCARBON SEARCH PROCESS *



* Grossly simplified for illustration purpose.

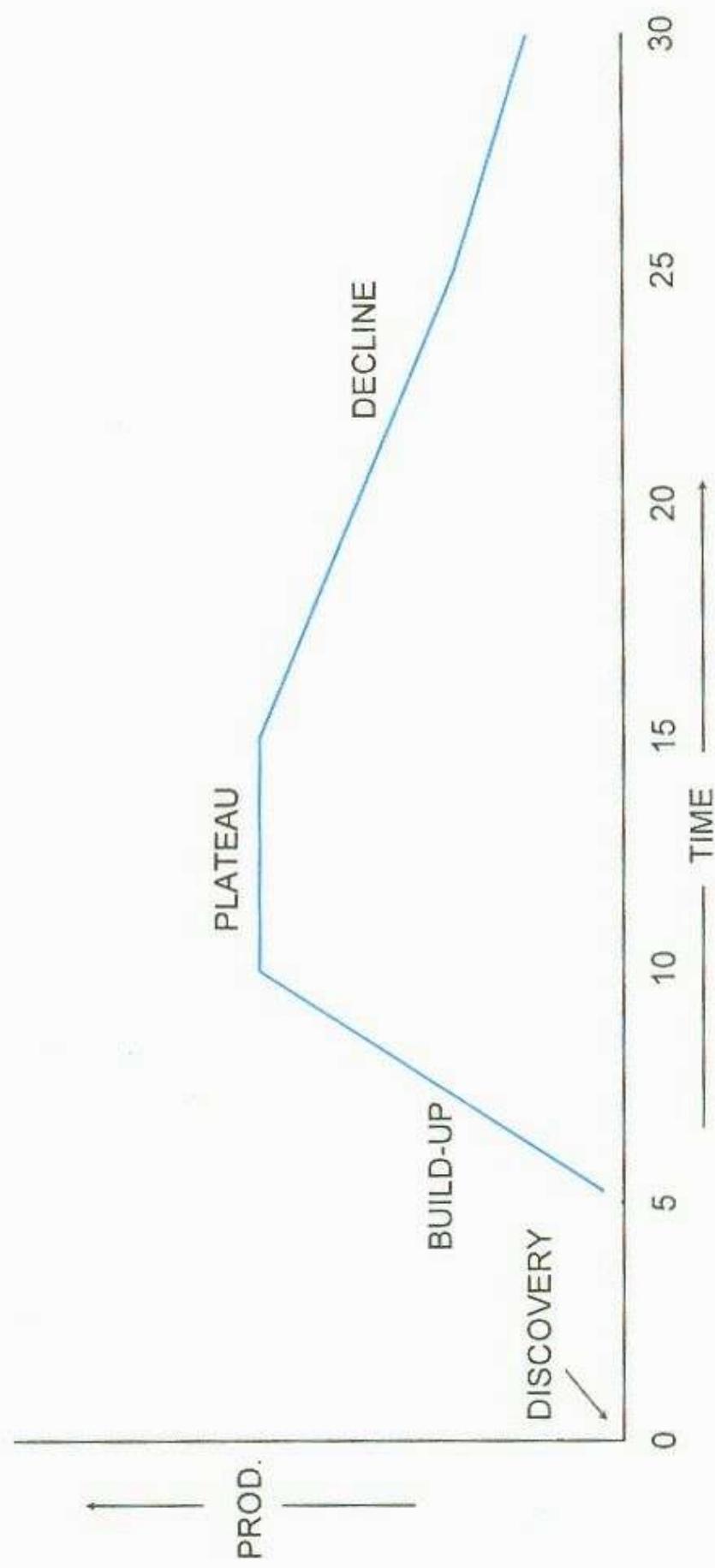
PHASES OF RESERVOIR LIFE CYCLE

All reservoirs progress through six phases in the production life cycle

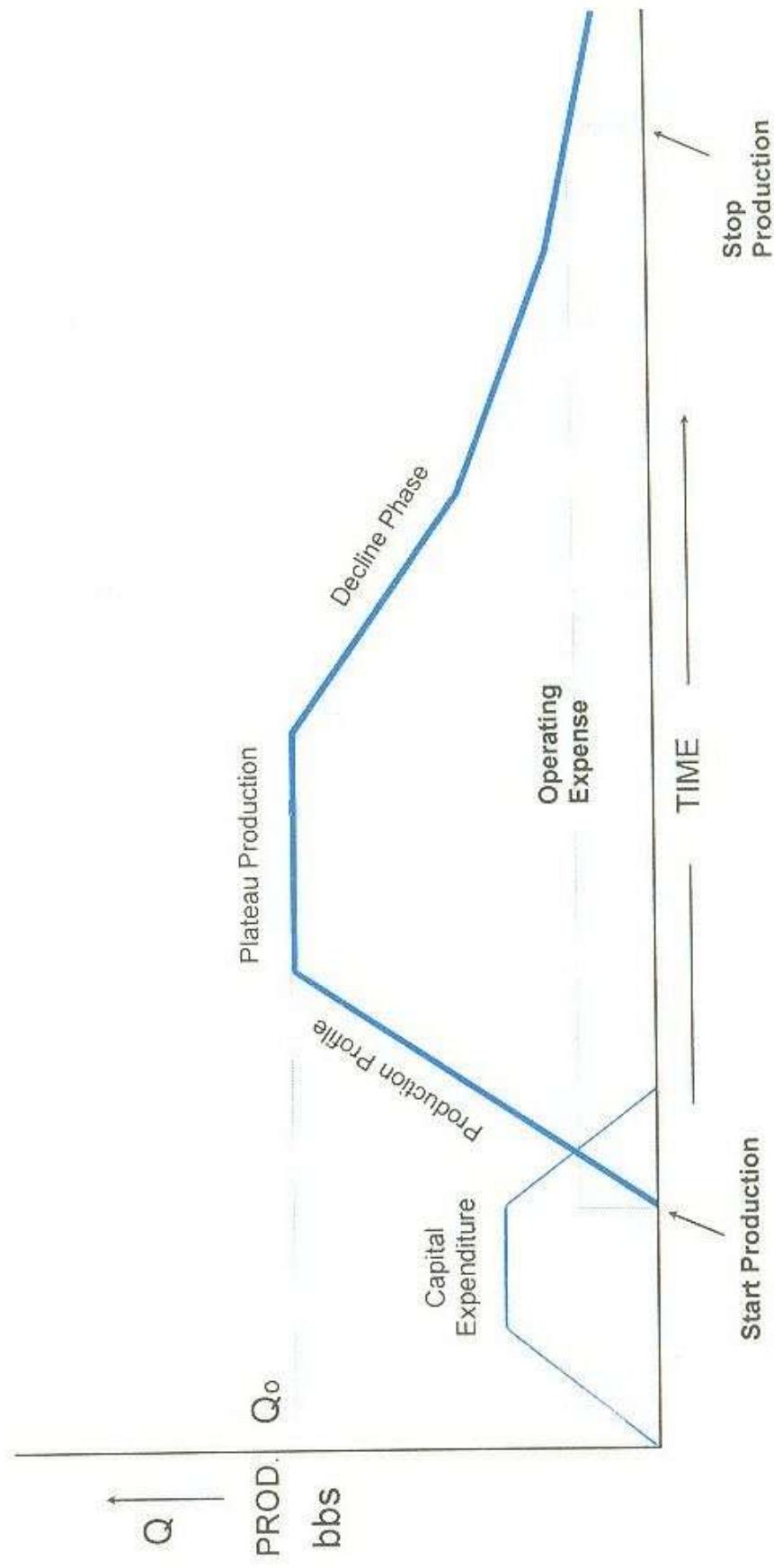
Discovery	Occurrence of hydrocarbons in the prospect established by exploratory drilling. Decision for appraisal based on available seismic data and well data of discovery well.
Appraisal	Most critical; with scanty information and least data available the company has to rapidly assess reservoir size, productibility and drive mechanism, decide well locations and numbers and commission surface facilities that may cost billions. Main concerns are to determine reservoir boundaries, drive mechanisms and large scale heterogeneities in the reservoir geometry.
Development	With development drilling, an abundance of data becomes available allowing more detailed understanding; simulation gets more sophisticated.
Plateau	As production reaches planned levels, accumulation of production data allows further refinement of simulation to history match reservoir performance. Result is more reliable projection of future production.
Decline	at this stage, the oil company must decide how to extract the most from a dying asset. Issues range from infill drilling, EOR, modifying surface facilities etc.
Abandonment	Majority of wells have ceased production and field rates are below economic levels. Field abandonment procedures activated; plugging of wells and partial or full removal of surface structures/facilities and restoration of landscape. Abandonment costs may run into millions.

The most important issue facing the reservoir manager is mapping the finer details of reservoir heterogeneity and geometry which controls connectivity and sweep efficiency. Whatever drive mechanism is operating, ultimate recovery depends on ensuring maximum connectivity between wells and producing formation. The more detailed the understanding of the formation geology, the reservoir geometry and finer the mapping of the heterogeneity, greater the ultimate recovery. Advances in this direction have been facilitated by four factors - multidisciplinary approach, application of 3D seismics, development of directional drilling technologies and computer power enhancement.

STAGES IN THE LIFE OF AN OIL FIELD



INVESTMENT PROFILE OF A PETROLEUM RESERVOIR



CATEGORISATION OF RESERVES STATUS (USSR)*

<u>Category</u>	<u>Status</u>
A	Reserves already under commercial exploitation.
B	Reserves proposed for commercial exploitation.
C-1	Proved commercial reserves incompletely delineated.
C-2	Reserves arising out of hydrocarbon discovery in the course of exploratory drilling.
D-1	Undrilled reserves in structures adjacent to known hydrocarbon producing fields.
D-2	Undrilled prognosticated resources in new sedimentary plays or basins.

* Formerly also used in ONGC.

CLASSIFICATION OF FIELD SIZES (USA)

<u>Category</u>	<u>MMBoe *</u>
Supergiant	> 10000
Giant	500 - 10000
Major	100 - 500
Large	
Class A	50 - 100
Class B	25 - 50
Class C	10 - 25
Class D	1 - 10
Significant	> 1

* Million barrels oil equivalent of initial recoverable reserves.

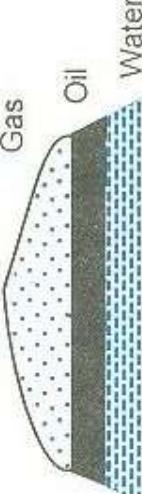
NATURAL GAS : COMPONENTS & PRODUCTS

<u>COMPONENT</u>		<u>PRODUCT</u>	<u>MAIN USE</u>
Methane	C1	C1	Fuel gas for heating, power generation and transport.
Ethane	C2	C2/C3	Feedstock for petrochemicals.
Propane	C3	LPG	Domestic/ commercial fuel.
Butane	C4		
Pentane	C5		
Heavier Fractions	C5 +	NGL	Feedstock, fuel.
Non-Hydrocarbons	H ₂ S He		Sulphur recovery Helium extraction
Non-Commercial	H ₂ O CO ₂		No commercial use.

Commonly used forms of natural gas :-

Natural Gas	Piped	Gas transported through pipes from producer to consumer; either methane or rich gas.
Compressed Natural Gas	CNG	Composed almost entirely of methane. CNG is natural gas compressed to a pressure of 229 bars. Main use in transport.
Liquified Natural Gas	LNG	Composed almost entirely of methane. LNG is natural gas liquified by cooling to a temperature of 161 °C below zero. Main use in power generation.
Liquified Petroleum Gas	LPG	Composed of propane and butanes. Liquified either by refrigeration or by pressure. Main use as domestic/commercial fuel.
Natural Gas Liquids	NGL	Composed of pentanes and heavier hydrocarbon gases recovered by processing in field separators, scrubbers, gas processing and reprocessing plants or cycling plants. Main use as industrial feedstock.

NATURAL GAS - MODES OF OCCURRENCE

<u>TYPE</u>	<u>GEOLOGICAL OCCURRENCE</u>	<u>PRODUCTION CONTROL</u>	<u>COMPOSITION</u>
FREE GAS (NON ASSO)		DISCRETIONARY Regulated as required.	Lean gas, predominantly methane.
CAP GAS		DEFERRED Production only in late phase of field.	Rich in heavier components C2+.
SOLUTION GAS		NON-DISCRETIONARY Production level controlled by oil rate & GOR.	Rich gas. C2 & C2+ components constitute about 50%.

CRUDE OIL GRADES

Condensate	A light colourless liquid hydrocarbon with an API gravity of more than 45° (upto 65°).
Light Crude Oil	Crude oil having API gravity between 25° - 45°. Invariably has low sulphur content and contains few impurities.
Heavy Crude Oil	Crude oil with API gravity in the range of 10° - 25° and viscosity in the range of 100 to 100,000 cp (centipoise). Contains few or no gaseous hydrocarbons. Generally rich in aromatics, has high sulphur content and many impurities.
Bitumen	Oil having gravity less than 10° and viscosity exceeding 100,000 cp. Its thick insitu state does not permit any recovery by primary methods.

FACTORS AFFECTING CRUDE OIL QUALITY

<u>Property</u>	<u>Remark</u>	<u>Range</u>
[°] API	API Gravity is the basic property for fixing price.	Range from 20-45; M. East oils around 35°; B. High crude 39° API.
Sulphur Content	High sulphur oils require extensive processing.	Maximum 0.5% by weight.
Carbon Residue	Related to asphalt content in oil.	A lower carbon residue means a higher quality oil.
Salt Content	Severe corrosion takes place if salt content is high.	Upto 15 lb/1000 bbl of oil.
Nitrogen	Not desirable. If high, it causes poisoning of catalysts used in processing.	Upto 0.25 % by weight.
Pour Point	The temperature at which an oil will no longer flow from a standard test tube. Measures the paraffin content.	Lower the pour point, lower the paraffin content of the oil.

TEMPERATURE PROPERTIES OF PETROLEUM PRODUCTS

Flash Point	The flash point of an oil is an indication of the risk of fire or explosion associated with its use or storage
	Kerosene 100 - 160° F
	Gas oils 125 - 175° F
	Residual FO 150° F
	Lubricating Oils 300 - 350° F
Octane Number	A measure of a gasoline's antiknock quality determined by tests made on engines running under moderate conditions of speed & load.
Cetane Number	Arbitrary scale 1-100 used to specify the ignition quality of diesel fuels just as octane number is used to specify the antiknock qualities of motor spirits. Most diesel fuels have Cetane Number in the range of 35-60. The more paraffinic the fuel, the higher the Cetane Number. DI Diesel Index from gravity and aniline point. CI Cetane Index from gravity and 50% distillation point of fuel.
Cloud Point	Measured on distillate fuels and is an indication of the temperature at which filters may become blocked and cause malfunctioning or stalling of diesel engine.
Pour Point	Temperature at which a liquid ceases to flow or at which it congeals.
Reid Vapour Pressure	A measure of the volatility of a fuel, its ability to vaporize.

