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Providing a Framework for Monitoring Reservoir Management Performance Using Key Performance Indicators in One of Iran's Oil Reservoirs

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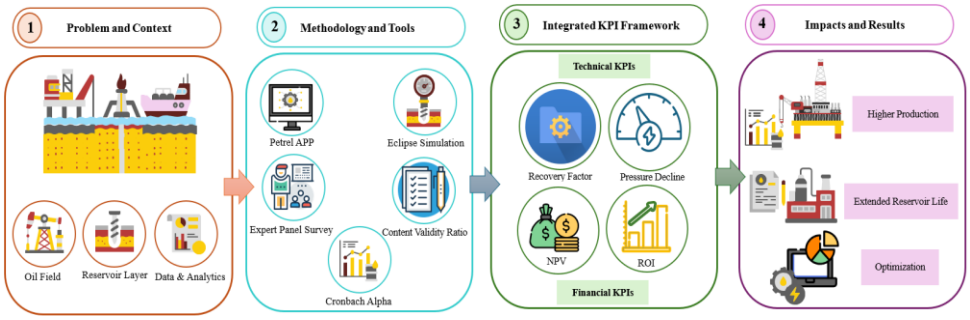
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A B S T R A C T

Given the technical and managerial challenges facing Iran's oil industry particularly in the field of reservoir management the design of a scientific, data-driven framework for monitoring and evaluating performance is an undeniable necessity. This study aims to present a comprehensive framework for supervising reservoir management performance, based on Key Performance Indicators (KPIs), applied to one of the country's oil reservoirs. The research is applied in nature and employs a mixed-method approach, including library and documentary studies, analysis of technical data from the selected reservoir, and interviews with industry experts. The statistical population consists of petroleum engineering specialists and reservoir management experts, selected through purposive sampling. Data validity was confirmed using the Content Validity Ratio (CVR), and reliability was measured via Cronbach's alpha. Multi-Criteria Decision-Making (MCDM) models and specialized software such as Petrel, Eclipse, and OFM were used for scenario planning, numerical simulation, and sensitivity analysis. Findings indicate that the systematic integration of technical KPIs such as recovery factor and production-to-pressure ratio with economic KPIs such as Net Present Value (NPV) and Return on Investment (ROI) can improve production efficiency, reduce payback time, and extend the economic life of the reservoir. The proposed framework can serve as a standard model for enhancing productivity and advancing scientific management practices in Iran's hydrocarbon fields.



1. Introduction

The oil and gas industry, as one of the most important pillars of global energy supply, has always faced numerous challenges related to optimal production, increasing recovery factor, reducing production costs, and ensuring economic sustainability. In this context, hydrocarbon reservoirs, as the most valuable upstream assets of the petroleum industry, require scientific and systematic management, as decisions made throughout the reservoir life cycle have a direct impact on production performance, field economic value, and the sustainable exploitation of underground resources [1-9]. Therefore, reservoir management is no longer limited solely to technical production operations; rather, it has evolved into an integrated decision-making system based on data analysis, performance evaluation, and continuous monitoring. Effective management of oil and gas reservoirs requires a comprehensive understanding of reservoir behavior, continuous monitoring of pressure and production variations, evaluation of well performance, and timely implementation of corrective actions. Considering geological complexities, operational uncertainties, and economic constraints, the application of advanced managerial tools for assessing reservoir conditions and guiding production processes has become an inevitable necessity [10]. In this regard, Key Performance Indicators (KPIs)

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have emerged as one of the most important tools for performance evaluation and control, playing a significant role in transforming operational data into valuable information for managerial decision-making [5].

