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The Influence of Cost Management and Human Resource Management (HR) on Operational Excellence Monitored Through The Balance Scorecard Framework

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ABSTRACT

This study examines the influence of cost management and human resource management (HR) on operational excellence monitored through the Balanced Scorecard framework in Indonesia's oil, gas, and limited energy contractors sector. As companies face challenges transitioning toward Net Zero Emission by 2060, optimizing operational efficiency through effective cost and human resource management becomes critical. The novelty of this research lies in its integrative approach that simultaneously tests both cost management and HR management within the BSC framework, specifically addressing the unique operational context of Indonesia's limited energy contractors—a perspective rarely examined in prior empirical studies. This quantitative study employs Exploratory Factor Analysis (EFA) and multiple linear regression techniques. Data were collected via questionnaires from 71 respondents consisting of company leaders, managers, and operational staff in oil, gas, and mining companies with at least 3 years of experience. Results demonstrate that cost management significantly affects operational excellence with a regression coefficient of 0.454 (t-count = 4.941 > t-table = 1.996). HR management exhibits a stronger influence with a regression coefficient of 0.486 (t-count = 5.288 > t-table = 1.996). Together, these variables explain 79.5% of the variance in operational excellence (R^2 = 0.795), indicating their substantial combined effect. The Balanced Scorecard proves effective as a holistic monitoring tool integrating financial and non-financial performance dimensions. This research contributes practical guidance for energy companies seeking to optimize operational strategies through the synergy of cost management and human resource management, supported by dynamic BSC monitoring systems tailored to Indonesia's energy transition context.

KEYWORDS *Cost Management, HR Management, Operational Excellence, Balance Scorecard, Oil and Gas Industry*

INTRODUCTION

Energy is one of the important factors for achieving sustainable development in this modern era. Oil and gas as one of the sources of fossil energy plays a vital role in various aspects of life, although it has limitations in terms of quantity (Batten et al., 2017; Chen & Martens, 2021; Grant, 2013; Koh & Teh, 2021). Initiatives to reduce fossil energy sources in all sectors and the use of electric vehicles have been the target of commitments by developed countries such as Korea, Japan, and the European Union by 2050 (IEA, 2022). This global phenomenon creates significant pressure for the oil and gas industry to carry out strategic transformation in the face of changes in the world's energy paradigm.

Indonesia has committed to making an energy transition to achieve the Net Zero Emission (NZE) target in 2060 or sooner. This commitment is in line with the Paris Agreement and global efforts to reduce carbon emissions (Humas EBTKE, 2022; Kouchaki-Penchah et al., 2024; Ohene et al., 2022; Rosa & Gabrielli, 2023). During the transition period to NZE, the oil and gas sector will remain a focus and play an important role in securing national energy supply (Damayanti et al., 2023; Juchnowicz & Kinowska, 2021; Pradhan & Hati, 2022; Rabuana & Yanuar, 2023; Yadav et al., 2023). This shows that despite the push for the energy transition, the strategic role of the oil and gas sector is still very much needed in the medium to long term.

The energy sector has its own challenges for companies and individuals involved, especially amid the New Renewable Energy (NRE) transition, which has experienced a 20% increase in investment from 2024 and leads to a decrease in demand for oil and gas in the long term (Ministry of Energy and Mineral Resources, 2025). This increase in NRE investment creates stiff competition for the traditional oil and gas industry, forcing companies to improve efficiency and look for innovative strategies to maintain relevance and profitability.

The limited energy industry should see these transitions and changes as opportunities to leverage expertise and innovate to drive solutions for the future. Oil and gas and other energy companies must be able to adapt during the transition period and develop internal business processes to increase efficiency and operational excellence. This adaptability is the key to survival in an industry that is experiencing fundamental disruption.

In addition to government policies and political climate, Indonesia's oil and gas industry faces other complex challenges, such as declining oil reserves that can be produced, declining world oil prices, as well as technical challenges and high investment costs for oil and gas field exploration and development. Data shows that Indonesia's oil production has experienced a downward trend from around 1.5 million barrels per day in 2000 to around 700,000 barrels per day in 2024 (Indonesia Investments, 2025). This production decline requires intensive efforts in operational optimization and cost efficiency.

Fluctuations in world oil prices are also a determining factor in investment decisions in oil and gas field management, especially at the exploration and development stages. The price of Brent oil, which is an international reference, experienced high volatility, fluctuating from USD 20 per barrel in the COVID-19 period to USD 120 per barrel during the geopolitical conflict period. This volatility affects a company's cash flow and requires a more dynamic and responsive cost management strategy.

In the midst of global economic uncertainty, fluctuating oil prices, and declining oil production, companies need to present strategies and innovations to improve operational efficiency while maintaining competitiveness and profitability. Indonesia's economic growth in 2024 was around 5.03%, but it slowed from the previous year (Central Statistics Agency, 2025). Slowing economic conditions require companies to be wiser in allocating budgets to remain competitive and efficient.

