

Project title

**“Analyzing the Role of Data Analytics in Business
Decision-Making in Aramco, Saudi Arabia”**

Student name

Saleh Obaid Alsubaie

Graduation Project – 1

Faculty of Management - Midocean University

Supervisors:

Dr. Abdurrahim Nader

Dr. Alaa Ahmed

Dr. Rokaya Saleh

Dr. Sara Faried

Faculty member- Faculty of management- Midocean University

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1. Chapter 1: Introduction

1.1. Research Background

The oil and gas business is undergoing a fundamental revolution, fueled by digital technology, with data analytics acting as the foundation for tackling operational challenges and influencing strategic choices. Saudi Aramco, the world's largest crude oil producer by volume, exhibits this transition. As of 2023, Aramco reported producing an average of 12.8 million barrels of oil equivalent per day, with huge datasets generated by over 100,000 sensors across its activities. This data analytics integration contributes to Saudi Vision 2030's emphasis on digital transformation, which aims to increase efficiency, cut costs by up to 15-20%, and foster innovation in a volatile market, such as fluctuating crude oil prices, which ranged from \$40 to \$120 per barrel in 2022 (Saudi Aramco, 2023).

Historically, decisions in the energy sector were based on expert opinion and retroactive analysis. However, the emergence of big data, artificial intelligence (AI), and machine learning has facilitated a paradigm shift towards predictive and prescriptive analytics. McAfee and Brynjolfsson (2012) discovered that data-driven firms had 5-6% greater productivity and profitability than their counterparts. In Aramco's ecosystem, analytics enables real-time reservoir monitoring, predictive maintenance (saving downtime by 30-50% in some circumstances), and supply chain optimization in the face of global disruptions like as the COVID-19 pandemic (Davenport and Harris, 2017).

Empirical data emphasizes analytics' importance in risk mitigation and sustainability. Wamba et al. (2017) demonstrated that big data analytics enhances supply chain resilience by 10-15%, which is critical for Aramco's worldwide network that includes upstream exploration, midstream transportation, and downstream refining. Kitchin (2014) examines how Internet of Things (IoT) analytics might improve operational excellence in industrial settings. However,

challenges remain, including data quality difficulties and integration hurdles in older systems, as mentioned by Gandomi and Haider (2015). Aramco has addressed this with its Digital Transformation Program, which invests \$1.5 billion per year in AI and analytics to create "safer, smarter operations" (Saudi Aramco, 2022).

Despite much study on analytics in business, sector-specific deficiencies persist. Studies such as Chen et al. (2012) concentrate on finance or manufacturing, ignoring the specific issues that energy corporations face, such as geopolitical risks and environmental laws. Aramco's strategy involves combining traditional oil operations with renewable energy investments, such as a \$5 billion investment in hydrogen projects by 2023. Empirical inadequacies include unexplored variations in analytics applications between upstream (e.g., seismic data for exploration) and downstream (e.g., petrochemical market predictions).

This study focuses on project managers, executives, and policymakers in the oil sector, notably at Aramco. Its importance is in delivering insights throughout the global energy transition, when analytics may maximize carbon capture (possibly decreasing emissions by 20-30%) and integrate renewables, aligning with net-zero targets (International Energy Agency [IEA], 2023). For Aramco, improved decision-making might result in annual cost savings of \$10-20 billion (Saudi Aramco, 2023).

The purpose of this research is to thoroughly examine data analytics' involvement in Aramco's corporate decision-making, including procedures, problems, and implications. By solving theoretical and practical gaps, it presents personalized frameworks for analytics-driven initiatives, therefore contributing to sustainable energy leadership.

1.2. Research Problem

Data analytics is revolutionizing global business decision-making, but its unique uses, methods, and implications inside Aramco—a significant participant in the energy sector—have received insufficient attention as digitalization and energy transformations accelerate. This highlights the crucial need for specialized study to better understand how analytics may be used effectively in high-stakes, data-intensive situations.

1.2.1. Theoretical Gaps

Theoretical frameworks for data analytics are frequently generalized, with little modification to the oil and gas industry's specific characteristics, such as unpredictable commodity prices and sophisticated reservoir models. While models like those in Chen et al. (2012) address analytics in business intelligence, they ignore energy-specific integrations such as AI-driven geophysical modeling, which Aramco employs to estimate oil recovery rates with 85% accuracy (Saudi Aramco, 2023). Few studies include geopolitical forecasts or sustainability measures, creating a hole in comprehensive theoretical models for companies like Aramco.

1.2.2. Practical Gaps

Practically, Aramco generates about 1 petabyte of data every day from operations, but fragmented systems, cybersecurity concerns, and legal limits (for example, data privacy under Saudi law) hamper real-time analytics adoption. This is demonstrated by occurrences such as the 2021 production interruptions, when improved analytics integration might have prevented losses estimated at \$500 million (IEA, 2023). These gaps show inefficiencies in converting data into meaningful choices throughout Aramco's value chain.

As a result, the primary study question is: How does Aramco use data analytics to make business decisions?

1.3. Research Significance

This study is valuable at both theoretical and practical levels as it improves knowledge of how data analytics is used in corporate decision-making at Saudi Aramco.

