Role of Digital Technology for Reliability and Improve Production in Oil & Gas Industry

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Abstract— **Energy plays a very important role to improve and maintain living standard of human beings, industrial growth and economy of the country. Oil and gas is still a major energy resource and it makes up to 40% of total energy production. Worldwide energy demand is increasing each day. The Energy Information Administration (EIA) projects India's demand will be more than double by 2040. Digital technology can play a very important role in meeting this demand by increasing oil and gas production. It can be used to predict future performance of an asset to identify areas where performance can be improved. It can also help to develop risk management plans by identifying areas where breakdowns in operations could occur even before they happen.**

A brief overview of digital technology in oil and gas industry is presented in this paper to improve the efficiency of oil and gas exploration, execution of the projects, increase reliability during operations and minimize execution & operational costs.

Index Terms—**Digital technology, Oil well optimization, Geology survey, Data analysis.**

I. Introduction

While the importance of Oil & Gas as an energy source grows throughout the world, recognition of digital technology is growing as an important means of improving each function during exploration, development, processing, and transportation. Oil and Gas are the most important non-renewable sources of energy so need of digital technology in the oil and gas industry sector is rising exponentially. Digital automation and technological advancements are helping industry to drive improvements in productivity, risk management, health safety & environment and reinventing the sector.

Digital technologies allow real-time production and equipment data to be viewed by operator in any locations. It is also used for following sub-surface analysis:

- Seismic Processing and Imaging
- Interpretation and Modeling
- Reservoir and Subsurface Evaluation
- Reservoir Engineering
- Well Planning and Drilling Engineering

Worldwide oil prices have dropped more than 50% since June 2014, and production is out pacing demand. This scenario means that oil and gas companies need to reinvent themselves by grabbing a hold of today's technologies. They must boost operational efficiency.

Digital 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.

II. DIGITAL TECHNOLOGY

Digital technology uses digital code to transmit signals and information between different devices. The data is converted into strings of ones and zeros and moved quickly to the next machine where it is converted back into media form. Oil and gas companies collect raw data using digital technologies to identify key opportunities. During planning, exploration and production, execution of a project, many of the important decisions are taken under uncertainty. This includes positioning of new wells and different development scenarios of the fields.

Turning a collected raw data using digital technologies from engineering disciplines into useful information is a challenging task for oil and gas companies. Data analysis identifies key opportunities from the data collected at various scales in depth as well as in a temporal fashion, both stationary and non-stationary by nature. The oil and gas industry has lot of data from different sources (wells and seismic surveys, operational data etc.) but these data need to be analyzed using statistical methods to support company decisions. The patterns found in the data when analyzed, can be used to make investment decisions, predict future performance of an asset, to identify areas where performance can be improved, and to develop risk management plans by identifying areas where breakdowns in operations could occur before they happen.

Analysis is basically the search for meaningful information from the large amounts of data. It uses mathematics, statistics, computer programming and knowledge about the operations in question to quantify performance. Big Data analytics may be new to some industries, but oil and gas industry is dealing with huge quantities of data to make technical decisions. Keith Holdaway defines big data as "an expression coined to represent an aggregation of datasets that are voluminous, complex, disparate, and /or collated at very high frequencies, resulting in substantive analytical difficulties that cannot be addressed by traditional data processing applications and tools".

Seismic software, data visualization tools, inspection tools and many other digital technologies continue to open new possibilities for the industry. With these new tools and advanced analytic capabilities, oil and gas companies can capture more detailed data in real time at lower costs, which can help them improve oilfield and plant performance by 6% to 8% according to research by Bain & Company.

III. APPLICATION

A. Exploration

Digital technology helps operators to collect geological data from remote geographical locations. Oil companies can get field properties by analyzing this collected data and comparing it against well performance. It can help oil and gas companies to improve their ability to characterize oil & gas basins with less trial-and-error methods. Artificial neural networks (ANN), fuzzy logic (FL) and genetic algorithms (GA) are human-level artificial

intelligence techniques which are currently being used in oil and gas reservoir management and simulation.