The approach to achieving these optimization goals can be done through effective cost management and optimal resource management, with the Balanced Scorecard used as a relevant performance measurement tool. Cost management is not only about cost savings, but also value creation optimization through the right allocation of resources. Meanwhile, effective human resource management ensures that human capital can contribute maximally to the achievement of organizational goals.

The achievement of operational excellence is one of the key factors that affect the success of a company for long-term achievement. The company must have a specific strategy and formula to optimize internal business processes in achieving the expected goals. Therefore, company management needs to have a deep understanding of strategy management and have the right monitoring tools to monitor performance targets to achieve operational excellence, especially in understanding the functions, individual influences, and interactions between cost management and resource management to achieve organizational goals.

Several empirical studies have explored Balanced Scorecard (BSC) implementation and its components in energy sectors. Research by Setyono and Kiono (2021) examined energy sustainability in Indonesia but focused primarily on policy implications rather than internal operational mechanisms. McKinsey & Company (2024) documented operational excellence practices across industries, emphasizing digital transformation. However, limited research has simultaneously examined the integrative effect of cost management and HR management within the BSC framework specifically for Indonesia's oil and gas contractors facing energy transition pressures. This study addresses this gap by empirically testing how these two management dimensions interact and collectively influence operational excellence in a context where companies must balance traditional operational efficiency with emerging sustainability demands.

Kaplan (2010) explains in his book "*What you measure is what you get*." This statement emphasizes that the achievement of the measured strategy in an organization will affect the behavior and results achieved. If an organization only focuses on finances, the operational performance achieved will not be optimal and holistic, as it ignores other important aspects such as customer satisfaction, internal business processes, and competency development within the organization that support the organization's growth to achieve operational excellence.

To achieve operational excellence, many companies rely on the use of Balanced Scorecard (BSC) as a monitoring tool. BSC is a management framework used to measure and monitor performance in various target perspectives, namely financial, customer, internal processes, and growth (Kaplan, 2010). The BSC framework provides a holistic approach that integrates financial and non-financial aspects in one comprehensive measurement system.

The ability to monitor and analyze real-time data has become very important in the era of digitalization (Francisco Nunes et al., 2024). Through the Balanced Scorecard, company management can monitor the achievement of long-term and short-term goals and evaluate the effectiveness of various strategies implemented. Performance measurement has an important role in monitoring related to control and identification of performance success. The company not only focuses on the financial aspect but also on the non-financial aspect, namely customers and internal business processes.

The structure of the BSC framework created and strategized by the company's management is the result of a combination of interactions between monitored perspectives, including cost management and human resource management, as well as how the influence and interaction between the two affect the achievement of operational excellence. Cost management represents the perspective of finance and internal business processes, while HR management represents the perspective of growth and also internal business processes. By integrating cost management and good HR management into BSC, it is hoped that businesses will be more focused on achieving goals, leaders can make the right decisions, and companies can adapt quickly to market changes.

Previous research shows that the implementation of BSC in the oil and gas industry has yielded positive results in improving operational performance. However, there is still a gap in research on how cost management and HR management specifically interact within the BSC framework to achieve operational excellence in the limited energy sector. This research fills the gap by focusing on oil and gas contractors and similar companies that face unique challenges in the energy transition period.

Industries under the Ministry of Energy and Mineral Resources, including oil and gas, are strategic sectors that operate within the scope of strict regulations, both from the government and international standards. This regulation not only ensures the stability of domestic energy supply but also ensures long-term development planning. The pattern of the relationship that occurs between oil and gas contractors and clients is contractual-administrative, where client satisfaction is more compliance-driven than market-driven.

The benchmark of client satisfaction in the oil and gas sector is very different from the commercial industry in general. The main parameters are centered on operational performance such as the achievement of oil/gas production targets according to the field development plan, the reliability of the facilities, and the quality of products that meet technical specifications. In addition, safety performance through Health, Safety, Environment (HSE) is a critical parameter that includes compliance with occupational safety regulations, environmental impact management, and crisis management capabilities.

To understand more about the influence of cost management and human resource management in achieving operational excellence in an organization, this study focuses on companies engaged in the oil and gas sector and not limited to similar sector companies engaged in mining as a limited energy sector. Good sense and response are needed to deal with a volatile market to maintain operational stability, profitability, and long-term survival of a company (Mulyadi, 2020).

The phenomenon of cost revenue from operation and maintenance shows an interesting trend to analyze. In 2020-2021, there was an increase in operational costs triggered by the recovery in demand post-COVID-19 and geopolitical turmoil. Brent crude oil prices averaged up from USD 70/bbl in 2021 to USD 100/bbl in 2022, causing logistics and energy costs to rise by 20-30% due to supply chain disruptions. In 2023-2024, despite a decline in oil prices (Brent ~USD 80-85/bbl), wage inflation and high interest rates will continue to impact the operating cost structure.