Key Performance Indicators enable managers to quantitatively measure the achievement of objectives and identify strengths, weaknesses, performance deviations, and improvement opportunities. In reservoir management, indicators such as recovery factor, production rate, reservoir pressure decline, production-to-injection ratio, water cut, operating cost per barrel, and economic indicators including Net Present Value (NPV) and Return on Investment (ROI) are considered essential criteria for evaluating the success of reservoir development and production strategies. The application of such indicators enables reservoir management to move from a traditional and reactive approach toward a predictive, data-driven, and continuous improvement-oriented system [4]. The experience of leading countries in the petroleum industry demonstrates that the implementation of comprehensive KPI-based performance monitoring frameworks has played a significant role in improving field productivity, reducing operational risks, and extending the economic life of reservoirs. In these countries, the integration of technical, economic, environmental, and managerial indicators with advanced technologies such as numerical simulation, artificial intelligence, big data analytics, and digital systems has provided a foundation for more accurate decision-making and efficient hydrocarbon resource management [2,8]. Consequently, the transition toward intelligent reservoir management and the utilization of performance evaluation frameworks have become among the main strategies adopted by major international oil companies. In Iran, considering the aging nature of many oil reservoirs, gradual reservoir pressure decline, increasing production costs, investment limitations, and the necessity of enhancing recovery factors, the need for establishing modern performance management systems has become increasingly evident. Many Iranian reservoirs are currently in the mature or late production stages of their life cycles, and their continued exploitation requires accurate managerial strategies, continuous performance monitoring, and the application of scientific approaches for production optimization [11-12]. Despite the importance of this issue, the lack of an integrated framework for defining, prioritizing, and monitoring performance indicators has resulted in many managerial decisions being based primarily on individual experiences and fragmented reports. Therefore, designing a comprehensive framework for monitoring reservoir management performance based on Key Performance Indicators can play a significant role in improving decision-making quality, enhancing managerial transparency, and increasing the efficiency of national petroleum resources. Such a framework establishes a connection between organizational strategic objectives and operational activities while enabling continuous reservoir performance assessment and timely identification of deviations [5]. Furthermore, the adoption of data-driven approaches and the integration of technical, economic, and managerial indicators can facilitate the transition of Iran's petroleum industry toward intelligent and sustainable reservoir management [13]. Accordingly, the present study aims to develop a comprehensive framework for monitoring oil reservoir management performance using KPIs. This research seeks to identify the most influential indicators affecting reservoir performance and to propose an applicable framework for evaluating, monitoring, and improving reservoir management performance. The proposed framework is expected to serve as a decision-support tool for the optimal management of hydrocarbon resources in the country. In the following sections of this chapter, the research problem, significance and necessity of the study, research objectives, research questions, conceptual and operational definitions of key terms, and the research scope will be presented.

1.1. Theoretical Foundations

The theoretical foundations of this research provide the conceptual framework required to understand reservoir management, performance monitoring systems, and the role of KPIs in improving the efficiency of hydrocarbon field operations. The development of an effective reservoir management framework requires a comprehensive understanding of geological characteristics, reservoir behavior, production processes, economic considerations, and modern decision-support tools. In fact, reservoir management has evolved from a traditional production-oriented approach into an integrated, data-driven, and multidisciplinary decision-making system aimed at maximizing sustainable hydrocarbon recovery [6].

1.2. Basic Definitions and Concepts

1.2.1. Definition of Reservoir Management

Reservoir management is a multidisciplinary process involving planning, implementation, monitoring, and controlling reservoir development and production activities with the objective of maximizing hydrocarbon recovery while minimizing technical, economic, and environmental risks. According to Rafiei et al. [14], reservoir management refers to a set of systematic activities for optimizing extraction operations, maintaining reservoir integrity, and achieving sustainable and economically efficient production. Similarly, Garcia et al. [3] defined reservoir management as a dynamic system based on continuous data collection, engineering analysis, and decision-making processes aimed at improving reservoir performance. Modern reservoir management integrates different scientific disciplines, including geology, reservoir engineering, production engineering, economics, and environmental management. Therefore, successful reservoir management requires continuous evaluation of reservoir behavior, monitoring of production trends, analysis of pressure changes, and timely implementation of corrective actions [10]. Due to geological uncertainties, operational complexities, and economic limitations, the application of scientific monitoring systems and performance evaluation frameworks has become essential for improving reservoir efficiency.