CRUDE OIL PROCESSING AND PRODUCTS

<u>Fraction</u>	<u>Boiling Range °C</u>	<u>Intermediates</u>	<u>Finished Products</u>
Gases	Upto 15	Methane, Ethane, Propane, Butane, LPG	Bottled gases
Light Distillates	15 – 175	Primary Flash Distillates (PFD); Straight Run Gasolines (SRG); Straight Run Benzene (SRB); Light Distillate Feedstocks (LDF); Catalytic Reformer Feedstocks	Motor Spirit (Petrol); Aviation Gasolines; Jet Fuels (Gasolines)
Middle Distillates	175 – 350	Naphtha, Kerosene, Gas Oils	Derivatives, Kerosene, Jet fuels, Domestic Heating Oils; Fuel Oils
Atmospheric Residues	> 350	Fuel Oils	Fuel Oils
Vacuum Distillates	350 – 550	Spindle Oils; Light Lubricating Oils; Catalytic Cracker Feed; Hydro Cracker Feed	Lubricating Oils; Paraffin Waxes
Vacuum Residues	Decompose on heating (crack or pyrolise)	Bitumens; Fuel Oil Blending	Bitumens or Asphalts
Deasphalted Residues	> 550	Bright Stocks; Cylinder Stocks	Lubricating Oils; Micro wax
Residual Materials (coal-like)	Decompose on heating (crack or pyrolise)	Asphaltenes (such as propane precipitated asphalt, PPA)	Fuel oils; Petroleum Cokes

For many crude oils the atmospheric residue is heavy fuel oil. Light residual fuel oils may be considered a blend of 50% heavy fuel oil and 50% gas oil.

MAJOR PETROLEUM PRODUCTS AND USES

<u>PRODUCT</u>	<u>MAJOR USE</u>
LPG	Mainly consumed as domestic fuel and balance as industrial fuel where it is technically essential.
Naphtha	As feedstock in fertiliser and in petrochemical sector and balance goes for other uses.
MS	Motor Spirit, entirely consumed in the spark ignition engine in automobile sector (cars, two/ three wheelers).
ATF	Aviation Turbine Fuel for commercial airlines and defence aircrafts.
SKO	Superior Kerosene Oil, fuel for cooking and lighting and on a limited scale used by industries for heating purposes.
HSD	High Speed Diesel, fuel for compressed ignition engines (trucks, buses, road rollers, tractors etc.), diesel pump-sets, harvesters and threshers etc. in the agricultural sector, railway engines, defence vehicles and fishing crafts and captive power generation.
LDO	Low Speed Diesel Oil, fuel for agricultural pump sets (stationary type), small industries, power generation and shipping bunkers.
FO/LSHS	Fuel & feedstock for fertilizer plants, industrial units and thermal power plants.
Bitumen	Road building and repairing material.
Lubes	Lubrication of automotive and industrial machinery.

TERMS RELATED TO GRID BASED INDUSTRIES

Diversity Factor	Concept which may be used for any power or energy supply system. It is the ratio of the sum of maximum demands of the separate consumers divided by the maximum demand made by an area. Ratio usually much greater than unity because maximum demand of individual consumers are not coincident.
Energy Unit	The energy unit for power is Btu or Kwh. For gas it is Btu or Kcal/m3. Power and gas are gradually integrating into a "Btu" business.
Base Load	The basic underlying level of demand or system minimum; the opposite of peak load; used in the context of gas supply and power generation.
City Gate	Refers to the point where gas/power passes from a main transmission system to a local distribution system; not necessarily a change of ownership.
Common Carriage	Obligation on transmission or distribution companies to allocate capacity to customers on a prorata basis, without discrimination between new and existing clients.
Energy Grid	Refers to the network of transmission and distribution system through which gas/power reaches industrial, commercial & domestic users.
Unbundling	Separation of energy production, transport and merchandising functions.
Netback	The value of the power/gas sold to the customer at the burner-tip less cost of transportation through the pipeline system and production/generation.

INTRODUCTION TO SEISMIC SURVEYS

All known hydrocarbon occurrences are found below mean sea level, mostly at depths ranging from 500 to 5000 m. The seismic method is by far the most important and reliable technique available for exploration i.e. locating the subsurface oil/gas accumulation and for reservoir definition. It utilises the propagation of waves through the earth depending upon the elastic properties of rocks.

The technique of acquisition consists of generating seismic waves and recording the two-way travel time. Primary seismic reflections occur at stratal surfaces having significant acoustic impedance contrast. Rock porosity and fluid content are the major elements controlling the impedance.

Basic task of interpretation is that of selecting those events on the seismic record which represent primary reflections, translating the two-way travel times to depth, mapping the reflecting horizons and generating subsurface geological models.

- 2D a survey designed to give geological information along two dimensional vertical slices. Grid spacing between acquisition lines generally in the range of tens or hundreds of meters.
- 3D data acquired for areal mode of processing. Grid lines are close spaced, generally less than 50 m. Gives information along horizontal as well as vertical slices.
- 4D time lapse 3D carried out periodically during the life of a producing field with the aim of tracking the movement of reservoir fluids.
- 4C-3D four component seismic in which shear wave data are collected from the reflected seismic energy in addition to pressure wave data. Processing the two streams of data opens up the possibility of providing a direct means of ascertaining whether a field holds commercially attractive volumes of hydrocarbons before actually drilling the prospect. At present, however, the technique is still in the developmental stage.
- VSP vertical seismic profile across a borehole obtained by suspending a geophone in the well on a cable and recording the signals for a shot fired on the surface near the well. The geophone is stationed at a different point for each shot to obtain a set of travel times. VSP provides a means of directly linking bore hole logging data with seismic sections.
- CWT cross well tomography, an elaboration of the VSP, whereby the seismic source is placed in one well and the geophone suspended in another well in the same formation. Provides a finer and more reliable means of well to well correlation.

MULTIFACET ASPECTS OF WELL DRILLING

1. Geotechnical survey of seabed prior to rig mobilization (for offshore wells).
 2. Navigational service to locate well position.
 3. Drilling Services - maintenance and operation of the rig ; drilling the well including the use of services of a directional drilling engineer
 4. Casing
the well is drilled in stages of reducing hole size with increasing depth. At each stage, usually after open-hole logging, casing pipe is lowered to secure the well.
 5. Cementing
Cementing of the casing by pumping slurry in the annulus between casing and formation.
 6. Mud Engineering
During drilling operations, a drilling fluid (mud) is circulated in the well for cooling the drill bit, lift rock cuttings out of the well and to provide the counter pressure to formation fluids. The "mud" has to be maintained at the specified parameters.
 7. Mud Logging
this involves the process of examining samples of the rock cuttings coming out of the well, monitoring drilling rates and analysis of gas in the mud.
 8. Well Logging
Open hole wireline logging in the formation intervals of interest before casing & cementing.
 9. Coring
Cutting of cylindrical sections of the formation encountered in the well for geological & petrophysical studies.
 10. Well Testing
Production testing of the well in case of a discovery ; includes bottom hole pressure measurements.
 11. Barge Services
Maintenance and operation of the jack-up or drill ship and power & water supply to the drilling operation.
 12. Supply Logistics
Supply of spares, chemicals, pipes, water, fuel to the drilling unit (supply boats in offshore)
 13. Crew Change
Logistics
Transfer and transport of drilling and ship/barge crews (helicopters in offshore)
 14. Diving Services
Divers and ROV (remote operated vehicles in offshore operations) for underwater work.
in remote locations onland and all offshore drilling units.
 15. House Keeping &
Catering
 16. Communication
Services
Especially critical in offshore operations; use of wireless telephony, radio, fax, for organising supplies, crew changes, reporting of drilling progress and receiving decisions/instructions, etc.

TYPES OF DIRECTIONAL WELLS

Probably the greatest advancement in drilling technology since the introduction of the rotary system has been the ability to deviate the wellbore from the vertical. The concept of directional drilling opened tremendous new opportunities for better recovery of oil & gas reserves, cost reduction in developmental activities and reaching geological targets previously considered inaccessible.

For purpose of definition, all wells can be considered variations of the directional well.

Vertical well	a well as understood in the conventional sense in which the well bottom is vertically below the surface well head system, i.e. the inclination is 0° .
Inclined well	a directional well usually with an inclination of upto 60° and a horizontal displacement approx. equal to or less than the true vertical depth. Because of the inclination, a greater surface area of the reservoir is open to production than a vertical well.
Horizontal well	highly deviated well drilled in order to increase length of producing zone with bore hole inclination approaching 90° from vertical.
Extended Reach Drilling (ERD)	a well with an average inclination of 60° for most of its length and a horizontal displacement greater than twice the true vertical depth; used to exploit fields/reservoirs that are located far from existing facilities or gaining access to a location which is inaccessible on the surface.
Multilaterals	multiple laterals drilled from a single parent well bore. Multilateral technology is rapidly gaining acceptance for cost & time saving and better reserves recovery.
Spliter wells	this system allows two wells to be separately drilled, cased and completed from the same surface slot.
Sidetracks	a long drift side track is a new well drilled in an existing production well which has ceased production. The LDST is achieved by cutting a window in the casing and targeting a location at a reasonable distance from the original subsurface production area.
Radials	a number of short laterals or radials made from the main bore hole in the same plane. Usually very high velocity of water is used to cut the formation to create the radials.

FORMATION EVALUATION

Various means are employed during drilling of a well and during its production phase to obtain information for evaluation of reservoir capacity and performance.

Coring	A core is a cylindrical section of rock a few inches in dia and several feet in length cut in the formation of interest during the drilling of a well. Core samples are used for detailed lithological and petrophysical studies.
Well Logging	This is a process of recording the properties of the formations encountered in the well with respect to depth. During the drilling operations, drilling is temporarily halted and the logging tool or sonde is run in the well on a conducting cable. The most important objective of open hole well logging is to detect the presence of hydrocarbons and measure critical properties like porosity and fluid saturations. A suite of logs combining resistivity, porosity and sonic tools is commonly used.
MWD	This is a process of well logging in which the recording is done without interrupting the drilling operations. Used in highly deviated wells in which running the conventional tools on cable is difficult. A MWD or measurement while drilling tool is placed in the drill string, just above the directional steering tool. The MWD tool measures and transmits to the surface real time directional steering data, drilling efficiency parameters and formation evaluation functions.
Bottom Hole Testing	Bottom hole testing is carried in proved hydrocarbon bearing wells during initial completion and at suitable intervals during the producing phase. A pressure recorder is lowered in the well to the desired depth on a wireline and various pressure measurements are taken in shut-in and flow conditions depending upon the nature of the study. These pressure measurements are extremely important in reservoir performance evaluation.
Production Logging	Carried out in a producing well. Like well logging, the measuring tool is lowered in the well bore on a conducting cable. But while well logging measures formation parameters, production logging measures the fluid & flow characteristics in the well. Helps in diagnosing the problems in an individual well for carrying out rectificatory measures.
Production Testing	Production testing is done in a newly drilled well before putting on initial production to measure surface fluid flow rates and pressures with different bean sizes. If there are a number of payzones encountered in the well, each payzone is tested separately.

OIL & GAS TREATMENT

The fluid stream which flows from the well is normally a mixture of oil, gas and water. These have to be separated and treated to meet certain specifications before sale.

Separation	Separation of the three phases, gas, oil & water is done in mechanical devices called separators. Liquid recovery or yield is determined by the choice of initial separator pressure and number of separation stages. Generally three stages i.e. high pressure separator, low pressure separator and stock tank (atmospheric pressure) are used. Separators may be horizontal, vertical or cylindrical type and for two phase or three phase separation.
Oil Treatment	Oil from the separator still contains some water in emulsion state which must be treated to remove the remaining water and salt. Most specifications call for a BS&W (bottom sediments & water) at 0.5 - 3.0% and maximum salt content of about 15 lbs/1000 bbl. Treatment done in horizontal or vertical vessels known as heater treaters.
Dehydration	Gas from separator is saturated with water vapor. Industry standards call for maximum water content of about 5 lb/mmcf. Common method of treatment is using of a glycol liquid dessicant.
Effluent Treatment	Water produced from the well stream and from the separator must be treated before disposal in a manner consistent with environmental protection. Specifications are generally for limiting the maximum oil content and/or salt content of the water before disposal (in case not injected back into depleted formations). The simplest device for effluent treatment is the skimmer tank.
Sweetening	Sour gas contains H ₂ S. The gas is "sweetened" to remove H ₂ S & CO ₂ to meet safety and corrosion protection specifications.
Compression	Centrifugal or reciprocating compressors are used to raise pressure of the produced gas before supply to the transportor's pipeline system.

COGENERATION, COMBINED CYCLE, DUAL CYCLE

Cogeneration (heat & power)	Efficient production of two forms of useful energy from the same fuel resource, using the exhaust energy from one production system as input for the other. Generally the primary energy form is thermal (steam) and secondary form is electrical e.g., natural gas used in gas turbines for generation of electrical power and the gas from exhaust is used for direct heating.
Combined Cycle (gas & steam)	The gas turbine exhaust heat produces steam to power a steam generator. Steam turbine output is obtained with no additional fuel input i.e., electrical power is obtained from two sources, the gas turbine and the steam turbine.
Dual Cycle (volume & pressure)	Heat addition is in two stages firstly at constant volume and then at constant pressure.

Cogeneration and combined cycle can be integrated to further improve efficiency.

PISTON ENGINES & TURBINES

Piston Engine	The pressure energy for doing the work is obtained by raising the pressure of the working fluid/fuel through volume reduction (compression) of the working fluid in a reciprocating piston - cylinder arrangement. Suitable for high starting torque and variable speed loads.
Turbine	The pressure energy for doing the work is obtained by raising the pressure of the working fluid through velocity increase of the working fluid flowing over the rotating blades of the turbine. Suitable for high and constant speed loads.

Note : The internal combustion engine and the combined cycle gas turbine are the two machine which account for most of the petroleum products and natural gas demand.

CORPORATE PLANNING : VARIOUS TERMS

Vision	A brief, specific & precise statement describing what the company would like to become in the future.
Value Statement	Spells out two or more important value issues such as ethics, environment, culture etc. in the transaction of its business.
Mission	States what business the company is going to be in, spells out the boundaries for the company's business and provide guidelines for the allocation of crucial resources of the company.
Objectives	States 5 or 6 of main objectives specifying the quantity, quality and time span for the attainment of the objectives. Objectives should be realistic and the link between vision, mission & objectives should be discernible. Generalised statements are avoided and excludes routine activities. The scale and scope of work flow from the vision and mission respectively.
Goals	Each objective may comprise a set of goals. The goals are in the nature of intermediate milestones for attainment of the objectives.
Strategy	Strategies are directed towards the achievement of corporate objectives and hence strategies should be linked with specific objectives. It is possible that the same strategy may be directed towards achievement of more than one objective or more than one strategy may be required for a single objective.
Project	An activity or a group of related activities to be completed within a scheduled time frame, at an estimated cost.
Programme	An activity which is usually of a recurring or continuing nature and for which funds are allocated periodically.
Tactical Plan	Short term operational measures which an organisation can take to improve its profitability or maximising shareholder value.
Strategic Plan	Long-term investment planning process to improve rate of return or maximising its wealth creating capacity.

