Oil & Gas Industry: Trends, Technology and Career

By

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Outline

• Global Energy Consumption & Growth
• Energy Mix and Trend
• The E&P Chain & Challenges – From Exploration Drilling to Field Development
• Technology and Trend that impacts E&P
• Oil Field Career
Global Energy Consumption & Growth

- Global oil and gas industry is a primary source of energy
- Global population was 1.6 billion in 1900, 2.5 billion by 1950 and > 7 billion today
- GDP multiplied by 40 over the period
- Energy consumption impacts growth and has increased by 13 over the period.
- World energy mix is a trade-off between multiple sources: Coal, Fossil, Hydro, Nuclear and renewables e.g. wind, geothermal, and Solar etc.

*Human development is closely linked to energy consumption or revolution.*
Global Energy Mix

- Fossil resources is an economic and efficient energy sources. Oil can be transported by such means as barges, oil pipelines, trains or trucks as adequate. Natural gas may require compression to boost its entry pressure. LNG makes transportation of gas more flexible.
- Energy is required for heating, about half of global demand, transportation – about 1/3 of global demand, and about 15% demand is for electricity.

**Oil and natural gas energies are dominant in the global energy mix today**
The Energy Trend

- Over 50 years of fossil resources to meet demand based on current consumption and proven oil resources
- North America’s unconventional resources (aka. shale oil plays) is a game changer
- Venezuela and Canada lead in heavy oil resources with proven oil reserves that rank 1st and 3rd globally.
- Middle East holds about half of the world ‘s proven oil reserves and 43% of the global natural gas reserves
- Sub-Saharan Africa remains prolific in the deep waters with almost 30% of the global oil & gas discoveries during the last 5 years,
- Recent hydrocarbon discoveries have been made in frontier basins, East and Southern Africa and Brazil with discovery of ultra-deep offshore pre-salt reservoirs,
- Production not reserves drives world economy (US with 2.6% of the world’s reserves)

As the oil price goes up, more resources become profitable to extract from the ground and are added to the global proven reserves.
The E&P Chain

- The global oil and gas industry comprises of three major sectors: upstream, midstream and downstream.
- Upstream: the exploration & production of natural resources,
- Midstream: the treatment, transportation and distribution of energy molecules
- Downstream: the transformation of extracted natural resources into petroleum products and their distribution to the final consumers.

- The upstream has two main actors: the Operating and Service companies
- Major operators are EXXON MOBIL, SHELL, CHEVRON, TOTAL, ENI and BP
- Major Service vendors are Schlumberger, Halliburton, Weatherford, Transocean, Saipem and Baker Hughes etc.
Challenges in the Upstream Oil Industry

- Significant increase of E&P investment made in the last decade
- High focus on quality, safety and processes to improve efficiencies, optimization & delivery
- Consequently E&P cost had risen by over 60% in last 5 years
- Companies adopt technology based on how they are structured to take advantage of challenges in the ever-changing competitive environment

The goal of E&P companies is to maximize the oil rent, which is the difference between crude oil price and the exploitation cost
Exploration Challenges

- Geologist are looking for a petroleum system that includes all the parameters required for hydrocarbon accumulations to exist.
  - These are a source rock (such as thin sediments or shales), a reservoir rock (such as carbonates or sandstones) and a seal rock (such as salt or shales) and are characterized by dynamic processes due to fluid movement.
- Gulf of Mexico and the Atlantic margins like Offshore Brazil and West Africa are the most prolific deep offshore areas (1 – 3 km water depth).
- Frontier basins such as the Arctic and ultra deep water are recent areas for exploration and require innovative techniques because of the difficulties of accessibility and climatic conditions. Deep water has high drilling risks and associated costs.

Probability of success - 60% (mature basins), about 10% (Frontier basins) between 20 – 30% (Existing deep offshore margins)
Potential reservoirs are called prospect until properly and more accurately investigated and checked by the geologist for the presence of hydrocarbons using seismic imaging and well drilling.

Geophysicist perform seismic acquisition, processing and interpretation workflow to enhance the petroleum exploration studies.

The goal of seismic exploration are to obtain an image of the subsurface, locate the prospects and propose well locations based on a geologic model.
Well Drilling

- Drilling an exploration well to reach the potential reservoir will help ascertain that hydrocarbons are present and acquire data, valuable in underexplored basins.
- Data from well logs, cores, cuttings, samples and pressures provide details about fluid and reservoir rock properties.