Digital technology can improve the way companies manage the entire process of drilling and connecting a well, reducing lag time and minimizing the number of wells in process at a time. For example, transmitting micro-seismic, 3D imaging over fiber-optic cables can improve new well delivery performance.

- It provides following advantages during Exploration:
- Reduction of well construction costs through analysis of data.
- Use of precise wellbore placement and faster ROP (Rate of Penetration).
- Optimization of real time drilling technology for reduced non-productive time.
- Meeting the growing energy demand for drilling practices with lower environmental footprints.

Digital oilfields (DOF) and intelligent wells with multiple sensors and gauges are generating a large data. This data helps to define a complex, heterogeneous landscape such as a reservoir –well-facility integrated system.

B. Risk Management

Managing mega / major capital projects in a global environment is becoming increasingly complex. Energy demand is increasing, and large oil and gas reserves are being depleted. Oil and gas companies are trying to drill multiple smaller wells to compensate.

Oil and gas companies need to make strategic decisions about which projects should be developed first to ensure their company's best performance.

Operational risks are another component of overall enterprise risks and information plays a very important role to reduce operational risks. Oil and gas companies need to take strategic, operational, and tactical decisions about their assets, whether they are resources, reserves, wells, plants, or facilities.

It is noticed that there is a disconnect between the tactical and the strategic levels. The strategists do not have visibility into costs and efficiencies across the portfolio of assets. Also, well/plant-level decisions are made based on the perspective of the individual plant or asset and these decisions may not support the profitability goals set at the corporate level. This disconnect negatively affects companies' ability to handle risks.

Remote sensors and drones are increasing the frequency of information about assets; analytics performed on this data can then help to reduce disconnect and provide enough information to support the profitability goals set at the corporate level.

C. Operations Management

The oil & gas industry is operating in increasingly remote geographical locations and harsher environmental conditions, with unconventional processes to extract oil and gas. Sensors, and
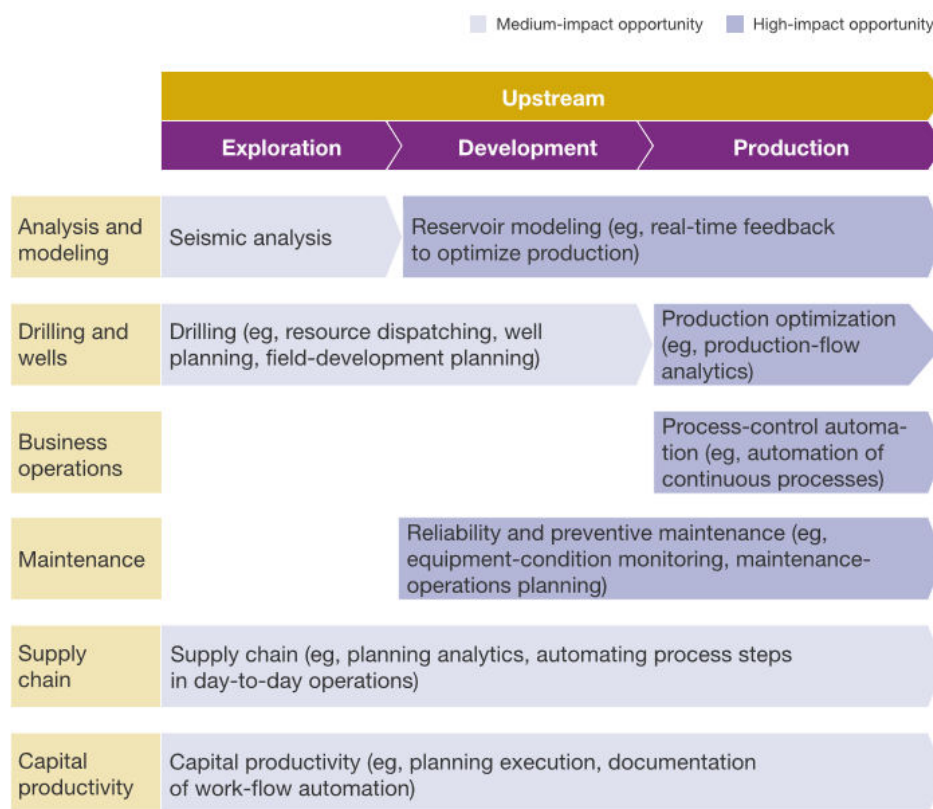
control systems offer oil and gas industry the chance to automate operations at geographically remote locations. Most oil and gas companies are starting to capture these opportunities and by successfully employing digital technology can significantly improve their production.