POLICY, PROGRAMME, PROCEDURE, PRACTICE, PROCESS

Policy	A general way of doing things as a guide to present and future decisions. In activities where frequent and periodic decision making is required, a firm may lay down guidelines or policies to facilitate such decision making. Policies pertain to internal operations of the company and to those decisions that have to be taken internally. With the increased complexity of tasks and emergence of various levels of decision making, it becomes imperative to lay down policies. Policies however need to be changed with changes in characteristics of the activities or changes in working environment. Policy measures are necessary to ensure consistency of decision making among managers and consistency of decisions with time.
Programme	The organising and scheduling of recurring or repetitive activities which constitute a complete workset. While a policy relates to decision making, a programme relates to the activities. Programmes are derived from policies.
Procedures	Refers to step by step formal and documented method and sequence in which each particular activity has to be performed. Procedures are meant to aid the efficient implementation of a programme by ensuring that each activity is fully completed within the shortest time possible. Laid down procedures are necessary to avoid disorderly and arbitrary ways of performing tasks which are essential to the business operations of a company. Since too many procedures result in inflexibility, procedures are established only for activities which are critical or where there are statutory and contractual obligations.
Practices	Best way of doing things; not formal or documented; general guidelines evolved from experience and knowledge; Majority of activities in an organisation, especially at the field operating levels are guided by best practices.
Process	A series of linked actions executed in a regular and orderly fashion. The thing being processed undergoes value addition or transformation at each stage of the process to give the final desired product/ result at the end of the chain.

BASIC STRATEGIES

There are a number of different strategies a company can adopt either separately or in combination thereof for improving competitiveness, risk reduction, expansion and growth.

Acquisition & Mergers

Acquisition & mergers of synergistic assets, capabilities and relationships designed for gains through improved scale and scope of operations and/or sharing of complementary skills. M&A strategy is used for expansion in the same industry segment ("bigger is better") or to increase scope in complementary business ("broader is better").

Diversification & Integration

Main driver for diversification is risk balancing and concentration on sales growth. Diversification is the spreading out from primary revenue earning activities into functionally related, value linkage or unrelated business ventures. Vertical integration through diversification into value linkage activities (e.g. E&P and R&M) minimises competitive effects and maximises market opportunities.

Divestment & Rationalisation

Divestment refers to disposing or freeing of reserves/assets with low and/or reducing returns/ utilisation. This strategy is an effective means for pruning costs and maximising long term cash flow. Includes downsizing and refocusing on primary activities.

The organisation's correct assessment and recognition of its areas of operational effectiveness and core competence are crucial to implement the right strategy.

Operational Effectiveness

Performing similar activities better than competitors perform them. Excellence in individual activities or functions.

Core Competence

Performing different activities from that of competitors or performing similar activities in different ways. Core competence is about combining activities i.e. how activities fit and reinforce one another.

Note : While operational effectiveness is essential, core competence is crucial for competitive advantage. It is harder for a rival to match an array of interlocking activities than merely to imitate a particular product feature, a marketing approach or even a process technology.

CORE COMPETENCE

In the long run, competitiveness of an organisation derives from the management's ability to develop and consolidate corporate wide technologies and skills into competencies that empower the various businesses to adapt quickly to changing opportunities.

Core competence is the collective learning in the organisation, especially how to coordinate diverse production skills and integrate multiple stream of technologies. The skills that together constitute a core competence coalesce around individuals who recognise the opportunities for combining their functional expertise with those of others in new and interesting ways.

Core competencies do not diminish with use, unlike physical assets, but are enhanced as they are applied and shared. Competencies are the glue that binds existing businesses and are the engines for new business development. Pattern of diversification and market entry are guided by the recognition and identification of core competencies.

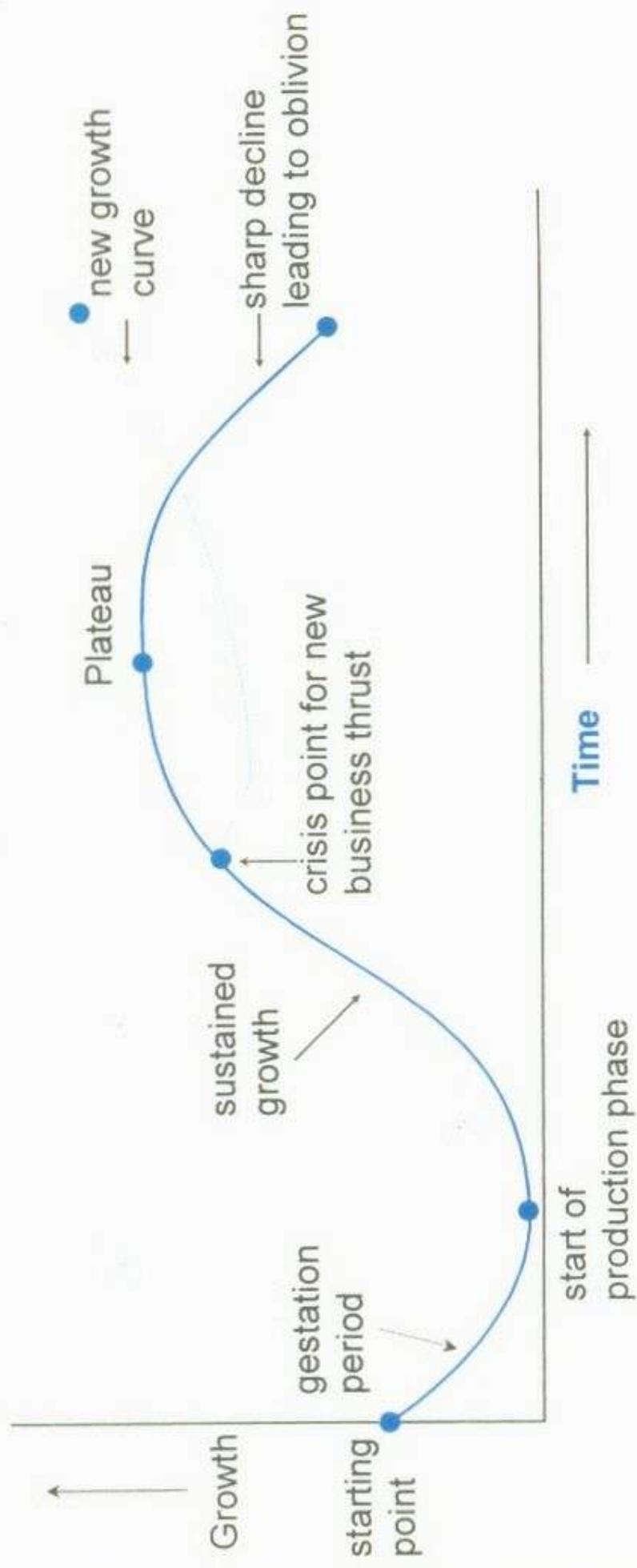
A company appearing to be a collection of discrete businesses may actually be built around a single core competence e.g. Sony produces a variety of products around its expertise or core competency in miniaturisation. Another example is Canon's core competency in optics & imaging. Unlike the battle for global brand dominance, which is visible, the battle to build world class competencies is invisible to people who are not looking for it.

Test for core competence

- provide access to a wide variety of markets
- should be difficult for competitors to imitate

Core competence is distinct from operational effectiveness which focuses an excellence in individual functions or activities. Core competence is what the rival does not have.

CRISIS POINT IN ORGANISATION LIFE



THE COMPONENTS OF RISK

Variability	Relates to recurring events whose relative frequency is known from experience and refers to the deviation from an expected value or variability.
Uncertainty	Relates to unique events whose probability can only be subjectively estimated.
Vagueness	Associated with the difficulty of making sharp distinctions i.e., gray area.
Ambiguity	Associated with choice between two or more alternatives.
Precision	Ability to repeat a measurement consistently within a small deviation.
Accuracy	Refers to the correctness of results. Solutions may be very precise but at the same time inaccurate.

Note : Risk may include any or all of above.

PROBABILITY, POSSIBILITY, PLAUSIBILITY

Probability	The likelihood or frequency of occurrence of an event. It is a means of expressing an outcome on a numerical scale that ranges from non-occurrence (0.00) to absolute certainty (1.00).
Possibility	The ease or feasibility of attainment of an objective. It is a means of expressing an outcome on a numerical scale that ranges from non-feasibility (0.00) to absolute possibility (1.00).
Plausibility	The reasonableness or usefulness of an evaluation. It is a means of expressing an estimate on a numerical scale that ranges from unjustifiable (0.00) to complete reasonableness (1.00).

Note : Probability and Possibility theories are not only conceptually different but are also mathematically distinct. Probability requires observation while Possibility requires knowledge.

RISK ANALYSIS

Business risks are defined in terms of the internal rate of return (IRR) and the weighted average cost of capital (WACC) for investments made in commercial/industrial projects.

Cost of Capital	This is the rate of return a business venture must earn to satisfy the expectations of investors who provide long term funds to it. It is the yardstick against which IRR is evaluated.
Rate of Return	Return from an investment is the realisable cash flow earned by its owner during a given period of time. Typically it is expressed as a percentage of the beginning of period value of the investment. Because of risk, the rate of return can take several possible values.
Risk	Refers to the deviation from expected value or variation in outcomes of a situation. A sophisticated measure of risk is the standard deviation. Risk can also be defined as the possibility that some variable event will negatively affect the returns of a project i.e. there is a perceived possibility or chance of loss.

Risk analysis is widely used by petroleum companies. Risks in E&P projects may be geological, engineering and financial. Risk associated with an exploration venture is a composite risk which can be analysed in terms of the risks associated with each of the elements which produce a discovery. Product prices and cost of capital are the two important financial risks in oil & gas projects.

Effective response to risk

- efforts/expenditure to lessen the risk e.g. use of 3D surveys in exploration.
- purchase of insurance against the risk that remains e.g. hedging to take care of price variations.

Iron Law of Risk Management :

Maximise the use of those operations where the desired result is to some extent computable and/or where the linkage between cause and effect is visible while minimising those actions over which no control of the outcome is possible and/or where the linkage between cause and effect is obscure.

COST-BENEFIT ANALYSIS

Investments in public utilities and Government funded projects such as roads, bridges, railways, parks etc. are evaluated using cost benefit analysis. This is a technique which attempts to set out and evaluate the social costs and social benefits of the investment to help decide whether or not the project should be undertaken. The essential difference between cost-benefit analysis and conventional investment appraisal is the stress on the social costs and benefits. The aim is to identify and measure the losses and gains in economic welfare which are incurred by society as a whole if the particular project in question is undertaken. It takes into account all significant costs and benefits not just simply the financial costs and revenues incurred and received.

Cost benefit analysis takes into account the economic costs or opportunity costs defined in terms of the value of the alternatives or other opportunities which have to be foregone in order to undertake the investment. It is a more rational approach to optimal decision making in public funded projects than real or accounting costs as it leads to better allocation of scarce resources.

Benefit Cost Ratio = PV of Benefits/Initial Investment

BCR should be > 1 for project to be acceptable.

Central tenets of CB Analysis :-

- i. Effects of implementing the project on society are no more or less than the aggregate effects on the individuals who comprise the society.
- ii. Benefits are measured by the willingness of individuals to pay for the outputs of the project.
- iii. Costs are calculated as the compensation required to exactly offset negative consequences of the project implementation.

ENVIRONMENTAL IMPACT ASSESSMENT

EIA is an assessment of the impact of an industrial installation or activity on the surrounding environment, conducted before work on that activity has commenced. The original baseline study, a key part of this process, describes the original conditions. The method used is a cost-benefit technique.

DEVELOPMENT OF MATHEMATICAL MODELS

A model is a concept from which one can deduce effects which can be compared to observations, then used in understanding significance of the observations. Models may be physical, mathematical or conceptual.

Model Development Steps :-

- i. Feasibility study regarding need of model and type of model to be used.
- ii. Construction of model logic - model structure and delineation of equations.
- iii. Translate logic into programming language.
- iv. Test & validate with historical data and statistics.
- v. Implementation.

Mathematical models are of two broad types - optimisation & simulation models.

Optimisation Model : a conceptually elegant method to maximise a certain objective function subject to various constraints. The most popular is the linear programming model which deals with problem of allocating limited resources among competing activities in the best possible way.

- i. Identification of decision variables which are to be determined.
- ii. Development of objective function as a linear function of the decision variable.
- iii. Definition of model constraints as inequalities/equalities of the linear functions.

Simulation Model : a more popular method is simulation analysis which may be used for developing the probability profile of a criterion of merit by randomly combining values of variables which have a bearing on the chosen criterion.

1. Model the project i.e. define the relationship of the dependent variable to the parameters and exogenous variables.

Parameters - input variables that are specified and held constant over all simulation runs.

Exogenous variables - input variables which are stochastic and outside the control of decision makers.

2. Specify the values of parameters and probability distributions of each of the exogenous variables.
3. Select a random value of each of the exogenous variables to determine value of the dependant variable.
4. Process at 3 is repeated several times with a new set of random values each time.
5. Plot frequency distribution curve for obtaining the least likely, most likely and mean value of the dependent variable.

SCENARIO ANALYSIS

Scenario analysis is an increasingly popular way to look at the future business environment as forecasters have become disillusioned with fancy mathematical and quantitative methods. Scenarios are possibilities and not probabilities. This type of analysis provides a more qualitative and contextual description of how the present will evolve into the future and emphasis is on conceptualisation rather than computation. It tries to identify a set of possible futures each of whose occurrence is plausible but not assured. This method appears to be a more reasonable and realistic approach than trying to predict statistically what will happen several years ahead.

Scenario analysis is best suited for those situations where a few crucial factors can be identified but not easily predicted. It offers the greatest advantage over other methods when uncertainty is high and historical relationships are shaky and the future is likely to be affected by events which have no historical precedent. Scenario analysis takes future uncertainty for granted and tries to identify what information is relevant for adaptation and flexibility.

Usually three scenarios are built up :

- i. Business as usual - assuming existing conditions to continue.
- ii. Most likely - based on events most likely to occur.
- iii. Optimistic - based on expectations of favourable circumstances.

SENSITIVITY ANALYSIS

Sometimes called "what if" analysis. Indicates sensitivity of criterion of merit (NPV, IRR etc.) to variations in basic factors.

Consists of the following steps :-

1. Set up relationship between the basic underlying factors (like quantity sold, unit selling price, life of project etc.) and NPV (or some other criterion of merit).
2. Estimate range of variation and most likely value of each of the basic underlying factors.
3. Study the effect on NPV of variations in the basic variables. Typically one factor is varied at a time. We could study for example, the variation of quantity on NPV or price on NPV, given the most likely values of the other variables.
4. Make graphical plot. NPV is taken as ordinate and the independent variable as abscissa.

