Using Artificial Intelligence to Manage Oil

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Introduction to the research:

Today, oil and gas are important pillars of the global energy sector.

All resources used in our daily lives are directly or indirectly linked to the oil and gas industry.

The oil and gas industry is an important necessity for global economic growth.

The economic growth of any country is linked to the size of its demand for energy, and with the increasing demand for energy and the development of its alternatives (renewable energy), oil and gas will continue to meet the world's needs in the coming years as it is one of the largest sectors in the world, especially the manufacturing industries.

Given the size of the sector and its support for the economy, it requires further progress in terms of digitization, artificial intelligence and machine learning.

The industrial revolution known as Industry 4.0 emphasizes the digitization and automation of industries and the creation of valuable products with the help of machine learning.

This research discusses how to introduce artificial intelligence and machine learning tools in the oil and gas industry to create added value in upstream, middle and final operations from exploration through storage, disposal and manufacturing industries to final delivery to customers. We can make the system digital and more efficient, there are many difficulties faced by the industry sector in transitioning to digitization and owning a system based on the use of artificial intelligence, which will provide huge data for the development of the oil industries.

The variation in the price of crude oil depends on many factors, such as current demand, future demand, supply and trading over time, based on data from past years and the trends they followed, and the availability of real-time data with the help of AI, models can be created to predict prices, taking into account all the influential parameters.

The importance of the research:

The importance of this research lies in introducing artificial intelligence in the fields of energy, oil manufacturing industries and control, and keeping pace with the great technological development in the world.

Research objective:

The main objective of the research is to use artificial intelligence to improve oil drilling, exploration and production operations, predictive maintenance and forecasting operational results and everything related to the oil industry to solve immediate problems and address them at a reasonable cost and time.

First: Using artificial intelligence in oil production.

Artificial intelligence is used to manage oil to improve efficiency, increase production and reduce costs.

This is done through: -

1. Oil exploration: - Using artificial intelligence to analyze geological and geophysical data to improve the accuracy of determining the locations of new oil fields.

2. Data analysis: - Analyzing large amounts of data related to production and operation to identify patterns and improve extraction operations.

3. Predictive maintenance: - Predicting potential failures in oil equipment and facilities before they occur, which reduces downtime and lowers costs.

4. Reservoir management: - Improving reservoir management through data analysis to ensure oil extraction with the highest possible efficiency.

5. Automation: Using automation techniques to improve drilling and extraction operations and reduce human intervention, which increases safety and efficiency.

6. Supply chain optimization: Improving supply chain planning and management through data analysis, demand forecasting, and resource allocation optimization.

Artificial intelligence (AI) can be used in multiple ways in the oil industry to improve efficiency, reduce costs, and increase safety. Here is how each of the following cases can be addressed:

1. Oil exploration:

➢ Using AI to analyze geological and geophysical data such as CT scans and seismic data.

➢ Applying deep learning techniques to extract complex patterns and indicators that indicate the presence of new oil fields, which increases the accuracy of locating new fields and saves exploration costs.

2. Data Analysis:-

➢ Using machine learning techniques to analyze large amounts of data related to production and operation, including drilling, production, and maintenance data.

➢ Identifying patterns and relationships between various operational variables to improve extraction operations and increase productivity.

3. Predictive Maintenance:-

➢ Applying machine learning algorithms to predict potential failures in oil equipment and facilities before they occur.

➢ Collecting and analyzing real-time sensor data to identify signs of wear or damage, enabling preventive maintenance and reducing downtime. (Nemat Abu Al-Souf, 2023)

4. Reservoir Management:-

➢ Using artificial intelligence to analyze data related to oil reservoirs, such as reservoir pressure, extraction rate, and oil distribution.

➢ Developing simulation models to improve extraction operations and ensure oil extraction with the highest possible efficiency, which reduces losses and increases productivity.

5. Automated Control:-

➢ Applying automated control and robotics techniques to improve drilling and extraction operations and reduce human intervention.

➢ Using artificial intelligence to analyze data in real time and make optimal operating decisions, which increases safety and reduces human error.

6. Improving the supply chain:-

➢ Using artificial intelligence to analyze data related to demand, supply, and market forecasts.