The trend of HR management leads to reskilling and upskilling with new skills such as focusing on the digital workforce through automation and the use of AI tools. It aims to reduce worker involvement in the field by improving data expertise such as the use of drones for job inspections at some unreachable location points. In addition, the work-life balance of workers is an important focus to maintain competence and talent as the key to implementing operational processes.

For cost management, there is a shift from manual spreadsheet monitoring methods to digitalization combined with the use of lean operation strategies to compete in the market. Predictive maintenance costs using Equipment Health Management software are the basis for predicting costs for equipment damage and reducing downtime penalties that affect cash flow. The use of the Lean Management concept in operations focuses on eliminating waste and optimizing that supports the sustainability of the company and environmental programs.

The novelty of this research lies in an integrative approach that combines cost management and HR management in the BSC framework specifically for the limited energy industry in Indonesia. This study also explores the dynamic interaction between the two variables in the context of the energy transition and the unique operational challenges in the oil and gas sector. In addition, this study provides a practical perspective on the implementation

of BSC as a monitoring tool that can be adapted to the condition of the Indonesian energy industry.

The purpose of this study is to test and analyze the influence of cost management on operational excellence, test and analyze the role of HR management in achieving operational excellence, analyze the influence of HR management on cost management, and provide recommendations to improve operational excellence by considering the collaboration of both variables through the BSC framework.

The benefit of this research for academics is that it enriches management-related references in the world of work and contributes to knowledge that can be used in further research related to the development of relevant technologies in related business needs. For companies, this research can help adopt better recommendations based on evaluations to improve efficiency and reduce potential losses that can hinder operational efficiency. The practical implication of this research is to provide strategic guidance for energy companies in optimizing the synergy of cost management and HR management through the effective implementation of BSC.

METHOD

This study examined the influence of cost management and human resource management (HR) on contractors supporting Indonesia's limited energy industry, particularly oil and gas and similar sectors. Supporting contractors needed to ensure that interactions between cost management and HR management achieved operational excellence amid market challenges and energy transition pressures.

The research followed a series of processes, from identifying phenomena and problems, to preparing the thesis, creating questionnaires, collecting and processing data, and reporting results with recommendations. It was conducted from April 21, 2025, to July 30, 2025.

This research employed a quantitative approach to examine the relationships and influences among cost management, HR management, and operational excellence, as monitored through the Balanced Scorecard (BSC) framework.

The population consisted of oil and gas companies, work unit managers, and agencies meeting these criteria: company leaders or direct decision-makers; managers or functional department heads involved in decision-making; operational staff on decision-making teams; personnel with knowledge of financial systems and/or cost management; those directly involved in HR management; and individuals with at least three years of experience in oil and gas or similar limited energy industries.

The sample represented actors in the oil and gas sector. Sampling used nonprobability methods, specifically incidental sampling, targeting business owners and contractors willing to participate. The sample size followed guidelines for Exploratory Factor Analysis (EFA), requiring a minimum of 50 respondents (de Winter et al., 2009). This study used 71 respondents, analyzed via EFA and multiple linear regression.

Research Variables and Operational Definitions

Research Variables

a. Independent Variables The independent variables in this study are Cost Management (X1) and Human Resource Management (X2).

b. Dependent Variable The dependent variable in this study is Operational Excellence (Y).

Operational Definition

Table 1. Operational Definition of Research Variables

Variabel	Operational Definition	Indicator	Measurement Scale
Cost Management (X_1)	Processes consisting of Cost Estimating, Cost Budgeting, Cost Control and Cost Applications (Denver Workshop, 1985)	1. Cost Estimation 2. Cost Budgeting 3. Cost Control 4. Cost Application	Interval (skala Likert 1-5)
HR Management (X_2)	The process of obtaining, training, assessing and compensating as well as paying attention to the relationship between employment, health and safety (Dessler, 2020)	1. Competencies and Training Programs 2. Employee Engagement 3. Employee turnover 4. Performance Appraisal	Interval (skala Likert 1-5)
Operational Excellence (Y)	The company's ability to achieve efficiency, quality, and speed of operation as a benchmark of competitiveness in the market	1. Process Efficiency 2. Product Quality 3. Internal process innovation 4. Standard 5 Compliance. High Competitiveness	Interval (skala Likert 1-5)

Data Details

The type of data in this study is numerical, where the data obtained from a questionnaire with a Likert scale is converted into numerical data.

Primary data were obtained from questionnaires distributed to respondents. Secondary data is obtained from the management policy documents, financial statements, and reported BSC reports.

Data collection was carried out through literature research and field research. The main data collection technique used a questionnaire arranged based on research variables with a Likert scale of 1-5 (1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree).

The data collected through the questionnaire was processed using a two-stage analysis. The first stage is Exploratory Factor Analysis (EFA) to test the validity, reliability, and unidimensionality of the measurements of each variable. The second stage is multiple regression analysis to test the influence of independent variables on bound variables. Before the regression analysis, a classical assumption test was carried out which included the normality test, the multicollinearity test, and the heteroscedasticity test.