NPV and IRR

$$\begin{aligned} \text{NPV} &= \sum_{t=1}^n \frac{[QxP - O - D](1-T) + D}{(1+k)^t} + \frac{S}{(1+k)^n} - I \\ &= \sum_{t=1}^n \frac{CF_t}{(1+k)^t} + \frac{S}{(1+k)^n} - I \end{aligned}$$

NPV = net present value of the project

n = life of project in years

Q = number of units sold annually

P = selling price per unit

O = operating cost

D = annual depreciation change

T = income tax rate

S = salvage value

I = initial investment

k = discount rate

CF = annual cash flow

IRR or internal rate of return is the discount rate which makes the net present value equal to zero.

$$O = \sum_{t=1}^n \frac{CF_t}{(1+k)^t} + \frac{S}{(1+k)^n} - I \quad \text{or} \quad I = \sum_{t=1}^n \frac{CF_t}{(1+k)^t} + \frac{S}{(1+k)^n}$$

i.e., initial investment = present value of cash flows.

For a project to be viable, NPV should be > 0 and IRR greater or equal to the WACC (weighted average cost of capital).

Risk adjusted discount rate method calls for adjusting the discount rate to reflect project risk.

$$k = i + n + d$$

i = risk free rate of interest.

n = adjustment for the firm's normal risk.

d = adjustment for the differential risk of project.

EVA AND WACC

1. **Return on Average Capital Employed (ROACE) = EBIT/ (average long term debts + interest bearing short term liabilities - (cash + marketable securities) + shareholders funds).**
2. **Return on Average Equity (ROAE)**
= Net Profit / Average Shareholders Funds
3. **Weighted Average Cost of Capital (WACC)**
= $[D/D+E \times (I \times (1-T))] + \{E/ D + E \times (RFR + RP)\}$
4. **Cost of Equity (COE)**
= Risk Free Rate (RFR) + Risk Premium (RP)
5. **Economic Value Added (EVA)**
= NOPAT - (Average Capital Employed) x WACC

Where :

D = debt taken as being the average value of debt for the period.

I = interest cost based on local short term interest rate.

T = marginal tax rate.

E = equity market capitalisation.

RFR = risk free rate based on the longest liquid government bond.

RP = an equity risk premium ranging from 5% to 12% based on business cum political risk. For India we can assume 12%.

NOPAT = net operating profit after tax.

EVALUATION OF OIL & GAS PROPERTIES

Evaluation of oil & gas properties are made for three reasons :-

1. Guide to management in allocating capital resources for development. Whenever investment opportunities exceed available capital, projects need to be ranked in order of desirability.
2. Guide to management for assessing the value for a property to be acquired/sold.
3. Information required by interested investors.

Oil & gas deposits being depletable natural resources, have a time limited earning capacity which affects their value in a way that usually does not apply to real estate or an industrial property.

Two different methods are available for assessing the value of the property or estimating a fair market price - the discounted cash flow method and option value method.

Discounted Cash Flow Details required include future production rates and operating costs over the life of the field, anticipated product price, interest rates, taxes, inflation and future investments required to keep project going. The two cash flow streams, inflow and outflow are discounted using weighted average cost of capital to obtain present values. The difference between the two would be the net present value of the property.

Option Value Method The key concept underlying oil industry application of option value method is that production profiles for real oil fields can be replicated in the paper markets with portfolios of crude oil/gas futures and swaps. Under the assumption of an exponential production-decline rate and a constant flat-term structure for forward interest rates, convenience yield and volatility, the value of the asset becomes a direct function of the spot oil price.

Note : In discounted cash flow method which is the most widely used method, the reserves are risked as below :

<u>Reserve Category</u>	<u>Risk factor</u>
Proved Developed	0.95
Proved Undeveloped	0.75 - 0.90
Probable	0.35 - 0.60
Possible	0.05

EQUATION FOR SMALL DISCOVERY EVALUATION

$$\Pi = -E + p \times NPV$$

$$NPV = P \times R \times [a / (a + i)] - O/i - I$$

$$R = 7758 \times \phi \times A \times h \times (1 - S_w) / \beta_o \times RF$$

where :-

Π = expected net present value of the exploration programme

E = present value of cost of exploration programme

p = probability of discovery being made

NPV = net present value of discovery excluding exploration costs

R = recoverable reserves, mmbbls

P = price of oil, \$/bbl

a = depletion rate of reservoir, fraction

i = discount rate, fraction

O = operating costs in first year, \$ mm

I = initial investment including well costs, \$ mm

ϕ = porosity, fraction

A = area of prospect, acres

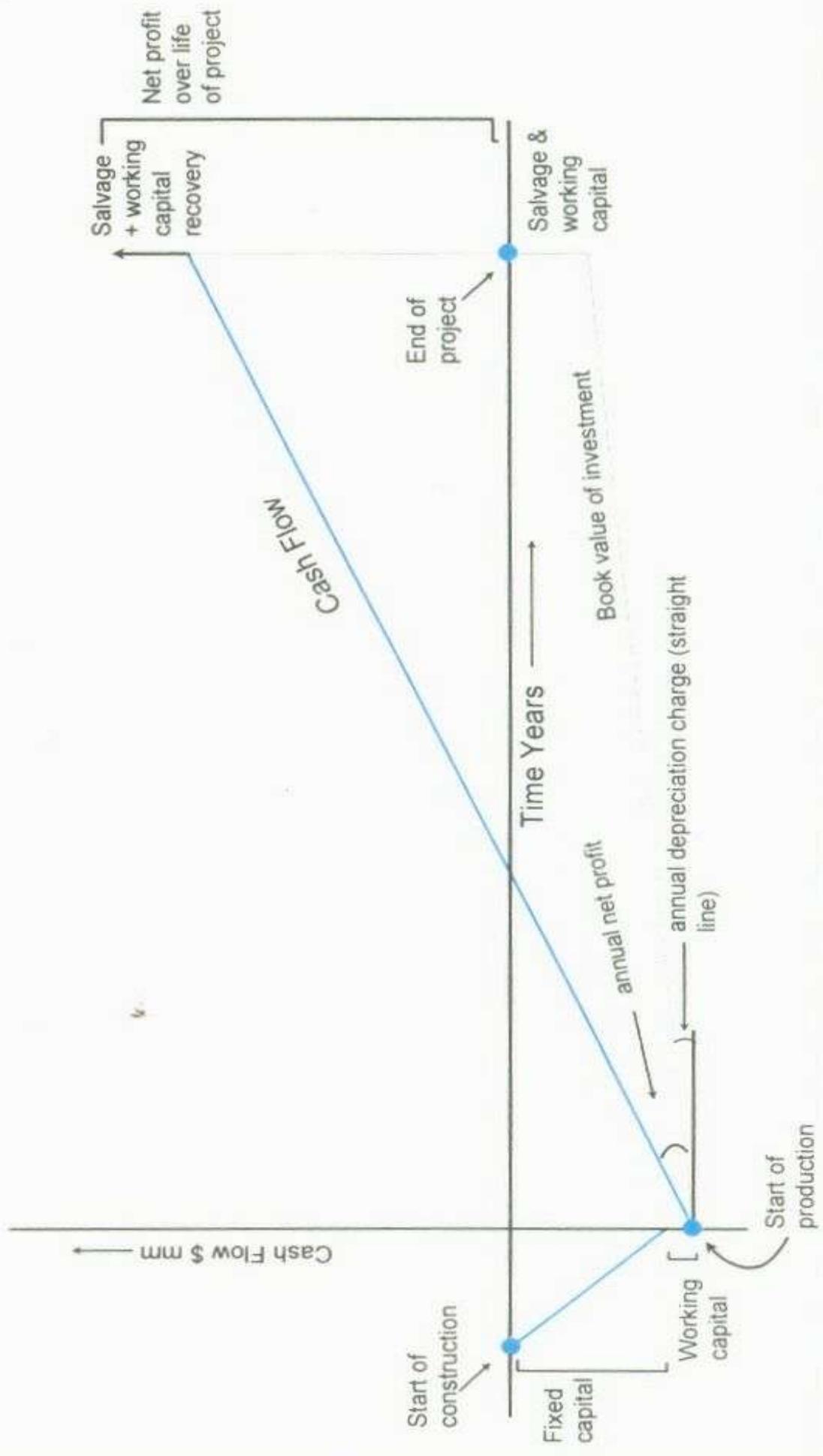
h = thickness of pay zone, feet

S_w = water saturation, fraction

β_o = formation volume factor, RB/STB

RF = Recovery factor, fraction

GRAPHIC OF CASH FLOW FROM A PROJECT



PETROLEUM LICENSE/ LEASE RIGHTS *

Petroleum
Exploration
License
(PEL)

Authorization taken for exploration efforts in a defined area or block demarcated for this purpose. The license confers exclusive rights for surveys, exploratory and appraisal drilling. PEL over an area is initially granted for a period of 4 years, extendable by two periods of one year each (4+1+1). On completion of 6 years, PEL can be granted for the same area through a fresh application. The licensee is at liberty to relinquish any part of the area. For onland areas, the PEL is granted by the respective State Governments and for offshore areas it is granted by the Central Government.

PSC

Under the Production Sharing Contract agreements, the blocks are awarded for seven years (2+2+3) instead of the PEL terms for six years (4+1+1). Companies are required to relinquish 25% and 50% of the original area at the end of Ph-I and Ph-II respectively. At the end of the third phase, those areas can be retained wherein hydrocarbons have been discovered.

Mining
Lease
(ML)

Authorization taken for commercial production. The lease confers exclusive rights for development and production . Once a discovery has been made and the field is to be developed for production, the exploration license has to be converted into a production lease in the form of a mining lease. As with the PEL, the ML for land areas is obtained from the State Governments and the offshore areas from the Central Government. The ML is valid for 20 years and can be extended as required and to be relinquished after production of petroleum ceases. The ML area is restricted to 250 sq. kms. per application. Once the ML is obtained, royalty and cess etc. are to be paid on the produced oil and gas.

* As applicable in India.

PETROLEUM FISCAL SYSTEMS

Two main systems being practiced world wide. Concessionary System accounts for about 50% of all fiscal systems and PSC another 45%.

Concessionary System

Allows private ownership. Oil companies take title to produced hydrocarbons at the well head and then pay the appropriate royalties and taxes. The royalties can either be paid in cash or kind.

Contract System (PSC)

State retains ownership. The fee is a share of production so that ultimately the oil company takes title to a share of the hydrocarbons, usually at the point of export. In a PSC, part of the entitlement is cost recovery.

The most characteristic feature of any fiscal system is contractor take, i.e. the percentage of profits to which the contractor is entitled. Govt. take is the complement of contractor take and is the key element in contract negotiations for exploration or development rights.

Revenue Protection

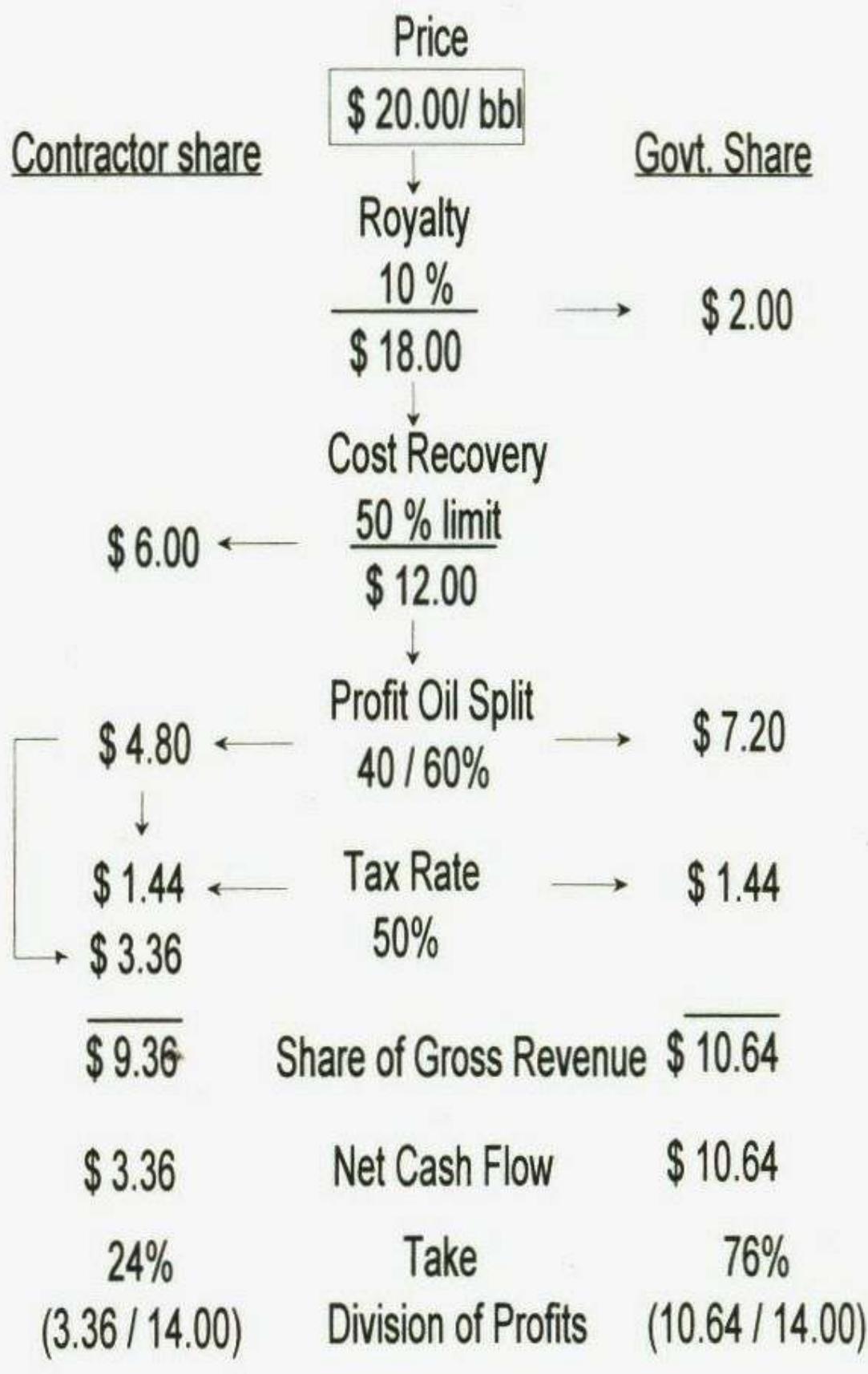
Minimum share of gross revenues a Government (including taxing authorities) will receive in any given accounting period from a given production stream.

Access to Gross Revenues

Complement to revenue protection is the maximum share of gross revenues a company or consortium can receive from its working interest. AGR may be limited by royalties, profit oil splits and/or cost recovery limits.

Note : Because of the existence of numerous reserves categories and diverse fiscal systems, the value of a similar property may vary dramatically worldwide.

PSC CASH FLOW TABLE *



* This is only an example for illustration purpose.

