CHALLENGES AND REQUIREMENTS FOR PETROLEUM ENGINEERING GRADUATES

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Abstract

The next generation of petroleum engineers will need knowledge in petroleum engineering, technology, innovation, and digital knowledge due to the industry's rapid adoption of technology and digitization and the need to address sustainability. They must also promote sustainability, meet the demand for efficiency, and be ready for a career path that will alter as the business advances quickly.

INTRODUCTION

This article suggests ways to improve petroleum engineering education in the next decades. This academic boost would help petroleum engineering students limit the quick growth of oil and gas technology. The report covered petroleum engineering's biggest trends. This trend is driven by the oil and gas industry, which innovates exploration, drilling, and production technology. The paper suggested changing students' learning outcomes through the Accreditation Board for Engineering and Technology to give recently graduated students the knowledge and skills they need to handle any job without additional training. Petroleum engineering students have an edge due to the essential skills in AI algorithms, sophisticated robotics, the internet of things, three-dimensional visualisation, and big data management. These abilities will assist oil and gas businesses boost productivity at oil fields and wells.

Oil engineers power the world. Petroleum engineers power everything. This haughty quote from the Society of Petroleum Engineers website shows our respect for our profession and the importance of educating the next generation of engineers to meet industry needs (Cunha, J.C. and Cunha, L.B, 2004).

Petroleum engineering has been an academic discipline for 100 years. Modern curriculum largely reflects advances in industrial and educational technologies. Petroleum engineers need a strong background in geology, oil well drilling, formation evaluation, oil and gas production, reservoir rocks and fluid properties, fluid flow in porous media, reservoir engineering, and oil property evaluation, as well as math, physics, and chemistry (Cunha, J.C. and Cunha, L.B, 2004).

Petroleum engineers' education have to keep pace with the industry's rapid technological improvement. Oil industry businesses formerly expected young graduates to be competent engineers who could quickly contribute and integrate into the workplace. Today's employers demand different. They still want technically skilled engineers who understand industrial technology, but they demand more. In addition to technical knowledge, today's ideal petroleum engineering graduate has a thorough understanding of the industry, a desire for lifelong learning, and the teamwork, communication, and

computer skills needed in today's global industry (Kazemi, H. et al., 2000) (Agbaraji, C.I., 2002).

Petroleum and other companies are quickly realising a technical skills shortage. Since the education sector is a crucial source of employees for this industry, we must rethink how we educate and train petroleum workers in our institutions. Due to the increasing experienced workforce, budgetary limits on training, increased staff turnover, decreased field exposure, diminishing graduate interest, etc. (Paul Ugoji et al. 2017).

This study focuses on the skills and employment needs of employers in many sectors, particularly the petroleum business. These standards guide the implementation of a successful plan that meets corporate needs while concentrating on important skill areas taught in our educational system. Higher education graduates will appear to understand employer-relevant topics like data analytics, big data, artificial intelligence, machine learning, robotics, nanotechnology, hydrogen fuel production, and carbon capture and storage, making them ready to work right away. This method lets universities showcase their weaker research and interests. Government and corporate partnership, notably from the oil and gas sector, may improve their academic programmes (Kamal, Medhat M., 2021).

Intercultural and transdisciplinary skills, health, safety, and environmental awareness, and other critical competences are mostly gained at work. Professors, corporate trainers, and managers must change their teaching methods to improve the future generation of petroleum engineers. Coaching requires managers rather than instructors (Kamal, Medhat M., 2021). Aggour (2005).

The most crucial upskilling for the next generation of petroleum engineers

As the industry has developed and evolved, it has become apparent that training engineers for competence during the first few years of their work is no longer sufficient. As shown in Figure 1, teachers must provide students with the knowledge and abilities necessary for success in the rapidly changing modern global economy. This necessitates the ability to adapt to new technologies, a deep understanding of the whole upstream industrial system, and competent behavioural attributes including teamwork and effective oral and written communication (Tamir Aggour, 2005). Unconventional oil and gas extraction, including heavy oil, oil shale, gas shale, and enhanced oil recovery, has begun in a number of countries. Thanks to recent advancements, the oil and gas industry is becoming more efficient, secure, and intelligent. To do this, businesses look for effective and competitive ways to digitise, automate, and solve challenging sub-surface engineering issues. Using artificial intelligence (AI) algorithms, for instance, oil and gas companies may boost productivity in their wells or oilfields and gain a competitive edge. Advanced robots and data management systems are being used more often, which speeds up processing times and decreases the need for human labour (Anirbid Sircar et al., 2021). Students studying petroleum engineering must master the following modern skills in order to operate in the oil and gas industry.

