MAKING THE RIGHT DECISIONS FASTER

A COMPREHENSIVE GUIDE TO ARTIFICIAL INTELLIGENCE FOR OIL & GAS

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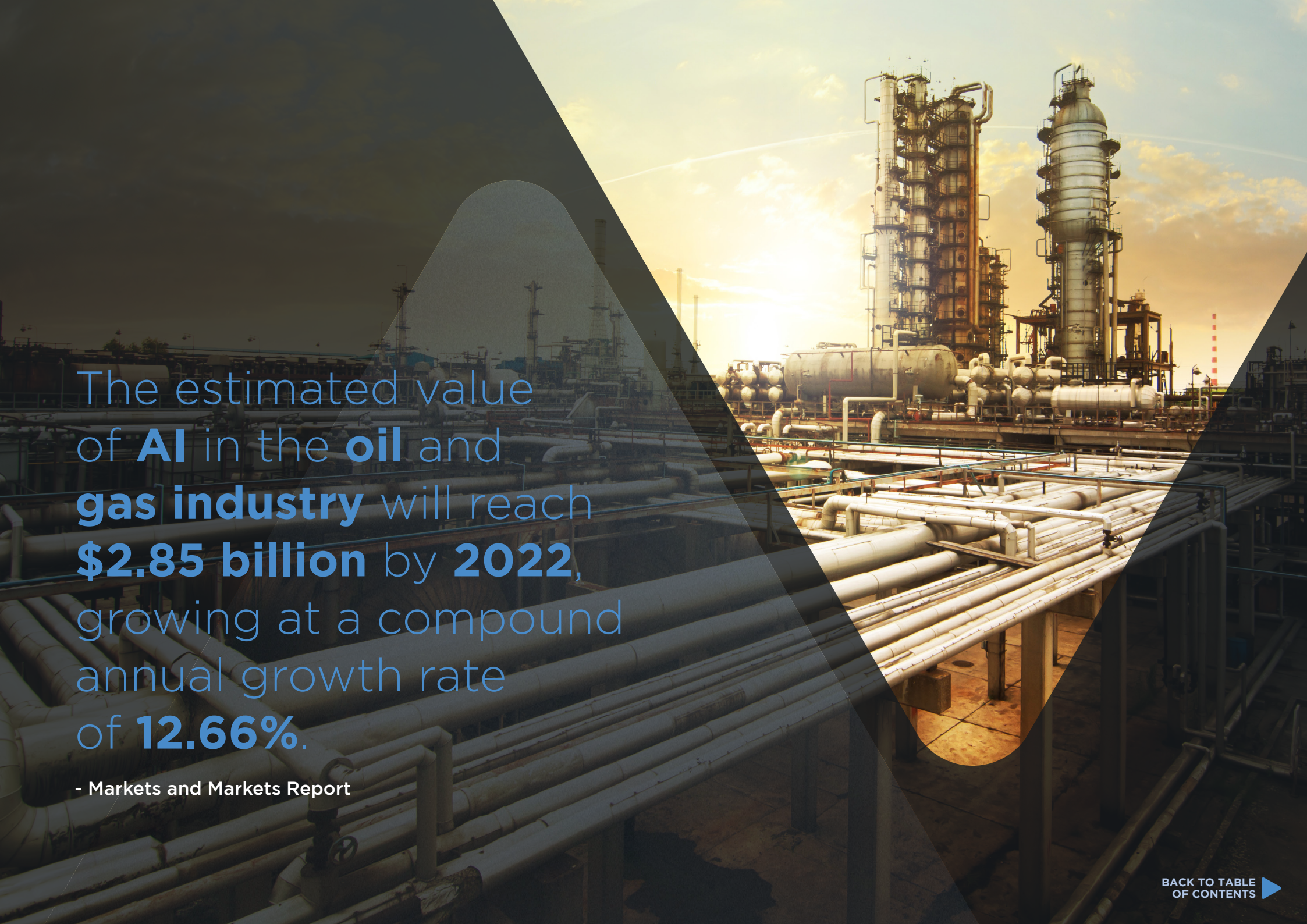

The estimated value of **AI** in the **oil** and **gas industry** will reach **$2.85 billion** by **2022**, growing at a compound annual growth rate of **12.66%**.