1.2.2. Introduction to Oil and Gas Reservoirs

A hydrocarbon reservoir is a natural underground geological formation consisting of porous and generally permeable rocks capable of storing and transmitting petroleum fluids. Hydrocarbons within these reservoirs may exist as crude oil, natural gas, or a combination of both, either as free fluids occupying pore spaces or dissolved within other reservoir fluids such as formation water. The formation of hydrocarbon reservoirs is the result of a long geological process occurring over millions of years. These processes include deposition of organic materials, burial under sedimentary layers, exposure to increasing temperature and pressure conditions, hydrocarbon generation, migration, and accumulation within suitable geological traps. Impermeable sealing formations prevent hydrocarbons from escaping toward the surface or surrounding formations and act as the cap rock of the reservoir system [15]. A detailed understanding of geological, lithological, and petrophysical properties of reservoirs, including rock type, pore structure, permeability, pressure, and temperature, provides the fundamental basis for production planning, reservoir management strategies, and enhanced recovery operations [16].

1.2.3. Main Components of a Hydrocarbon Reservoir

A hydrocarbon reservoir consists of three fundamental components: reservoir rock, reservoir fluids, and cap rock. The interaction between these components determines the storage capacity, fluid movement behavior, production capability, and economic potential of the reservoir. Understanding the characteristics and behavior of each component is essential for defining appropriate KPIs and evaluating reservoir management performance [17].

1.3. Reservoir Rock

Reservoir rock represents the solid framework that provides the storage space and flow pathways required for hydrocarbon accumulation and movement. The ability of reservoir rocks to store and transmit fluids is mainly controlled by two important petrophysical properties: porosity and permeability. Porosity is defined as the ratio of void volume within the rock to the total bulk volume of the rock and represents the storage capacity of the reservoir. The amount and type of porosity are affected by several geological factors, including sedimentation processes, grain size, grain arrangement, compaction, diagenesis, and cementation [7].

Primary porosity refers to the pore spaces formed during the initial deposition of sedimentary materials. Factors such as grain size, grain shape, packing arrangement, and cementation strongly influence the development of primary porosity. Larger grains generally create greater pore spaces; however, the presence of fine particles or excessive cementation can significantly reduce porosity. Rounded grains usually generate higher pore volume compared with angular grains because they create more effective packing arrangements. Furthermore, mineral cementation processes, such as calcite or quartz precipitation between grains, decrease available pore spaces and reduce primary porosity. Secondary porosity develops after the formation of the original rock structure due to geological processes such as dissolution, fracturing, dolomitization, and tectonic activities. This type of porosity has significant importance in reservoir engineering because it can increase storage capacity and create high-permeability flow channels [18].

Dissolution of soluble minerals such as calcite, dolomite, feldspar, and gypsum by groundwater or acidic fluids can generate new pore spaces, especially in carbonate reservoirs [7]. Natural fractures caused by tectonic stresses, pressure variations, or reservoir depletion can create interconnected pathways that significantly improve fluid transmission capability. Dolomitization, through the replacement of calcite minerals with dolomite, may also modify pore structures and enhance reservoir quality. Effective porosity represents the interconnected pore volume that contributes directly to fluid flow within the reservoir. Unlike total porosity, effective porosity only considers pore spaces that are hydraulically connected and capable of transmitting oil, gas, or water. Therefore, this parameter is particularly important because it determines the actual volume of producible fluids within the reservoir.

Permeability refers to the ability of reservoir rock to transmit fluids through interconnected pore networks. While porosity determines the storage capacity of a reservoir, permeability controls the ability of fluids to flow toward production wells and directly affects reservoir productivity. Permeability is influenced by pore size, pore connectivity, fracture networks, pore geometry, and fluid saturation conditions. Sandstone and carbonate reservoirs demonstrate different production behaviors due to their distinct geological characteristics. Sandstone reservoirs generally possess higher primary porosity, more uniform pore structures, and relatively predictable fluid flow behavior. These reservoirs commonly exhibit porosity values between 15% and 30%, while permeability may range from several tens to hundreds of millidarcies depending on grain size and cementation degree. However, excessive cementation or clay content can significantly reduce permeability. In contrast, carbonate reservoirs generally have lower average porosity (approximately 5–15%) but may contain significant secondary porosity caused by fractures and

dissolution processes. Although their average permeability may be low, localized high-permeability channels can create rapid fluid movement and complex production behavior. Due to their strong heterogeneity, predicting production performance and designing enhanced recovery strategies in carbonate reservoirs is more challenging compared with sandstone reservoirs.