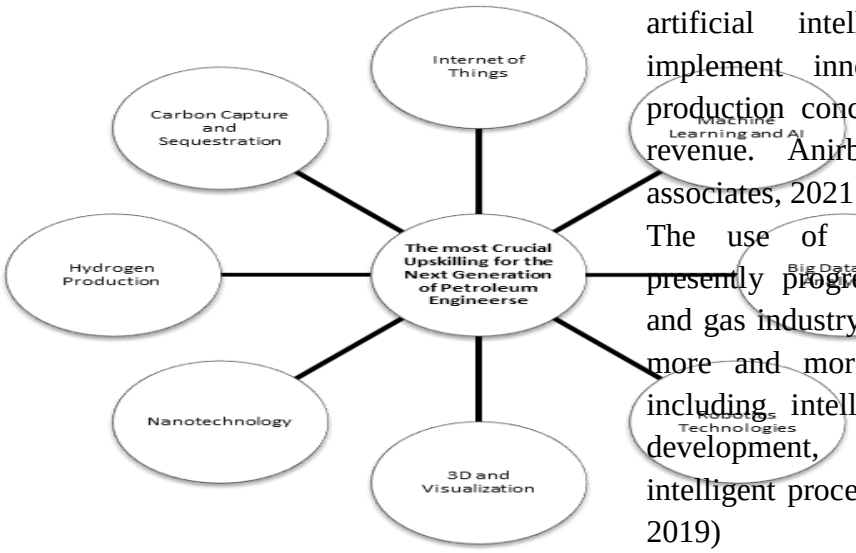

Figure 1: The most crucial upskilling for the next generation of petroleum engineers

- **Internet of Things**

The oil and gas industry uses the Internet of Things to boost production, optimise equipment, guarantee worker safety, and keep an eye on outlying locations. Real-time data gathering is made possible by the placement of sensors within wells, blowout preventers, and choke valves. With the use of this knowledge, oil and gas start-ups can swiftly identify damaged equipment, supporting field engineers in foreseeing and managing situations. Oil and gas companies may save maintenance costs and have total insight into their equipment or operations by using Internet of Things technologies. This will boost income while bringing down overall operating expenses. R.G. Alakbarov and M.A. Hashimov, 2018

- **Machine Learning and ArtificialIntelligence**

The upstream, middle, and downstream operations of the oil and gas sector increasingly use artificial intelligence and data science to tackle difficult issues. Managers in the oil and gas industry use artificial intelligence to find and implement innovative exploration and production concepts in order to increase revenue. Anirbid Sircar as well as associates, 2021

The use of artificial intelligence is presently progressing quickly in the oil and gas industry as the concept permeates more and more parts of the industry, including intelligent drilling, intelligent development, intelligent pipeline, intelligent processing, and so on. (Kumar, 2019)

Using an optimisation method, the best way to increase overall oil production was found. The parametric analysis allows for the comparison of several machine learning algorithms to predict seismic features, wireline data, and permeability. 2019 Secchi and Teixeira

- **Big Data and Analytics**

Data analysts in the industry may benefit from production and reservoir performance data by using big data platforms. Engineers who wish to boost production and guarantee the best use of the oil and gas reserves may benefit from this as well. The oil and gas business gains more value when choices are made to use big data analytics to lower operating costs and increase profit. The basic goal of big data is to provide resources for handling and analysing the enormous amounts of data. Recently, integrated asset modelling, closed-loop reservoir management (CLRM), and integrated asset management (IAM) technologies were combined to produce a new generation of reservoir simulation. This will lead to a novel information-oriented approach to reservoir modelling, which will be enhanced by predicting reservoir performance. (Mehdi Mohammad and Farshid Torabi, 2020)

- **Robotics Technologies**

Robotic technologies are used throughout the drilling, production, and transportation phases of the upstream and downstream of the oil and gas production process. The most prevalent types of these systems are wireless sensor networks, in-pipe inspection robots, and tank inspection robots. Robotics technologies are primarily used to examine, maintain, and repair industrial facilities more often and more accurately. The automation of 3D tasks raises the bar for health, safety, and environmental regulations while also boosting economic efficiency because fewer people are needed for continuous plant maintenance and manipulation, production cycles, and floor space requirements (Amit Shukla, Hamad Karki, 2016).

- **Three-Dimensional and Visualization**.

The creation of realistic representations of subsurface reservoirs and other oil and gas equipment is aided by three-dimensional (3D) modelling and outstanding graphics. 3D modelling replicates the production and injection phases during the reservoir's lifespan in conjunction with historical production data. This makes it easier to anticipate hazards that might affect the reservoir's safety. Engineers in the oil and gas sector optimise production and operational planning using the data. Additionally, 3D modelling and visualisation improve performance for the oil and gas sectors while lowering costs and reducing hazards. A crucial step in understanding and using reservoir simulations or models is their presentation. In the lack of visualisation, particularly big, sophisticated models, such as three-dimensional/three-phase reservoir models, may be rendered unusable. By encouraging integration and engagement, visualisation strengthens ties between geoscientists and reservoir engineers. To improve our efficacy, it is essential to translate the vast quantities of simulation data into clear visualisations. Austin, A.Z., from 1993 (2005 Aggour, Tamir

- **Nanotechnology**

Numerous uses of nanoparticles have spawned brand-new scientific and technical disciplines. Nanoscience and nanotechnology are these disciplines. In contrast to nanotechnology, which deals with the design, characterisation, production, and usage of materials and devices based on the nanoscale, nano-science is the study of the processes and principles influencing the behaviour of materials at the nanoscale level. As seen by recent years, the use of nanotechnology in the oil and gas business is expanding. Numerous uses of nanotechnology in the oil and gas sector have been reported, including the release of methane from gas hydrates and the drilling and hydraulic fracturing fluids, oil well cementing, enhanced oil recovery, corrosion inhibition, well logging, and methane viscosity reduction in heavy oil. (2017) Fakoya, Muili Feyisitan, and others.

