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CURRENT TRENDS AND TECHNOLOGIES IN THE OIL AND GAS INDUSTRY

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***Abstract* — This paper presents an overview of the current trends and technology in the oil and gas industry. The role of service companies, the current R&D expenditures of the international Oil Companies (IOCs) and service companies is also shown to provide direction for the advancement of technology in the oil and gas industry. Typical technologies for the different phases in the oil and gas production process are also presented. The paper concludes with a review of remote operations and smart fields operations otherwise known as digital oil fields.**

***Keywords* - Trends, Technologies, Oil and gas Industry, IOCs, R&D expenditures.**

I. INTRODUCTION

The Oil and Gas industry is driven by advances in Technology. The impact of technology in the Oil and Gas industry started with Edwin L. Drake's 71 Feet drilling of an oil well which yielded 400 gallons of pure oil every 24 hours and was further reinforced by the development of the technology for the separation the oil and water. The oil and gas industry has continued to develop in pursuit of larger quantities of petroleum from increasingly complex geologic structures. [1]

II. KEY PLAYERS IN THE OIL AND GAS INDUSTRY

There are four major players in the oil and gas industry [2]. They are

- International Oil and Gas Companies (IOCs)
- Independent Oil and Gas Companies
- Service Companies
- Research Institutions

A. Oil Industry growth phase and the characteristics of the phases

The Oil and Gas industry development can be classified into different phases [3]

Growth Phase: During the growth phase of the oil and gas industry, the following characteristics are predominant.

(i) Aggressive expansions
(ii) Mergers and Acquisitions
(iii) Increased R&D expenditure (Build technology)
(iv) Production mainly from onshore fields.

Maturity phase: During the Maturity phase the characteristics change to the following

i. Decreased onshore production.
ii. Increased OPEX cost due to aging of the facilities.
iii. Increased security risks.
iv. Increased variation in Oil Prices.
v. New projects become costlier, less economical and more technically challenging.
vi. Stricter legislation from host countries (local content).
vii. Lower investment in technology (IOCs Buy technology rather than build technologies)
viii. Increased offshore penetration

With the maturity phase comes a need to focus on enhanced oil recovery methods and more efficient operations. This is achieved by

1. Increase in the use of technology (4D Seismic study for exploration, Horizontal Drilling)
2. Reduction in personnel exposure to risks
3. Increase in the use of automation
4. Increase in offshore and Natural gas expenditure
5. Increase in research for alternative energy and clean energy
6. Reliance on service companies for the development of technology

In recent years the vast majority of large scale discoveries have been made offshore, with much less exploration activity onshore. One reason why exploration drilling has largely focused offshore has been due to the differences between marine and land seismic technology.[4]

B. Impact of New technology on Oil and Gas production.

A primary benefit of new technology has been the conservation of natural resources by increasing the percentages of oil and gas recovered from existing reservoirs. Many breakthroughs and thousands of incremental advances in exploration and production have increased oil recovery levels from less than 10 percent (of the initial volume in place) to in excess of 70 percent, in some cases.[5]

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C. Motivation for the development of technology

Companies are motivated to invest in R&D by basic economics. Service companies want to sell a better service than any other company, thus increasing their market share. They also invest in technology to develop patents, later turned into products or licensing possibilities that will return a stream of revenue for years. Large independents and multinational petroleum companies also invest in R&D and their motivation is also primarily economic, but it is focused on the near-term reward of increased shareholder value while maintaining long-term sustainability.

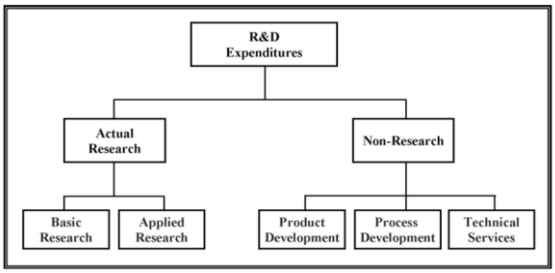

Figure 1 R&D Expenditures

Figure 1 shows the R&D expenditures. The bulk of the R&D is diverted to the Non Research areas which involves expenditure on product development, process development and Technical services. Figures 2 and 3 shows the expenditure pattern of the IOCs and the service companies. The results show an increase in the R&D expenses by service companies while it shows a decrease in the R&D expenses by the IOCs.

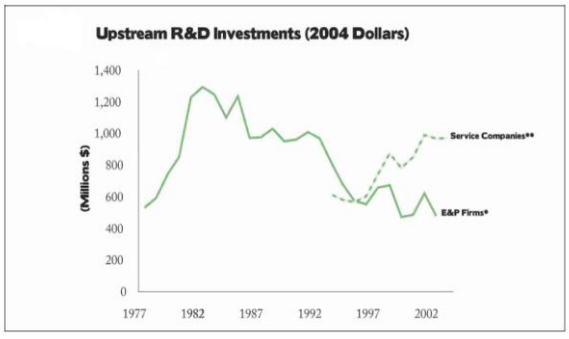

Figure 2: R&D Expenditure by IOCs

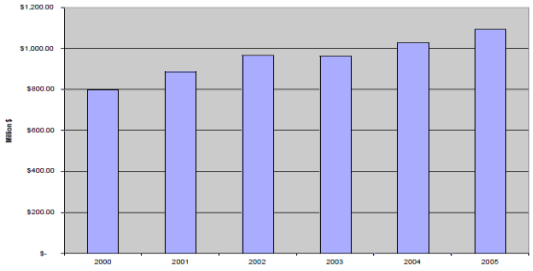

Figure 3: R&D Expenditure by Service companies

D. Requirements for effective development of Technology

The development of successful technology requires the confluence of three areas of expertise:

1. Knowledge and understanding of the problems likely to be solved through application of the technology. This knowledge resides within the industry.
2. Expertise in the science and engineering details behind the new technology. This lies in the service companies and research institutions
3. The business acumen required to secure funding, develop products and services, and create markets.

