Comprehensive Well Evaluation: A Deep Dive into Well Analysis Case Study

Problem Statement:

The focal point of this case study is the strategic utilization of the ShaleWellCube database, a comprehensive resource provided by Rystad Energy, housing an extensive repository of data encompassing more than 1.5 million horizontal, fracked vertical, and conventional wells spanning across the regions of the US, Canada, and Argentina. The core objective of this endeavour is to orchestrate an in-depth exploration into the reservoir of well-related information, meticulously examining historical monthly production records and an array of intricate well attributes. Augmenting this analysis, the study endeavours to enrich the insights through the integration of projected production figures, inferred parameters, meticulous cost appraisals, breakeven pricing evaluations, NPV and IRR computations, and inclusive coverage of activities related to flaring and venting. The prime tenets of this undertaking encompass a meticulous portrayal of well characteristics, the precise prognostication of production trends within the US, the benchmarking of well, operator, and basin performances, and the unearthing of a multitude of insights housed within the wealth of information encapsulated by ShaleWellCube.

What is Expected?

This comprehensive case study involves a multifaceted exploration of the L48 oil supply landscape, focusing on data-driven insights and projections. The primary objectives comprise the meticulous assessment of oil, gas, and NGL supply at the regional level, spanning up to the year 2024. Furthermore, the study delves into the thorough analysis of L48 Activity Metrics, enabling the tracking of company- or basin-level trends in the lead-up to quarterly earnings. This includes dynamic insights into metrics such as rig demand and completed wells per month, bolstered by forecasts extending up to 2024. The project also facilitates the benchmarking of operational performance by juxtaposing diverse cost, productivity, and efficiency metrics for both public and private operators. This broad comparison spans extensive geographies while offering the flexibility to focus on specific areas of interest. The case study's scope further extends to an economic examination of well performance, utilizing Rystad Energy's comprehensive research on service costs and PDP production forecasts. This enables the comprehensive assessment of the economic viability of each well in the database, encompassing breakeven prices, rates of return, NPV, and other pertinent indicators. In addition, the technical assessment of well data is a key facet, centralizing publicly available information on shale wells. This includes critical aspects like perforation records, chemical disclosures, string records, proppant composition, and more. The project's data engineering perspective involves designing robust pipelines to integrate, cleanse, transform, and enrich the diverse datasets, fostering comprehensive analyses and insights that drive informed decision-making.

1. Historical and Forecast Production?
2. Operators With Highest Well Count?
3. Who are Flaring More?
4. Which shale play has the highest monthly production of oil and gas combined?
5. What is the average well length across all wells in the dataset?
6. How does the monthly production of Ethane compare to that of dry gas for a specific operator?

Data Dictionary:

https://github.com/manojkumarsingh77/Shell2023/blob/main/WellAnalysis/DataDictionary/WellAnalysis_DataDictionary.pdf

Data Sets:

https://github.com/manojkumarsingh77/Shell2023/blob/main/WellAnalysis/DataSets/WellAnalysis.zip

Case Study Execution Plan:

- The execution of each Case Study will involve a group of 4 or 5 members, with each member assigned specific tasks to align with the project's objectives.

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- Each group member will work concurrently on their designated tasks, ensuring parallel progress, and the integration of individual contributions will occur during the Final Stage of the project.
- On the Final day, the completed Case Study will be presented to the Shell Subject Matter Experts (SME) and UNext Mentors, providing an opportunity to showcase the project's outcomes and achievements.
- The entire project development process will be implemented using a Continuous Integration/Continuous Deployment (CI/CD) pipeline. This approach ensures seamless integration of code changes, automated testing, and efficient deployment, promoting collaboration and efficiency throughout the project lifecycle.

Technicalities:

In order to address the given problem statement, we will adhere to a standard data pipeline pattern. This structured approach will ensure a systematic and efficient workflow for data processing and transformation.

The data pipeline will consist of the following key stages:

- Data Ingestion.
- Data Processing.
- Data Storage.
- Data Visualization and Reporting.

Data Layers:

As part of a structured data storage approach, you will implement measures to ensure efficient data organization and management. The data will be divided into separate parent folders, one for each team, with sub-folders for **RAW**, **STG (Staging),** and **CURATED** data:

Parent Folders: Each team involved in the project will have its dedicated parent folder to manage their data processing activities. This ensures data isolation and promotes collaboration within the team.

RAW Sub-folder: The RAW sub-folder within each team's parent folder will be used to store the raw and unprocessed data acquired from various sources. This includes the data ingested through Azure Data Factory or any other data ingestion mechanism.

STG (Staging) Sub-folder: The STG sub-folder will serve as an intermediate storage location where data from the RAW sub-folder is transformed and prepared for further processing. This staging step ensures data quality and consistency before moving it to the CURATED sub-folder.

CURATED Sub-folder: The CURATED sub-folder will hold the processed and curated data ready for visualization and analysis. This data is transformed, cleansed, and enriched to meet specific business requirements.

Reference architecture diagram:

The provided architecture diagram serves as a foundational reference for each team to envision their own version while building upon it. This diagram presents a clear and structured visualization of the system's components and their interactions. Each team is tasked with developing their own iteration of the architecture diagram, using the provided sample as a foundation. This approach fosters creativity and empowers teams to tailor the solution to meet specific requirements and address unique challenges. By building upon the initial reference, teams can explore diverse design choices and leverage individual expertise, resulting in a comprehensive and adaptable solution. This collaborative process ensures a successful outcome that aligns with the project's goals and objectives.