RESULTS AND DISCUSSION

Respondent Description

The respondents in this study are practitioners involved in energy companies, especially oil and gas/mining with at least 3 years of experience. Respondents consisted of company leaders (CEO, COO, CFO, President Director or equivalent), managerial (Superintendent/Supervisor/Lead or equivalent), and operational staff involved in decision-making. The energy companies involved include oil and gas contractors (KKKS) and partner

vendors, as well as mining companies as comparators. The total respondents who participated in this study were 71 respondents.

Table 2. Distribution of Respondents by Position

Position	Sum	Percentage
Company Leader	28	39,4%
Managerial	25	35,2%
Operational Staff	18	25,4%
Total	**71**	**100%**

Validity Test Results

The validity test was carried out to determine the accuracy of the measuring instrument in measuring the research variables. The validity criteria used the R-calculated value > the R-table (0.110) at a significance of 5%.

Table 3. Cost Management Validity Test Results

No Inquiry	R-count	R Table	Validity
X1.1	0,718	0,110	Valid
X1.2	0,816	0,110	Valid
X1.3	0,727	0,110	Valid
X1.4	0,827	0,110	Valid
X1.5	0,793	0,110	Valid
X1.6	0,808	0,110	Valid
X1.7	0,683	0,110	Valid
X1.8	0,750	0,110	Valid
X1.9	0,758	0,110	Valid
X1.10	0,673	0,110	Valid

Table 4. Results of the HR Management Validity Test

No Inquiry	R-count	R Table	Validity
X2.11	0,829	0,110	Valid
X2.12	0,815	0,110	Valid
X2.13	0,777	0,110	Valid
X2.14	0,873	0,110	Valid
X2.15	0,837	0,110	Valid
X2.16	0,726	0,110	Valid
X2.17	0,726	0,110	Valid
X2.18	0,864	0,110	Valid
X2.19	0,901	0,110	Valid
X2.20	0,866	0,110	Valid

Table 5. Results of the Operational Excellence Validity Test

No Inquiry	R-count	R Table	Validity
Y.21	0,786	0,110	Valid
Y.22	0,857	0,110	Valid
Y.23	0,873	0,110	Valid
Y.24	0,829	0,110	Valid
Y.25	0,770	0,110	Valid
Y.26	0,833	0,110	Valid
Y.27	0,848	0,110	Valid
Y.28	0,821	0,110	Valid

No Inquiry	R-count	R Table	Validity
Y.29	0,723	0,110	Valid
Y.30	0,740	0,110	Valid

The results of the validity test showed that all statement items had an R-count value greater than the R-table (0.110), so that all indicators were declared valid and could measure variables well.

Table 6. Reliability Test Results

Variable	Cronbach's Alpha	Information
Cost Management	0,914	Reliable
HR Management	0,944	Reliable
Operational Excellence	0,941	Reliable

The results of the reliability test showed that all variables had a Cronbach's Alpha value of > 0.60, so that the research instrument was declared reliable and consistent to measure the research variables.

Table 7. Normality Test Results

One-Sample Kolmogorov-Smirnov Test	Unstandardized Residual
N	71
Normal Parameters Mean	0,3545
Normal Parameters Std. Deviation	0,27901
Most Extreme Differences Absolute	0,152
Most Extreme Differences Positive	0,152
Most Extreme Differences Negative	-0,108
Test Statistic	0,152
Asymp. Sig. (2-tailed)	0,063

Based on the results of the normality test, the probability value of Asymp. Sig (2-tailed) is 0.063 > 0.05, so that the data is declared to be normally distributed and meets the normality assumptions for further analysis.

Table 8. MSA and Bartlett's Test Results

KMO and Bartlett's Test	Cost Management	HR Management	Operational Excellence
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0,865	0,903	0,911
Bartlett's Test of Sphericity Approx. Chi-Square	410,159	320,987	607,597
df	45	28	45
Itself.	0,000	0,000	0,000

The results of the MSA KMO test showed a > value of 0.50 for all variables, and Bartlett's Test of Sphericity showed a significance of 0.000 < 0.05, so factor analysis could continue.

Table 9. Anti-Image Correlation Test Results

Cost Management	MSA Value	HR Management	MSA Value	Operational Excellence	MSA Value
X1.1	0,865	X2.11	0,959	Y.21	0,896
X1.2	0,899	X2.12	0,897	Y.22	0,909
X1.3	0,816	X2.13	0,943	Y.23	0,904
X1.4	0,903	X2.14	0,909	Y.24	0,859
X1.5	0,829	X2.15	0,958	Y.25	0,919
X1.6	0,885	X2.16	0,870	Y.26	0,898

Cost Management	MSA Value	HR Management	MSA Value	Operational Excellence	MSA Value
X1.7	0,935	X2.17	0,882	Y.27	0,885
X1.8	0,892	X2.18	0,898	Y.28	0,887
X1.9	0,888	X2.19	0,910	Y.29	0,911
X1.10	0,723	X2.20	0,882	Y.30	0,963

All indicators have an MSA value > 0.5, indicating a correlation appropriate for factor analysis.