SIZE OF A BUSINESS ENTERPRISE

Three parameters generally used to indicate the size of a business enterprise

- | | |
|--------------------------|---|
| 1. Revenue | The receipts to the organisation from the sale of its goods & services. Fortune 500 companies are ranked according to revenue. |
| 2. Assets | The total investment in net fixed assets. In the case of E&P companies, this would include producing property. |
| 3. Market Capitalisation | Currently gaining importance as a measure of both the size and value of the company. It is the product of the number of shares of the enterprise and the average share price in a given period. |

VALUE OF AN E&P COMPANY

A company involved in the upstream area is basically dealing with a wasting asset which has a finite life and therefore the E&P business represents a self liquidating process of converting reserves/assets into cash flow via production. Thus while non upstream companies can anticipate an indefinite life, the upstream companies can only ensure longevity, if they are successful in replacing reserves. Secondly, exploration focus on a small number of provinces limits diversity and tends to concentrate risk.

Value of an E&P stock is hence determined by the potential upside i.e. value to be delivered by management in future periods

$$\begin{aligned}\text{Value of E&P Stock} &= \text{Value of Proven Assets} + \text{Value of Potential Reserves} \\ &= \text{NPV (Proven Assets)} + \text{Premium (Potential Reserves)}\end{aligned}$$

The premium that the market anticipates comes from the exploration programme i.e. exploration spending and availability of a prospects portfolio.

Companies that are most favoured by investors are those that are capable of adding most value to their assets and show potential for strong growth. These are companies with critical mass in their key operating areas and are therefore in a position to select best opportunities and take advantage of them.

BALANCE SHEET & INCOME STATEMENT

Balance Sheet	Shows the <u>financial position</u> of a firm <u>at a given point of time</u> , say 31 st March of each year. It summarises the liabilities and assets of the firm at a point of time.
Income Statement	Show the <u>financial performance</u> of a firm <u>over a given period of time</u> , say 1 st April to 31 st March of each year. It summaries the revenue and expenses of the firm over a period of time.

Balance Sheet Equation

Net Income/Profit	= Π
Retained Earnings	= P
Contributed Capital	= E
Net Worth	= K ; Working Capital = k
Assets	= A ; Current Assets = a
Liabilities	= L ; Current Liabilities = l
Revenue	= R
Expenses	= C

$$k = a - l$$

$$K = A - L$$

$$K = E + P$$

$$P = R - C$$

$$A = L + E + R - C$$

This is the balance sheet equation. The (R-C) terms represents the P&L Account. Hence P&L is an integral part of the Balance Sheet i.e. it is an expansion of one of the terms of the balance sheet.

CAPITAL RECOVERY PROCESSES (DD&A)

All costs or money outlays can be distinguished into operating expenses (operating activities) or capital expenditure (investing activities). While operating expenses are fully accounted for in the year of incurrence, investments are first capitalised as fixed assets, producing property or exploration expenditure and then periodically written off depending upon the capital recovery method.

Depreciation	Applicable to “wearing” assets. It is the process of prorating as expense the capitalised costs over a period of years. Depreciation recognizes the decline in useful life of an asset due to wear and tear. In general, an item can be declared depreciable if it will retain a usable or reasonable value over a definite period of time based on its life expectancy and has a salvage value.
Depletion	Applicable to “wasting” assets. It is the process of prorating as expense the capitalised cost of a producing property. Depletion recognises the exhaustion of a resource or the reduction in its value through the production/ extraction process. In general, an item can be declared depletable if it retains a usable value over a definite period of time and has a residual value.
Amortization	It is the writing off of intangibles recognised as assets. It is a means of reduction over a period of years of the value of an expenditure which is not expensed e.g. leases, survey costs, exploratory drilling etc. These have no future use and no salvage or residual value.

The unit of account is the area covered by a license or lease (PEL/ML). If a certain portion of a license/lease is surrendered or declared as producing and the balance portion continuing under exploration, related costs are segregated and amortised/ depleted as the case may be.

Under the Successful Effort Method (SEM), survey costs are expensed in the year these are incurred and the successful/undecided exploratory well is carried as Well-in-Progress till the producing property is created or is expensed in the year when determined to be dry. Some companies follow the Full Cost Method in which all exploratory efforts are capitalised and then amortised over a period of time.

Producing property is created when hydrocarbon reserves are determined to be proved. PP comprises of capitalised successful exploration costs, development drilling costs and related production facilities in the lease area (ML).

COMMON FINANCIAL TERMS

Terms as used by Department of Public Enterprises /MoF

Sales	Turnover + Other income.
Cost of Sales	Total operating expenses including statutory charges + Loan revaluation + Recouped cost.
Cost of Production	Cost of sales - Cess - Sales tax.
Value of Production	Total sales including other income - Cess - Sales tax.
Value Added	Total sales - Total operating expenses - Statutory charges + Manpower (including bonus & gratuity).
Gross Margin	PBIT + Interest payments - Interest received + Recouped cost + Deferred exchange loss.
Net Worth	Own funds + Reserves and surplus - Misc. expenses.
Capital Employed	Net Worth + Unsecured loans - Investment - CWIP - Unallocated expenditure.
Working Capital	Current assets, loans & advances, deposits, investments - Current liabilities and provisions excluding cash credits and provisions for gratuity.

Terms as used by SEBI

Equity	Total issues and subscribed equity capital.
Operating Profit	Profit before interest, depreciation and tax.
Net Profit	Profit after deducting interest, depreciation and tax.
Gross Profit	Profit after interest but before depreciation and tax.
GP/Sales	Gross Profit/Net Sales.
OP/Sales	Operating Profit/Net Sales.
Net Worth	Equity Capital + Free Reserves.
RONW	Net Profit/Net Worth.
Market CAP	Market Price of Share x No. of Shares.

UNIT COSTS IN E&P ACTIVITIES

S = Survey Costs \$ mm (Acquisition + Processing + Interpretation + Support)
Unit Survey Cost = S/LK

X = Exploratory Drilling Costs \$ mm
m = Total Exploratory Meterage Drilled
Unit Drilling Cost = X/m

Ra = Reserves Accretion mmboe
Finding Cost = (S + X)/Ra ----- FC \$/boe

Y = Development Drilling Cost \$ mm
F = Costs of Production Facilities
Rd = Reserve upgraded to proved developed category mmboe
Development Cost = (Y+F)/Rd ----- DC \$/boe

Replacement Cost* = FC + DC ----- RC \$/boe

P = Production of oil & gas mmboe
O = Operating Expenses \$ mm
Lifting Cost = O/P ----- LC \$/boe

Well Head Cost = RC + LC ----- WC \$/boe

Sale Price = WC + Taxes + Margin \$/boe

Note :

1. ONGC Production Cost is calculated as below :-

Prod.Cost /boe = (operating expenses + statutory charges + recouped costs + net interest + exchange loss) / Quality sold

2. Internationally, drilling cost per metre is estimated as below :-

Drilling Cost \$/m = [[(Drilling hrs + Trip hrs) x Rig rate \$/hr] + Bit cost \$ + Support cost \$]/ Well depth m

* Replacement cost defined as the cost incurred in finding a bbl of oil/gas and making it ready for production.

COMPREHENSIVE LIST OF PERFORMANCE INDICATORS

1. Firm Value	Market Capitalisation + Net Debt.
2. Net Asset Value	Discounted value of proved reserves in ground.
3. Cash Flow	Net Income + DDA + Deferred Taxes.
4. Current Ratio	Current Assets/Current Liabilities.
5. Quick Ratio	(Current Assets - Inventories)/Liabilities.
6. Reserves Replacement Rate	Reserves Added/Production.
7. Replacement Costs	Costs incurred in acquiring, exploring, developing oil & gas reserves and making ready for production.
8. Production Costs	Expenses required to withdraw oil & gas from the ground, maintenance, transportation costs and production taxes.
9. Production Growth	Percentage increase in oil & gas production per annum.
10. R/P Ratio	Reserves remaining at end of year divided by production in that year.
11. Net Contribution	Price Realisation - Production cost.
12. Reinvestment Rate	Total costs incurred in oil & gas activities divided by internally generated cash flow.
13. Debt/Equity Ratio	(Total Long Term Debt)/(Total Capitalisation).
14. Productivity	Production/No. of Employees.
15. Profitability	Net Profit/Capital Employed.
16. Revenue Growth	Percentage increase in oil & gas revenues per annum.

CORPORATION CASH FLOW DIAGRAM



ASSETS AND RESOURCES

Asset	An asset is a property or property right owned by a business that is acquired at a measurable cost and has value either because it will be converted into cash or because it is expected to benefit future operations. Includes fixed assets like plant & machinery, liquid assets like cash & inventory and intangibles like goodwill, lease etc.
Equity	An equity is an owner's claim against the assets of a firm. It is the residual value of a company's assets after all outside liabilities other than shareholders have been allowed for. The equity of a company under liquidation is the property of holders of ordinary shares.
Capital	Collection of goods used to promote the production of other goods instead of being valuable solely for the purpose of immediate enjoyment. Also the money with which a company runs its business, obtained by issuing shares or borrowing (debentures, loans etc.).
Reserves	Reserves & surplus are accumulated undistributed or retained profits of the company which are put aside as reserves. Can be converted into equity or share capital by issuing bonus shares.
Net Worth	Sum of Equity and Reserves & Surplus, less accumulated losses and intangibles.
Resources	A source for the supply of something in the production of goods & services. Resources available to a company include tangible assets, human resources, information, technology etc.

VALUE & PRICE

Value	The perceived worth of an asset and measured by comparison. It is a theoretical precept whose practical manifestation is price. Value is the price negotiated in an open and unrestricted market between a willing seller and a willing buyer.
Price	The practical manifestation of value. In a real market situation, a gap exists between the intrinsic value of an asset and the price at which it is traded.
Rent	Economic rent is any excess of actual earnings over earnings which are just sufficient to keep the factor of production in its present employment.

EXPENDITURE & EXPENSE

Expenditure	Costs incurred by an enterprise towards acquisition of assets for long term use e.g. capital expenditure on purchase of platforms, drilling of development wells, etc.
Expenses	Expired costs or costs incurred in connection with the revenue earning activities or operations e.g. expenses on water injection, administration etc.
Cost	Compensation for loss or sacrifice in the production of goods or service or in the meeting of an obligation.
Period Costs	Costs related to time e.g. salaries, rentals etc. and incurred even if there is no production.
Product Costs	Costs related to physical activity in producing goods or service and proportional to the quantity produced e.g. materials costs.

EQUITY TRANSACTIONS

Disinvestment	Reduction in the equity held by an existing shareholder, who derives the benefit of transaction. The capital structure of enterprise remains unchanged i.e. the total equity remains the same but number of shareholders increase. No change in assets.
Dilution	Decrease in the ownership value of a share as a result of increasing the number of shareholders by converting debenture or any other long term loans into shares or issuing fixed shares without a corresponding increase in assets. It lowers the net asset value & EPS and is not beneficial to the existing shareholders. The capital structure is changed with no change in assets.
Divestment	Disposal of equity holding in full or in part with a corresponding decrease in assets.
Diversification	A term generally used to express the process whereby a company acquires assets/equity in another company in a different business segment i.e. in a segment other than its primary revenue earning activities.

INFORMATION HIERARCHY

Data	Isolated raw facts or pieces of statistics; unrelated and uninterpreted; collection of numbers, words, symbols that can be processed.
Information	Data organised to impart relevance and purpose. The result or product of processed data and placed in same context. No predictive value. Simple trend type analysis and comparisons.
Knowledge	Information that is processed or displayed for understanding why and what, conveys patterns and interrelationships. Generation of ideas.
Intelligence	Knowledge with predictive value and insight into processes/systems. Generation of scenarios.
Wisdom	Knowledge that is so thoroughly assimilated that it leads to sagacity, judgement and insight.

GRADES OF INVESTMENTS

Gambling	Putting down money to make a very quick gain in a matter of minutes or hours. Gamblers create risks where none exist and depend purely on luck.
Speculation	An activity in which a party assumes high risks, often with no regard for the safety of principal, to achieve large capital gains. Superior to gambling in the sense that the speculator depends to some extent on his intelligence and instinctual feeling of market conditions. Also the time span in which the gain is sought to be made is usually in terms of weeks or even months.
Investment	The investor also assumes risks but only those which already exist in the market place. The gain sought is a reasonable return, usually over a long period. Success depends on intelligence and knowledge of market conditions and experience.

Note : Investment plays its major role in the physical markets while speculation is a recognised and legitimate activity in the future markets.

HEDGING & DERIVATIVES

In a market based economy, the need for futures trading arises mainly because of price variability in primary commodities and their products.

Commodity futures markets enable market functionaries engaged in purchase or sale of physical goods to reduce their price risks by offering the facility of hedging.

Hedging involves counter buying or selling of standardised futures contract against the corresponding sale futures or purchase respectively of the equivalent physical commodity. As the prices in the physical and futures markets by and large move in close unison, losses in the physical market arising from adverse movements are offset either fully or substantially by the gains in the futures market and vice-versa.

Insofar as futures market provides a forum for speculation, it enables all those, whether dealing in physical commodities or not and who have the necessary market information and intelligence, to use futures markets to test their price judgments. The futures markets function as a result of the diversity of participants' interests and opinions.

Derivatives have been receiving a great deal of attention recently and as markets for futures, swaps and options have grown and matured in the oil & gas industry, companies are seriously exploring the sources of this potential for value creation.

Futures	legally binding commitments to deliver or accept a specified quantity and quality of oil on a particular future date at a given location. Most transactions come to term within six months.
Option	a contract which establishes the right but not the obligation to buy or sell a futures contract on a given date at a predetermined strike price.
Swap	an oil swap is a transaction in which one party (the producer) agrees to make payments to a second party (financial institution) equivalent to the value of a specified volume of oil at the market price. The financial institution makes reciprocal payments for the same volume at a fixed price. Different from futures in that instead of an exchange, transactions are through a financial institution or trading company. The transaction is purely financial and no physical shipments occur.

CREDIT RATING

Credit Rating a simple system of gradation which essentially reflects the probability of timely payment of interest and principal by a borrower on a debenture, preference share, fixed deposit or short term instrument. Applicable to companies as well as countries. The evaluation is carried out by professionally qualified persons and includes data collection, analysis and meetings with key personnel to discuss strategies, plans and other issues in the company that may affect credit worthiness.

Three agencies in India are doing credit rating

- 1. CRISIL Credit Rating & Information Services of India Ltd.
- 2. ICRA Investment Information and Credit Rating Agency of India Ltd.
- 3. CARE Credit Analysis and Research Ltd.

Rating symbols

AAA	Highest Safety
AA	High Safety
A	Adequate Safety
BBB	Moderate Safety
BB	Inadequate Safety
B	High Risk
C	Substantial Risk
D	In Default

+ and - signs may be used after the rating symbol to indicate comparative standing within the category.

NOTE : Certain letters may be prefixed (depending upon the rating agency) to distinguish the different instruments being rated.

Major international agencies are Standard & Poor, Moody and Duff & Phelps.