1.3.1. At the theoretical level

The study advances management and data analytics theory by presenting energy-sector-specific viewpoints on the application of data analytics in corporate decision-making. It builds on current analytical frameworks, such as those presented by Davenport and Harris (2017), by including industry-specific factors like real-time Internet of Things data and geopolitical risk concerns. This study lays the groundwork for future research on digital transformation in resource-intensive businesses by filling gaps in the literature concerning high-volume and complicated data environments.

1.3.2. At the practical level

At the practical level, the study provides useful insights for Saudi Aramco executives by suggesting ways for increasing operational efficiency, lowering maintenance and operating costs, and improving risk management through data-driven decision-making. Furthermore, the findings promote alignment with Saudi Vision 2030's digital transformation goals by emphasizing the importance of data analytics in improving organizational performance. The findings may also help policymakers and industry players plan and evaluate investments in digital infrastructure and technology to assist Saudi Arabia's economic diversification efforts.

2. Chapter 2: Literature Review

2.1 Introduction

Data analytics has become an essential component of modern corporate settings, allowing firms to translate raw data into actionable insights that aid decision-making processes. Because of the complexity, size, and volatility of operations in data-intensive sectors like oil and gas, analytics plays an even more important role. This chapter examines the literature on data analytics as the independent variable and corporate decision-making as the dependent variable, as well as the link between the two. It also identifies gaps in earlier research, notably in terms of Saudi Aramco and the energy industry.

2.2 The Independent Variable: Data Analytics

Data analytics is the systematic computer examination of data to identify patterns, correlations, and insights that can help organizations achieve their goals.

According to Chen et al. (2012), data analytics includes approaches such as descriptive, predictive, and prescriptive analytics, which assist companies in understanding previous performance, forecasting future trends, and recommending best practices.

Davenport and Harris (2017) stressed that firms that use analytics-driven initiatives get a competitive edge by increasing efficiency, creativity, and responsiveness. In the oil and gas industry, analytics is frequently employed in reservoir simulation, drilling optimization, predictive maintenance, and supply chain management.

Wamba et al. (2017) further said that big data analytics skills considerably improve organizational performance by enhancing decision quality and operational efficiency. Analytics in extremely complex contexts, such as Saudi Aramco, is enabled by technologies like as Artificial Intelligence (AI), Machine Learning (ML), and the Internet of Things (IoT), which allow for real-time data gathering and analysis.

However, Gandomi and Haider (2015) recognized critical hurdles connected with data analytics, such as data quality concerns, integration difficulties, and the requirement for sophisticated technical capabilities. If these problems are not addressed appropriately, they might hinder the successful deployment of analytics.

2.3 The Dependent Variable: Business Decision-Making

Business decision-making is the process of determining the best course of action among available options in order to fulfill corporate goals. Traditionally, decision-making was mainly based on management experience and intuition. However, modern companies are increasingly relying on data-driven decision-making (DDDM) to increase accuracy and minimize ambiguity.

Power (2007) characterized decision-making as a systematic process aided by information systems and analytical tools. With the incorporation of analytics, decision-making has become more evidence-based, allowing managers to assess risks, anticipate outcomes, and maximize performance.

Decision-making in the energy business is very complicated due to turbulent market circumstances, substantial operational risks, and large-scale investments. According to the International Energy Agency (2023), organizations that use sophisticated analytics are better able to react to market swings and regulatory changes.

Furthermore, data-driven decision-making improves organizational agility by allowing for faster, more informed reactions to operational difficulties. This is especially crucial for corporations like Saudi Aramco, where decisions may have a substantial financial and strategic impact.

2.4 The Relationship Between Data Analytics and Business Decision-Making

The relationship between data analytics and business decision-making is well-established in the literature. Data analytics enhances the quality, speed, and efficacy of choices by delivering accurate, timely, and relevant data.

McAfee and Brynjolfsson (2012) discovered that data-driven firms are more productive and lucrative than those that use traditional decision-making approaches. Their study found that using analytics leads to improved strategic and operational decisions.

Similarly, Wamba et al. (2017) proved that big data analytics skills improve decision-making performance by increasing information processing and lowering uncertainty. Analytics allows businesses to shift from reactive to proactive decision-making by forecasting future trends and detecting potential dangers.

In the oil and gas business, analytics aids decision-making in a variety of areas, including exploration, production, maintenance, and supply chain management. Predictive analytics, for example, may foresee equipment breakdowns, allowing businesses to take proactive steps to decrease downtime.

Despite these benefits, various factors impact the interaction between analytics and decision-making, including corporate culture, technology infrastructure, and data governance. According to Gandomi and Haider (2015), without adequate integration and administration, data analytics may not completely contribute to successful decision-making.

2.5 Conclusion

This chapter examined the current literature on data analytics and corporate decision-making, emphasizing its relevance in modern businesses. Data analytics is a strong tool that improves decision-making by offering insights into accuracy, efficiency, and strategic planning.

The research supports a substantial beneficial association between data analytics and decision-making performance. However, most studies focus on broad business contexts, with little emphasis paid to the special issues and uses of the oil and gas sector, notably in organizations such as Saudi Aramco.

This study intends to address this vacuum by investigating how data analytics is used in Saudi Aramco and how it effects corporate decision-making in a complex and data-intensive environment.

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