- Markets and Markets Report

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INTRODUCTION

Artificial Intelligence is a tool, not a threat. Discover how you can adapt these tools to enable your business.

An introduction to Artificial Intelligence.

As the adoption of artificial intelligence (AI) grows across industries, so does the need for education on how businesses can navigate AI strategies.

So what exactly is AI? Simply stated, AI is the ability of a machine or computer program to think and learn. Although most people have probably heard about AI by now, it can be somewhat of a buzzword and can be seen as overwhelming or too challenging to implement in your own business.

AI is not new and it is not scary, but it is something that companies of all sizes need to embrace.

By making sense of the data your company collects every day, AI can unlock new possibilities and boost productivity to drive your business forward.

This business enabler will help you use the data that you collect – from acquired data to trends, image and video footage, and many things in between – to make better decisions, increase operational efficiency, and reduce risks.

How, where, and when AI can be used within your business may surprise you. Let's take a deeper look.

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DEBUNKING AI MYTHS

According to a recent article by Brookings Institute, "Few concepts are as poorly understood as Artificial Intelligence."

Before we look at some of the ways that AI can help enable your business, let's first demystify some of the common misconceptions about AI.

1

MYTH

AI is too high tech for my business.

FACT

Regardless of how technical your business is, AI is an enabler and can be utilized across companies of all sizes.

2

MYTH

AI is a fad. I should wait for others to test it out first.

FACT

AI has been around for many years and is evolving from a tech trend to a business requirement that should be adopted to gain maximum benefits.

3

MYTH

AI is too complex for my company to implement.

FACT

Implementing AI can seem challenging, but it doesn't have to be! This eBook will explore a number of ways to enable your path to AI success.

4

MYTH

We have too much unstructured data; I don't even know where to start.

FACT

All AI projects start with complex and unstructured data, so you have nothing to be worried about. Machine and Deep Learning can help solve this challenge for you.

5

MYTH

I need to invest huge amounts of money to even begin starting AI projects in my company.

FACT

AI is an evolving technology that you can scale in accordance with your business needs. You don't have to invest big; start small and simply scale as your requirements grow.

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USE AI TO YOUR ADVANTAGE

"**AI** can help find cost reductions by tackling a range of problems. Its deployment in upstream operations could yield collective savings in capital and operating expenditures of **$100 billion to $1 trillion by 2025**."

- PricewaterhouseCoopers

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USE AI TO YOUR ADVANTAGE

How can you use AI to tackle problems
and find cost reductions in your common workflows?

WHAT IF

AI took the jobs you didn't want to do and did them for you?

WHAT IF...

- Tests were reviewed automatically and provided you with accurate parameter recommendations?
- Tedious and error-prone tasks were automated and produced accurate results?
- Certain types of noise, such as bad traces, linear noise trends, or multiples could be removed intelligently?

WHAT IF

AI enabled your business to make better decisions and reduce risk?

WHAT IF...

- You could better plan your projects based on previous project statistics?
- Your drilling program was designed based on information about previous successes and failures?
- Your costs were reduced and profits were increased based on data analysis and not emotionally biased decisions?

WHAT IF

AI allowed you to increase your operational efficiency?

WHAT IF...

- Downtime was decreased and repair costs were minimized by predicting and preventing catastrophic failures?
- You could more easily pass on knowledge to new generations of employees?
- You could better monitor operations 24/7/365 over X years at Y locations?

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AI MAKES LIFE EASIER

What if AI took the jobs you didn't want to do and did them for you?

Position AI to do the monotonous, error-prone tasks that geophysicists dread, and enable them to do more high-value work that they excel at and actually enjoy.

Within traditional E&P work, there are quite a few tedious and error-prone tasks, such as:

- Field equipment QC.
- Processing tasks including trace editing, first break picking, algorithm parameter testing, velocity analysis, velocity model building, and continuous quality control.
- Interpretation tasks, such as picking horizons, picking faults, generating geobodies, and identifying potential traps.
- Recovery tasks, such as drilling program design, how, where, and when to frac, how to keep the drill in the formation, and how to get the resource to the surface.