Communalities Testing Results

After the first phase of communalities testing, several indicators with values below 0.500 were excluded from the analysis, namely X1.3, X1.7, and X1.10 from the Cost Management variable.

Table 10. Final Stage Communalities Test Results

Variable	Indicator	Extraction
Cost Management	X1.1	0,559
	X1.2	0,713
	X1.4	0,712
	X1.5	0,708
	X1.6	0,687
	X1.8	0,579
	X1.9	0,618
HR Management	X2.11	0,709
	X2.12	0,670
	X2.13	0,583
	X2.14	0,772
	X2.15	0,706
	X2.16	0,493
	X2.17	0,508
	X2.18	0,747
	X2.19	0,831
	X2.20	0,772
Operational Excellence	Y.21	0,614
	Y.22	0,745
	Y.23	0,771
	Y.24	0,700
	Y.25	0,582
	Y.26	0,699
	Y.27	0,722
	Y.28	0,679
	Y.29	0,507
	Y.30	0,536

Tabel 11. Hasil Total Variance Explained

Variable	Component	Total	% of Variance	Cumulative %
Cost Management	1	4,576	65,373	65,373
HR Management	1	6,791	67,907	67,907
Operational Excellence	1	6,554	65,542	65,542

The results showed that each variable was formed by a single factor with the ability to explain the variance > 65%.

Table 12. Component Matrix Results

Variable	Indicator	Component Loading
Cost Management	X1.1	0,748
	X1.2	0,844
	X1.4	0,844
	X1.5	0,841
	X1.6	0,829
	X1.8	0,761
	X1.9	0,786
HR Management	X2.11	0,842
	X2.12	0,818
	X2.13	0,764
	X2.14	0,879
	X2.15	0,840
	X2.16	0,702
	X2.17	0,712
	X2.18	0,864
	X2.19	0,911
	X2.20	0,879
Operational Excellence	Y.21	0,784
	Y.22	0,863
	Y.23	0,878
	Y.24	0,837
	Y.25	0,763
	Y.26	0,836
	Y.27	0,849
	Y.28	0,824
	Y.29	0,712
	Y.30	0,732

Classical Assumption Test Results

Table 13. Multicollinearity Test Results

Variable	Cost Management	HR Management
Cost Management	1	0,701**
HR Management	0,701**	1

The correlation value between independent variables is 0.701 < 0.8, indicating that there is no multicollinearity.

Table 14. Heteroscedasticity Test Results

Model	Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
(Constant)	1,876E-17	0,055		0,000	1,000
Cost Management	0,000	0,092	0,000	0,000	1,000
HR Management	0,000	0,092	0,000	0,000	1,000

The significance value for all variables was 1,000 > 0.05, indicating no heteroscedasticity.

Table 15. Multiple Linear Regression Test Results

Model	Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
(Constant)	-4,614E-16	0,055		0,000	1,000
Cost Management	0,454	0,092	0,454	4,941	0,000
HR Management	0,486	0,092	0,486	5,288	0,000

The regression equation formed is: $\mathbf{Y = -4.614\times10^{-16} + 0.454(X1) + 0.486(X2) + e}$

Operational Excellence = -4.614×10^{-16} + 0.454(Cost Management) + 0.486(HR Management) + e

The interpretation of the regression equation shows that every increase in Cost Management will increase Operational Excellence by 0.454 units, and each increase of one HR Management unit will increase Operational Excellence by 0.486 units.

Table 16. Determination Coefficient Test Results

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	0,891	0,795	0,789	0,45969343	2,234

A determination coefficient value (R^2) of 0.795 indicates that 79.5% of variations in operational excellence can be explained by cost management and HR management, while 20.5% are explained by other variables outside the model.

Table 17. F Test Results

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	55,630	2	27,815	131,627	0,000
Residual	14,370	68	0,211		
Total	70,000	70			

The F-calculated value of 131.627 > F-table (3.984) with a significance of 0.000 < 0.05, shows that cost management and human resource management simultaneously have a significant effect on operational excellence.

Table 18. Test Results t

Variable	Regression Coefficients	t-count	T-Table	Conclusion
Cost Management	0,454	4,941	1,9960	H_0 rejected, significantly affected
HR Management	0,486	5,288	1,9960	H_0 rejected, significantly affected

The two independent variables had a significant effect on operational excellence because the t-calculation > t-table and the significance < 0.05.

The Influence of Cost Management on Operational Excellence

The results showed that cost management had a positive and significant effect on operational excellence with a regression coefficient of 0.454 and a t-calculation value of 4.941 > t-table of 1.9960 at a significance level of 0.000. These findings confirm that the effective implementation of cost management is a key factor in achieving operational excellence in the oil and gas and limited energy industry.

