INTELLIGENT INTEGRATED SUBSURFACE MODELING (IISM)

Addressing ADNOC E&P Challenges

ADNOC RESEARCH AND TECHNOLOGY DEVELOPMENT

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AGENDA

▪ Overview – ADNOC
▪ Challenges & Solutions
▪ IISM Program
▪ Solution Examples
▪ Results & Impacts
ADNOC BUSINESS & 2030 STRATEGY

ADNOC is the largest oil and gas company in the UAE and is among the top ten in the world.

- **3.5 million** barrels of oil production capacity per day
- **~11 bcf** of natural gas production capacity per day

**More Profitable Upstream**
- **Increase Capacity**
  - From 3 to 5 MMbd capacity
- **Improve Efficiency**
  - 70% recovery from mature assets
  - Further savings in operational initiatives
- **Access New Resources**
  - New exploration blocks for concession

**More Sustainable & Economic Gas Supply**
- **Unlock Undeveloped reservoirs**
  - 1.1 Bscfd by 2025
- **Develop Unconventional**
  - 1 Bscfd by 2030
- **Climate, Emissions, and Energy**
  - Decrease GHG by 25% by 2030
  - Expand CCUS capacity by 500%
ADNOC & INDUSTRY CHALLENGES

Integration
- Fallback in production guidance due to lack of integration
- Lack of production optimization action tracker
- Fast outdating model's requiring constant updates
- Large number of inactive strings
- Complex mapping of stacked channels & thin sands
- Poor recovery due to high reservoir complexity
- Flow assurance issues impeding well rates
- Challenging process system optimization of sour gas production

Subsurface & Surface
- Time consuming modeling & simulation workflows
- Absence of adaptive & intelligent drilling solutions
- Large model size with long simulation runtimes

Productivity
- Massive database with complex data structure
- Laborious & time-consuming data processing workflows
- Isolated disciplines hindering fast & efficient model update
- Complex decision making under uncertainty
- Complex setup to keep reservoir models up to date
ADNOC IISM SOLUTIONS & ROADMAP

ADNOC Challenges

Integration
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Subsurface & Surface
- Absence of adaptive & intelligent drilling solutions
- Inactive simulation workflows
- Large number of inactive strings
- Poor recovery due to high reservoir complexity
- Large model size with long simulation runtimes
- Time consuming modeling & simulation workflows
- Absence of adaptive & intelligent drilling solutions

Productivity
- Fast outdated models requiring constant updates
- Large number of inactive strings
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Seismic
- ML-Assisted Seismic Fault Interpretation
- ML-Seismic Horizon Tracking & RGT Model Generation
- ML-Seismic Stratigraphy
- ML-Seismic Conditioning

Petrophysics
- ML-Assisted Log QC & Reconstruction
- ML-Assisted Data QC Lab
- ML-Assisted Data Pre-Processing Lab
- Permeability Prediction & Rock Typing Framework
- ML-Assisted Saturation Height Modelling
- Optimal Layer Size to Capture All Heterogeneities

Static
- Static Model Health Check
- Permeability Streak Integration
- Intelligent U&O Processing
- Fast Track Dynamic Simulation Testing
- Horizontal Well Calibration Function
- Water Saturation Modeling

PVT
- Intelligent PVT & EOS modeling - Foundation
- Gas Injection Laboratory Data Prediction using ML
- Intelligent U&O Processing
- AI Flash Embedded in Reservoir Simulation
- Gas Reservoir / Gas Cap Fluid Properties Prediction using ML
- Entire PVT Laboratory Data Prediction using ML
- Consistency Check of PVT Laboratory Data

Dynamic
- Dynamic Model Update & Consistency Check
- IISM Integration to Build Reservoir Digital Twin
- Automated Dynamic Model Initialization
- ML-Based Model Calibration
- Value of Information Surveillance for Optimum Reserve/Well Monitoring
- AI-Driven Well Placement Optimization Under Uncertainty

Drilling
- Intelligent Drilling Risk Analysis & Integration
- Equipment Recommender System (Bits & Motors) & Drill Bit Survival Modeling
- Intelligent Drilling Risk Analysis & Integration
- Drilling Parameter Roadmaps
- Equipment Recommender System (Bits & Motors) & Drill Bit Survival Modeling

Phase 1
Phase 2
Objectives

- Enable UAE and ADNOC 2030 Digital Strategy
- Enable Integrated Projects Execution De-Risking

Project Phases

- Phase 1
  - Proof of Concepts of AI Technology
  - Leveraging AI & Automation in Subsurface Modeling
- Phase 2
  - System Expansion & Integration
  - AI & Data Integration Across Disciplines
IISM - INNOVATION BUILDING BLOCKS

**Subsurface Disciplines**

- Seismic
- Petrophysics
- Dynamic
- PVT
- Production
- Process
- SCAL
- Drilling
- AI

**Building Blocks**

- **Intelligence:** embedding AI and automation at all levels to extract insights, optimize processes and elevate people productivity.

- **Integration:** enabling a smooth data flow between AI solutions ensuring a deep integration to avoid integration losses.

- **Operationalization:** enabling a seamless journey from modeling to operations optimization.
Seismic
ML-based solution to automate seismic stratigraphic interpretation & detection of interesting stratigraphic features.

Petrophysics
ML-assisted solution to automate QA/QC & reconstruction of well log & core (SCAL & RCA) data.

Static
ML-driven solution to identify & predict permeability clusters per zone, per rock type & even in the absence of rock types.

Dynamic
ML-based solution to generate “ensemble” of history matched reservoir models using intelligent proxy models.

PVT
ML-driven automated solution that predicts gas injection laboratory experiments for EOR studies.

Drilling
ML-based solution that analyzes drilling data to identify an optimum set of drilling parameters.
IISM – RESULTS & POTENTIAL IMPACTS

“... Over the next 30 years the IISM has the potential of delivering more than **10 billion dollars** in added value to ADNOC alone. And multiples of this to the industry at large...”

Reduce FDP lifecycle from over **3 years** to under **5 months** resulting in massive value generation.

Establish **intelligent processes** for faster data processing and interpretation resulting in **97% efficiency gain**.

Unlock opportunities through **AI-driven FDP optimization** leading **3-5% increase** in production.
THANK YOU