1.4. Research Background

1.4.1. Domestic Studies

Akbari et al. [11] conducted a study entitled "Optimization Process of Key Performance Indicators for Karang Reservoir Operation". In this research, historical production, pressure, and injection data over a ten-year period were collected and analyzed using qualitative data analysis methods and advanced reservoir modeling techniques. By performing sensitivity analysis of key indicators and developing different management scenarios, they demonstrated that simultaneous optimization of reservoir pressure, injection rate, and production rate could increase ultimate recovery by approximately 15% and reduce operational costs by 10%. The importance of this study lies in its contribution to establishing a strategic and data-driven reservoir management system for Iranian oil fields. Taghizadeh et al. [19], in their study entitled "Evaluation of the Effect of Gas Injection on Increasing Oil Recovery Factor in Southern Iranian Reservoirs", investigated different gas injection scenarios using numerical simulation and fluid flow analysis. Their results indicated that selecting an optimized gas injection strategy could improve the recovery factor by up to 12%. The findings highlighted the importance of optimizing injection operations and extending the economic life of oil fields. Hosseini et al. conducted research entitled "Analysis of Reservoir Fluid Dynamic Behavior Using Data from the Aghajari Field". By applying numerical modeling techniques and analyzing actual production rate, pressure, and fluid injection data, they demonstrated that dynamic variations in production indicators could identify critical periods of injection performance and pressure decline. Their findings emphasized the importance of continuous data acquisition and integration of operational data with reservoir management scenarios. Zarei et al. [20] investigated "The Impact of Well Testing Data Quality on the Accuracy of Management Indicators". Using data mining techniques and statistical analysis of well-testing data, they found that improving the consistency between actual well-test data and reservoir management models could reduce KPI estimation errors by approximately 25%. This study highlighted the critical role of reliable data infrastructure in improving reservoir planning and decision-making accuracy.

Abedi et al. [21], in a study entitled "Assessment of the Impact of Dynamic Data on Strategic Decision-Making in the Shadegan Field", applied dynamic reservoir modeling by integrating production and injection data. Their results indicated that intelligent analysis of dynamic data improved decision-making accuracy and increased ultimate recovery efficiency by nearly 10%. The study emphasized the strategic importance of dynamic reservoir data for future-oriented field management. Keshavarz et al. [18], in their research entitled "Life Cycle Analysis of Key Performance Indicators in Large Oil Fields", examined the evolution and management of important indicators, including ultimate recovery factor, gas-oil ratio, and water production, in three major Iranian oil fields. Using qualitative modeling and identification of critical transition points, they concluded that systematic archiving and life-cycle analysis of KPIs could improve policy-making accuracy by approximately 25% and support more reliable long-term reservoir management decisions.

1.4.2. International Studies

The transformation of operational management approaches in oilfields, particularly through data-driven analytics and digitalization, has become a fundamental pillar for enhancing performance. Recent studies demonstrate that the utilization of dynamic and self-adaptive KPIs significantly boosts system capability in identifying operational challenges and responding to crises. This managerial flexibility stands in stark contrast to traditional reactive models and serves as a vital step toward achieving agile field management. Beyond dynamic indicators, the integration of diverse data sources such as combining 4D seismic data with operational KPIs—has opened new horizons in production strategies. This integrated approach has not only improved the accuracy of identifying low-performance reservoir zones by approximately 22% but has also optimized injection planning and reservoir management. Furthermore, the application of machine learning for precisely predicting oil well performance decline, with success rates exceeding 90%, highlights the immense potential of intelligent tools in preventing unexpected production losses and shifting from traditional management to predictive practices. At the infrastructural level, the use of the IoT for real-time monitoring, coupled with big-data analytics, has effectively reduced equipment downtime by nearly 28%, leading to lower production costs and enhanced operational efficiency [22]. Despite these global technological and managerial advancements, a significant gap remains in the governing models of Iran's oil industry. The persistence of reactive approaches over predictive models hinders the realization of strategic objectives, such as increasing recovery factors, reducing costs, and ensuring sustainable production over the medium and long term. In addressing this challenge, there is an urgent need to design a localized, KPI-based framework that aligns national energy policies with technical and economic operational requirements. Such an approach could serve as a catalyst for enhancing the competitiveness, resilience, and sustainable development of the Iranian oil industry.

