Petroleum and Mining Engineering College

Department of Petroleum Reservoir Engineering

Third stage

Petroleum Product Engineering

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10:30 Am

Completion Design Consideration

Production technology contributes substantially as one of the major technical functions within an operating company and in particular, to its economic performance and cashflow. As with any commercial venture, the overall incentive will be to maximize profitability and it is in this context that the operations for which the production technologist is responsible, are at the sharp end of project economics. The objectives of an oil company operation could be broadly classified, with respect to two complimentary business drivers, namely:

(a) Maximizing the magnitude of and accelerating cash flow

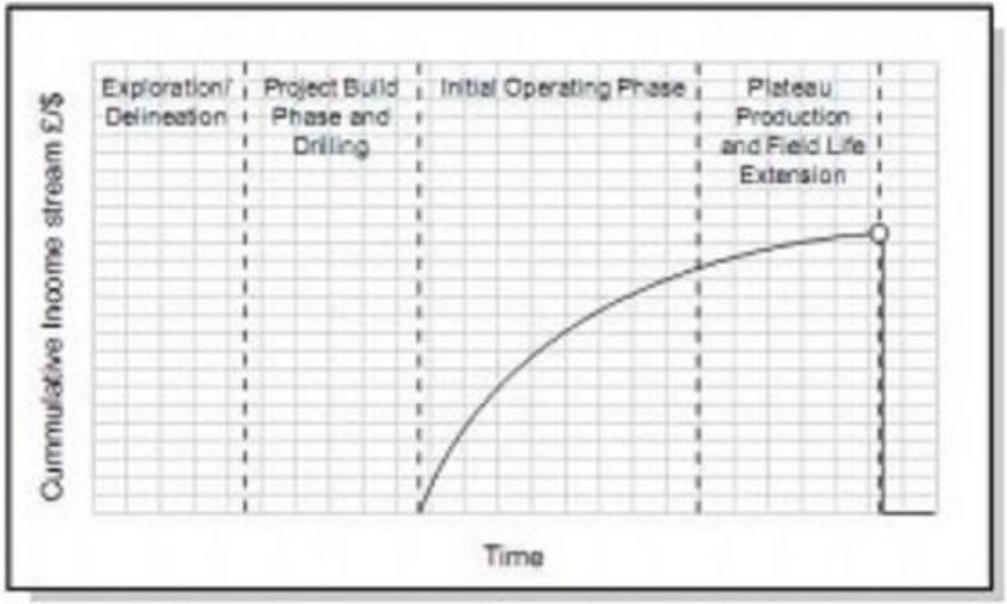
(b) Cost minimization in terms of cost/bbl.

Total cost minimization may not be recommended.

1- Cashflow: The overall objectives would ideally be to maximize both cashflow and recoverable reserves. This would normally require maintaining the well in an operational state to achieve

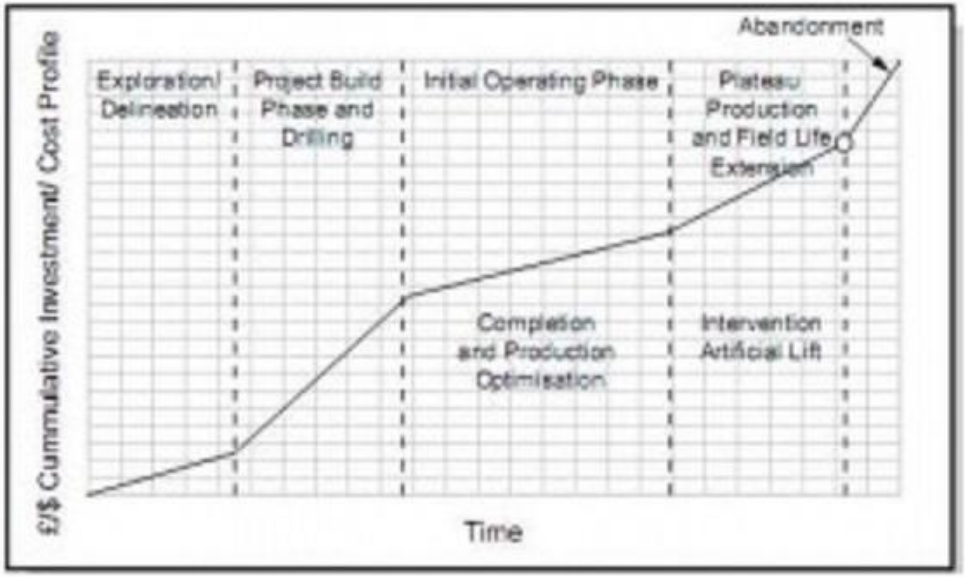
- maximum production rates
- maximum economic longevity
- minimum down time

This is shown in Figures bellow:



2- Cost: In this category there would be both fixed and direct costs, the fixed costs being those associated by conducting the operation and the direct or variable costs being associated with the level of production and the nature of the operating problems. The latter costs are therefore defined in terms of cost per barrel of oil produced. On this basis the production technologist would seek to:
    - Minimize capital costs
    - Minimize production costs
    - Minimize treatment costs
    - Minimize workover costs

From the above, the bulk of the operations for which the production technologist is responsible or has major inputs to, are at the sharp end of ensuring that the company's operations are safe, efficient and profitable. There for before a production well is drilled, a great deal of planning must be undertaken to ensure that the design of the completion is the best possible. A number of factors must be taken into account during this planning stage, which can broadly be split into the objective of well drilling, reservoir considerations and mechanical considerations.



Reservoir considerations

- Natural rock reservoir

  The geological and experimental studies that conduct to delineate the nature of rock reservoir (type of rock, including fault, reservoir permeability, etc…) is important to select the adequate completion design.

- Producing rate

  To provide maximum economic recovery is often the starting point for well completion design. Among other factors producing rate should determine the size of the producing conduit.

- Multiple reservoirs

  Multiple reservoirs penetrated by a well pose the problem of multiple completions in one drilled hole. Possibilities include multiple completions inside casing separated by packers, or several strings of smaller casing cemented in one borehole to provide in effect separate wells. Other possibilities include commingling of hydrocarbons from separate reservoir downhole, or drilling several boreholes from one surface location.

- Reservoir drive mechanism

  Reservoir drive mechanism may determine whether or not the completion interval will have to be adjusted as gas-oil or water-oil contacts move. A water drive situation may indicate water production problems. Dissolved gas and gas drive reservoirs usually mean declining productivity index and increasing gas-oil ratio.

- Secondary recovery requirements

  Secondary recovery needs may require a completion method conductive to selective injection or production. Water flooding may increase volumes of fluid to be handled. High temperature recovery processes may require special casing and casing cementing materials.

- Stimulation

  Stimulation may require special perforating patterns to permit zone isolation, perhaps adaptability to high injection rates, and a well hookup such that after the treatment the zone can be returned to production without contact with killing fluids.

- Sand control

Sand control problems alone may dictate the type of completion method and maximum production rates. On the other hand, reservoir fluid control problems may dictate that a less than desirable type of sand control be used.

- Artificial lift

  Artificial lift may mean single completions even where multiple zones exist.

- Workover requirements

  Workover frequencies, probably high where several reservoirs must be drained through one wellbore, often dictate a completion conducive to wireline or through-tubing type recompletion systems.