Chapter 14
Oil and Gas Industry Challenges for the Next Decade:
Strategies to Face Them From the Education of Future Petroleum Engineers

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ABSTRACT

Hydrocarbons are one of the most important sources of energy globally. The processing, use, and commercialization of these resources are the basis of the world economy, even in an era of energy transition like the one experienced today, in which alternative energies are developing rapidly. Activities carried out in the hydrocarbon industry contribute a large amount of energy-related CO2 emissions, in addition to other environmental risks such as hydrocarbon spills, soil and groundwater contamination, and fires. As a result, the importance of the industry has been overshadowed, even though because of these same activities, engineering and scientific advances have been achieved to optimize the production of hydrocarbons to satisfy global demand. Consequently, it is expected that the oil and gas industry will face challenges in the environmental, operational, and social context during the next decade.

INTRODUCTION

Hydrocarbons are non-renewable natural resources whose derivates are used in most of the daily use products, specially in fuels for different means of transportation and industrial machinery, as well as raw products for plastics, pharmaceutical, textiles, solvents, among others.

The hydrocarbon world trading is one of the major economic driving forces across the globe, as it controls the development of importing and exporting countries by contributing to the balance of payments and currency generation, which in turn allows the improvement of each country infrastructure. Further, the oil and gas industry is a significant source of employment and taxes.

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Despite the great importance of hydrocarbons in the global socioeconomic context, in recent years important debates had arisen about the imminent depletion of oil and gas reservoirs and the increasing demand for them, and with it, the question of how the world is using them. Also, the necessary activities for hydrocarbon exploration and production have proven to cause sever environmental problems such as marine oil spills, ground water contamination, soil contamination, explosions and fires, among several others.

The fact that hydrocarbons continue to be essential in the social, economic and industrial development of the world and the fact that their use carries environmental risks and their imminent depletion, requires the modern oil industry to face challenges, including the effective regulation of oil activities, the development of technologies that allow safe and sound hydrocarbon production to satisfy the global demand, and the responsible exploration and production of challenging fields such as non-conventional reservoirs or deep and extra-deep waters reservoirs.

The challenges can be faced if all sectors related to hydrocarbon production work together and focus on a common objective. These sectors are governmental, economic, operational, and academic.

From the academia, educational programs aimed at training professionals who can develop in the hydrocarbon and energy industry in general, must consider the current problems and the future panorama of the oil industry in order to raise awareness among their students of the skills and attitudes that this important industry currently requires, and that allow them to successfully perform in the future.

This work briefly describes some of the challenges that the oil industry deals with at a global level, as well as some recommendations to strengthen academic plans in petroleum engineering so that future professionals acquire the necessary skillset to face three specific challenges in the industry during the next decade: digital transformation, energy transition and challenging specialized technical operations.

THE CHALLENGES OF THE OIL INDUSTRY FOR THE NEXT DECADE USING NEW TECHNOLOGY TRENDS

The International Society of Petroleum Engineers (SPE International) held the "SPE Workshop: Oil and Gas Technology for a Net-Zero World – Defining Our Grand Challenges for the Next Decade" workshop in January 2023, an event in which Panelists from international oil operating and service companies met, as well as financial and environmental stakeholders related to energy development. In this workshop, the technical development and research challenges for the global energy industry over the next decade were defined. Additionally, social or non-technical challenges related to industry education and advocacy are identified. The mentioned challenges will be briefly described below.

Enhanced Recovery from Non-Conventional Resources

Despite the accelerated development of non-fossil energies and their use, it is expected that the demand for oil and gas will continue to increase, at least until 2050 (EIA, 2013). The previous decade, the extraction of hydrocarbons from unconventional reservoirs, through horizontal drilling and hydraulic fracturing, helped meet global demand for hydrocarbons. However, production in this type of reservoir declines rapidly, and therefore the final recovery on average is 10% (Halsey et al., 2023).

Non-conventional reservoirs are interestingly challenging because of the nature of their characteristics such as ultra-low permeability, high fluid absorption and extremely low diffusion flow rates. Due to these