2. Materials and Methods

The present study is an applied research in terms of its objective, aiming to identify, prioritize, and evaluate KPIs in the management of oil reservoirs in Iran. Regarding the research design, this study adopts a mixed-method approach, in which quantitative data obtained from the technical and operational information of the selected reservoir are integrated with qualitative data derived from the perspectives and experiences of oil industry experts. The application of this approach enables the simultaneous utilization of statistical analysis accuracy and the depth of knowledge gained from expert experiences, thereby enhancing the validity and reliability of the research findings [23]. In the quantitative phase, operational data of the selected reservoir, including oil, gas, and water production rates, reservoir pressure, fluid injection volumes, well characteristics, and historical performance indicators, are extracted from the databases of the National Iranian Oil Company and specialized reservoir management software, including Eclipse, OFM, and Petrel, and subsequently analyzed. In the qualitative phase, experts and specialists in reservoir management, production engineering, reservoir engineering, and energy economics are consulted to identify, validate, and prioritize the key performance indicators. The statistical population of this research consists of two main groups. The first group includes all oil reservoirs managed by the National Iranian Oil Company, from which the Aghajari oil field has been selected as the case study. The selection of this field is based on several criteria, including its strategic importance, long production history, high production capacity, implementation of fluid injection operations, and availability of extensive historical operational data. The second group of the research population comprises oil industry experts and specialists with practical experience in reservoir management, field development, production operations, and performance evaluation. The sampling method employed in this research is purposive sampling. In the quantitative section, the Aghajari oil field was selected based on criteria such as national significance, availability of reliable operational data, diversity of operational conditions, and the potential for generalizing the results to similar reservoirs. In the qualitative section, experts were selected according to specific criteria, including at least 10 years of relevant professional experience, participation in reservoir management and optimization projects, and familiarity with key performance indicators].The data collection tools consist of three main components. First, library and documentary studies are conducted using domestic and international scientific resources, technical reports of oil companies, and specialized standards such as SPE guidelines and API standards. Second, technical and operational data of the selected reservoir are obtained from petroleum industry information systems and specialized reservoir software. Third, semi-structured questionnaires and expert interviews are used to collect qualitative data in order to identify and prioritize the effective indicators in reservoir performance management [2,13]. The data analysis process is conducted in several stages. Initially, quantitative data are examined using descriptive statistical methods and trend analysis to evaluate the historical performance of the reservoir. Subsequently, the extracted key performance indicators, based on the literature review and expert opinions, are weighted and ranked using multi-criteria decision-making (MCDM) techniques, including AHP, TOPSIS, and IROC. Furthermore, sensitivity analysis, Monte Carlo simulation, and uncertainty assessment methods are applied to evaluate the impact and robustness of the identified indicators. Finally, by integrating the quantitative and qualitative findings, a localized framework for evaluating the performance of oil reservoir management in Iran is developed. To ensure the validity and reliability of the research instruments, the content validity of questionnaires and interview protocols is assessed through expert judgment and the Content Validity Ratio (CVR) index. Moreover, the reliability of the instruments is evaluated using Cronbach's alpha coefficient and the test–retest method. Accordingly, the proposed research methodology, through combining real field data, quantitative analyses, and expert knowledge, provides a comprehensive framework for evaluating and improving oil reservoir performance management.