EXAMINATIONS

Audit	A management tool used to help measure performance in terms of compliance and efficiency against internal and external standards or generally accepted procedures.
Assessment	A management tool used to examine estimates of the value of a property e.g. reserves in the case of a petroleum company. Engineering evaluation or assessment is not as disciplined as auditing, the guidelines are more general and actual rules are non-existent. Evaluation is done to maximise the reasonable worth of a property through planning either for development or for sale/purchase.
Due diligence	Systematic review and verification of the information contained in oil and gas reserve evaluation reports, prospects or other documents used by one or more interested parties. A due diligence team normally consists of an engineer, geologist and accountant. Only guidelines available are those promulgated by SPE.
Inspection	To make a close examination of a product or process for compliance with quality standards. Regular inspections are part of the quality control process.
Investigation	To enquire into any matter, to assess the causes culminating into damages/losses of any kind, and to <i>prima-facie</i> fix the accountability if the losses/damages arise out of deviations from accepted procedure and practices.
Review	A critical examination of policies, procedures, practices processes, systems etc. in order to ascertain need for revision and recommend suitable modifications for improvement.
Appraisal	An examination of a project or investment based on certain criteria of merit to establish the profitability of the project or economic viability/feasibility of undertaking the business venture.

MEASUREMENT

A measurement is a comparison with a yardstick. All business activities are a constant exercise in measurement - productivity, performance, profitability, growth, competitiveness etc. in relation to the company's own past achievements and in relation to a rival's achievements. Measurement is implicit in improvement and what cannot be measured cannot be improved. Since all results cannot be quantified in the known sense of the term, different types of scales are used to suit different needs. What matters is not the absolute magnitude but the trend that the measurement will give, even if the individual readings are approximate.

Nominal	A nominal scale is a list used as a measure of identity. Serial numbers serve as labels to identify. Statistics used is elementary.
Ordinal	In this scale, the numbers reflect the relative rank order of items. Measures only what is bigger or better or more profitable but not how much bigger or better or profitable. Statistically not much can be done except to determine the median and rank coefficient.
Interval	Interval scale provides numbers which reflect difference among items, the measurement units being equal e.g. Temp, Time, IQ Scales etc. Can be subject to significant statistical analysis; calculations of mean, standard deviation, correlation coefficient.
Ratio	Highest type of scale with absolute zero as starting point e.g. measures of weight, volume, length etc. Numbers reflect ratios among items. Can be used for detailed statistical treatment.

COMPARISON

Benchmark	A figure or a level of achievement which is important with economic or psychological significance.
Target	The amount or level of work, which is aimed to be achieved within a given period.
Index	A small list of items used to represent a larger population for purposes of showing variation in prices, costs, production etc. with time. Changes are compared with an agreed base or starting level.
Milestones	Two or more intermediate targets or yardsticks that are set to monitor performance during the execution of a project or programme.
Standards	Criteria set up and established by specialist authorities/institutes as models for measurement of quantity, quality and value.
Indicators	Statistics published by official agencies showing extent of changes in economic parameters like inflation, interest rates, prices, industrial investments etc.

PRODUCTIVITY, PERFORMANCE; PROFITABILITY

Productivity/Performance can be defined as the measure of output or value added by the factor of production (i.e. a person or piece of equipment). All useful activities or work can be distinguished into two categories physical type (producing "products") and knowledge type (producing "results").

Productivity	In physical type activities (manufacturing, moving, data entry etc.) productivity can be fully measured in terms of quantity produced in a given period. The required quality is inbuilt in the process or maintained at predetermined levels.
Performance	In knowledge type work, it is the quality of output or the result that is important and not quantity. The performance is assessed on the basis of quality of the output or value added for a given quantum of work.
Profitability	A measure of the earning capacity of a venture or organisation. Earning is defined as the balance after accounting for all expenditure. Profitability concept is applicable to a project or business investment while productivity/performance is related to factors of production.
Morale	Applicable to a group. Morale is the summation of the feelings of employees as a group towards the various aspects of their jobs, the company, working conditions etc.
Motivation	Applicable to individuals and comprises all the internal urges which make the individual strive for doing things.

EFFICIENCY & EFFECTIVITY

Efficiency	Doing things in the right way; concerned with the right way of performing a task. The more output that is obtained from a given input, the more efficient the performance.
Effectivity	Doing the right things; concerned with doing the right task. The closer the extent to which the output requirements are met, the more effective the performance. However efficient a manager maybe at performing his tasks, but if the choice of tasks is not right, he is ineffective.
Capability	The ability to undertake certain programme/actions. The organisation is considered capable if the capability is used for value enhancement and wealth creation.
Capacity	The amount which can be produced or the level of work that can be carried out.

QUALITY

A measure of the grade of goodness or the extent to which a product or service meets the desired requirements at a given cost. It refers to the results of a process or activity.

Higher quality generally entails higher costs because of reduced tolerances and more exacting standards but at the same time quality control measures help to lower production costs through reduction in wastage, close monitoring and eliminating causes of unsatisfactory performance.

Since there is no absolute measure of quality, it is judged with respect to internal standards and prescriptions of the company or compared against standards published/promoted by specialist organisations/ institutes such as ISO, API etc.

Defining quality in physical type activity (e.g. in manufacturing or mining) is relatively simple; the greater the deviation from set standards, poorer the quality and smaller the deviation, higher is the quality. It is much more difficult to grade the quality of performance in knowledge type activities (e.g. preparation of a report).

HR - SEVEN STEPS TO EXCELLENCE *

Seven common and universal HR practices in the world's most admired companies

1. Mission statement and company objectives are taken very seriously by top management as reference to decision making.
2. Top management knows precisely what they are looking for in the people being employed, promoted and posted. Intense psychological testing may be done to determine suitability for a job, rank or post.
3. Career development of employees is seen as an investment and not a routine activity.
4. Promotion is done from within the company whenever possible.
5. Workforce satisfaction is regularly measured by a variety of frequent internal surveys and evaluation schemes.
6. Performance is rewarded and long term performance is valued more than short term.
7. Appropriate remuneration to attract the best people and retain them.

* From a Fortune 500 Survey.

TECHNOLOGY

Technology is the application of knowledge and experience in the production of goods & services with the objectives of improving quality, bringing cost effectiveness or to open new opportunities.

Innovation & invention are the key drivers of technological advances and these developments manifest themselves in the form of new equipment or processes and the knowledge, skill, training and resources to put them to use.

Technology and science are interrelated but distinct areas of human endeavor. Science answers the 'why' : technology deals with the "how".

The growth or expansion of an organisation requires an increase in quantity and/or quality of its productive equipment/processes. The increase in quantity is capital investment. The increase in quality is technological advancement.

IMPROVEMENT, INNOVATION, INVENTION

Improvement	Aims at making existing products, processes or methods better. It is a continuing activity that requires specific quantitative goals such as annual improvements of 3% or 5% in cost, quality, production etc.
Innovation	Making new things happen. It is the systematic use of opportunities arising from the changes in demographics and technology and recognition or finding of new ideas, methods for putting them to use. Innovation requires a certain degree of creativity and the integration of knowledge from two or more points of reference.
Invention	Thinking up new things or processes into existence. Entirely a creative activity based on assimilated knowledge and insight.

EFFECTIVE RESEARCH

1. The university concept of R&D is not appropriate for industry. In the university research may be the search for new knowledge as an end in itself. In industry, research is the search for new utility.
2. The technology-driven approach to R&D is unproductive. The business-driven approach is more effective. In the technology driven R&D, work is centered on improving technology. In the business driven method, the company first identifies business or operational goals and then initiates R&D to work out the science & technology needed for converting the goals into commercial propositions.
3. Research is separate work but not a separate and specialised function of the organisation. Research has to be closely integrated with operational activities and built on cross-functional teamwork, including finance and HR personnel.
4. Most R&D is confined to what is happening in its traditional technology. Awareness and concern with technology outside one's own field and industry is also increasingly necessary.
5. Larger outlay on R&D does not ensure greater commercial success. The key to success is effective R&D. Creating a totally new product/ process may involve only redefining or reframing a problem.
6. Research is not one effort but three: improvement, innovation and invention.
7. Development, the translation of research results into products, processes and applications, must go hand in hand with research.
8. Research requires both long range and short range results and the short term results must be steps in a continuing long term process.
9. Research goals must not be trivial but aimed high for significant improvements in operational performance and cost effectiveness.
10. Research, like everything else, has to be measured.

ISO 9000

ISO 9000 A series of international standards for quality management and quality assurance published by the International Organisation for Standardisation (ISO). The ISO system establishes principles for a company to use its organisational structure, resources and work processes in a planned manner for assuring a consistent quality in the production of goods or services. ISO 9000 first published in 1987 is applicable to a wide range of organisations and industries including the manufacturing of products and delivery of services.

A company may seek certification to a specific standard of the 9000 series depending upon the nature of its business - i.e. either ISO 9001, 9002 or 9003

A company can contract with a nationally accredited certifying agent of ISO 9000 to review for compliance with the systems. If compliance is established, the company will receive a formal certification of ISO 9000. The accredited body regularly revisits the company to ensure continued compliance.

ISO 9000 Quality management and quality assurance standards - guidelines for selection and use.

ISO 9004 Quality management & quality system elements - guidelines.

ISO 9001 Quality systems - design, development, production, installation, servicing.

ISO 9002 Quality systems - production & installation.

ISO 9003 Quality systems - final inspection and tests.

Note: Above is not the complete series. Environment dealt under ISO 14000 series.

INVENTORY MANAGEMENT : TERMS

Inventory	The detailed list of movable goods or items such as raw materials, stocks, spares, operational supplies & equipment etc. showing the quantity and value of each item.
Inventory Control	The systematic location, storage and recording of items in such a way that desired degree of service can be made to the operating units at minimum ultimate cost.
Codification	Identification & classification of equipment, spares, raw materials, components etc. to suit specific need of the organisation. Codification is necessary to prevent duplication and multiplicity of stores and mistakes which are caused by normal practice of describing the material.
Verification	Procedures for physically checking the items in stores against the records which are kept in the receipt and issue of material such as store receipt book, store issue register, bin cards, stores ledger, issue indents etc.
ABC Analysis	A method of inventory control whereby the inventory is divided into three categories (viz A,B,C) on the basis of the total value of consumption per annum. The system is based on the assumption that a small no. of items account for a disproportionately large value in terms of periodic consumption and vice-versa. Hence greater attention is paid to "A" items and routine procedures for "C" items.

ECONOMIC ORDER QUANTITY

$$Q = (2qC_1/C_2)^{1/2}$$

TC = Purchase cost + Procurement cost + Carrying cost

$$C_T = \frac{qC_3}{Q} + \frac{q}{2} C_1 + \frac{QC_2}{2}$$

- | | |
|----------------------|--------------------------------|
| Q | Economic order quantity |
| Q | annual usage or consumption |
| C₁ | Procurement cost per order |
| C₂ | annual carrying cost/unit/year |
| C₃ | purchase price/unit |
| T_C | total cost |

ENTERPRISE RESOURCE PLANNING

ERP stands for the IT system that enables the integration of various transaction based activities into one unified system. ERP by facilitating integration and data integrity is a foundation for decision making and streamlining the entire supply chain. SAP/R3 is the leader in ERP systems worldwide both on functional coverage and embedded technology. Oracle, Baan and Peoplesoft are the other significant players.

The various areas covered by ERP are :

Financial Accounting, treasury management, enterprise controlling, asset management

Logistics Production planning, materials management, maintenance, quality control, project systems, sales & distribution

Human Resources Personnel management, training and development, skills inventory

The workflow integrates the entire organisation with flexible assignment of tasks and responsibilities to locations, positions, jobs, groups or individuals. Every employee is integrated in the "value chain" by providing a versatile inbox at his or her workplace which can be configured individually.

The monitoring requirement of the senior management is addressed by the Executive Information System.

Information is stored in a summarised format in a large data warehouse and can either be updated online from the transaction system or can be updated periodically.

The goal in ERP is that the company uses one software package with a number of integrated modules rather than multiple, conflicting systems, each with its own language and data formats e.g. a user in materials management could see the same data on his or her screen as a colleague in finance or production. Data is entered only once for the entire enterprise instead of continuously recapturing and reentering.

For ERP to be successful many changes need to be made in the organisation. Processes need to be changed and rewards and incentives rethought, to induce new behaviours aligned with the new processes and underlying technologies. Typically most ERP projects wander off course due to lack of effective leadership and accountability.

INTELLECTUAL PROPERTY

Patent	An official document showing that a person/company has exclusive rights to make and sell an invention. This is registered with the patent office and others are prevented from making the identical product/process.
Trademark	A name or design which has been registered by the manufacturer/service provider and which others cannot use.
Brand	Make of a product which can be recognised by its name or its design and which gives the company competitive advantage.
Copyright	A legal right which a writer/publisher has to publish a work and not have it copied for a specified no. of years.
Logo	Symbol or design or group of letters used by a company as a mark on its products and in advertising. Unlike a trademark, this is not registered.
Goodwill	Name given to the valuable personal relationships that are established between an organisation and its customers.

BUSINESS RIGHTS

License	Official document or authorization which permits a group or individual to do something e.g. to carry out exploration.
Lease	Written contract for letting or renting of a property or equipment for a defined period against payment of a fee.
Lien	the legal right to take or keep possession of goods or property until owner has settled a debt or fulfilled a contract.
Franchise	Permission or right to trade using a brand name in a specified geographical area against payment of royalty.
Charter	Hire or rent equipment for a special purpose at agreed rates.
Tenancy	Agreement to occupy a property for a fixed period.
Concession	a defined area granted to a company for extraction of minerals under specified terms & conditions and for a fixed period.

PRINCIPLES OF BRAINSTORMING

Brainstorming is a technique for facilitating generation of various alternatives for problem solving. It is a means of getting a large number of ideas from a group of people in a short time. To be successful, a brainstorming should follow certain principles and basic rules.

- 1. Problem** must be specifically and clearly spelt out. The success of the session would depend on how the problem is defined.
- 2. Suspend Judgment** no idea should be treated as silly or impracticable. A brainstorming session is a forum for expressing not evaluation.
- 3. Quantity** quantity should be encouraged. The session should be free, frank and relaxed to generate as many ideas as possible.
- 4. No limitation** limitations or restrictions, financial, procedural, organisational etc. should not be imposed.
- 5. Free wheeling** this means letting go of barriers or inhibitions and allow oneself to dream and drift around the problem.
- 6. Cross-Fertilisation** ideas must be allowed cross-fertilisation which is why it is advisable to have a group session instead of individual sessions
- 7. Group Formation** the ideal number of people for a brainstorming is about 12, taking into account group dynamics.
- 8. Level of Participants** it is advisable that the boss not be present. Presence of senior management brings in hesitation and restricts free flow of ideas.
- 9. Record** All the ideas generated should be faithfully recorded & serially numbered.
- 10. Evaluation** this is left to the end of the session when the participants are asked to select the best few that are considered useful and worth further examination.

BARRIERS TO THINKING

Thinking is the process of moving from one idea to another or changing an unfamiliar situation to a familiar one so as to enable us to deal with it.

Thinking is one of those very common terms which are taken for granted, but seldom practiced.

Without an ability to think, there can be no creativity or innovation or fruitful analysis or even decision making.