How AI can help:

- AI allows your geo-scientists to concentrate on the areas where they bring the most value including improving techniques and developing process improvements.
- AI can enable your machines to do the tedious, repetitive tasks that can be trained and automated.

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AI MAKES YOUR BUSINESS BETTER

What if AI enabled your business to make better decisions and reduce risk?

Position AI to help you base your decisions on data and history.

Problem: Planning the drilling program for safety against overpressure, leakage, blowouts, and fire, as well as planning secondary recovery operations for safety to maximize resource recovery can be difficult.

AI Solution: Let AI do the statistical analysis and make recommendations on ways to progress in the project based on past successes and avoid the pitfalls based on prior failures.

Problem: Deciding on lease locations and potential reserves to include in the program can be a challenge.

AI Solution: Networks can be trained to know which areas make good prospects, history of recovery in the area, depths of recovery, successful recovery efforts, accidents, and expected rates of recovery with different simulation techniques.

Problem: Making drilling decisions to minimize the risk of drilling dry holes can be time consuming.

AI Solution: AI can be used to help geologists and petroleum engineers concentrate on the mechanics of the problem instead of the routine decisions that can be subject to emotions, allowing AI to help make decisions based on historical data.

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AI INCREASES OPERATIONAL EFFICIENCY

What if AI allowed you to increase your operational efficiency?

Position AI to perform monitoring and potential problem detection/prevention in your business operations.

Exploration & Production operations can become very expensive and processes can be quite cumbersome. Any number of things can go wrong that can result in a loss of revenue and increased cost due to downtime and equipment replacement. But what if you could solve some of these operational shortcomings with AI solutions? Using AI, you can base your decision making on data-driven metrics and historical information as opposed to more manual processes that rely on human resources. Here are some ways that AI can help:

Problem: Equipment monitoring is currently very manual and in-person monitoring is sometimes necessary to detect possible issues.

AI Solution: Systems can be monitored 24/7/365/X-Years/Y-Locations to help detect potential problems through continuous monitoring and feedback systems. Instead of relying on periodic inspections for finding and predicting failures, continuous monitoring allows issues to be discovered and dealt with before they become catastrophic.

Problem: Expensive equipment breaks catastrophically or unexpectedly

AI Solution: Networks can learn how equipment should look and sound, and what failures look like as they progress in severity. A little bit of rust can be distinguished from dangerously corroded rusty areas; hoses and pipes can be monitored for leaks or potential areas of weakness.

Problem: Providing new employees with necessary skills for proper equipment management requires expensive, and potentially dangerous, on-site training.

AI Solution: AI combined with VR/AR can be used to build and conduct virtual training based on known hazards without the costs and dangers of on-site training.

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CHALLENGES & OPPORTUNITIES IN E&P

Now that we have learned about the ways that AI can enable your business, we'll look at some of the specific challenges that AI can help you solve.

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CHALLENGES & OPPORTUNITIES IN E&P – ACQUISITION

As data are collected, continuous monitoring can save time and reduce total cost by helping to prevent re-work.

Setting the data collection geometry to get the proper positioning, density, and redundancy can be challenging. Leveraging prior knowledge can help with making these decisions.

Collection system monitoring can be tedious as conditions can change rapidly. Getting the survey information and the recorded data synchronized is another challenge. Modern equipment helps, but errors still occur. AI can use the recorded data to help identify issues with the equipment and geometry problems.

Picking first breaks is one of those cases where "you don't need them until you need them". When it's easy, they aren't necessary, but when it's hard to see and pick them, you need them more than ever, and the more accurate they are the better. Using AI to enhance the accuracy and decrease the time to generate the picks is critical for static estimation.

CHALLENGES

- Time and cost of a seismic collection operation
- Determination of collection parameters
- Monitoring collection equipment
- Survey geometry accuracy

OPPORTUNITY

- Continuous monitoring of data quality
- Size and spacing of spread and design of Slip Sweep timing
- Continuous statistics for failure prediction and operational accuracy
- Continuous checking for live spread, coordinates, elevations, and obstacles
- Enhancing the accuracy and timing of this critical step for static estimation

ACQUISITION

- Data quality
- Recording system performance

LEVERAGE AI / ML TO:

- Design survey geometry based on past successes and failures
- Increase confidence that the recorded data will be useful
- Monitor equipment and schedule regular maintenance and increase catastrophic failure prevention
- Increase efficiency, reduce overall project cost, and increase profit

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CHALLENGES & OPPORTUNITIES IN E&P – PROCESSING

Parameter testing in processing can be challenging and is often subjective.