III. Typical Technologies For The Oil And Gas Industry

A. Operations

There are a number of new technologies currently being deployed in oil and gas operations. A very prominent example is the Clamp-On Gas flow measurement technology. The Ultrasonic Clamp-On Gas flow measurements techniques have the following advantages:[6]

1. It is the ideal solution for non-invasive gas flow measurement.
2. It offers a bi-directional flow measurement with high dynamics and high precision over the whole measuring range.
3. It is also completely wear-free. And suited for high pressure applications
4. The measurement is not influenced by high moisture content or by dust.
5. Typical applications are in measurement on natural gas pipelines, natural gas storage facilities, compressor stations and in the offshore natural gas production process.

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B. Explorations

A very prominent technology currently being utilized for exploration is the horizontal drilling technology. The characteristics and advantages of the Horizontal Drilling technology include:

1. Directional drilling technologies allows for enhanced access into unconventional resources.
2. Reduction of well construction costs through drilling and evaluation technology.
3. Use of precise wellbore placement and faster ROP (Rate of Penetration).
4. Optimization of real time drilling technology for reduced non productive time.
5. Meeting the growing demand for drilling practices with lower environmental footprints

C. Integrations/workflows

It is implemented in an integrated software solution portfolio spanning many E&P domains for subsurface analysis, including:

1. Seismic processing and imaging
2. Interpretation and modeling
3. Reservoir and subsurface evaluation
4. Reservoir engineering
5. Well planning and drilling engineering

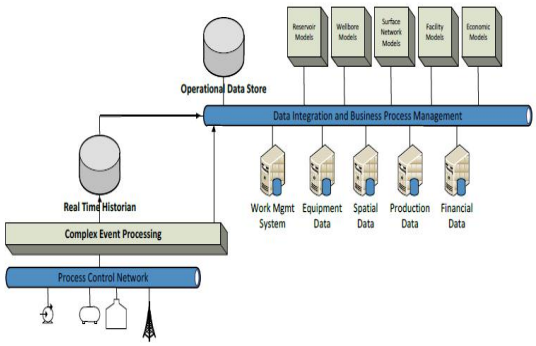

Figure 4: Data Integration and Business Process Management [7]

The Data Integration and Business Process Management components are in many ways the heart of a more effective IT architecture, providing a central mechanism for the movement of data between systems, equipment and other elements in the IT infrastructure.[7] This is shown in Figure 4.

D. Remote operations

The current security situation in the Niger delta in Nigeria and the fact that most onshore oil and gas producing facilities are in the maturity phase witnessing declining production profile makes it necessary for operators to optimize production costs. One way this can be achieved involve the deployment of remote operations. Remote operations coupled with collaborative work environments provide opportunity for the operation and control of remote plants and site from a single secure location. This system provides tremendous advantages including

1. Cost savings in terms of logistics cost incurred in moving personnel and security teams to the production facilities,
2. Time saving in terms of shorter response times due to the fact that commute time eliminated
3. Increased staff utilization Remote operations makes it easy to have specialist located in as secure areas monitoring critical equipment located in geographically separated locations.

Remote operations currently find application in the following areas:

1. Onshore and Offshore applications
2. Wellhead: Oil Wells, Gas Wells, Water Injection Wells, Gas Injection, etc.
3. Pumps
4. Electrical Submersible Pumps (ESPs), PCP and RLPs
5. Downhole Gauges
6. Control Valves
7. Flow Measurement Systems, Flow Meters, Test Separators
8. Pipeline Stations
9. Instrumentation/Sensors: temperature, pressure

E. Smart fields

Smart fields are developed by the linking of State-of-the-art exploration and production (E&P) technology and Information and communication protocols to achieve economies of scale and real time oil well management and production, while saving on operational costs. [5][8][9]
Shell has experienced a 10% sustained improvement in production, 5-10% increase in recovery, 20% reduction in operating costs, and as high as a 75% reduction in workflow cycle times in its core processes. [4]

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F. Opportunities for digital oil fields

Centralized monitoring and maintenance planning
Digital Oilfields allow real-time production and equipment data to be viewed in locations many hundreds, or even thousands of miles away. This has a number of potential advantages:

- Supply chain benefits – centralized maintenance planning allow more efficient management of equipment and spares, even if execution is managed locally.
- Potential to outsource management of critical equipment – Maintenance of major equipment such as turbines can be outsourced to the manufacturers for maintenance purposes. (Condition Monitoring)
- Consistent application of a maintenance strategy – centralized maintenance planning will assist in the application of a firm-wide maintenance strategy

Value optimization

Digital Oilfield Technology has the potential of bringing real-time data to many parts of the business, potentially allowing more informed trading and risk management decisions to be taken.

Functional deployment

While most local assets have, by necessity, a degree of local expertise, access to deep subject matter expertise is often costly and limited. Digital Oilfield Technology has the potential to allow much closer integration between company subject matter experts, and local assets.

IV. CONCLUSION

Technology has been the force behind the advancement of the oil and gas industry and advances in technology will be required to further increase the efficiency of the oil and gas production process

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