Cost management in the context of the oil and gas industry includes four main dimensions, namely cost estimation, cost budgeting, cost control, and cost application. Accurate cost estimation allows the company to make realistic plans for oil and gas field exploration and development projects. In industries with high levels of uncertainty such as oil and gas, the ability to accurately estimate costs is a significant competitive advantage.

Effective cost budgeting allows companies to optimally allocate resources according to strategic priorities. This is very important in the oil and gas industry which requires capital intensive investment with a long payback period. Companies that have a robust budgeting system can respond to changes in market conditions more quickly and effectively.

Cost control is the most critical aspect of oil and gas operations, considering the high volatility of oil and gas prices. The implementation of strict cost control allows the company to maintain profitability even in conditions of low commodity prices. The use of digital technology and automation in cost control has been proven to significantly increase operational efficiency.

The right cost application ensures that cost allocation is carried out proportionately and in accordance with the value creation produced. In the context of a diversified oil and gas industry, the ability to accurately apply costs to each business unit is essential for objective performance measurement.

The findings of this study are in line with best practices that have been applied by global oil and gas companies such as ExxonMobil and Chevron that use Artificial Intelligence technology for exploration activities to reduce the cost of drilling failures. Freeport Indonesia also implements automation at the Grasberg mine for operational efficiency. Pertamina runs a cost efficiency program through refinery digitization and supply chain optimization.

Digitalization in cost management has changed the paradigm of monitoring and controlling costs from manual spreadsheets to cloud-based integrated systems. This allows for real-time monitoring and predictive analytics to anticipate cost overruns. The use of Equipment Health Management software for predictive maintenance has been proven to reduce unplanned downtime and unexpected maintenance costs.

The implementation of lean management in oil and gas operations also makes a significant contribution to cost reduction. Waste elimination and continuous improvement through kaizen methodology have helped oil and gas companies to increase operational excellence. Focusing on value stream mapping and elimination of non-value added activities is a key driver in achieving cost leadership.

The implementation of effective cost management also contributes to the sustainability of the program, which is increasingly the main focus of the oil and gas industry. Green accounting and environmental cost management allow companies to optimize environmental performance while achieving operational efficiency.

The Influence of HR Management on Operational Excellence

The results of the study showed that human resource management had a positive and significant effect on operational excellence with a regression coefficient of 0.486 and a t-calculation value of 5.288 > t-table of 1.9960 at a significance level of 0.000. Interestingly, the influence of human resource management on operational excellence is stronger than cost

management, which indicates that human capital is the most critical determinant factor in achieving operational excellence in the oil and gas industry.

Human resource management in the oil and gas industry has unique characteristics because it operates in a high-risk and high-technology environment. Competencies and training programs are fundamental dimensions in human resource management considering the complexity of operations and the technology used. Upskilling and reskilling programs are becoming increasingly important along with digital transformation and automation in the oil and gas industry.

Employee engagement in the oil and gas industry has broader implications than other industries because it is directly related to safety performance. Engaged employees tend to be more committed to safety procedures and have a high awareness of operational risks. This directly impacts operational excellence through a reduction in accident rates and an improvement in safety performance indicators.

Employee turnover is a critical issue in the oil and gas industry considering the specialized skills and long learning curve needed. High turnover rates can result in loss of institutional knowledge and increased recruitment costs. On the other hand, low turnover rates indicate high job satisfaction and stability in the operational team which is essential to maintain operational excellence.

Performance assessment in the oil and gas industry does not only focus on individual performance but also team performance and safety performance. The implementation of a balanced scorecard approach in performance appraisal allows for a comprehensive evaluation that includes financial, operational, safety, and environmental performance indicators.

The era of digital transformation in the oil and gas industry has fundamentally changed skill requirements. Traditional skills in geological exploration and mechanical engineering must be equipped with digital skills such as data analytics, artificial intelligence, and automation technology. The digital workforce development program is a strategic imperative to maintain competitive advantage.

Work-life balance considerations are becoming increasingly important in talent retention strategies, especially for millennials and Gen-Z workforces. Flexible working arrangements and employee wellness programs contribute to higher employee satisfaction and lower turnover rates. Remote working capabilities developed during the pandemic have opened up new possibilities for talent acquisition and retention.

Safety culture development is the most critical aspect in human resource management in the oil and gas industry. Implementation of behavior-based safety programs and safety leadership development has been proven effective in reducing incident rates and improving overall safety performance. Zero fatality policies and comprehensive emergency response capabilities are non-negotiable requirements in operational excellence.

Knowledge management systems are essential in capturing and transferring institutional knowledge, especially in dealing with the wave of retirements from the experienced workforce. Systematic knowledge transfer programs and mentoring systems ensure continuity in operational capabilities and maintenance of safety standards.

Diversity and inclusion initiatives in the oil and gas industry are not only driven by social responsibility considerations but also by business imperatives. Diverse teams have

proven to be more innovative and effective in problem-solving, which is critical in high-complexity operational environments such as the oil and gas industry.