Given the size of the data volumes and the complexity of the processing sequences it can be very time consuming to prepare, execute, and analyze typical algorithm tests. Many test results could be automatically compared against theory to help with choosing the optimum parameters.

Data QC after each processing step is critical to the success of the operation. QC can be subjective and sparse. Automating the analysis of the expected improvement from one process to the next can help with understanding and adjusting the parameters and process order.

Many processes also require secondary input data, such as velocity models and design gates. AI can be used to assess the quality of the support data for each step.

CHALLENGES

- First Break Picking
- Parameter test analysis
- Processing sequence determination
- Processing step QC and analysis
- Velocity model and earth model building and depth imaging accuracy

OPPORTUNITY

- Quantify test results against known correct answers or observed criteria
- Analysis of and dependency checking for process order and parameters
- Validate the test results against known criteria
- Continuous checking for convergence instead of divergence

PROCESSING

- Efficiency
- Accuracy
- Automatic parameter and workflow determination

LEVERAGE AI / ML TO:

- Improve processing algorithm order, parameterization, results analysis, and dependency resolution
- Reduce scientist frustration and burnout
- Increase efficiency and accuracy of detailed analysis steps, such as first break identification, velocity analysis, and step to step QC of the pre-stack and stacked data volumes

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CHALLENGES & OPPORTUNITIES IN E&P – INTERPRETATION

Fault and horizon interpretation is the heart of the exercise.

Known geologic horizons and markers are identified in the seismic volumes and mapped spatially to help the drilling engineers predict depths to layers. This interpretation can be tedious and gets more problematic as the complexity of the geology increases and the quality of the migrated seismic data volumes decreases. Automating and optimizing this step in the sequence has been the subject of different research projects for decades. Recent advances in AI have enabled automation of this particularly important and complicated step.

Seismic attributes can be added to the interpretation to give more information and increase corroborative evidence related to the interpretation. This adds value, reduces risk, and improves the overall model, which will in turn improve the depth imaging results.

CHALLENGES

- Fault and Horizon interpretation
- Incorporation of post-stack and pre-stack seismic attributes into the interpretation
- Well log interpretation
- Synchronization of seismic and wells in depth
- Seismic signature interpretation and analysis

OPPORTUNITY

- Pick accurate faults and horizons more efficiently
- Add additional corroborative evidence to the interpretation
- Increase efficiency and accuracy of well log interpretation
- Ensure that the seismic is at the proper depth and spatial position
- Automate the location of potential bright spots or flat spots

INTERPRETATION

- Horizon and fault interpretation
- Geobody interpretation

LEVERAGE AI / ML TO:

- Increase efficiency in classical geologic horizon and fault interpretation
- Improve earth models by using known information as a basis for identifying transitions and improving interpolations between known data points
- Improve the location and positioning of potential reservoirs to help the drilling engineers plan well bore paths and construction

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CHALLENGES & OPPORTUNITIES IN E&P – RESERVOIR MODELING

There are many variables to consider when planning a well.

Well trajectory, mud density and composition, surface waste management, which drill bits to use, and selection of additional sensors and equipment are all variables that must be taken into account when planning a well. AI can be used to tap into the wealth of information that exists about previous and current wells to help plan successful programs. Using AI to compare known objectives and parameters to previous successes and failures can be critical to planning successful drilling programs.

Hydraulic fracturing can be very costly and has high risk involved. Knowing where to frac and how to conduct the operation without doing undesirable damage to either the well bore itself, surrounding rocks, or neighboring formations is imperative. Proposed fracturing parameters can be compared to historical information to help verify the well completion program.