3. Results and Discussion

In this chapter, the results obtained from the implementation of the proposed reservoir management performance monitoring framework based on KPIs are presented and analyzed. The analysis begins with a description of the dataset collected from the selected oil field, followed by the extraction and evaluation of each technical KPI using actual field data.The primary objective of this chapter is to evaluate the effectiveness of the proposed framework in improving monitoring accuracy, enhancing management transparency, and supporting scientific decision-making in reservoir management. The analysis of the selected KPIs facilitates the identification of both positive and negative trends in reservoir operation and management, thereby providing a sound analytical basis for proposing corrective actions aimed at improving managerial performance. Furthermore, the findings obtained from the data analysis are compared with established performance standards and predefined operational objectives. The impact of adopting modern technologies and data-driven analytical tools on improving both operational and economic efficiency is also assessed. Through this approach, the chapter provides a comprehensive evaluation of reservoir management performance, highlighting its strengths, opportunities for improvement, and existing challenges, while establishing the foundation for the conclusions and practical recommendations presented in the subsequent chapter.

3.1. Oil Recovery Factor

The Oil Recovery Factor (RF) was calculated using the following equation. Based on documented studies and field data, the parameters required for this calculation are defined as follows:

$$RF(\%) = \frac{Cumulative\ Oil\ Production}{Original\ Oil\ in\ Place(OOIP)} \times 100$$

where:

- RF = Oil Recovery Factor (%)
- Cumulative Oil Production (Np) = Total cumulative oil produced from the reservoir (bbl)
- OOIP = Original Oil in Place (bbl)

The values of these parameters were obtained from documented field reports and reservoir engineering studies of the selected reservoir. The calculated recovery factor was subsequently used as one of the principal technical KPIs for evaluating reservoir management performance.

Table1. Initial Well Data

Well ID	Well Name	Water Cut(%)	Oil Production Rate (bbl/day)	Cumulative Oil Production (bbl)	Well Depth (m)	Porosity (%)	Well Completion Date [a]	Completion Date (Gregorian)
1	Well_1001	56	1863	2875127	3683	11	1374/07/25	1995
2	Well_1002	19	750	2220675	2475	29	1399/01/06	2020
3	Well_1003	76	537	1193052	2455	34	1380/05/27	2001
4	Well_1004	65	1071	2950603	2828	15	1400/05/08	2021
5	Well_1005	25	840	272866	2894	10	1373/10/02	1994
…	…	…	…	…	…	…	…	…
217	Well_1217	56	1066	840141	2434	23	1391/05/18	2012
218	Well_1218	37	1022	2795401	2446	15	1380/11/04	2001

Source: Research findings
Note: ellipses (…) denote omitted data due to the large dataset size.
a: Dates are in the Solar Hijri (Persian) calendar format

3.2. Data Cleaning and Preparation of the Initial Aghajari Well Dataset

After collecting the raw data from 218 wells in the Aghajari reservoir and compiling the initial dataset, all records were systematically examined for missing values, invalid entries, and out-of-range observations. No missing or unrealistic values were identified, and all data were verified to fall within technically acceptable ranges(Table1). The subsequent KPI calculations and TOPSIS analysis. Consequently, after verification and quality control, the finalized dataset was adopted as the primary database for the calculation and analysis of the wells' key technical performance indicators.

Table2. Technical, Production, and Water Cut Data of the Aghajari Wells

Well/Option	Recovery Factor (%)	Water Cut (%)	Oil Produced (Bbl)	Production Cost ($/bbl)	Pressure Fluctuation (psi)
Well_1	44.37	56.8	67276	7.59	1708
Well_2	54.16	62.6	14218	5.77	1613
Well_3	50.44	57.1	13062	6.70	1460
Well_4	48.18	54.5	68135	7.18	1512
Well_5	40.65	40.7	68484	8.88	1736
Well_6	40.65	48.7	15866	8.42	1714
Well_7	38.99	45.7	97427	7.14	1461
Well_8	52.72	45.1	97064	10.92	1539
Well_9	48.22	66.2	14128	8.63	1542
Well_10	50.04	49.4	15472	6.42	1719
Well_11	38.35	63.9	15860	5.61	1458
Well_12	54.49	56.3	13533	5.92	1492
Well_13	52.15	61.0	97620	6.48	1770
…	…	…	…	…	…
Well_217	43.53	40.4	11868	7.24	1846
Well_218	50.69	58.3	13454	6.62	1543