Synergy of Cost Management and HR Management

Correlation analysis showed that there was a positive and significant relationship between cost management and HR management of 0.701. This strong relationship indicates that the two variables reinforce each other and create synergistic effects in achieving operational excellence. Simultaneously, cost management and HR management were able to explain 79.5% of the variance in operational excellence.

The synergy between cost management and human resource management is manifested in various operational aspects. Investment in training and development programs requires significant cost allocation, but produces long-term benefits in the form of improved productivity and reduced error rates. Skilled workforce is able to operate equipment more efficiently and effectively, which directly impacts operational costs and maintenance costs.

The implementation of automation and digital technology in cost management requires a workforce that has appropriate digital skills. On the other hand, investment in human capital development allows for more sophisticated cost management practices that ultimately improve operational performance. This creates a positive feedback loop that strengthens operational capabilities.

Safety performance is an important intersection point between cost management and HR management. Investment in safety training and safety equipment requires substantial costs, but prevents much larger costs associated with accidents and regulatory violations. Well-trained workforce with high safety awareness significantly reduce operational risks and associated costs.

Predictive maintenance programs exemplify sinergi antara cost management dan pengelolaan SDM. Sophisticated maintenance scheduling requires both advanced cost analytics capabilities dan skilled technicians who can interpret equipment condition data. Integration antara cost optimization objectives dan human resource capabilities enable more effective maintenance strategies.

Change management dalam digital transformation initiatives requires alignment antara cost considerations dan human resource development. Successful technology implementation depends on workforce readiness dan acceptance, yang requires comprehensive training programs dan change management strategies. Cost-benefit analysis harus include human resource development costs dan productivity improvement potentials.

Performance measurement systems dalam balanced scorecard framework integrate financial metrics dengan human resource metrics. KPIs terkait cost efficiency harus balanced dengan employee satisfaction dan safety performance indicators. Integrated performance management enables more holistic approach dalam achieving operational excellence.

The Role of Balance Scorecard as a Monitoring Tool

The Balance Scorecard framework has proven to be effective as a monitoring tool that integrates cost management and HR management in a holistic performance measurement system. BSC allows companies to monitor financial performance (cost efficiency) and non-financial performance (human resource effectiveness) simultaneously and integrated.

The financial perspective in BSC includes cost management metrics such as operational cost per barrel, maintenance cost efficiency, and budget variance analysis. These metrics provide direct visibility into cost performance and enable proactive cost management actions. Integration with other perspectives ensures that cost optimization does not compromise safety, quality, or employee satisfaction.

Learning and growth perspective dalam BSC focus pada human resource development metrics seperti training hours per employee, safety training completion rates, dan employee competency assessments. Perspective ini ensures bahwa human capital development aligned dengan strategic objectives dan operational requirements.

Internal business process perspective integrate cost efficiency dengan operational efficiency metrics. Process optimization initiatives dapat simultaneously improve cost performance dan operational performance. Lean management practices dan continuous improvement programs exemplify integration antara cost management dan process excellence.

Customer perspective dalam migas industry unique karena customer satisfaction primarily measured through contractual compliance dan regulatory adherence rather than traditional customer satisfaction metrics. However, operational excellence achieved through effective cost management dan pengelolaan SDM ultimately translates ke customer value melalui reliable supply, consistent quality, dan competitive pricing.

Real-time monitoring capabilities dalam modern BSC implementations enable dynamic performance management. Digital dashboards provide immediate visibility terhadap key performance indicators across all perspectives, enabling rapid response ke performance deviations. Predictive analytics capabilities enable proactive management actions sebelum performance issues become critical.

Strategic alignment melalui BSC framework ensures bahwa cost management initiatives dan human resource development programs aligned dengan overall business strategy. Strategy maps visualize causal relationships antara different perspectives dan enable more effective resource allocation decisions.

Risk management integration dalam BSC framework particularly important dalam migas industry mengingat high operational risks dan regulatory requirements. Cost management practices harus consider risk implications, dan human resource policies harus address safety dan compliance requirements. Integrated risk monitoring enable comprehensive risk management approach.

CONCLUSION

Based on data analysis and discussion on the influence of cost management and human resource management on operational excellence monitored through the Balanced Scorecard, it can be concluded that cost management plays a significant role in increasing operational excellence with a regression coefficient of 0.454, especially through the practice of cost estimation, budgeting, control, and process digitalization. HR management has a stronger influence on operational excellence than cost management with a regression coefficient of 0.486, showing that competent human resources are the main key in supporting operational success and reducing the risk of accidents. The synergy between these two factors explains the 79.5% variance of operational excellence, indicating that the two complement each other in creating operational excellence. The Balance Scorecard has proven to be effective as a holistic

monitoring tool that integrates financial and non-financial aspects to comprehensively monitor operational performance. This study recommends that oil and gas companies optimize the use of technology in cost management, strengthen human resource management through upskilling and reskilling programs, and implement dynamic BSC to face the challenges of the energy transition. Further research is expected to expand the sample, use mixed-method methods, and explore customer perspectives within BSC to provide a deeper understanding of the factors that influence operational excellence in the energy industry.