CHALLENGES

- Drilling program design, mud recipe, pressure management
- Fracking program design and execution
- Recovery methods and resource management
- Primary and secondary recovery program design and execution

OPPORTUNITY

- Optimize the drilling program for distance and safety
- Optimize the location of the fracturing stages in the well bores throughout the reservoir
- Optimize the resource recovery based on prior knowledge and conditions
- Design secondary recovery operations based on existing knowledge

RESERVOIR MODELING

- Volumetrics
- Reservoir simulation

LEVERAGE AI / ML TO:

- Develop drill plans based on prior experience and knowledge of successes and problems
- Define the fracking program to hit the optimum spots with the right pressure to maximize production based on previous experience
- Design the recovery procedures based on prior experience to enhance safety and optimize resource volumes

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GET STARTED ON AN AI PROJECT

Let's get started!

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HOW TO GET STARTED ON AN AI PROJECT

Getting started doesn't have to be scary.

Beginning any project can seem overwhelming, but beginning an AI project? That sounds intimidating!

Good news: it doesn't have to be as complicated as it sounds.

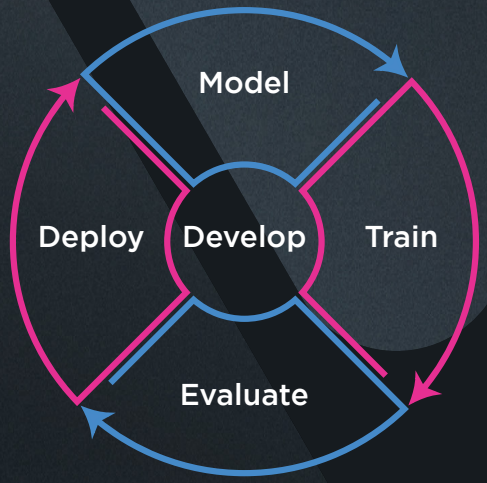
The Development Stage

To kick off your AI project, you will start in the development stage. In this stage, AI developers, or data scientists, will use powerful client devices to create, model, develop, and ultimately deploy your AI project. Then, once a solution has been deployed, a powerful workstation at the edge allows you to continue to collect and sort data in near real-time.

THE STARTING POINT OF AI PROJECTS

AI developers train complex models (learning algorithms) using data such as text, images, voice, and video.

The ultimate goal of this AI development phase is to extract relevant insights that enable more efficient business processes.



EDGE COMPUTING

Once an AI model has been refined and perfected, it is then deployed in the real world. The use of workstations at the edge allows you to acquire, analyze, sort, and inference data in near real-time.

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WHAT HARDWARE DO YOU NEED TO GET STARTED?

Now that we have looked at how to get started on your AI project, you'll need to equip yourself with the correct tools to get the job done.

A mistake that many companies make is to immediately begin their project by going to the cloud or to the data center. This is expensive and doesn't necessarily provide the performance that your data scientists need to be agile and productive in their development.

A high-performance workstation provides the best solution for your data scientists to begin their AI projects.

How Workstations Augment Cloud

Cost Management

Unlimited computing comes at a cost and is not efficient or agile

Data Security & GDPR

Recent regulation changes can limit the use of cloud computing

Visualization

Effortlessly explore and interact with billions of records in milliseconds

Why Workstations Over Servers

GPU Isolation per Data Scientist

Using locally hosted servers w/ GPUs can be cumbersome - not 1:1

Oversubscribed Usage

Data Scientists can be easily frustrated when hardware is not available

Software Flexibility & Optimization

AI workloads vary and migrating systems can impact productivity

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WHY WORKSTATION FOR AI PROJECTS?

High performance workstations allow you to “get it right” before scaling your AI solution to ultimately solve your business objective.

Training AI models can demand vast amounts of processing power, system memory, storage, and a number of GPUs. Workstations have the power and performance to handle even the most complex AI projects.

Why Workstation for AI

CPU & PCI-E Heavy Workloads

Both processor GHz & clock speed

Memory Intensive Projects - 64GB+

Larger AI models = more memory - 384GB is not uncommon

Multi-GPU Configurations

GPU accelerated workloads can use GPU Framebuffer

SSD & Storage Rich Specifications

Storage speed & latency is important

I/O & Connectivity Requirements

Regardless of the size/location of data - access is important

Ubuntu Linux OS Certifications

Open Source Developer Community

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CONFIGURING A WORKSTATION FOR AI PROJECTS

Artificial Intelligence workloads can be notoriously compute intensive and require large amounts of power to complete model training tasks accurately and efficiently.