> Improving supply chain planning and management by improving resource distribution, forecasting demand, and reducing loss and waste in transportation and distribution operations. (Al-Sanousi, Suhaib Abdullah, 2024)

Second: Using artificial intelligence to preserve oil reservoirs and protect the environment.

To achieve optimal spatial management of oil reservoirs while maintaining spatial pressures, reservoir life, and protecting the environment, artificial intelligence and modern technologies can be used as follows:

1. Analysis of geological and geophysical data:-

> Using artificial intelligence to accurately analyze geological and geophysical data, which enables understanding the distribution of oil within the reservoir and the physical and mechanical properties of the reservoir.

> Developing three-dimensional models of the reservoir that help identify areas with high oil density and areas that need to maintain pressure.

2. Predictive Models and Pressure Management: -

> Applying machine learning techniques to build predictive models that predict reservoir behavior based on current and past production data.

> Using these models to effectively manage pressure within the reservoir, helping to achieve a balance between oil extraction and pressure maintenance to prevent reservoir degradation.

> Using smart injection techniques (such as water or gas injection) to control pressure and maintain environmental balance within the reservoir.

3. Real-time monitoring: -

> Using sensors and the Industrial Internet of Things (IIoT) to collect real-time data from the reservoir and equipment.

> Analyzing this data using artificial intelligence techniques to detect any abnormal changes in pressure or production and taking immediate corrective action.

4. Optimal well design: -

> Using artificial intelligence to design wells in a way that minimizes environmental impact and maintains reservoir integrity.

> Determining optimal drilling locations and drilling techniques that minimize environmental impact and maximize extraction efficiency. (Hong Li- Haiyang Yu Nai Cao He Tian Shiqing Cheng,2020,p.p3)

5. Sustainable Environmental Management:-

> Applying artificial intelligence techniques to analyze the environmental impact of extraction operations and develop strategies to reduce these impacts.

> Monitoring air, water and soil quality using sensors and data analysis to ensure compliance with environmental standards and reduce pollution.

6. Reservoir Life Management:-

> Develop balanced extraction strategies that take into account the long life of the reservoir and preserve its resources in the long term.

> Use artificial intelligence to identify the best extraction practices that reduce reservoir degradation and increase its lifespan.

By implementing these procedures, optimal spatial management of oil reservoirs can be achieved, appropriate pressure can be maintained, reservoir life can be extended, and the environment can be preserved. (Ahmed Mustafa, 2023)

Third: The role that artificial intelligence plays in improving water injection operations for oil extraction.

Water injection operations are a common technique for improving oil recovery from reservoirs by maintaining pressure and pushing oil towards productive wells. Artificial intelligence plays a crucial role in improving these operations and increasing their effectiveness. Here is how artificial intelligence can help in water injection operations:

1. Historical data analysis:-

➢ Use artificial intelligence to analyze historical data related to previous water injection operations and their results.

➢ Build predictive models based on this data to predict the future performance of water injection.

2. Reservoir Model Design:-

➢ Develop 3D reservoir models using machine learning and deep learning techniques, taking into account the geological and hydrodynamic characteristics of the reservoir.

➢ Use these models to determine the best water injection locations and quantities to achieve maximum benefit.

3. Monitor and adjust the process in real time:-

➢ Use sensors to collect real-time data on reservoir pressures, water injection rates, and oil production rates.

➢ Analyze this data using artificial intelligence techniques to adjust water injection parameters in real time to ensure optimal pressure is maintained within the reservoir.

4. Optimize injection strategies:-

➢ Apply continuous optimization algorithms to develop dynamic injection strategies that respond effectively to reservoir changes.

➢ Determine the optimal time periods for water injection and the optimal quantities to achieve maximum oil recovery while minimizing costs.

5. Performance evaluation and adaptation:

➢ Use artificial intelligence to periodically evaluate the performance of water injection operations.

➢ Modify injection strategies based on the evaluation results to adapt to any changes in the reservoir or operational conditions.

6. Predicting environmental impacts:

➢ Analyzing the potential environmental impacts of water injection operations using artificial intelligence models.

➢ Developing strategies to reduce environmental impacts and ensure compliance with environmental standards.

7. Data management and integration:

➢ Collecting and analyzing data from various sources related to water injection operations, including geological and hydrodynamic data.