There are a number of barriers to the thought process, an understanding of which improves thinking.

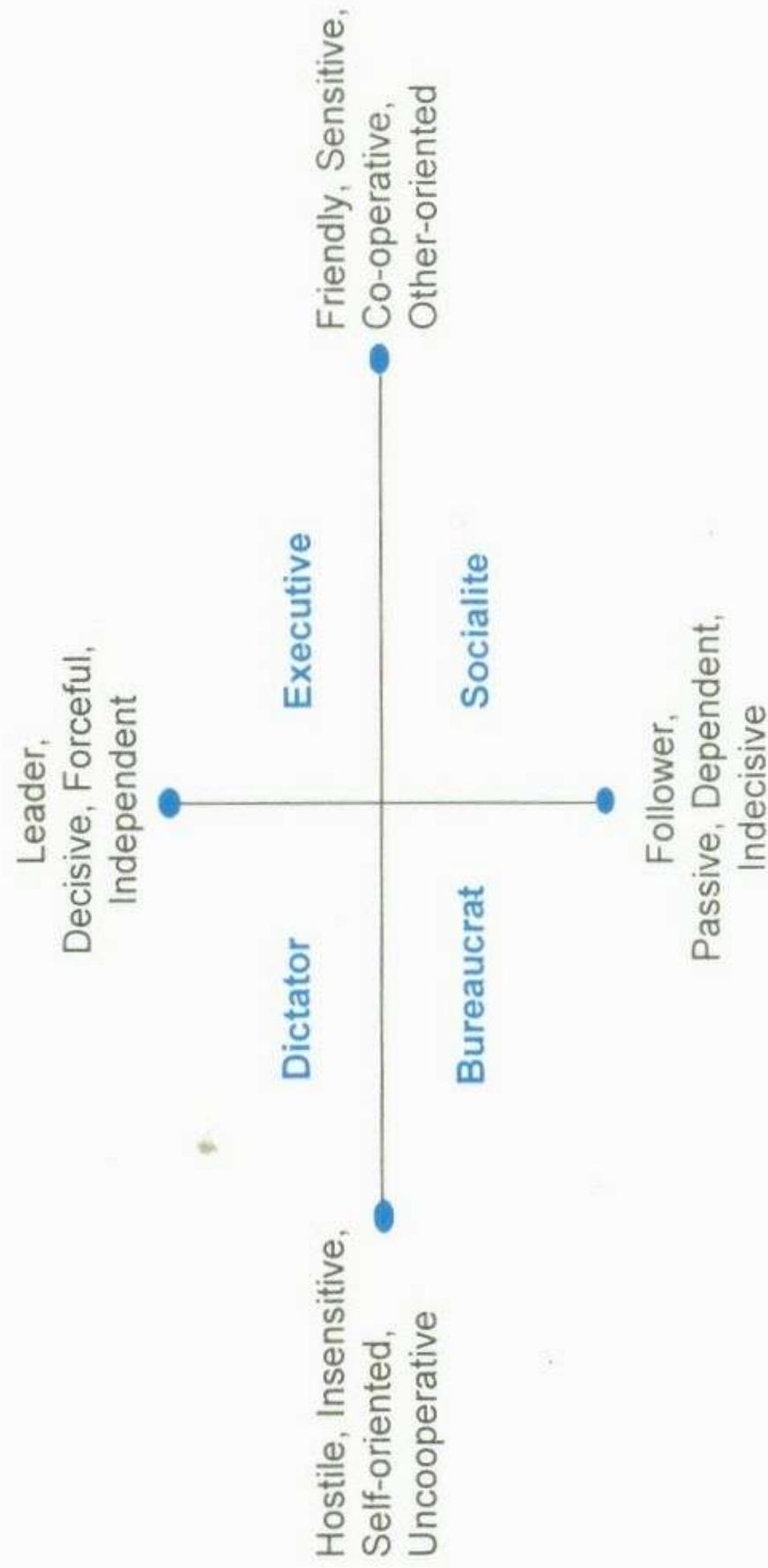
- | | |
|-------------------------|--|
| 1. Conditioning | we are conditioned to see things in a certain way, based on background, values, preferences and prejudices. |
| 2. Conformity | trying to view things in the expected way and to accept what has hitherto been accepted, i.e. ideas and patterns that have already been established. |
| 3. Correlation | thinking involves the ability to connect apparently unrelated pieces of data or information to generate an idea. This ability obviously comes from knowledge and experience as data and information have first to be known before they can be connected up. |
| 4. Instinctual Response | this is a fixed reaction so that a particular situation elicits a particular response. The number of such inbuilt responses are limited, hence there is no means of coping with new or unfamiliar situations for which ready made responses are not available. |

RECOGNISING A LEADER

All goal oriented organised activities require leaders, whether it is a small team or a large organisation. In the minds of most people, leadership has come to be associated with charisma. Management experts like Peter Drucker and Tom Peters, however consider performance rather than charisma to be the essence of leadership. In their view, based on studies of hundreds of successful companies and historical figures, a leader in the true sense has the following basic characteristics or traits.

1. Intelligence, Imagination & Integrity these qualities impart in the leader an ability to think matters clearly, define goals and establish priorities and a willingness to act on intuition.
2. Capability & Capacity a leader knows his job; puts in greater effort than his subordinates; has a reputation for competence rather than “resourcefulness”.
3. Responsibility & Simplicity leadership is seen as a responsibility rather than a position conferring rank & perks. Authority is seldom flaunted and he is comfortable without special privileges; much more concerned/focused on achieving results and solving problems; inward oriented individual who does not seek the limelight.
4. Trust able to earn trust; to trust a leader, it is not necessary to like him or even to agree with him. Trust is the conviction that a person means what he says and his actions and words are compatible and consistent.
5. Urgency strong sense of urgency to get things done or moving into action as quickly as possible, often misunderstood as “impatience”.

PRIMARY PERSONALITY TRAITS



AUTHORITY, ACCOUNTABILITY, AUTONOMY

Authority	is the right to exercise certain powers vested in the person by virtue of his position. Authority can be delegated downwards i.e. from a boss to his subordinates.
Accountability	responsibility or obligation to do something or get something done so that desired results are achieved. Accountability cannot be delegated.
Autonomy	the freedom to act independently within the limits of delegated authority so as to achieve the desired results.

Authority and Accountability are like the bow & arrow, hammer & anvil, man & woman - each becoming dysfunctional without the other. Authority that is not held accountable or imposing accountability without the necessary authority leads to bad decisions, wastage, poor performance and misutilisation of the company's resources.

TEN PRACTICES OF EFFECTIVE DELEGATION

1. Responsibilities be clearly defined and communicated.
2. Responsibility be coupled with corresponding authority.
3. Creation of accountability for carrying out the assigned duties.
4. No employee be subject to definite orders from more than one source.
5. A group of activities that share a common objective should also be managed ultimately by one person.
6. Promotions, rewards, disciplinary actions always be approved by the direct superior of the affected employee.
7. Employees whose work is subject to regular inspection be given facilities to maintain an independent quality control system.
8. Performance measurement be done against laid down criteria and schedules.
9. Open line of communication between superior and subordinate.
10. Honesty and transparency in the relationship.

ORGANISATIONAL RELATIONSHIPS

Parent Company	Corporation or other business enterprise that owns controlling interest in one or more subsidiary companies. Engages directly in activities of the subsidiaries.
Holding Company	Controls other companies through stock ownership but does not engage directly in their productive operations. Main purpose is to exercise financial control.
Subsidiary Company	A company whose controlling interest (i.e. more than 50%) is owned by a parent/holding company.
Joint Venture	A business enterprise where two or more companies enter a temporary partnership in a project. A joint venture can be incorporated or unincorporated.

BUSINESS RELATIONSHIPS

MOU	Memorandum of Understanding. It is a freely negotiated document between two parties specifying the intentions, obligations and mutual responsibilities of both parties. An MOU is not enforceable by law.
Contract	An agreement between two or more parties to create legal obligations between them. Most contracts are made in writing. The essential elements of a contract are that an offer made by one party is accepted by the other and consideration or payment of money is involved. The terms of contract are expressed in the document or implied. A breach by one party entitles the other party to sue for damages.
Agreement	An understanding between two or more parties which explains how they will act. Can be in written or verbal form.
Accord	A settlement or agreement in harmony.

Note : Forming a business relationship involves bargaining i.e. settlement on the price of the transaction and/or negotiation i.e. formal discussion and settlement of terms and conditions of the relationship.

TYPES OF FORMAL ORGANISATIONS

Company	An entity incorporated, under the Companies Act, by a group of people or promoters for transacting a business.
Conglomerate	A business organisation consisting of a holding company and a group of subsidiary companies, each of which may produce a separate and dissimilar range of products and services.
Corporation	A statutory body incorporated under a Parliament Act or by issue of a charter to run a state-owned business.
Cooperative	A body incorporated under Cooperatives Act, with the motive of utilisation of the produce by the members. The workers are also the owners and share the profits.
Society	A body incorporated under the Societies Act, for transacting a business on non-profit basis.
Task Force	A temporary group of persons who come together for achieving the defined objectives within a stipulated time.
Think Tank	A group of experts who advise or put forward plans for a larger body or organisation.
Committee	An official or formal group of people, which meets to discuss problems or projects within its area of assigned responsibility, in order to arrive at recommendations or decisions. The use of a committee combines the experience and judgement of several persons rather than a single individual in reaching decisions. Usually of a permanent nature.
Working Group	A special group of people constituted to work out modalities and suggest measures for addressal of objectives within a time frame.
Consortium	An association formed by two or more companies agreeing to pool their resources in order to undertake a particular large scale and costly project.

TYPES OF PAYMENTS & EARNINGS

Bonus	An extra payment made in addition to normal payment as an incentive and linked to productivity.
Incentive	An extra payment offered as an encouragement to meet targets or objectives.
Wages	Refers usually to weekly or hourly pay, for work done, to workers who are taken on a temporary basis. Payment most often in cash.
Salaries	Payment for work made to regular employees, usually in the form of a monthly cheque.
Emoluments	Pay, salary or fees or the earnings of a director of a company who is not an employee.
Remuneration	Generally used for total monthly earnings of an employee.
Gratuity	a gift of money or donation which is separate from and in addition to the payment made for a service rendered e.g. a tip.
Ex-gratia	Payment made as a favour or goodwill gesture and not the result of any legal obligation or contract.
Honorarium	Money paid to a professional person in lieu of a fee.
Commission	Money paid to a salesman or agent as a percentage of sales.
Fee	Money paid for work carried out by a professional person e.g. accountant, doctor, lawyer, consultant etc.
Dividend	Part of the net profits of a company distributed to share holders
Interest	Income earned on savings, fixed deposits & debentures. It is payment for delayed gratification.
Profit	Earnings that result from a business after accounting for all expenses. It is a payment for risk taking and entrepreneurship.
Rent	Payment received for permitting the use of a property.
Price	The value received from the sale of an asset, property or share.

APPROPRIATIONS : VARIOUS TERMS

Tax	Money which an individual or organisation is required to pay to the Govt. as a contribution to the financing of public expenditure. Direct tax is assessed on the payer's income or profit. Indirect tax is paid as part of price when a product or service is purchased.
Tariff	a duty paid for importing/exporting goods. (Also rate of charging for electricity, gas, hotel rooms, train tickets etc.).
Customs	same as import tariff.
Excise	a levy on certain goods produced within the country.
Sales Tax	a tax paid on each item sold.
Toll	a fixed compensation payable for the privilege to use a service usually a bridge or road or telephone service.
Cess	an appropriation made by an official body on production or sales of certain goods and used for development of the industry.
Royalty	a fee or a share of proceeds paid for the right to produce/use a product/property/service following a lease, license or franchise.
Levy	an imposition by an authority in the form of a tax or fine.
Duty	amount which is payable by natural, legal or moral obligation.
Octroi	a charge imposed on goods brought into a municipality.

Note : The terms tax, levy, duty are often used interchangeably.

TERMS RELATED TO SHARES

Book Value	Net Worth/No. of Shares.
Face Value	Value written on the share certificate.
Premium	Extra charge for new shares i.e. the amount by which market price is higher than face value.
Capital Gain	The earnings from selling the share at a price higher than purchase price. Long term gain (share held for more than a year) are taxed at a lower rate than short term gain (share held for less than one year).
EPS	Profit After Tax/No. of Shares.
P/E Ratio	Market Price of Shares/EPS.
Dividend	Portion of profits paid to shareholders calculated as a percentage of the face value of the share.
Cover	EPS/Dividend Per Share.
Yield	Dividend Per Share/Market Price of Share.
Volatility	The difference between highest price and lowest price as a percentage of lowest price in a given period.
Volume	Total number of transactions of the share in a period.
Bull Market	A buyers market in anticipation of a rise in price of the share.
Bear Market	A sellers market in anticipation of a fall in price of the share.
Rights Issue	An issue of new shares which existing shareholders may buy (usually at a discount) in proportion to current holding.
Bonus Issue	Extra shares issued free of charge to existing shareholders in proportion to the size of their current holding.
Total Yield	(Dividends + Price Appreciation + Bonus + Rights)/ Total Cost.

TEN PRINCIPLES TO TAKE NOTE OF *

- 1. Parkinson's Law**
Work expands to fill the time available for its completion.
- 2. Peter's Principle**
In a hierarchy, every man tends to rise to his level of incompetence.
- 3. Murphy's Law**
In commercial life, if something can go wrong, it will.
- 4. Pareto's Law**
In any system or organisation, a small percentage of the total is responsible for a larger proportion of the value. Also called the 80/20 Rule as 80/20 seems to be the normal ratio between majority and minority figures.
- 5. Gresham's Law**
If a series of decisions are to be made, those that are more routine and repetitive will tend to be made before the ones that are unique and require considerable thought i.e. routine decisions overshadow policy decisions.
- 6. Law of Unanticipated Consequences**
Actions of people/organisations/governments always have effects that are unanticipated or unintended.
- 7. Groupthink Principle**
Groups make riskier decisions than individuals and groups tend to make consensus decisions rather than decisions based on realistic appraisal of alternative courses of action.
- 8. Self Interest Principle**
Humans often tend to take decisions that will enhance or keep their own position secure rather than on the basis of what is best for the organisation.
- 9. Conditioning Principle**
Basic belief systems have a tremendous affect upon how individuals approach a problem and their ability to solve or to take decisions regarding solutions. Also humans tend to deal with problems at face value than looking beyond the more obvious aspects of the problem.
- 10. Distortion Principle**
Human beings carry an ability to receive, interpret and emotionally distort every message they receive.

* Enunciations of management/human behavior experts based on experience and observations.