Exploration well could be a success, if hydrocarbon reservoir is discovered that can be exploited commercially. Several appraisal wells may be required to acquire further data.
Field Developments

- How will the wells be drilled, vertical or horizontal?
- Will the wells be subsea or surface wells? What will be the wells' trajectories?
- Fixed or floating platforms? And how many of them will be needed for the development of the field? Manning levels?
- How many development phases will be needed? Will the production be stored and exported?
- What is the reservoir depletion strategy? Is pressure maintenance or lift required? How?

Field architecture is critical to economically and safely developing an oilfield
Life Cycle of an Oilfield

Number of wells = \frac{\text{Field plateau rate}}{\text{Production rate per well}}

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Oilfield Technologies

- The oilfield operation philosophy would impact the unit cost of exploration and exploitation.
- Unit cost is the ratio of annual cost performance to the annual total production.
- Reduction of the unit cost will increase profitability assuming a fixed price of oil and environmental risk.
- Information Technology for data acquisition, analysis and data management such as used to integrate production data with supply chain.

*Fit for purpose technology adoption will help reduce the unit cost of exploration and exploitation.*

Some game changing technology

- Directional drilling
- Multistage hydraulic fracturing
- Seismic imaging 3D and 4D
- Fiber optic sensing
- LWD and MWD
- Rig and bits
- Drilling and completion fluids
- Expandable sand screens
- Subsea and FPSOs
- Digital oilfield
- Artificial Lift
- LNG and FLNG
Offshore and Onshore Seismic, Drilling Rigs & Production Systems
Trend that impacts E&P

• Demand for energy and consequently energy prices is impacted by the political and world economic landscape, movement in US dollar as the dominant currency and the application of innovative technologies in the oil industry.

• Technology – a key factor that has enabled the economical exploitation of shale oil and gas. U.S. is experiencing growth in hydrocarbon production – thanks to multi-stage hydraulic fracturing and horizontal drilling technologies - and today has begun exporting oil in commercial quantities.

• Renewables & Energy Efficiency - Technology advancement has led to the development of “game changers” like electric and solar powered devices / transportations (e.g. energy saving light bulbs and smart cars) that will in turn reduce future demand for hydrocarbon.
Geosteering enables the drilling to stay in the target reservoir leading to maximum hydrocarbon recovery.

- Azimuthal gamma and resistivity, or regular LWD/MWD tools (basic gamma) are used in proactive geosteering.
- Without geosteering there is the risk that the drill bit exits the reservoir’s productive zone. This leads to high angles, out of zone time, and more significantly, more oil/gas left in the ground.
- Proactive geosteering involves anticipating the bit exiting the zone and correcting course before any out-of-zone footage is logged.
- Requires an experienced geosteering geologist and a directional driller.
Benefit of Technologies

• PDC cutter increased bit durability by revolving 360 resulting in reduced frequency of wellbore trips saving $0.3 million, increased performance by 50% and led to 280% increase in production above the average.

• Dual gradient drilling technique led to savings of 11% in cost of a GOM well drilled to 22,500 ft in 2500 ft water depth and savings of 30% in a well drilled to 18,000 ft in 7000 ft water depth.

• Installed wellbore lifts and multi-stage hydraulic fracturing have led to increases in field production by several folds.

Technology adoption will help reduce the unit cost of exploration and exploitation.
Challenges in the Downstream Oil Industry

*Downstream is focused on margins which is the difference between the value of the outgoing product and the cost of the ingoing feedstock.*
Oilfield Career

- Start with the right education – take courses in geology, formation evaluation, drilling etc.
- Enter a world of choices and challenges – go places, work in multidisciplinary teams, develop models, enjoy personal and financial rewards
- Develop talents – within a multinational corporation and independent operator or a service provider
Life Without Oil

46% of oil goes to making gasoline, but what makes up the other 54%?

Medicine
Most of the counter medications, homeopathic products and vitamins are derived from benzene, a product of petroleum.

Cosmetics
Makeup and shampoo that has oils, perfumes, waxes and color are all produced with the help of petrochemicals.

Plastics
Almost all plastics are made from petrochemicals, from your iPhone to that bottle of water. It is 4-5% of the total petroleum consumption.

Synthetic Rubber
Thousands of products rely on rubber such as shoes, tires, wet suits, breast implants, gloves.

Cleaning Products
All those ingredients you can’t pronounce in the ingredients list, all of which are very poisonous.

Asphalt
There are over 11 million miles of paved road in the world. Asphalt aka bitumen is the glue that binds the minerals together.

A few other products made with Oil
“The Stone Age did not end for lack of stone, and the oil age will end long before the world runs out of oil"

Sheikh Ahmed Zaki Yamani, former Oil Minister of Saudi Arabia

Thank you for your attention

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