



### Business challenge

Determining the hydrocarbon storage capacity and production characteristics of carbonate rock samples requires time and technical expertise. ADNOC wanted to speed the process without sacrificing accuracy.

### Transformation

Analysis of rocks acquired from deep in the earth helps oil and gas companies optimize field development plans, but the process requires both time and expertise. With help from IBM® Services, the IBM Cloud™ platform and the IBM Watson® Visual Recognition service, ADNOC is harnessing the power of AI to transform and accelerate the process.

### Results

**Increases delivery speed and consistency**

of reservoir rock sample descriptions

**Accelerates model construction**

to de-risk multibillion-dollar reservoir development decisions

**Preserves expertise**

that petrographers have spent decades developing

# Abu Dhabi National Oil Company (ADNOC)

## Enhancing accuracy, consistency and speed of rock analysis to support better decisions

Founded in 1971, ADNOC is a major diversified group of energy and petrochemical companies. It produces about three million barrels of oil and 10.5 billion cubic feet of raw gas each day. Its integrated upstream, midstream and downstream activities are carried out by 14 specialist subsidiary and joint venture companies.

*“By developing an innovation partnership with IBM Watson, we are ensuring that the level of description and interpretation remains at the expert level.”*

—Douglas Boyd  
Technical Center Petrophysicist  
Abu Dhabi National Oil Company

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## A time-consuming process

Abu Dhabi, the largest of seven emirates in the United Arab Emirates (UAE) in both area and population, is one of the world's richest sources of hydrocarbons. Nearly nine percent of the world's known oil reserves and five percent of its natural gas reserves lie within carbonate rock deep below Abu Dhabi's deserts and waters.

ADNOC is one of the world's largest producers of oil and gas. It recognizes the value of incorporating AI into its business processes in order to optimize operations, enhance recovery and improve decision making. ADNOC is leading the adoption of AI by streamlining the way it studies Abu Dhabi's hydrocarbon reservoirs.

Oil producers like ADNOC seek to maximize oil recovery efficiency by using the fewest wells, the least amount of water and the lowest expenditure. Working towards this goal, engineers construct digital reservoir simulation models to test reservoir behavior, including storage space (porosity), the ability to flow (permeability) and the amount of oil (potential recovery). The models allow engineers to consider different development characteristics, including well spacing, the type of well, the number of wells and pressure maintenance schemes.

The foundation of a reservoir simulator's predictive accuracy used to guide management's

multibillion-dollar field development decisions—is the fidelity of the geological model. Geology relies on visual microscopic rock descriptions obtained using an optical microscope in a slow, labor-intensive process that has barely changed since the birth of modern geology in 1793.

Furthermore, when a petrographer with decades of experience retires, ADNOC loses that person's accumulated experience. And with so many fast-paced, highly technical careers to choose from, few young people are choosing to become petrographers. For these reasons, ADNOC sought a way to preserve its experts' experience and enhance the process, possibly within a machine.

## A fundamental shift in how science gets done

For the past several years, IBM has focused on Industry 4.0 initiatives in the oil, gas and petrochemicals industry in the Middle East, leading on digital transformation programs. Partnering with national oil companies in the region is a top priority as IBM works to deliver value through pragmatic partnerships that center on AI, machine learning, the industrial Internet of Things (IoT), cybersecurity and blockchain.

At the same time, Hani Nehaid, ADNOC's Geoscience Team Leader, and his team were considering using AI to augment and accelerate the thin section description process. So when

Nehaid, along with Douglas Boyd, Technical Center Petrophysicist and Hesham Shebl, Technical Center Geologist (Petrographer), encountered an IBM representative at an industry dinner, the potential of utilizing AI and Watson™ solutions to address this challenge with visual recognition technology became a subject of mutual interest.