Source: Research findings
Note: ellipses (…) denote omitted data due to the large dataset size

Based on the field data collected from 218 wells, the KPIs were calculated. The evaluated indicators included the Recovery Factor (RF), Water Cut (WC), Cumulative Oil Production (COP), Production Cost per Barrel (PCB), and Reservoir Pressure Fluctuation (RPF) for each well(Table2). According to the commonly accepted thresholds reported in the literature, the recovery factor was classified into three categories: low (less than 45%), moderate (45–52%), and high (greater than 52%). Similarly, appropriate classification thresholds were established for the remaining variables. In addition, a composite efficiency index was developed, defined as the ratio of cumulative oil production to the product of production cost and reservoir pressure fluctuation. Wells with recovery factors exceeding 52% exhibited superior operational performance in terms of both energy efficiency and production cost optimization. the results reveal a strong and statistically significant correlation among the principal technical indicators, including oil production, recovery factor, water cut, and reservoir pressure. These findings indicate a systematic relationship among the components of the production system and the technical performance of the wells. Furthermore, the analysis highlights the significant influence of the economic indicator, namely production cost, on operational performance. The observed negative correlation between production cost and both cumulative oil production and recovery factor emphasizes the importance of improving technical efficiency as a means of reducing production costs. Overall, the Spearman correlation analysis demonstrates that improving the recovery factor through effective control of water cut is associated with increased oil production and reduced operating costs. Moreover, the Injection-to-Production Ratio (IPR) plays a significant role in enhancing well performance and improving the overall operational condition of the reservoir.

4. Conclusions

This study was conducted with the aim of designing and validating a comprehensive framework for monitoring the performance of oil reservoir management in Iran based on KPIs, using the Aghajari oil field as a case study. The main problem addressed in this research was the lack of an integrated, scientific, and data-driven system for evaluating reservoir management performance, as well as the necessity of transitioning from traditional

experience-based approaches toward intelligent and evidence-based management. Accordingly, this study attempted to identify, prioritize, and analyze effective performance indicators in order to develop a practical framework for continuous reservoir performance monitoring and managerial decision support. The findings revealed that effective reservoir management performance evaluation requires simultaneous consideration of technical, economic, environmental, and managerial dimensions, and reliance on a single indicator cannot provide a comprehensive understanding of reservoir conditions. In this regard, 32 Key Performance Indicators were identified and prioritized through a combination of literature review, reservoir data analysis, and expert opinions. The results demonstrated that technical indicators, including the Recovery Factor (RF), Productivity Index (PI), and Water Cut, have strong relationships with production performance and reservoir health. Furthermore, economic indicators such as NPV and ROI play a significant role in evaluating the economic feasibility of different development and production scenarios. The analyses conducted in the Aghajari oil field indicated that effective management of production and injection processes, control of pressure decline, and continuous monitoring of reservoir behavior can improve recovery performance, reduce operational risks, and extend the economic life of the field. In addition, the sensitivity analysis results showed that RF, PI, and NPV are the most sensitive indicators to changes in production and injection scenarios and can therefore be considered as key parameters in managerial decision-making processes. The application of numerical modeling tools and specialized software, including Petrel, Eclipse, and OFM, also enabled more accurate analysis of reservoir behavior and evaluation of the potential consequences of management decisions.In response to the main research question, the results indicated that an effective framework for monitoring oil reservoir management performance in Iran should be based on three fundamental pillars: first, the selection and prioritization of key performance indicators according to the specific characteristics of each reservoir; second, the integration of these indicators with data-driven infrastructures and advanced technologies; and third, the establishment of continuous monitoring mechanisms and feedback systems for improving managerial decisions. Such a framework can enhance data transparency, improve decision-making quality, and facilitate more efficient utilization of the country's hydrocarbon resources.Despite the achievements of this research, several limitations were encountered, including restricted access to some confidential reservoir data, the limited time period available for evaluating the implementation of the proposed framework, and dependence on specialized external software. Nevertheless, the findings demonstrate that establishing a KPI-based performance management system can serve as an effective step toward transforming Iran’s oil industry from traditional management practices to scientific, intelligent, and data-driven reservoir management.