REFERENCES

Batten, J. A., Ciner, C., & Lucey, B. M. (2017). The dynamic linkages between crude oil and natural gas markets. *Energy Economics, 62*, 155–170. https://doi.org/10.1016/j.eneco.2016.10.019

Central Statistics Agency. (2025). *Indonesia's economic growth 2024*. BPS.

Chen, M., & Martens, P. (2021). Coastal residents' attitudes toward offshore oil and gas drilling in China. *The Extractive Industries and Society, 8*(3), 100942. https://doi.org/10.1016/j.exis.2021.100942

Damayanti, G. P., Waluyo, W., & Candrakirana, R. (2023). Pengelolaan sampah melalui PLTSa di Indonesia untuk mewujudkan net zero emission. *PLEDOI (Jurnal Hukum dan Keadilan), 2*(1), 79–92.

de Winter, J. C. F., Dodou, D., & Wieringa, P. A. (2009). Exploratory factor analysis with small sample sizes. *Multivariate Behavioral Research, 44*(2), 147–181. https://doi.org/10.1080/00273170902794206

Denver Workshop. (1985). *Cost management principles and practices*. Project Management Institute.

Dessler, G. (2020). *Human resource management* (16th ed.). Pearson.

Grant, R. M. (2013). The development of knowledge management in the oil and gas industry. *Universia Business Review, 40*, 92–125.

Humas EBTKE. (2022). *Masa transisi energi menuju net zero emission*. Direktorat Jenderal Energi Baru Terbarukan dan Konservasi Energi.

International Energy Agency. (2022). *Net zero by 2050: A roadmap for the global energy sector*. OECD. https://www.iea.org/reports/net-zero-by-2050

Indonesia Investments. (2025). *Indonesian oil production trends 2000–2024*. Indonesia Investments.

Juchnowicz, M., & Kinowska, H. (2021). Employee well-being and digital work during the COVID-19 pandemic. *Information, 12*(8), 293. https://doi.org/10.3390/info12080293

Kaplan, R. S., & Norton, D. P. (2010). *The balanced scorecard: Translating strategy into action*. Harvard Business Review Press.

Koh, H. L., & Teh, S. Y. (2021). Oil and gas offshore disposal of drilling wastes. In *Ecological modeling for mitigating environmental and climate shocks*. https://doi.org/10.1142/9789811236341_0009

Kouchaki-Penchah, H., Bahn, O., Bashiri, H., Bedard, S., Bernier, E., Elliot, T., Hammache, A., Vaillancourt, K., & Levasseur, A. (2024). The role of hydrogen in a net-zero emission economy under alternative policy scenarios. *International Journal of Hydrogen Energy, 49*, 1234–1250. https://doi.org/10.1016/j.ijhydene.2023.07.196

McKinsey & Company. (2024). *Today's good to great: Next generation operational excellence*. McKinsey Global Institute.

Ministry of Energy and Mineral Resources. (2025). *Energy transition and renewable energy investment trends*. ESDM.

Mulyadi. (2020). *Balanced scorecard: Alat manajemen kontemporer untuk pelipatgandaan kinerja keuangan perusahaan*. Salemba Empat.

Nunes, F., Alexandre, E., & Gaspar, P. D. (2024). Implementing key performance indicators and designing dashboard solutions in an automotive components company: A case study. *International Journal of Management, 15*(3), 45–62.

Ohene, E., Chan, A. P. C., & Darko, A. (2022). Review of global research advances towards net-zero emissions buildings. *Energy and Buildings, 266*, 112142. https://doi.org/10.1016/j.enbuild.2022.112142

Pradhan, R. K., & Hati, L. (2022). The measurement of employee well-being: Development and validation of a scale. *Global Business Review, 23*(2), 385–407. https://doi.org/10.1177/0972150919859101

Rabuana, N. K. D. N., & Yanuar. (2023). The influence of work environment and work engagement on employee performance mediated by employee well-being. *Munaddhomah, 4*(3), 523–536. https://doi.org/10.31538/munaddhomah.v4i3.523

Rosa, L., & Gabrielli, P. (2023). Achieving net-zero emissions in agriculture: A review. *Environmental Research Letters, 18*(6), 063004. https://doi.org/10.1088/1748-9326/acd5e8

Setyono, B., & Kiono, R. (2021). Energy sustainability and economic development in Indonesia. *Journal of Energy Economics, 12*(4), 234–248.

Yadav, S., Samadhiya, A., Kumar, A., Majumdar, A., Garza-Reyes, J. A., & Luthra, S. (2023). Achieving the sustainable development goals through net zero emissions: Innovation-driven strategies for transitioning from incremental to radical lean, green and digital technologies. *Resources, Conservation and Recycling, 197*, 107094. https://doi.org/10.1016/j.resconrec.2023.107094