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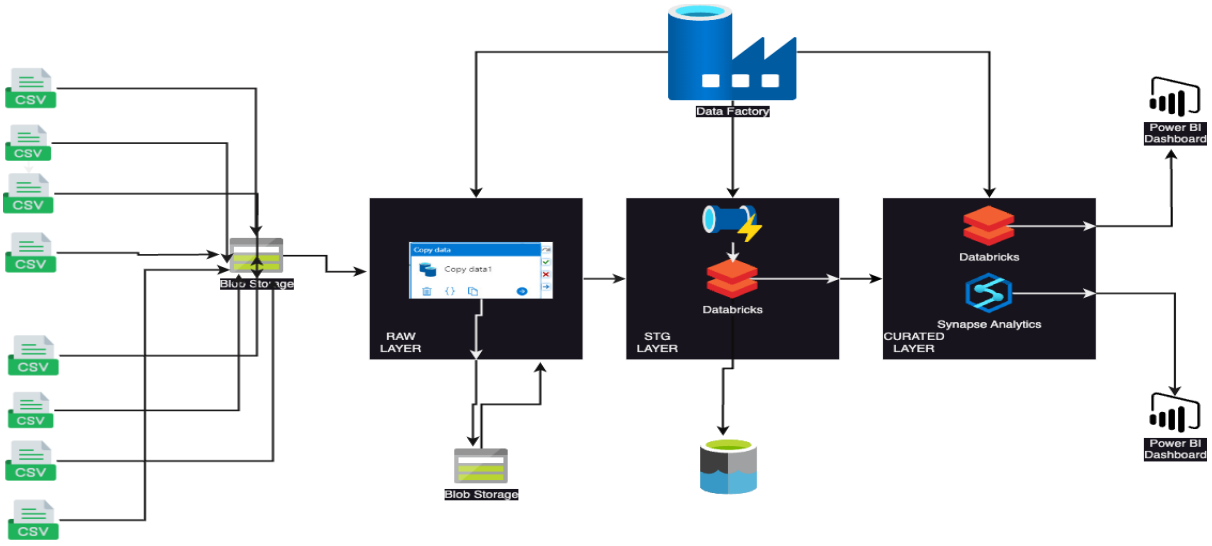

Activity Breakdown:

In the case study, data engineers will perform data ingestion and cleansing activities to ensure data quality and integrity. They will create a reusable and secured connection for data ingestion and handle tasks like removing duplicate records, handling missing values through imputation techniques, and correcting data anomalies.

For ETL and analysis, data engineers will filter out irrelevant or incomplete data, aggregate data to calculate summary statistics, transform data types and create derived columns, perform data joining based on common keys, and apply data partitioning for improved query performance. They will also conduct data deduplication and implement validation checks to ensure data quality and adherence to business rules.

The Case Study is divided into two parallel streams, each handled by separate teams:

i. **Stream 1:** This stream utilizes SQL Data Warehouse/Database (SQL DW/DB) as the data storage and management solution. The team in charge of this stream will leverage the capabilities of Power BI for data visualization and creating interactive dashboards. The combination of SQL DW/DB and Power BI ensures efficient data processing, storage, and analysis, providing stakeholders with valuable insights to support data-driven decision-making.

ii. **Stream 2:** In this stream, the team will employ Azure Databricks with SQL End-point (ADB SQL End-point) as the data processing and analysis platform. Power BI will be used for data visualization and interactive dashboard creation. By leveraging the distributed data processing capabilities of Azure Databricks and combining it with Power BI's visualization capabilities, this stream enables efficient and scalable data processing, ensuring stakeholders have access to timely and insightful information.

By splitting the case study into these two streams, the project benefits from parallel efforts, maximizing efficiency and expertise in both SQL-based and Databricks-based data processing approaches. This approach allows for a comprehensive exploration of different technologies, resulting in a well-rounded and robust solution for meeting the specified data processing and visualization requirements.

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Deliverables:

Create a presentation which has:

Slide 1: BatchName_FirstName_SecondName
Slide 2: Problem statement
Slide 3: Implemented data flow diagram showing various technical components and Layers.
Slide 4-6: Snapshots of developments in each layer (RAW, STAGING(STG), CURATED)
Slide 7: Screenshot of dashboards built on Power BI.
Slide 8: GitHub link where solution is available
Slide 9: System Demo
Slide 10: Q&A
Slide 11: Challenges faced, learnings, suggestions, and feedback.

Rubrics for Case Study Evaluation:

Deliverables / milestones	Remarks	Max Marks
▪ GitHub account creation (5 Marks) ▪ Proposing your own Architecture design and details (15Marks)	Activities	20
▪ Data Management and Storage (10 marks)	Activities	10
▪ Data ingestion and Transformation technique details (20 marks)	Activities	20
▪ Visualization of data, by keeping scope of Business User (10 Marks) ▪ Story telling by visualizing data (10 marks)	Activities	20
▪ Live presentation of Solution on Azure portal (15 marks) ▪ Viva (15 marks)	Activities	30
	Total Marks	**100**