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***“The more data points we can use, the better and more efficient our models, our development plans and our ultimate hydrocarbon recovery will be. This is fundamental to the success of our industry.”***

—Hesham Shebl, Technical Center Geologist (Petrographer), Abu Dhabi National Oil Company

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Boyd explains: “We had a short discussion with the IBM rep about how we could pursue this aspiration. We started by working together with their data scientists to repeatedly train the platform. Then we prepared a small sample set for them to analyze as a proof of concept. This delivered very accurate results, equivalent to our most experienced petrographer. We were very impressed, and we moved ahead from there.”

In this case, an IBM team comprising representatives from IBM Industry, IBM Services and IBM Cloud

divisions worked with ADNOC to begin the first phase of a multi-phase project. Together, they moved from simple to increasingly difficult tasks, employing AI-driven elements of cognitive image recognition, natural language processing and regression. The team spent four weeks training the Watson Visual Recognition service to label two-dimensional (2-D) rock images according to their visual characteristics.

As the project continues, the team plans to train the Watson solution to extract additional information from the images. Explains Shebl: “We want to greatly expand the rock image thin section data we capture from Abu Dhabi's subsurface. Many of the management and development decisions we make are based on the properties and interpretations our petrographers make. The more data points we can use, the better and more efficient our models, our development plans and our ultimate hydrocarbon recovery will be. This is fundamental to the success of our industry.”

## Radical increases in speed and accuracy

ADNOC's use of AI to augment geological research has already been successful. Though drilling and scanning rock samples must remain manual processes, image classification is now much faster and more automated. Because

Watson can analyze 527 images per second, analyzing all of the samples taken from a single reservoir now takes only minutes—not months.

Beyond the increase in classification speed, Nehaid and his team are already experiencing several other key advantages of the AI-driven Watson solution. With analysis time reduced significantly, ADNOC can evaluate many more rock samples from many more wells, generating more deterministic data. This, in turn, leads to more accurate and effective subsurface models.

The solution also improves consistency. Says Nehaid: “Two different geologists with different levels of experience will provide different levels of accuracy in their rock descriptions. With IBM Watson, we are ensuring that the description and interpretation is always at the expert level and that it will remain consistent throughout the years.”

He continues: “These factors are enhancing our subsurface models, which in turn significantly de-risk and support better investment decisions in multibillion-dollar field developments.”

Watson’s AI libraries provide ADNOC with a way to preserve its petrographers’ decades of experience without having to undergo the years-long process of bringing new experts up to speed. Says Nehaid: “The solution lets us free up our geologists’ time to focus on model generation, as well as transfer our experts’ knowledge and experience to the machine so we can take advantage of their experience after they move on.”

Nehaid and his team are optimistic about the future of the project. Says Shebl: “Ultimately, I see machine learning assisting the entire process of creating representative geological models and helping us create a clear understanding of the subsurface. Cutting-edge technology and innovation partnerships are allowing us to create development plans that help us achieve our strategic goals: to increase recovery at the end of a field’s life to 70 percent, and ultimately to help create a more profitable ADNOC upstream.”

IBM, too, is encouraged by the success of the ADNOC engagement. Talal Malas, Cognitive and Analytics

Practice Leader with IBM Middle East and Africa, explains: “We believe that AI is a partnership between man and machine. This initiative with ADNOC is one of the most exciting use cases in the chemicals and petroleum industry—cognitive geology, which emulates geologists and petrophysicists in classifying rock samples with high accuracy at an enormous scale. It’s the perfect example of how AI boosts productivity and frees up highly skilled experts for higher value activities.”

Yahya Mahmoud, Industry Leader for Industrial Products and Chemicals and Petroleum Industry for IBM Middle East and Africa, adds: “At IBM we believe in innovation that matters, for our company and for the world. We dare to create original ideas with focus and dedication to our clients’ success. The partnership between ADNOC and IBM brought these values to life. The entire value chain builds up from the geosciences, it was intuitive to start there. We share ADNOC’s aspiration of further developing the solution to tap into more data points from the subsurface to enhance hydrocarbon recovery.”

## Solution components

- IBM® Cloud™
- IBM Services
- IBM Watson® Visual Recognition

### Take the next step

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