- **Hydrogen Fuel**

In order to cut greenhouse gas (GHG) emissions and enhance energy storage, hydrogen is being researched as a possible alternative for different fluids used in transportation. Natural gas is needed as a feedstock to create the two types of hydrogen, grey hydrogen and blue hydrogen. Therefore, more natural gas would need to be produced in this region. Natural gas is converted into hydrogen, and as a consequence, carbon dioxide

(CO2) is emitted in concentrated streams. The separated CO2 may be safely compressed and fed into a depleted natural gas field there if manufacturing is done nearby.

• **Carbon Capture and Storage/Sequestration Climate change is a very important problem**.

The best way to substantially support the effort required to address climate change must be taught to the children. The SPE Gaia Sustainability Programme gives the oil and gas industry and representatives of its stakeholders fresh insights on sustainability concerns in order to inform our members about climate change.

More than 60% of the world's greenhouse gas emissions come from stationary industrial sources including carbon dioxide (CO2) emissions from power plants. However, this CO2 may be caught, stored, and injected to oil reservoirs that are losing oil by employing a "enhanced oil recovery" (EOR) procedure. As a consequence, the oil sector has the opportunity to engage in operations that will dramatically lower emissions and, in the case of EOR, boost oil field recovery. These activities include EOR and CO2 collection and storage.

Educational Challenges: Standard and Accreditation

Due to the accreditation requirements established by the Accreditation Board for Engineering and Technology, the majority of undergraduate programmes in petroleum engineering provide similar curriculum. Gradually changing curriculums are implemented. The petroleum engineering courses are not going to undergo any major changes very soon. Every year, new technology is added into the courses. More emphasis will probably be placed on economics, interpersonal abilities, and in-depth understanding of the petroleum business. Furthermore, petroleum engineering departments need to find out how to keep its faculty stable despite the enormous fluctuations brought on by the sector's boom and bust cycles. (2000) (W.D. Von Gonten)

The suggested appropriate strategy for updating the students' outcomes

To stay up with technical innovation in the oil and gas business and sustain the department's academic growth, the decision-makers might devise two plans, one short-term and the other long-term.

The short-term strategy calls for an upgrade of 10% to 20% (for the selected courses) to the petroleum engineering curriculum in order to address the most current technical developments in the industry. In this 10% to 20% upgrade, the following sophisticated technologies (themes) will be given priority:

- Application of Artificial Intelligence and Machine Learning (AI)
- Utilizing robotics technology
- Making use of nanotechnology
- Visualization and three-dimensional application. (Packages of industrial software)
- Use of Internet of Things
- Big Data & Analytics Applications

Long-term partnerships between relevant departments would be strengthened via petroleum engineering programmes on a local, regional, and global level (sharing of research experience and reform and updating of curriculum). Additionally, petroleum engineering programmes must

adapt to the industry's evolving needs and innovations while continuing to place a strong focus on its core technologies and concepts. This calls for constant dialogue between industry and academics. The channels of communication between the two sides must be robust and important in order to develop and promote the partnership.

A robust and well-designed curriculum is meaningless for showing all these procedures without the appropriate faculty to present it. Education involves much more than only delivering information. Students must be motivated to study throughout their lives, independent thinking must be encouraged, and complex problem-solving techniques must be used. From the very first semester of their undergraduate studies, teachers should stress to students how important foundational topics are to their future coursework and professional jobs. Teachers must also actively help pupils develop skills like cooperation and communication that are essential for their future employment. Faculty in petroleum engineering should possess the requisite subject-matter competence, hands-on engineering experience, and the necessary motivating and instructive abilities.

Conclusions

Students studying petroleum engineering nowadays must have access to and training in the most recent knowledge and abilities that the oil and gas business has to offer. To keep up with the significant technical developments anticipated in the oil and gas business over the next few decades, the curriculum must simultaneously include new ideas and innovations.

It is impossible to believe that students who graduate from our institutions, which rely on outdated and underdeveloped curricula, would have the knowledge and abilities needed to use the new technology. In order to achieve this aim, faculty preparation, scientific infrastructure, and institutional infrastructure are all necessary. To create a sustainable cooperation plan and improve petroleum engineering courses and laboratories, cooperation with national and international enterprises is also necessary. High-achieving students will thus be more equipped for the workforce.

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