AI SOLUTIONS REQUIRE POWER & PERFORMANCE

- Intel® Xeon® Processors
- ECC Memory
- NVIDIA® Quadro® GPU
- Storage

- I/O & Connectivity
- OS & Frameworks
- Scalability & Design
- Security & Reliability

Data scientists need to create their own sandbox-style environments for early model development on the desktop. Since these AI workflows need to learn from millions of parameters inside of every training model, it is critical that users can securely access their data with both speed and accuracy.

Training AI models can demand vast amounts of processing power, system memory, storage, and a number of GPUs.

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CONFIGURING A WORKSTATION FOR YOUR AI PROJECT

AI Workstations for Data Science

To make it even easier to get started on your AI project, Lenovo has created a new class of workstations that are configured with AI solutions in mind. Built on the world's most advanced NVIDIA® Quadro RTX™ GPUs, the Lenovo AI workstation is perfect for not just handling, but accelerating, AI projects such as data preparation, model training, and visualization.

The AI Workstation maximizes productivity, reduces time to insight, and lowers the cost of your AI projects in one robust, readily deployable solution.

NVIDIA

RECOMMENDED **LENOVO AI WORKSTATIONS**

ThinkStation P920

ULTIMATE AI DATA SCIENCE WORKSTATION

- HUGE AI MODEL TRAINING WORKFLOWS
- DATA PREPARATION & VISUALIZATION

- 2x Intel® Xeon™ SP 8C+ CPUs up to 4.4GHz
- 2x NVIDIA® Quadro RTX™ 8000 GPUs w/NVLINK
- 384GB+ ECC DDR4 Memory
- 1TB PCIe M.2 SSD Storage
- Ubuntu 20.04 LTS Certified Linux OS
- NVIDIA® AI Data Science Software Stack

ThinkStation P520

POWERFUL AI DATA SCIENCE WORKSTATION

- SMALLER SIZED AI MODEL TRAINING WORKFLOWS
- DATA PREPARATION & VISUALIZATION

- Intel® Xeon™ W Class 6C+ CPUs
- 1-2x NVIDIA® Quadro RTX™ 8000 GPUs
- 64GB or 128GB DDR4 Memory
- 512GB or 1TB PCIe M.2 SSD Storage
- Ubuntu 20.04 LTS Certified Linux OS
- NVIDIA® Data Science Software Stack

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WHY CHOOSE LENOVO FOR YOUR AI PROJECTS?

Lenovo Workstations are at the forefront of Artificial Intelligence: delivering maximum levels of performance, ultimate platform scalability, and the industry's highest levels of reliability.

The entire Lenovo Workstation P Series portfolio has been engineered from the ground up to not just meet but exceed the rigorous performance requirements of today's most demanding AI workloads.

Systems like the ThinkStation P920 support the largest number of NVIDIA® GPUs, up to 2x Intel® Xeon™ Scalable CPUs, over 1TB of ECC Memory, and the largest amount of data storage, delivering the highest possible levels of performance of any workstation.

As configurations and hardware requirements can change from project to project, the tool-less, modular ThinkStation chassis allows for simple, easy upgrades. Perfect for demanding, yet constantly changing, business environments.

- INDUSTRY'S #1 FOR WORKSTATION RELIABILITY
- TRI-CHANNEL COOLING
- NVIDIA® NGC/ RAPIDS READY
- LOW ACOUSTICS
- PLATINUM EFFICIENT PSUs
- TOOL-LESS MODULAR CHASSIS

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CONCLUSION

Make the right decisions faster with AI.

AI is a business enabler that can be used to help you solve specific business challenges.

AI can make your life easier and your business better and more efficient than ever before.

There are significant areas of opportunity to implement AI solutions across all stages of E&P.

Using AI, you can solve some of the industry's most common challenges across acquisition, processing, interpretation, and reservoir modeling.

Using high-powered workstations can be a cost-effective and secure solution for starting your AI project.

Lenovo has high-powered, reliable workstations that can help you to get started on your AI projects.

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