> ➢ Using artificial intelligence techniques to integrate data and provide comprehensive insights that help in making informed decisions.

By applying these techniques, water injection operations can become more efficient and effective, leading to increased oil recovery, reduced costs, and preservation of the reservoir and the environment. (Jassim Haji, 2023)

Fourth: Using artificial intelligence in the process of monitoring oil from the beginning of production to export platforms.

Artificial intelligence can be introduced into the process of monitoring oil from the beginning of production to export platforms and preventing its leakage or smuggling. These are major challenges that artificial intelligence can contribute to addressing effectively.

The following is an explanation of how artificial intelligence is used in this context:

1. Production monitoring

> ➢ Operational data analysis: Using artificial intelligence to analyze production data from wells and factories in real time to identify any unexpected deviations in production that may indicate leaks or smuggling.

> ➢ Failure prediction: Applying machine learning models to predict potential equipment malfunctions, allowing preventive maintenance and reducing the chances of leaks.

2. Leak detection

> ➢ Smart sensors: Installing sensors along pipelines and platforms to collect real-time data on pressure, temperature, and flow. Artificial intelligence can analyze this data to detect leaks immediately.

> ➢ Image and video analysis: Using computer vision techniques to analyze images and videos from surveillance cameras installed on pipelines and platforms to detect any leaks or illegal activities.

3. Preventing smuggling: -

> ➢ GPS and tracking: Tracking the movement of oil tankers and trucks using GPS and analyzing their paths using artificial intelligence to ensure that they only follow authorized routes.

> ➢ Pattern analysis: Using machine learning to analyze typical operational patterns and detect any deviations that indicate smuggling attempts.

4. Supply chain management

> ➢ Inventory monitoring: Using artificial intelligence to analyze inventory data at different stages of the supply chain to ensure that it is consistent with announced production and identify any discrepancies that may indicate leakage or smuggling.

> ➢ Demand forecasting: Analyzing market and demand data to determine the required quantities of oil and ensuring that the quantities transported and stored are consistent with these expectations.

5. Security and Access Control

> ➢ Biometric Control:- Using facial and fingerprint recognition technologies to control access to oil facilities and export platforms, reducing the chances of unauthorized access.

> ➢ Early Warning Systems:- Installing early warning systems based on artificial intelligence to detect any illegal attempts to access facilities or equipment.

6. Historical and Predictive Data Analysis:

> ➢ Historical Data Analysis:- Using artificial intelligence to analyze historical data related to production and transportation to identify potential patterns of leaks or smuggling.

> Predictive Models:- Developing predictive models based on artificial intelligence to identify areas and times most vulnerable to smuggling or leakage attempts and taking appropriate preventive measures.

The application of these advanced solutions contributes to enhancing the security and efficiency of oil production and transportation operations, reducing losses and protecting valuable assets. Is there a specific aspect of these solutions that you would like to know more about? (Opeyemi Bello[1], Javier Holzmann', Tanveer Yaqoob[1], Catalin Teodoriu[2], 2015, p.p. 128)

Fifth: The role of artificial intelligence in improving tax accounting processes.

Using tax accounting meters and matching the quantities delivered and received can be very effective in preventing oil theft and smuggling. Artificial intelligence can play a major role in improving this process. Here is how to implement this:

1. Installing tax accounting meters: -

> Smart meters: - Installing smart meters at all production and transportation points (such as wells, pipelines, oil tankers, and export terminals) to collect data accurately in real time.

> Data recording: - Automatically recording all data related to the quantities delivered and received in a central database.

2. Data collection and analysis: -

> Instant data analysis: - Using artificial intelligence to analyze the data collected from the meters in real time to monitor any unexpected deviations.

> Machine learning: - Applying machine learning models to identify normal operating patterns and detect any differences that indicate leakage or smuggling.

3. Quantities Matching

> Recorded Quantities Matching: Comparing the data recorded from meters at different points (such as production, storage, transportation, and export) to verify that the delivered quantities match the received quantities.

> Detecting discrepancies:- Using artificial intelligence to analyze the discrepancies between the delivered and received quantities and identify the possible causes of these discrepancies, whether due to leaks, smuggling, or measurement errors.