Enhancing operational effectiveness can be approached in at least two ways:

- Through digital interaction, transact and engage with companies, as well as how these new interactions can create mutual value.

- Through process re-invention, use embedded analytics to continuously monitor, measure and refine decisions related to organizational operations. This can help transform organizations for greater agility and precision that enable new growth.

Most oil and gas producing facilities are in the maturity phase and oil & gas production is declining from mature facilities. It becomes necessary for Oil & Gas companies to optimize their 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 many remote plants and site from a single location.

Automation in the energy sector offers many potential benefits in exploration, development, production and transportation. Below Figure shows highest-impact automation opportunities in upstream operations:

Fig-1 Automation Opportunities, Source [8]

Technology helps operators to maximize asset and well integrity, increase field recovery are just a few of areas digital technology can help to optimize production efficiency.

D. Environment, Health and Safety Management

Health, safety and environment (HSE) is a huge concern in the oil and gas industry. Safety failures in the industry may have fatal consequences. Accidents have occurred in the oil and gas industry during the last couple of years having devastating outcomes both on the environment and the lives of the people.

New technologies can help oil and gas companies to enhance their safety by providing timely information to the top management. Safety is everyone's responsibility and oil and gas companies are emphasizing on it. It is necessary for management to get their employees' feedback and suggestions about hazards and dangers to make sure that everyone contributes to build a safety culture. Conventional reporting is time consuming and stressful and sending these reports to the top management are quite difficult from remote locations. With new technologies, employees can provide site reports from the remote location which can be received by top management in short period of time. It also gives an opportunity to the company to analyze the data to support the decisions.

E. Communication

Communication is very important for smooth production. Oil and gas fields often span over hundreds and even thousands of square kilometres across remote areas that often lack cellular coverage. Demand is increasing in oil and gas industry for field communications. Oil and gas companies have complex operations and need real time data from multiple onshore and offshore locations to make the decisions. To get real time data oil and gas companies are relying on robust telecommunications.

Oil and gas field communications require high capacity strong and reliable wireless networks that operate over large areas under extreme environmental conditions. Ideally, wireless oil and gas communication networks deliver broadband speeds and form a scalable foundation to securely support multiple applications that increase operational efficiency and safety on one cost-effective physical infrastructure. A single network should simultaneously support a range of fixed and mobile oil and gas exploration and production applications such as:

- Drill Rig Communications and Diagnostics – Safety is more important in oil and gas industry. Monitoring rig operations are becoming increasingly important for safety and efficiency on rig floors. When more data is available with the operators, it can be analysed to increase operational efficiency and avoid unforeseen events.

- Supervisory Control and Data Acquisition (SCADA) – It is a system used to control remote equipment during production. It is used for measurement of oil and gas flow, monitoring and control of storage tanks and pipelines etc.

- Real-time Video Feeds and Surveillance – Digital technology provides remote situational awareness and information that can facilitate decisions, improve safety, and deliver early visibility into critical situations unfolding.