BARREL OIL EQUIVALENTS

<u>PRODUCT</u>	<u>boe/ ton</u>
LPG	11.60
NGL	10.40
Natural Gasoline	10.00
Aviation Gasoline	8.90
Motor Gasoline	8.50
Naphtha	8.50
LDF	8.36
SBP	8.34
ATF	8.00
Paraffin Wax	7.87
Petroleum	7.87
Kerosene	7.75
Diesel Oils	7.40
Crude Oil	7.35
Paraffin Oil	7.14
Lubricants	7.00
Refinery Fuels/ RFO	6.65
Greases	6.30
Water	6.29
Asphalt	6.06
Bitumin	5.90
Petroleum Coke	5.50
Bituminous Coal	4.52
Natural Gas (1000 m3)	6.00

BRITISH THERMAL UNIT EQUIVALENTS

<u>PRODUCT</u>	<u>MMBtu</u>
1 Ton Coal (Bitumin)	26.20
1 Ton Crude Oil	42.63
1 Mm3 Natural Gas	36.39
1 Cord Wood	20.15
1 Btu	1.050 KJ 0.252 KC 0.293 Wh 77.82×10^3 ft-lb

1 British Thermal Unit (Btu) is the heat energy required to raise the temperature of one lb of water by 1°F .

1 KWh is the energy available from 1000 watts for one hour = 3412 Btu.

Calorific Value Calorific value of a fuel is the quantity of heat released on combustion usually in Btu/lb or Kcal/Ton for solid fuels or Btu/ ft^3 or Kcal/ m^3 for gases. Values may be on gross or net basis, the technical difference being that gross values assume that water formed during combustion is liquified while the net values assume that the water stays in vapour phase.

COMMONLY USED OIL FIELD ABBREVIATIONS

bbl	Barrel; a term most generally used to denote a unit volume of crude oil or petroleum products.
boe	Barrel oil equivalent (energy equivalence).
btu	British thermal unit; unit of energy measurement.
mcf	Thousand cubic feet, generally used for measurement of gas volumes.
mmcmd	Million cubic metres per day, generally used for measurement of gas flow rates.
f.o.b.	free on board, i.e. the price or cost at the point of loading.
c.i.f.	cost, insurance & freight i.e. the cost at the point of unloading.
psi	Pounds per sq. inch; a measure of pressure.
CAPEX	Capital Expenditure.
OPEX	Operating Expenses.
FOREX	Foreign Exchange.
bu	Billion units; where one unit = 1 kwh, a unit of power.
Kcal/m3	Kilocalories per cubic metre; calorific value.
n.t.p.	Normal temp and pressure 0° C and 14.7 psi.
s.t.p.	Standard temp and pressure 15° C and 14.7 psi.
° API	Degree API used for liquids with specific gravity lower than water.
s.g.	Specific gravity quoted at 60°/60° F; ratio of density of liquid to density of water or density of gas to density of air.

COMMONLY USED OIL FIELD CONVERSIONS

1 atmosphere = 34 feet water = 30" Hg = 14.7 psi = 1.03 kg/cm² = 10⁵ pascals

1 Kg/cm² = 10 m water = 14.22 psi 1 bar = 14.5 psi

1 m³ = 6.29 bbls = 35.3 cu. ft.

1 bbl = 159 litres = 5.61 cu ft = 42 gallons

1 lb = 453.6 gm

1 carat = 0.2 gm

1 hp = 746 watts

1 Kcal = 4.19 KJ

1 KWh = 860 Kcal

1% salt concentration = 10,000 ppm = 10 gm/litre

1 acre = 0.4 hectares 1 hectare = 2.47 acres

1 acre-foot = 7758 bbls

Temperature Equivalence :

$$\frac{^{\circ}\text{F} - 32}{9} = \frac{^{\circ}\text{C}}{5} = \frac{^{\circ}\text{R}}{4} = \frac{\text{K}-275}{5}$$

$$^{\circ}\text{R} = ^{\circ}\text{F} + 460$$

$$\text{K} = ^{\circ}\text{C} + 273.16$$

$$^{\circ}\text{API} = (141.5/\text{SG}) - 131.5$$

COMPUTER : COMMON TERMS

Data Storage	<p>Data is stored in computers as binary digits or bits, eight bits is called a byte; thousand bytes is a kilobyte (KB); a million bytes is megabyte (MB) and a billion bytes is a giga byte (GB).</p> <p>Data can be stored in floppy discs, hard discs or CDs and DVDs. Floppy discs are small and portable magnetic discs on which data can be written or read from. They are enclosed in a protective jacket and have limited storage capacity. Common are the 3.5 inch discs with 1.44 MB of memory. Hard disc is a fixed or removable disc enclosed in its drive mechanism. Greater read/ write speed and capacity than a floppy. Compact Disc is an optical disc read by a laser. The information stored is permanent and cannot be changed or erased, hence called Read Only Memory (ROM). Typically a CD-ROM can store about 600 MB data and read by using the CD drive in the computer. A variation is the CD-Writer. Along with the read facility, this drive enables recording on specially made CDs. The DVD (Digital Video Disc) is a double layered optical disc with capacity typically about 10 times that of a normal CD.</p>
PC	<p>A personal use computer small enough to fit on the users desk; generally includes a monitor, CPU, input devices like keyboard, mouse and storage devices like hard disk and floppy drives etc. In comparison a mainframe computer is designed for processing very large volume of data at very high speeds and is usually shared by multiple users.</p>
Server	<p>A server is a computer that provides services to other computers (clients) in a network. A server links computers together to allow them to share software, files, applications and access to devices such as printers, modems etc.</p>
Modem	<p>Modulator-Demodulator equipment for connecting a computer to a telecommunication line, enabling transfer of data from one place to another by changing the analogue signal to digital and vice-versa.</p>

COMPUTER : COMMON TERMS

Network	A grouping of computers with ability to communicate with each other. A local area network connected through direct lines is known as LAN, while a network over a much larger geographic area connected through telecommunication lines is known as a WAN (wide area network). A network which is within a particular organisation is called an Intranet.
Protocol	The program that defines the operating rules and procedures on how computers will act when communicating with each other. Standard protocols allow computers from different manufacturers to communicate; the computers may use different softwares, provided that the programmes running on both ends agree on what the data means.
Operating System	Operating system is the basic software controlling a computer. It coordinates and manipulates computer hardware, organises files in storage, limits hardware errors and the loss of data. When the computer is turned on, the operating system gets loaded automatically.
Multimedia	A system which integrates text, graphics, animation, sound and full motion video through a computer. The multimedia can also be used in an interactive manner.
Hypertext	It is a system for presenting information in which computer text, images etc. are linked together in a complex, non-sequential manner that permit the user to browse through related topics, regardless of their presented order.
E-mail	Strictly speaking e-mail encompasses all electronic transmission of data, but typically the term 'e-mail' is used to denote the transfer of data/ graphics from a sender to recipients in a network, using computers.
Virus	A self copying computer programme that interferes with hardware, data files and operating system and designed to avoid detection.

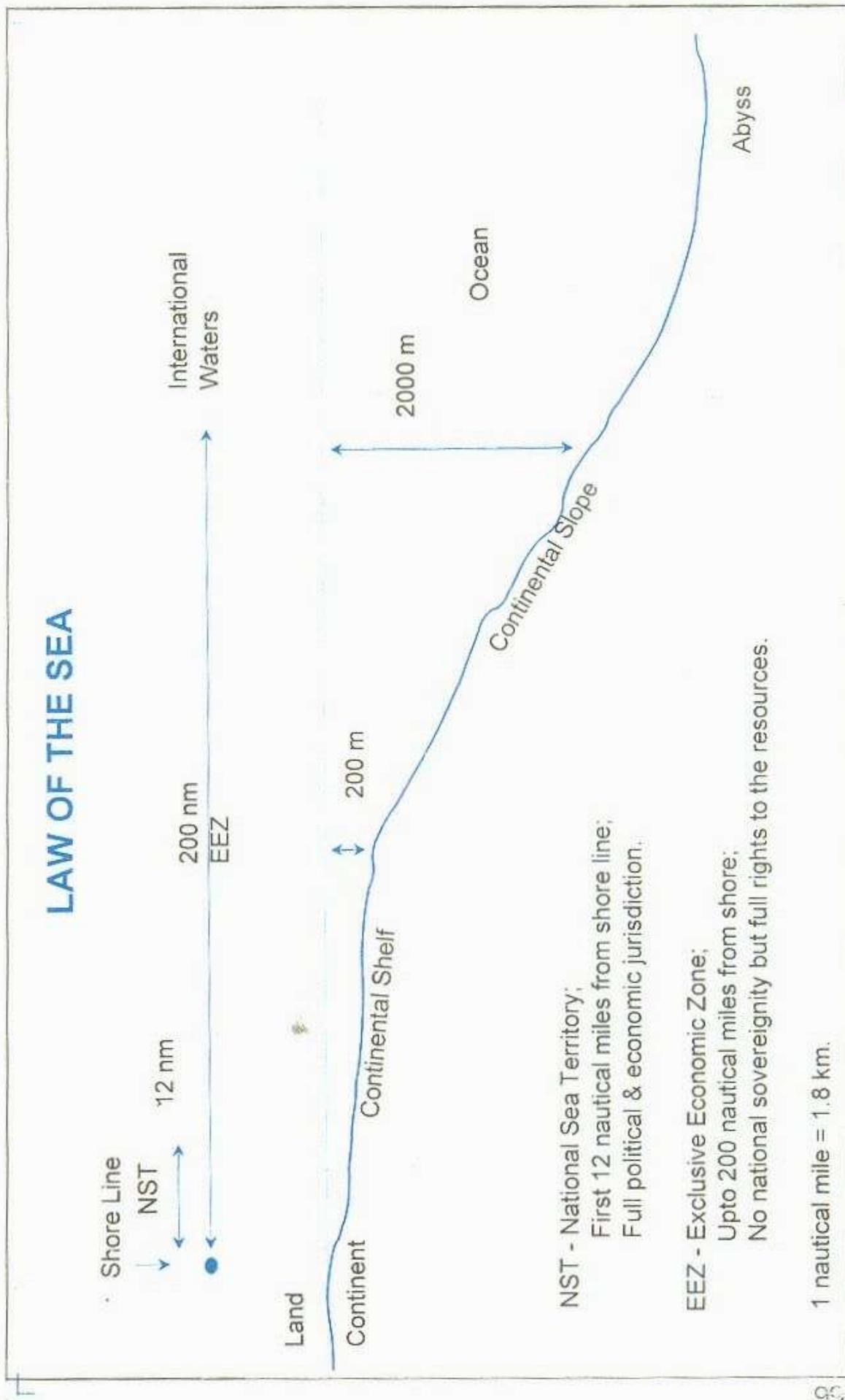
INTRODUCTION TO THE INTERNET

Internet	Internet is a loosely configured rapidly growing web of heterogeneous networks including corporate, educational, research computer networks around the world. Internet (and e-mail) evolved from an R&D communications network project viz. Advance Research Project Agency Network (ARPAnet) of the US Defence Department in 1969. This was an experimental network enabling researchers at Universities and other facilities in the US to electronically transfer data to each other and remotely run computers.
	Three main factors govern Internet. First, it allows a variety of dissimilar computers and networks to communicate with one another. Second is decentralisation, as no single organisation owns, manages or regulates the Internet. And the third, philosophy- it is a society with its own convictions. One important philosophy is that resources should be shared.
IP	The Internet Protocol is the most important of the protocols on which Internet is based. It allows a packet (a bundle of data) to traverse multiple networks on way to its final destination.
Website	The location on a server connected to the Internet, where information of any organisation or individual is available (free or paid). The Website has an address by which any person can visit to view, download or interact with the information.
Service Provider	A business that provides connection to the Internet.
Leased Line	A dedicated as opposed to dial up telecommunication line used to link a local user with a service provider.
Account	It is a record keeping arrangement in a network for each authorised user for identification, administration and security purpose. The account holder can gain access only after using the assigned login and password information.
User Name	An address that designates a personal account on a large computer.

INTRODUCTION TO THE INTERNET

Domain	Domain is the hierarchical structuring used in E-mail addresses.
Address	An individualised sequence of alphanumeric characters that identify a particular user/ computer/ Website on a network. The address has a user identity (ID) and the machine address that consists of a series of concentric domains. The user ID and the machine address are separated by the symbol “@”. Ex.: cpd@delhi.ongc.co.in In this address “cpd” is the user identity located in “delhi” in the sub-domain of “ongc” which is the network through which Internet has to route messages; “co” is for company and “in” is the top level domain indicating the country India.
	In USA, the top level domains include com - commercial organisation; edu - educational; gov - government; mil - military; net - networking; org - other organisations
Gateway	The hardware and software that connect computer networks that use different protocols or that transfer data between two incompatible applications on a network. The gateway reformats data so that it is acceptable to the receiving network or application.
Host	A central network computer system accessible by other computers on the network.
Telnet	The Internet formalities that allow remote login to distant computers. Also the name of the program implementing the protocol.
WWW	World Wide Web is a collection of files, called Websites or Web pages distributed all over the world. The WWW can be accessed by a computer connected to the Internet by programmes called browsers.
Surfing	To explore the Internet, especially the WWW, also called browsing or cruising. Involves moving from one website to another by using the links in the site.

LAW OF THE SEA



NST - National Sea Territory;
First 12 nautical miles from shore line;
Full political & economic jurisdiction.

EEZ - Exclusive Economic Zone;
Upto 200 nautical miles from shore;
No national sovereignty but full rights to the resources.

1 nautical mile = 1.8 km.

OFFSHORE UNITS & INSTALLATIONS

- A. MODU** Mobile Offshore Drilling Unit; integrated unit carrying a complete rig with all necessary auxiliaries, stores and accommodation; can be towed or sailed from one drilling site to another. The main categories of MODUs are bottom supported (submersibles and jack-ups) and floating (ships and semi-submersibles). The oldest mobile unit is the submersible which is essentially a barge sunk to bottom of shallow waters. The most popular offshore drilling unit is the jack-up which can operate in shallow to medium water depths. Jack-ups are used in water depths upto 100 m. Anchored or moored semi-submersibles and ships can operate in depths upto 1000 m. Dynamically positioned vessels are independent of water depth.
- B. Production Platforms**
- i. Steel Jacket Most common type of production platform is the jacket platform consisting of a steel structure which is piled into the seabed and platform decks on top of the jacket. The necessary equipment is placed on the decks; well heads, manifolds, separators, pumps, compressors, water treatment, accommodation etc.
 - ii. Gravity Structure A concrete platform or gravity structure which because of its immense weight and large base remains stable on seafloor without piling.
 - iii. Guyed Tower Bottom-hinged or compliant platform whose vertical stability is derived from guys (side mooring system).
 - iv. TLP Tension Leg Platform is a floating platform allowing the use of conventional well completion technique and surface wellheads. Heave motion is fully suppressed by a vertical anchoring system.
 - v. FPSO Floating Production, Storage and Offloading vessels are increasingly popular units which combine storage function with production. In water depths greater than 300 m, subsea production systems tied to floaters have become the standard.
- C. Specialised Vessels** To build, install and maintain offshore structures and pipelines, many specialised ships, cranes and others units have been developed. Most important are the pipelay barges and crane ships. The smaller vessels include supply boats, tugs, crew boats, diving support ships, etc.

Note : All MODU, Production Platforms and the large specialised vessels are provided with helicopter landing facilities.