Author Contributions

All authors contributed equally to the conception, preparation, and writing of this manuscript.

Conflict of Interest

The authors, while observing publication ethics in the referencing, declare the absence of interest of conflict.

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AI Used Statment

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References

[1] P. Alonso, S. Martinez & D. Cooper. *Journal of Petroleum Data Management*, 2024, **38(2)**, 95-114.
[2] Y. Chen, K. Li, H. Zhang. *Energy Science & Engineering, 2021,* **9(1)**, 116-128.
[3] R. Garcia,Y. Lim & D. Park . *Journal of Petroleum Data Science*, 2020, **7(3)**, 60-81.
[4] M. Jones, R. Patel & A. Smith. *Drilling Data Journal*, 2020, **18(4)**, 212-229.
[5] R. Kapplan, S. Bailey. *Journal of Energy Management*, 2024, **49(1)**, 41-66.
[6] S. Kim, J. Park, Y. Lee. *Smart Energy Solutions*, 2024, **17(1)**, 90-109.
[7] Kruger, I. Nazarov, P. Svennson. *Journal of Oilfield Intelligence*, 2022, **21(3)**, 33-54.
[8] G. Murphy, Q. Liao, P. Zhang. *Oilfield KPIs Review*, 2017, **5(2)**, 41-59.
[9] S. Natcher, R. Kumar, T. Jones. *Journal of Production Maintenance*, 2019, **11(4)**, 122-149.
[10] M. Jafari, A. Ghasemi, D. Naderi. *Energy Report*, 2020, **5**, 128-137.
[11] Kordzangeneh, B. Habibnia & M. Akbari. *Iranian Journal of Oil and Gas Science and Technology*, 2022, **11(3)**, 80-98.
[12] S.M. Razavi, , R.S. Gharebagh , N. Mostoufi1 , J. Chaouki , K.D.P. Nigam3 . *Iranian Journal of Chemical Engineering*, 2024, **21(4)**, 62-77.
[13] A. Akbari, M. Mousavi, S. Rezaei. *Iranian Journal of Petroleum Engineering*, 2023, **46(2)**, 101-117.
[14] R. Rafiei. *Environment, Development and Sustainability*, 2021, **25(3)**, 2777-2807
[15] H. Mohammadi, Y. Sadeghi, M. Karami. *Journal of Petroleum Exploration and Development*, 2017, **44(3)**, 198-210.
[16] A. Kazemi. *Environmental Science and Bioengineering*, **3(1)**, 21-32.
[17] M. Jafari. *Journal of Natural Resources Management*, 2021, **10(2)**, 100-115.
[18] S. Keshavarz. *Geosystem Engineering*, 2022, **29(1)**, 124-145.
[19] A. Ejraei Bakyani, A. Taghizadeh, A. Nematollahi Sarvestani, F. Esmaeilzadeh & D. Mowla. *Journal of Petroleum Exploration and Production Technology*, 2018, **8(4)**, 1425-1441
[20] P. Zarei. *Petroleum*, 2022, **6(4)**, 321-328.
[21] H. Abedi. *Management Strategies and Engineering Sciences*, 2025, **3(2)**, 1-25.
[22] Y. Taguchi, T. Sato, D. Watanabe. *Society of Petroleum Engineers Journal*, 2025, **63(1)**, 101-127.
[23] M. Safaei-Farouji, M. Jafari, A. Semnani, T. Gentzis, B. Liu, K. Liu, M. Shokouhimehr, M. Ostadhassan, *Journal of Natural Gas Science and Engineering*, 2022, **103**, 1-12.