- Asset Tracking – Digital technology is also used for asset tracking and updating the location of fixed and mobile assets in the field. It is also helpful to improve operations and contributes to safety and security.

- Field Workforce Connectivity – Communication is one of the most important factors for successful operations and worker safety. Field work connectivity keep work force in the field connected with access to SCADA data, instant messaging and email at remote sites.

- Communication with Remote worker – Voice IP phones for mobile workers even in remote areas improve operational efficiency and worker safety. This technology uses internet instead of traditional telephone lines and cellular access technologies such as frequency division multiple access (FDMA), time division multiple access (TDMA) and code division multiple access (CDMA).

- Security and Surveillance Systems – Digital technology enhances facility security with electronic access control at entry points or secured locations in the facility. Video cameras can be installed for security at gates or around the site perimeter.

- Very Small Aperture Terminal (VSAT) – VSAT is a small satellite dish that is installed at the site, land, or water, and provides multiple communication capabilities. A typical system provides 3 to 6 dial tones (IP telephones) as well as a broadband connection for computers used on the remote sites.

IV. CHALLENGES

Digital technologies demand a fundamentally different, digital workforce. They also drive democratized, customized, and seamless work experiences. In the current situation, technical work force is the biggest problem. Oil and gas industry is facing a major demographic crisis in recruiting and retaining an employee to fill in the digital knowledge and experience gap.

Oil and gas companies are lacking in analytics capabilities. It is very important in order to compete in an industry where decisions are moving faster, and the stakes are growing ever higher. Creating a world-class analytics capability takes time and investment, and it can only happen with a sustained focus by top management.

V. CONCLUSION

Now a days, thousands of sensors and smart devices are monitoring and controlling equipment on rigs and in oil fields around the world, making oil and gas companies no strangers to digital technology or big data. Oil and gas companies are just at the starting blocks of digital transformation. If they plan to out run their competitors, they must quickly race to full digital adoption.

Digital technologies are transforming the management of oil and gas activities by enabling the optimization of overall business performance. Digital technologies are not only rapidly changing the practice of work, but they are also reshaping the very nature of the workforce.

Digital technologies help oil and gas companies in conservation of natural resources by increasing the percentages of oil and gas recovered from existing reservoirs and reducing the

operational cost. Oil and gas companies need to improve their analytics capabilities in order to overcome the manpower challenges.

Disclaimer: This paper does not represent any Ponticelli Upstream LLC position and it is in no way related to Ponticelli Upstream LLC.

REFERENCES

[1] F. Idachaba "Current Trends and Technologies in the Oil and Gas Industry" International Journal of Emerging Technology and Advance Engineering Vol: 2 No7, pp. 234-237, 2012.

[2] Keith Holdaway , Harness Oil and Gas Big Data with Analytics, Wiley & SAS Business, Cary, 2014.

[3] Riccardo Bertocco and Vishy Padmanabhan "Bid data Analytics in oil and gas" [Online]. Available: www.bain.com

[4] Rich Holsman "Oil and Gas Companies: How digital is transforming workas we know it" [Online]. Available: https://www.accenture.com/us-en/insight-oil-gas-companies-digital-transforming-work.aspx

[5] (2015) Oil + Gas Monitor website. [Online]. Available: http://www.oilgasmonitor.com/category/technology/

[6] Richard Swinford, Vikram Gupta, Russell Pell and Sameer Aness "Field Telecommunications in the Oil & Gas Industry" [Online]. Available: http://www.hermes.uk.com/sites/default/files/Arthur%20D%20Little%20Field%20Telecoms%20Report.pdf

[7] Roberta Bigliani "Reducing Risk in Oil and Gas operations" IDC Energy Insights, pp 1-13, 2013

[8] Stefano Martinotti, Jim Nolten, Jens Arne Steinsbo "Digitizing oil and gas production" [online] available : http://www.mckinsey.com/insights/energy_resources_materials/digitizing_oil_and_gas_production

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