4. Alarm and Warning Systems:

> Instant Alerts:- Activating an alarm system based on artificial intelligence to send immediate alerts when any unjustified discrepancies between the delivered and received quantities are detected.

> Cause Analysis:- Providing detailed analyses of the possible causes of the discrepancies, which helps in taking appropriate action quickly.

5. Predictive Maintenance Management:

> Equipment Maintenance:- Using the data collected by the meters to analyze the performance of the equipment and determine when it needs preventive maintenance, which reduces the chances of breakdowns and leaks.

6. Enhancing Security:

> Access Control: Using AI technologies to control access to meters and monitor any unauthorized attempts to tamper with data.

> Video Analysis: Analyzing video footage from surveillance cameras installed at main checkpoints to detect any unusual activity indicating smuggling or tampering.

7. Periodic Reports and Analyses:

➢ Periodic Reports: Producing periodic reports showing the quantities produced, transported, and exported, and comparing these quantities with the data recorded from the meters.

➢ Advanced Analyses: Using AI to provide advanced analyses that help in making decisions based on accurate data and future expectations.

8. Integration with government systems:

➢ Automatic Reporting: Integrating the system with the relevant government systems for tax accounting to provide automated and accurate reports that facilitate control and verification processes. (Marco Cocchi, Leone Mazzeo)

Sixth: Using AI in oil marketing operations.

Implementing these measures can enhance transparency and efficiency in oil production and transportation operations, effectively reducing waste and preventing smuggling. Is there a specific aspect you would like to know more about?

Marketing oil using artificial intelligence (AI) to get the highest profits can be achieved through several strategies. Here are some of the best ways:

1. Big data analysis:-

➢ Using AI to analyze huge amounts of data related to oil supply and demand, and predict future market trends.

➢ This can help in making informed decisions about production and pricing.

2. Supply chain optimization:-

➢ Using AI to improve the efficiency of the supply chain, including transportation, storage, and distribution.

➢ Reducing operational costs and increasing efficiency can lead to increased profits.

3. Dynamic pricing:-

➢ Using AI algorithms to determine dynamic prices based on changing factors such as supply and demand, market fluctuations, and competition.

➢ This can help in achieving the highest possible return on each deal.

4. Risk Management: -

➢ Using AI models to predict risks associated with market fluctuations and take appropriate preventive measures.

➢ This can help reduce potential losses and increase financial stability.

5. Targeted Marketing: -

➢ Using AI to analyze customer behavior and needs and direct marketing campaigns more effectively.

➢ This can lead to increased demand for oil products and enhance profitability.

6. Sentiment Analysis: -

➢ Using AI techniques to analyze sentiment and general trends in the media and social networks.

➢ This can help predict the impact of news and events on oil prices and make appropriate decisions.

By integrating these strategies, oil companies can make the most of AI to increase their profits and improve their operational efficiency. (Al-Rikabi, Sadiq, 2023)

Abstract

The use of artificial intelligence (AI) in the oil sector can provide significant benefits, including improved efficiency, reduced costs, and increased safety. The following are conclusions and recommendations on the use of AI in this field:

First: Conclusions

1. AI can improve operational efficiency by analyzing big data from oil wells and equipment, which helps improve production and maintenance operations.

2. AI models can predict failures before they occur by analyzing past performance data, enabling predictive maintenance and reducing unplanned downtime.

3. AI helps analyze geological and geophysical data to more accurately locate oil and gas, reducing the risks and costs associated with exploration.

4. AI can be used to monitor working conditions and analyze safety data to identify potential hazards and intervene before accidents occur.

5. AI enables processing and analysis of large amounts of data faster and more effectively, which helps in making informed decisions.

Secondly: Recommendations

1. Oil companies should invest in AI technologies and develop the necessary infrastructure to collect and analyze data effectively.

2. Provide training programs for employees to enable them to use AI technologies effectively and enhance their technical skills.

3. Build partnerships with technology companies and research institutions to develop innovative solutions tailored to the oil sector.

4. Companies should apply strong ethical principles in the use of AI to ensure privacy, security, and transparency in the collection and use of data.

5. Initiate pilot projects to test AI technologies in different environments and analyze the results to identify benefits and areas for improvement.

6. By following these conclusions and recommendations, oil companies can leverage AI to improve their operations, increase efficiency, and reduce costs and risks.

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